

3G Internet and Women's Empowerment in Sub-Saharan Africa

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Abstract

Digital transformation is rapidly reshaping economies worldwide, yet its implications for women's empowerment in developing regions remain poorly understood. This paper examines the impact of mobile broadband expansion on women's empowerment in Sub-Saharan Africa by combining geocoded household survey data from 15 countries with 3G network coverage data from 2003 to 2023. To address endogeneity, I exploit exogenous variation in lightning strike frequency as an instrumental variable for 3G network rollout. The results show that increased 3G coverage significantly raises women's overall employment—driven primarily by self-employment and agricultural work—but simultaneously reduces their participation in major household decisions and increases their exposure to intimate partner violence. Further analysis reveals that men in areas with greater 3G network coverage are more likely to justify domestic violence in situations when women deviate from traditional gender roles, express a stronger desire for additional children, whereas women's acceptance of domestic violence and fertility preferences remain largely unchanged. Overall, these findings support the male backlash theory, suggesting that men may resort to coercive control when women's expanding economic opportunities or digital connectivity are perceived as threats to gender hierarchies.

Keywords: Mobile Internet, Empowerment, Sub-Saharan Africa

JEL Classification: J16, O33, O12, O55

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1 Introduction

Worldwide, women face greater barriers than men in mobility, access to resources, and participation in the labor force. These disparities are especially pronounced in developing countries, where restrictive social and gender norms continue to define women’s roles and limit their opportunities (Jayachandran, 2021; Field et al., 2021). Such constraints restrict women’s agency—their capacity to make independent choices—and hinder broader progress toward gender equality.

The recent digital transformation in developing countries, particularly the rapid expansion of mobile phone and internet, could offer promising avenues to alleviate these structural barriers.¹ Previous research shows that access to mobile phones and internet facilitates job search (Dammert et al., 2015; Stevenson, 2008; Bhuller et al., 2023), improves labor market outcomes (Hjort and Poulsen, 2019; Chiplunkar and Goldberg, 2022), and promotes financial inclusion (D’Andrea and Limodio, 2024). Such changes have the potential to strengthen women’s agency and empowerment within the household. On the other hand, increased digital access may also provoke resistance in contexts of entrenched patriarchy. In that cases, men may perceive women’s growing connectivity and economic independence as a challenge to traditional gender hierarchies, responding with greater surveillance, restrictions on mobility, or even violence. This interplay between digital access and intra-household dynamics raises key empirical questions: Does internet access improve women’s labor market participation? And does it enhance their agency or empowerment within the household?

In this paper, I investigate the impact of 3G internet access on women’s empowerment in Sub-Saharan Africa on several dimension, including labor market participation, intra-household decision-making, and domestic violence against women. I focus on 3G as it represents the critical inflection point for mobile broadband adoption in the region, enabling the widespread use of feature-rich applications and internet services. For the main analysis, I primarily rely on two data sources. Data on mobile broadband coverage come from Collins Bartholomew’s Mobile Coverage Explorer, which provides annual, operator-sourced 3G and 2G coverage data at a 1×1 km raster resolution; for this study, these data are aggregated to measure coverage in 55 km × 55 km grid cells from 2003 to 2023.² Data on empowerment outcomes—including labor market participation, intra-

¹The Sustainable Development Goals explicitly emphasize universal and gender-equitable internet access (Target 9.C) and call on governments to “enhance the use of enabling technology, in particular information and communication technology, to promote the empowerment of women” (Target 5.B; United Nations, 2019)

²While 3G data are only available from 2006 onward, 3G coverage is recorded as zero for all grid cells from 2003–2005, as no sample countries had adopted it before 2006.

household decision-making autonomy, and sexual autonomy—are drawn from standard Demographic and Health Surveys (DHS) with GPS data for 15 countries over the same period. The GPS coordinates of the DHS clusters (groups of villages or urban neighborhoods) are then used to link each household’s survey responses to the 3G coverage data of its corresponding grid cell.

One of the main challenges to uncovering the causal impacts of 3G internet access on women’s empowerment outcomes is that the rollout of 3G internet across and within the regions of sub-Saharan Africa might not be random. Many countries might give priority to investing in digital infrastructure, which is reflected in their national policies during these periods. Also, the mobile operators might be more interested in expanding their network in the relatively developed regions where women’s socio-economic status is already relatively better. To tackle these challenges, following [Manacorda and Tesei \(2020\)](#) and [Gurieva et al. \(2021\)](#), I employ an instrumental variable approach, leveraging exogenous variation in historical lightning strike intensity in the region. Specifically, I instrument 3G internet coverage with historical average lightning frequency (1995-2015) in each grid cell in the study area. Historical lightning strike frequency is correlated with the 3G rollout because mobile operators may not choose to invest in areas prone to frequent lightning, as lightning strikes can cause serious damage to telecom infrastructure—particularly cell towers—making network installation and maintenance more costly and risky.

After confirming that average lightning strike intensity is a valid instrument for 3G internet coverage, I first document that an increase in 3G network coverage in the locality affects an individual’s internet use. I find that the 3G internet coverage increases internet use of both men and women significantly: A one-unit increase in 3G coverage within a grid cell—moving from no coverage to full coverage in the locality—raises women’s daily internet use by 11.9 percentage points (182% relative to baseline) and men’s daily internet use by 41.9 percentage points (346% relative to baseline).

Next, I examine the impacts of 3G internet coverage on women’s empowerment indicators, including women’s employment, decision-making agency, and exposure to domestic violence. I find that 3G internet access has mixed results on women’s empowerment outcomes. I find that an increase in 3G internet coverage significantly increases women’s overall employment: Moving from no coverage to full 3G network coverage in the locality- raises women’s likelihood of being employed by about 17.7 percentage points (24% relative to baseline). Examining the types of jobs revealed that the women’s employment gain is concentrated only in self-employment and employment in the agricultural sectors. I also explore the impacts of 3G access on men’s labor market outcomes. The results revealed that 3G network expansion has no measurable impact on men’s em-

ployment.

Turning to intra-household response to the increased 3G access, I find that the increase in 3G access does not strengthen women's autonomy in household decision-making. In fact, an increase in 3G internet access significantly reduces women's say on major household decisions, own healthcare and family visits, and their ability to negotiate safer sex lives. Analyses of the impacts of 3G internet access on intimate partner violence further revealed that greater 3G access increases domestic violence against women: Moving from zero to full 3G coverage within the respondent's local area raises the probability of experiencing any domestic violence (either sexual or physical violence) by 16.6 percentage points (75% relative to the baseline mean of 22.3%) and physical violence by 17.2 percentage points (91% relative to the baseline mean of 18.9%).

The core finding reveals a nuanced pattern: while greater 3G access increases women's labor market participation, primarily through self-employment and agricultural work, this positive gain is accompanied by a reduction in their decision-making power within the household and a significant rise in Intimate Partner Violence (IPV).

To interpret these findings, I draw on economic theories of domestic violence, which conceptualize IPV as part of an intra-household bargaining process. Standard bargaining models (Tauchen et al., 1991; Farmer and Tiefenthaler, 1996; Aizer, 2010) predict that IPV should decline as women's relative labor market conditions improves, since higher earnings or employment enhance their fallback options within marriage. My results diverge from this theoretical expectation: while 3G expansion increases women's overall employment, it is also associated with higher IPV. This pattern aligns instead with the male backlash mechanism, in which men respond violently when women's improved economic opportunities pose threats or perceived as a threats to traditional gender hierarchies (Macmillan and Gartner, 1999). Importantly, in my study, the backlash is unlikely to stem from threats to men's breadwinner status, as women's employment gains occur mainly in self-employment and agricultural work rather than formal paid employment. Instead, the perceived threat likely arises from women's growing access to information, greater connectivity due to digital access.

I provide evidence on three key channels that help explain how this male backlash operates in the context of digital expansion. The first involves the reinforcement of patriarchal attitudes and gender norms. The results show that greater 3G coverage is associated with a higher acceptance of IPV among men, particularly in justifying wife beating for violating traditional roles—such as neglecting childrens, burning food—or social norms, such as arguing with husbands, refusing sex, or leaving the home without permission. In contrast, women's attitudes toward IPV are largely unchanged, indicating that digital

access reinforces patriarchal beliefs primarily among men rather than reshaping gender norms more broadly. This pattern suggests that while the internet may expand women's opportunities, it also strengthens men's normative justification for using violence to preserve authority within the household.

A second mechanism operates through fertility preferences. I find that the higher access to 3G access appears to widen the gender gap in fertility desires among married couples. Among women, greater 3G coverage has no detectable impacts on fertility and or fertility preferences, while men in the same areas are more likely to express a desire for additional children. This divergence reflects women's exposure to new information and changing aspirations facilitated by digital connectivity, which may conflict with men's traditional expectations regarding family size. The tension between these preferences can lead to resistance and conflict within households, particularly when women's growing reproductive autonomy is perceived as undermining male authority.

Finally, to provide more direct evidence with the notion of male backlash in the context of the study, I show that 3G coverage is positively associated with men's controlling behaviors (although estimates are not statistically significant in the 2SLS estimation), which are often considered predictors of domestic conflicts. These effects are concentrated in the marital (mis)trust related behaviors such as husband's jealousy when wife talk to men, husbands insisting on knowing their wives' whereabouts or accusing them of infidelity. In contrast, the effects on the women's mobility restrictions such as preventing women from meeting friends or limiting family contact, are small and insignificant. This indicates that digital expansion fosters a subtler, suspicion-driven form of control rather than overt restrictions on mobility. In sum, as women's digital engagement increases their social visibility and independence, some men appear to respond through intensified monitoring and coercive control as a means of reasserting authority.

Taken together, the results highlight the double-edged nature of digital inclusion. While connectivity has the potential to improve women's participation in the labor market, it may not necessarily translate into broader empowerment within the household; instead may reduce their autonomy in the household and lead to male backlash in the forms of intimate partner violence. Policies aimed at fostering women's empowerment should consider both economic inclusion and the intra-household power dynamics that shape women's autonomy and well-being.

My paper contributes to a growing literature on the economic impacts of broadband internet. [Hjort and Poulsen \(2019\)](#) document that the roll-out of high-speed cable internet in 12 African countries substantially increased overall employment, especially among high-skilled workers. Extending this line of inquiry, [Chiplunkar and Goldberg \(2022\)](#) ex-

amine the gendered employment impacts of the expansion of the 3G mobile internet in 14 lower and middle income countries from Asia, Africa and Latin America and find increase in the employment rates for both men and women, with gendered occupational shifts: men moved from unpaid agricultural work to small agricultural enterprises and wage jobs in the manufacturing and service sectors, while women took on more unpaid agricultural jobs and operated more small businesses. Some studies explore the impact of the mobile Internet on economic outcomes, focusing on a specific country. For example, [Bahia et al. \(2023\)](#) documents that the expansion of mobile broadband in Tanzania increased household consumption, reduced poverty, and shifted labor from agriculture to wage and non-farm employment, with the strongest effects among young, skilled men and educated women. My paper contributes to this literature adding evidence on another dimension that remains largely unexplored: how broadband internet access shapes intra-household power dynamics. I provide evidence that while mobile broadband improves women's labor market participation, it can reduce women's autonomy in intra-household decision-making and increases domestic violence.

The literature exploring the impact of digital access on women's intra-household bargaining power is still limited. Most of the papers in this realm explore the impacts of mobile money. For example, [Riley \(2024\)](#) documents how mobile money platforms in Uganda empower women by enhancing their bargaining power and enabling them to resist household pressures. In another recent study in Uganda, [Greco et al. \(2025\)](#) documents a trade-off while examining the impact of digital vs cash-based money transfers: digital cash transfer through mobile money increases women's labor income and say in household decision-making, but it triggers male backlash at home, while cash-based transfers promote harmony but less autonomy. My paper adds to this literature by showing that digital connectivity itself—not only financial access—can reshape intra-household bargaining power.

My paper also contributes to the growing literature on how broadband internet access shapes gender norms. [Barboni et al. \(2024\)](#) evaluate an Indian program providing free smartphones and 4G access to women and find only short-lived effects on phone use, gender norms, and labor participation, suggesting that affordability alone cannot close digital gender gaps. In contrast, [Chung et al. \(2025\)](#) show that mobile network expansion in Afghanistan, instrumented by lightning strike intensity, improved attitudes toward women's education, employment, and leadership, particularly among men, and increased women's political participation. Their findings highlight that digital connectivity can weaken restrictive gender norms primarily through attitudinal and informational channels, even in highly patriarchal societies. My paper extends this evidence to Sub-

Saharan Africa, showing that while digital access can increase women’s labor market participation, it can strengthen restrictive gender norms and lead to male backlash in the form of domestic violence.

This paper also contributes to the growing literature leveraging exogenous employment shocks to examine the causal relationship between women’s economic participation and domestic violence. The evidence presents a mixed picture. For instance, [Chin \(2012\)](#) finds that rainfall-induced increases in female employment in India reduce IPV by limiting women’s exposure to violent partners. Similarly, [Molina and Tanaka \(2023\)](#) show that proximity to garment factories in Myanmar increases women’s employment and reduces IPV, while [Sanin \(2025\)](#) documents that increases in female employment due to coffee mill expansion in Rwanda reduces domestic violence against women by raising the opportunity cost of incapacitating women during high-demand seasons. In contrast, [Erten and Keskin \(2024\)](#) find that Cambodia’s WTO-induced trade shocks—which reduced men’s employment but increased women’s labor force participation—led to higher IPV as a result of male backlash. My paper extends this literature by examining how mobile broadband expansion—an emerging form of economic and informational empowerment—affects IPV, revealing that digital connectivity can both enhance women’s employment and trigger backlash through reinforced gender norms and spousal control.

My paper also contributes to the implications of internet access on other broader social and political outcomes, including political mobilization ([Manacorda and Tesei, 2020](#); [Fergusson and Molina, 2019](#)), trust in government ([Guriev et al., 2021](#)), social capital ([Geraci et al., 2022](#)), and educational outcomes ([Jain and Stemper, 2024](#)).

The rest of the paper proceeds as follows. Section 2 describes the data and the variables. Section 3 describes the empirical strategy. Section 4 presents the results. Section 5 presents a discussion of potential mechanisms. Section 6 concludes.

2 Data

2.1 Demographic and Health Surveys (DHS)

For information on women’s empowerment indicators, I rely on Demographic and Health Survey (DHS) data from Sub-Saharan African countries. DHS are nationally representative, individual- and household-level surveys conducted in developing countries since 1984. They interview both women aged 15-49 and men aged 15-49, but its primary focus is on women, and fewer men are surveyed. DHS collect information on a wide range of topics, including health, labor market participation, women’s participation in intra-household decision-making, and demographic characteristics. Early DHS phases (During

the 1980s and 1990s) focused on core indicators, including fertility, mortality, maternal and child health, and employment status. From the early 2000s onward, the surveys expanded to include measures of women’s empowerment, such as autonomy in household decision-making and ability to negotiate over safer sex, along with detailed employment and occupation-related information.³ The detailed questions on these measures in the DHS survey are shown in the Appendix Table A1.

For the analysis, I restrict to the countries from Sub-Saharan Africa for which both geo-coded DHS data and 3G mobile network coverage data are available. I drop the countries that appear only in one round of DHS survey. This leaves a sample of 15 countries with a total 57 survey years (or 40 DHS rounds) between 2003 and 2023. The list of countries and survey waves included in the analysis is provided in Table 1. The GPS coordinates identify the location of each DHS cluster (groups of villages or urban neighborhoods) and are essential for linking respondents to local 3G internet coverage. The summary statistics for the variables from the DHS survey are reported in Table 2.

2.2 Mobile Network Coverage data

To measure the rollout of 3G, I use annual 3G mobile network coverage data for the years 2006–2023, provided by Collins Bartholomew’s (CB) *Mobile Coverage Explorer*. CB compiles this dataset from network coverage information submitted by individual mobile network operators worldwide to the GSM Association, which represents the interests of the global mobile phone industry. The data are provided as a raster layer with a resolution of approximately 1×1 km, where each pixel takes the value 1 if there is 3G network coverage and 0 otherwise. Using this binary network coverage data and population density data from NASA, I calculate population-weighted 3G coverage at the 0.5° grid-cell level (approximately 55×55 km at the equator) for sub-Saharan African countries, representing the share of people covered by a 3G network within each grid cell.⁴ I aggregate the network coverage data at the 0.5 degree grid cell level because the historical average

³Women’s empowerment, a complex and multifaceted concept, is commonly defined as a woman’s capacity to make meaningful choices, decisions, and exercise control over her life and resources. In the context of economic empowerment, this also involves achieving fulfillment through meaningful and gainful employment (Laszlo et al., 2020).

⁴For a grid cell j in year t , 3G internet coverage is defined as:

$$3G\text{Coverage}_{jt} = \sum_{p \in j} \text{Coverage}_{pt} \times \text{PopWeight}_{p,2005},$$

where Coverage_{pt} equals 1 if pixel p within grid cell j has 3G network coverage in year t , and 0 otherwise. $\text{PopWeight}_{p,2005}$ is the share of the 2005 population of the grid cell residing in the pixel p , such that $\sum_{p \in j} \text{PopWeight}_{p,2005} = 1$.

lightning strikes data 1995-2015), which is crucial for the identification strategy for this study, are provided with a resolution of 0.5 degrees.

Figure 1 illustrates the expansion of 3G networks across sub-Saharan African countries between 2007 and 2023. Figure A1 zooms into a selected country—Nigeria—to provide a more detailed view of both the fine-grained geographic resolution of the data and the rapid expansion of mobile network infrastructure over time. This spatial granularity is crucial for linking household-level survey responses to local variation in mobile broadband availability.

2.3 Lightning Strikes and Other Geographic Data

I utilize several geographic datasets in this study, including data on lightning strikes, rainfall, temperature, and elevation.

Data on the average number of lightning flashes over the period 1995–2025 are obtained from the Global Hydrology and Climate Center (GHCC), which provides publicly available data collected by the U.S. National Aeronautics and Space Administration (NASA) through space-based sensors (Cecil et al., 2017). Lightning flash times and spatial locations are recorded at an approximate resolution of 10 km, while the aggregated average lightning flash data are publicly released at a 0.5-degree grid-cell resolution.⁵

Data on monthly precipitation and temperature are drawn from the ERA5 reanalysis dataset produced by the European Centre for Medium-Range Weather Forecasts (ECMWF). From these data, I compute average annual rainfall and temperature over 1980–2023 at 0.5-degree grid cells for the Sub-Saharan African countries included in the analysis. In addition, I use elevation data to calculate the standard deviation of elevation within each 0.5-degree grid cell.

3 Empirical Strategy

To examine the impact of 3G internet on women’s empowerment, I start by estimating the following baseline specification:

$$y_{ijct} = \alpha + \beta \cdot 3G_{jct} + X'_{ijct}\gamma + Z'_{jct}\lambda + \phi_j + \tau_{ct} + \varepsilon_{ijct}, \quad (1)$$

where y_{ijct} is the outcome of individual i in grid cell j , country c , and year t . $3G_{jct}$ is the key explanatory variable which represent population-weighted 3G internet coverage in grid cell j , country c , and year t . X'_{ijct} is a vector of individual-level controls (age,

⁵The average lightning data from NASA are available at <https://ghrc.nsstc.nasa.gov/>.

age squared, education dummies, and urban/rural residence). Z'_{jct} is a vector of cell-level controls, including long-run climatic conditions (average rainfall and temperature interacted with linear time trends), standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. ϕ_j denotes grid-cell fixed effects that absorb time-invariant local factors, and τ_{ct} denotes country-year fixed effects that absorb national shocks and policy changes.

A major challenge in establishing a causal relationship between 3G internet and women's empowerment is the possibility that the 3G infrastructure is not randomly assigned between regions. For example, mobile operators may be more likely to expand 3G networks in areas that are already more economically developed. In such places, women might already have higher rates of labor force participation or greater autonomy, regardless of the availability of 3G. This raises concerns about reverse causality, where higher levels of empowerment could help attract 3G investments, as well as omitted variable bias, where unobserved factors such as local governance or national development strategies influence both 3G rollout and women's outcomes. To address these concerns, in the baseline specification, I include grid-cell fixed effects, which control for time-invariant local characteristics, such as geographic features, cultural norms, or baseline infrastructure conditions, and country-by-year fixed effects, which account for national-level changes over time, including shifts in political leadership, macroeconomic conditions, or policies affecting women's status or digital access. To further mitigate endogeneity concerns, I employ a two-stage least squares (2SLS) strategy using average lightning strike frequency in grid cells as an instrument. This approach builds on recent studies ([Manacorda and Tesei, 2020](#); [Guriev et al., 2021](#)), which argue that lightning strikes makes network installation and maintenance more costly and risky, thereby discouraging investment in affected areas.⁶ A key identification concern in the instrumental variable strategy is the possibility that lightning frequency may be correlated with other environmental and infrastructural factors that also influence women's empowerment outcomes. Specifically, regions with higher lightning density may systematically differ in terms of average rainfall, temperature, elevation, or even the rollout of earlier-generation mobile technologies such as 2G. These factors, in turn, could directly or indirectly affect women's labor force participation or decision-making autonomy, independent of 3G availability. To address this potential threat to identification, I control for average rainfall and temperature (1980–2023) to account for long-run climatic conditions; the standard deviation of elevation within grid

⁶[Manacorda and Tesei \(2020\)](#) instrument mobile phone coverage in Africa using lightning strike incidence, arguing that strikes damage signal infrastructure and hinder network expansion. [Guriev et al. \(2021\)](#) adopt a similar strategy, using lightning as an instrument to estimate the impact of 3G mobile broadband coverage on political support across countries.

cells to capture Topographic variation; and population-weighted 2G coverage to isolate the effect of prior mobile connectivity. By conditioning on these covariates, the exclusion restriction becomes more credible—lightning is unlikely to affect women’s empowerment through any channel other than the availability of 3G internet coverage.

I estimate the following 2SLS model:

First stage:

$$3G_{jct} = \pi_0 + \pi_1 (\text{Lightning}_j \times t) + X'_{ijct}\delta + Z'_{jct}\mu + \phi_r + \tau_t + u_{jct}, \quad (2)$$

Second stage:

$$y_{ijct} = \alpha + \beta \cdot \widehat{3G}_{jct} + X'_{ijct}\gamma + Z'_{jct}\lambda + \phi_r + \tau_t + \varepsilon_{ijct}, \quad (3)$$

where $\text{Lightning}_j \times t$ denotes the average lightning strike frequency in grid cell j (1995–2015), interacted with a linear time trend.⁷ The other variables are already described in the equation (1). Standard errors are clustered at the grid-cell level to account for within-cell serial correlation.

Table 3 reports the first-stage results using the full sample of the study, showing that areas with higher historical lightning strike frequency experienced significantly slower 3G network expansion over time. The coefficient on the instrument is -0.012 and statistically significant at the 1 percent level, implying that a 1% increase in lightning strike frequency reduces 3G coverage by 0.012 percentage points per year. Given a mean 3G coverage of 13.9%, this effect is economically meaningful when accumulated over time. The first-stage F-statistic of 29.20 indicates a strong instrument. The specification includes grid-cell and country-year fixed effects, along with baseline controls, supporting the validity of the instrument for identifying the causal impact of 3G coverage.

4 Results

This section presents the main results. I first confirm that 3G network expansion increases individual internet use—an essential first stage demonstrating that mobile broadband improves digital connectivity. I then examine how access to 3G internet affects women’s empowerment across three dimensions: labor market participation, intra-household decision-making, and exposure to intimate partner violence.

⁷Since average lightning frequency is a time-invariant measure, it is interacted with a linear time trend to construct a instrument for 3G network expansion in the empirical analysis.

4.1 Individual Internet Use

I begin by examining whether local 3G network availability increases individual internet use. The most recent DHS surveys (2015–2023) ask respondents whether they have ever used the internet and, if so, how frequently in the past month. From these responses, I construct two binary indicators: (i) daily internet use and (ii) weekly or more frequent use.

Table 4 shows that greater 3G network availability significantly increases internet use for both women and men. For women, the OLS estimates indicate that a one-unit increase in 3G coverage—moving from zero to full coverage—raises the probability of daily internet use by 4.4 percentage points ($p < 0.05$) and weekly or more frequent use by 5.8 percentage points ($p < 0.10$). Relative to women’s baseline usage rates (6.6% daily; 9.8% weekly), these effects correspond to increases of approximately 67% and 59%, respectively.

The 2SLS estimates are considerably larger. Moving from zero to full 3G coverage increases daily and weekly internet use by 11.9 and 19.5 percentage points, respectively (both $p < 0.01$). Relative to women’s baseline rates, these correspond to increases of approximately 182% and 198%, respectively.

For men, the OLS results show that full 3G coverage increases daily internet use by 11.9 percentage points ($p < 0.10$) and weekly use by 14.6 percentage points ($p < 0.05$), representing relative increases of roughly 98% and 92% compared to baseline rates (12.1% and 15.8%). The 2SLS estimates imply even larger, though less precisely estimated, effects: full 3G coverage increases daily internet use by 41.9 percentage points ($p < 0.05$)—a 346% increase relative to the mean—and weekly use by 13.9 percentage points (an 88% increase), though the latter is not statistically significant.

These results confirm that 3G expansion substantially increases internet use for both women and men, with women experiencing especially large proportional gains given their lower baseline access.

4.2 Labor Market Outcomes

Having established that 3G availability increases women’s internet use, I next examine whether improved 3G access translates into better labor market outcomes for women. Using individual-level data from the DHS, I construct indicators for employment in the past 12 months, employment type (paid work, self-employment, family work, and work for others), and sectoral employment (agricultural vs. non-agricultural) based on respondents’ primary occupation.

Table 5 presents the estimated effects of 3G coverage on women’s employment outcomes. The OLS estimates show a positive relationship between 3G availability and employment, driven largely by increases in self-employment. Sectoral results indicate higher participation in agricultural work and lower engagement in non-agricultural activities.

In the OLS estimates, a one-unit increase 3G coverage within a grid cell—moving from zero to full coverage in the locality—raises women’s probability of working by 4.6 percentage points ($p < 0.05$) and of being self-employed by 4.0 percentage points ($p < 0.05$). Relative to their respective means (73% employed and 56% self-employed), these correspond to increases of roughly 6% and 7%. Agricultural employment rises by 7.4 percentage points ($p < 0.01$)—a 22% increase relative to the baseline rate of 33%—while non-agricultural employment falls by 2.5 percentage points, or about 6% of the mean (both $p < 0.10$).

The 2SLS estimates, which exploit exogenous variation in 3G expansion, are larger and more precisely estimated. A one-unit increase in 3G coverage increases the probability that a woman is employed by 17.7 percentage points ($p < 0.05$), relative to a baseline of 73 percent (a 24% increase). Self-employment rises by 24.5 percentage points ($p < 0.05$), or 44% relative to the mean of 56 percent, while the effect on paid employment is negative but not statistically significant. Employment gains are concentrated in agriculture, where participation increases by 62.7 percentage points ($p < 0.01$)—nearly a 189% increase relative to the mean—while non-agricultural employment declines by 45.9 percentage points ($p < 0.01$), corresponding to a 117% reduction relative to the baseline share of 39 percent.

These results suggest that mobile broadband primarily expands women’s access to self-employment and agricultural work—activities that are home-based and compatible with domestic responsibilities—rather than formal wage employment. This pattern likely reflects both structural and normative constraints: non-agricultural jobs typically require greater mobility, skills, and access to productive resources that remain limited for women. Enhanced connectivity may also improve agricultural productivity through better access to market information and farming practices.

For men (Table 6), the 2SLS estimates show no statistically significant effects of 3G coverage on employment outcomes. A one-unit increase in 3G coverage raises the probability of employment by only 1.7 percentage points, with negligible changes in sectoral composition. Given men’s already high baseline employment rate of 96 percent, these null effects suggest that the labor-market benefits of digital expansion accrue primarily to women, particularly those previously constrained by limited access to information and mobility. The increase in women’s economic participation naturally raises the question of whether these labor-market gains translate into greater decision-making power within

households—or whether they provoke resistance from male partners. I explore these dynamics next.

4.3 Intra-Household Decision-Making

To assess whether 3G internet access strengthens their agency within the household, I estimate the effects of 3G coverage on household decision-making and sexual autonomy. The DHS surveys ask married women who makes decisions regarding their own health-care, major household purchases, and visits to family or friends. I define an indicator equal to one if the respondent participates in any of these decisions (alone or jointly with her husband) and zero otherwise.⁸

Table 7 reports the results. The OLS estimates show no significant associations, while the 2SLS estimates reveal sizable and statistically meaningful declines in women’s decision-making authority. A one-unit increase in 3G coverage—moving from zero to full coverage—reduces women’s participation in decisions about large household purchases by 16.0 percentage points ($p < 0.10$) and in their own healthcare by 16.2 percentage points ($p < 0.10$). These declines represent reductions of roughly 31 percent and 29 percent relative to their baseline means. The effect is largest for decisions regarding family visits: full 3G coverage lowers women’s participation by 28.9 percentage points ($p < 0.01$), a 45 percent decrease relative to the mean.

The estimated effects on sexual autonomy are negative but smaller and statistically insignificant. Full 3G coverage decreases the probability that a woman can refuse sex by about 7.6 percentage points (an 11 percent decline) and that she can ask her partner to use a condom by 13.3 percentage points (a 24 percent decline).

Overall, these findings indicate that women’s economic gains from digital access do not automatically translate into greater bargaining power within the household. Instead, improved access to information and work opportunities appears to weaken women’s autonomy at home.

4.4 Intimate Partner Violence

To examine whether the observed decline in household autonomy is accompanied by an increase in coercive or violent behaviors, I analyze women’s exposure to intimate partner violence (IPV). The DHS domestic violence module records experiences of physical, sex-

⁸While there is debate over whether solo or joint decision-making best reflects empowerment (Peterman et al., 2021), there is broad agreement that exclusive male decision-making implies limited female agency.

ual, and emotional abuse.⁹ Because information on emotional violence is not consistently available, I focus on physical and sexual violence. I construct three binary indicators: any domestic violence (physical or sexual), physical violence, and sexual violence experienced in the past 12 months.

Table 8 reports the results. The OLS estimates are small and statistically insignificant, whereas the 2SLS estimates reveal sizable and significant effects. A one-unit increase in 3G coverage—moving from zero to full coverage—raises the likelihood that a woman experiences any form of domestic violence by 16.6 percentage points ($p < 0.10$) and physical violence by 17.2 percentage points ($p < 0.05$). Relative to mean prevalence rates of 22 percent and 19 percent, these correspond to increases of approximately 75 percent and 91 percent, respectively. The estimated effect on sexual violence is smaller—7.8 percentage points—and statistically insignificant, though its magnitude implies a 92 percent increase relative to the baseline incidence of 8 percent.

Summary of Results. Taken together, the results show that the expansion of 3G mobile broadband substantially increases individual internet use for both women and men, with proportionally larger gains for women given their lower baseline access. Improved connectivity translates into higher female employment, driven primarily by self-employment and agricultural work rather than paid employment. Despite these labor market gains, women’s participation in household decision-making—particularly regarding major purchases, personal healthcare, and family visits—declines. At the same time, greater 3G internet access is associated with a rise in intimate partner violence, suggesting that the benefits of digital expansion for women’s economic inclusion are accompanied by heightened household tensions and reduced autonomy.

4.5 Mechanisms

The results presented in the previous section reveal a nuanced pattern: the expansion of 3G networks increases women’s labor market participation—mainly through self-employment and agricultural work—yet reduces their decision-making power within households and increases intimate partner violence (IPV).

To interpret these findings, I draw on economic theories of domestic violence, which conceptualize IPV as part of an intra-household bargaining process (Tauchen et al., 1991; Farmer and Tiefenthaler, 1996). In these frameworks, household members negotiate over resources, decision-making, and labor allocation, and violence may arise as a means of

⁹Violence categories follow World Health Organization (WHO) definitions; see Appendix Table A2 for details.

influencing these outcomes. Some models extend this framework to include a *backlash mechanism* (Macmillan and Gartner, 1999), whereby improvements in women’s bargaining power—through income, employment, or other forms of empowerment—disrupt traditional gender hierarchies. In response, men may resort to violence either to reassert dominance or as an emotional reaction to perceived threats to their social status. The motives underlying domestic violence can be classified as either instrumental or expressive: instrumental violence is used strategically to extract resources (Bloch and Rao, 2002; Menon, 2020) or maintain control over household decisions (Anderson and Bidner, 2021), whereas expressive violence reflects emotional or status-related impulses rather than calculated incentives (Card and Dahl, 2011).

Bargaining approach. Standard household bargaining models predict that IPV should decline when women’s relative economic position improves and rise when it deteriorates. Consistent with this prediction, Aizer (2010) find that narrower gender wage gaps reduce IPV, and Anderberg et al. (2016) show that higher male unemployment reduces IPV, whereas higher female unemployment increases its incidence. However, my results diverge from this theoretical expectation: while 3G expansion increases women’s overall employment—driven primarily by self-employment and agricultural activities—it is also associated with higher IPV.

Male backlash. The observed rise in IPV alongside greater female labor market participation is consistent with a *male backlash mechanism*, in which men respond violently when women’s economic opportunities or autonomy challenge traditional gender hierarchies. Yet, because 3G expansion does not significantly increase women’s paid employment, the backlash is unlikely to stem from threats to men’s breadwinner status. Instead, digital connectivity may provoke new forms of perceived threat arising from women’s increased access to information, social visibility, and changing gender norms.

To explore this possibility, I examine whether 3G internet access influences gender norms, using attitudes toward domestic violence as a proxy.¹⁰ Specifically, I use DHS survey questions that ask respondents whether a husband is justified in beating his wife under situations where she may have failed to fulfill traditional household roles (e.g., burning food or neglecting children) or violated prevailing social norms (e.g., arguing with her husband, refusing sexual relations, or going out without permission). The results in Table 12 show that greater 3G coverage is associated with a higher acceptance of

¹⁰A growing body of evidence links the social acceptability of IPV to its prevalence, particularly among working women in Sub-Saharan Africa (Cools and Kotsadam, 2017) and India (Dhanaraj and Mahambare, 2022), underscoring the role of social norms in shaping domestic violence.

IPV among men but not among women. For men, the estimated coefficients are positive and statistically significant in most cases, indicating that men in areas with greater digital access are more likely to justify wife beating. By contrast, the effects for women are small and statistically insignificant, except for a modest positive association when the wife “argues.” Overall, these findings suggest that digital expansion may reinforce patriarchal attitudes among men while having limited effects on women’s views about IPV.

Fertility-related dynamics may also contribute to IPV through a backlash mechanism if digital access influences couples’ fertility preferences or women’s reproductive autonomy, thereby challenging traditional gender norms. In many African societies, women’s reproductive roles are central to household and social identity, making this dimension crucial for understanding IPV. When women prefer fewer children than their husbands, and greater bargaining power enables them to act on these preferences, it may provoke resistance from men who perceive such behavior as undermining their authority or fertility goals. Existing evidence supports this channel: women’s independent decision-making regarding contraceptive use has been shown to increase the risk of IPV in several contexts, as men view such autonomy as a threat to their control over reproduction (Ojha and Babbar, 2024; Anukriti et al., 2022). Hence, greater access to reproductive health information and autonomy over fertility decisions—potentially facilitated by digital connectivity—can trigger male backlash aimed at maintaining control over reproductive outcomes.

Table 15 provides evidence consistent with this mechanism by examining how 3G coverage relates to fertility outcomes and preferences among married couples using DHS couples’ data.¹¹ The results reveal a clear gender divide. Among wives, greater 3G coverage shows no measurable effects on childbirth in the last year or fertility preferences, suggesting that women’s reproductive behavior and desired family size remain largely unchanged with digital access. The effects on son preference are also small and statistically insignificant.¹² In contrast, husbands in areas with greater 3G access are more likely to report wanting additional children. Together, these findings suggest that digital expansion increases men’s fertility aspirations without corresponding changes among women, thereby widening gender gaps in reproductive preferences which may result in household conflict and IPV.

To provide more direct evidence consistent with the backlash mechanism, I examine husbands’ controlling behaviors, which often accompany IPV. Increased internet connec-

¹¹I also estimate this relationship for the full sample of married women and men. The results, reported in Appendix Table A4, are qualitatively similar.

¹²Using DHS data, I measure son preference as an indicator equal to one if the respondent reports a larger ideal number of sons than daughters, and zero otherwise.

tivity may heighten men’s monitoring and mistrust by expanding women’s opportunities to interact with others outside the home. These behaviors can manifest in different forms, ranging from restrictions on women’s mobility to heightened jealousy and suspicion. The DHS survey asks women whether their husband or partner: (i) becomes jealous or angry when they talk to other men, (ii) accuses them of infidelity, (iii) insists on knowing their whereabouts, (iv) prevents them from meeting female friends, or (v) limits their contact with family or relatives. I construct a *Controlling Behavior Index* based on the average of these five indicators and further distinguish between two sub-indices: a *Spousal Trust Index* (items i–iii) and a *Mobility Restriction Index* (items iv–v).

The analysis provides additional evidence consistent with backlash dynamics. Both OLS and 2SLS estimates show a positive association between 3G coverage and spousal control, although the 2SLS estimates are not statistically significant at conventional level. The effects are concentrated in the *Spousal Trust Index*: women in areas with greater 3G coverage are more likely to report that their husbands insist on knowing their whereabouts, become jealous when they talk to other men, and accuse them of infidelity. In contrast, the coefficients for the *Mobility Restriction Index*—whether husbands prevent women from meeting friends or limit contact with relatives—are small and statistically insignificant (Table 13 and Appendix Table A3). These results suggest that internet-driven backlash manifests less through restrictions on women’s physical mobility and more through suspicion-driven control. In contexts where digital access expands women’s social networks and visibility, husbands appear to respond with jealousy and mistrust as a means of reasserting authority. Such behaviors constitute coercive control and are recognized in the public health literature as key predictors of escalation into physical or sexual violence (Hamberger et al., 2017; Dichter et al., 2018; Kanougiya et al., 2021).

Alternative channels. Several additional mechanisms may also help explain the main findings. First, extramarital relationships could potentially link internet access to IPV. Greater internet connectivity may facilitate private communication and expand opportunities for engaging in extramarital affairs, potentially leading to household tension and conflict. To test this, I use DHS data in which both men and women report whether they had a sexual relationship with someone other than their spouse or partner in the past 12 months. The results, reported in Table 14, show negligible and statistically insignificant effects of 3G coverage on women’s likelihood of engaging in extramarital sex. Among men, 3G access has no significant effect for the overall sample and a negative effect for currently married men. These findings suggest that changes in extramarital behavior are unlikely to explain the observed increase in IPV associated with digital expansion.

Second, women’s digital financial inclusion could be another channel. I find that that greater 3G internet access substantially increases women’s likelihood of owning a bank account and using mobile money services (see Table A5). These tools—such as mobile banking and digital payments—can enhance women’s financial autonomy. However, this empowerment may also provoke intimate partner violence, as husbands may perceive it as a challenge to traditional authority or use coercion to extract wives’ financial resources.

Third, digital access may influence intra-household time allocation by increasing couples’ engagement in online or information-related activities. Greater exposure to mobile technology or online work could reduce the time women devote to domestic and caregiving responsibilities, thereby challenging traditional gender expectations and household divisions of labor. However, due to data limitations, I am unable to directly test this mechanism using couples’ time-use information.

Finally, digital connectivity may reshape aspirations, social comparisons, and mental health through exposure to social media and broader online networks, which can, in turn, heighten household conflict. However, given the limitations of the data, I did not explore these channels in the current study. Taken together, these mechanisms highlight that the expansion of digital infrastructure can have complex social repercussions that extend beyond its direct economic effects, influencing household dynamics, gender relations, and overall well-being.

5 Heterogeneity Analysis

Women’s baseline opportunities and constraints differ depending on location, education, and life stage, which may condition how they respond to the expansion of mobile internet. To examine this, I disaggregate the results along three key dimensions: urban vs. rural residence, high vs. low education, and younger vs. older age groups. The results consistently highlight that the labor market benefits of 3G access are uneven, while the intra-household effects are broadly shared.

Table 9 shows the effects of 3G coverage on women’s empowerment in urban and rural areas. In urban settings, 3G access has no detectable impact on women’s employment, but significantly reduces women’s autonomy in family visits and increases women’s exposure to physical violence. These findings suggest that in contexts where women already participate heavily in the labor market, digital access primarily intensifies household tensions rather than expanding opportunities.

In rural areas, by contrast, 3G access increases employment. Moving from zero to full 3G coverage raises the probability of working in the past year by about 28 percentage

points ($p < 0.10$). However, these gains do not extend to paid work and are accompanied by declines in household decision-making power and increase in domestic violence. These results highlight a double-edged effect: connectivity enables rural women to participate more in work, but undermines their bargaining position within households.

Table 10 considers heterogeneity by women's education. Among more educated women, 3G coverage has little effect on employment, paid work, or intra-household decision-making, but has a positive effects on domestic violence.

Among less educated women, the greater 3G access has a modest positive effects on overall employment (not significant). However, increased 3G access lead to a decline in autonomy in decision-making, especially in family visits and increase in domestic violence.

Finally, Table 11 disaggregates the effects by age groups. For younger women (Aged below 30), a 100 percentage-point increase in 3G access raises the likelihood of working in the past year by 18 percentage points ($p < 0.10$), but has no impact on paid work. At the same time, younger women experience significant declines in autonomy in family visits and increase in domestic violence outcomes thought later are not statistically significant.

Older women (Aged 30 or above), by contrast, do not experience employment gains. However, expanded 3G access lead to decline in their intra-household decision-making autonomy and increase in domestic violence for them.

Taken together, the heterogeneity analyses reveal a consistent pattern. The economic benefits of 3G coverage are concentrated among disadvantaged groups—rural women, those with lower education, and younger cohorts—who are drawn into the labor force, though often into unpaid or agricultural work. At the same time, across nearly all groups, household decision-making power decline and domestic violence increase.

6 Conclusion

Rapid digital transformation has reshaped economic and social life worldwide, yet its implications for gender equality remain poorly understood. This paper examines the effects of mobile broadband expansion on women's empowerment in Sub-Saharan Africa. The analysis shows that greater 3G internet coverage increases women's overall employment, primarily through higher participation in self-employment and agricultural work, with no significant effect on paid employment. However, these economic gains do not translate into greater autonomy within households. Instead, 3G expansion reduces women's participation in major household decisions and increases their likelihood of experiencing intimate partner violence (IPV). Further analysis reveals that men in areas with greater

3G network coverage are more likely to justify domestic violence when women do not comply with traditional gender roles, express a stronger desire for additional children, and display increased controlling behaviors in the home.

Together, these findings highlight the double-edged nature of digital inclusion. While mobile broadband expands women's economic opportunities and access to information, it may also triggers marital conflicts in contexts with deeply rooted patriarchal norms. The results underscore that the benefits of digital technologies may depend critically on complementary social and institutional conditions. Policies aimed at promoting women's empowerment should therefore pair investments in digital infrastructure with efforts to challenge discriminatory norms and strengthen women's bargaining power within households and communities.

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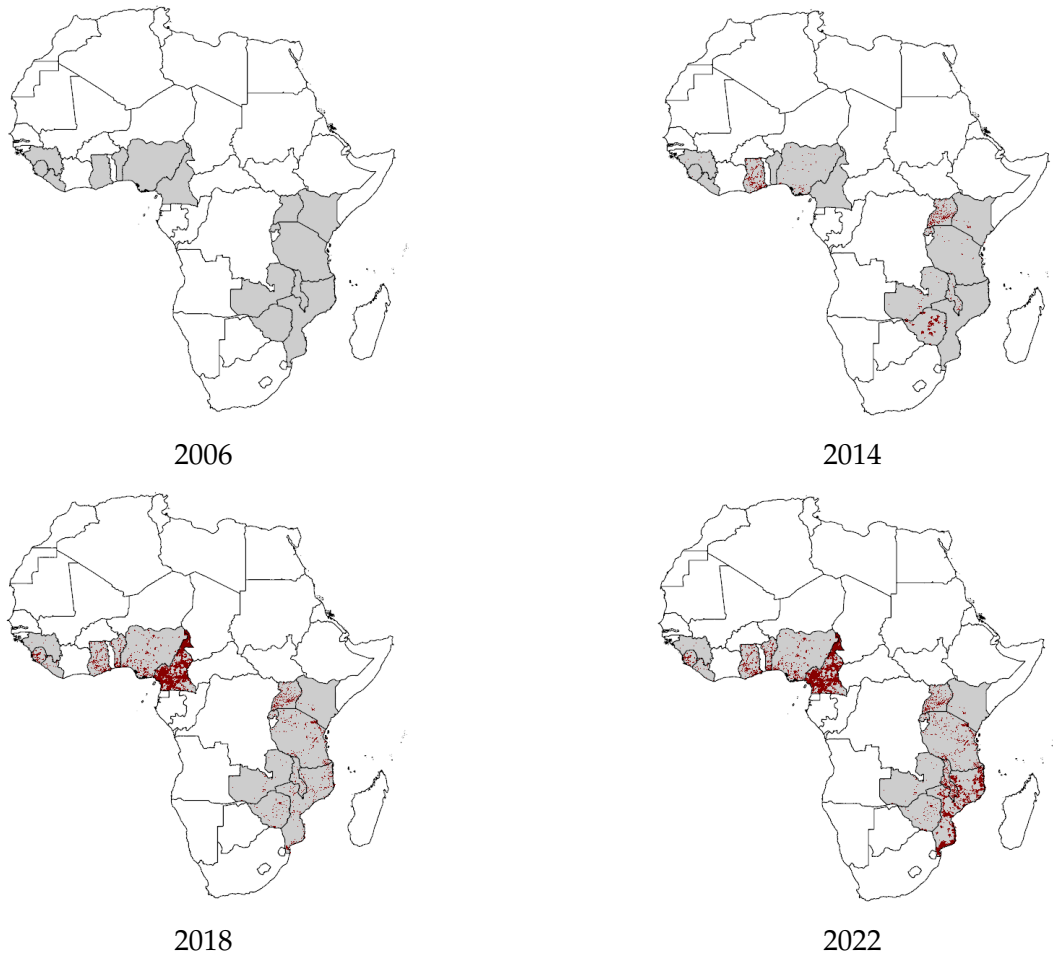
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7 Figures and Tables

Figure 1. 3G Expansion in Africa



Notes: This figure illustrates the expansion of 3G network coverage in 15 Sub-Saharan African countries (shaded in gray) from 2006 to 2022. Red areas indicate regions with 3G coverage, while gray areas represent regions without coverage.

Table 1. List of DHS Survey Rounds by Country Used in this Study

Country	Survey Years
Benin	2011-12, 2017-18
Cameroon	2004, 2011, 2018-19
Ghana	2003, 2008, 2022-23
Guinea	2005, 2012, 2018
Kenya	2003, 2008-2009, 2014
Liberia	2006-07, 2019-20
Malawi	2004-05, 2010, 2015-16
Mozambique	2011, 2022-23
Nigeria	2003, 2008, 2013, 2018
Rwanda	2005, 2010-11, 2014-15
Sierra Leone	2008, 2019
Tanzania	2009-10, 2015-16, 2022
Uganda	2006, 2016
Zambia	2007, 2018-19
Zimbabwe	2005-06, 2010-11, 2015

Table 2. Summary Statistics

Panel A: Characteristics of Married Women					
Variable	N	Mean	Std. Dev.	Min	Max
Age	354,281	31.31	8.55	15	49
Urban residence	354,281	0.309	0.462	0	1
No education	354,276	0.363	0.481	0	1
Primary education	354,276	0.369	0.483	0	1
Secondary education	354,276	0.227	0.419	0	1
Higher education	354,276	0.041	0.199	0	1
Worked in last 12 months	354,126	0.731	0.444	0	1
Worked for pay	353,874	0.534	0.499	0	1
Worked as self-employed	353,786	0.558	0.497	0	1
Worked for family member	353,786	0.097	0.296	0	1
Worked for someone else	353,786	0.076	0.265	0	1
Worked in Agriculture	354,281	0.332	0.471	0	1
Worked in Non-agriculture	354,281	0.392	0.488	0	1
Woman decides large purchases either alone or jointly	353,201	0.519	0.500	0	1
Women decides own healthcare either alone or jointly	349,029	0.568	0.495	0	1
Women decides visiting family or relatives either alone or jointly	353,220	0.645	0.479	0	1
Can refuse sex to husband	280,282	0.669	0.470	0	1
Can ask husband to use condom	273,103	0.560	0.496	0	1
Any intimate partner violence in last 12 months	161,390	0.223	0.416	0	1
Any physical violence in last 12 months	161,390	0.189	0.392	0	1
Any sexual violence in last 12 months	161,350	0.085	0.278	0	1

Panel B: Characteristics of Married Men					
Variable	N	Mean	Std. Dev.	Min	Max
Age	136,141	37.43	9.38	15	59
Urban residence	136,141	0.328	0.469	0	1
No education	136,138	0.213	0.409	0	1
Primary education	136,138	0.367	0.482	0	1
Secondary education	136,138	0.327	0.469	0	1
Higher education	136,138	0.093	0.290	0	1
Worked in last 12 months	136,091	0.963	0.188	0	1
Worked for pay	133,298	0.794	0.405	0	1
Worked in Agriculture	136,141	0.441	0.496	0	1
Worked in Non-agriculture	136,141	0.513	0.500	0	1

Notes: Summary statistics are based on Women’s and Men’s records from DHS samples (2003–2023) used in this study. Means are reported as proportions for binary variables. Panel A reports characteristics of married women aged 15-49; Panel B reports characteristics of married men aged 15-59. Domestic violence variables in Panel A have smaller sample sizes as they are collected from a sub-sample of women.

Table 3. First Stage: Instrumenting 3G Coverage with Lightning Strike Frequency

	3G Coverage
$\log(\text{Lightning strike frequency}) \times \text{year}$	-0.012*** (0.002)
Observations	354,120
R-squared	0.837
Grid cell FE	Yes
Country \times Year FE	Yes
Mean dep. var	0.139
F-statistic	26.30

Notes: Robust standard errors in parentheses, clustered at the grid-cell level. The dependent variable is population-weighted 3G mobile network coverage in the grid cell. The instrument is the historical average of lightning strike frequency in the grid cells, interacted with a linear time trend. The specification includes grid-cell fixed effects, country-year fixed effects, and the baseline controls used in the 2SLS regressions presented in this paper. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. 3G Internet Coverage and Individual Internet Use

	Women		Men	
	Use internet daily (1)	Use internet weekly+ (2)	Use internet daily (3)	Use internet weekly+ (4)
Panel A: OLS Estimates				
3G Coverage	0.044** (0.022)	0.058* (0.033)	0.119* (0.064)	0.146** (0.070)
R-squared	0.327	0.387	0.373	0.413
Panel B: 2SLS Estimates				
3G Coverage	0.119*** (0.038)	0.195*** (0.061)	0.419** (0.183)	0.139 (0.128)
F-statistic	12.11	12.11	8.681	8.681
R-squared	0.192	0.213	0.228	0.254
Mean Dep. Var	0.0655	0.0984	0.121	0.158
Mean 3G Coverage	0.330	0.330	0.335	0.335
Observations	80,692	80,692	31,447	31,447
N Countries	8	8	8	8

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. The sample includes only married women and covers Benin (2017, 2018), Cameroon (2018, 2019), Ghana (2022, 2023), Liberia (2019, 2020), Malawi (2015, 2016), Mozambique (2022, 2023), Tanzania (2015, 2016, 2022), and Zambia (2018, 2019).

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 5. 3G Internet Coverage and Women's Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Work	Work for pay	Self- employed	Work for family	Work for others	Work in agri	Work in non-agri
Panel A: OLS Estimates							
3G Coverage	0.046** (0.019)	-0.017 (0.027)	0.040** (0.020)	-0.014 (0.014)	0.021*** (0.008)	0.074*** (0.023)	-0.025 (0.021)
R-squared	0.184	0.206	0.153	0.132	0.164	0.369	0.262
Panel B: 2SLS Estimates							
3G Coverage	0.177** (0.087)	-0.072 (0.128)	0.245** (0.107)	-0.029 (0.061)	-0.037 (0.034)	0.627*** (0.156)	-0.459*** (0.119)
F-statistic	26.30	26.30	26.28	26.28	26.28	26.30	26.30
Observations	354,120	353,868	353,780	353,780	353,780	354,120	354,120
Mean dep. var	0.731	0.535	0.558	0.0968	0.0761	0.332	0.392
Mean 3G coverage	0.139	0.139	0.139	0.139	0.139	0.139	0.139
N countries	15	15	15	15	15	15	15

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married women and covers the DHS surveys listed in Table 1. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 6. 3G Internet Coverage and Men's Employment

	(1)	(2)	(3)	(4)
	Work	Work for pay	Work in agri	Work in non-agri
Panel A: OLS Estimates				
3G Coverage	0.002 (0.009)	-0.086*** (0.026)	0.066*** (0.023)	-0.061*** (0.021)
R-squared	0.143	0.249	0.376	0.355
Panel B: 2SLS Estimates				
3G Coverage	0.017 (0.036)	-0.018 (0.111)	0.019 (0.119)	0.019 (0.112)
R-squared	0.005	0.022	0.131	0.125
F-statistics	24.44	23.33	24.44	24.44
Observations	136,072	133,279	136,072	136,072
Mean dep. var	0.963	0.794	0.441	0.514
Mean 3G coverage	0.142	0.145	0.142	0.142
N countries	15	15	15	15

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married men and covers the DHS surveys listed in Table 1. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 7. 3G Internet Coverage and Women’s Decision-making Power in the Household

Outcome:	(1) Decides large purchase	(2) Decides own healthcare	(3) Decides family visits	(4) Can refuse sex	(5) Can ask partner to use condom
Panel A: OLS Estimates					
3G Coverage	0.014 (0.022)	0.021 (0.022)	0.005 (0.025)	0.032 (0.021)	-0.016 (0.023)
R-squared	0.212	0.223	0.180	0.162	0.244
Observations	353,196	349,028	353,214	280,276	273,097
Panel B: 2SLS Estimates					
3G Coverage	-0.160* (0.084)	-0.162* (0.092)	-0.289*** (0.093)	-0.076 (0.076)	-0.133 (0.087)
R-squared	0.017	0.014	0.008	0.012	0.031
First-stage F-stat	26.24	24.36	26.30	25.08	25.48
Observations	353,196	349,028	353,214	280,276	273,097
Mean dep. var	0.519	0.568	0.645	0.669	0.560
Mean 3G coverage	0.139	0.141	0.139	0.163	0.165
N countries	15	15	15	15	15

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents’ age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married women and covers the DHS surveys listed in Table 1. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 8. 3G Internet Coverage and Intimate Partner Violence

	Domestic violence (1)	Physical violence (2)	Sexual violence (3)
Panel A: OLS Estimates			
3G Coverage	0.017 (0.017)	0.014 (0.015)	0.014 (0.012)
R-squared	0.105	0.102	0.065
Panel B: 2SLS Estimates			
3G Coverage	0.166* (0.100)	0.172** (0.087)	0.078 (0.065)
R-squared	0.006	0.005	0.002
F-statistic	21.30	21.30	21.30
Observations	161,007	161,007	160,968
Mean dep. var	0.223	0.189	0.0848
Mean 3G coverage	0.133	0.133	0.133
N countries	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. The sample includes only married women from the domestic violence module of the DHS surveys, covering Benin (2017, 2018), Cameroon (2004, 2011, 2018, 2019), Ghana (2008, 2022, 2023), Kenya (2003, 2008, 2009, 2014), Liberia (2006, 2007, 2019, 2020), Malawi (2004, 2005, 2010, 2015, 2016), Mozambique (2011, 2022, 2023), Nigeria (2008, 2013, 2018), Rwanda (2005, 2010, 2011, 2014, 2015), Tanzania (2009, 2010, 2015, 2016, 2022), Uganda (2006, 2016), Zambia (2007, 2018, 2019), and Zimbabwe (2005, 2006, 2010, 2011, 2015). * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 9. 3G Internet Coverage and Women's Empowerment: Urban vs. Rural

Outcome:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Work	Work for pay	Decides large purchase	Decides own healthcare	Decides visit relatives	Domestic violence	Physical violence	Sexual violence
Panel A: Urban Areas								
3G Coverage	-0.073 (0.078)	-0.137 (0.115)	-0.066 (0.087)	-0.097 (0.093)	-0.194* (0.101)	0.171 (0.108)	0.186* (0.111)	0.049 (0.071)
F-statistic	24.57	24.53	24.49	23.01	24.50	17.48	17.48	17.48
Observations	109,277	109,199	108,997	107,422	108,947	49,217	49,217	49,203
Mean dep. var	0.709	0.615	0.595	0.632	0.701	0.202	0.175	0.0698
Mean 3G coverage	0.229	0.229	0.229	0.233	0.229	0.230	0.230	0.230
N countries	15	15	15	15	15	13	13	13
Panel B: Rural Areas								
3G Coverage	0.283* (0.154)	-0.006 (0.220)	-0.228 (0.153)	-0.233 (0.202)	-0.275 (0.184)	0.329** (0.133)	0.285** (0.116)	0.191** (0.093)
F-statistic	23.13	23.13	23.06	20.67	23.10	22.37	22.37	22.36
Observations	244,842	244,668	244,198	241,605	244,266	112,164	112,164	112,139
Mean dep. var	0.741	0.499	0.485	0.539	0.620	0.233	0.195	0.0912
Mean 3G coverage	0.099	0.099	0.099	0.100	0.099	0.091	0.091	0.091
N countries	15	15	15	15	15	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married women.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 10. 3G Internet Coverage and Women’s Outcomes: High vs Low Education

Outcome:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Work	Work for pay	Decides large purchase	Decides own healthcare	Decides visit relatives	Domestic violence	Physical violence	Sexual violence
Panel A: High Education (Secondary education or above)								
3G Coverage	0.070 (0.101)	-0.031 (0.164)	-0.093 (0.107)	-0.116 (0.137)	-0.081 (0.115)	0.207* (0.123)	0.213* (0.119)	0.066 (0.082)
F-statistic	17.78	17.72	17.77	16.65	17.90	9.821	9.821	9.819
Observations	94,773	94,715	94,493	93,794	94,438	48,774	48,774	48,761
Mean dep. var	0.726	0.618	0.654	0.692	0.755	0.195	0.164	0.0709
Mean 3G coverage	0.230	0.230	0.230	0.232	0.230	0.214	0.214	0.214
N countries	15	15	15	15	15	13	13	13
Panel B: Low Education (Below secondary education)								
3G Coverage	0.166 (0.114)	0.066 (0.164)	-0.146 (0.102)	-0.156 (0.117)	-0.271** (0.115)	0.237* (0.130)	0.197* (0.112)	0.166* (0.092)
F-statistic	27.06	27.08	27.04	24.30	27.10	27.06	27.06	27.06
Observations	259,217	259,023	258,573	255,104	258,644	112,448	112,448	112,422
Mean dep. var	0.733	0.504	0.470	0.522	0.604	0.236	0.200	0.0907
Mean 3G coverage	0.106	0.106	0.106	0.107	0.106	0.098	0.098	0.098
N countries	15	15	15	15	15	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents’ age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married women.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 11. 3G Internet Coverage and Women's Outcomes: Younger vs. Older Women

Outcome:	(1) Work	(2) Work for pay	(3) Decides large purchase	(4) Decides own healthcare	(5) Decides visit relatives	(6) Domestic violence	(7) Physical violence	(8) Sexual violence
Panel A: Younger Women (Aged below 30)								
3G Coverage	0.175*	0.002	-0.148	-0.111	-0.214*	0.200	0.197	0.136
	(0.106)	(0.144)	(0.096)	(0.121)	(0.114)	(0.141)	(0.127)	(0.089)
F-statistic	27.84	27.86	27.91	25.46	27.95	22.05	22.05	22.04
Observations	161,762	161,646	161,195	159,564	161,249	78,515	78,515	78,497
Mean dep. var	0.651	0.459	0.461	0.517	0.599	0.239	0.203	0.0912
Mean 3G coverage	0.129	0.129	0.129	0.131	0.129	0.124	0.124	0.124
N countries	15	15	15	15	15	13	13	13
Panel B: Older Women (Aged 30 or above)								
3G Coverage	0.122	-0.017	-0.143	-0.137	-0.174*	0.248**	0.233**	0.125*
	(0.084)	(0.144)	(0.094)	(0.099)	(0.098)	(0.104)	(0.092)	(0.074)
F-statistic	29.03	29.05	29.01	26.25	29.09	24.16	24.16	24.16
Observations	192,351	192,215	191,994	189,457	191,958	82,815	82,815	82,794
Mean dep. var	0.798	0.598	0.567	0.610	0.683	0.208	0.177	0.0785
Mean 3G coverage	0.147	0.147	0.147	0.149	0.147	0.142	0.142	0.142
N countries	15	15	15	15	15	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using log(average lightning-strike frequency) interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes only married women.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 12. 3G Internet Coverage and Justification for Wife-Beating

	(1) Wife neglects children	(2) Wife burns food	(3) Wife argues with husband	(4) Wife refuses sex	(5) Wife goes outside without permission
Panel A: Men					
3G Coverage	0.133* (0.078)	0.121** (0.048)	0.108* (0.064)	0.142** (0.061)	0.181** (0.078)
Observations	130,678	130,821	130,360	130,345	130,314
Mean dep. var	0.178	0.057	0.150	0.095	0.159
Mean 3G coverage	0.147	0.147	0.147	0.148	0.147
First-stage F-stat	23.02	22.87	22.86	22.97	23.04
Panel B: Women					
3G Coverage	-0.092 (0.080)	0.012 (0.062)	0.144* (0.081)	0.085 (0.069)	-0.074 (0.084)
Observations	351,393	351,302	350,830	349,878	350,920
Mean dep. var	0.320	0.152	0.276	0.239	0.300
Mean 3G coverage	0.139	0.139	0.139	0.139	0.139
First-stage F-stat	26.44	26.31	26.24	26.22	26.31

Notes: The table reports 2SLS estimates of the effects of 3G coverage on the acceptability of intimate partner violence (IPV). Each column corresponds to whether respondents agree that a husband is justified in beating his wife under a given circumstance. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. Sample includes married women and men, and covers the DHS surveys listed in Table 1.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 13. 3G Internet Coverage and Husband's Controlling Behavior

	(1) Controlling Behavior Index	(2) Sub-Index: Spousal Mistrust	(3) Sub-Index: Mobility Restrictions
Panel A: OLS			
3G Coverage	0.020* (0.012)	0.036** (0.016)	-0.003 (0.011)
Observations	152,089	152,461	153,714
R-squared	0.098	0.100	0.069
Panel B: 2SLS			
3G Coverage	0.066 (0.068)	0.099 (0.089)	0.024 (0.058)
First-stage F-stat	25.00	25.03	24.89
Observations	152,089	152,461	153,714
Mean dep. var	0.286	0.386	0.136
Mean 3G coverage	0.139	0.139	0.138
N countries	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using log(average lightning-strike frequency) interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. The sample includes only married women from the domestic violence module of the DHS surveys, covering Benin (2017, 2018), Cameroon (2004, 2011, 2018, 2019), Ghana (2008, 2022, 2023), Kenya (2003, 2008, 2009, 2014), Liberia (2006, 2007, 2019, 2020), Malawi (2004, 2005, 2010, 2015, 2016), Mozambique (2011, 2022, 2023), Nigeria (2008, 2013, 2018), Rwanda (2005, 2010, 2011, 2014, 2015), Tanzania (2009, 2010, 2015, 2016, 2022), Uganda (2006, 2016), Zambia (2007, 2018, 2019), and Zimbabwe (2005, 2006, 2010, 2011, 2015). * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 14. 3G Internet Coverage and Extramarital Sex by Gender

	Dependent variable: Extra-marital sex (1/0)			
	(1) All women	(2) Married women	(3) All men	(4) Married men
3G Coverage	0.028 (0.028)	0.002 (0.028)	-0.025 (0.055)	-0.116** (0.057)
Observations	532,554	342,138	247,203	133,438
Mean dep. var	0.135	0.024	0.274	0.148
Mean 3G coverage	0.156	0.141	0.152	0.143
N countries	15	15	15	15
F-statistics	29.97	26.26	25.89	24.81

Notes: The table reports 2SLS estimates of the effect of 3G coverage on the likelihood of engaging in extramarital sex. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects and control for individual characteristics (age, age², education, and urban residence), as well as climatic and geographic covariates.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table 15. 3G Internet Coverage and Fertility Preferences: Wives vs. Husbands

VARIABLES	Wife			Husband	
	Childbirth last year (1)	Wants more children (2)	Has son preference (3)	Wants more children (4)	Has son preference (5)
Panel A: OLS Estimates					
3G Coverage	0.016 (0.013)	0.004 (0.015)	0.011 (0.020)	0.006 (0.025)	0.005 (0.021)
R-squared	0.074	0.335	0.056	0.269	0.095
Panel B: 2SLS Estimates					
3G Coverage	-0.007 (0.056)	-0.041 (0.061)	-0.030 (0.062)	0.162** (0.082)	-0.052 (0.076)
R-squared	0.041	0.263	0.001	0.163	0.001
First-stage F-stat	21.74	21.74	21.74	22.28	22.28
Observations	103,788	103,788	103,788	103,788	103,788
Mean dep. var.	0.245	0.674	0.198	0.703	0.384
Mean 3G coverage	0.141	0.141	0.141	0.141	0.141
N countries	15	15	15	15	15

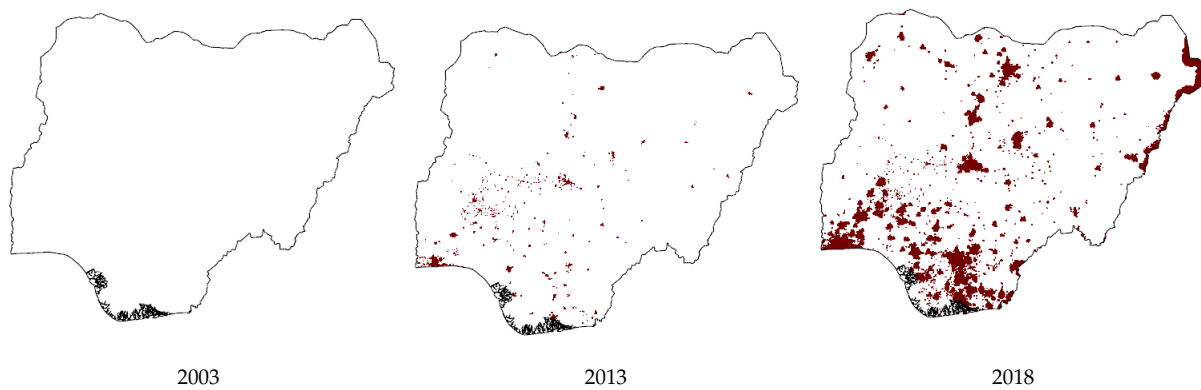
Notes: Robust standard errors in parentheses, clustered at the grid-cell level. All regressions include grid-cell and country-year fixed effects. Individual controls include respondents' age, education, and urban/rural residence. Panel A reports OLS estimates; Panel B reports 2SLS estimates instrumenting 3G coverage with $\log(\text{average lightning-strike frequency})$ interacted with year.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

A APPENDICES

A.1 Appendix Figures and Tables

Figure A1. 3G Network Coverage Expansion in Nigeria



Notes: The maps illustrate the expansion of 3G mobile network coverage in Nigeria between 2003 and 2018. Areas shaded in red indicate regions with 3G coverage.

Table A1. DHS Questions on Employment, Intra-Household Decision-Making, and Sexual Autonomy

Panel A: Employment-related questions

- Aside from your own housework, have you done any work in the last 7 days?
 - Aside from your own housework, have you done any work in the last 12 months?
 - What is your occupation? That is, what kind of work do you mainly do?
 - Are you paid in cash or kind for this work, or are you not paid at all?
 - Did you work for others, family members, or as self-employed?
-

Panel B: Intra-Household Decision-Making and Financial Autonomy

- Who usually makes decisions about major household purchases: you, your (husband/partner), both jointly, or someone else?
 - Who usually makes decisions about health care for yourself: you, your (husband/partner), both jointly, or someone else?
 - Who usually makes decisions about visits to your family or relatives: you, your (husband/partner), both jointly, or someone else?
-

Panel C: Sexual Autonomy Questions

- Can you say no to your husband if you do not want to have sexual intercourse?
 - Could you ask your husband to use a condom if you wanted him to?
-

Table A2. DHS Questions on Husband's Controlling Behaviors and Domestic Violence

Panel A: Controlling Behaviors by Husband/Partner

- Husband gets jealous or angry if you talk to other men.
- Husband frequently accuses you of being unfaithful.
- Husband does not permit you to meet your girl friends.
- Husband limits your contact with your family.
- Husband insists on knowing where you are at all times.
- Husband does not trust you with any money.

Panel B: Domestic Violence Questions (Asked if Ever Married or Lived with a Partner)

Physical Violence (Last 12 Months)

- Has your husband/partner slapped you or thrown something at you?
- Has your husband/partner pushed, shaken, or had something thrown at you?
- Has your husband/partner punched you with his fist or something harmful?
- Has your husband/partner kicked, dragged, or beaten you up?
- Has your husband/partner choked or burned you on purpose?
- Has your husband/partner threatened or attacked you with a knife, gun, or other weapon?

Sexual Violence (Last 12 Months)

- Has your husband/partner physically forced you to have sexual intercourse when you did not want to?
- Has your husband/partner forced you to perform other sexual acts you did not want?

Emotional Violence (Last 12 Months)

- Has your husband/partner humiliated you in front of others?
 - Has your husband/partner threatened you or someone you care about with harm?
 - Has your husband/partner insulted you or made you feel bad about yourself?
-

Table A3. 3G Internet Coverage and Husband's Controlling Behaviours

	(1)	(2)	(3)	(4)	(5)
	Jealous if talks with men	Accuses of unfaithfulness	Insist on knowing whereabouts	Not permit meeting female friends	Limit contact with family
Panel A: OLS					
3G Coverage	0.065*** (0.023)	0.031** (0.015)	0.012 (0.022)	0.009 (0.013)	-0.016 (0.011)
R-squared	0.086	0.100	0.091	0.064	0.054
Panel B: 2SLS					
3G Coverage	0.097 (0.113)	0.107 (0.081)	0.102 (0.135)	0.049 (0.068)	0.001 (0.059)
First-stage F-stat	24.99	24.97	24.89	24.90	24.91
Observations	153,077	153,801	153,949	153,952	153,917
Mean dep. var	0.527	0.197	0.435	0.164	0.109
Mean 3G coverage	0.138	0.138	0.138	0.138	0.138
N countries	13	13	13	13	13

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. The sample includes only married women from the domestic violence module of the DHS surveys, covering Benin (2017, 2018), Cameroon (2004, 2011, 2018, 2019), Ghana (2008, 2022, 2023), Kenya (2003, 2008, 2009, 2014), Liberia (2006, 2007, 2019, 2020), Malawi (2004, 2005, 2010, 2015, 2016), Mozambique (2011, 2022, 2023), Nigeria (2008, 2013, 2018), Rwanda (2005, 2010, 2011, 2014, 2015), Tanzania (2009, 2010, 2015, 2016, 2022), Uganda (2006, 2016), Zambia (2007, 2018, 2019), and Zimbabwe (2005, 2006, 2010, 2011, 2015). * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table A4. 3G Internet Coverage and Fertility Preferences: Women vs. Men

	Women			Men	
	Childbirth last year (1)	Wants more children (2)	Son preference (3)	Wants more children (4)	Son preference (5)
Panel A: OLS Estimates					
3G Coverage		-0.002	0.019*	0.010	0.012
-0.002	(0.008)	(0.010)	(0.012)	(0.021)	(0.018)
R-squared	0.071	0.346	0.044	0.286	0.086
Panel B: 2SLS Estimates					
3G Coverage	0.006	0.014	0.022	0.138**	-0.073
	(0.033)	(0.048)	(0.040)	(0.068)	(0.067)
F-stat	26.28	26.36	26.03	23.67	23.51
Observations	354,275	353,542	333,817	132,164	125,502
Mean dep. var.	3.252	0.657	0.197	0.688	0.378
Mean 3G coverage	0.139	0.139	0.141	0.146	0.146
N countries	15	15	15	15	15

Notes: Robust standard errors in parentheses, clustered at the grid-cell level. All regressions include grid-cell and country-year fixed effects. Individual controls include respondents' age, education, and urban/rural residence. Panel A reports OLS estimates; Panel B reports 2SLS estimates instrumenting 3G coverage with $\log(\text{average lightning-strike frequency})$ interacted with year.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Table A5. 3G Internet Coverage and Women's Financial Inclusion

	(1)	(2)
	Has bank account	Uses mobile money
Panel A: OLS Estimates		
3G Coverage	0.097	0.045
	(0.087)	(0.068)
R-squared	0.300	0.402
Panel B: 2SLS Estimates		
3G Coverage	0.310**	0.360***
	(0.122)	(0.134)
R-squared	0.180	0.131
F-stat	12.11	12.11
Observations	80,692	80,691
Mean dep. var.	0.129	0.266
Mean 3G coverage	0.330	0.330
N countries	8	8

Notes: Panel A reports OLS estimates; Panel B reports 2SLS estimates, where 3G coverage is instrumented using $\log(\text{average lightning-strike frequency})$ interacted with year. Robust standard errors are in parentheses, clustered at the grid-cell level. All specifications include grid-cell and country-by-year fixed effects, and control for respondents' age, age squared, education level dummies, urban/rural residence, long-run climatic conditions (average rainfall and temperature interacted with linear time trends), the standard deviation of elevation interacted with linear time trends, and population-weighted 2G coverage. The sample includes only married women and covers Benin (2017, 2018), Cameroon (2018, 2019), Ghana (2022, 2023), Liberia (2019, 2020), Malawi (2015, 2016), Mozambique (2022, 2023), Tanzania (2015, 2016, 2022), and Zambia (2018, 2019).

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$