Fertility Impacts of 3G Mobile Expansion: Evidence from Nigeria

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Digital revolution and fertility

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- Despite this theoretical potential, estimating the **causal impacts** of digital technology on fertility, especially in high-fertility contexts, has proven to be challenging
- Some evidence mobile phone ownership associated with lower parity / lower ideal family size (Billari, Rotondi and Trinitapoli, 2020); knowledge and access to contraception (Rotondi et al., 2020)

Research question

- Does expansion of 3G internet have a **causal effect** on fertility?
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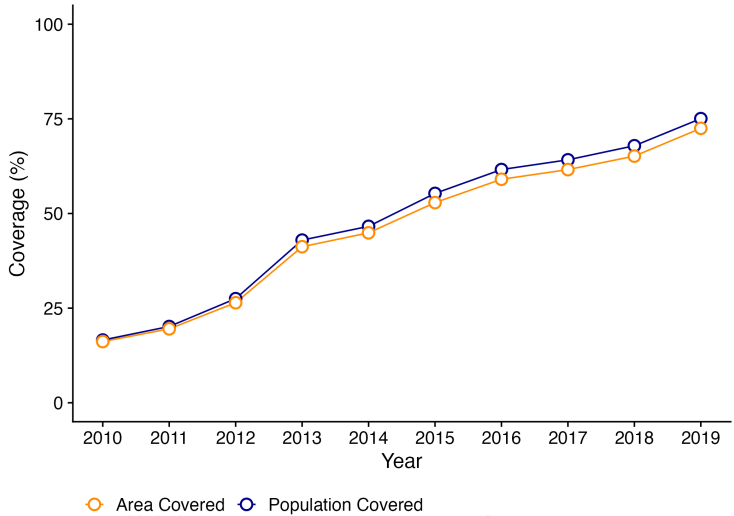
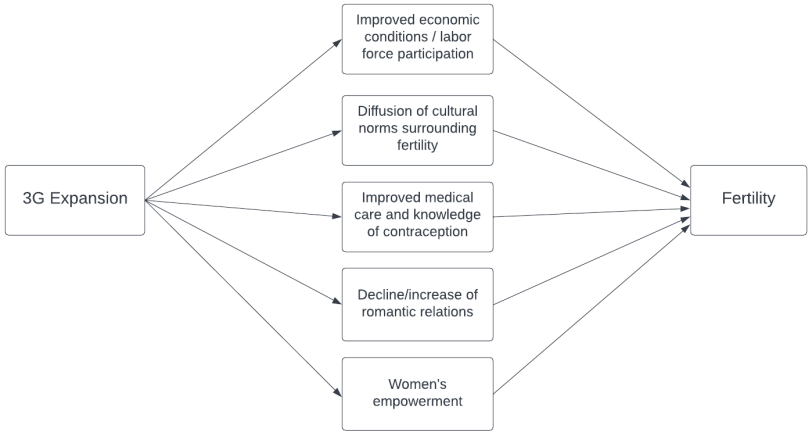
  - 3G coverage enables mobile internet (social media, exposure to ideas from global elites, etc.)
- What are mechanisms linking 3G expansion with fertility behavior?

Focus on Nigeria: Rapidly expanding 3G infrastructure



Theoretical Framework



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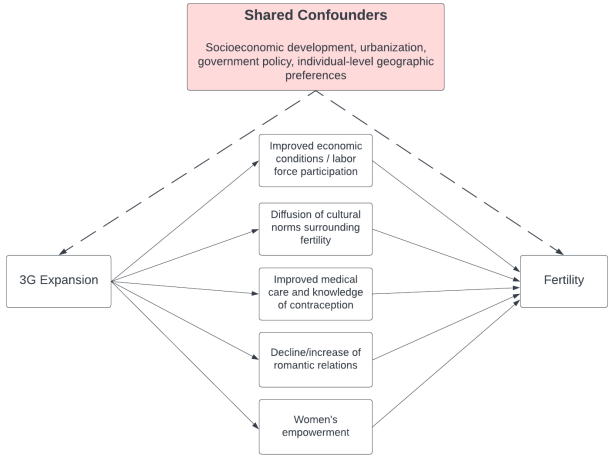
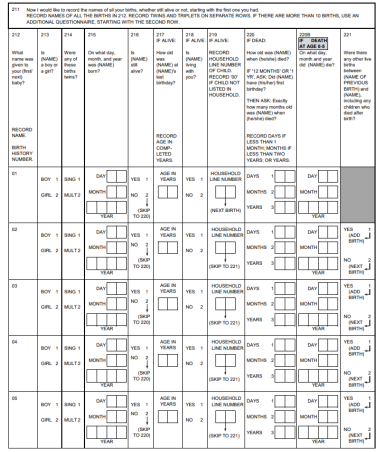


Fertility + Mobile Coverage Data

- Generate longitudinal panel:
  - 2018 Nigeria DHS birth history (2010-2018), geo-referenced
  - Annual mobile coverage maps (2010-2018)



SECTION 2. REPRODUCTION

211 Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had.
RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS AND TRIPLETS ON SEPARATE ROWS. IF THERE ARE MORE THAN 10 BIRTHS, USE AN ADDITIONAL QUESTIONNAIRE, STARTING WITH THE SECOND ROW.

212 What name was given to your (first/ next) baby? RECORD NAME. BIRTH HISTORY NUMBER.	213 Is (NAME) a boy or a girl?	214 Were any of these births twins?	215 On what day, month, and year was (NAME) born?	216 Is (NAME) still alive?	217 IF ALIVE: How old was (NAME) at last birthday? RECORD AGE IN COMPLETED YEARS.	218 IF ALIVE: Is (NAME) living with you?	219 IF ALIVE: RECORD HOUSEHOLD LINE NUMBER OF CHILD. IF CHILD NOT LISTED IN HOUSEHOLD,	220 IF DEAD: How old was (NAME) when (he/she) died? IF '12 MONTHS' OR '1 YR', ASK: Did (NAME) have (his/her) first birthday? THEN ASK: Exactly how many months old was (NAME) when (he/she) died? RECORD DAYS IF LESS THAN 1 MONTH; MONTHS IF LESS THAN 2 YEARS; OR YEARS.	220B IF DEATH AT AGE 0-5 On what day, month and year did (NAME) die?	221 Were there any other live births between (NAME OF PREVIOUS BIRTH) and (NAME), including any children who died after birth?
01	BOY 1 GIRL 2	SING 1 MULT 2	DAY / MONTH / YEAR	YES 1 NO 2 (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER (NEXT BIRTH)	DAYS 1 MONTHS 2 YEARS 3	DAY / MONTH / YEAR	
02	BOY 1 GIRL 2	SING 1 MULT 2	DAY / MONTH / YEAR	YES 1 NO 2 (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	DAY / MONTH / YEAR	YES 1 (ADD BIRTH) NO 2 (NEXT BIRTH)
03	BOY 1 GIRL 2	SING 1 MULT 2	DAY / MONTH / YEAR	YES 1 NO 2 (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	DAY / MONTH / YEAR	YES 1 (ADD BIRTH) NO 2 (NEXT BIRTH)
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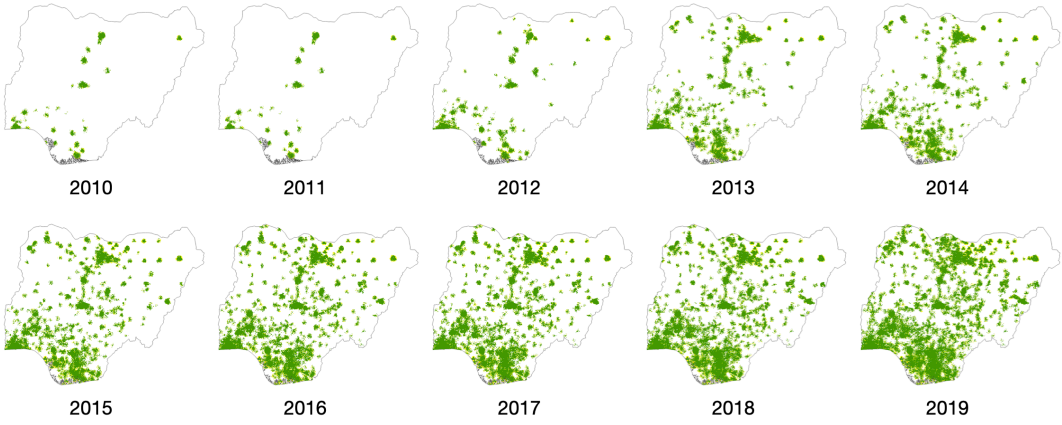
DHS Birth History

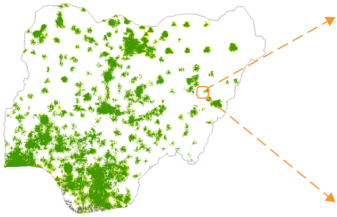
3G Coverage Rollout in Nigeria



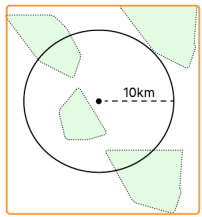
Source: GSMA Mobile Coverage Maps

Constructing longitudinal panel

Annual coverage maps (2010-2018)



Calculating 3G coverage in clusters



Combine with Nigeria 2018 DHS to create longitudinal panel

Woman ID	Year	Birth	3G Coverage	DHS Cluster	DHS Covariates
10 47 3	2010	0	0.000	001	X
10 47 3	2011	0	0.000	001	X
10 47 3	2012	1	0.000	001	X
10 47 3	2013	0	0.000	001	X
10 47 3	2014	1	0.716	001	X
10 47 3	2015	0	0.771	001	X
10 47 3	2016	0	0.780	001	X
10 47 3	2017	0	0.781	001	X
10 47 3	2018	0	0.916	001	X

Analytic Strategy (Two-Way Fixed Effects)

$$LB_{ict} = \beta_0 + \underbrace{\beta_1 3G_{ct}}_{\text{3G coverage intensity}} + \underbrace{\gamma_c}_{\text{Cluster FE}} + \underbrace{\delta_t}_{\text{Year FE}} + \underbrace{\boldsymbol{\beta}\mathbf{X}i}_{\text{Controls}} + \epsilon_{ict}$$

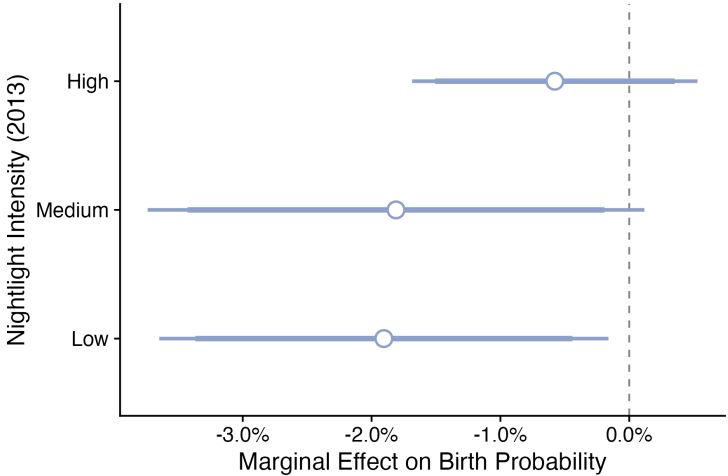
where

- LB_{ict} is an indicator for whether woman i in cluster c at time t had a live birth in the past year
- $3G_{ct}$ denotes the proportion of the population in cluster c covered by 3G service in year t

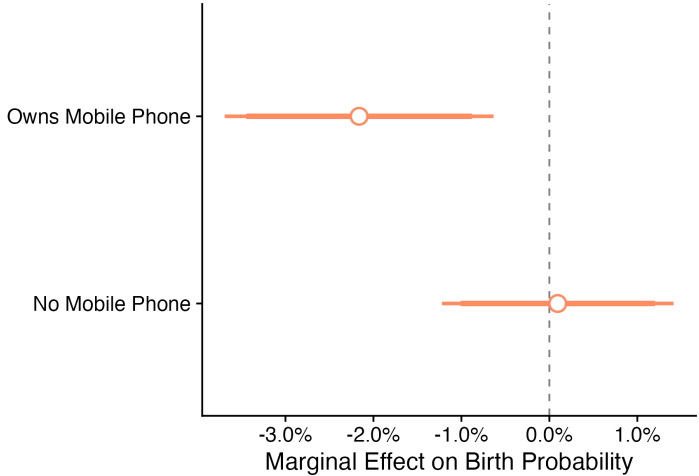
Effect of 3G Coverage on Recent Birth

	Model 1	Model 2	Model 3
Intercept	0.184***		
	(0.002)		
3G Coverage (Population Share)	-0.049***	-0.011*	-0.011*
	(0.005)	(0.005)	(0.005)
2G Coverage (Population Share)		0.005	0.005
		(0.017)	(0.017)
Individual-level controls			X
Fixed Effects: DHS Cluster		X	X
Fixed Effects: Year		X	X
Fixed Effects: Age		X	X
Fixed Effects: Parity (Lagged)		X	X
Observations	116178	116178	116178
R^2	0.002	0.087	0.089

Heterogeneity by development level (nightlights proxy)



Heterogeneity by mobile phone ownership



Alternative specifications - mother fixed effects

	Model 1	Model 2 (0 Parity)
3G Coverage (Population Share)	-0.043***	-0.054***
	(0.006)	(0.009)
2G Coverage (Population Share)	-0.003	0.026
	(0.024)	(0.031)
Fixed Effects: Mother	X	X
Fixed Effects: Year	X	X
Fixed Effects: DHS Cluster	X	X
Fixed Effects: Parity (Lagged)	X	X
Observations	194,067	60,732
R^2	0.292	0.277

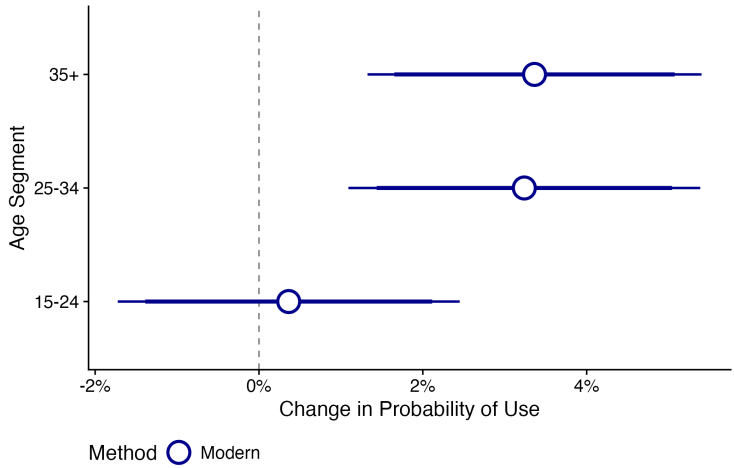
Testing Mechanisms

- Not longitudinal, measured in 2018 Nigeria DHS...
- Suggestive descriptive evidence of association between 3G expansion (2010-2018) and outcomes (not causal...)

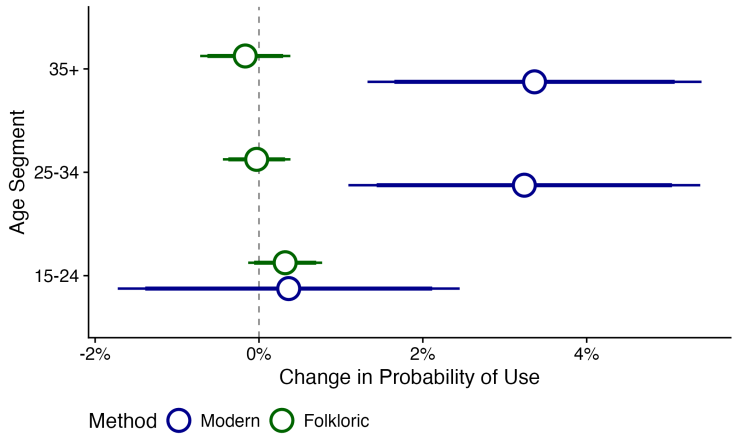
Delayed cohabitation, decreased ideal family size

	Age at First Cohabitation	Ideal family size
3G coverage expansion (cluster-level)	0.160	-0.248**
	(0.100)	(0.092)
Wealth quintile	0.088*	-0.085***
Currently working	-0.343***	0.207***
Education level	0.711***	-0.482***
Religion (Islam)	0.003	-0.002
Access to radio	0.015	0.083**
Access to television	0.090	-0.164***
FE - Birth Cohort	X	X
FE - State	X	X
Cluster covariates (rainfall, nighlights, IMR)	X	X
Observations	7202	23566

3G associated with higher modern contraception uptake



But not folkloric methods...



Conclusion

- Used mobile coverage maps and retrospective fertility histories to create a **longitudinal panel**, exploiting plausibly exogenous rollout of 3G coverage
- Full 3G coverage expansion has **causal effect** of approximately 7% reduction in probability of birth over baseline
- Plausible mechanisms:
  - Strong association between 3G expansion and ideal family size + modern contraception usage
  - Smaller association in age of first cohabitation
- **Next steps**: Investigate mechanisms in more causal framework (2013 survey), robustness check with instrument variable

Thank You

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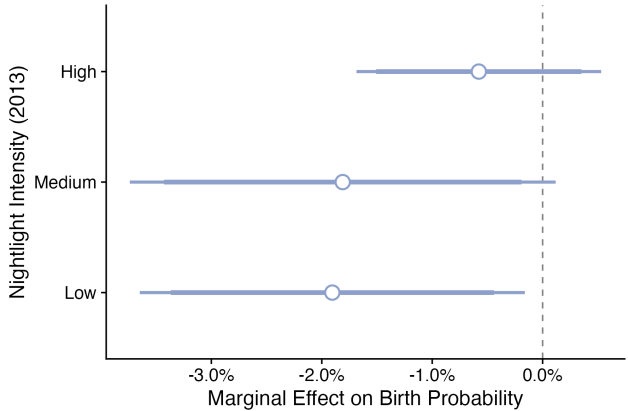

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