Information and Communication Technologies (ICTs) and Inter-Ethnic Marriage in Sub-Saharan Africa

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Abstract

Inter-ethnic marriage is often seen as a symbol of integration and social openness, and its absence as an indication of persistent ethno-racial hierarchies. Using Demographic and Health Survey (DHS) data from 21 sub-Saharan African (SSA) countries covering over 170,000 couples, this study offers two major contributions. First, we provide updated estimates of IEM in SSA, showing that IEM has been on the rise over the past 40 years, increasing roughly from 17% to 23%. While IEM has traditionally been higher in East and South Africa, the recent rise in IEM is mostly driven by countries in West and Central Africa, such as Cameroon and Côte d'Ivoire. Second, we enrich the literature on the determinants of IEM by spatially and quasi-experimentally showing that exposure to technology is a powerful force behind the increase in IEM, suggesting that connectivity and exposure to globalized cultural scripts may have contributed make ethnic boundaries more porous.

Keywords: Unions; inter-ethnic dynamics; technology; connectivity; Africa

Introduction

Inter-ethnic marriages (IEM) – i.e., a form of intermarriage where partners form unions across racial or ethnic lines – have long been seen as a measure of the strength of cleavages within societies (Kalmijn 1998), as they combine an indication of assortative mating patterns, residential segregation (i.e., who meets whom and where), and a signal of who is thought to be an acceptable spouse in terms of race/ethnicity. Intermarriage by race/ethnicity is thus seen as indicative of social integration because choosing to intermarry indicates not only a weakening of the social and symbolic boundaries of racial and ethnic groups, but also that racial and ethnic minorities are seen as increasingly equal to the majority (Blau et al. 1982; Kalmijn 1991; 1998; Muttarak and Heath 2010). Promoting social mixing and social integration has profound implications for societal inequalities, as these aspects are found to correlate positively with social solidarity and trust, as well as higher social mobility (Roth and Peck 1951; Schwartz et al. 2016). This study focuses on inter-ethnic marriage in sub-Saharan Africa (SSA), a world region characterized by very high ethnic diversity (Ajide et al. 2019), as well as rising levels of economic inequality (Pesando 2021; Shimeles and Nabassaga 2018). Therefore, our study has profound implications for the study of intra- and

inter- generational social mobility in the African context, a topic that is of key relevance in light of SSA's growing role in the geopolitical and sociodemographic landscape.

Alongside important anthropological work on IEM in Africa (Arens and Arens 1978; Peil 1975; Smith 2005), two recent studies have focused on cross-country patterns of inter-ethnic marriage in the region. On one hand, Crespin-Boucaud (2020) used Demographic and Health Surveys (DHS) from 15 SSA countries to uncover the intricacies between inter-ethnic and inter-faith unions. She documented that IEM increased between 1950s and 1990s, partly explained by increases in urbanization and education levels, while inter-faith marriages decreased, driven by decreasing levels of religious diversity. On the other hand, Bandyopadhyay and Green (2021) also used DHS data, yet from a broader sample of 26 countries, to show that IEM has been increasing over time, driven by a combination of factors such as urbanization, literacy/education, declines in polygamy, increasing employment outside agriculture, and delays in marriage age.

Although both studies hint at the possibility that, as SSA continues to modernize via massive educational expansion, urbanization, and modernization, IEM will continue to rise, neither adopts a marriage-cohort perspective, nor takes at stab at isolating the key contribution of any one determinant of IEM (at the time of union formation) in a quasi-experimental manner. We do so by isolating the role of exposure to Information and Communication Technologies (ICTs). As such, this study is unique in blending existing sociological and anthropological work with recent efforts in the field of digital demography aimed at exploring the implications of the digital revolution for multiple aspects of family life across low- and middle-income countries (Billari et al. 2020; Pesando 2022; Pesando et al. 2021; Rotondi et al. 2020; Toffolutti et al. 2020; Zheng et al. 2019).

Our contribution is twofold. First, we provide updated estimates of IEM in SSA, showing that IEM has been on the rise over the past 40 years, increasing roughly from 17% to 23%. While IEM has traditionally been higher in East and South Africa, the recent rise in IEM is mostly driven by countries in West and Central Africa, such as Cameroon and Côte d'Ivoire. Second, we enrich the literature on the determinants of IEM by examining how the expansion of mobile Internet infrastructure affects the likelihood of entering an interethnic couple in sub-Saharan Africa. We do so by combining DHS data on 21 SSA countries with mobile coverage maps from the Collins Bartholomew Mobile Coverage Explorer and adopting a geospatial approach whereby quasi-exogenous variation emerges from exposure to mobile coverage in the local geographical area of the respondent in the year before union formation. In doing so, we contribute to the existing literature by spatially and quasi-experimentally showing that exposure to technology is a powerful force behind the increase in IEM, suggesting that connectivity and exposure to globalized cultural scripts may have contributed make ethnic boundaries more porous.

There are several mechanisms through which ICTs may affect the likelihood of forming unions across ethnicities. The traditional literature on contact theory suggests that different aspects of modernization, typically proxied by educational expansion, tend to promote greater tolerance of individuals from different backgrounds, whereas more educated individuals are more likely to come into contact with members of other groups. Similarly, any factor that might increase inter-cultural contact before marriage could lead to greater intermarriage, with strong evidence for the positive role of urbanization (Choi and Tienda 2017) and service in the armed forces (Arens and Arens 1978; Peil 1975; Smith 2005). We build on this background by framing exposure to ICTs and digital connectivity as another indicator of modernization that may boost intergroup contact by making communication – and, potentially, community organization and community dynamics – smoother, swifter, and more direct. Digital technologies enhance the potential for information to swiftly reach multiple people and boost people's opportunities to connect with broader and more diverse networks, thus opening up new paths for social learning, community engagement, and mutual information exchange (Westoff and Koffman 2011). Differently from television and radio, which tend to spread a "unidirectional" flow of information and feature a more localized focus, Internet and social media – including mobile-Internet accessed through phones – enable exposure to media content that is "reciprocal" and transcends national boundaries, exposing individuals to globalized cultural scripts that may shift their opinions, views, and preferences towards multiple aspects of social life and may shape the desirability and social acceptability of certain ideas, roles, behaviors and institutions, including IEM (Varriale et al. 2021).

Data and methods

For this project, we pool information from Demographic and Health Surveys (DHS) covering 21 SSA countries and leverage a geospatial approach building on geo-localized maps from Collins Bartholomew Mobile Coverage Explorer on mobile-network operators (mostly 2G and 3G) present in the local geographical area of the respondent prior to the union, in a spirit similar to Cariolle et al. (2024), Choi et al. (2023), and Hjort and Poulsen (2019). These annual maps show the geographic extent of 2G and 3G cell phone coverage, representing the ability to make phone calls and send text messages (2G), or more comprehensive access to the internet or social media platforms and online messaging apps via mobile internet connections (3G). These maps are generated from submissions by mobile network operators around the world, who are members of the GSM Association. They consist of 1×1 km binary grid cells that take the value 1 if the cell has 2G or 3G coverage and 0 otherwise. We control for both networks since the 2G network was instrumental to Internet access in the first half of the 2010s, while Internet access mostly relied on the 3G network from the second half (26% of total mobile connections in SSA were made through 2G network as of 2021, as reported in GSMA, 2022). We build a couple-level file from the DHS and keep all those surveys that provide complete information on both partners' ethnicity, timing of first

union, as well as geospatial coordinates that allow merging with external sources. Combining DHS survey responses with mobile coverage spatial polygons allows us to locate whether respondents fall within or outside of mobile coverage boundaries.

To ensure proper matching between partners, we restrict the sample to couples where partners have been married only once (about 82% of women in the sample). To identify timing of union, we leverage information from women in over 90% of cases and complement this with information obtained from men in case of missingness of the former. This resulted in a sample of about 170,000 couples across 21 countries, as shown in Table 1 below. Technically, our marriage cohorts with the samples at hand date back to the 1950s-1960s. However, given that the expansion in mobile coverage in SSA started around the late 1990s, most of our analyses will be focused on the period between 2000 and 2018. Note that the terms marriage and union in this study will be used interchangeably.

Table 1: Subset of SSA countries in the study sample and number of couples per country

Country code	Country	Region	Number couples
BF	Burkina Faso	West/Central	12,550
BJ	Benin	West/Central	8,377
CM	Cameroon	West/Central	7,018
CD	Congo, Democratic Republic	West/Central	5,926
CI	Cote d'Ivoire	West/Central	5,788
ET	Ethiopia	East/South	13,850
GA	Gambia	West/Central	3,636
GH	Ghana	West/Central	7,959
GN	Guinea	West/Central	6,695
KE	Kenya	East/South	12,433
LB	Liberia	West/Central	1,598
ML	Mali	West/Central	10,469
MW	Malawi	East/South	9,059
MZ	Mozambique	East/South	1,828
NG	Nigeria	West/Central	23,074
SN	Senegal	West/Central	15,447
SL	Sierra Leone	West/Central	7,671
TG	Togo	West/Central	3,345
UG	Uganda	East/South	3,046
ZA	Zambia	East/South	648
ZM	Zimbabwe	East/South	8,912

The main dependent variable is inter-ethnic marriage, i.e., a dummy which equals one if partner's self-reported ethnicities differ, and zero otherwise. The main independent variable is mobile coverage in

the local geographical unit of the respondent. Indeed, respondents may have moved between union formation and time of the survey, hence we adopt a series of robustness checks to control for this issue. Methodologically, we run a simple linear probability model (LPM) predicting likelihood of entering an inter-ethnic union as a function of mobile coverage in the local geographical unit the year before the union formed. This simple specification includes basic individual-level controls, year fixed effects, geographic fixed effects (at different levels of analysis), and standard errors clustered at the Primary Sampling Unit (PSU) level, which aligns with the level of "treatment" (i.e., "coverage") assignment. At this stage, we run two types of models, one that includes all observations, i.e., it also includes those geographical areas in which mobile coverage was null (i.e., most areas before the 2000s), and one where we subset the data to the period between 2000 and 2018. In subsequent analyses, we will further refine this methodology by adopting a series of lags in the main independent variable, as well as applying a staggered difference-in-differences specification.

Preliminary findings

Figure 1 visualizes trends in IEM across marriage cohorts in the SSA countries included in the study. The Figure has three panels, to ease visualization. The top panel reports macro-trends for all countries together, and for countries in West/Central Africa and East/South Africa pooled, separately. The middle panel zooms into IEM patterns across West and Central African countries (14 countries), while the bottom panel zooms into East and South African countries (7 countries).

Findings from the top panel ("Macro areas") reveal that IEM has increased across 40 years of marriage cohorts, from about 17% to about 23%. Most of this increase is accounted for by West/Central Africa, where levels have traditionally been lower but have increased steadily. Conversely, levels in East/South Africa have traditionally been higher but have decreased rapidly over the past decade. The middle panel ("West and Central Africa") confirms that IEM has increased across cohorts in West and Central Africa, yet cross-country variation is pronounced, with countries such as the Gambia and Mali showing persistently high rates of IEM, countries such as Cameroon and Côte d'Ivoire showing low levels of IEM in earlier cohorts followed by rapid increases, and countries such as Democratic Republic of Congo showing persistently low levels of IEM. Lastly, the bottom panel ("East and South Africa") shows similarly high levels of cross-country variability, with Zimbabwe and Uganda featuring very high levels of IEM, rising in the former country and declining in the latter one, and countries such as Zambia exhibiting low and stable levels of IEM. Despite country-specific differences, glimpsing at all panels reveals quite neat increases in IEM across marriage cohorts.

Figure 1: Trends in inter-ethnic marriage in SSA across 40 years of marriage cohorts

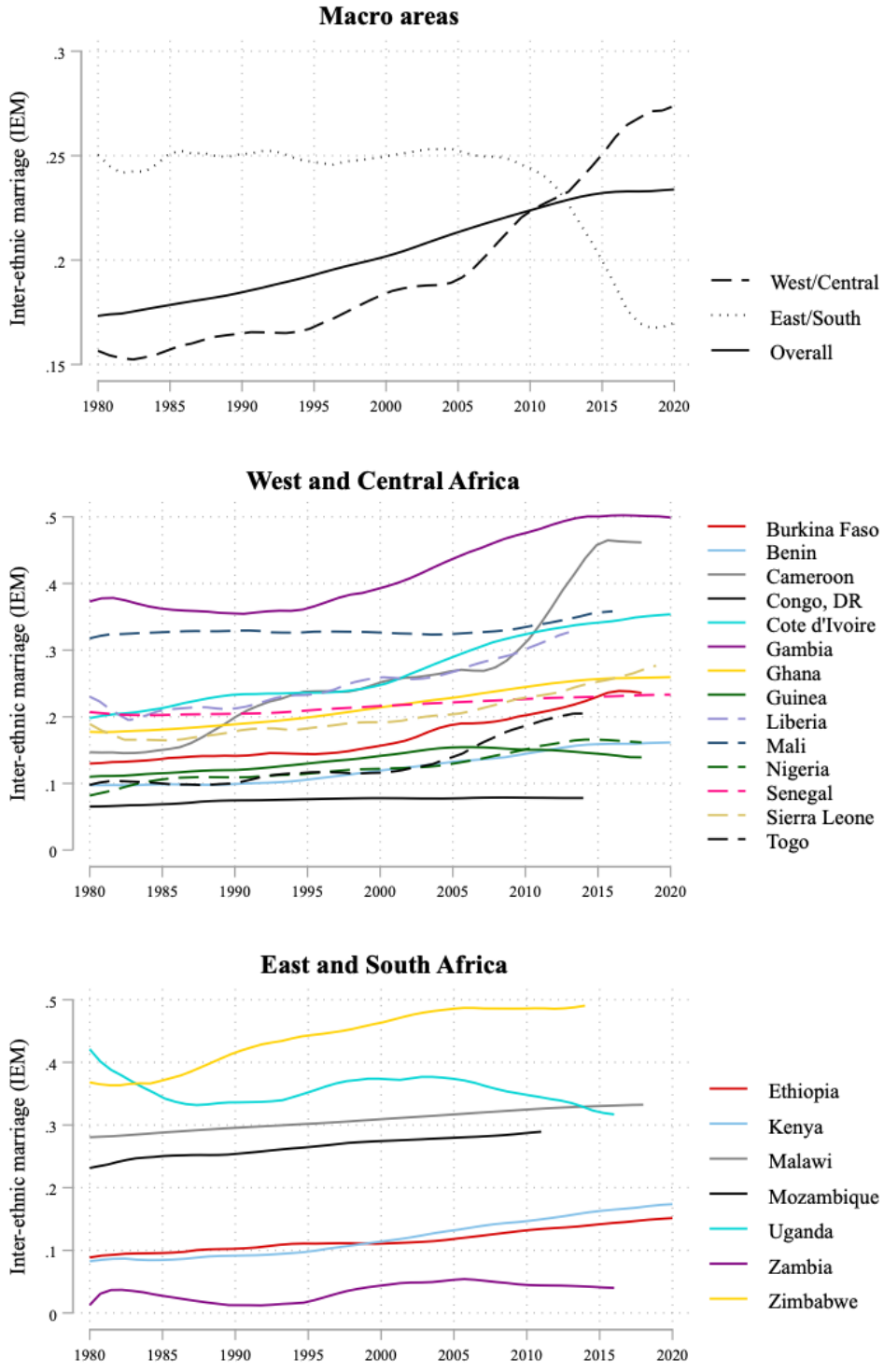

Table 2 provides results on the association between mobile coverage and likelihood of entering an inter-ethnic union. The Table focuses on pooled analyses with country fixed effects, as well as with fixed effects and lower geographical levels of analyses, namely village and PSU. Findings suggest that exposure

to mobile coverage is associated with an increase in the likelihood of IEM by 4-9 percentage points, depending on specification. In percentage terms, the most conservative specification reveals a positive strong association close to 20%.

Table 2: Relationship between mobile coverage and IEM, pooled analyses

	Inter-ethnic marriage					
	Whole period			**2000-2018 period**		
	Country FE	Admin1 FE	Admin2 FE	Country FE	Admin1 FE	Admin2 FE
2G/3G coverage in local area	0.086***	0.058***	0.043***	0.089***	0.060***	0.043***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Observations	178,466	176,875	176,875	91,834	91,557	91,557
R2	0.071	0.117	0.157	0.072	0.126	0.179

Note: *p<0.1; **p<0.05; ***p<0.01.

Table 3 assesses this same relationship in each individual country. Results are again highly robust and consistent. The association is positive in all countries, and statistically different from zero in over half of them (12 countries). Most sizeable associations over 10 percentage points are observed in Cote d'Ivoire (14.3pp), Mozambique (14.1pp), Zimbabwe (13.8pp), and Mali (11pp).

Table 3: Relationship between mobile coverage and IEM, country-specific analyses

	2G/3G coverage in local area		
	Coefficient	N	R2
Burkina Faso (BF)	0.083***	12,863	0.036
	(0.018)		
Benin (BJ)	0.033*	8,737	0.077
	(0.019)		
Cameroon (CM)	0.091***	7,557	0.131
	(0.022)		
Congo, Democratic Republic (CD)	0.062***	5,634	0.151
	(0.016)		
Cote d'Ivoire (CI)	0.143***	5,680	0.075
	(0.020)		
Ethiopia (ET)	0.041	14,349	0.070
	(0.026)		
Gambia (GA)	0.027	2,735	0.086
	(0.032)		
Ghana (GH)	-0.009	8,006	0.058
	(0.020)		
Guinea (GN)	0.033	6,933	0.044
	(0.021)		
Kenya (KE)	0.041***	11,921	0.082
	(0.012)		
Liberia (LB)	0.087*	1,603	0.136
	(0.046)		
Mali (ML)	0.110***	11,266	0.061
	(0.025)		
Malawi (MW)	0.040*	9,322	0.078

	(0.022)		
Mozambique (MZ)	0.141***	1,845	0.154
	(0.034)		
Nigeria (NG)	0.011	23,217	0.055
	(0.010)		
Senegal (SN)	0.091***	15,548	0.068
	(0.011)		
Sierra Leone (SL)	0.026	7,528	0.073
	(0.020)		
Togo (TG)	0.028	3,630	0.051
	(0.026)		
Uganda (UG)	0.051	3,020	0.189
	(0.033)		
Zambia (ZA)	0.039	649	0.118
	(0.042)		
Zimbabwe (ZM)	0.138***	8,990	0.078
	(0.019)		

Note: *p<0.1; **p<0.05; ***p<0.01

Next steps

In next iterations, before the conference, we will:

- Clean the estimates addressing more thoroughly other possible threats to identification, such as selective migration;
- Compute measures of ethnic heterogeneity and fractionalization in the local geographical area to account for marriage-market characteristics at time of union formation (i.e., computing segregation indices such as Duncan and Herfindahl);
- Account for broader controls capturing local and regional development (e.g., nighttime lights);
- Subset the analyses overtime to capture the staggered shift from 2G to 3G, and from 3G to 4G, instead of pooling all of these together;
- Focus on the subset of countries which have information on mobile-phone ownership at the individual level, and use this as control, as well as potentially use this within an Instrumental Variable framework where mobile-phone coverage in the local geographical area serves as IV for individual-level mobile-phone ownership;
- Expand on the sociological relevance and sociological mechanisms at play.

References

Ajide, K. B., Alimi, O. Y., and Asongu, S. A. (2019). Ethnic diversity and inequality in sub-Saharan Africa: Do institutions reduce the noise? *Social Indicators Research*, 145: 1033-1062.

Arens, W., and Arens, D. A. (1978). Kinship and marriage in a polyethnic community. *Africa: Journal of the International African Institute*, 48(2), 149–160.

Bandyopadhyay, S. and Green, E. (2021). Explaining inter-ethnic marriage in sub-Saharan Africa. *Journal of International Development*, 33(4): 627-643.

Billari, F. C., Rotondi, V., and Trinitapoli, J. (2020). Mobile phones, digital inequality, and fertility: Longitudinal evidence from Malawi. *Demographic Research*, 42(June), 1057–1096.

Blau, P. M., Blum, T. C., and Schwartz, J. E. (1982). Heterogeneity and intermarriage. *American Sociological Review*, *47*(1): 45–62.

Cariolle, J., Elkhateeb, Y., and Maurel, M. (2024). Misinformation technology: Internet use and political misperceptions in Africa. *Journal of Comparative Economics*, 52(2): 400-433.

Choi, K. H., and Tienda, M. (2017). Marriage-market constraints and mate-selection behavior: Racial, ethnic, and gender differences in intermarriage. *Journal of Marriage and the Family*, 79(2), 301–317.

Crespin-Boucaud, J. (2020). Interethnic and interfaith marriages in sub-Saharan Africa. *World Development*, 125: 104668.

GSMA (2022). The Mobile Economy 2022: Technical Report. https://www.gsma.com/mobileeconomy/wp-content/uploads/2022/02/280222-The-Mobile-Economy-2022.pdf.

Hjort, J., and Poulsen, J. (2019). The arrival of fast Internet and employment in Africa. *American Economic Review*, 109(3): 1032-1079.

Kalmijn, M. (1991). Status homogamy in the United States. *American Journal of Sociology*, *97*(2): 496–523

Kalmijn, M. (1998). Intermarriage and homogamy: Causes, patterns, trends. *Annual Review of Sociology*, 24(1), 395–421.

Muttarak, R., and Heath, A. (2010). Who intermarries in Britain? Explaining ethnic diversity in intermarriage patterns. *The British Journal of Sociology*, *61*(2), 275–305.

Peil, M. (1975). Interethnic contacts in Nigerian cities. *Africa: Journal of the International African Institute,* 45(2), 107–122.

Pesando, L. M. (2021). Educational assortative mating in sub-Saharan Africa. Compositional changes and implications for household wealth inequality. *Demography*, 58(2): 571-601.

Pesando, L. M. (2022). Safer if connected? Mobile technology and intimate partner violence. *Demography*, 59(2), 653–684.

Pesando, L. M., Rotondi, V., Stranges, M., Kashyap, R., and Billari, F. C. (2021). The Internetization of international migration. *Population and Development Review*, 47(1), 79–111.

Roth, J. and Peck, R. F. (1951). Social class and social mobility factors related to marital adjustment. *American Sociological Review*, 16(4):478–487.

Rotondi, V., Kashyap, R., Pesando, L. M., Spinelli, S., and Billari, F. C. (2020). Leveraging mobile phones to attain sustainable development. *Proceedings of the National Academy of the Sciences*, 117(24), 13413–13420.

Schwartz, C. R., Zeng, Z., and Xie, Y. (2016). Marrying up by marrying down: Status exchange between social origin and education in the United States. *Sociological Science*, 3:1003–1027.

Shimeles, A., and Nabassaga, T. (2018). Why is inequality high in Africa? *Journal of African Economies, 27,* 108–126.

Smith, D. J. (2005). Legacies of Biafra: Marriage, "home people" and reproduction among the Igbo of Nigeria. *Africa: Journal of the International African Institute*, 75(1), 30–45.

Toffolutti, V., Ma, H., Menichelli, G., Berlot, E., Mencarini, L., and Aassve, A. (2020). How the internet increases modern contraception uptake: Evidence from eight sub-Saharan African countries. *BMJ Global Health,* 5(11), 1–10.

Varriale, C., Pesando, L. M., Kashyap, R., and Rotondi, V. (2022). Mobile phones and attitudes towards women's participation in politics: Evidence from Africa. *Sociology of Development*, 8(1), 1–37.

Westoff, C. F., and Koffman, D. A. (2011). The association of television and radio with reproductive behavior. *Population and Development Review*, 37(4), 749–759.

Zheng, S., Duan, Y., and Ward, M. R. (2019). The effect of broadband internet on divorce in China. *Technological Forecasting and Social Change,* 139(May 2017), 99–114.