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Ethnic politics and the diffusion of mobile technology in Africa

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HIGHLIGHTS

- Ethnic power-sharing depends on groups' population shares (Francois et al. 2015).
- Study on the effect of population shares on mobile phone infrastructure.
- Identification strategy exploits artificial drawing of African borders.
- Larger ethnic groups have more and better mobile phone infrastructure.
- Ethnic power-sharing thus affects the diffusion of mobile technology in Africa.

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ABSTRACT

We analyze the effect of an ethnic group's country-level population share on the mobile phone infrastructure in Africa. Consistent with the African power-sharing arrangements documented by Francois et al. (2015), we find that larger ethnic groups benefit from a higher concentration of mobile phone infrastructure and a higher fraction of UMTS cell sites.

1. Introduction

Mobile phones are considered one of the key technologies that are expected to improve the livelihoods of millions of Africans over the coming years (Aker and Mbiti, 2010).[1] They can reduce the search costs for economic agents and readily provide them with data on market prices (e.g. Aker, 2010; Aker and Fafchamps, 2015; Tadesse and Bahiigwa, 2015), and they facilitate informal risk sharing (Jack and Suri, 2014; William and Suri, 2014). However, despite the many economic benefits and high rate of adaptation of mobile phones across the continent, only about half of Africans currently have access to mobile phones.[2] So far, we know little about the drivers behind the diffusion of mobile phone infrastructure in Africa. Buys et al. (2009) find that mobile phone coverage is correlated with income, population density, and an area's geographic characteristics.

In this study, we examine how ethnic politics affects mobile phone infrastructure. The reasons are twofold. First, ethnic politics is known to shape the provision of public goods, including infrastructure, in Africa (e.g., Franck and Rainer, 2012; Burgess et al., 2015; Weidmann et al., 2016; Dimico, 2017). Second, mobile phone infrastructure may well depend on publicly provided goods, such as building infrastructure, access to the grid (or continuous supply of fuel for generators), and the protection of mobile phone assets.

Francois et al. (2015) document that in Africa, an ethnic group's population share is a good predictor of its share of cabinet positions and, thereby, its power. Inspired by this contribution, we study whether the size of ethnic groups indeed shapes mobile phone infrastructure across ethnic groups within African countries.

The main problem in answering this question is that a positive correlation between an ethnic group's country-level population share and mobile phone infrastructure could be the result of better

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[1] Of course, mobile phones can also increase household income elsewhere; see, e.g., Hübler and Hartje (2016) on Southeast Asia.

[2] The Economist, ''Mobile phones are transforming Africa'', December 10, 2016.

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organized ethnic groups that are both larger and more technologically advanced. We therefore follow Michalopoulos and Papaioannou (2013, 2014) and Dimico (2017) in exploiting the artificial drawing of African borders in European capitals in the second half of the 19th century.

2. Data

The ethnolinguistic map by Murdock (1959) shows the spatial distribution of ethnic groups in the mid- to late- 19th century. Following Michalopoulos and Papaioannou (2013, 2014), we overlay the boundaries between these traditional ethnic homelands with country borders for the years 2000–2010 to identify partitioned ethnic homelands and build new geographical units that represent the intersection of ethnic homelands and countries.[3] These 646 new geographical units, which we call country-ethnicity regions, are our units of analysis.

Our outcome variables measure the prevalence of mobile phone infrastructure in each of these country-ethnicity regions. The raw data are from OpenCellID (http://opencellid.org), which is the world's largest open data collection of the global GPS positions of cell sites.[4] The data contain the location information (longitude and latitude) of almost seven million unique cell sites worldwide, including around 644 000 in Africa as of December 2016 (when we accessed the data). This location information allows assigning each cell site to a specific country-ethnicity region. In addition, the OpenCellID data also contain information on the type of phone network used (GSM, UMTS, etc.).

We use these data to create two measures of mobile phone infrastructure, namely, the number of cell sites per km^2 (in logs), which is a proxy for local cell-phone coverage, and the fraction of UMTS cell sites out of all cell sites. UMTS (third-generation mobile technology, 3G) is more advanced than GSM (second-generation mobile technology, 2G). Among other functions, UMTS enables mobile Internet access and video calls.

Following Michalopoulos and Papaioannou (2013), we use the population map by UNEP/GRID Sioux Falls to compute the total population for all country-ethnicity regions. Our main explanatory variable is an ethnic group's country-level population share, $cpopshare_{ic} = pop_{ic}/\sum_j pop_{jc}$, where pop_{ic} is the population in country-ethnicity region ic. We further use these data to construct population-based control variables.

To control for the effects of regional economic development on the expansion of mobile phone infrastructure, we follow Michalopoulos and Papaioannou (2013, 2014), De Luca et al. (2015), and Alesina et al. (2016) in using satellite data on nighttime light intensity from the National Oceanic and Atmospheric Administration as a proxy for economic activity in country-ethnicity regions.[5]

In addition, we use the geographical control variables by Michalopoulos and Papaioannou (2013), such as the mean elevation, the soil suitable for agriculture, malaria suitability, petroleum fields and diamond mines, as well as distances to the sea, the closest border, and the capital. Furthermore, we compute the total kilometers of roads in each country-ethnicity region.

Table 1 provides the summary statistics of our key variables.[6]

3. Empirical strategy

We estimate the effect of an ethnic group's country-level population share ($cpopshare_{ic}$) on mobile phone infrastructure (mpi_{ic}) by using the following specification:

$$mpi_{ic} = \alpha_i + \beta_c + \gamma\ cpopshare_{ic} + X_{ic}\Delta + \epsilon_{ic}.$$

The ethnic homeland fixed effects, α_i, ensure that the coefficient of interest, γ, is only estimated on the basis of the differences across country-ethnicity regions belonging to the same (partitioned) ethnic homeland i, and cannot be due to some group- or homeland-specific traits. The country fixed effects, β_c, control for all time-invariant country-level characteristics. We further add control variables at the country-ethnic homeland level, represented by vector X_{ic}. They capture geographical characteristics or information on the population distribution beyond $cpopshare_{ic}$ to ensure that the coefficient γ indeed captures the effect of ethnic groups' country-level population shares rather than other population-related characteristics.

We follow Michalopoulos and Papaioannou (2013, 2014) in clustering the standard errors, ϵ_{ic}, at the country- and the ethnolinguistic family level using the methodology of Cameron et al. (2011).

4. Findings

Table 2 presents our results for cell sites. In column (1), we regress cell sites per km^2 (in logs) on the ethnic groups' country-level population shares ($cpopshare_{ic}$) without any fixed effects or control variables. We find a strong positive association between the two. In column (2), we add population density (in logs), nighttime light intensity per capita (in logs), and the set of geographical control variables to account for economic and geographic factors, as well as settlement patterns. The coefficient drops by half but remains statistically significant.

In column (3), we include ethnic homeland fixed effects to draw inference only from the comparison of country-ethnicity regions that belong to the same ethnic homeland. The coefficient remains very similar. In column (4), we further add country fixed effects. The coefficient estimate of 3.61 implies that an increase by one standard deviation in an ethnic group's country-level population share (0.149) leads to a 54% increase in cell sites per km^2.

In column (5), we add total population (in logs) and the ethnicity-level population share. The former accounts for the possibility that more populous country-ethnicity regions may benefit from economies of scale in infrastructure investment, and the latter for the possibility that more populous fragments of a partitioned ethnic homeland may be more economically successful. In column (6), we further add the total kilometers of roads (in logs) to control for other infrastructure investments that might be correlated with investments in mobile phone infrastructure. The coefficient of interest decreases slightly, but remains statistical significant.

In Table 3, we show that the ethnic groups' country-level population share has also a positive effect on the fraction of UMTS cell sites among all cell sites. In terms of magnitude, the estimated coefficient in column (4) suggests that an increase by one standard deviation in an ethnic group's country-level population share leads to an increase in the fraction of UMTS cell sites by almost 6 percentage points, which correspond to more than a quarter of the sample mean of the fraction of UMTS cell sites.

5. Conclusion

We find that the power-sharing arrangements documented by Francois et al. (2015) have substantial consequences on the diffusion of mobile phone infrastructure within African countries.

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3 As small partitions can be the result of imprecisions of the underlying maps, we follow Michalopoulos and Papaioannou (2013) in excluding all partitions of less than 100 km^2. In addition, we use alternative data to check whether the 68 partitions between 100 and 1000 km^2 are traditional ethnic homelands in the respective country. We keep 31 of these partitions and drop the remaining 37. The Online Appendix describes this procedure and shows that the estimated coefficients are very similar and the precision slightly improved if we keep these 37 partitions.

4 A cell site refers to a base transceiver station. Each base transceiver station has a unique cell ID. Each cell tower can have multiple base transceiver stations.

5 Henderson et al. (2012) and Hodler and Raschky (2014) document that nighttime light intensity is strongly related to GDP at the level of countries and subnational administrative regions, respectively.

6 The Online Appendix provides more information on our data.