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Employment and the gender digital divide in Latin America: A decomposition analysis

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ABSTRACT

There is a vast literature that examines the determinants of the gender digital gap in developing countries, and puts forth policy recommendations to mitigate it. However, few studies examine how gender differences in labor force participation and employment patterns affect ICT adoption in general, or Internet use in particular. This matters because employment and the types of jobs that men and women do correlate with different opportunities to access the Internet and develop digital skills, both of which contribute to overall Internet engagement. This study contributes to fill this gap by exploring how gender differences in employment affect the digital gender gap in four Latin American countries. The findings point to differences in employment patterns between men and women as the largest single contributor to the gender gap in Internet use in these countries, ahead of differences in other predictors of Internet use such as income, age and education. Further, our results suggest that the correlation between employment and Internet use is stronger among women than men, which we attribute to the fact that women tend to work in more ICT-intensive sectors (e.g., health services and education). Estimates from a decomposition analysis suggest that if women were employed at the same rate as men the gender digital gap in these countries would be reduced by at least a quarter.

1. Introduction

Despite sustained gains in connectivity across developing countries in the past two decades, there persists a sizable gap in Internet use between men and women. Globally, the ITU estimates that 48.3% of women regularly use the Internet, compared to 55.2% of men (ITU Facts and Figures, 2020). However, the gender gap in Internet use is significantly larger in most developing countries. Further, in relative terms the gap has grown in recent years, thus defying expectations that gender differences in online access would gradually disappear over time.

There is a sizable literature that examines the determinants of the gender digital gap and puts forth policy recommendations to mitigate it (Alozie and Akpan-Obong, 2017; Bhandari, 2019; Gray et al., 2017; Rashid, 2016; Wasserman and Richmond-Abbott, 2005). Interestingly, however, few studies examine how gender differences in labor force participation and employment patterns affect ICT adoption in general, or Internet use in particular. This matters because employment patterns and the types of jobs that men and women do correlate with different opportunities to access the Internet and develop digital skills, both of which contribute to Internet engagement. Work-related Internet use takes particular importance in developing countries where residential broadband

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penetration tends to be limited.

This study examines how differences in labor force participation between men and women affect the gender divide in Internet use in Latin America. Further, it presents evidence suggesting that gender differences in types of employment are also relevant to explain the gender digital divide. For example, women are not only less likely to be employed but also more likely to work part-time and under informal labor arrangements, which correlate with fewer opportunities to access the Internet at work or build digital skills through workplace training. On the other hand, women are more likely than men to work in retail, health care, education and other ICT-intensive sectors, thus potentially increasing the effect of employment on Internet engagement.

The data for this study is sourced from large-scale, nationally representative household surveys in Ecuador, Guatemala, Mexico and Peru, administered by the national statistics offices in each country. These four countries were selected based on the availability of large samples and high-quality data, but are not necessarily representative of the rest of the region. They include a country in the top quartile of GDP per capita in Latin America (Mexico), two countries near the regional median (Ecuador and Peru) and a country in the bottom GDP quartile (Guatemala). The empirical approach combines logit regression modelling with a decomposition technique developed by Yun (2004), which extends the standard Oaxaca-Blinder decomposition technique to nonlinear outcomes. Decomposition analysis, originally developed for analyzing wage differentials between groups of workers, is increasingly common in ICT policy studies (e.g., Barrantes et al., 2019; Liao et al., 2016; Manlove and Whitacre, 2019).

The results show that gender differences in employment are the single largest contributor to the gender gap in Internet use in the four countries included in the study. Further, our results indicate that the correlation between employment and Internet use is significantly stronger for women than men, which we attribute to the fact that women tend to work in more ICT-intensive sectors such as retail, government administration, health care and education (ILO/ECLAC, 2019). Estimates from the decomposition analysis suggest that, if women had the same distribution on employment as men, the gender digital gap in these countries would be reduced by at least a quarter.

The study makes two significant contributions. First, it contributes to our understanding of the digital gender gap by shedding light on the nexus between structural factors that prevent women from full participation in labor markets and gender differences in Internet engagement. Second, the findings offer important evidence to policies aimed at reducing the digital gender gap in developing countries. Such policies must necessarily be different from those of advanced countries, where overall Internet adoption levels hover around 90% (compared to about 50% in developing countries), and where gender gaps in labor force participation, education and other key areas are significantly smaller (WEF, 2020).

The organization of this study is as follows. The next section presents a review of the extant literature about the nexus between employment and Internet adoption, along with an overview of the labor markets in the countries included in the study that help contextualize the findings. This section also offers the theoretical underpinning for the research questions addressed in the following sections. The section that follows offers a discussion of the data, methods and key variables. Descriptive statistics on employment and Internet use for the countries in the sample are also presented. The presentation of results in section 4 is followed by a discussion of findings and policy implications in section 5. There are several limitations to the study that relate to the small number of countries in the sample, the lack of fine-grained data about Internet use patterns or digital skills, and the empirical strategy utilized. These limitations are also discussed in section 5.

2. Background literature

By any measure available, large gender disparities persist in labor markets across Latin America. On average, women are paid about 20% less than men doing similar work and with similar qualifications. Despite ongoing gains in educational attainment, female labor force participation has stagnated at about 25 p. p. Lower than that for men, while female unemployment is about 37% higher across the region. Among those in the labor force, women are twice as likely to work part time. Informality, another structural characteristic of labor markets in Latin America, disproportionately affects women, in particular young women entering the labor force and those living in rural areas (ILO/ECLAC, 2019).

These gender disparities in employment reflect several institutional and cultural factors. While a full accounting is beyond the scope of this paper, we briefly note three points relevant to our study. First, the persistence of social norms about family roles result in women being responsible for much of the care work in the household (including caring for children and elderly family members), which severely constraints their labor force participation.[1] Interestingly, as Campaña et al. (2015) show using data from Mexico, Ecuador, Peru and Colombia (3 of the 4 countries included in this study), the gender gap in total work hours (including both paid and unpaid) is inversely related to education attainment. Second, there is evidence that stereotyping and discrimination continue to limit women's labor opportunities in the region (Galarza and Yamada, 2014), and these factors are compounded in contexts of high labor informality. Third, the limited availability of childcare services in the region significantly penalizes young mothers. In a recent study, Berniell et al. (2019) find that the birth of the first child results in a 17% drop in labor force participation, a 40% increase in part-time work and a 30% drop in wages. More importantly, these effects remain relatively unchanged within the first decade after the birth of the first child.

There are several ways in which labor market disparities between men and women result in different opportunities to access the Internet and develop digital skills in the workplace, as well as in different patterns of Internet use. First, consider the fact that less than half of all households in Latin America subscribe to a residential broadband service (ITU, 2019, pp. 115–139). This makes workplace

[1] For the countries included in this study, the latest data available indicates that women undertake 81.1% of household labor in Ecuador, 89.6% in Guatemala, 77.2% in Mexico and 73.2% in Peru (ILO/ECLAC, 2019).

access all the more important as a location to connect to the Internet and build digital skills, many of which cannot be developed through mobile broadband use alone (Napoli and Obar, 2014). As is the case with other general-purpose technologies, experience and continued exposure ("learning by doing") are critical to develop digital skills that can be easily transferred from workplace use to other contexts (Carte et al., 2011).

Second, employers are likely to invest in ICT training for workers. While these investments in human capital may be limited to the tasks required and the information systems utilized in a particular organization, as noted above many ICT skills are generalizable and easily transferable to other contexts (Oberländer et al., 2020). Generally speaking, workplace training will be associated with increased familiarity with computing devices, information systems, and applications such as email and web browsers (van Laar et al., 2017). Further, such human capital investments are more likely among employers in ICT-intensive sectors, but will naturally be skewed against part-time workers, a point to which we return below.

It is apparent that each of these potential links between employment and Internet engagement will affect men and women differently. At the most basic level, gender differences in labor force participation and employment will lead to fewer opportunities for women to access the Internet in the workplace. Table 1 shows that gender differences in labor force participation are large for the countries under study, ranging from 15 p. p. In Peru to 44 p. p. In Guatemala. Given the generally low level of unemployment in Latin America, differences in unemployment rates are somewhat less relevant but still significant, particularly in Peru where women are almost twice as likely to be unemployed.

Lower rates of labor force participation and higher unemployment also mean that women are less likely to receive ICT training from employers. Further, it is well established that employers are less willing to make human capital investment in part-time workers, which as shown in Table 1 are disproportionately female. Some studies also suggest that employers discriminate against women in job-training programs because female workers are perceived as less committed and more likely to leave the organization in the long term (Mitsakis, 2019).

This study also builds upon the findings of decades of research about the determinants of Internet use. While the initial wave of studies focused attention on key demographic variables - among them income, race, age and education (e.g., Fairlie, 2004; Chaudhuri and Flamm, 2005; Prieger and Hu, 2008 - scholars later turned attention to issues of human capital (e.g., Hargittai & Shafer, 2006; van Deursen and van Dijk, 2011) and attitudes towards technology (e.g., van Deursen & Helsper, 2015). Interestingly, however, relatively little attention has been paid to employment in this literature, and in particular to differences in employment patterns between men and women.

There are however notable exceptions. Ono and Zavodny (2005) compare gender differences in IT use and skills between the US and Japan. The authors find a significantly larger gap in Japan, which they attribute to the disproportionate employment of women in part-time, nonstandard jobs where exposure to ICT and digital skills training is limited. In the UK context, Helsper (2010) similarly finds that employment status is associated with different online activities for men and women, however these differences tend to disappear after retirement. This finding is also corroborated in the US context (e.g., Yu et al., 2016), suggesting that variations in employment trajectories between men and women correlate with different online engagement patterns, but that these differences tend to diminish once older adults leave the workforce.

A related empirical literature has explored how increased Internet access affects the proclivity of women to participate in the labor market. This literature rests on two main hypotheses. The first posits that Internet access allows women with care responsibilities to work remotely, thus promoting labor force participation among more educated women. For example, Dettling (2017) finds evidence that high-speed broadband availability in the US has increased labor force participation for college-educated, married women (but not for single women or for men). The second hypothesis, one that is perhaps more relevant to developing countries but more difficult to test, is that Internet access promotes women's labor force participation by challenging social norms about gender roles. For example, Viollaz and Winkler (2020) find that increased Internet access in Jordan promoted labor force participation (but not actual employment) among women, and suggest this is partly explained by the weakening of gender-biased social norms.

Comparatively speaking, there are fewer empirical studies addressing gender inequalities in Internet access and use in Latin America. This may be partly explained by the fact that the raw magnitude of gender gaps in the region is smaller than in other developing regions (ITU Facts and Figures, 2020). There are however several notable exceptions. Using data from national household surveys, Hilbert (2011) finds a small but statistically significant male advantage in Internet use in 9 of the 12 countries included in the study. However, when limiting the analysis to those currently employed, the advantage either disappears or reverses in favor of women in 7 out of the 8 countries for which disaggregated data is available. In similar study using national household survey data, Grazzi and Vergara (2014) find that being employed correlates with Internet use in 5 out of the 7 countries included in the study, although no

Table 1
Gender and employment in selected Latin American countries.

	Labor force participation rate[a]		Employment rate[a]		Unemployment rate[a]		Weekly hours[b]	
	Male	Female	Male	Female	Male	Female	Male	Female
ECUADOR	77.5	53.0	75.1	51.0	3.1	3.8	39.8	33.6
GUATEMALA	83.1	38.7	81.7	37.7	1.6	2.4	48.6	39.6
MEXICO	77.1	45.4	74.5	43.9	3.4	3.4	49.7	38.9
PERU	78.1	63.1	74.4	58.6	4.7	7.2	44.9	37.6

[a] Source: ILO, 15+ years, 2019Q4.
[b] Source: SEDLAC, 15+ years, 2018.

gender disaggregated results are reported.

Grey et al. (2017) use aggregate data from the Latin Barometer survey covering 18 countries in the region and find, on average, a small but statistically significant difference in favor of men in frequency of Internet use. Further, the results suggest that countries with more gender equality (measured through the UN Index of Gender Equality, which includes labor force participation among its components) tend to have higher levels of gender parity in Internet use. Barrantes et al. (2019) also use data from an ad-hoc survey in 5 countries (Argentina, Colombia, Guatemala, Peru and Paraguay) to examine how different factors contribute to the digital gender divide, measured through an index that includes ICT access, experience, and types of use. Using a decomposition technique similar to this study, the authors find that employment status is one of the largest contributors to the ICT gender gap, second only to educational attainment. Interestingly however, there are significant cross-country variations in the results. While this may be partly attributed to the relatively small samples used for country-wide estimations (about 1500 cases in each country), these variations suggest the need for more research attention to the topic.

3. Data and methods

3.1. Data sources and sample

The survey data used in this study was collected by the national statistics offices of the respective countries. These are nationally-representative, face-to-face household surveys based on probabilistic stratified sampling for urban and rural conglomerates. The exception is Guatemala, where we take advantage of recent national census data. Each national statistics office provides the individual and household sample weights that adjust for non-response. These weights are included in the estimation models presented throughout the study.

There are numerous advantages to using large-scale surveys (in comparison to ad-hoc surveys with smaller samples). For example, large samples enable data partitions and the use of empirical strategies unfeasible with small samples. In addition, data collection through face-to-face interviews is critical, as fieldwork strategies that rely on information technologies (such as online panels or random digit dialing) are likely to produce biased estimates of ICT use (Bethlehem, 2010).

At the same time, the surveys used in this study have several drawbacks. First, there are variations in sampling methods, sample sizes, and more importantly in the questionnaires administered in each country. Another drawback is that survey questionnaires typically contain a relatively small number of items about Internet access and types of use. This limits the ability to measure Internet engagement beyond first-order characteristics such as use (vs. nonuse) and location of use. Further, there are important differences in how some of these variables are measured across surveys (discussed in the next section).

Because of these differences in the survey data, we model each country separately, and comparisons between countries should be interpreted as indicative of common patterns rather than as precise point estimations of differences. Table 2 provides a snapshot of the survey characteristics in each country. Given our interest in how employment status affects Internet use, we restrict samples to the adult population (18 and over).

3.2. Variables and descriptive statistics

Our main variable of interest is Internet use. In all of the countries in the study, Internet use refers to use regardless of access location, device, or access technology. It therefore includes both fixed and wireless access, smartphone-only users, as well as use in multiple locations (workplace, public access places and so forth). There are nonetheless differences in the time frame utilized to measure Internet use across countries. In Ecuador, respondents are asked about Internet use in the last 12 months, whereas in Mexico and Guatemala the same question refers to use within the last 3 months. In the case of Peru, the question refers to Internet use but does not include a time frame.

The control variables are those identified in the extant literature as key determinants of Internet adoption, such as income, education, age, family composition, urban vs. rural location, and the availability of Internet service at home (Fairlie, 2004; Flamm and Chaudhuri, 2007; Hauge and Prieger, 2010; author, 2017; Manlove and Whitacre, 2019). It is worth noting that employment is measured in national household surveys regardless of type of labor contract or access to benefits, and thus includes both formal and informal workers. In the case of household income, this variable is not available for Guatemala, and in Mexico the survey uses a proxy

Table 2
Surveys and sample characteristics.

Country	Survey	Source	Sample size (18+)	Year
ECUADOR	Encuesta Nacional de Empleo, Desempleo y Subempleo (ENEMDU)	Instituto Nacional de Estadificas y Censos (INEC)	70,248	2017
GUATEMALA	XII Censo Nacional de Población y VII de Vivienda	Instituto Nacional de Estadísticas Guatemala (INE)	8,743,632	2018
MEXICO	Encuesta Nacional sobre Disponibilidad y Uso de Tecnologías de la Información en los Hogares (ENDUTIH)	Instituto Nacional de Estadística y Geografía (INEGI)	109,670	2018
PERU	Encuesta Residencial de Servicios de Telecomunicaciones (ERESTEL)	Organismo Supervisor de Inversión Privada en Telecomunicaciones (OSIPTEL)	30,720	2018

Table 3
Descriptive statistics (%).

	Ecuador			Guatemala			Mexico			Peru		
	Men	Women	gap	Men	Women	gap	Men	Women	gap	Men	Women	gap
Internet use	57.1	54.2	2.9***	35.1	29.8	5.2***	65.3	61.9	3.4***	63.7	57.8	5.9***
Location of use												
Home	70.3	73.9	−3.6***	n/a	n/a	n/a	88.5	90.7	−2.2***	36.7	37.1	−0.4
Workplace	33.3	25.0	8.3***	n/a	n/a	n/a	62.6	42.8	19.8***	4.3	3.4	0.9**
Education	10.4	10.5	−0.1	n/a	n/a	n/a	15.7	15.2	0.5	0.8	0.9	−0.1
Internet use (employed only)	57.1	57.4	−0.3	36.6	50.5	−13.9***	67.7	74.7	−7.0***	65.7	65.4	0.3
Numbers of obs	33,617	36,631		41,13,216	46,30,416		51,889	57,781		14,762	15,958	

***p < 0.01, **p < 0.05, *p < 0.1.

for household income (measured in four socioeconomic categories) based on household assets and other factors.

Table 3 presents descriptive statistics for our main variable of interest. As shown, the overall gender gap in Internet use ranges from 5.9 p. p. In Peru to 2.9 p. p. In Ecuador. While these differences appear relatively small in comparison to other developing countries, they are statistically significant and large in absolute numbers. For example in the case of Peru, the difference amounts to about 1 million fewer women than men who are online. There are also notable gender differences in location of use. Men are more likely to cite use at the workplace, while women are more likely to cite use at home. However, these unconditional results ignore differences in employment status and the gender division of unpaid household labor, which as noted falls disproportionately on women. If the sample is restricted to those who are employed (part or full time), the gap in Internet use either disappears (Peru and Ecuador) or reverses in favor of women (Guatemala and Mexico). This suggests that employment status not only is an important determinant of Internet use, but also that the effect may be different for women than men. We return to this point in the main results section below.

3.3. Method

This study applies two empirical strategies, each offering a different approach to address our main research question. The first relies on a standard multivariable logit regression that estimates the impact of individual and household-level demographics on the probability of Internet use. From this model, we calculate the interaction between gender and employment, with particular attention to differences in the effect of employment on Internet adoption for men and women. We emphasize differences in the additive scale, often referred to as interaction contrast (IC).

The second strategy uses a decomposition technique proposed by Yun (2004) and further developed by Powers et al. (2011). The technique extends the decomposition technique originally developed by Oaxaca (1973) and Blinder (1973) to non-linear models (e.g., probit or logit). While the original technique was developed for linear models, and can lead to misleading estimates when the outcome of interest is binary, as is our case, the method proposed by Yun (2004) overcomes this problem by generalizing the technique regardless of the functional form of the model. This strategy helps identify the contribution of each demographic factor to the observed differences in Internet use between men and women by decomposing the gender digital gap into two components: a first component that captures differences in observable characteristics between men and women (for example, differences in employment rates); and a second component that captures differences in coefficients, or in other words, in the effect that these observable characteristics have on

Table 4
Probability of Internet use (log odds coefficients).

	ECUADOR	GUATEMALA	MEXICO	PERU
Female (=1)	−0.178	−0.045	0.018	−0.208
	(0.039)***	(0.002)***	(0.041)	(0.052)***
Employed (=1)	0.199	0.473	0.526	0.486
	(0.046)***	(0.002)***	(0.045)***	(0.056)***
Age	−0.076	−0.013	−0.096	−0.087
	(0.008)***	(0.000)***	(0.007)***	(0.009)***
Age squared	−0.000	−0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)	(0.000)**
Elementary school (=1)	1.082	1.484	1.061	0.474
	(0.050)***	(0.002)***	(0.043)***	(0.091)***
High school only (=1)	1.476	2.055	1.825	1.332
	(0.046)***	(0.003)***	(0.060)***	(0.064)***
Bachelor or higher (=1)	2.717	3.775	2.841	2.397
	(0.067)***	(0.006)***	(0.074)***	(0.076)***
Per capita HH income (log)	0.555	n/a	n/a	0.400
	(0.026)***			(0.034)***
Socioeconomic level = 2	n/a	n/a	0.709	n/a
			(0.055)***	
Socioeconomic level = 3	n/a	n/a	1.127	n/a
			(0.072)***	
Socioeconomic level = 4	n/a	n/a	1.366	n/a
			(0.113)***	
Urban (=1)	0.736	0.603	0.396	0.817
	(0.040)***	(0.002)***	(0.049)***	(0.081)***
Presence of children (=1)	0.188	0.035	0.079	0.140
	(0.046)***	(0.002)***	(0.044)*	(0.058)**
HH members	−0.042	−0.077	−0.112	−0.136
	(0.011)***	(0.000)***	(0.014)***	(0.017)***
Residential access (=1)	1.688	2.143	1.960	4.070
	(0.044)***	(0.003)***	(0.042)***	(0.085)***
Constant	−1.242	−1.290	1.578	−3.823
	(0.202)***	(0.008)***	(0.164)***	(0.293)***
Observations	69,172	8,725,065	108,615	29,605

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.
Note: Incomplete elementary school is the reference category for educational attainment.

the outcome of interest (in our case, the probability of using the Internet).

Suppose that Y, a binary variable that takes the value of 1 if the individual is online and 0 otherwise, is a function of a linear combination of independent variables through the non-linear function F:

$$Y = F(X\beta)$$

where F is a once-differentiable function that maps a linear combination of $X(X\beta)$ to Y, X is the vector of explanatory variables and β is the vector of parameters.

In the context of this study, the gender digital gap $\overline{Y}^{male} - \overline{Y}^{female}$ can be decomposed as follows:

$$\overline{Y}^{male} - \overline{Y}^{female} = \left[\overline{F(X_{male}\beta_{male})} - \overline{F\left(X_{female}\beta_{male}\right)}\right] + \left[\overline{F\left(X_{female}\beta_{male}\right)} - \overline{F\left(X_{female}\beta_{female}\right)}\right]$$

Note that the first term in brackets represents the part of the digital gender gap that can be attributed to gender differences in observable characteristics (or "endowments"), while the second term represents the part attributable to gender differences in parameters. Because the second term also includes the part attributable to variation from unobserved variables, the interpretation of decomposition results generally emphasizes the first term.

To determine the contribution of each variable contained in X to the differences in the probabilities of Internet use between the two groups, it is necessary to find a proper weight for each variable, which Yun (2004) proposes to approximate in two stages. In the first, the function is evaluated using mean characteristics, while in the second, a first-order Taylor expansion around $\overline{X}_{male}\beta_{male}$ and $\overline{X}_{female}\beta_{female}$ is used to linearize the characteristics and coefficients effects.

The final expression proposed by Yun (2004) is:

$$\overline{Y}^{male} - \overline{Y}^{female} = \sum_{i=1}^{k} \omega^{i}_{\delta X}\left[\overline{F(X_{male}\beta_{male})} - \overline{F\left(X_{female}\beta_{male}\right)}\right] + \sum_{i=1}^{k} \omega^{i}_{\delta\beta}\left[\overline{F\left(X_{female}\beta_{male}\right)} - \overline{F\left(X_{female}\beta_{female}\right)}\right]$$

where weights for characteristics are approximated by $\omega^{i}_{\delta X} = \frac{(\overline{X}^{i}_{male} - \overline{X}^{i}_{female})\,\beta^{i}_{male}}{(\overline{X}_{male} - \overline{X}_{female})\,\beta_{male}}$ and weights for coefficients are approximated by $\omega^{i}_{\delta\beta} = \frac{\overline{X}^{j}_{female}\,(\overline{\beta}^{i}_{male} - \overline{\beta}^{j}_{female})}{\overline{X}_{female}\,(\overline{\beta}_{male} - \overline{\beta}_{female})}$. As expected, the sums of weights. $\sum_{i=1}^{k} \omega^{i}_{\delta X} = \sum_{i=1}^{k} \omega^{i}_{\delta\beta} = 1$.

4. Results

We begin by presenting results from the first strategy. The logit models in Table 4 estimate the probability of Internet use conditional on observable characteristics. The majority of the predictor variables have the expected effect across the four countries: age is inversely related to the probability of Internet use, whereas education, income, the presence of children, urban location, and residential broadband subscription increase the probability of being online. The only exception is the number of household members which contrary to expectations is inversely related to Internet use.

Considering our main variables of interest, we first note that, after controlling for observable demographics, women remain less likely to report Internet use in Ecuador, Guatemala and Peru. The magnitude of the effect is particularly large in Ecuador and Peru: in the odds ratio scale, the odds of Internet use are 16% lower for women in Ecuador and 19% in Peru. Interestingly, this is not the case in Mexico, where other predictor variables absorb the gender gap identified in the descriptive statistics (Table 3). As predicted, employment status is a strong predictor of Internet use in all four countries. In the odds ratio scale, the magnitude of the effect ranges from 22% in Ecuador to 69% in Mexico in favor of those who are employed. Overall, these findings validate previous results (discussed in section 2) that point to gender and employment as key predictors of Internet adoption.

At the same time, previous studies also suggest that education moderates the relationship between employment and Internet use (e.g., Dettling, 2017). A common hypothesis is that more educated women will use the Internet regardless of labor force participation, thus weakening the employment effect as education increases. We explore this hypothesis in Table 5, which presents the difference in the predicted probability of Internet use between employed women (EW) and non-employed women (UW) by level of education. To facilitate interpretation, we categorize women into two groups: more educated (proxied as education beyond high school diploma) and less educated women (high school diploma or less).

As expected, employment significantly increases the probability of Internet use among women regardless of education in the four countries in the sample. However, the magnitude of the increase is larger among less educated women in three of the four countries. The difference is particularly noticeable in Guatemala and Mexico, where employment increases the probability of being online by about 18 p. p. Among women with high school diploma or less, compared to about 6 p. p. Among more educated women. In other words, the effect in the likelihood of Internet use is three times larger, thus confirming the hypothesis that the employment effect wanes as education rises.

Turning to our main question about whether employment affects Internet use differently for men and women, we estimate the interaction in the additive scale by calculating model predictions of Internet use across the following four groups: employed men (EM), unemployed men (UM), employed women (EW), and unemployed women (UW). The interaction contrast IC is defined as:

$$IC = [Pr(EM) - Pr(UM)] - [Pr(EW) - Pr(UW)]$$

Table 5
Predicted probability of Internet use among women by employment and level of education.

	(A) More education	(B) Less education	Interaction contrast\ (A-B)
	[Pr (EW) – Pr(UW)]	[Pr (EW) – Pr(UW)]	
ECUADOR	0.048***	0.041***	0.006
	0.009	*0.007*	*0.011*
GUATEMALA	0.054***	0.230***	−0.176***
	0.001	*0.000*	*0.001*
MEXICO	0.060***	0.237***	−0.177***
	0.008	*0.007*	*0.011*
PERU	0.062***	0.097***	−0.034***
	0.010	*0.009*	*0.013*

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

Table 6 presents the differences in model predictions of Internet use for men and women by employment status as well as the resulting interaction contrast *IC*. As shown, being employed has a significantly larger additive effect on the probability of Internet use for women than for men. The difference is largest in Guatemala, where employment increases the probability that women are online by about 30 p. p., compared to about 7 p. p. For men (about 23 p. p. Difference). In the other countries, the difference ranges from about 5 p. p. (Peru) to about 11 p. p. (Mexico). Overall, these findings validate the hypothesis that, while employment is a significant contributor to Internet adoption across genders, the effect is significantly larger for women.

Fig. 1 offers a visualization of these results. In each panel, the red line represents the change in the predicted probability of Internet use for women associated with employment, while the blue line represents the change in the same probability for men. In other words, for each country the figure plots the difference in internet use between employed and unemployed men (Pr (EM) – Pr(UM)), and the same difference for women (Pr (EW) – Pr(UW)).

As shown, considering only those who are employed (relative to those who are unemployed or not in the labor force), the gender digital divide disappears in Peru and Ecuador, and reverses in favor of women in Guatemala and Mexico. The key takeaway from Fig. 1 is that being employed is a significantly stronger predictor of Internet use for women. This is perhaps most apparent in the case of Ecuador, where employment does not change the predicted probability of internet use for men but has a noticeable positive effect for women (of approximately 10%), as well as in Guatemala where the predicted probability of use more than doubles for employed women (compared to an increase of about 20% for men).

The second empirical strategy decomposes the digital gender gap into its contributing factors (Table 7). The table first presents an aggregate decomposition of the gap using the same predictors as in the logit models above. In this first approximation, the gap is decomposed into two parts: a part attributable to gender differences in observable individual characteristics, and a part attributable to differences in parameters (or in other words, in the effect of these characteristics on the probability of Internet use).

As shown, differences in observable characteristics (such as age, educational attainment and our main variable of interest, employment) explain the greater part of the gender digital gap in Guatemala (65%), Mexico (74%) and Peru (77%). In other words, if women had the same distribution on these characteristics as men, one would expect the digital gender gap in these countries to fall by at least two-thirds. The exception is Ecuador, where differences in characteristics explain only about a third of the digital gender gap.

Next, the table shows results from a detailed decomposition that estimates the unique contribution of each predictor in the model. Each predictor variable is further decomposed into a part attributable to gender differences in the distribution of the variable and a part attributable to differences in parameters. The sign of the coefficient indicates whether the characteristic or parameter contributes to an increase (positive sign) or a decrease (negative sign) in the digital gender gap. In other words, the sign indicates whether the characteristic or parameter represents an advantage or a disadvantage to women (relative to men), depending on whether it increases or decreases the probability of Internet use. For brevity, Table 7 shows results for our main variable of interest only. The full set of decomposition results is available in Table A1.

Table 6
Additive effect of employment on the probability of Internet use by gender.

	(A) Men	(B) Women	Interaction contrast (A-B)
	[Pr (EM) – Pr(UM)]	[Pr (EW) – Pr(UW)]	
ECUADOR	0.000	0.077***	−0.076***
	(0.007)	(0.006)	(0.009)
GUATEMALA	0.069***	0.295***	−0.226***
	(0.000)	(0.000)	(0.001)
MEXICO	0.140***	0.255***	−0.115***
	(0.007)	(0.006)	(0.009)
PERU	0.093***	0.142***	−0.049***
	(0.008)	(0.006)	(0.011)

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

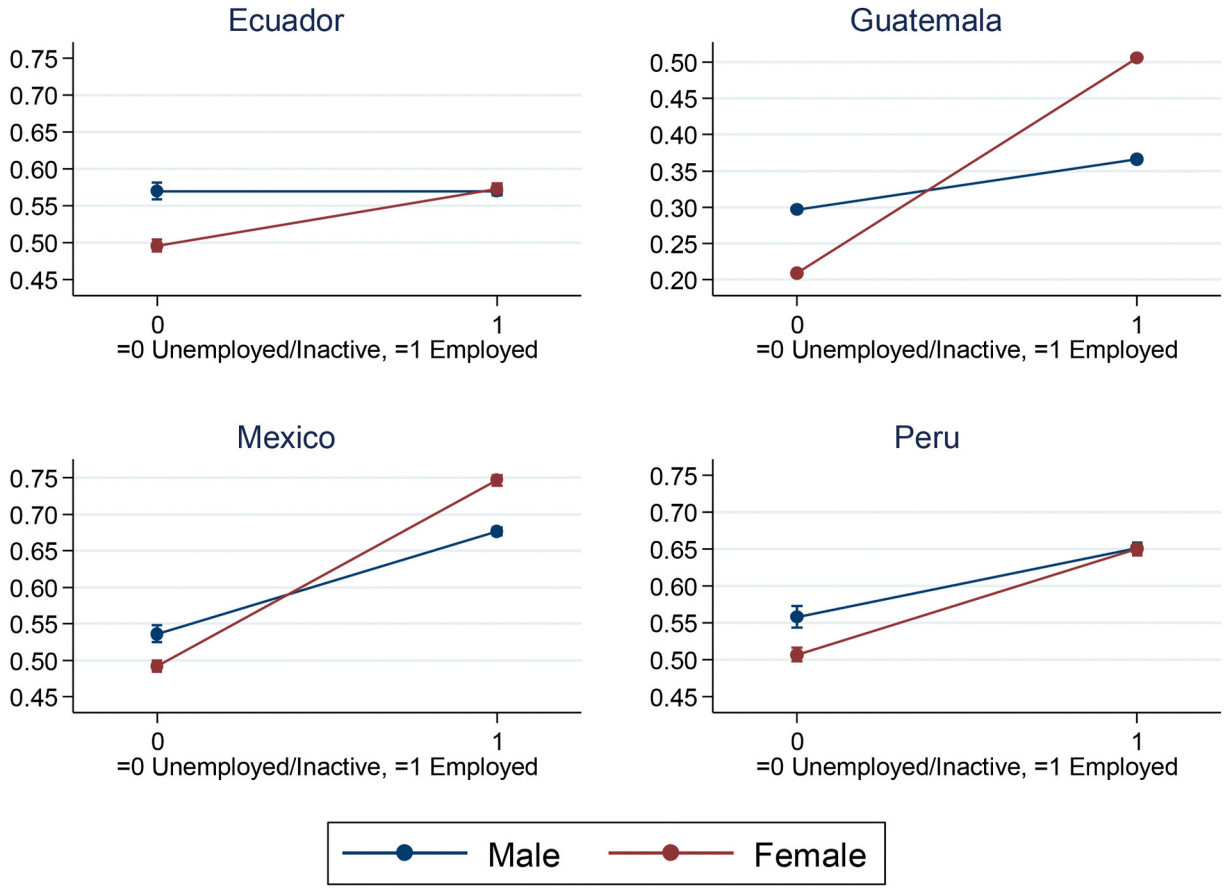

Fig. 1. Predicted probability of Internet use by gender and employment status.

Table 7
Decomposition of gender differences in Internet use.

	ECUADOR		GUATEMALA		MEXICO		PERU	
	Coefficient	%	Coefficient	%	Coefficient	%	Coefficient	%
ALL VARIABLES								
Characteristics	0.010*** (0.003)	33.3	0.034*** (0.000)	64.8	0.024*** (0.003)	73.6	0.045*** (0.004)	77.5
Parameters	0.021*** (0.005)	66.7	0.018*** (0.000)	35.3	0.009* (0.005)	26.4	0.013** (0.007)	22.5
EMPLOYMENT								
Characteristic	0.007** (0.003)	22.0	0.017*** (0.000)	32.2	0.011*** (0.003)	32.5	0.029*** (0.004)	50.1
Parameter	−0.002 (0.006)	−6.5	−0.010*** (0.000)	−18.1	−0.013** (0.007)	−40.2	0.018** (0.008)	31.2
# of observations	69,172		8,725,065		108,615		29,605	

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

Despite some variation across the four countries studied, the results generally validate the hypothesis that gender differences in employment are the single largest contributor to the difference in Internet use between men and women. This is most apparent in Peru, where about half of the gender gap in Internet use can be attributed to men being employed at a significant higher rate than women. This suggests that, if women were equal to men in the distribution of employment, the digital gender divide in Peru would be reduced by about half. While the estimated contribution is slightly lower for Guatemala and Mexico (about 32%) as well as Ecuador (22%), employment remains the largest single contributor to the digital gender gap in these countries, ahead of gender differences in other predictors of Internet use such as income, age and education (see Table A1).

Regarding the contribution of differences in employment parameters, the results are less consistent, which may in part reflect the fact that interpretation is more ambiguous because parameter coefficients also capture the effect of unobserved variables. The sign of the coefficient for employment is negative in Guatemala and Mexico, thus indicating that women gain more Internet use from

employment than men. This is consistent with our interpretation of the logit model findings above (Table 6), and suggests that if the effect of employment on Internet use for women was equalized to that for men, the gender digital gap would in fact increase by about 18% in Guatemala and about 40% in Mexico. On the other hand, the sign of the coefficient for employment is positive in Peru, while it is non-significant in Ecuador. Overall, these mixed results offer only partial validation to the hypothesis that, because of differences in employment patterns and occupations, having a job has a larger effect on Internet use among women than men.

5. Discussion and conclusions

The digital gender gap has not emerged in a vacuum. Rather, the diffusion of new technologies such as the Internet has been shaped by institutional factors and social norms that militate against gender equality in several areas, among them employment. These forces are particularly strong in countries where gender parity in workplace rights and business opportunities has not been fully institutionalized, and where traditional attitudes about family roles and occupational segregation prevail.

Latin America is an interesting case in point. The region has experienced major institutional and cultural changes over the past 50 years that have significantly narrowed gender gaps in education, political representation and several other key areas (Bando, 2019). As an example, young women in the region (25–34 years old) are now more educated than men, and most countries (including the countries in our sample) have enacted legislation barring gender discrimination in hiring (Pagés and Piras, 2010). However, there is evidence that labor markets remain shaped by gender stereotypes as well as lingering institutional barriers that work against female workers, actual or potential (Chioda, 2016). For example, none of the countries in this study meet the ILO guidelines for maternal and paternal leave, and domestic work legislation (which disproportionately affect women) remains underdeveloped (OECD, 2020). In other words, while there has been much progress towards gender parity in Latin America in past decades, this is less evident in labor market indicators.

The connection between employment and Internet adoption is well established in the empirical literature. Workers often acquire ICT experience and skills through the workplace, and those skills are easily transferrable to other contexts. Further, having access at work is all the more important in developing countries where the majority lives in households that do not subscribe to residential broadband. However, there are few studies that explore the nexus between gender, employment and Internet adoption in emerging regions. This study contributes to fill this gap by exploring how differences in employment patterns between men and women affect Internet use in Ecuador, Guatemala, Mexico and Peru.

The findings suggest that higher employment rates among men explain between a quarter and a half of the observed gender gap in Internet use in these countries, ahead of other common predictors of use such as age, education and income. According to our estimates, equalizing the distribution of employment among women to that of men would reduce the gender digital gap by about 22% in Ecuador, about 32% in Guatemala and Mexico, and about 50% in Peru. Further, we find evidence (though not conclusive) that being employed has a larger impact on the likelihood of being online for women than for men, possibly because of gender differences in occupations. Female workers are overrepresented in education, health, public administration and other ICT-intensive sectors (Gasparini et al., 2015), with the pace of ICT adoption in these sectors accelerating as a result of the COVID-19 pandemic.

The findings from the decomposition analysis also suggest that variations in labor market structure are likely to affect the nexus between gender differences in employment and Internet use. For example, in countries with a larger service sector the payoff to labor force participation by women is likely to be larger, while the reverse may be true for countries with a larger share of agricultural employment such as Ecuador (29%) and Guatemala (31%).[2] Cross-country differences in attitudes towards female employment are also likely to shape career paths for women, resulting in different opportunities to work in more ICT-intensive occupations. At the very least, the countries in this study provide a baseline against which to compare findings from other countries and regions.

From a policy perspective, we caution against interpreting these results as evidence that gender matters less than other studies suggest. On the contrary, the findings indicate that the institutional and cultural factors that shape labor markets have broader implications for opportunities to access the Internet and develop digital skills. In turn, these narrow women's career opportunities and limit labor force participation. Further, the connection between gender differences in employment and online engagement suggests an opportunity to better articulate digital inclusion policies with those aimed at closing gaps in employment. For example, there is evidence from pilot initiatives that digital upskilling programs targeted at low-income women may allow for leapfrogging into higher-paying jobs in the service economy, thus simultaneously promoting labor force participation and online engagement (for a discussion, see OECD, 2018).

There are several limitations to this study that warrant further investigation about the nexus between employment and the gender digital divide. The first is that employment patterns and the structure of labor markets vary greatly in Latin America. While the countries in this study exhibit some of these structural variations, whether the findings are representative of other countries in the region remains an open question. Another limitation relates to the survey data used in the study, which does not capture quality of Internet access, frequency of use, and other important dimensions of online engagement. Some studies suggest that, when these dimensions are included, the digital gender gap in the region is considerably larger (e.g., World Wide Web Foundation, 2020). In addition, understanding gender differences in online skills and how they relate simultaneously to employment and Internet engagement is critical, but this type of data is not available for the countries in our sample. This calls for renewing efforts to collect standardized, gender disaggregated data about digital literacy throughout the region.

[2] Source: The World Bank.

Finally, there is much uncertainty about these findings in the aftermath of the COVID-19 pandemic. On the one hand, there are indications that the pandemic has promoted the expansion of residential broadband in Latin America, which has been driven in part by government policies addressing the needs of households with children following the closure of school campuses. On the other hand, the data on labor force participation from advanced countries suggests a disproportionate negative impact on women's labor force participation because of care responsibilities, which is likely to be even larger for the region due to the persistence of traditional gender-role norms.[3] These open questions suggest a fertile area for gender-focused research about Internet and employment in the post-pandemic context.

Appendix. Table A1

	ECUADOR		GUATEMALA		MEXICO		PERU	
	Coefficient	%	Coefficient	%	Coefficient	%	Coefficient	%
ALL VARIABLES								
Characteristics	0.010***	33.3	0.034***	64.8	0.024***	73.6	0.045***	77.5
Parameters	0.021***	66.7	0.018***	35.3	0.009*	26.4	0.013**	22.5
Difference in Characteristics								
Employment	0.007**	22.0	0.017***	32.2	0.011***	32.5	0.029***	50.1
Age	0.005***	15.1	0.000***	0.2	0.007***	22.5	−0.008***	−14.1
Age squared	0.001	1.8	0.001***	2.7	−0.001**	−3.8	0.002**	4.2
HH income (log)	0.006	18.8	n/a		n/a		0.003***	5.2
Socioeconomic = 2	n/a		n/a		0.0001***	1.6	n/a	
Socioeconomic = 3	n/a		n/a		−0.000***	−0.5	n/a	
Socioeconomic = 4	n/a		n/a		−0.001***	−3.2	n/a	
Urban (=1)	−0.001***	−2.8	−0.001***	−1.5	−0.000***	−0.3	−0.000***	−0.6
Residential access (=1)	−0.003***	−9.2	−0.001***	−2.1	0.001***	3.1	0.004***	6.2
Elementary school (=1)	0.001***	2.7	0.011***	21.0	0.001***	3.9	−0.000**	−0.4
High school only (=1)	0.006***	18.1	0.001***	21.0	−0.002***	−7.2	0.005***	8.9
Bachelor/higher (=1)	−0.008***	−27.1	0.005***	2.7	0.008***	25.0	0.011***	18.5
Presence children (=1)	−0.002***	−6.4	0.000**	10.0	−0.001	−1.6	0.000	−0.6
HH members	0.000***	0.2	0.000***	−0.6	0.001***	1.7	0.000***	0.2
Difference in Parameters								
Employment	−0.002	−6.5	−0.010***	−18.1	−0.013**	−40.2	0.018**	31.2
Age	−0.074	−238.8	0.049***	93.1	−0.085**	−255.4	0.009	15.0
Age squared	0.056*	180.4	−0.026***	−49.2	0.041*	122.5	−0.009	−15.4
HH income (log)	0.045*	145.0	n/a		n/a		−0.019	−32.0
Socioeconomic = 2	n/a		n/a		0.000	0.1	n/a	
Socioeconomic = 3	n/a		n/a		0.001	2.7	n/a	
Socioeconomic = 4	n/a		n/a		−0.001	−2.8	n/a	
Urban (=1)	−0.013**	−42.7	0.002***	3.2	0.004	13.2	−0.013	−21.4
Residential access (=1)	0.002	5.9	0.001***	1.2	−0.01*	−29.0	0.028	47.7
Elementary school (=1)	−0.002	−5.3	−0.004***	−6.8	−0.002	−5.5	−0.003	−4.3
High school only (=1)	−0.003	−10.2	−0.002***	−3.5	0.001	3.7	−0.006	−9.9
Bachelor/higher (=1)	−0.004	−12.6	−0.001***	−1.0	0.005***	15.0	−0.008	−14.5
Presence children (=1)	0.019***	60.4	−0.005***	−8.8	0.002	5.2	−0.005	−9.2
HH members	0.001	2.4	0.011***	20.9	0.011	32.6	−0.023	−39.3
Constant	−0.004	−12.1	0.002*	4.2	0.054**	164.2	0.044	74.6
# of observations	69,172		8,725,065		108,615		29,605	

***p < 0.01, **p < 0.05, *p < 0.1.

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[3] See for example "COVID-19 widens gender gap in labor force participation in some but not other advanced economies", available at https://www.piie.com/blogs/realtime-economic-issues-watch/covid-19-widens-gender-gap-labor-force-participation-some-not.

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