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The Untapped Economic Potential of Including Women in the Digital Economy in the APEC Region

APEC Policy Partnership on Women and the Economy

September 2022

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INTRODUCTION

This document was prepared by the Center for Mathematical Moeling of the University of Chile (CMM) in the context of the PPWE 07 2020A project, "The Untapped Economic Potential of Including Women in the Digital Economy in the APEC Region", where the ultimate objective is to perform an economic estimate of the untapped potential of including women in the digital economy in the APEC region.

In the first part of the document, the foundations of the study are laid through the definitions of the main conceptual and operational distinctions used to explore gender digital gaps and their economic consequences. The main data sources available are explored in section two, where several international and regional reports and indicators that collect information on the access and use of technology are presented . Despite these efforts, it is identified that data sources on this matter are scarce and with little historical development in time, particularly in some APEC economies.

Afterwards, the barriers and drivers to female participation in the digital economy and its relationship with economic indicators are analysed with different methodologies and data sources, exploring gaps in low-skill technological involvement (internet access) and high-skill technological involvement (enrolment and graduation from science, technology, engineering and mathematics (STEM) and information, communication, and technology (ICT) careers). Data from the Economist Intelligence Unit (EIU, 2021) and the World Bank's Gender Data Portal (World Bank, 2022) were used to construct indicators of access to the internet and STEM careers, respectively, and different sources of data were used to explore economic determinants that can allow linking digital gaps with economic effects, i.e., GPD per capita and GPD growth (EIU, 2021; World Bank, 2022).

The most relevant and significant variables in female access to the digital economy were educational variables, cost of access to technology and technological services, variables of basic and technological infrastructure, and variables related to government policies. In the case of APEC economies, a socioeconomic model was calibrated to find the most relevant variables.

The cost of the untapped economic potential of including women in the digital economy was estimated for 2020 at 94 billion dollars in the APEC region. Finally, the last chapter offers a set of conclusions and recommendations.

BACKGROUND

This section is focused on conceptual definitions and the general background regarding both the digital and the gender digital gap. It presents the general barriers identified in the literature for women accessing digital technology and some impacts on economic variables.

Digital Gap

In the last few decades, a new industrial revolution with the acceleration and spread of information and communication technologies (ICTs) has occurred. This revolution has undoubtedly changed the way people live, work, and interact with each other and how societies, businesses, and economies operate and develop (Herbert, 2017). The scale and scope of mobile technology enable billions of people worldwide to access essential services and information, often for the first time, to meet their life's needs (GSMA, 2021). In addition, several scholars and policy-makers agree that being digitally excluded may have negative consequences on development and well-being , particularly of children and adolescents (Livingstone, Carr, & Byrne, 2015; UNICEF, 2017).

The spread of COVID-19 has accelerated economies' digital transformation with a surge in e-learning, streaming, online shopping, marketing, and teleworking (OECD, 2021; CEPAL, 2021). As a result of confinement measures, companies and organizations from different sectors have been forced to migrate to new ways of operating, speeding up the process of immersion in the digital age and integrating new modalities of service provision congruent with the new reality imposed by the pandemic (CEPAL, 2021).

Despite the relevance and potential gains from accessing and using digital technologies, its impacts are unequally distributed and, therefore, often unrealized. The extent and pace of digital development contribute to unequal development trajectories among people and economies. In the current context of ICT-driven globalization, there are serious concerns that the inequalities among different economies and people may grow, exacerbating existing material disparities with strong social consequences. As Herbert states, "this mixed picture suggests that digital development is not only disrupting development pathways but is also a continuation of traditional development challenges and divides" (Herbert, 2017, pp.2).

There are several conceptualizations of the digital divide (for a review, see (Hargittai & Hsieh, 2013)). Kularski and Möller (2012) conceptualize the digital gap as enacted by a limitation of physical access to information technology (IT) and a lack of technical skills, both of which often contribute to each other in circular causation. Norris (2001) adds to this definition the disparities between developed and developing economies, the rich and poor, and the men and women of those economies . General discussions on the topic have also included differences between access (as opportunity) and use and how, in the latter, there are real spaces to engage, mobilize, participate in public life, and empower users (DiMaggio, Hargittai, Celeste, & Shafer, 2004; Hilbert, 2011). Similarly, Atwell (2001) makes a valuable distinction between primary and secondary digital gaps. The primary digital gap concerns differences in Internet access, and the secondary digital gap refers to differences in Internet use.

Regarding the primary digital divide, multiple studies of digital technologies measure participation through access. One of the most commonly used measures is mobile phone ownership (GSMA, 2021; OECD, 2018) and access to mobile internet (GSMA, 2021; OECD, 2018). The International Telecommunication Union (ITU) estimated that approximately 4.9 billion people—or 63 percent of the world's population—used the internet in 2021. This number represents an increase of 17 percent since 2019, and approximately 782 million people were online during that period. However, it also shows that 2.9 billion people are still offline. Over 3 billion people in low- and middle-income economies (LMICs) access the internet from a mobile phone[1]. Mobile is the primary way women and men access the internet in developing economies, accounting for 85 percent of broadband connections in 2020[2] (GSMA, 2021).

Finally, in addition to gaps in internet access, digital gaps can also exist in 'higher skills' technological involvement, engagement, and labour. People can use and produce technological means. While 'using' generally requires low technological skills, 'producing' requires access to specialized training, education, and labour opportunities. Gaps in these areas will potentially produce very different impacts on economic development and the economic well-being of people.

Digital Gender Gap

The digital gender divide refers to differences between genders regarding indicators of access and use of digital and information technologies and access to STEM education and technology-intense labour markets. Concerns about these potential differences have been studied since the beginning of extended internet use. For instance, early surveys showed that women were less likely to access the internet than men. This is critical since access to digital technologies, skills, and platforms has the potential to empower women economically and socially by creating new employment and entrepreneurship opportunities, removing barriers to trade, improving access to finance and information, and improving their business processes and communications. In addition, any gender gap in digital access and use can have important consequences on connectivity and work in the current pandemic context, enhancing the impact of the pandemic on the female workforce (CEPAL, 2021).

In general, even when the gender digital gap has shown a decreasing trend, it is still persistent around the globe. For example, in 2019, approximately 55 percent of men were internet users compared to 48 percent of women (ITU, 2020). In the APEC region, recent data showed that women use the internet to a lesser extent than men in every economy except in the U.S, with the widest gaps in Peru, Indonesia, and Malaysia (OECD, 2019; ITU, 2019).

[1] GSMA Intelligence, Q1 2021

[2] International Telecommunication Union (ITU) estimates for 2019.

Regarding access to mobile technology, since 2017, women have been found to be approximately 10% less likely than men to own a mobile phone and consequently to use mobile internet (ITU, 2019; GSMA, 2021). The Global System for Mobile Communications Association estimates that 143 million fewer women than men have a mobile phone (GSMA, 2021), and the Mobile Gender Gap Report (2021) shows that at least 230 million fewer women access the mobile internet than men.

In relation to the secondary gender digital divide, studies have found differentiated patterns of use between men and women (DiMaggio, Hargittai, Celeste, & Shafer, 2004). In general, men show a greater breadth of internet use, use of gaming websites and other websites, and download more material from the internet than women (Joiner, Stewart, & Beaney, 2015). Males are also more likely to use the internet for entertainment than females (Jackson et al., 2001; Scweingruber et al., 2001; Sherman et al., 2000). In contrast, females are more likely to use their time on the internet for instant messaging and using it as a communication tool (Dunahee & Lebo, 2016; Ono & Zavodny, 2007; Wasserman & Richmond-Abbott, 2005). Different patterns have also been found in social media. While women use social networks to maintain social relationships, men use them to search for information (Haferkamp, Eimler, Papadakis, & Kruck, 2012; Krasnova, Veltri, Eling, & Buxmann, 2017), although most of these studies have focused on Europe and the US (Boyd & Ellison, 2010). In the APEC region, the ITU indicators database (2019) shows that women were found to use the internet less than men for online job applications, online banking, using online software and applications, writing computer codes, among others.

Women's low representation in access, graduation and work in the STEM and ICT areas is also a global concern. Several international comparative studies have shown that women remain underrepresented in these disciplines in many regions around the world, including OECD economies (OECD, 2019), Latin America (Lopez-Bassols, Grazzi, Guilllard, & Salazar, 2018), Europe and Central Asia (World Bank, 2017). Specifically, in the APEC region, a recent framework was developed to promote actions towards including more women in STEM. This framework includes a range of issues affecting the hiring, retention, and advancement of women in these fields, and proposes a set of cross-cutting recommendations to enhance women and girls' opportunities in STEM (APEC, 2016).

Regarding the causes of digital gender gaps, substantial research has shown that interaction between macro (organization of economies and social norms in place regarding gender differences) and institutional measures (policies and initiatives) must be considered when exploring reasons for existing gender gaps in technological access and use. For example, the literature on the socioeconomic determinants of the gender gap in internet access around the world identifies gender gaps in income, employment, and education as the most important variables (Hafkin & Huyer, 2007; Fatehkia, Kashyap, & Weber, 2018). For example, Hilbert (2011) found that gender gaps in both internet and mobile use could be explained by women's lower levels of literacy, employment, and income in Latin American economies. This indicator may capture the financial and institutional constraints that women face when going online (Fatehkia, Kashyap, & Weber, 2018). Consequently, with the impact of socioeconomic variables on digital literacy and use, the cost of technology remains the most significant barrier to owning and using a

mobile phone, especially for women who are less financially independent than men. Studies have shown how less access for women leads to low confidence in the use of digital technologies, and time poverty hinders access to ICT studies, as women usually bear the brunt of domestic and care work, leaving them with little or no time for leisure, training or upskilling (OECD, 2019).

In addition to socioeconomic determinants, social norms also affect women's access to and use of mobile technology and often contribute to women facing barriers to mobile phone ownership and use more acutely than men. Stereotypes, values and beliefs about gendered skills and abilities create gendered expectations and perceptions of abilities that hinder girls' and women's confidence in technological environments (Gill, Brooks, McDougall, Patel, & Kes, 2010). Gender stereotypes sustain that women are "naturally" less tech-savvy and more technophobic, and technology itself has not been designed to meet the women's needs (Hilbert, 2011). Several authors have raised concerns about the problems associated with the masculine nature of ICTs, the patriarchal structure within which ICTs are introduced, the feminization of low-skill ICT jobs, and the degradation and devaluation of women employed in certain sectors (Ghosh, 2004; Gothoskar, 2000; Lie, 1991; Stanworth, 1998; Wajcman, 1991). Other experts have pointed out some of the benefits that ICTs have brought to women in developing economies and how women themselves have negotiated gender relations at the household and community levels (Kelkar & Nathan, 2002; Lee, 2004; Ng & Mitter, 2005), rooted in structural gender inequalities, and more research is needed to understand them in their specific contexts (Herbert, 2017). Safety concerns and online harassment have also emerged as important barriers for women following the patriarchal structure within ICTs (GSMA, 2015).

Systemic barriers, including a lack of gender-disaggregated data at all levels (e.g., mobile subscribers, economy-level statistics) and unconscious biases within organizations, have kept the focus off women and sustained the gender gaps in ownership and usage (GSMA, 2015)(p.6). Digital technology also shapes social norms and values by facilitating connections and exposure to different lifestyles, values, and norms. For those who do not access and use digital technologies, conservative gender roles can become more entrenched (Intel Corporation, 2013)(p.34).

Finally, another reason for the gender divide is a greater lack of official identification of women in government records. Worldwide, nearly 2.5 billion people lack official identification, particularly affecting women in poor rural areas of Africa and Asia. Lack of official identification is a significant barrier to accessing educational, welfare, and financial services (Daha & Gelb, 2015). This has a significant gender dimension, as women are less likely to have official identification than men, and they are more likely to seek welfare and education services for their families. A government-used innovation called blockchain provides a permanent and immutable record of identity for citizens and businesses (Herbert, 2017).

Costs of Exclusion

Reports that measure the cost of the exclusion of women from the digital world are scarce, and only one could be identified.The Alliance for Affordable Internet (A4AI)modelled the gender gaps of 32 low- and middle-income economies (LLMICs), covering over 70% of the collective gross domestic product (GDP), and paired it with existing models from the ITU that calculate the economic effect of increasing mobile and fixed broadband penetration. This model gives an estimate of the total effect of the digital gender gap on the GDP of these 32 economies and projects the future impact if governments do not address the problem (A4AI, 2021). The report found a substantial and persistent digital gender gap of approximately 30%. The economic loss is estimated at approximately $1 trillion USD in GDP and $126 billion USD in 2020 as a result of women's exclusion from the digital world. These losses have impacts on taxes, and the study shows that governments have not pushed enough policies and interventions to close the gender gaps found.

AVAILABLE DATA SOURCES ON WOMEN'S PARTICIPATION IN THE DIGITAL ECONOMY IN THE APEC REGION

Substantial international efforts have produced different data sources to measure indicators of digital access, use, and skills related to gender issues. Table 1 shows data sources related to women's participation in the digital economy in the APEC region (links to websites can be found in the annexes in Table 11):

Table 1: Available data sources

Source of data related to the gender gap	Has data from digital gender gap (YES/NO)	Percentage of APEC members included (%)	Update frequency annual or greater (YES/NO)	Years of measurement for ICT data
ITU	YES	76%	NO	2010-2020
University of Oxford in collaboration with the Qatar Computing Research Institute	YES	86%	YES	2018-2021
GSMA	YES	11%	NO	2010-2020
A4AI	YES	5%	YES	2010-2020
Economist Intelligence Unit (EIU)	YES	95%	YES	2016-2020
European Gender Equality Index	YES	0%	NO	2013-2020
Gender Equality Observatory (ECLAC)	NO	14%	YES	
Gender Data Portal (World Bank)	YES	86%	NO	2017
IHSN	NO	10%	NO	
Pacific Data Hub	YES	0%	NO	2013-2019
Survey on Gender Equality at Home	NO	52%	NO	
UNECE (United Nations Economic Commission for Europe)	YES	10%	NO	2000-2020

The five most relevant data sources for measuring ICT access and use by gender are described below. It is necessary to emphasize that the primary source of information used in the analysis will be the EIU since it has the most extensive coverage of APEC economies.

International Telecommunication Union (ITU)

The ITU has collected data on internet use as well as specific ICT or digital skills by the gender and economic zone of the user. These data are collected using economy-level representative surveys, which are used to derive ground truth internet use or digital skills gender gap indicators.

Despite being one of the most reliable sources of information for estimating the internet gender gap, this database presents a series of difficulties due to the frequency of information updates,

since it relies on information reported to the ITU. The database contains 113 economies with information on internet users disaggregated by gender, where the last measurement date ranges from 2016 to 2020. In that sample, 5 of the 21 APEC members are not included (Canada; the United States; the Philippines; New Zealand; and Papua New Guinea).

In the case of the remaining 16 members, the most recent information available is for 2020, except for Australia, Chile (2017), Brunei Darussalam and Japan (2019). Within the samples of APEC economies, it is observed that since 2012, there are, on average, two data samples taken by gender, challenging the generation of a model with correlating variables such as GDP.

University of Oxford in Collaboration with the Qatar Computing Research Institute

On this site[3], data was found related to the index covered by the publications of Ridhi Kashyap, Ingmar Weber, and Masoomali Fatehkia (Fatehkia, Kashyap, & Weber, 2018). The website includes details of monthly indicators since 2018 using information from Facebook. This data source might be considered unrepresentative of economies where Facebook usage is extremely low. The Facebook-based indicator presents a good correlation with the information from the ITU, especially in economies where this social network is highly used. Only four APEC economies do not have values for the indicator: Chinese Taipei; Hong Kong, China; and Papua New Guinea.

GSMA

The GSMA is a global organization unifying the mobile ecosystem and adjacent industries around the globe. It has published reports that provide an expanded source of information on a limited set of economies. Its studies are based on its own research, published in 2010 (GSMA, 2010), 2015 (GSMA, 2015), 2018 (GSMA, 2018), 2019 (GSMA, 2019), 2020 (GSMA, 2020) and 2021 (GSMA, 2021), for a universe of 4, 22, 23, 18, 15 and 8 economies, containing 0, 3, 6, 3, 2 and 0 APEC member economies, respectively. These reports provide a valuable source of information regarding mobile users by gender. They also provide data on the use and opportunities offered by the internet for education, security, and access, among others. Although this source of information may not be relevant for the realization of an econometric model, it is helpful to identify factors and elements of internet use differentiated by gender.

EQUALS and A4AI

EQUALS and A4AI are organizations that have published recent work related to the cost of exclusion (A4AI, 2021) and the lessons that can be achieved through the reduction of the gaps in internet access and use (Equals, 2021). The A4AI report is focused on 32 low-income developing economies where only one APEC economy participated. The value of this study is that it presents a 9-year history of internet access by gender, where the imputation of the missing data of the series was constructed through models.

[3] More information in Table 11: Website links for Data Sources

Economist Intelligence Unit (EIU)

The Inclusive Internet Index, commissioned by Facebook and conducted by the Economist Intelligence Unit, provides a rigorous benchmark of economy-level internet inclusion in 120 economies across four categories: availability, affordability, relevance, and readiness. This index has been published in the last five years (2017-2021). The Inclusive Internet Index assesses and compares economies according to their enabling environment for the adoption and productive use of the internet (EUI, 2021). According to the EIU, the index outlines the current state of internet inclusion across 120 economies and tries to help policymakers achieve a clearer understanding of the factors that contribute to a comprehensive and sustainable inclusion.

This index occupies various data sources (EUI, 2021), and the missing data of the series are estimated through ordinary least squares (OLS). In particular, the data on the percentage of men and women who connect to the internet are built with information compiled by Gallup and ITU, and the GDP data are collected from the World Bank (see Table 12).

The EIU data have information from 20 of the 21 APEC economies, as the most comprehensive source of information and the one selected for this report (details of this information can be found in the annexes in Table 12).

Availability of explanatory variables of women's participation in the digital economy in the APEC region

In all the data sources considered, there are various metrics regarding different levels of access to the digital economy:

- Level of internet access: The level of internet access by gender is best obtained through household surveys, but there are relatively few APEC members that carry them out. For most economies, organizations such as the ITU estimate internet access with variables related to household surveys in the economy and their relationship to whether they have a computer (ITU 2021). Internet access can be mainly through mobile accesses, network points, and fixed accesses. The experience, potential, and use of each mode of access are different, and statistics related to the mode of internet access and use by gender are scarce. In the case of mobile access and use, the closest value is mobile phone ownership to make personal calls, which includes statistics by gender. There is information only on subscriptions, without relating these to gender variables, in the case of fixed access.
- Level of technological relevance on the digital economy: Gender statistics related to education and the use of technology are scarce. The most widely used proxy is women's participation in STEM education programs. Two databases collect this variable: the Gender Data Portal of the World Bank, which contains the direct proportion of women who graduate from these programs, and the EIU, which creates variables regarding government policies and programs to promote women's participation in these educational institutions. A variable of technological relevance of another type could be

women's use of the internet for online buying, paying bills, or educating themselves. However, this type of information does not have a historical basis that allows it to be used in this study.

- Level of participation in the labour market related to the digital economy: neither global nor regional statistics at the APEC level allow us to identify the actual impact on the labour market by gender in the digital economy. The closest proxies are related to the level of employment by gender, unemployment, and participation in the industrial and services sector by women. These are very general statistics and insufficient for this report.

Table 2: Explanatory variables of women's participation in the digital economy

Topic	Variable	Type of data	Gender data	APEC member representation	Years of data covered	Database	Source
Access	**Internet access**	**Measurement**	**YES**	**20**	**2016-2020**	**EIU 3i**	**EIU, Gallup, ITU**
	Mobile subscribers	Measurement	YES	20	2016-2020	EIU 3i	EIU, Gallup, ITU
	Fixed-line subscribers	Measurement	NO	20	2016-2020	EIU 3i	ITU
Techno-logy	**Female share of graduates from science, technology, engineering and mathematics (STEM) programmes, tertiary**	**Measurement**	**YES**	**10**	**1991-2019**	**WB Gender Data Portal**	**UNESCO Institute for Statistics**
	Use of internet (buy or pay bills)	Measurement	YES	18	2017	WB Gender Data Portal	Global Findex database
	Female STEM education plan	Modelled	YES	20	2016-2020	EIU 3i	EIU research
Labour *	Employment in industry (% of total employment)	Modelled	YES	20	1991-2019	WB Gender Data Portal	International Labour Organization, ILOSTAT database
	Employment/Unemployment, 15+	Measurement	YES	17	1991-2019	WB Gender Data Portal	International Labour Organization, ILOSTAT database
	Employment/Unemployment, 15+	Modelled	YES	20	1991-2019	WB Gender Data Portal	International Labour Organization, ILOSTAT database
	Employment/Unemployment, ages 15-24	Measurement	YES	17	1991-2019	WB Gender	International Labour

Topic	Variable	Type of data	Gender data	APEC member representation	Years of data covered	Database	Source
						Data Portal	Organization, ILOSTAT database
	Employment/Unemployment, ages 15-24	Modelled	YES	20	1991-2019	WB Gender Data Portal	International Labour Organization, ILOSTAT database
	Proportion of time spent on unpaid domestic and care work	Measurement	YES	1	1991-2019	WB Gender Data Portal	United Nations Statistics Division

* There are no gender, labour, or digital economy variables across APEC economies.

Table 2 shows the variables of interest in the databases used in this study. The focus will be placed on the internet access variable to explain access and the female share of graduates from science, technology, engineering, and mathematics (STEM) programs to explain technological relevance.

EXISTING DRIVERS AND BARRIERS TO FEMALE ACCESS TO THE INTERNET IN APEC ECONOMIES

To identify barriers to female participation in the digital economy through internet access, the following methodology was implemented:

- In an exploratory analysis, all the variables of the Inclusive Internet Index were considered. Then, the most relevant variables based on the influence on the relative participation of women on the internet were selected.
- To characterize APEC economies based on the EIU variables, a decision tree model was made. Through data segmentation based on the selected variables, groups with similar characteristics were identified.
- Finally, based on the previous exploratory analysis, a socioeconomic model was built with the EIU variables. Gender information contained in the Human Development Report of the United Nations Development Program was also added.

The exploratory analysis and the decision tree model were aided by Power BI Software and the socioeconomic model by Stata. The information on internet access for men and women that the Economist Intelligence Unit (EIU) used to construct their Inclusive Internet Index[4] was used. However, the access by gender variable was available only since 2017. Therefore, data from the last four years were used in modelling differences in access (2017-2020). Socioeconomic indicators related to economic activity and inequality, such as GDP per capita, the GINI coefficient, and ranking economy, were also considered in model building. Some characteristics that may affect the internet market and access, such as the average speed of both mobile and fixed internet accesses, the cost of a smartphone in each economy, the cost of a fixed line for broadband internet access, and the coverage of the 2G, 3G and 4G networks in each economy, were also included.

Additionally, some indicators of gender gaps in education (mean years of schooling), mobile access, unemployment rate, labour force participation and the human development index from the data centre of the Human Development Report of the United Nations Development Program (UNDP)[5] were constructed. Unfortunately, the UNDP reported their information until 2019, and estimations included these data only from 2017 to 2019.

The variable to estimate female participation or access to the internet will be $GGAP_{it}$

$$GGAP_{it} = \frac{\%\ of\ female\ population\ with\ internet\ access}{\%\ of\ male\ population\ with\ internet\ access} - 1$$

$GGAP_{it}$ will be negative when the presence of men with internet access is greater than that of women. The data related to APEC correspond to 4 years of measurement from 2017 to 2020 for

[4] Available at https://theinclusiveinternet.eiu.com/

[5] Available at https://hdr.undp.org/en/data

20 APEC economies (Table 3). Data for Brunei Darussalam could was not available. Following this, we counted 80 observations for each variable, which are insufficient to calibrate decision tree models and identify relevant variables. For this reason, the sample was expanded to 120 economies and four years of measurement to reach 480 observations per variable to be studied. Table 2 presents the gender gap for each APEC economy by year.

Table 3: $GGAP_{it}$ for APEC economies

Economy	2017	2018	2019	2020
Australia	-4.3%	-3.2%	-4.3%	-2.1%
Brunei Darussalam	-	-	-	-
Canada	0.0%	-1.1%	-4.2%	-2.1%
Chile	2.9%	2.9%	-1.4%	-3.7%
China	-4.5%	-3.0%	7.9%	7.5%
Hong Kong, China	-2.4%	-10.5%	-10.5%	0.0%
Indonesia	-17.6%	-8.8%	-8.1%	-10.9%
Japan	-15.8%	-10.7%	-13.2%	-13.8%
Malaysia	-4.1%	-4.1%	-5.1%	-6.4%
Mexico	-6.1%	-22.4%	-11.1%	-9.5%
New Zealand	2.2%	1.1%	-1.1%	-2.1%
Papua New Guinea	-12.0%	-12.5%	-11.0%	-10.2%
Peru	-34.7%	-25.0%	-29.0%	-23.1%
The Philippines	16.7%	1.9%	14.0%	3.1%
The Russian Federation	-1.3%	-5.1%	-5.2%	-3.8%
Singapore	-4.5%	-1.2%	-2.3%	-4.4%
Korea	-8.1%	-9.1%	-5.6%	-1.1%
Chinese Taipei	-8.2%	3.9%	-4.3%	3.5%
Thailand	-13.5%	-15.3%	1.9%	-11.8%
The United States	-1.1%	3.4%	-1.1%	0.0%
Viet Nam	-6.4%	-16.1%	-21.8%	-13.6%

Three methodologies were used to find elements that influence the $GGAP_{it}$. The first approach was through linear regression estimates of the variables with the variable of interest. The above information provide two results: one is the slope or impact that one variable has on another, and the second is how commonly the effect is measured through the count of cases where the found impact is fulfilled. In the case of having categorical variables within the comparison, the algorithm used was stochastic dual coordinate ascent (SDCA), which is a stochastic optimization method that, depending on the loss function used, delivers a support vector machine or a logistic regression. As a consequence, both results have the same interpretation capabilities as a linear estimation[6].

[6] Explanation adapted from (Microsoft, 2022)

The second methodology sought to find interesting datasets or data segmentations using decision trees. This gave rise to the study of cases that combine a series of characteristics based on the variables that can be identified as barriers or drivers of $GGAP_{it}$. A fast tree algorithm, suitable for unbalanced data, left aside analyses with other segmentation methods. The decision trees were based on the variable of interest, in this case, the $GGAP_{it}$, and sequentially searched for the best variable that could separate the data in such a way as to better explain the variations of the $GGAP_{it}$. After each subdivision, it was evaluated if the amount of data was representative enough to represent a pattern (usually with a 95% confidence level)[7]. For this reason and due to the limited amount of data, it was not possible to obtain representative relationships.

For the third approach, an econometric model was developed to estimate the socioeconomic determinants of $GGAP_{it}$. Here, the information from the EIU was complemented with information from the Human Development Report of the United Nations Development Program. The econometric model estimated to understand the determinant of the gender gap in internet access for APEC's economies had the following structure:

$$GGAP_{it} = \alpha_i + \delta_t + \theta' GG_{it} + \beta' SE_{it} + \gamma' IM_{it} + \varepsilon_{it}$$

where

$GGAP_{it}$ The relative gender gap in internet access (ratio of internet women users and internet men users) in economy i at year t.

α_i Fixed effect for economy i.

δ_t Fixed effect for year t.

GG_{it} Vector of gender gap variables for economy i at year t: relative gender gaps in education (mean years of schooling), mobile access, unemployment rate, labour force participation, and human development index.

SE_{it} Vector of socioeconomic variables for economy i at year t: GDP per capita, GINI, population percentage under the poverty line, business environment ranking, and democracy index.

IM_{it} Vector of internet market variables for economy i at year t: average speed of mobile internet access, average speed of fixed internet access, cost of a smartphone, cost of a fixed line for broadband internet access, coverage of the 4G network.

ε_{it} Standard error of the estimation.

[7] Explanation adapted from (Microsoft, Power BI, 2022)

The former equation was estimated using ordinary least squares in Stata 17.0. There are several differences regarding the size of APEC economies; therefore, control for those differences using the population of each economy as a weight in the estimations was used. The results of three different models will be presented: *(i)* an unweighted least squares estimation, i.e., without weighting by population; *(ii)* weighted least squares using populations as weights; and *(iii)* weighted least squares using the inverse of the populations as weights. The first assigns equal weights for each APEC economy; hence, the size of each one does not matter on the determinants of the gender gap in internet access. The second put more weight on those economies with a higher population (e.g., China; the United States; Indonesia; and The Russian Federation) in the analysis of the determinants of the gender gap to reflect the characteristics of those economies. The final estimation puts more weight on those economies of APEC with a lower population (e.g., Chile; Hong Kong, China; New Zealand; Papua New Guinea; and Chinese Taipei) to reflect the characteristics of those smaller economies.

Drivers of female access to the internet

Table 4 shows the main drivers for improving women's access to the internet and the consequential decrease of the $GGAP_{it}$.

Table 4: Drivers of women's participation in the $GGAP_{it}$

Variable	Unit	Threshold	Average internet gender gap in the world increases by	Average internet gender gap in APEC region increases by	APEC population excluded by threshold
Level of literacy	% of population	96.4>x	20.7%	9.4%	22.7%
Mobile phone cost (postpaid tariff)	% of monthly GNI per capita	1.826<=x	21.3%	6.2%	9.6%
Internet exchange points	Number of IXPs per 10 million inhabitants	1.27>x	17.6%	6.0%	81.1%
Availability of e-government services in local language	Qualitative rating 0-2, 2=best	1>x	16.3%	4.9%	2.7%
Network coverage (min. 3G)	% of population	93>x	19.7%	4.9%	10.3%
Mobile phone cost (prepaid tariff)	% of monthly GNI per capita	1.357<=x	15.1%	4.6%	5.2%
Female e-inclusion policies*	Qualitative rating 0-2, 2=best	1>x	5.4%	4.5%	85.9%
Bandwidth capacity	Bit/s per internet user	37,812>x	19.5%	4.2%	61.3%
Rural electricity access	% of population	99>x	16.9%	3.9%	18.5%

*The original variable has three components: the comprehensive female e-inclusion plan, female digital skills training plan, and female STEM education plan. The comprehensive female e-inclusion plan includes the internet gender gap. For that reason, the variable was reconstructed with the other two components.

One of the most important variables for both APEC members and non-APEC members is the economies' level of literacy; higher levels of literacy lead to higher female internet use. Literacy is the main vehicle to be able to take advantage of what the internet offers. There is currently an approximately estimated 22.7% of the population of APEC economies that could improve this access indicator.

Mobile telephony and the economic possibility of accessing it is the second driver for the reduction of $GGAP_{it}$; thus, low costs lead to high adoption of the service. Mobile phone cost values are

expressed as a percentage of monthly income. The relatively low cost of postpaid and prepaid plans has an impact of 6.2% and 4.6%, respectively, on $GGAP_{it}$, representing 1.826% and 1.357% of income monthly. Another key factor, expressed as 3G coverage, is the coverage of the population with the capacity to access wireless data services. A coverage above 93% in the population improves the $GGAP_{it}$ at 4.9%, with a potential population for this improvement of 10.3%.

The internet infrastructure is also preponderant in the impact of the $GGAP_{it}$. The existence of multiple IXPs accounts for the robustness of the internet network. However, in the case of APEC, some economies naturally do not have many IXPs because they are islands and, in other cases, due to policies on opening the internet to foreign content. Consequently, this index may not be representative of the $GGAP_{it}$, estimated at 6.0%.

Economy-level female e-inclusion policies were recalculated with respect to the original EIU indicator since they indirectly included the gender gap ratio. This variable was constructed with two other variables, the existence of strategies addressing female e-inclusion and policies or government initiatives that encourage women and girls to study STEM subjects. This indicator generates a relative improvement in the $GGAP_{it}$ indicator of 4.5% on average when both types of policies are in place in the economy. In the case of the APEC region, there is a lack of progress on this point, since 85.8% of the economies do not push forward both types of policies, and 27% of the APEC economies have only one type in place.

In general, almost all APEC members have availability of e-government services in the local language. Only 2.7% of the population is excluded, but in those where online services are not available, implementing them would result in a positive effect for the decrease in the $GGAP_{it}$, estimated at an average improvement of 4.9%.

Another important factor is the international bandwidth capacity, which measures the total used capacity of international internet bandwidth. According to the EIU variables (EUI, 2021), used international internet bandwidth refers to the average traffic load (expressed in bits per second) of international fibre optic cables and radio links carrying internet traffic. This factor is essential to estimate the quality of the network and access to international content. It allows interaction with email services, search engines, and downloading audiovisual content; even though a rate of 38 Kbps seems very low, a large percentage of the population has a bandwidth capacity under this value. This low value can be explained by the high concentration of local content from some members that do not access much international content, in particular, large economies of Asia. This opening, on the other hand, acts as a driver in the decrease of the $GGAP_{it}$ and potentially improves the indicator's value by up to 4.2%.

Finally, one of the most relevant infrastructure indicators is the existence of rural electricity, which enhances the inclusion of women in the digital economy. Even though access to the digital economy can be given through device phones, these need to be recharged. In APEC member economies where access to electricity among the rural population exceeds 99%, the $GGAP_{it}$ improves by 3.9%.

Barriers to female access to the internet

The barriers to increasing women's participation in the digital world through internet access are shown in the following table:

Table 5: Barriers to female access to the internet

Variable	Unit	Threshold	Average internet gender gap in the world decreases by	Average internet gender gap in APEC region decreases by	APEC population included by threshold
Government efforts to promote 5G	Qualitative rating 0-3, 3=best	1<=x	13.5%	6.9%	25.3%
Mobile phone cost (prepaid tariff)	% of monthly GNI per capita	0,9>x	14.1%	6.2%	20.0%
Educational attainment	Years of schooling	10<=x	19.0%	5.9%	72.2%
Fixed-line broadband subscribers	Per 100 inhabitants	20<=x	17.5%	5.7%	26.2%
Internet users	% of households	60<=x	21.0%	5.6%	60.6%
Mobile phone cost (postpaid tariff)	% of monthly GNI per capita	1,3>x	18.1%	5.5%	23.7%
Average revenue per user (ARPU, annualized)	USD	90<=x	19.9%	4.4%	71.5%
Smartphone cost (handset)	Score of 0-100, 100=most affordable	75<=x	15.0%	4.2%	81.6%
Unlicensed spectrum policy	Qualitative rating 0-3, 3=best	1<=x	13.8%	3.8%	19.8%
e-Commerce content	Score of 0-100, 100=best	69<=x	16.8%	3.6%	71.2%
Network coverage (min. 2G)	% of population	99<=x	11.2%	2.6%	28.2%

As expected, several of the barriers also acted as drivers. This is the case for all those variables that have a monotonically increasing or decreasing behaviour concerning the $GGAP_{it}$. The main difference between barriers and drivers is that the impact is measured from the point of view of a barrier. Elements that hinder the possibility of decreasing the $GGAP_{it}$ participation are different than if one estimates the impact of moving from a good state to a better one, which was already addressed in the drivers. For example, mobile phone cost (prepaid tariff) is less important in terms

of impact than mobile phone cost (postpaid tariff) if one observes it as a driver, but as a barrier, mobile phone cost (prepaid tariff) is second in importance in Table 5.

As in the case of drivers, the economic barriers to access to mobile communication play an essential role. The high prices of prepaid and postpaid plans and smartphone-type mobile equipment are one of the main elements that make the $GGAP_{it}$ fall by 6.2%, 5.5%, and 4.2%, respectively. High mobile phone prices are a barrier that prevents an economy from having a good $GGAP_{it}$ indicator. However, at the same time, a low average revenue per user (ARPU) for wireless operators also has a negative effect on the $GGAP_{it}$, which in principle seems to go against the market competition and the presence of low telephony prices. In this way, an annualized revenue per user of less than 90 USD has a negative impact of 4.4% on the $GGAP_{it}$. This effect can have two explanations. One is that greater consumption by users will lead to a higher ARPU, which would be directly related to the generalized use of the data service that impacts the $GGAP_{it}$. The second interpretation is that a higher ARPU is related to a higher-income economy, which generally has a positive or close to zero $GGAP_{it}$.

There are two barriers related to the economy's telecommunications policy. One of them is the presence of government efforts to promote 5G rollout across use case applications. The absence of these policies has a negative impact of 6.9%. The second barrier is the unlicensed spectrum policy. This indicator assesses the economy's ability to expand broadband connectivity by assessing its openness to provisioning an unlicensed spectrum for greater WiFi access and other productive uses. The absence of these policies causes an average drop of 3.8% of the $GGAP_{it}$ compared to the average APEC economies where these policies exist. The promotion of 5G reflects the government's interest in fostering new technologies that allow access to the internet and a set of larger real world applications, which is directly related to making society participate in the digital world, including men and women. On the other hand, the nonexistence of policies that allow access to transmission technologies with low-power free spectra has repercussions on the cost of services and loss of flexibility. This can promote an environment of innovation that allows access to the internet with greater coverage for the general population, improving the $GGAP_{it}$.

One of the variables that presents an almost linear relationship with the $GGAP_{it}$ is the years of educational attainment. In economies where schooling is less than 10 years, the GGAP moves away from values close to zero, generating a drop of 5.9 percentage points. In general, more years of schooling give people a high capacity to take advantage of being online. What is interesting is that having fewer years of schooling harms women more, but since this indicator is not disaggregated by gender, it could be related to the fact that women in certain economies have fewer years of schooling than men on average.

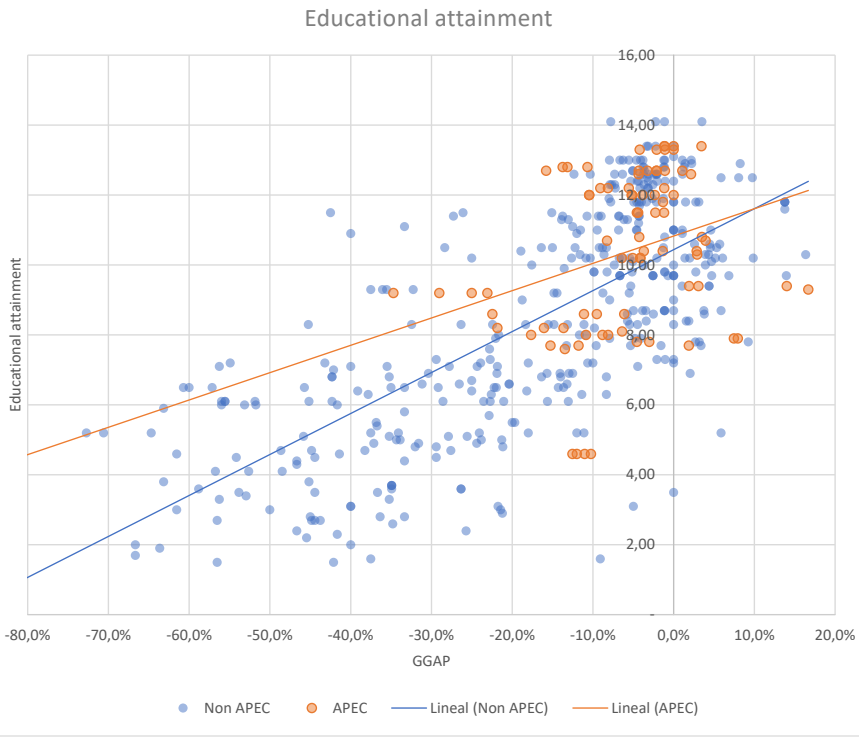

Figure 1: Educational attainment vs. internet gender gap

There are two variables related to internet access and use that constitute barriers. The first is access to fixed-line broadband: in economies where access to fixed-line broadband is less than 20%, the $GGAP_{it}$ is 5.7% lower than in economies with a more significant number of fixed-line internet accesses. The above effect is a natural barrier to the development of internet access in general, which is particularly detrimental to women. The second variable, level of use, represents the percentage of households with internet access. If this value is less than 60%, in the APEC region, the $GGAP_{it}$ worsens by 5.6%, including a potential population of 60.6% below this limit.

Although there were several variables related to the value e-commerce provided to people, the availability of online services/e-commerce was generally thought to increase internet adoption for women: economies where the e-commerce content score obtained from the United Nations Conference on Trade and Development (UNCTAD) was less than 69 implied an average drop of 3.6% in the $GGAP_{it}$. The market availability of buying and selling goods and services through the internet attracts all segments of the population to participate in the digital economy.

The last barrier is universal access by the economy to mobile telecommunications networks. In economies where only 1% of the population does not have access to any type of mobile communication, $GGAP_{it}$ is 2.6% lower on average than in economies where the entire population is covered by mobile telephony. This barrier affects men and women unequally, which indicates that in economies where there are isolated areas without telecommunications, women are left behind in internet access.

Segment Analysis

To find interesting subgroups, a decision tree was run (Purdila & Pentiuc, 2014). The objective of a decision tree algorithm is to create subgroups of data points relatively similarto the variable of interest, in this case, $GGAP_{it}$, by splitting the data in several steps into high and low group values of the variable. The decision tree takes each explanatory variable and chooses the variable that gives it the best split. For example, if the data are filtered for only the economies with a high level of literacy, will those separate economies that gave a high $GGAP_{it}$ vs. a low $GGAP_{it}$? Or maybe it is better to filter the data to separate economies that have high and low levels of educational attainment[8].

As shown in Figure 2, the main element in determining a high or low $GGAP_{it}$ in APEC member economies is the level of literacy: if literacy exceeds 96%, the group of APEC economies in the four years of measurement has an average of -2.1% of $GGAP_{it}$, while if it is lower, the average drops to -13%. Then, within high-literacy economies, if the fixed-line monthly broadband cost is greater than 1.5% of the gross national income (GNI)[9], it leads to lower levels of $GGAP_{it}$. This may seem counterintuitive, since a higher cost represents a barrier to access, but this happens because economies with low GNI such as China and the Philippines have high $GGAP_{it}$ values, which differ from New Zealand and Chile in that the annualized ARPU of mobile phone companies is greater than 97 dollars. The effect of ARPU in this case again goes against the average behaviour of this variable, since in the subgroup of China, the Philippines, New Zealand, and Chile, it divides them into two groups of different $GGAP_{it}$, for the values of 2020, where China and the Philippines average 5.2% of $GGAP_{it}$ and New Zealand and Chile average -2.9% of $GGAP_{it}$.

[8] Explanation adapted from (Microsoft, Power BI, 2022)

[9] Gross national income (GNI) is the total amount of money earned by a nation's people and businesses.

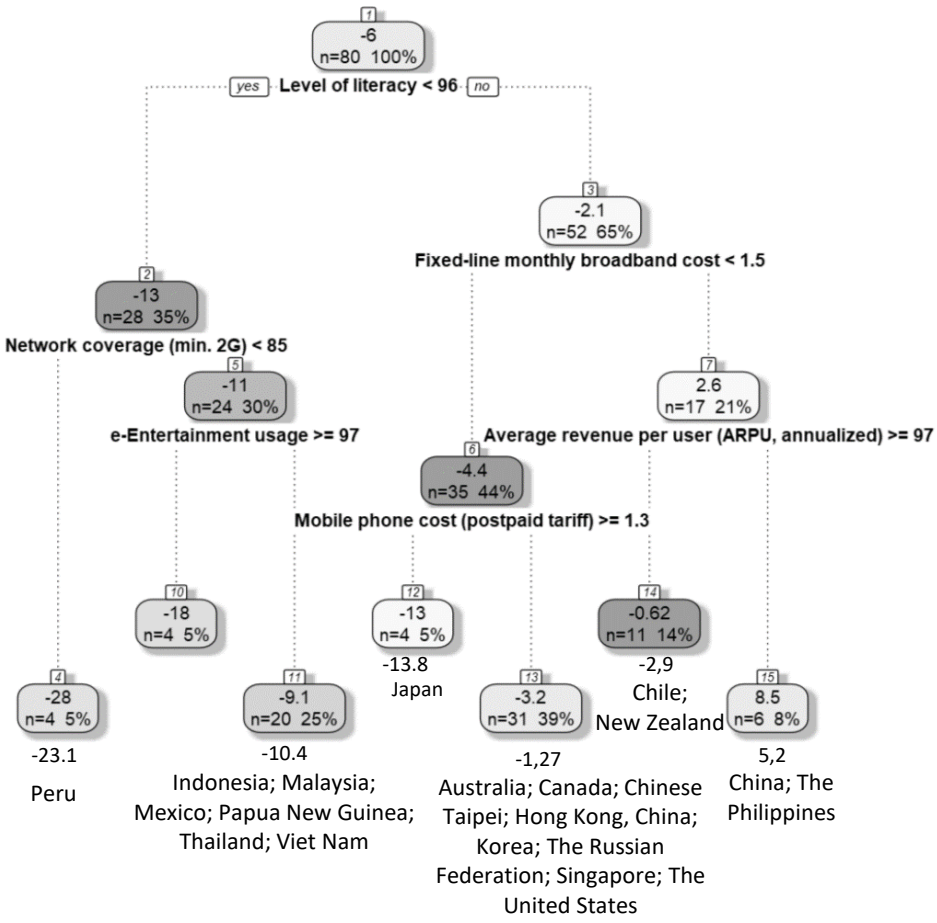

Figure 2: Decision tree for APEC economies. Note: The number at the top of each node represents the average gender gap. The total sample includes 20 economies with four measurements (Brunei Darussalam does not have enough data for classification).

When placed in Node 6 of Figure 2, a negative effect of the mobile set cost (postpaid tariff) above 1.3% of the GNI can be seen. In the case of Japan, it leads to the lowest level of $GGAP_{it}$ among economies with a high level of literacy.

Within the economies with a literacy level below 96%, the differentiating factor turned out to be the coverage of the population with mobile technology. Notably, Peru has a penetration below 85% and has the highest $GGAP_{it}$in the APEC region.

Estimation of the socioeconomic determinants of the gender gap in internet access in the APEC region

For this analysis, econometric tools similar to those used in previous studies (Hilbert, 2011; (Hafkin & Huyer, 2007; Fatehkia, Kashyap, & Weber, 2018) were used to understand the socioeconomic determinants of the gender gap in internet access for the APEC region. As mentioned , the results of three estimations are presented: one from an unweighted least squares estimation, i.e., without weighting by population, one from a weighted LS using populations as weights, and one from a weighted LS using the inverse of the populations as weights. The first assigns equal weights for each economy member of APEC; hence, the size of each one does not matter on the determinants

of the gender gap in internet access. The second estimation places more weight on those economies with a higher population (e.g., China; the United States; Indonesia; and The Russian Federation) in the analysis to reflect the characteristics of those economies. The final estimation places more weight on those economies of APEC with a lower population (e.g., Chile; Hong Kong, China; New Zealand; Papua Guinea; and Chinese Taipei) to reflect the characteristics of those smaller economies. Table 6 presents the results.

Table 6: Determinants of the gender gap (GG) in internet access for APEC economies

Variable	**(1) Unweighted OLS**	**(2) OLS weighted by population**	**(3) OLS weighted by the inverse of population**
Relative GG in mobile access	0.796**	0.706**	0.649***
	(0.300)	(0.311)	(0.190)
Relative GG in unemployment rate	-0.161	-0.267	0.209
	(0.232)	(0.250)	(0.157)
Relative GG in human development index	8.833**	10.17***	5.070
	(3.323)	(3.039)	(3.580)
Relative GG in labour force participation	-2.914	-1.343	-4.651*
	(3.498)	(4.622)	(2.680)
Relative GG in mean years of schooling	-0.736	2.440	-1.054
	(1.538)	(2.153)	(0.960)
GDP per capita	3.01e-07	-1.02e-05	-1.38e-05**
	(8.65e-06)	(9.29e-06)	(5.54e-06)
GINI	-0.0321	-0.0188	-0.00641
	(0.0959)	(0.114)	(0.0965)
Proportion of population in poverty	0.282	0.425**	0.0139
	(0.183)	(0.200)	(0.123)
Democracy index	-0.0107	0.0478	-0.0719
	(0.0964)	(0.123)	(0.0668)
Business environment ranking	0.0615	0.119	0.0676
	(0.0876)	(0.0744)	(0.0700)
Average fixed-line broadband speed	-0.00121	-0.00110	4.26e-05
	(0.00137)	(0.00196)	(0.000985)
Average mobile internet speed	-0.000919	-0.00120	0.00124
	(0.00168)	(0.00274)	(0.00148)
Smartphone cost	-0.00202	-0.00111	-0.000641
	(0.00192)	(0.00187)	(0.00217)
Fixed-line broadband cost	-0.0226	-0.0374*	0.0564
	(0.0312)	(0.0192)	(0.0512)
Coverage of 4G network	-0.000573	-0.000276	-0.00110
	(0.000825)	(0.00102)	(0.000916)
Constant	-4.168	-10.85	1.239
	(4.884)	(8.044)	(3.360)
Observations	60	60	60
R-squared	0.897	0.941	0.937
Fixed effect by economy	Yes	Yes	Yes
Fixed effect by year	Yes	Yes	Yes

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

Table 6 shows that regardless of the size of the economy, the gender gap in mobile phone access explains the gender gap in internet access (the estimated coefficient is statistically significant at the 5% level). This result is expected, since mobile access has a higher penetration level in the population than fixed-line access. This is consistent with the results in DiMagio and colleagues (2004) and Haight and colleagues (2014) for the United States and Canada, who found that the gender gap in internet access tends to disappear with increasing internet penetration. Since mobile internet penetration is the main source of overall internet penetration, if more women (relative to men) have access to mobile phones, that should reduce the observed gender gap.

The table also shows that the gender gap in human development for large population economies explains the gap in internet access (the estimated coefficient is statistically significant at the 5% level). The human development index (HDI) provides a single index measure to capture three key dimensions of human development: a long and healthy life, access to knowledge (measured as average years of schooling), and a decent standard of living (measured as gross economy-level income per capita) (Roser, 2014). Therefore, the gender gap in the HDI already captures two dimensions that previous studies mentioned as important determinants of the gender gap in internet access: differences in education and differences in income. The results are consistent with the positive and statistically significant estimation of the population living under poverty over the gender gap in internet access for large population economies. It seems that escaping poverty increases the opportunity to access the internet market.

It is worth noting that the gender gap in the HDI and the population under the poverty line do not explain the gender gap in internet access in small population economies. Moreover, the GDP per capita variable is statistically significant and has a negative sign for those economies, suggesting that once differences in mobile access are controlled, which also depends on income, a higher level of income does not help to reduce the gender gap in internet access in small economies.

EXISTING DRIVERS AND BARRIERS TO FEMALE PARTICIPATION IN STEM EDUCATION IN APEC ECONOMIES

As a complement to the previous analyses, researchers explored drivers and barriers to female participation in STEM education programs. The main objective was to assess the relationships of economic and other variables that may impact the economic growth and production of the STEM-related labour force.

Information on women's participation in STEM throughout APEC economies is scarce. Table 7 OBJ shows that only 6 economies have enough information to carry out a model using imputation techniques, while 12 economies have four or fewer measurements.

Table 7: Female share of graduates from science, technology, engineering and mathematics (STEM) programmes, tertiary (%), through the years and economies

Economy Name	Level of Data	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
China	no data available										
Hong Kong, China	no data available										
Japan	no data available										
Papua New Guinea	no data available										
The Russian Federation	no data available										
Chinese Taipei	no data available										
Australia	high data	31.1	30.9		30.2		30.7	31.0	31.7		32.1
Brunei Darussalam	high data	49.1	50.4	41.7	50.5	49.4			49.2	51.9	
Chile	high data	22.8	21.3	20.2		19.9	19.5	18.6	18.2	18.5	18.8
Korea	high data	26.1	27.6		27.1	27.6	27.7	27.9	26.0	26.4	25.2
Mexico	high data	34.1	33.7	33.0	32.4		31.9	31.2	31.3	31.1	30.6
The United States	high data			31.4	30.9	31.0	31.6	31.9	33.4	34.0	
Malaysia	medium data	41.8	41.7	42.3	42.1	45.3			38.6		
New Zealand	medium data						34.1	34.2	33.9	35.1	35.0
Viet Nam	medium data	22.4	24.3	23.5		25.2			40.7	36.5	
Canada	low data						32.9	31.9	31.7	31.4	
Indonesia	low data							37.5	36.1	36.2	37.7
Peru	low data									33.5	47.8
The Philippines	low data										36.3
Singapore	low data									33.7	34.3
Thailand	low data								29.7	30.1	

Overall, the level of female participation in STEM education is related to women's participation in the labour market globally. Because of the low number of APEC economies with data, sets of

economies like those in APEC were created to extend their results to the members of APEC.[10] Based on this, the methodology used was as follows:

- Information from the Gender Data Portal of the World Bank (World Bank, 2022) was used to obtain the share of graduates from science, technology, engineering, and mathematics (STEM) programs. There was information available for only 9 APEC economies (see Table 7, medium and high data).
- Due to the above, to generalize the results, an expanded sample of economies was taken, including 81 economies, for which 45 variables were collected with the aim of characterizing the member economies of APEC by their resemblance to these economies. The variables were mainly related to the employment market, entrepreneurship, GDP, primary education, and gender policies (see Table 13).
- Based on the previous classification, a segmentation of economies was made into four groups of economies to analyse the effect of socioeconomic variables on female participation in STEM education programs. These could be decisive for an improvement or detriment of this indicator.

The estimated econometric model to understand the determinant of the female share of graduates from STEM programs for the selected economies had the following structure:

$$fSTEM_{it} = \alpha_i + \delta_t + \theta' GG_{it} + \beta' SE_{it} + \gamma' IM_{it} + \varepsilon_{it}$$

where

$fSTEM_{it}$ Female share of graduates from STEM programs in economy i at year t.

α_i Fixed effect for economy i.

δ_t Fixed effect for year t.

LA_{it} Vector of labour force participation and policies.

SE_{it} Vector of socioeconomic variables for economy i at year t: GDP per capita, GDP per capita growth, and percentage of exportations in ICT of goods and services.

IM_{it} Vector of internet market variables for economy i at year t: internet penetration, the internet gender gap.

ε_{it} Standard error of the estimation.

The former equation was estimated using ordinary least squares in Stata 17.0. The groups of economies were constructed based on the decision tree segmentation b, with a target variable $fSTEM_{it}$. We have four possible groups:

- Group 1: economies with average female labour force percentages over and equal to 29% and average youth female unemployment (15-24) below 11%.

[10] Variables such as employment and unemployment have representation on 20 APEC economies, excluding only Chinese Taipei (see Table 2)

- Group 2: economies with average female labour force percentages over and equal to 29% and average youth female unemployment over 11% and where a law that prohibits discrimination in access to credit based on gender does not exist.
- Group 3: economies with average female labour force percentages over and equal to 29% and average youth female unemployment over 11% and where the law prohibits discrimination in access to credit based on gender in 2017.
- Group 4: economies with average female labour force percentages below 29%.

The APEC economies that belong to the segmentation by groups are the following:

- Group 1: Australia; China; Hong Kong, China; Japan; Korea; Mexico; Papua New Guinea; Peru; the Philippines; Chinese Taipei[11]; Thailand; Viet Nam.
- Group 2: Brunei Darussalam; Chile; Indonesia; Malaysia; The Russian Federation; Singapore.
- Group 3: Canada; New Zealand; the United States.
- Group 4: No APEC economies.

The groups are heterogeneous (see Table 8). However, on average, Group 1 is composed of economies with a diverse level of income per capita, high economic growth, and a change over time in laws that limit discrimination against women. And low unemployment rates for young women, a high level of technology exports, and a high level of years of education for women.

Group 2 includes economies that have not adopted laws prohibiting discrimination in access to credit based on gender, low female participation in the labour market and high female unemployment rates, as well as relatively high years of schooling for women, with a low value of democracy index.

Group 3 comprises economies with high per capita income and a low growth rate, a high legal development of norms against gender discrimination, greater participation of women in the labour market, and lower relative unemployment than men but with a relatively lower HDI for women.

Table 8: Average value of the explanatory variables in APEC economy groups

Variable	APEC Group 1	APEC Group 2	APEC Group 3
GDP per capita (constant 2015 US$)	$17,367	$20,076	$44,862
GDP per capita growth (log (%))	4.1%	3.2%	1.8%
The law prohibits discrimination in access to credit based on gender (1=yes; 0=no)	0.49	0	1

[11] Chinese Taipei is not listed as a separate economy in the World Development Indicators. For most indicators, data for Chinese Taipei are not aggregated with those for China (World Bank, 2022). For this reason, and only for this chapter related to STEM participation, Chinese Taipei was included in Group 1.

Variable	APEC Group 1	APEC Group 2	APEC Group 3
Employment in industry (% of total employment) (modelled ILO estimate)	20.3%	22.9%	20.3%
Ratio of female to male labour force participation rate (%) (modelled ILO estimate)	76.9%	70.1%	84.1%
Ratio of female to male unemployment	99.2%	114.6%	74.8%
Unemployment, youth female (% of female labour force ages 15-24) (modelled ILO estimate)	7.6%	17.7%	13.1%
Exportations in ICT of goods and services (%)	15.1%	9.7%	4.6%
Internet gender gap for year 2018	-7.9%	-1.9%	-0.5%
Individuals using the internet (% of population)	51.0%	56.4%	81.1%
Ratio of female to male HDI	96.8%	96.7%	94.4%
Ratio of female to male years of school	102.2%	102.8%	99.8%
Democracy index	8.20	7.05	8.60

In general terms, the variables related to the democracy index, inequality in the HDI, together with the variables of employment and internet penetration level of the economies, are the most important to determine the participation of women in educational programs in STEM (see Table 9).

The following table shows the results of the four models used for the groups of economies (see Table 14 for groups of economies) for the selected variables.

Table 9: Socioeconomic model for female share of graduates from science, technology, engineering and mathematics (STEM) programmes, tertiary (%)

Variable	Group 1	Group 2	Group 3	Group 4
GDP per capita (constant 2015 US$)	1.430E-05 (3.726E-04)	6.457E-04 (5.478E-04)	4.920E-05 (8.920E-05)	-2.041E-03** (7.633E-04)
GDP per capita growth (log (%))	-0.044 (0.383)	0.189 (0.254)	0.102 (0.830)	0.369 (0.473)
The law prohibits discrimination in access to credit based on gender (1=yes; 0=no)	0.399 (1.280)		0.524*** (-3.290)	29.752 (19.460)
Employment in industry (% of total employment) (modelled ILO estimate)	-0.249 (0.271)	-0.121 (0.201)	0.159 (-0.910)	-0.848 (0.681)
Ratio of female to male labour force participation rate (%) (modelled ILO estimate)	0.372 (0.330)	-0.212* (0.124)	0.110** (2.290)	-1.318*** (0.464)
Ratio of female to male unemployment	-2.587 (2.988)	0.425 (1.330)	1.795 (-0.550)	0.047 (0.307)
Exportations in ICT of goods and services (%)	0.412 (0.290)	-0.092 (0.092)	0.064* (1.670)	-0.506 (0.795)

Variable	Group 1	Group 2	Group 3	Group 4
Internet gender gap for year 2018	-1.261 (1.143)	2.230 (5.052)	0.279 (0.330)	3.190** (1.571)
Individuals using the internet (% of population)	0.102* (0.058)	-0.055 (0.053)	0.023*** (-2.820)	-0.120 (0.116)
Ratio of female to male HDI	-24.969 (35.198)	80.779* (48.709)	9.259 (-1.150)	20.334 (67.470)
Ratio of female to male years of schooling	3.610 (21.288)	-12.433 (15.541)	8.895*** (3.130)	-27.406 (18.800)
Democracy index	5.617*** (1.520)	0.109 (0.753)	0.604*** (-4.170)	2.424** (1.184)
Observations	153	135	342	81
R-squared	0.814	0.955	0.878	0.849
Fixed effect by economy	Yes	Yes	Yes	Yes
Fixed effect by year	Yes	Yes	Yes	Yes

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

As the table above shows, disparate effects on female participation in STEM programs were found in the different groups of economies, contrasting variables that have an important effect (those that were found significant) and the direction of these effects. This result confirms that participation in STEM careers is profoundly affected by the socioeconomic and developmental context and that economies vary in social norms and gender roles (Charles & Bradley, 2009).

In the economies of Group 1, the democracy index has a great positive impact on participation in STEM. This is mainly explained by the fact that this group contains European economies, plus Australia and Korea, where there is a relatively high female participation in STEM and a high democracy index. In economies such as Burundi and Burkina Faso, there is low female STEM participation and a low democracy index. The proportion of individuals using the internet shows an increasing trend in all economies. For this reason, any increasing interannual trend in participation in STEM correlates well with this variable, which does not necessarily mean that there is a relationship. Including more variables related to other areas of education and the labour market could improve the analysis.

In Group 2, the disparity in the HDI is an important factor in determining participation in STEM. The negative value is explained by the fact that economies such as Uruguay, Malaysia and Indonesia, among others, have moved from lower participation in STEM to higher participation, while the HDI indicator has improved for women. This suggests that the higher the level of the HDI for women in a group of economies, the greater participation in STEM is achieved. In Chile and other economies, as gaps in the labour market for women have decreased, women's interest in participating in STEM programs has fallen. The phenomenon of Chile is worth studying in detail since it is an economy with particularly low female participation in STEM, with a tendency to continue to decline, even though other indicators related to women's equality continue to improve.

Group 3 is characterized by having three very relevant variables to determine the participation of women in STEM. A legislative change within the period to prohibit discrimination in access to credit based on gender has a positive impact on STEM. The second variable is the ratio between schooling years of women and men. This ratio is higher in economies with relatively high income per capita, high labour participation of women, and low unemployment. These economies also have relatively high participation of women in STEM. The third variable is related to the democracy index, where economies with a higher democracy index have greater participation in STEM, as is the case of Canada, New Zealand, and the United States.

In general, the variables associated with economic factors are not related to the participation of women in STEM. This may be because there might be a temporary lag between education, the labour market, and its economic impact, unlike with access variables that allow finding short-term relationships in the variables.

CHALLENGES TO THE INCORPORATION OF WOMEN INTO THE DIGITAL ECONOMY IN THE APEC REGION

The first challenge identified is data availability to determine if women are effectively accessing the digital economy. Within all the information collected, and despite the efforts of many international entities, it was possible to notice a lack of history and continuity in the frequency of the measurement of indicators related to gender, and in the cases in which it was measured frequently, indicators varied more than expected. For example, the $GGAP_{it}$on average is -6%, but its average standard deviation is 4% within APEC economies. Indicators of internet use were even scarcer, with only one World Bank measurement in 2017.

Among the greatest challenges to understanding the gaps in the inclusion of women in the digital economy is the need to collect information at the micro level within the economies since it is known that the gaps in access, education, and labour markets are not distributed equitably territorially. For instance, urban and rural differentiation by gender is essential to enrich the analysis and true scope of public policies.

The construction of variables, such as internet access and labour participation by gender, which are mostly modelled by organizations such as the ITU and ILO and are not measured, constitutes a limitation on the true impact that certain social policies can have economically. In many cases, this approach can underestimate the impacts of including a segment of the population that, in many cases, has been relegated.

Many of the challenges identified by other authors are related to education: obtaining digital technology skills, female enrolment in education programs in STEM , or gaining higher levels of digital literacy. With the data available, it was not possible to assess the relative impact of digital literacy or STEM-related dispositions and career commitments on the digital gender gap. However, the lack of basic conditions such as literacy and educational enrolment in some APEC economies are crucial barriers to obtaining higher digital education and skills. In addition, indicators related to primary conditions such as literacy level and educational attainment were relevant for the incorporation of women into the digital economy.

In relation to the barriers and drivers of the $GGAP_{it}$, there are at least two paths to take: the path of the economies with a high level of incorporation of women, and the path of the economies with low levels of this indicator. In economies with a high level of $GGAP_{it}$, the challenges are to promote e-government services, improve state-of-the-art mobile networks, promote female e-inclusion policies and improve internet infrastructure and rural electricity infrastructure.

On the other hand, in economies where the inclusion of women in the digital world is low, promoting the benefits of next-generation mobile technologies, having a high base of people connected to the internet, and having policies, such as those for the radio spectrum that privilege the delivery of services at lower costs and the promotion of e-commerce content, are challenges that governments must face. Being able to guarantee telecommunication services at reasonable

prices, particularly mobile telephony, is one of the barriers with an immediate impact on women's access to the digital economy.

Finally, it is relevant to highlight that challenges differ among APEC economies. In this report, models that allow comparing different impacts on the digital gender gaps in large and small economies in the region were presented. This analysis showed that in larger economies, there is a stronger effect on the human development index and on people living under the line of poverty. In contrast, GDP per capita and the gender gap in labour participation impact the gender gap in smaller economies.

ESTIMATION OF THE UNTAPPED POTENTIAL OF INCLUDING WOMEN IN THE DIGITAL ECONOMY

The estimation of the cost of not having more women in the digital economy follows the recent literature on the effects of the gender gap in internet access on economic activity. The methodology developed by the Alliance for Affordable Internet (A4AI) in its 2021 report was adapted for this report to estimate the economic consequences of the digital gender gap in several economies.[12] The applied methodology can be summarized as follows:

1. Identifying the gender gap in internet access in APEC economies in recent years, using the information available from EIU.
2. Identifying the impact of the gender gap in economic activity, such as its impact on GDP growth. Estimations of the impact of fixed and mobile broadband on GDP growth from an endogenous growth model in a panel of 96 economies were used (Minges, 2015). For APEC economies, the most conservative estimation in the Minges study estimated an elasticity of 0.0015 of 3G penetration on economic growth.
3. Modelling a linear relationship between the logarithm of GDP per capita and the logarithm of internet access:

$$\ln(GDPpc) = \alpha + \beta \ln(Int\ Access) + Other\ Variables$$

Overall internet access can be decomposed into a weighted sum of internet access by men and women:

$$Int\ Access = \frac{Total\ Internet\ Users}{Total\ Population}$$

$$= \frac{Pop.of\ Women}{Total\ Pop.} \times \frac{Women\ Int.Users}{Pop.of\ Women} + \frac{Pop.of\ Men}{Total\ Pop.} \times \frac{Men\ Int.Users}{Pop.of\ Men}$$

$$= w_w\ Int\ Acess_w + w_m\ Int\ Acess_m$$

If we define the relative gender gap in internet access as $rggi = \frac{Int\ Acess_w}{Int\ Acess_m}$, we can rearrange terms to express internet access as:

$$Int\ Access = (w_w + w_m) \times Int\ Acess_m + w_m \times Int\ Acess_m \times (rggi - 1)$$

Therefore, we can apply the following formula to obtain the impact of the gender gap in internet access on economic growth:

[12] Available at https://a4ai.org/research/costs-of-exclusion-report/

$$\frac{\partial \ln(GDPpc)}{\partial \ln(rggi)} = \beta \frac{rggi}{\frac{1}{w_w} + (rggi - 1)}$$

For example, if the weight of women in the population is 50% and the relative gender gap is 0.9 (i.e., women have 10% less access to the internet than men), this formula indicates that the elasticity of the gender gap in internet access on economic growth is 0.47 times the elasticity of internet access on economic growth.

4. Modelling the elasticity of the gender gap in internet access to GDP per capita for each APEC economy using the formula and the data in 2020 for each economy. Then, this elasticity was applied to the gender gap of each economy and the GDP per capita to calculate the implied amount in US dollars. Finally, this result was multiplied by the total population to calculate the total cost of the gender gap in internet access for each economy.

Some APEC economies did not have a gender gap in internet access in 2020, such as China; Hong Kong, China; the Philippines; Chinese Taipei; and the United States. For those economies, we estimate a total cost of zero. The following table summarizes the estimated impact.

Table 10: Estimation of the cost of the gender gap on GDP per capita for APEC economies

Economy	Gender Gap Int Access 2020	Population, Women (%) 2020	Elasticity of GGI on GDPpc	GDPpc 2020 (USD$)	Total Population (millions)	Total Cost of Gender Gap in Int Access (millions of USD$)
Australia	-0.02	50.2	0.07%	54,910	25.5	2,219
Brunei Darussalam	…	…	…	…	…	…
Canada	-0.02	50.4	0.07%	46,370	37.7	2,751
Chile	-0.04	50.7	0.07%	15,010	19.1	792
China	0.07	48.7	0.08%	10,410	1395	----
Hong Kong, China	0.00	54.1	0.08%	50,840	7.5	----
Indonesia	-0.11	49.7	0.07%	4,050	267.5	8,263
Japan	-0.14	51.2	0.07%	41,690	126.5	51,643
Malaysia	-0.06	48.6	0.07%	11,200	32.4	1,639
Mexico	-0.10	51.1	0.07%	9,430	128.9	8,436
New Zealand	-0.02	50.8	0.08%	42,670	5	339
Papua New Guinea	-0.10	48.9	0.07%	2,780	8.9	176
Peru	-0.23	50.3	0.07%	6,740	33.2	3,393
The Philippines	0.03	49.8	0.08%	3,850	109.6	----
The Russian Federation	-0.04	53.7	0.08%	11,260	149	5,098
Singapore	-0.04	47.7	0.07%	59,590	5.7	1,042
Korea	-0.01	49.9	0.07%	33,720	51.3	1,481

Economy	Gender Gap Int Access 2020	Population, Women (%) 2020	Elasticity of GGI on GDPpc	GDPpc 2020 (USD$)	Total Population (millions)	Total Cost of Gender Gap in Int Access (millions of USD$)
Chinese Taipei	0.03	50.0	0.08%	26,514	23.6	----
Thailand	-0.12	51.3	0.07%	7,260	69.8	4,311
The United States	0.00	50.5	0.08%	65,760	331	----
Viet Nam	-0.14	50.1	0.07%	2,540	97.3	2,346

Source of primary information: EIU and World Bank

We estimate 94 billion dollars as the cost of the internet access gender gap for those APEC economies with a gender gap in internet access in 2020.

CONCLUSIONS AND RECOMMENDATIONS

The first conclusion of the study is the need for APEC members to institutionalize the collection, analysis, and monitoring of data disaggregated by gender. Having reliable and constant data available can improve the estimation of gender gaps in internet access. Improving information regarding the use of technology is central to understanding other significant untapped potentials of engaging women in the digital economy. With better information quality, government policies could be designed more effectively and target more specific action areas. For example, suppose internet access in the economy could be determined by labour sector and gender. In that case, efforts could be focused on the most affected areas and not necessarily on general policies. The lack of good quality information constitutes an opportunity to strengthen alliances and joint resources to harmonize the statistics of each economy and among statistical institutes or offices across the APEC region.

Despite the foregoing, it was found that governments can drive more inclusion of women through their policies. These need to include the promotion of new technologies and internet infrastructure, initiatives aimed at lowering cost barriers to internet access, and direct policies for the inclusion of women in the digital economy. In this sense, it is necessary to institutionalize gender policies, mainstreaming these in all government structures.

Another important lesson from this study is that the basic conditions to promote a high level of incorporation of women into the digital economy must not be ignored; elements such as promoting literacy, class attendance, and improving the supply of rural and urban electricity continue to be determining elements, even in economies with a high GDP.

Many of the variables not directly related to internet access, such as government, legislative and educational policies that seek to reduce gender gaps, may have time lags with respect to their impacts on increasing the well-being of society, which can be noted through the comparisons among different economies. For this reason, these gap reduction policies should be evaluated in the medium and long term, and immediate effects on the growth of the various economies should not be expected.

ANNEX/APPENDIX

Data Sources

Table 11: Website links for Data Sources

Source of Data related to Gender Gap	Website
ITU	https://www.itu.int/ITU-D/ict/statistics/Gender/index.html https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx
University of Oxford in collaboration with the Qatar Computing Research Institute	https://www.digitalgendergaps.org/project
GSMA	https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2013/01/GSMA_Women_and_Mobile-A_Global_Opportunity.pdf https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2016/03/GSMA_Bridging-the-gender-gap_Methodology3.2015.pdf https://www.gsma.com/mobilefordevelopment/resources/the-mobile-gender-gap-report-2018/ https://www.gsma.com/mobilefordevelopment/resources/mobile-gender-gap-report-2019/ https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/05/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf https://www.gsma.com/r/gender-gap/
A4AI	https://a4ai.org/research/costs-of-exclusion-report/
Economist Intelligence Unit	https://theinclusiveinternet.eiu.com/
European Gender Equality Index	https://eige.europa.eu/gender-equality-index/2019
Gender Equality Observatory (CEPAL)	https://oig.cepal.org/es
Gender Data Portal (World Bank)	https://datacatalog.worldbank.org/search/dataset/0037654/Gender-Statistics
IHSN	http://datanavigator.ihsn.org/#1998&2014|K2=1&K2_5=1&K2_51=1
Pacific Data Hub	https://pacificdata.org/dashboard/sdg-5-gender-equality
Survey on Gender Equality at Home	https://data.humdata.org/dataset/survey-on-gender-equality-at-home
UNECE	https://w3.unece.org/PXWeb2015/pxweb/en/STAT/STAT__30-GE__09-Science_ICT/02_en_GEICT_InternetUse_r.px/

EIU Detailed indicator list

Table 12: EIU Detailed indicator list, extracted from (EUI, 2021)

No.	Indicator	Units	Description	Source
1.1.1	Internet users	% Of households	This measures the number of people who have used the Internet in the past 12 months. A higher number of people using the Internet indicates greater connectivity.	ITU
1.1.2	Fixed-line broadband subscribers	Per 100 inhabitants	This measures fixed-line broadband subscriptions per 100 inhabitants. The higher the number of subscriptions, the greater the level of Internet connectivity.	ITU
1.1.3	Mobile subscribers	Per 100 inhabitants	This measures mobile-cellular telephone subscriptions per 100 inhabitants. A higher number of smartphones increases the propensity to use the Internet and related services, especially advanced mobile services, though this may be concentrated among certain groups. There is a cap on mobile subscriptions at 130. All economies that exceed this value will receive 130 as the maximum possible value. This cap accounts for differences in SIM user behavior, including influxes in tourism, migrant workers, and other factors that can play into the over-estimation of the number of subscribers.	ITU
1.1.4	Gender gap in internet access	% Difference	This measures the gap between male and female access to the Internet (% male access - % female access / % male access). Positive values indicate that male access exceeds female access. A smaller or negative gap indicates greater female connectivity.	EIU, Gallup, ITU
1.1.5	Gender gap in mobile phone access	% Difference	This measures the gap between male and female access to mobile phones (% male access - % female access / % male access). Positive values indicate that male access exceeds female access. A smaller or negative gap indicates greater female connectivity.	EIU, Gallup, ITU
1.2.1	Average fixed broadband upload speed	Mbps	This measures average fixed broadband upload speed. Averages are based on Ookla's analysis of Speedtest data. A faster speed is a positive indicator for better performance.	Ookla
1.2.2	Average fixed broadband download speed	Mbps	This measures average fixed broadband download speed. Averages are based on Ookla's analysis of Speedtest data. A faster speed is a positive indicator for better performance.	Ookla
1.2.3	Average fixed broadband latency	ms	This measures average fixed broadband latency (or how long it takes for data to travel between its source and destination). Averages are based on Ookla's analysis of Speedtest data.	Ookla

No.	Indicator	Units	Description	Source
1.2.4	Average mobile upload speed	Mbps	This measures average mobile upload speed. Averages are based on Ookla's analysis of Speedtest data. A faster speed is a positive indicator for better performance.	Ookla
1.2.5	Average mobile download speed	Mbps	This measures average mobile download speed. Averages are based on Ookla's analysis of Speedtest data. A faster speed is a positive indicator for better performance.	Ookla
1.2.6	Average mobile latency	ms	This measures average mobile latency (or how long it takes for data to travel between its source and destination). Averages are based on Ookla's analysis of Speedtest data.	Ookla
1.2.7	Bandwidth capacity	Bit/s per Internet user	This measures total used capacity of international Internet bandwidth, in bits per second per Internet user. Used international Internet bandwidth refers to the average traffic load (expressed in bits per second) of international fiber optic cables and radio links carrying Internet traffic. More Bits/s indicates better quality. There is a cap on bandwidth capacity at 3,000,000. All economies that exceed this value will receive a score of 100.	ITU
1.3.1	Network coverage (min. 2G)	% Of population	This measures the percentage of people covered by 2G networks (number of people as a percentage of the total population). The higher the percentage, the greater the number of people connected.	ITU
1.3.2	Network coverage (min. 3G)	% Of population	This measures the percentage of people covered by 3G networks (number of people as a percentage of the total population). The higher the percentage, the greater the number of people connected.	ITU
1.3.3	Network coverage (min. 4G)	% Of population	This measures the percentage of people covered by 4G networks (number of people as a percentage of the total population). The higher the percentage, the greater the number of people connected.	ITU
1.3.4	5G deployment	Qualitative rating 0-2, 2=best	This indicator measures whether 5G New Radio (NR) technology has been deployed in any area of the economy, either as a trial or for commercial or public use.	EIU, Ookla
1.3.5	Government initiatives to make Wi-Fi available	Qualitative rating 0-2, 2=best	This indicator looks at whether the government provides public Wi-Fi access in the largest city in the economy and whether the Wi-Fi is free to connect to Initiatives that come at no cost to the consumer are likely to promote usage	EIU economy research

No.	Indicator	Units	Description	Source
1.3.6	Private sector initiatives to make Wi-Fi available	Qualitative rating 0-2, 2=best	This indicator looks at whether the largest privately owned ISP provides public Wi-Fi access to its customers in the largest city in the economy and whether the Wi-Fi is free to connect to. Initiatives that come at no cost to the consumer are likely to promote usage.	EIU economy research
1.3.7	Unlicensed spectrum policy	Qualitative rating 0-3, 3=best	This indicator assesses the economy's ability to expand broadband connectivity by way of assessing its openness to provisioning unlicensed spectrum for greater Wi-Fi access and other productive uses. Higher prices, poorer service, lost productivity, loss of competitive advantage and untapped innovation can all be outcomes of preventing flexibility.	EIU economy research
1.3.8	Internet exchange points	Number of IXPs per 10 million inhabitants	This indicator measures the number of Internet exchange points (IXPs) in each economy. The higher the number of IXPs, the wider the infrastructure coverage.	EIU, PCH, PeeringDB, TeleGeography
1.4.1	Urban electricity access	% Of population	This indicator measures the urban electrification rate (%). The higher the percentage of population with access to electricity, the easier it is for people to gain access to the Internet.	IEA, World Bank
1.4.2	Rural electricity access	% Of population	This indicator measures the rural electrification rate (%). The higher the percentage of population with access to electricity, the easier it is for people to gain access to the Internet.	IEA, World Bank
2.1.1	Smartphone cost (handset)	Score of 0-100, 100=most affordable	This measures the indexed scores of the price of an entry-level handset to the consumer, as a percentage of GNI per capita. Generally, the lower the cost of a smartphone handset, the higher the adoption rates.	GSMA
2.1.2	Mobile phone cost (prepaid tariff)	% Of monthly GNI per capita	This measures the price of a prepaid 1 GB mobile data plan, as a percentage of monthly income. Generally, the lower the mobile phone data cost, the higher the adoption rates. There is a cap on prepaid mobile phone cost as % of monthly GNI per capita at 65%. All economies that exceed this value will receive a score of 0.	Research ICT Solutions, A4AI, ITU, EIU
2.1.3	Mobile phone cost (postpaid tariff)	% Of monthly GNI per capita	This measures the price of a postpaid 1 GB mobile data plan, as a percentage of monthly income. Generally, the lower the mobile phone data cost, the higher the adoption rates. There is a cap on postpaid mobile phone cost as % of monthly GNI per capita at 65%. All economies that exceed this value will receive a score of 0.	ITU, World Bank

No.	Indicator	Units	Description	Source
2.1.4	Fixed-line monthly broadband cost	% Of monthly GNI per capita	This measures the price of fixed-line monthly broadband to the consumer as a percentage of monthly income. Generally, the lower the broadband cost, the higher the adoption rates. There is a cap on fixed-line monthly broadband cost as % of monthly GNI per capita at 350. All economies that exceed this value will receive a score of 0.	ITU, World Bank
2.2.1	Average revenue per user (ARPU, annualized)	USD	This measures the average revenue per user (ARPU) for wireless operators. Generally, the higher the ARPU, the higher the adoption rates.	Axiata, GSMA, ITU, TeleGeography
2.2.2	Wireless operators' market share	HHI score (0-10,000)	This measures the market concentration among all wireless operators. The Hirschman-Herfindahl Index measures the concentration of markets as follows: HHI < 3,000, “unconcentrated”; 3,000 ≤ HHI < 4,000, “moderately concentrated”; and HHI ≥ 4,000, “highly concentrated”. A lower HHI score indicates a more competitive environment.	EIU, TeleGeography
2.2.3	Broadband operators' market share	HHI score (0-10,000)	This measures the market concentration among all broadband operators. The Hirschman-Herfindahl Index measures the concentration of markets as follows: HHI < 3,000, “unconcentrated”; 3,000 ≤ HHI < 4,000, “moderately concentrated”; and HHI ≥ 4,000, “highly concentrated”. A lower HHI score indicates a more competitive environment.	EIU, TeleGeography
3.1.1	Availability of local news in local languages	Qualitative rating 0-4, 4=best	This indicator measures whether the economy has news websites that provide information online in local language(s). It gives additional credit for economies with news websites in local languages other than the official language. If news websites are available in local languages, adoption becomes more likely.	EIU economy research
3.1.2	Concentration of websites using economy-level domains	Qualitative rating 0-3, 3=best	This measures the proportion of websites in the top 25 most-visited websites that use an economy code top-level domain (ccTLD). The higher the proportion, the more likely there are popular websites catering to local content needs.	Alexa Internet
3.1.3	Availability of e-Government services in the local language	Qualitative rating 0-2, 2=best	This measures whether the government of the largest city in the economy has a website that offers transactional services, including applying for a business license or permit. The availability of government services online is likely to increase adoption.	EIU economy research
3.2.1	e-Finance content	Qualitative rating 0-2, 2=best	This measures whether the largest retail banking institution offers online banking services. Online banking services are likely to stimulate economic activity.	EIU economy research

No.	Indicator	Units	Description	Source
3.2.2	Value of e-finance	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about personal finance. A higher proportion of respondents that value e-finance in their economy suggests that more relevant content is available.	EIU survey
3.2.3	e-Health content	Qualitative rating 0-3, 3=best	This measures whether the Ministry of Health in the economy has a website that provides information regarding healthcare, and also provides e-Health services functionalities. Easily available health information is likely to inform both social and economic activity and increase adoption.	EIU economy research
3.2.4	Value of e-health	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about health and fitness. A higher proportion of respondents that value e-health in their economy suggests that more relevant content is available.	EIU survey
3.2.5	e-Entertainment usage	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about how often respondents use the Internet for entertainment purposes. A higher proportion of respondents that use the Internet for entertainment in their economy suggests that more relevant content is available.	EIU survey
3.2.6	e-Commerce content	Score of 0-100, 100=best	This indicator seeks to measure the availability—and extent—of electronic commerce (e-commerce) in the economy, which can serve both as a way to buy products and to sell them. E-content refers to both electronic (online) and mobile commerce. Greater availability of online services/e-commerce is generally thought to increase Internet adoption.	UNCTAD
3.2.7	Value of e-Commerce	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about how often respondents purchase goods via the Internet. A higher proportion of respondents that use the Internet for purchasing goods in their economy suggests that more relevant content is available.	EIU survey
3.2.8	Open data policies	Qualitative rating 0-2, 2=best	This indicator measures the existence of government "open data" policies that promote the dissemination of public-sector (public and publicly funded) data, as well as the existence of government open data platforms.	EIU economy research
4.1.1	Level of literacy	% Of population	This indicator assesses the extent of literacy within economies. In order to use the Internet for useful purposes, such as to read news and access health or educational information, people must be able to read. The higher the level of literacy,	UNESCO

No.	Indicator	Units	Description	Source
			the higher the capacity to take advantage of being online.	
4.1.2	Educational attainment	Years of schooling	This indicator measures educational attainment through average years of schooling (ISCED 1 or higher). Internet adoption tends to be higher among highly educated groups. The greater the number of years of schooling, the higher the capacity to take advantage of being online.	Pew Research Center, UNDP
4.1.3	Support for digital literacy	Qualitative rating 0-3, 3=best	This measures whether the government has a plan or strategy that addresses digital literacy for students and training for teachers. Higher digital literacy increases the capacity of users to take advantage of being online.	EIU economy research
4.1.4	Level of web accessibility	Qualitative rating 0-4, 4=best	This measures whether the government website passes W3C guidelines on web accessibility. If websites are not accessible to people with disabilities, there are fewer opportunities to use them.	EIU economy research
4.2.1	Privacy regulations	Qualitative rating 0-2, 2=best	This measures whether the economy has data protection law(s) and whether there are legal or financial penalties in place for firms that do not follow the law. Clear and transparent laws and financial penalties mean users can tell what is legally acceptable within the economy, which increases their capacity to take advantage of being online.	EIU economy research
4.2.2	Trust in online privacy	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about how confident respondents are that their activity online is private. A higher proportion of respondents who claim they are confident their online activity is private increases the capacity to take advantage of being online.	EIU survey
4.2.3	Trust in Government websites and apps	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about the extent to which respondents trust information they receive from government websites and apps. A higher proportion of respondents who trust these sources increases the capacity to take advantage of being online.	EIU survey
4.2.4	Trust in Non-government websites and apps	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about the extent to which respondents trust information they receive from government websites and apps. A higher proportion of respondents who trust these sources increases the capacity to take advantage of being online.	EIU survey

No.	Indicator	Units	Description	Source
4.2.5	Trust in information from social media	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions about the extent to which respondents trust information they receive from social media. A higher proportion of respondents who trust these sources increases the capacity to take advantage of being online.	EIU survey
4.2.6	e-Commerce safety	%	This is an indicator taken from the EIU "Value of the Internet" survey. The indicator looks at economy-level responses to questions regarding the extent to which respondents agree with the statement "Making purchases online is safe and secure". A higher proportion of respondents who agree with this statement increases the capacity to take advantage of being online.	EIU survey
4.3.1	Economy-level female e-inclusion policies	Qualitative rating 0-4, 4=best	This indicator measures the existence of policies that encourage women and girls to access the Internet, support digital skills training for women and set targets for women to study STEM subjects. The policy score is the weighted sum of the following indicators: 4.3.1.1 to 4.3.1.3	EIU economy research
4.3.1.1	Comprehensive female e-inclusion plan	Qualitative rating 0-2, 2=best	This indicator assesses whether strategies addressing female e-inclusion exist to help address gender digital divides. The indicator also examines whether e-inclusion strategies exist to address female Internet access and adoption. To help score this indicator, the EIU team calculates the gender gap using the same method as the ITU and GSMA. Instead of measuring a pure percentage difference in access to the Internet, the EIU measures the gender gap as the ratio of the difference in male and female access to male access, or: Male access – Female access / Male access We then set a cut-off value of 10%, in line with ITU and GSMA estimates for the global gender gap. Economies that have a gender gap of less than 10% receive a 2, regardless of their gender inclusion policies. Economies with a gender gap of over 10% receive a 1 if they have a gender inclusion policy, while economies with a gender gap over 10% and without a gender inclusion policy receive a 0.	EIU economy research
4.3.1.2	Female digital skills training plan	Qualitative rating 0-1, 1=best	This indicator assesses whether strategies addressing female e-inclusion exist to help address gender digital divides. The indicator examines whether e-inclusion strategies exist to address digital skills training for women. A current strategy helps women take advantage of being online.	EIU economy research
4.3.1.3	Female STEM education plan	Qualitative rating 0-1, 1=best	This indicator assesses whether policies or government initiatives exist that encourage girls and women to study STEM subjects. A current strategy helps women take advantage of being online.	EIU economy research

No.	Indicator	Units	Description	Source
4.3.2	Government e-inclusion strategy	Qualitative rating 0-2, 2=best	This measures whether the government has any current initiatives or strategies in place that address e-inclusion—the inclusion and promotion of Internet access for underserved groups. "Current" means that the strategy has been developed within the past five years. Underserved groups include the elderly, youth, low-income groups, ethnic minorities, and people with disabilities. A current and inclusive strategy promotes the safe and widespread use of the Internet.	EIU economy research
4.3.3	Economy-level broadband strategy	Qualitative rating 0-3, 3=best	This measures whether the government has a current economy-level broadband strategy that promotes widespread Internet use and has been published recently. "Recently" is defined as within the past two years for the top score of 3, or five years for a score of 2.	EIU economy research
4.3.4	Funding for broadband buildout	Qualitative rating 0-1, 1=best	This indicator assesses whether the economy has an active government program(s) that helps subsidize or incentivize the buildout of broadband networks. Revised from an indicator looking only at Universal Service Funds (USF) as a method for improving broadband buildout, this indicator expands the scope of the question by addressing other financing options including USFs, in addition to tax credits, low-interest loans, and other government funding sources. This indicator helps address the principle that all citizens should have access to a baseline level of telecommunications services within an economy.	EIU economy research
4.3.5	Technology-neutrality policy for spectrum use	Qualitative rating 0-1, 1=best	This indicator assesses the economy's ability to expand broadband connectivity by way of gauging operator flexibility within an economy's spectrum policy to migrate to the next generation of network technology. Higher prices, poorer service, lost productivity, loss of competitive advantage and untapped innovation can all be outcomes of preventing flexibility. Technology neutrality is a policy approach that allows the use of any technology in any spectrum band. With technology neutrality in place, mobile operators can offer services through any technology (2G/3G/4G/LTE) using any of the frequencies in their possession ("refarming"). The freedom to deploy network of any technology using the available spectrum enhances overall efficiency, leading to benefits for the economy's mobile phone users.	EIU economy research
4.3.6	Economy-level digital identification system	Qualitative rating 0-2, 2=best	This measures whether the economy has an economy-level digital identification (e-ID) system that can be used online to access government services. The existence of an e-ID system promotes the safe and widespread use of the Internet.	World Bank

No.	Indicator	Units	Description	Source
4.3.7	Government efforts to promote 5G	Qualitative rating 0-3, 3=best	This indicator assesses government efforts to promote 5G roll-out across use case applications (e.g., FWA, eMBB, mMTC, IoT, URLLC). The top score is given to economies that have a policy or strategy to promote 5G that mentions more than one potential use case for 5G technology.	EIU economy research

Gender Data Portal Variables

Table 13: Gender Data Portal Variables Used

Topic	Variable	Definition
Education	Human Capital Index (HCI) (scale 0-1)	The HCI calculates the contributions of health and education to worker productivity. The final index score ranges from zero to one and measures the productivity as a future worker of child born today relative to the benchmark of full health and complete education.
Education	Human Capital Index, Lower Bound (scale 0-1)	The HCI lower bound reflects uncertainty in the measurement of the components and the overall index. It is obtained by recalculating the HCI using estimates of the upper bounds of each of the components of the HCI. The range between the upper and lower bound is the uncertainty interval. While the uncertainty intervals constructed here do not have a rigorous statistical interpretation, a rule of thumb is that if for two economies they overlap substantially, the differences between their HCI values are not likely to be practically meaningful.
Education	Human Capital Index, Upper Bound (scale 0-1)	The HCI upper bound reflects uncertainty in the measurement of the components and the overall index. It is obtained by recalculating the HCI using estimates of the upper bounds of each of the components of the HCI. The range between the upper and lower bound is the uncertainty interval. While the uncertainty intervals constructed here do not have a rigorous statistical interpretation, a rule of thumb is that if for two economies they overlap substantially, the differences between their HCI values are not likely to be practically meaningful.
Entrepreneurship	Time required to start a business (days)	Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. If a procedure can be speeded up at additional cost, the fastest procedure, independent of cost, is chosen.
Entrepreneurship	Time required to start a business, female (days)	Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. If a procedure can be speeded up at additional cost, the fastest procedure, independent of cost, is chosen.
Entrepreneurship	Time required to start a business, male (days)	Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. If a procedure can be speeded up at additional cost, the fastest procedure, independent of cost, is chosen.

Topic	Variable	Definition
Economic and Social Context	GDP (current US$)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates. For a few economies where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used.
Economic and Social Context	GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2015 prices, expressed in U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
Economic and Social Context	GDP per capita (current US$)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars.
Economic and Social Context	GDP per capita (constant 2015 US$)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2015 U.S. dollars.
Education	School enrollment, primary (gross), gender parity index (GPI)	Gender parity index for gross enrollment ratio in primary education is the ratio of girls to boys enrolled at primary level in public and private schools.
Education	School enrollment, primary (% gross)	Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Primary education provides children with basic reading, writing, and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art, and music.

Topic	Variable	Definition
Employment and Time Use	There are periods of absence due to childcare accounted for in pension benefits (1=yes; 0=no)	The indicator measures whether pension contributions are paid or credited during maternity or parental leave, or the leave period is considered a qualifying period of employment used for the purpose of calculating pension benefits; or there are mechanisms to compensate for any contribution gaps and to ensure that the leave period does not reduce the assessment base or pension amounts, or if there are no mandatory contributory pension schemes, but there is a noncontributory universal social pension conditioned on noncontributory requirements with no means test attached.
Employment and Time Use	The age at which men and women can retire with full pension benefits is the same (1=yes; 0=no)	The indicator measures whether the statutory age at which men and women can retire and receive an irrevocable minimum old-age pension is the same. If transitional provisions gradually increase, decrease or equalize the statutory retirement age, the answer reflect the age according to the report's data collection cycle, even if the law provides for changes over time.
Employment and Time Use	The mandatory retirement age for men and women is the same (1=yes; 0=no)	The indicator measures whether the relative ages at which men and women must cease employment or can be terminated by their employer are equal.
Employment and Time Use	The age at which men and women can retire with partial pension benefits is the same (1=yes; 0=no)	The indicator measures whether the age at which men and women can retire and receive partial pension benefits is the same, or if the age at which men and women can retire and receive partial benefits is not mandated. Partial pension benefits refer to a reduced or proportional minimum old-age pension payable to workers who did not accumulate enough work experience or contributions or have not reached the statutory age to qualify for a minimum old-age pension. If transitional provisions gradually increase, decrease or equalize the statutory retirement age, the answer reflect the age according to the report's data collection cycle, even if the law provides for changes over time.
Assets	The law grants spouse’s equal administrative authority over assets during marriage (1=yes; 0=no)	The indicator measures whether spouses retain administrative power over those assets each brought to the marriage or acquired during marriage, and their accrued value, without the need for spousal consent; or spouses administer their separate property, but for major transactions, such as selling or pledging the property as collateral, spousal consent is required, or if both spouses have equal rights in the administration and transaction of joint property.
Assets	The law prohibits discrimination in access to credit based on gender (1=yes; 0=no)	The indicator measures whether the law prohibits discrimination by creditors based on gender or prescribes equal access for both men and women when conducting financial transactions, entrepreneurial activities or receiving financial assistance, or if the law prohibits gender discrimination when accessing goods and services (and services are defined to include financial services).

Topic	Variable	Definition
Employment and Time Use	The law provides for the valuation of nonmonetary contributions (1=yes; 0=no)	The indicator measures whether there is an explicit legal recognition of such contributions and the law provides for equal or equitable division of the property or the transfer of a lump sum to the stay-at-home spouse based on nonmonetary contributions; or the default marital property regime is full community, partial community or deferred community because these regimes implicitly recognize nonmonetary contributions at the time of property division and benefit both spouses regardless of who purchased the property or holds title to it. Nonmonetary contributions include caring for minor children, taking care of the family home, or any other nonmonetized contribution from a stay-at-home spouse.
Norms and Decision-making	There is no legal provision that requires a married woman to obey her husband (1=yes; 0=no)	The indicator measures whether a married woman is legally required to obey her husband.
Violence	There is legislation specifically addressing domestic violence (1=yes; 0=no)	The indicator measures whether there is legislation addressing domestic violence that includes criminal sanctions or provides for protection orders for domestic violence, or the legislation addresses "harassment" that clearly leads to physical or mental harm in the context of domestic violence.
Violence	There is legislation on sexual harassment in employment (1=yes; 0=no)	The indicator measures whether there is a legal provision or legislation that specifically protects women against sexual harassment in employment, including unwelcome verbal or physical conduct of a sexual nature.
Employment and Time Use	The government administers 100% of maternity leave benefits (1=yes; 0=no)	The indicator measures whether leave benefits are fully administered by a government entity, including compulsory social insurance schemes (such as social security), public funds, government-mandated private insurance or employer reimbursement of any maternity leave benefits paid directly to an employee.
Employment and Time Use	There is paid parental leave (1=yes; 0=no)	The indicator measures whether both parents are legally entitled to some form of full-time paid parental leave either shared between mother and father or as an individual entitlement that each can take regardless of the other.
Employment and Time Use	Employment in industry, female (% of female employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The industry sector consists of mining and quarrying, manufacturing, construction, and public utilities (electricity, gas, and water), in accordance with divisions 2-5 (ISIC 2) or categories C-F (ISIC 3) or categories B-F (ISIC 4).

Topic	Variable	Definition
Employment and Time Use	Employment in industry, male (% of male employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The industry sector consists of mining and quarrying, manufacturing, construction, and public utilities (electricity, gas, and water), in accordance with divisions 2-5 (ISIC 2) or categories C-F (ISIC 3) or categories B-F (ISIC 4).
Employment and Time Use	Employment in industry (% of total employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The industry sector consists of mining and quarrying, manufacturing, construction, and public utilities (electricity, gas, and water), in accordance with divisions 2-5 (ISIC 2) or categories C-F (ISIC 3) or categories B-F (ISIC 4).
Employment and Time Use	Employment in services, female (% of female employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The services sector consists of wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services, in accordance with divisions 6-9 (ISIC 2) or categories G-Q (ISIC 3) or categories G-U (ISIC 4).
Employment and Time Use	Employment in services, male (% of male employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The services sector consists of wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services, in accordance with divisions 6-9 (ISIC 2) or categories G-Q (ISIC 3) or categories G-U (ISIC 4).
Employment and Time Use	Employment in services (% of total employment) (modeled ILO estimate)	Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The services sector consists of wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services, in accordance with divisions 6-9 (ISIC 2) or categories G-Q (ISIC 3) or categories G-U (ISIC 4).

Topic	Variable	Definition
Employment and Time Use	Ratio of female to male labor force participation rate (%) (economy-level estimate)	Labor force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labor for the production of goods and services during a specified period. Ratio of female to male labor force participation rate is calculated by dividing female labor force participation rate by male labor force participation rate and multiplying by 100.
Employment and Time Use	Ratio of female to male labor force participation rate (%) (modeled ILO estimate)	Labor force participation rate is the proportion of the population ages 15 and older that is economically active: all people who supply labor for the production of goods and services during a specified period. Ratio of female to male labor force participation rate is calculated by dividing female labor force participation rate by male labor force participation rate and multiplying by 100.
Employment and Time Use	Labor force, female	Female labor force comprises women ages 15 and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time jobseekers. Not everyone who works is included, however. Unpaid workers, family workers, and students are often omitted, and some economies do not count members of the armed forces. Labor force size tends to vary during the year as seasonal workers enter and leave.
Employment and Time Use	Labor force, female (% of total labor force)	Female labor force as a percentage of the total shows the extent to which women are active in the labor force. Labor force comprises people ages 15 and older who supply labor for the production of goods and services during a specified period.
Employment and Time Use	Labor force, total	Labor force comprises people ages 15 and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time jobseekers. Not everyone who works is included, however. Unpaid workers, family workers, and students are often omitted, and some economies do not count members of the armed forces. Labor force size tends to vary during the year as seasonal workers enter and leave.
Employment and Time Use	Labor force, male	Male labor force comprises men ages 15 and older who supply labor for the production of goods and services during a specified period. It includes people who are currently employed and people who are unemployed but seeking work as well as first-time jobseekers. Not everyone who works is included, however. Unpaid workers, family workers, and students are often omitted, and some economies do not count members of the armed forces. Labor force size tends to vary during the year as seasonal workers enter and leave.
Employment and Time Use	Unemployment, youth female (% of female labor force ages 15-24) (modeled ILO estimate)	Youth unemployment refers to the share of the labor force ages 15-24 without work but available for and seeking employment.

Topic	Variable	Definition
Employment and Time Use	Ratio of female to male youth unemployment rate (% ages 15-24) (modeled ILO estimate)	Ratio of female to male youth unemployment is the percentage of female to male youth unemployment rates.
Employment and Time Use	Unemployment, youth male (% of male labor force ages 15-24) (modeled ILO estimate)	Youth unemployment refers to the share of the labor force ages 15-24 without work but available for and seeking employment.
Employment and Time Use	Unemployment, youth total (% of total labor force ages 15-24) (modeled ILO estimate)	Youth unemployment refers to the share of the labor force ages 15-24 without work but available for and seeking employment.
Employment and Time Use	Unemployment, female (% of female labor force) (modeled ILO estimate)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.
Employment and Time Use	Unemployment, male (% of male labor force) (modeled ILO estimate)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.
Employment and Time Use	Unemployment, total (% of total labor force) (economy-level estimate)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment. Definitions of labor force and unemployment differ by economy.
Employment and Time Use	Unemployment, total (% of total labor force) (modeled ILO estimate)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment.
Population	Rural population (% of total population)	Rural population refers to people living in rural areas as defined by economy-level statistical offices. It is calculated as the difference between total population and urban population.

Groups of Economies

Table 14: List of economies

Group	Economies
G1	Australia; Austria; Burkina Faso; Burundi; El Salvador; Germany; Iceland; Kazakhstan; Korea; Lao PDR; Madagascar; Mexico; Netherlands; Niger; Norway; Switzerland; Zimbabwe
G2	Armenia; Brazil; Bulgaria; Canada; Chile; Colombia; Costa Rica; Ecuador; Georgia; Ghana; Indonesia; Lesotho; Malaysia; Panama; Sri Lanka; Turkey; Uruguay
G3	Azerbaijan; Belgium; Bulgaria; Canada; Croatia; Cyprus; Czech Republic; Denmark; Dominican Republic; Estonia; Finland; France; Greece; Guyana; Honduras; Hungary; Ireland; Italy; Kyrgyz Republic; Latvia; Lithuania; Luxembourg; Moldova; Mongolia; New Zealand; North Macedonia; Poland; Portugal; Romania; Serbia; Slovak Republic; Slovenia; South Africa; Spain; Sweden; Ukraine; United Kingdom; the United States
G4	Algeria; Bahrain; India; Iran, Islamic Rep.; Morocco; Oman; Qatar; Saudi Arabia; Tunisia; United Arab Emirates; West Bank and Gaza

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