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Gendered Nature of Digital Inequality: Evidence for Policy Considerations

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* The views expressed in this paper are those of the author and do not necessarily represent those of the United Nations.

Gendered Nature of Digital Inequality: evidence for policy considerations

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0. Executive Summary

Despite gender and digitalisation being priority issues on the global agenda based on the potential of access to mobile phones and the Internet to improve livelihoods, lives and life opportunities, **there is only very patchy gender data for evidence-based digital policy formulation.** The COVID-19 pandemic has highlighted the now critical need for digital substitution to mitigate the devastating effects of the pandemic and lockdowns, bolstering calls by the UN Secretary General for a New Digital Compact. The pandemic has revealed the absence of data, particularly gender data, in some of the most basic indicators, highlighting the need for systematic digital data collection that can be disaggregated.

Without this data there is **little way of assessing the progress being made towards the Sustainable Development Goals (SDGs) and the ICT sub-targets** that underpin them. There are also challenges with poor data. This is the case both with regards to accuracy and granularity. The resulting inaccurate data is potentially more damaging than no data at all, when used to make decisions affecting people's very existence in the digital era.

Using various multilateral and regional data sources and case studies, this paper creates a collage of available supply- and demand-side information at the international, regional and national level. From this it assesses the implications of the uneven distribution of opportunities and harms associated with the processes of digitalisation and datafication and the intensifying outcomes of digital inequality.

It does so by **adopting an intersectional approach to understanding inequality,** despite the quantitative approach of the paper. Since gender is constructed differently over time and locations, it is impossible to separate from race, class, culture and religion, and cannot be understood in terms of discrete, quantifiable indicators or even a single area of social science. Efforts to move beyond descriptive statistics allow for some demonstration of the **various factors determining the exclusion of people living at the intersection of multiple inequalities, particularly gender.** To reach policy makers and to inform and influence decision-making it is necessary to produce rigorous gender-differentiated data which will surface other gender inequalities and may isolate the exact points of policy intervention required.

With the data collected within the United Nations (UN) statistical system adopting binary notions of gender, the study looks largely at the differences between men and women. The problem of doing so from an intersectional approach to inequality are acknowledged. At the international level we know from modelling of national representative data that Internet penetration broadly tracks GNI per capita and that this is reflected in progress towards gender parity largely because of higher education levels. These are not direct correlations however and there are several anomalies indicating the **impact of culture, religion and other less quantifiable factors on the participation** of women.

The data reveal **stark differences in the capacity to access the Internet, across different regions, countries within regions and groups within countrie**s; and suggest the potential of policy to change digital outcomes. Although Internet access has been increasing in all regions of the world, progress in Africa still lags other regions. This applies both to the scale of Internet access and to the inequalities therein. Nevertheless, there does appear to be evidence of declining inequalities as access moves beyond a critical mass.

Despite gains made in reducing gender inequalities in access to digital technologies, **female access was overall found to be lower than for men** (**barring rare exceptions). This was so for both individual access and in analysis of small businesses by gender**. In response to the COVID-19 pandemic lockdowns, women users appear more likely to digitally substitute for social and communicative use cases and less so for directly productive purposes such as working from home, online business activities, platform work and human capital development.

The findings also highlight **the heterogeneity of women** around the world by analysing the differences which exist across different categories of individuals. Women in seemingly similar country contexts face very different outcomes in terms of equal access to and use of technology. Even within countries, stark differences are observed for women accessing the Internet across factors such as geographic distributions, education, age and business formalisation.

The influence of these factors on access and use are themselves not independent from each other either. There is a strong **need for deeper analysis of nationally representative individual-level data to better understand these intersectional inequalities, the** linkages between technological developments and their potential to contribute to socio-economic development. This will ensure the right policy interventions which do not exacerbate current inequalities.

Supply and demand side data show that several low-income countries still have infrastructure deficits that prevent Internet uptake outside major centres. **Many low- and middle-income countries have broadband coverage of over 90%. Yet, several of the least developed countries have Internet penetration rates below 20% of the population,** the critical mass considered necessary to generate the network effects associated with economic growth and development (Gillwald and Mothobi, 2019). This indicates that **access and use challenges relate more to the demand-side factors such as awareness, affordability, digital literacy** on the consumption side and digital skills, financial access on the labour and production side. The demand side evidence available indicates that the main barrier to Internet access in Africa and other countries surveyed in the 2018 After Access Survey, is the price of the smart device. The main constraint on use is the price of data.

Modelling of the data also shows that Internet uptake and intensity of use correlates with the level of education, and its corollary, income. The concentration of women amongst those marginalised from digital services, applications and platforms is primarily explained by their lack of education and income. The lack of access to education and income may be determined by social, cultural, religious and biological factors. This is borne out in certain Asian countries in the 2018 After Access Survey.

As women are concentrated amongst those most marginalised from digital services, policy and regulatory interventions that ensure the availability of broadband networks and reduce the price of devices and data are likely to increase Internet accessibility for poorer and rural women, and men, and other people currently most marginalised from services. As Internet access figures increase, gender indicators will move towards the parity we have seen in mobile voice services once they become universalised.

But this is a long way off in most developing countries with much of the population still offline. It will also not happen equitably, with those at the intersection of multiple inequalities least likely to come online, even as coverage increases, and prices decrease. This will require systemically redressing underlying structural inequality that is mirrored in digital inequality. Equitable digital inclusion will require not only digital policy interventions but integrated strategies to improve education and employment opportunities and thereby incomes.

If there are to be more equitable outcomes, **far more effective data collection** is essential to enable disaggregated analyses by sex, income, education, employment and age for the informed and innovative policy that will be required to regulate these dynamic, complex and adaptive information systems. This will require multilateral agencies, development banks and states to move beyond the rhetoric of statistics as a public good. To ensure that standardised, non-proprietary data is publicly available for public planning, research and preferential commercial benefits for marginalised groups will require concerted policy intervention and the dedication of resources to make this happen.

The implications of failing to address digital inequality in the information era are severe as the Secretary General has pointed out. While global reform and donor agendas have shifted from digital inequality and its measurement for purposes of policy intervention to issues of data and algorithmic governance, the ramifications and governance challenges of remedying the exclusion of significant parts of the global population in the digital polity and economy are not unrelated.

While proposed ethical and responsible design in data driven technologies may go some way to alleviating some of the obvious problems associated with bias, lack of transparency, they are unable to deal with the structural inequality reflected in the generation of data at scale and the systemic perpetuation of historical injustices in their application to millions of micro decisions made daily on the basis of giant social networking data sets.

The exclusion of people from online financial services, remote and platform work and digital production makes them invisible in the data extracted by global monopoly digital platforms for the purposes of creating lucrative digital intelligence. As a result, **those at the intersection of multiple inequalities, and particularly black women, are absent, underrepresented and discriminated against in automated algorithmic decision-making**

Efforts to ensure digital inclusion of all are becoming more complex. While the structural inequalities that are reflected in digital inequality, and data injustice will only be addressed through broader more fundamental economic and social transformation, there are systemic issues perpetuating digital inequality and data injustice that can be redressed through policy intervention. At the very least it will require the **regulation of data to safeguard human rights but also economic regulation to ensure access to and the protection and use of data.** To promote more equitable and just outcomes, positive discrimination in the areas of consumer protection, data protection, public procurement and data access and sharing is required.

High quality public data is necessary to identify the precise points of policy intervention, necessary regulation and nature of governance. It is required for planning and implementation and to measure and assess policy and regulatory outcomes and the progress being made towards a more equitable and sustainable planet.

To this end, in addition to other policy considerations, and particularly in the context of developing countries, **as a single key recommendation, it is proposed that there is a 1% contribution from the domain name system (DNS) registration fees of all countries towards a digital solidarity fund. This could be allocated based on applications by states to the fund to enable the gathering of digital data that can be disaggregated, analysed and evaluated.**

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1. Introduction

UN Secretary-General, Antonio Guterres,[1] has described digitalisation as one of two seismic shifts that will shape the 21st Century, the other being climate change. He has cautioned, however, that both will widen inequalities even further unless urgently addressed on a planetary scale. As affordable and meaningful access to digital services become critical to inclusive social and economic engagement, and indeed to survival, as witnessed during the COVID-19 pandemic, redressing the digital inequality paradox (Gillwald 2014) has become one of the most wicked policy problems of our time. From a policy and regulatory perspective, the paradox lies in the tension between the objective of getting more people online, more actively and productively, and the objective of reducing digital inequality. Yet, as more people are connected, and as advanced technologies are layered over unevenly accessed and used underlying and foundational technologies, digital inequality is increasing. This is not only the case between those online and those offline (as is the case in a voice and basic text environment). It is also between those who have the technical and financial resources to use the Internet optimally, and those who are 'barely' online. The latter includes those who only have partial access to poor-quality or expensive data services that do not permit them to be 'always on' or to use data-intensive services. The gap is widening between those who passively consume a limited number of basic services and those able to put technology to full and productive use, and the few able to innovate and contribute to the prosperity of nations.

The call for digital equality has been foremost in organisational agendas both at the international and national levels over the years, based on the premise that the Internet can contribute to the achievement of the Sustainable Development Goals (SDGs). One of the precepts of the 2030 Agenda for Sustainable Development – "leave no one behind" – hinges on gender equality. SDG Goal 5b specifically identifies the enhanced use of enabling technology, in particular ICTs,(UNGA, 2015) to promote the empowerment of women (UNGA, 2015).

With gender equality firmly on the global agenda, many multilateral agencies and development banks have documented that digital transformation can provide opportunities for marginalised women to be economically empowered. The Organization for Economic Cooperation and Development (OECD, 2018) has highlighted that through the Internet, mobile phones, digital platforms and digital financial services, opportunities are provided that can help bridge the digital divide. It is envisaged that these technological services can allow women to access jobs and earn income as well as provide them with better access to knowledge and information. This is however hindered by the lack of access, inability to afford the services, lack of education and existing discrimination and sociocultural norms. Without access to digital services the likelihood of developing science, technology, engineering and mathematics (STEAM) skills is considerably reduced. The OECD report further states the relatively lower level of female enrolment in the science, technology, engineering, mathematics (STEM) and ICT-related courses, can widen the gender gap and result in greater inequality.

Policy reform has long been focused on supply-side solutions of network extension to maximise the coverage of the country. Yet, to understand the drivers of gender inequality for policy purposes, it is necessary to understand both supply-side and demand-side factors.

[1] See Nelson Mandela Foundation Annual Lecture 2019 https://www.un.org/sustainabledevelopment/a-new-social-contract-for-a-new-era/

Dearth of data

Not much progress has made since the Partnership on Measuring the Information Society (ITU, 2021) noted that internationally comparable, reliable gender-related data are lacking, including on ICTs and education, access to and use of ICTs, barriers to Internet access and use, employment in the ICT sector itself and in ICT occupations across many sectors, ICTs in the workforce and in entrepreneurship, several aspects of mobile phone use, and financial inclusion, particularly in developing countries.

There is, as a result, hardly any global data available that can be used to establish a baseline from which progress towards the SDG targets can be measured.

The World Bank's World Development Report (World Bank, 2021) notes that when data quality is poor it lacks granularity, accuracy, and comparability. Lack of granularity and accuracy can occur when data are not available at the desired level of disaggregation. They note that the gaps in data on women and girls are particularly severe. Only 10 of the 54 gender-specific indicators (19%) in the SDGs are widely available, based on international standards for measurement, and only 24% of the available gender-specific indicators are from 2010 or later. There is little data that can be disaggregated to identify or confirm the unequal impact of digitalisation on different categories of people or communities and therefore the points of policy intervention to redress it. This is so particularly in the Global South where most people reside – many of them far removed from the transformative potential of digital technologies.

The World Bank (2021) notes that though the pandemic drove demand for statistics, and particularly gender disaggregated statistics, it also interrupted the supply. More than half of low-income countries (LICs) and low- and middle-income countries (LMICs) reported that the COVID-19 pandemic affected the ability of national statistical offices to produce socio-economic statistics. This problem requires immediate attention, but building effective, gender-aware data systems will require sustained financial and human capital investments.

So, while the gendered nature of digital inequality has been recognised for years, there is very little data on women – both because data are not collected and because when they are, they are not or cannot be disaggregated. Criado Perez, 2019: xvi) describes this gender data gap as "silences that are everywhere". Humanity's story uses men as default, the story of women is about "…absence and that makes it hard to write about". But these silences, she points out, have consequences - some of which may be trivial, but others may have serious consequences for livelihoods and even lives. There are female-specific concerns that affect nearly every aspect of women's concerns. Criado Perez (2019) surfaces these as the female body, women's unpaid care burden, and male violence against women. Unaddressed in the analogue world they reflect in the digital realm.

Often because the more complex and nuanced nature of gender makes it hard to quantify or assess, gender is reduced to a narrow binary and biological framing as male and female within the UN statistical system and in sectoral policy frameworks developed by multilateral agencies and development banks to promote gender parity. Such approaches treat both groups as homogeneous, failing to recognise the intersectional nature of inequality and the relational nature of power between both men and women, men and men, and women and women. The gender data gap (or absences) Perez speaks of increases further when it comes to black and brown women, working class women and even more so for women in the informal sector, in rural areas in some countries, in unpaid domestic labour or in the survivalist economy. As digital inclusion increasingly becomes essential to active citizenry and economic participation, the consequences of these data gaps impact differently on peoples' lives, livelihoods and life opportunities.

It is not all women who experience digital inequality and certainly not to the same extent, and while there may be patterns of patriarchy and power, not all men are in a privileged position to access digital services. It is those people at the intersections of other inequalities of class, race, ethnicity, gender, sexuality, or urban or rural location that are most marginalised. What we do know is that women are concentrated amongst the less educated and poor, and that their lower levels of education (and as a result, formal sector employment) as well as their unpaid and therefore unvalued reproductive and domestic functions means they are overrepresented amongst the digitally excluded. But their gender on its own is not the determinant of their marginalisation (Gillwald and Mothobi 2019). Indeed, from an evidence-based policy perspective, women at the intersections of multiple inequalities shared by some men, may have more in common with men than with women with whom they only have in common their gender.

Intersectionality

Conceptually this paper draws on some of the core ideas of intersectionality identified by Collins and Bilge (2020) – social context, power relations, social inequality, relationality, social justice and complexity. As an analytical tool these concepts together lend themselves to understanding the intersectional nature of digital inequality and the multifaceted points of policy intervention required to redress or reduce it.

Collins and Bilge (2019) highlight the importance of social context, which is especially significant when importing policy reforms designed in the Global North into the Global South.

Power relations can as equally be analysed through the "intersections of racism, sexism, capitalism and heterosexism, as they can be across domains of power – structural, disciplinary, cultural and interpersonal intersections." (Collins and Bilge 2019). In the context of digital and data governance this concept is used to analyse market power, state power, and the power of some individuals over others.

The concept of global social inequality shows how intersectional frameworks that take power relations into account, assist with analysis of how national state power works with different interests. This perspective can generate new questions on social inequality relevant to understanding interests at play in policy formulation.

Social justice has informed much of the focus of critical inquiry and praxis that characterises intersectionality. What has not always been recognised is that fostering social justice, often expressed in human rights discourses, requires complex analysis of global economic inequality, not only equal rights for people. Without economic or material justice the rules may appear to be equally applied to everyone, yet still produce unequal and unfair outcomes (Collins and Bilge 2019:33).

Relationality provides a tool to analyse the connections between what are often portrayed in literature and politics as oppositional categories such as gender and race. Relationality enables insight into how these might rather be compounding dimensions of oppression or exclusion. This is particularly important because it opens new lines of inquiry and praxis, a characteristic or potential of intersectionality very valuable to policy formulation.

Complexity required in undertaking intersectional analysis provides the multiple lenses necessary to conceptualise the dynamic and globalised processes of digitalisation and datafication that we seek to measure and on which basis we seek to develop policy.

Critical praxis also constitutes an important feature of intersectional inquiry that is both "attentive to intersecting power relations and vital for resisting social inequality and injustice". The utility of intersectionality as a form of critical inquiry provides frameworks to study the effect of digitalisation, across local, regional, national and global social contexts. Intersectionality as a critical praxis does the same but in ways that "explicitly challenges the status quo and aims to transform power relations" (Collins and Bilge 2019:36).

As gender is constructed differently at different times across cultural locations and can be approached as a "social relation of inequality or as a core component of identity politics", it "cannot be reduced to a discrete variable". Yet it is often necessary to empirically inform policy through precise, rigorous gender-differentiated data to enable identification of the precise points of policy intervention as Steans and Tepe-Belfrage (2016) have argued. They propose that for policy purposes and to reach different audiences, the approach to gender rather be "…a strategic mode; to treat gender as if it was a coherent and stable category of analysis." (2016:2)

While seeking to avoid "binary constructions and gender essentialism", this paper treats gender as a strategic mode for the collection and analysis of data required to inform evidence-based policy, drawing on Stearns and Tepe-Belfrage (2016:3).

This framing of the 'intersectional' measures of sex, race, income and education (class), and location (urban and rural) provide insights into the multidimensional nature of digital inequality. Although the quantification of dimensions of intersectionality will be correctly critiqued for instrumentalism, if analysed in the context of intersectional enquiry and praxis, drawing on concepts of social justice, relationality, complexity and inequality, they can support more nuanced policy analysis.

With this conceptual framing of the gendered nature of digital inequality, this paper critically examines the international data that is available to ascertain what data exists and what it tells us at global and regional levels. It then draws on demand-side data from Research ICT Africa's (RIA) 2018 After Access survey of 20 countries from the Global South to provide some insights into the gendered nature of digital inequality at the level of low- and middle-income countries (LMICs).[2] The paper then draws on phone survey data from a two After Access survey countries, Nigeria and South Africa to examine the degree to which men and women were able to use digital substitution to mitigate the effects of the COVID-19 pandemic through remote work, schooling, financial transacting and securing social grants and relief. Finally, it draws out some insights from the latest 2022 African After Access survey to understand any implications for the gender equity objectives of the SDGs in the African context. Throughout it will refer to qualitative research that has been undertaken to better

[2] The global South After Access survey was undertaken between 2017 and 2019 by IEP in Latin America, LIRNEasia in South-East Asia and by Research ICT Africa in Asia. The household and individual survey undertaken in each country, was complemented by an informal sector survey in some countries

understand the complex and immeasurable dimensions of digital inequality.

The paper then draws out some of the policy and regulatory implications of this overview of the gendered nature of digital inequality, so that more equitable and inclusive digital outcomes can be produced. From the limited data available, it extrapolates the consequences of not redressing digital exclusion. Specifically, without access to the Internet and the platforms and social networks that drive Internet take up and generate the data that is extracted by global tech monopolies for the purposes of generating surplus value, those marginalised from these services cannot be represented in the datasets.

Data and methodology challenges

At the global level, the data on use is very limited and there is inadequate qualitative and quantitative research in this regard to date. As the USAID put it: "…issues such as intersectionality and negative and unintended consequences of gender-based digital initiatives require more targeted research, data collection, analyses, and reporting" (USAID 2021).

The need for both qualitative and quantitative research to provide a holistic evidence-based picture for policy formulation cannot be overemphasised. While quantitative data can allow us to get empirical evidence on factors contributing to the digital gender divide, it often raises more questions which can only be answered and supported through qualitative research methods. Evidence of gender gaps in ICTs have been well documented, but mostly through simple statistics which can often misrepresent the causal factors of digital inequalities.

While the International Telecommunication Union (ITU) is spearheading and making strides to develop standard definitions for ICT indicators and methodologies for ICT data collection, there is still a lack of consensus and agreement on these definitions and methodologies across countries and continents. This is a contributing factor to the dearth of ICT indicators and sex-disaggregated data at the global level and more so amongst developing countries. Country data provided to the ITU as per agreement are often limited and outdated.

The methods to measure the gender digital divide are not standardised and only 69 countries are said to report sex-disaggregated data on internet access to the ITU. The ICT use indicators collected vary from one organisation to the next.

Official statistics on ICT indicators – and more so sex-disaggregated data – is very limited and what is available is heavily reliant on supply- side data from operators that is often used directly as administrative data without any verification or auditing. A small amount of ICT data is collected during national census exercises, but this tends to be the most basic indicators only and even then, the standard ITU definitions are not used, making any comparisons flawed.

There is the need for accurate data and evidence to provide insights into why the gender gaps persist. This includes stand-alone nationally representative and sex-disaggregated ICT surveys to be able to assess the full extent of people's digital capacities, limitations, and challenges at the national level. In some instances, there seems to be a lack of awareness or acknowledgement of the necessity of this data and an acceptance and reliance on supply-side data and ad-hoc and often segmented ICT studies. But generally, there is also a lack of political will to invest in such nationally representative ICT studies. Most statistical offices are also constrained by a lack of resources and research capacities to carry out these kinds of studies.

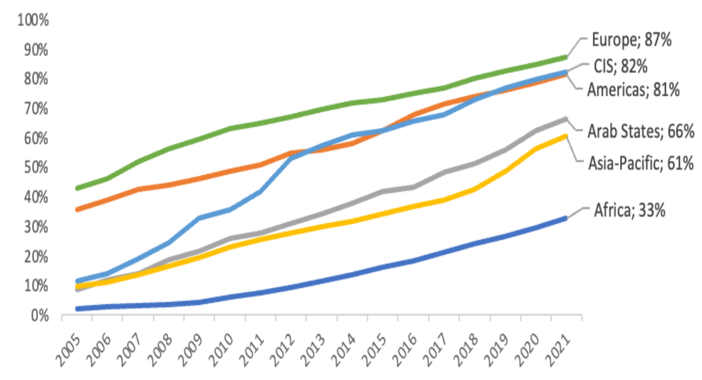
As indicated, there is little data at the international level to really assess our progress towards the digital targets of the SDGs, especially in the Global South. With prepaid mobile services being the predominant form of telephony and Internet access in the Global South, traditional supply-side administrative data is unable to identify even unique subscribers from the active SIM cards in a country. Demand-side surveys undertaken in developing countries have produced extensive evidence on multiple SIM use – as high as six SIMs per person on average in some countries (Stork et al., 2013). Together with non-personal use, SIMs associated with the growing Internet of Things (IoT) industry, and the use of SIMs in satellite surveillance and business processing, outside of a nationally representative demand-side data collection, (whether through a census or household survey), it is very difficult to assess voice or Internet penetration. This means that for the purposes of policy intervention, it is impossible to accurately disaggregate data by sex, income or education or to identify the causes of unequal access to and use of digital goods and services.

2 The global landscape: Overview of international gender surveys, indices, reports[3]

2.1 Global and regional trends

The ITU data are the only international data available for comparative purposes and, despite the challenges of gathering accurate data, are likely to be at least indicative of digital developments. Global internet penetration has increased from only 16% in 2005 to 63% in 2021 (ITU, 2021). While the upward trend is common across the regional breakdown (Figure 1), some parts of the world, particularly Africa, are lagging the rest of the world. Whereas Europe, the Commonwealth of Independent States (CIS) and the Americas have all achieved Internet access for more than 80% of the population, Africa's Internet penetration in 2021 stands at only 33%, lower than the rate observed for Europe and the Americas 16 years prior in 2005.

Figure 1: Regional trends in Internet penetration

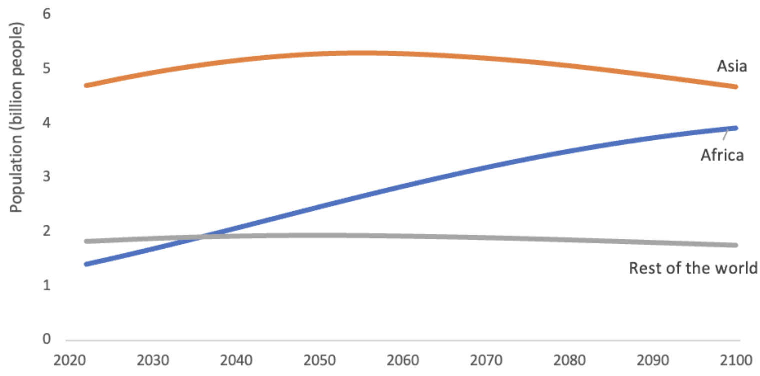


Source: (ITU, 2021)

Unless Internet adoption can be rapidly scaled up in Africa, the region's share of Internet non-users, currently already at 25% (ITU, 2021), will be set to increase significantly going forward as Africa is expected to be the main source of population growth over this century. According to the UN's (2022) population forecasts (Figure 2), Africa's population will increase from its current level of 1.4 billion to 2.5 billion by 2050 and to 3.9 billion by 2100. Over this period, Asia's population is expected to increase initially, before declining back to its current level by 2100, whereas the population of the rest of the world is expected to decline gradually. This means that the proportion of the world's population living in Africa is expected to grow, increasing the continent's share in the global population from 18% currently to 25% by 2050 and 38% by 2100.

[3](See also ITU https://www.itu.int/hub/publication/d-ind-global-01-2022/)

Figure 2: Regional population growth forecasts

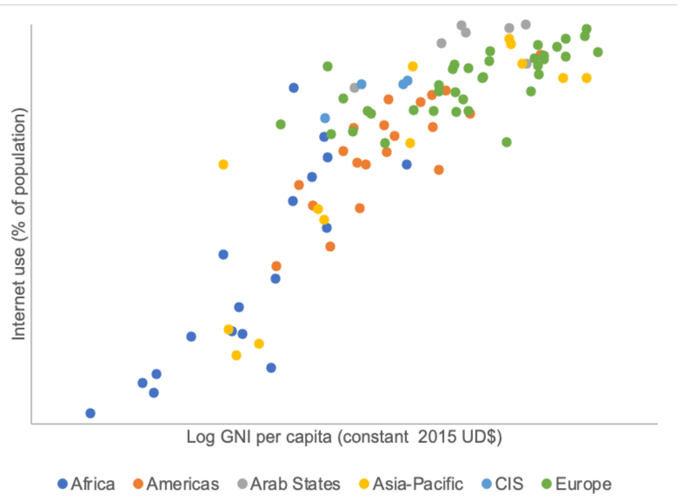


Source: (ITU, 2021)

Similarly, the Asia Pacific region encompasses countries like Pakistan, which has a GNI per capita of USD1 471 and Internet penetration is estimated to be at 17%, as well as countries like the Democratic Republic of Korea, which has a GNI per capita of USD31 111 and Internet penetration of 97%. Although there appears to be a positive correlation between GNI per capita and Internet penetration, with higher levels of income associated with higher Internet use, there are clear exceptions. For example, Cambodia has a GNI per capita of USD1 268 and an Internet penetration rate of 65%, whereas Sudan, although having a higher level of GNI per capita at USD2 161 has a substantially lower Internet penetration rate at only 14%. Conversely Italy has a GNI per capita of USD30 164 and an internet penetration rate of 71%, whereas Morocco, with a lower GNI per capita of USD2 775, has achieved a higher internet penetration rate of 84%.

Even within regions however there are large differences in access to the Internet. Figure 3 plots real Gross National Income (GNI) per capita against the percentage of the population using the Internet. Africa encompasses countries like Burundi, which has a GNI per capita of USD287 and Internet penetration of less than 3%, and Egypt, which has a GNI per capita of USD3 906 and Internet penetration estimated to be above 70%.

Figure 3: National Internet use against vs real GNI per capita



Source: (ITU, 2021; World Bank, 2022)

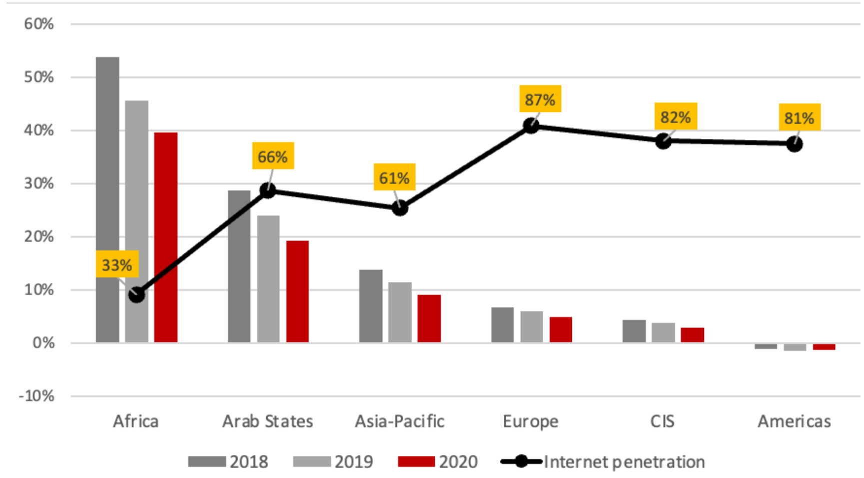
2.2 The gender dimension

According to ITU estimates for 2019, globally and in all regions, men use the Internet more than women. Globally, Internet penetration rates are 12% lower for women than men – 48.4% of women use the Internet in comparison to 58.3% of men (ITU, 2021). The gender gap[4] in relation to Internet access is negatively correlated with Internet penetration, (ITU, 2021). This can be seen in Figure 4 which shows the gender gap in Internet access by region from 2018 to 2020, as well as the

[4] The gender gap is calculated as the percentage difference between the proportion of men using the internet and women, relative to the average for the population:

Gender gap (%)= % of adult men using the Internet-% of adult women using the Internet% of the adult population using the Internet

Figure 4: Gender gap in Internet usage by region, 2018-2020



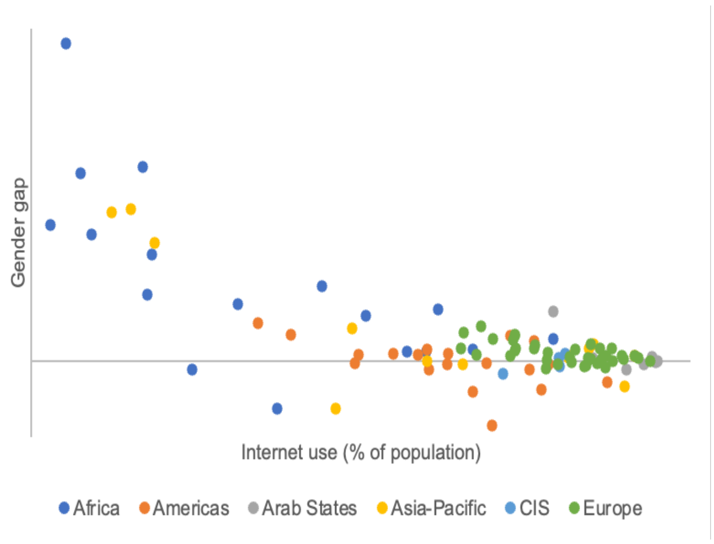
Source: (ITU, 2021)

share of Internet users for each region as at 2020. Where Internet adoption is higher, the gender gap is generally lower. The graph also illustrates that over the three-year period there was a decline in the gender gap across all regions, the only exception being the Americas which is the only region where women are estimated to use the Internet more than men.

Although the gender gap does appear to decline as Internet access increases, it is not a perfect correlation. For example, Europe has the highest Internet penetration (Figure 4), however, there is a larger gender gap than in the Commonwealth of Independent States (CIS) and the Americas. Similarly, the Arab States have a higher level of Internet penetration than Asia-Pacific yet also have a significantly larger gender gap. This can be further illustrated through Figure 5 below which maps Internet penetration against the gender gap for 99 countries where data are available. Although the trend does suggest a positive relationship there are notable exceptions; for example, in Bahrain and Algeria, despite achieving Internet penetration of 84%, a gender gap of 16% has persisted. Conversely in Zimbabwe, despite only achieving an Internet penetration of 29%, the gender gap has been eliminated with female Internet use exceeding that of males (30% versus 29%).

The ITU also documented that while in Europe and Central Asia the gender gaps in Internet use decreased between 2013 and 2019, all other regions recorded an increase in this gap during the same period. The data further showed that while the gender gap for Internet use has narrowed in most regions since 2013, the gap in Africa has widened with 25% fewer women than men using the Internet (ITU, 2017).

Figure 5: Cross-country comparison of Internet penetration versus digital gender gap



Source: (ITU, 2021)

Studies have shown that in sub-Saharan Africa, access to the Internet is mainly through mobile phones and in some of the countries surveyed which had the lowest penetration of Internet use in 2012, the mobile phone was the first point of entry into the Internet for many individuals Stork et al., 2012). The ITU estimates for 2020 confirm that mobile is the primary way men and women access the Internet in LMICs, stating that this accounted for 85% of broadband connections in 2021 (ITU). While 83% of women own a mobile phone, they are 7% less likely to do so than men – globally there are about 143 million fewer women than men who own a mobile phone. In the case of smartphone ownership, globally the gender gap has widened slightly to 18% after a drop from 20% in 2017 to 16% in 2020. The widening gender gap since 2020 has been attributed to the increasing gender gap in smartphone ownership in sub-Saharan Africa and in South Asia (GSMA, 2022). Unsurprisingly, therefore, although about 58% of women use mobile Internet, they are 15% less likely to use it than men. This sums up to 933 million women globally who are not using mobile Internet, with the largest gender gaps in South Asia (36%) and Africa (37%).

In the most recent Mobile Gender Gap report, the GSMA found that while women's uptake of mobile Internet is increasing in LMICs, the rate of adoption has slowed[5]. The study showed that currently 60% of women use mobile Internet in LMICs. However, the number dropped from 110 million in 2020 to only 59 million in 2021 (GSMA, 2022). The study further showed that women are 16% less likely to use mobile Internet than men, a slight increase from 15% in 2020. While the gender gap remains relatively unchanged across most regions, in South Asia, the gap seemed to have widened from 36% in 2020 to 41% in 2021.

Research investigating the gender digital divide has provided varying results. While some qualitative studies support stereotypes that women are averse to technology in comparison to men, others counter that women tend to embrace digital communication under specific circumstances (Cummings & O'Neil, 2015:9, (Suwana and Lily, 2017)Buskens & Webb, 2009).

3. What we do know about gender at the intersection of other inequalities

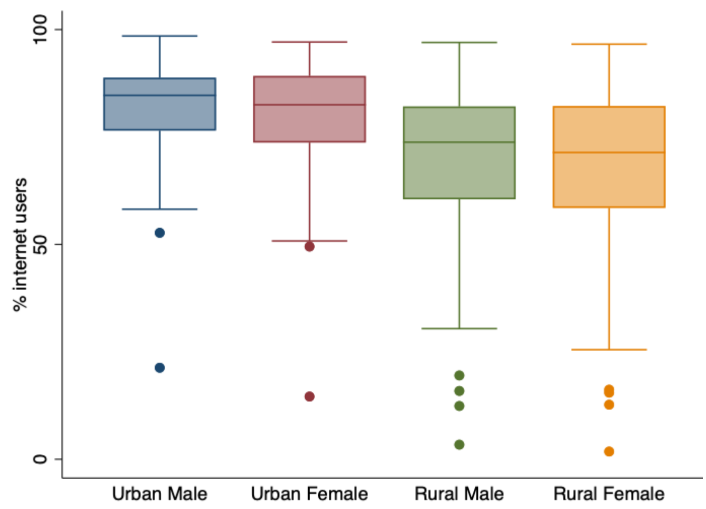
3.1 Supply-side intersectionality analysis of regional data

Gender gaps at the aggregate level of global and regional data mask significant differences which exist between different groups of females within countries. Even from a very basic disaggregation by urban and rural areas it is clear that gender aggregations mask significant differences between females. Figure 6 shows the distribution of Internet access by gender and rural or urban location at the country level[6]. While the female average is lower than that of males for both rural and urban areas, there are far lower rates observed for rural areas than urban areas and there is more contrast between urban and rural areas than between different genders. In fact, the distribution of Internet usage rates for urban

[5] The analysis is based on the results of the GSMA surveys in 10 LMICs in 2021, supplemented by survey results from an additional 18 countries from GSMA surveys conducted in the last 4 years, as well as survey results from an additional 10 countries from surveys conducted by other organisations. From these data sets, an extrapolation model was developed to estimate the gender gaps across all LMICs.

[6] There were 49 countries included in the assessment based on the availability of data by gender and by rural/urban location: Algeria, Armenia, Australia, Azerbaijan, Belarus, Belgium, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Cabo Verde, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Dominican Republic, Egypt, El Salvador, Estonia, France, Georgia, Hungary, Indonesia, Israel, Italy, Japan, Kazakhstan, Republic of Korea, Lithuania, Malaysia, Malta, Mozambique, Palestine, Paraguay, Peru, Portugal, Romania, Russia Serbia, Slovakia, Spain, Switzerland, Thailand, Ukraine, Uzbekistan, Zimbabwe.

Figure 6: Distribution of country Internet adoption by gender and urban/rural location



Source: (ITU, 2021)

females aligns much closer with urban males than rural females and similarly the distribution for rural females aligns relatively closer with rural males than urban females. The evidence emerging from the RIA ICT surveys showed that women and men are not equally able to access and use ICTs, with women generally having less access to ICTs compared to men (Deen-Swarray et al., 2012; (ITU, 2021) found that there were also differences in the probability of ICT access for women in rural versus urban areas. On average, women in urban areas faced no difference in the probability of mobile phone ownership compared to men. However, when it came to Internet use, women still faced lower probabilities in both rural and urban areas.

While there is consensus on the digital gender gap, the size and determinants of these gaps have not been adequately considered. For example, Deen-Swarray et al. (2013) found important differences in the sex variable for mobile use in the rural and urban sub-populations, giving rise to the hypothesis that men and women in different socioeconomic groups (e.g., rural/urban) may face different probabilities of ICT adoption and use. Looking at these groups in isolation and controlling for education and other human and social resources, the modelling study by (Kahn et al., 2022) demonstrated their heterogeneous nature and that the constraints facing different socio-economic groups vary.

The models showed no systematic effect of being female on the probability of mobile phone ownership. In some cases, for example in South Africa, Mozambique and Botswana, it was observed that, contrary to expectations, women had a higher probability of ownership of mobile phones relative to men. While sex was not found to be a determinant of the likelihood of Internet use, at lower levels of significance there was some evidence of a conventional gendered relationship, where women are less likely to use the Internet than men (Khan et al., 2016).

Mobile phone ownership was found to be a significant enabler of Internet use (Khan et al., 2016). The study further demonstrated that the increased urban mobile ownership and Internet use in comparison to rural areas reflects the continued urban and rural digital divide. Women and men in urban areas and rural areas were found to have different experiences of ownership and use. The study also found that income and education are robustly associated with mobile ownership – a 1% increase in income was associated with between a 1.6% and 16% increase in the probability of mobile ownership. For education, one additional year of formal education can be expected to lead to anywhere from a 0.5% to 3.4% increase in the probability of mobile ownership.

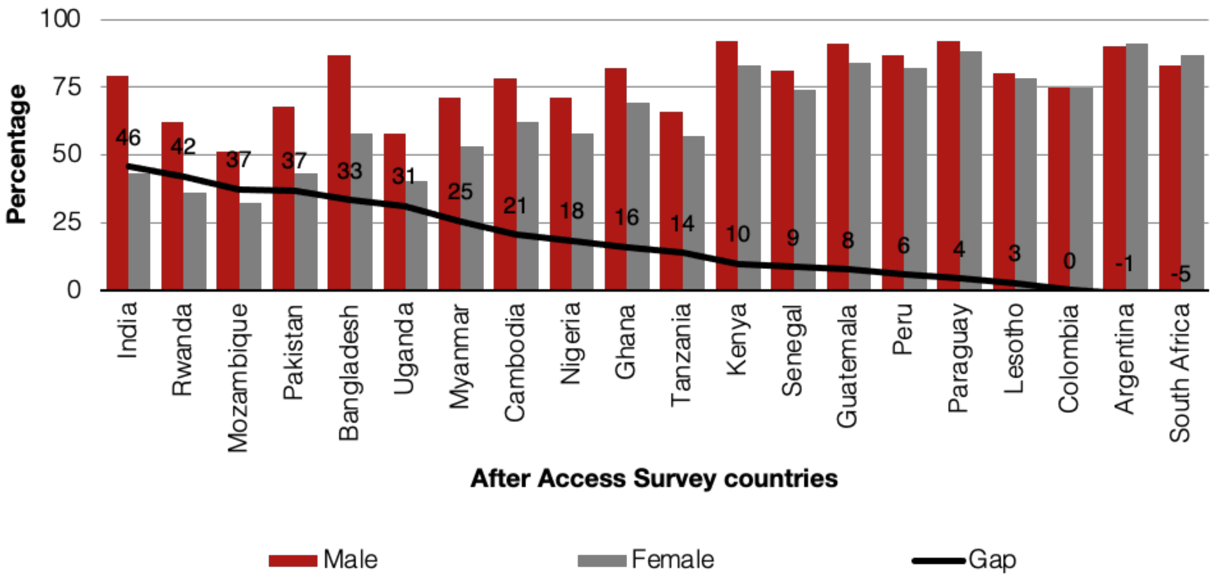
3.2 Demand side intersectionality analysis of gender gaps in the Global South

To understand the gender gap in the global South, LIRNEAsia, DIRSI and RIA conducted analyses using data from the 2018 After Access survey. The aim was to address the data challenges involved in understanding gendered digital inequality through quantitative and qualitative analysis of ICT access and use in 17 of the 20 After Access countries. The After Access surveys are some of the very few nationally representative ICT sector studies that fully explore the demand-side aspect of ICT access and use. This makes it possible for the data to be disaggregated based on sex to provide an accurate picture of gender differences in access and use of ICTs.

Gender gaps in ICT access and use

There is an overall negative correlation between the level of mobile phone penetration and the gender gap in mobile ownership, with some exceptions (Figure 7). For instance, although Colombia has lower mobile phone ownership than other Latin American countries, it has gender parity in mobile ownership. Of all the countries in the After Access survey, India, Rwanda, Mozambique and Pakistan show the highest gaps between men and women in mobile phone ownership. Overall, 21% of women used the Internet, compared to 32% of men, implying a significant gender gap of 42%. Most countries showed a statistically significant difference in Internet access between genders at 99% confidence (Table 1). Rwanda and Bangladesh show the highest gender gap in Internet use, followed by India, Mozambique, and Nigeria, which has by far the largest population in Africa (comparable to that of Bangladesh). These populous nations therefore account for many unconnected women in the Global South, with gender gaps greater than in some of the least-developed countries in Africa. Male Internet usage was higher than that of females for practically all the countries surveyed, although the magnitude and the significance of the gap varied.

Figure 7: Gender disparity in mobile phone ownership in Africa and the Global South



Source: 2018 After Access survey data

Table 1: Gender gaps in Internet usage, 2018

Country	Internet use: Total	Internet use: Female	Internet use: Male	Gender Gap	t-test (Pr F=M)	
Paraguay	56%	57%	55%	-5%	0,1265	
Columbia	78%	78%	77%	-1%	0,7334	
Argentina	77%	76%	78%	3%	0,8494	
Ecuador	80%	77%	85%	10%	0,0029	***
Peru	70%	66%	77%	15%	0,0000	***
Lesotho	32%	31%	36%	17%	0,1311	
S. Africa	49%	45%	53%	17%	0,0377	**
Guatemala	61%	55%	69%	23%	0,0000	***
Senegal	29%	25%	32%	23%	0,0241	**
Uganda	14%	12%	16%	30%	0,0043	***
Kenya	25%	21%	30%	38%	0,0001	***
Tanzania	14%	11%	16%	40%	0,0002	***
Ghana	26%	20%	31%	42%	0,0000	***
Cambodia	33%	28%	43%	45%	0,0000	***
Pakistan	17%	12%	21%	53%	0,0000	***
Nigeria	28%	20%	37%	61%	0,0000	***
Mozambique	9%	6%	13%	75%	0,0000	***
India	17%	10%	24%	80%	0,0000	***
Bangladesh	12%	7%	17%	84%	0,0000	***
Rwanda	8%	5%	12%	87%	0,0001	***
TOTAL	24%	19%	29%	40%	0,0000	***

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

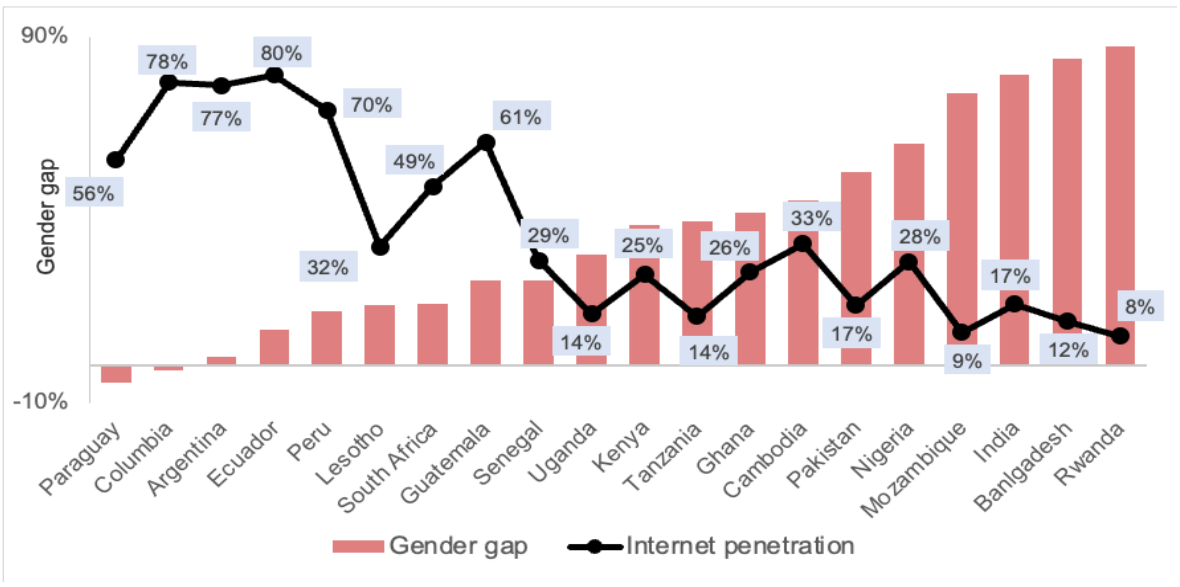
Source: 2018 After Access survey data

In Africa, for instance, Rwanda and Nigeria were found to have among the highest gender gaps in Internet use, despite the vast differences in the size of the populations and landmass of these two countries. However, the gap for South Africa and Senegal was relatively small and was statistically significant only at 95%. Lesotho had the smallest gender gap in Africa and there was no statistical significance even at confidence as low as 90%.

Internet diffusion level and gender gaps

Although generally, higher Internet diffusion is associated with a lower gender gap in internet use, the correlation in the data was relatively weak, supporting the idea that there is a base threshold of Internet diffusion which countries need to reach before network effects allow for the reduction in gender inequalities. Lower gender gaps loosely corresponded with higher levels of Internet diffusion (Figure 8). This is particularly evident for countries like all the surveyed Latin American countries, Lesotho, South Africa, and Senegal, which have higher levels of Internet penetration and lower gender gaps, as well as countries like Mozambique, India, Bangladesh and Rwanda which have low levels of Internet penetration and very large gender inequalities in terms of use. However,

Figure 8: Relationship between Internet penetration and gender inequality



Source: 2018 After Access survey data

there are notable exceptions, particularly Cambodia and the West African countries of Ghana and Nigeria, which have achieved relatively high Internet penetration rates of between 26% and 33%, yet still have large gender gaps of between 42% and 61%.

GNI per capita and gender gaps

Gender digital inequality has an even weaker relationship with income levels (as measured by GNI per capita) than with Internet penetration. Aside from South Africa, the level of GNI per capita does not differ substantially across the different countries, despite significant variation in the gender gaps in Internet use (Figure 9). Overall, the five Latin American countries, together with South Africa, are the richest among the countries surveyed and they show the lowest gender gap in internet use (Figure 10). In contrast, the poorer African countries show high gender disparity in mobile and particularly Internet use. However, these disparities are lower than in some higher-income Asian countries, where we see some of the greatest disparities in income. Nigeria and Ghana again stand out with the highest income levels outside of South Africa, yet high gender inequalities are evident. Lesotho has the smallest gender gap, yet the GNI per capita falls in the lower half of the counties selected. The GNI per capita in India and Bangladesh is more in line with that of Ghana and Kenya, but both countries, together with Tanzania (which is also among the poorest countries surveyed), have much lower gender disparities than the Asian countries surveyed.

The analysis also supports findings from other research that in general, the gender gap in mobile phone ownership aligns with GNI per capita. The countries with the lowest gender gap in mobile phone ownership are among the six richest countries surveyed (Argentina, Colombia, Peru, Paraguay, Guatemala and South Africa). South Africa has one of the highest income disparities worldwide yet was found to have one of the lowest mobile gender gaps. On the other hand, the highest gender gaps in mobile phone ownership were recorded amongst the poorer

Figure 9: Relationship between GNI per capita and gender inequality

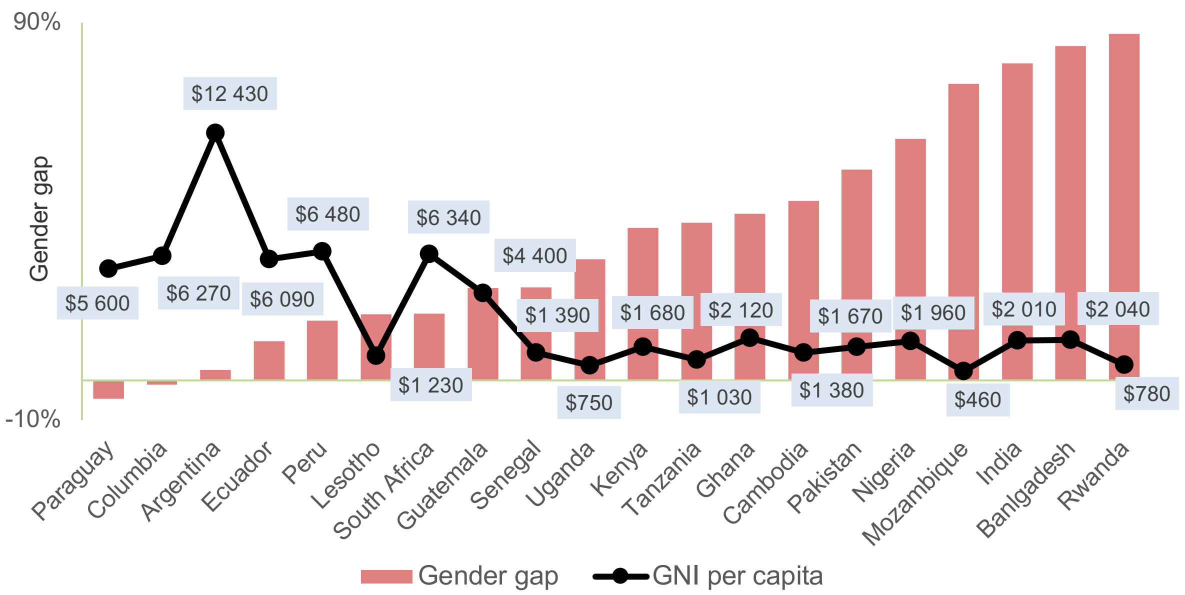


Figure 10: Gender disparity in Internet use in Africa and the Global South

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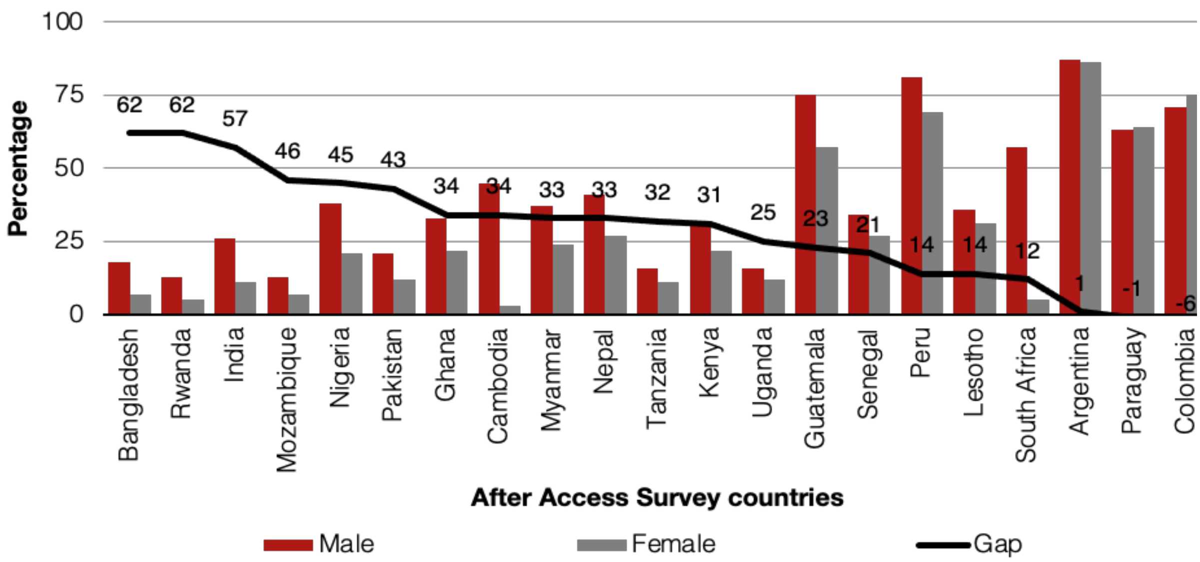


Notes: The Internet gender gap for African countries is measured based on 15 years+ while other Global South countries only consider ages 15–65.

Source: 2018 After Access survey data

S

African countries surveyed. The highest gender variance in African mobile ownership is in Rwanda and Mozambique. The Internet gender gaps in Rwanda and Mozambique are also double those of other developing African countries.

Besides South Africa, of the African and Asian countries surveyed, the only country within range of the Latin American countries is Kenya,

with a relatively low mobile phone gender gap of 10% and a mobile phone penetration rate in line with the LMICs of Latin America. Ghana – with a similar GNI per capita in 2016 to Kenya – follows, with a gender gap of 16%. Nigeria, with a GNI per capita twice that of Kenya or Ghana, has a higher mobile gender gap of 18% and a penetration rate similar to Cambodia. Cambodia has the lowest GNI per capita of the countries surveyed in Asia, roughly in line with Ghana and Kenya. Nevertheless, Cambodia's gender gap for mobile phone ownership is just 20%, by far the lowest of the Asian countries surveyed – 15 percentage points below Pakistan and Bangladesh, and 25 percentage points below India. With the highest GNI per capita of nearly USD2 000 in 2016, India has a staggeringly high gender gap: 46% in mobile phone ownership, and 57% in Internet access.

However, there are interesting anomalies. For example, although Argentina's GNI per capita, at over USD 10 000, is more than double that of the other top performers that cluster around the USD5 000 mark, Argentina performs only marginally better than Colombia in terms of mobile phone ownership gender parity.

Intersecting identities and gender gaps

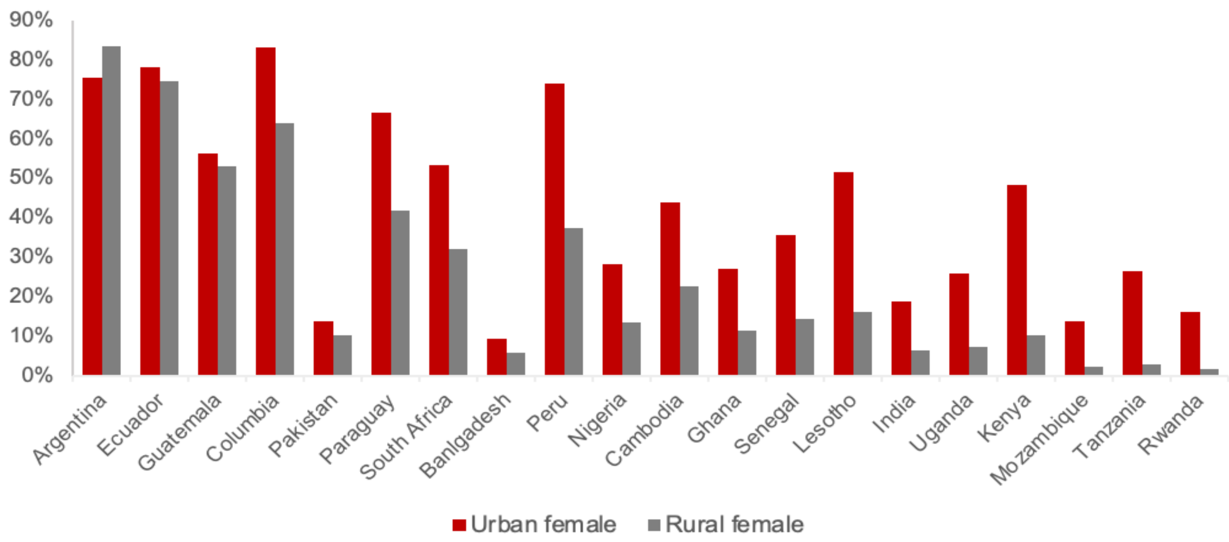
Amongst females there is also significant variation between different population groups. As Figure 11 and Figure 12 show, Internet access is significantly lower for older age groups and increases as education increases.

Summarising the data available, a UNICEF brief on the Digital Divide for Girls (Tyers-Chowdhury and Binder, n.d.) highlights the dearth of research on gender differences in digital access for children under the age of 18 (largely because of the ethics clearances required). However, the limited data available confirm a similar pattern for girls as for women, with girls having lower mobile phone ownership, internet use and access to information than boys.

Digital inequality is even higher among urban and rural area dwellers (Figure 13). Similarly, female Internet access also differs across urban and rural settings. In most countries, urban penetration rates were significantly higher than for rural areas. Across the 20 countries surveyed, there was an estimated 125% gap between females in urban and rural areas. The gap between females in urban and rural areas is particularly large in Africa with Uganda, Kenya, Mozambique, Tanzania and Rwanda all having female rural gaps in excess of 150%.

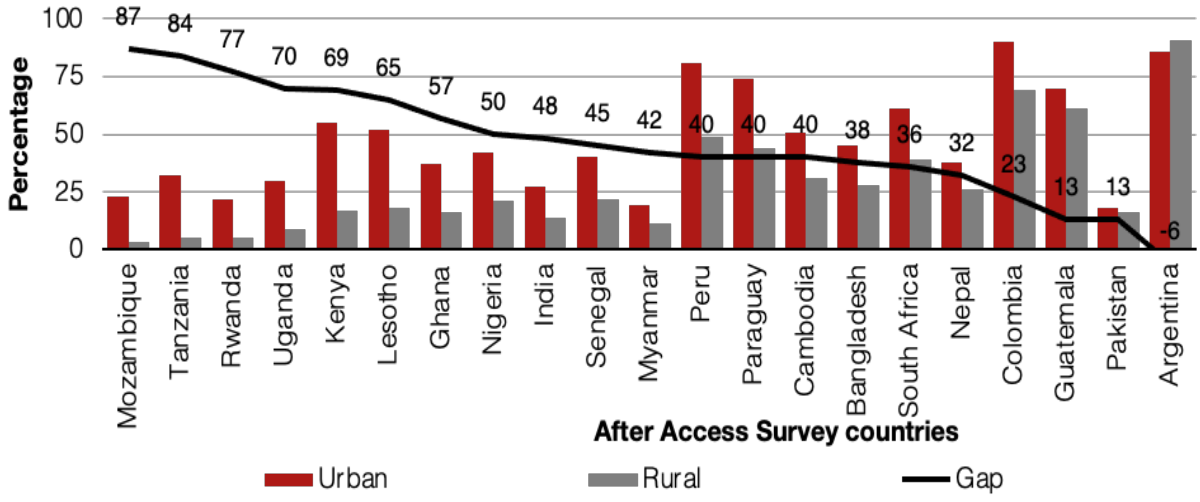
Even in South Africa, with over 95% broadband coverage, less than half of its rural population is connected to the Internet. While the gender gap is relatively low at only 12%, the urban–rural gap is 36%. In Tanzania, while gender disparity (32%) is relatively low for a least-developed country, the urban–rural disparity is 84%. Mozambique has the highest urban–rural gap at 87%, while Nepal, which has similarly low GNI per capita, only has a 32% geographic location gap. Rwanda and Lesotho have high urban–rural divides, despite strong supply–side interventions that have resulted in extensive mobile broadband coverage across the countries.

Figure 12: Female Internet access by country and geographic location type



Source: 2018 After Access survey data

Figure 13: Urban–rural disparity in Internet use in the Global South countries surveyed



Source: 2018 After Access survey data

An exception is Argentina, which has one of the highest Internet penetration rates of the countries surveyed – here, females in rural areas have a higher Internet penetration rate than females in urban areas.

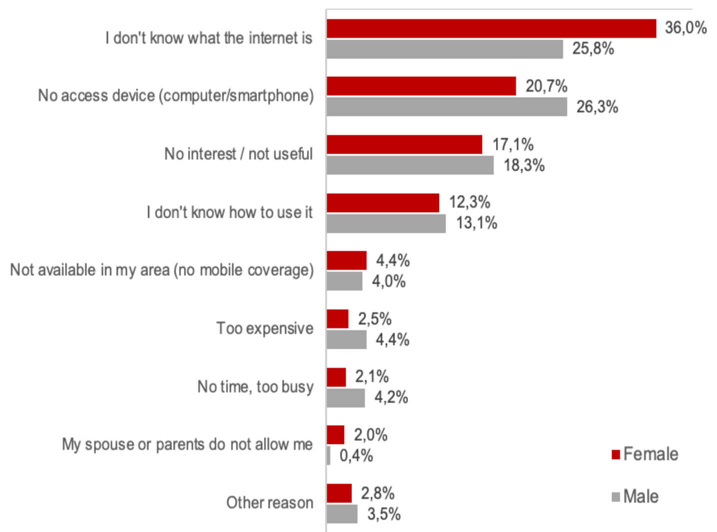
This analysis indicates that beyond the availability of digital infrastructure, other demand-side factors contribute to the digital marginalisation of rural people. Those at the intersections of various forms of exclusion – women, rural dwellers, the poor and, in the case of South Africa, black people — are the worst off.

Reasons for not using the Internet

The findings from the 2018 survey highlight the demand-side challenges to achieving the SDG ICT goals. These include but are not limited to affordability, low levels of education, low-income levels, digital literacy and limited availability of local and relevant content online.

For women not using the Internet, the main reason across the countries surveyed was a lack of awareness with 36% of non-users claiming they do not know what the Internet is. The gender comparison for men in Figure 14 shows that while this is also a significant issue for men, it is less so than for women, and that having access to a relevant device is a larger issue. Men are also more likely than women to cite affordability and time pressure as key issues

Figure 14: Main reasons for not using the Internet, for men and women



Source: 2018 After Access survey data

while women are more likely to be held back by not being allowed to use the Internet by their spouse or parent. Increasing awareness of the Internet and its potential benefits amongst women, as well as providing education on how to use it, will help to reduce the effect of the lack of awareness and skills and will allow survey data to then identify the relevance of other potential barriers better such as device access, coverage and affordability.

There was more variation observed across the different countries than across genders as can be observed in the cross-country comparison of the reasons women are not using the Internet (Table 2). While awareness is still the main limiting issue in Kenya, Ghana, Nigeria, Lesotho and Senegal, women in Mozambique, Rwanda, South Africa, Tanzania and Uganda know about the Internet but are held back mainly by device access. Mobile coverage appeared to be perceived as a significant barrier only in Rwanda and South Africa, while South Africa and Tanzania appeared to be the drivers of gender power asymmetries manifesting in women being prevented from using the Internet or social media by their spouse or parents (Gillwald & Mothobi, 2019).

As in the case of most studies on the gender gap, the barriers identified that contribute to the mobile gender gap continue to be affordability, literacy and digital skills, as well as safety and security, and these also remain the top barriers to mobile Internet use for those who are aware of mobile Internet (GSMA, 2022).

Table 2: Main reasons for women not using the Internet, by country in 10 African countries

	Kenya	Mozambique	Ghana	Nigeria	Rwanda	South Africa	Tanzania	Lesotho	Uganda	Senegal
I don't know what the Internet is	35%	0%	43%	45%	6%	0%	0%	52%	0%	55%
No access device (computer/smartphone)	19%	77%	24%	10%	51%	35%	64%	13%	62%	13%
No interest/not useful	10%	13%	15%	22%	4%	7%	13%	12%	13%	13%
I don't know how to use it	24%	3%	10%	10%	0%	16%	14%	14%	10%	9%
Not available in my area (no mobile coverage)	3%	1%	2%	4%	31%	18%	1%	1%	4%	1%
Too expensive	2%	1%	2%	3%	4%	5%	1%	1%	3%	3%
No time, too busy	2%	0%	1%	3%	0%	3%	0%	2%	3%	2%
My spouse or parents do not allow me	1%	0%	1%	2%	1%	7%	5%	1%	1%	1%
Other reason	4%	4%	3%	2%	2%	9%	2%	4%	3%	3%

Source: 2018 After Access survey data

3.3 Gender analysis of informal sector ICT access and use

The African component of the 2018 After Access survey included an informal businesses survey, which was piggybacked on the household survey in nine countries.[7]

Across the nine countries, 4 409 business surveys were completed which were estimated to represent more than 26 million micro and informal businesses. The distribution of these businesses over the countries surveyed is provided in Table 3. While most businesses had one sole owner, a number had multiple owners. For the purposes of this analysis, a business is considered female- owned if ownership is either entirely female or, if there is mixed gender ownership, then females should make up at least 50% of the owners. Of the total 46% were either owned by one woman or by a group of women, 36% were owned by men, 5% were owned by a group including both men and women and for 13% the ownership structure could not be determined. The relative breakdown of ownership in this way differed across the

[7] In this sense it is not nationally representative but indicative of access and use trends. All small and informal businesses were listed in sampled enumerator areas and then sampled. Retail chains, large formal businesses, banks, etc. were not included in the listing or sampling.

Table 3: Overview of informal sector businesses included in the 2017/18 After Access Survey

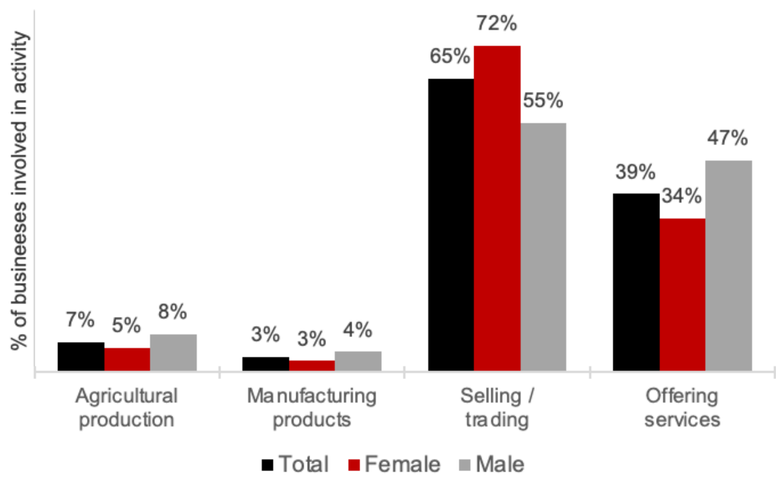
	n (obs)	weighted	Ownership			
			Female	Male	Mixed	Unknown
Kenya	421	1 391 659	44%	43%	12%	1%
Mozambique	430	559 020	50%	45%	5%	0,5%
Ghana	499	964 917	43%	39%	6%	13%
Nigeria	567	20 011 459	49%	31%	4%	16%
Rwanda	388	142 508	20%	65%	10%	5%
South Africa	391	619 999	29%	57%	13%	1%
Tanzania	500	2 069 975	34%	61%	5%	1%
Uganda	696	291 331	38%	46%	14%	2%
Senegal	517	347 305	30%	65%	5%	0,0%
Total	***4 409***	***26 398 172***	***46%***	***36%***	***5%***	***13%***

Source: 2018 After Access survey data

different countries. Despite accounting for more businesses across all the countries, women ownership was lower than for men in five of the nine countries.[8]

Most small businesses are involved in selling or trading, an activity which almost two thirds of businesses surveyed undertook. As can be observed in the breakdown of activities in Figure 15, this is significantly more than other activities and also an activity undertaken by a higher proportion of female-owned businesses than male owned. Offering services was the second most prevalent activity and this had a strong bias towards male-owned businesses. Agricultural production and manufacturing products were far less common activities across the businesses surveyed.

Figure 15: Activities of informal sector businesses, by gender of business ownership



Source: *2018 After Access survey data (business survey)*

The degree of dominance of activities which businesses were involved in differed across the different countries, however the ordering was relatively consistent with what is observed at the aggregate level. The bias towards male or female ownership does differ across the different countries although some clear patterns emerge as evident from the breakdown in Table 4 where the highest proportion of gender ownership is shaded for each activity within each country. Only in agricultural production is there a large degree of variation in terms of gender bias; for all the other activities there is consistency in the direction of the bias across seven of the nine countries.

More distinct gender gaps are observable when looking at the nature and performances of the businesses. Figure 16 shows the share of male and female businesses which satisfy several key performance and descriptive indicators. Female-

[8] Namely: Rwanda, South Africa, Tanzania, Uganda and Senegal

Table 4: Activities of informal sector businesses, by country and gender of business ownership

	Agricultural production		Manufacturing products		Selling / trading		Offering services	
	F	M	F	M	F	M	F	M
Kenya	12%	18%	1%	4%	79%	60%	23%	43%
Mozambique	12%	4%	2%	10%	84%	82%	3%	9%
Ghana	10%	14%	6%	12%	74%	51%	25%	45%
Nigeria	4%	8%	2%	4%	72%	49%	38%	55%
Rwanda	6%	12%	2%	9%	86%	78%	27%	22%
South Africa	3%	3%	6%	6%	63%	72%	31%	27%
Tanzania	9%	3%	4%	3%	67%	69%	22%	28%
Uganda	21%	26%	5%	10%	66%	50%	11%	16%
Senegal	20%	10%	2%	6%	67%	62%	27%	40%
Total	***5%***	***8%***	***3%***	***4%***	***72%***	***55%***	***34%***	***47%***

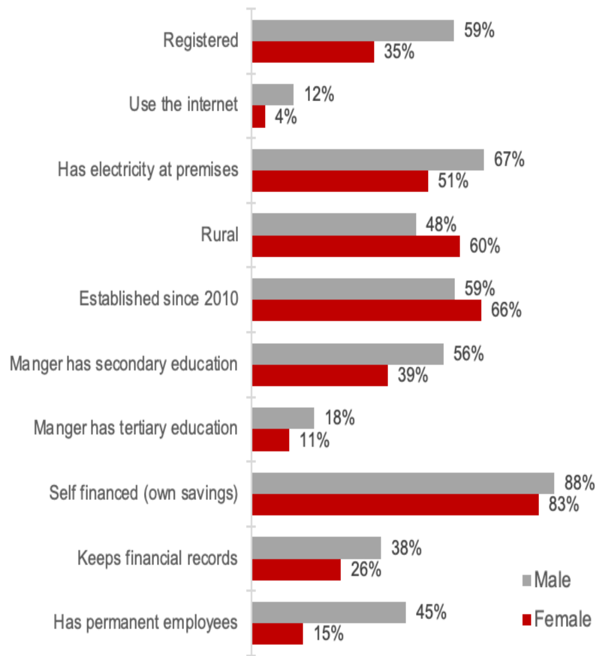
Source: *2018 After Access survey data (business survey)*

A discrete choice regression model was applied across the countries to identify the main determinants of Internet use across the small businesses surveyed. After several different models were tested, a probit explanatory (independent) variables model was chosen based on the Hosmer-Lemeshow goodness-of-fit test and the amount of variation in Internet use explained by the model (see Appendix A for more details on the different model specifications tested).

owned businesses were observed to be more likely to be rural and to have been established since 2010. However, on all the indicators relating to performance male-owned businesses scored higher. Male-owned businesses are more likely to be registered, to use the Internet, to have electricity, to keep financial records and to have permanent employees working for them. They are also more likely to be self-financed reducing debt financing reliance and are more likely to be run by a manager with a higher education. It is therefore not surprising to observe in Table 5 that female businesses have lower turnover, profit, and asset value than male-owned businesses.

However, the substantial size of the gaps is still alarming with the male-owned businesses having an average turnover more than double that of females and average profit more than four times higher. Interestingly, female businesses, although less likely to have permanent employees, tend to employ slightly more employees when they do. Also, although more likely to have been established since 2010, the average age of female-owned businesses is slightly higher than that of male-owned businesses.

Figure 16: Breakdown of male and female business on key performance and descriptive indicators



Source: 2018 After Access survey data (business survey)

Table 5: Characteristics of male- and female informal firms

	Male	Female
Business age (years)	8.44	9.11
Number employees	2.51	2.80
Turnover	6 499 161	3 092 665
Profit	1 764 204	437 575
Value of assets	440 994	196 029

Source: 2018 After Access survey data (business survey)

Gender was determined to be a statistically significant factor (95% confidence level) affecting Internet use, with female ownership estimated to reduce the probability of Internet use for small businesses by six percentage points. More significant was whether businesses were registered and whether they kept financial records, increasing the probability of using the Internet by nine and seven percentage points respectively. Both factors were significant at 99% and both point to a higher level of formalisation of businesses. At 95% confidence, having a business manager with secondary education was estimated to increase the probability of Internet use by five percentage points. Newer businesses also appeared to be more likely to use the Internet than those established longer ago, with each additional year since being established decreasing the probability of Internet use by just over a quarter of a percentage point. Once these variables had been controlled for, it became insignificant whether the business was located in an urban or rural area.

Table 6: Regression outputs on the determinants of Internet use for small businesses

	Regression coefficients	Marginal effects
Ownership gender (female dummy)	-0.511** (0.204)	**-0.0560**** (0.0232)
Registered (dummy)	0.811*** (0.206)	**0.0889***** (0.0258)
Keeps financial records (dummy)	0.660*** (0.219)	**0.0724***** (0.0235)
Years since business was established	-0.0262** (0.0121)	**-0.00287**** (0.00142)
Manager has at least a completed secondary education (dummy)	0.426** (0.186)	**0.0467**** (0.0216)
Rural location (dummy)	-0.332 (0.232)	**-0.0364** (0.0252)

Robust standard errors in parentheses

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

Source: Own calculations using 2018 After Access survey data (business survey)

3.4 Platform work

A study by Institute of Peruvian Studies LIRNEAsia and Research ICT Africa examined the prevalence of gig work across 20 countries in the Global South and pay gaps between men and women engaged in this work (Aguilar et al., 2020). The study found that African countries have very low rates of platform work, which is a function of the low use of Internet on the continent (in 2019, only one in five women in Africa used the Internet, and only two in five men did). Due to a lack of online skills and resources, platform work in Africa is also not the classical 'microwork' associated with small packages of online work like data gathering or analysis, but rather platform-sourced physical labour, such as e-hailing or domestic work. Although there is a large domestic work platform in South Africa that is spreading to other countries, it constitutes a relatively small percentage of online workers, which means that very few women are engaged in platform work, even platform-sourced online work prevalent in Africa (Mothobi et al., 2018). While the existence of an enabling environment through digital infrastructure is necessary for the adoption of platform work, the study found gendered pay gaps at the global level that cannot be explained by access to technology. Instead, these gaps likely reflect the persistent discrimination that women face in the labour market, whether in traditional jobs or new avenues of work. This highlights the importance of pairing inclusive labour policies with more data- gathering efforts to understand this emerging field of employment.

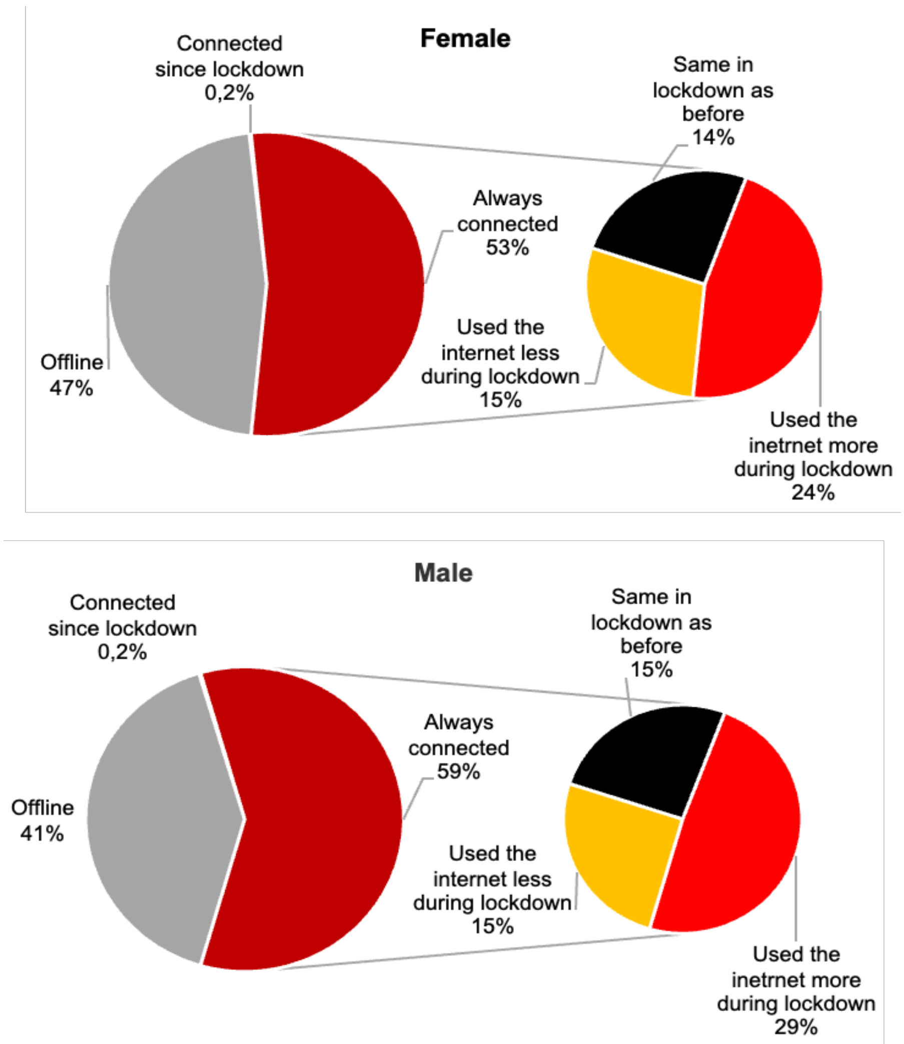
3.5 Gender and digital substitution for risk mitigation under pandemic lockdowns

The COVID-19 pandemic drastically accelerated digitalisation around the world through a move towards contactless interactions because of enforced lockdown regulations as well as personal avoidance stemming from fear of contracting and spreading the virus (Katz et al 2021, 2022). Physical school closures meant that many children and youth needed to shift learning to online platforms, placing additional pressure on women due to the disproportionate child-care burden compared to males (Spaull and Van der Berg, 2020). In this environment, those most able to achieve digital substitution (defined as the change from not conducting an activity digitally to conducting it digitally; Box 1) were more likely to experience lower levels of disruption and hardship.

While there is a lack of data available to assess these dynamics in the necessary depth at the global level, recent phone surveys conducted in South Africa and Nigeria reveal significant gender differences in the ability to digitally substitute (see Appendix B for more details on these surveys). Both South Africa and Nigeria have high levels of structural inequality and both countries experienced hard lockdowns as well as extended school closures and restrictions on business activity. Given longitudinal household and data from RIA's ICT access and use survey cover more than a decade, the impact of the pandemic-related lockdown needs to be historically reviewed.

Being unable to conduct the face-to-face interviews amidst the lockdowns, the sample was drawn from a mobile database which accounts for SIM card duplication covering over 90% of the population. Figure 17 shows that a significant proportion of respondents only

Figure 17: Breakdown of survey respondents in terms of the impact of lockdown on Internet use, by gender



Source: RIA COVID Response for Equity Survey data

owned basic or feature phones which are limited.

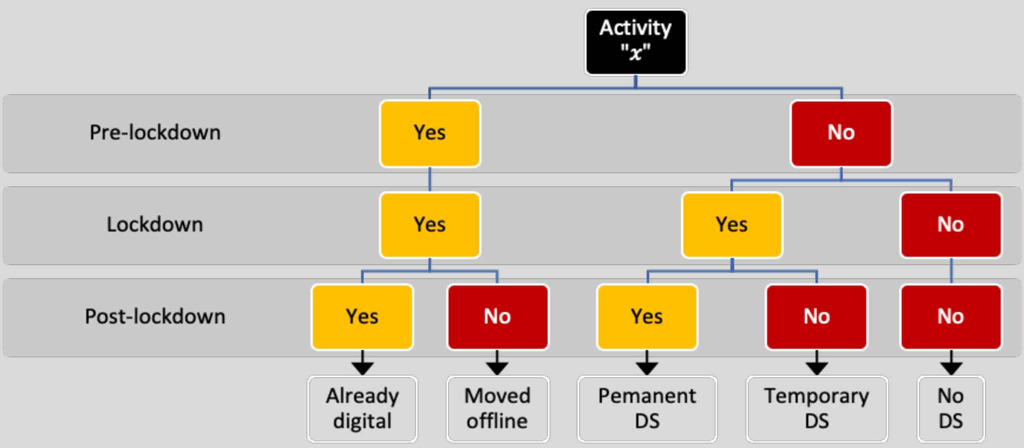
Box 1: Framework for assessing digital substitution during the COVID-19 pandemic

There are eight different categories of digital substitution which were prominent ways in which individuals were able to mitigate the impact of COVID-19 by moving activities online. Each of these are listed below along with the corresponding questions in the phone surveys.

1. **Financial services (FS)**
   - Receive or send money, make payments, receive vouchers
2. **Food**
   - Order groceries
   - Order meals
3. **Health**
   - Access health services (order medicine, online consultations, etc.)
4. **Media**
   - Stream movies and TV series
   - Watch YouTube
   - Stream music
5. **Communication & social media (CSM)**
   - Send messages (e.g., WhatsApp, Facebook Messenger, etc.)
   - Use social media (e.g., Facebook, Instagram, TikTok, Twitter, etc.)
   - Become active in my community
6. **News**
   - Follow Covid-19 news and updates
   - Follow the news in general (other than Covid-19)
7. **Work**
   - Work from home
8. **Learning**
   - Attend online classes for school or university (remote learning)
   - Online learning and training other than school, university

The survey questions are structured such that it is possible to see whether an individual started doing each activity online during each country's hard lockdown period, as well as whether they started doing each activity online more or less during and after lockdown or stopped using the activity after the lockdown period had ended. Taking a strict definition of digital substitution to mean the change from not conducting an activity digitally to conducting it digitally (i.e. ignoring cases where the there are changes in the frequency or degree of activity done digitally), there are four potential paths which an individual could take with regards to each activity which are outlined in Figure 17 below.

Figure 17: Digital substitution (DS) pathways



.in their capacity to go online and hence to digitally substitute socio-economic activities. Across the two countries, prior to the lockdown, there was a higher share of Internet use by men than women (59% compared to 53%). The impact of the lockdown in fact led to a very small number of individuals (0.2%) going online for the first time. Of all Internet users, however, almost half of both males and females began to use the Internet more during lockdown. There was a slightly higher share of males using the Internet more, suggesting that males who were online were better able to harness it to perform more online activities during lockdown, as well as having greater access to the Internet in the first place. This highlights the importance of getting more females online to be able to digitally substitute critical activities in times of need.

The level of digital substitution varied across different activity types both in absolute terms and in terms of the relative comparison between the two countries as in Table 7. Across both countries there appeared to be low levels of digitalisation across the main activities analysed, with the highest levels observed for activities which generally have lower direct economic value to consumers, specifically accessing media, communicating and using social media, and following news. These were also where there were the greatest levels of digital substitution. In Nigeria there were nearly 4.4 million people who started using digital platforms for communication and social media during the COVID-19 lockdown (the highest rate of digital substitution observed for the country) and the majority of them continued to use them after the lockdown was ended. In South Africa the highest rate was observed for accessing news and information with 2 million individuals beginning to use digital channels in this regard during lockdown and 1.8 million continuing after lockdown ended.

There are some notable differences between the two countries which come to light using the framework adopted for this study. For example, while there were similar rates of digital substitution for digital financial services in the

Table 7: Digital substitution during COVID-19 lockdowns in Nigeria and South Africa

	FS	Food	Health	Media	CSM	News	Work	Learning
Nigeria								
Already digital	10%	2.67%	1.05%	23,51%	37,74%	20,08%	5,89%	3,69%
Moved offline	0.02%	0.13%	0.14%	0,53%	0,37%	0,78%	0,32%	0,54%
Permanent DS	0.68%	0.27%	0.36%	4,42%	6,03%	1,46%	1,33%	1,23%
Temporary DS	2.05%	1%	0,22%	1,19%	0,36%	1,35%	1,02%	0,52%
No DS	87.24%	95.93%	98.24%	70,35%	55,50%	76,32%	91,44%	94,03%
South Africa								
Already digital	15.28%	5.9%	1.94%	30,14%	54,50%	27,08%	6,29%	4,10%
Moved offline	0.99%	0.28%	0.11%	2,12%	0,92%	0,87%	0,98%	0,79%
Permanent DS	2.11%	1.73%	0.65%	3,47%	2,05%	5,28%	2,54%	2,69%
Temporary DS	0.7%	0.76%	0.15%	0,71%	0,75%	0,73%	1,24%	2,16%
No DS	80.92%	91.33%	97.15%	63,56%	41,79%	66,04%	88,95%	90,27%

Source: RIA COVID Response for Equity Survey data

two countries, in Nigeria this was a temporary change with most individuals moving back to non-digital after the lockdown ended, whereas in South Africa the move appeared more permanent. Similarly digital substitution for ordering groceries or meals was more of a temporary phenomenon in Nigeria whereas in South Africa it was more permanent.

Looking at the differences between men and women in Nigeria in Table 8 shows that men went into the lockdown with already higher use of digital channels across all the activities aside from learning and generally exhibited higher rates of digital substitution. The most notable exceptions were using communication and social media where 2.3 million women moved to digital channels during lockdown and 95% of those continued to after the lockdown ended. There were relatively similar proportions of women and men in Nigeria who moved to working online either as employees working from home or through moving their business to online platforms, accounting for a combined 2.33% of females surveyed and 2.36% of males. However, men appeared slightly more likely to stay working online, with a higher share of women only substituting temporarily compared to men.

As with Nigeria, the South African gender comparison in Table 9 shows that more men were using digital channels for most activities continue to do so after the lockdown ended. This results in a digital substitution rate of 4.1% (of which 3% were on a permanent basis) compared to 3.3% (1.9% permanently) for men prior to lockdown, again with only one exception, in Despite there being some positive findings in terms of females being able to substitute digitally, particularly in the South African case, men retain an overall higher rate of digitalisation across activities. Reducing the digital divide and ensuring that women are as able as men to access the benefits of digital services to protect against future shocks requires a greater understanding of the driving forces which enable or restrict digital substitution.[9]

[9] Gaining a better understanding of the impact of COVID-19 on digitalisation of individuals and small businesses, and how this has changed the gender dynamics therein, requires nationally representative data which can be compared before and after the pandemic. The 2022 After Access survey is currently available for South Africa, providing an opportunity to look at this country as a case study to identify key shifts which have occurred.

Table 8: Gender comparison of digital substitution during COVID-19 lockdown in Nigeria

	FS	Food	Health	Media	CSM	News	Work	Learning
Female								
Already digital	7.65%	2.20%	0.76%	20.34%	33,92%	15,83%	5,02%	4,01%
Moved offline	0%	0.08%	0.08%	0.62%	0,30%	0,68%	0,18%	0,57%
Permanent DS	0.25%	0.23%	0.35%	5.03%	7,10%	1,06%	1,24%	1,35%
Temporary DS	1.89%	0.81%	0.15%	1.28%	0,48%	1,40%	1,09%	0,33%
No DS	90.21%	96.69%	98.66%	72.74%	58,20%	81,02%	92,47%	93,74%
Male								
Already digital	11.91%	3.06%	1.28%	26.10%	40,86%	23,53%	6,60%	3,42%
Moved offline	0.04%	0.17%	0.18%	0.45%	0,43%	0,87%	0,44%	0,51%
Permanent DS	1.04%	0.31%	0.36%	3.93%	5,15%	1,78%	1,40%	1,13%
Temporary DS	2.18%	1.15%	0.28%	1.12%	0,27%	1,31%	0,96%	0,67%
No DS	84.82%	95.31%	97.89%	68.4%	53,30%	72,51%	90,60%	94,26%

Source: RIA COVID Response for Equity Survey data

Table 9: Gender comparison of digital substitution during COVID-19 lockdown in South Africa

	FS	Food	Health	Media	CSM	News	Work	Learning
Female								
Already digital	13.89%	5.61%	2.22%	26.42%	51,63%	24,34%	4,29%	3,34%
Moved offline	0.50%	0.24%	0.08%	2.13%	0,44%	0,81%	0,61%	0,91%
Permanent DS	2.46%	1.98%	0.68%	3.84%	2,89%	6,09%	2,99%	2,61%
Temporary DS	0.96%	0.93%	0.18%	0.84%	1,11%	0,93%	1,14%	2,53%
No DS	82.18%	91,24%	96.84%	66.77%	43,93%	67,82%	90,96%	90,62%
Male								
Already digital	17.15%	6.3%	1.57%	35.13%	58,16%	30,78%	8,95%	5,12%
Moved offline	1.65%	0.33%	0.14%	2,10%	1,55%	0,95%	1,48%	0,63%
Permanent DS	1.39%	1.41%	0.62%	2,99%	0,93%	4,23%	1,94%	2,80%
Temporary DS	0.36%	0.53%	0.11%	0,55%	0,28%	0,46%	1,37%	1,66%
No DS	79.46%	91.43%	97.56%	59,23%	39,07%	63,58%	86,27%	89,78%

Source: RIA COVID Response for Equity Survey data

4. Conclusion: Policy implications and recommendation.

Across the world there is evidence of inequalities in access to technology and while recent years have seen a closing of the gap globally the share of women accessing the Internet is still estimated by ITU to be nearly 10% lower than that of men. This gap is particularly severe in the Global South with a survey across twenty countries in Africa, Asia and Latin America in 2018 revealing an Internet usage rate for women which is 40% lower than that of men.

The analysis of the impact of COVID-19 on access to the Internet in Nigeria and South Africa showed that there was limited digital substitution, with few people coming online for the first time during the pandemic. Amongst those online there was an increase in the amount of online activity conducted. This dynamic was, however, not gender neutral – Even amongst those who are connected, women in the Global South appeared less able to harness the Internet for directly productive means such as online work, e-commerce or human capital development. Female individuals and female-owned small businesses were more limited to social and communicative use cases.

Moving beyond descriptive indicators, the 2018 After Access data was used to demonstrate the intersectional aspects of exclusion by exploring the gender issue in relation to location (urban-rural), education and income variables. The data was further modelled to identify some of the underlying factors affecting digital gender inequality. Through data modelling, the study found that education and the associated low levels of income were the key determinants of access to the Internet. With women being generally less educated and having low levels of income, they are at a disadvantage when it comes to Internet use. The data for the Asian countries in the survey further highlight the importance of intersectionality as it demonstrates the risks of classifying women as a 'homogenous group' which in turn influences interventions to address the inequality they face.

Whereas it is advocated that ICT surveys be conducted on a regular basis, it should be noted that "much of the quantitative research fails to assess the intersectional nature of marginalisation" (Gillwald and Mothobi, 2019)). Studies conducted by RIA over the years have shown that using descriptive indicators alone to measure the gender gap tend to mask inequalities across groups of men and women (Gillwald and Mothobi 2019; Khan et al., 2016; Deen-Swarray et al., 2012). These studies have also demonstrated that the disparities in Internet access exist not only between men and women, but also amongst women within countries. Measuring gender gaps only at the aggregate level further masks these significant differences.

What this series of studies show is that whether living in rural areas or city slums, women located at the intersection of other factors of exclusion, such as class, race and associated marginalisation from education and employment, will experience even greater digital inequality than women generally.

It is critical that policy makers understand the heterogeneity of women both across different country settings and across different female groups within countries based, for example, on geographic location (urban/rural), age, education and economic status. This analysis showed that there are intersectional inequalities across all these groups which need to be isolated and understood to identify the precise and multiple points of policy intervention required.

Policy considerations

As this paper covers a range of areas and emphasises the importance of context, this section covers an unexhaustive range of arising policy considerations in redressing intersectional digital inequality and opens up the emerging issue of data injustice. ~~and data injustice~~. Efforts to ensure digital inclusion of all are becoming more complex. While the structural inequalities that are reflected in digital inequality, and data injustice will only be addressed through broader more fundamental economic and social transformation, there are systemic issues perpetuating digital inequality and data in justice that can be redressed through policy intervention.

Pro-poor strategies are gender strategies

Poor women are concentrated amongst those currently marginalised from digital services. They would be the beneficiaries of wider strategies geared at bringing online those currently offline. In this regard, States should be creating enabling environments for the private delivery of digital public goods (Internet, cybersecurity, data) through low-risk policy experimentation; crowding in of productive private and community resources; low regulatory transaction cost models, that utilise unused spectrum, particularly in rural areas, and that bring affordable, adequate quality services to people. However, the implications and possible unintended gender and intersectional consequences of interventions aimed more broadly at bringing more people online need to be part of any policy or regulatory impact assessment.

Critical deconstruction of gender and regulation

The main barrier to Internet uptake is the price of the smart device, while the main constraint on use is the price of data. It is important from a policy point of view to understand the necessary interventions required to overcome these obstacles to objectives of universal access in country contexts. This requires informed regulation if it is to avoid unintended consequences. Mandating data price reductions in countries where there are still substantial investments in network extension will produce benefits for existing users but will not necessarily enable those without coverage to come online.

Likewise, lifeline strategies mandating operators to provide all users with a small amount of free data (50 or 100 MBs) may have the unintended consequence of subsidising large users at the expense of investments in network extension or inhibit innovative cost innovations that have emerged in the market for price-sensitive users. Such strategies, as mooted during pandemic lockdowns in some countries, provided relief to price-sensitive users but were not accompanied with strategies to reduce the price of smart devices. This could have very easily been done through reductions by States on the extremely high customs duties (as much as 30%) on devices and by removing the excise duties on data services in some countries that have pushed poor people (significantly poor women) offline.

Likewise, the additional spectrum released to operators – often dominant operators best placed to deploy it rapidly to meet the demand for data resulting from the pandemic – enabled improved services to existing end users but was seldom used innovatively to bring community, micro, dynamic spectrum operators into the market (despite proposals by them to do so, in countries such as South Africa) that would be able to offer lower cost services.

The point is that, without targeted and positively discriminating interventions, services intended to benefit the public at large may reinforce and perpetuate existing inequities. High-end women users may have enhanced services with such interventions. Price sensitive users, of which a disproportionate number are women, may benefit from mandatory price reductions. But this may be at the expense of women at the intersections of other inequalities relating to location, education and income.

Targeted interventions - the need for positive discrimination

This is evident in the sex-disaggregated data from the 2018 African After Access informal sector survey which demonstrated the far greater use of ICTs by men-owned than woman-owned micro-business. Incidentally, this correlated with considerably higher revenues (in the context of very low uptake of ICTs within the informal sector). Targeted support through subsidies and training programmes could improve access and use of digital services that would improve efficiencies and potentially expand opportunities for both mean-owned and women-owned microfirms.

Need for cross-sectoral policy formulation

As the issue of digitalisation is now so cross-cutting, from a position of trying to redress systemic marginalisation and discrimination, the development of transversal policy is essential. The policy challenge of digital inequality is primarily a human development issue. Until there is greater equality and gender parity in education systems, for instance, there is little chance of gender equity in the digital realm. As in other areas, equal access is not sufficient. Active strategies are required to keep girls in school at puberty, and proactively expose them to maths and science, to prepare those with the aptitude to develop higher level skills.

While digital literacy is a bridging measure to get people onto the Internet it is not sufficient to enable people to maximise the opportunities offered by the Internet. Broader human and economic development is needed to overcome the digital inequality paradox. Without integrated policy intervention to overcome this wicked policy problem, the layering of rapidly advancing technologies will exacerbate inequality. Because of the additional network effects and increased complexity to derive their value, the expanding gap will not only increase between those off and online, but also between those minimally online and those benefiting from the efficiencies of transacting, working and even producing online.

Implications for data and content regulation

Digital inequality has significant gender implications when considered in the context of the new data-driven technologies and platforms that characterise contemporary economy and society. The implications of vast numbers of people, disproportionately poor women, not having access to the Internet is that they are increasingly excluded from the economy and society. The lack of access to the Internet prevents people from engaging in time- and cost-saving online services. It prevents the unemployed without Internet access or digital skills from performing platform work and to access new forms of labour. It prevents small businesses that are offline from enjoying efficiency and, increasingly, cost gains associated with being online, as well as opportunities to expand businesses.

The gendered nature of digital inequality is reflected in access to and use of the Internet. This is in turn reflected and amplified in the uneven distribution of both opportunities and harms associated with big data analytics, machine learning and artificial intelligence. The exclusion of people from online services, remote and platform work and digital production makes them invisible in the vast amounts of user-generated data extracted by global monopoly digital platforms for the purposes of creating lucrative digital intelligence. The rise of these platforms can result in severe ramifications for those invisible or underrepresented in that data as it is used for the algorithmic decision-making underpinning daily life. Those absent and underrepresented, (such as black women, are likely to be discriminated against in the algorithmic decision-making that is being opaquely used to make and direct decisions that affect them.

With the intensification of datafication, the uneven distribution of benefits associated with the new forms of value creation both between and within countries requires new forms of regulation and global governance. From an intersectional perspective this highly uneven impact of digitalisation, datafication and platformisation is not caused by a single factor and cannot be redressed by attention to a single cause. Those at the intersections of multiple inequalities are least able to enjoy the opportunities and least able to mitigate the risks associated with rapidly advancing technology. With the layering of advanced data-driven technologies over existing digital and social inequalities, the poor outcomes of existing policies are arguably amplified and result in an even greater exclusion of people at the intersections of multiple inequalities from the potential to improve lives and livelihoods.

While the harms associated with such data-extractive value creation (such as breaches of data subjects' privacy rights or online abuse and gender violence) are universal, their impacts are highly uneven. Many people are unable to exercise their rights online (and very often offline). Even where data regulators may have been established, the institutional and legal challenges of extra-jurisdictional enforcement are impossible without global cooperation and alignment – which most developing countries do not necessarily have the institutional capacity to engage in.

Beyond the challenges of safeguarding citizens as data subjects, states are challenged by the need to create an enabling environment for data value creation locally, in the face of increasing global concentration in digital and data global markets. There is a need for economic regulation to ensure public access to quality public data and create opportunities for greater participation by marginalised groups. The primary way to deal with bias in the giant datasets that dominate commercial activity is to ensure that historically marginalised groups gain access to the foundational digital and data infrastructures and services on top of which these platforms and services operate, to be better represented. Economic regulation of data to ensure access and sharing through data commons or for purposes of public value creation also have potential for enabling greater participation in data value creation.

Active inclusion of all those affected by decisions in processes of policy formulation, regulation and governance is essential to ensure more equitable and just digital and data outcomes.

Data, good data, disaggregated data

If there are to be more equitable outcomes, far more effective data (that can be disaggregated by sex, income, education, employment and age) is essential for the informed and innovative policy that will be required to regulate the dynamic, complex and adaptive information systems. This will require multilateral agencies, development banks and states to move beyond the rhetoric of statistics as a public good, to ensure that standardised, non-proprietary data is publicly available for public planning, research and preferential commercial exploitation for marginalised groups.

Realising global digital public goods (Internet, cybersecurity, data) at the national level will require global collaboration and investment in the collection of standardised digital and data indicators to identify precise points of policy intervention to redress the uneven distribution of opportunities (and harms), associated with increasingly globalised, advanced information technologies, particularly those at the intersection of multiple inequalities.

Recommendation

To this end, in addition to the policy considerations above, and particularly in the context of developing countries, **as a single key recommendation, it is proposed that there is a 1% contribution from the domain name system (DNS) registration fees of all countries towards a digital solidarity fund. This could be allocated based on applications by states to enable the gathering of digital data that can be fully disaggregated, analysed and evaluated**

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Appendices

Appendix A: Model specification for the determinants of Internet use

After analysis of the literature and the data from the After Access surveys, ten different combinations of independent variables were selected and tested to see which best determined internet use amongst small businesses. For each combination of independent variables, probit and logit regressions were tested to determine which one provided the best fit. A Linear probability model using Least Squares Regression was tested, however as most of the variables being tested were dummy variables this led to some marginal effects falling outside of the range from zero to one which made interpretation non-sensical, making this an inappropriate analysis technique.

Probit and logit models

The study utilised a probit regression model on whether or not a business uses the Internet for any of its activities. If y_i is a dummy variable which takes on a value of 1 if business i uses the internet, then:

$$Pr\,Pr\,(y_i \;= 1 \mid x_i) = F(x_i\beta)$$

Where x_i represents a column vector of explanatory variables. The explanatory variables are assumed to determine y_i through the latent linear utility model:

$$y_i^* = \alpha + x_i\beta + \varepsilon_i$$

Such that: $y_i = \{1 \;\; if\; y_i^* > 0 \;\; 0 \; if\; y_i^* \leq 0$

The errors are assumed to be standard normal in order to allow for estimation through a probit model. The alternative model, the logit (or logistic) model by contrast assumes the errors are standard logistic.

The outputs from the Hosmer-Lemeshow test, which indicated the "goodness-of-fit" of the model, as well as the Pseudo R2 statistic, which shows the amount of variation in the dependent variable explained by the independent variables, for each model specification is provided in Table 10 with the optimal choice identified through being shaded in. Robust standard errors are used for all model specifications.

Appendix B: Mobile phone survey methodology

One of the biggest challenges for policymakers, researchers and the humanitarian community is how to obtain information about the affected population when natural disasters or pandemics strike. Information is critical to the design and implementation of life-saving policies, yet very often researchers face hurdles and struggle to collect information consistently prior to or during a time of crisis so that it is available when required. Technological innovation provides a way of mitigating this, thanks to a broad-based boom in mobile phone ownership in African countries. The COVID-19 pandemic has renewed interest in mobile phone surveys as researchers and policymakers seek to better understand the various socio-economic impacts of the pandemic.

A number of approaches have been used to generate a sampling frame for a mobile phone survey, which include sampling from respondents of a baseline survey that had a representative frame and a high response rate, obtaining a list of valid phone numbers from a telecom company or private firm, and the use of random digit dialling (RDD). RIA adopted a survey design that consisted of a phone survey that employed the RDD method. RDD is a type of probability sampling where telephone or mobile phone numbers are randomly generated using computer software and applied as a sample for research projects (Elliott, 2020). The methodology is well established within the science and health sectors of developed countries (US, UK and Canada, to mention a few). Despite the inherent low response rates and reliance on self-reporting, RDD was the most suitable approach to implement the survey

Table 10: Goodness-of-fit of regression model specifications

#	Variables	Pseudo R2		Goodness of fit: Hosmer-Lemeshow Prob > chi2	
		Logit	Probit	Logit	Probit
1	Ownership gender	0,03	0,03	-	-
2	Ownership gender Registered (dummy) Keeps financial records (dummy) Years since business was established Manager has at least a completed secondary education (dummy)	0,23	0,23	0,23	0,46
3	Ownership gender Registered (dummy) Keeps financial records (dummy) Years since business was established Manager has at least a completed secondary education (dummy) Rural location (dummy)	0,24	**0,24**	0,80	**0,93**
4	Ownership gender Log of profit Manager has at least a completed secondary education (dummy)	0,15	0,15	0,00	0,01
5	Ownership gender Log of profit Manager has at least a completed secondary education (dummy) Rural location (dummy)	0,17	0,17	0,22	0,50
6	Ownership gender Business offers a service (dummy) Rural location (dummy)	0,10	0,10	0,07	0,07
7	Ownership gender Business offers a service (dummy) Rural location (dummy) Registered (dummy) Keeps financial records (dummy) Years since business was established Manager has at least a completed secondary education (dummy)	0,28	0,27	0,25	0,22
8	Ownership gender Country indicators (base = Nigeria)	0,06	0,06	0,87	0,93
9	Ownership gender Registered (dummy) Keeps financial records (dummy) Years since business was established Manager has at least a completed secondary education (dummy) Rural location (dummy) Country indicators (base = Nigeria)	0,28	0,27	0,37	0,09
10	Ownership gender Registered (dummy) Keeps financial records (dummy) Years since business was established Manager has at least a completed secondary education (dummy) Rural location (dummy) Business offers a service (dummy)	0,28	0,27	0,25	0,22

considering the national prohibitions on face-to-face interactions and movement in 2021.

The RDD drew on a combined list of all mobile phone numbers allocated to mobile operators in South Africa supplied by the regulator (ICASA) for a sample of 2 000 respondents. The frame was first weighted by the market share of South Africa's four mobile network operators before a stratified random sample of 102 500 seven-digit numbers from this sample was generated in Stata. Just as in face-to-face surveys, the representativeness of the study might be challenged, especially in populations that have significant disparities in mobile phone ownership. In cases where most of the targeted population do not own a mobile phone, there exists a significant gender gap in mobile ownership, or there is lower rural coverage, mobile phone surveys are at most representative of the population that has a working phone. However, in populations that have high rates of mobile phone penetration like most Sub-Saharan African countries, mobile phone surveys might achieve national representativeness. For instance, in a country such as South Africa, where some statistics show that there are more mobile subscriptions than the people living in South Africa, the use of mobile phone surveys might be efficient. However, it is important to note that most of these studies that show that there are more subscribers than the population are based on unique SIM cards and not unique individuals. An appropriate statistic to use when considering mobile phone surveys is the number of unique individuals who have regular access to a mobile phone.

A study conducted by RIA in 2017 shows that about 84% of the target population in South Africa has access to a mobile phone. By 2018 this figure had jumped to 95% (Pew Research Center, 2018). This is a clear indication that by 2020 the figure might have accelerated to be very close to 100%. Therefore, for a country such as South Africa, with high levels of mobile phone ownership, the representativeness of a phone survey is high.

Table 11: Statistical sampling summary for South Africa

Variable	Number	Variable	Statistic
Data collection period	2 months	Invalid interviews	129
Calls logged by enumerators	9 516	Overall sample size	2 026
Asked to be called back	272	Consent (%)	100
Refused	3 387	Female	56.5%
Ineligible	57	Male	43.4%
Margin of error	4%	Identify as other (gender)	0.1%

Source: RIA Phone Survey 2021

Another challenge associated with the use of the RDD method is the lack of information on non-respondents and other information for weighting the data (according to urban and rural, for example). However, to understand mobile phone users, the study uses information obtained from the RIA's nationally representative RIA 2017/18 After Access surveys to make weighting adjustments for race and probability of mobile phone ownership as a means of reducing bias due to non-response and lack of representation. The data was weighted using the inverse of individual selection probabilities and racial design weights were used to match the survey data with the known population proportions.

Reference

Elliott, R. (2020, September 29). What is Random Digit Dialing? GeoPoll. https://www.geopoll.com/blog/what-is-random-digit-dialing/