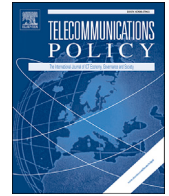


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## Exploring the walled garden theory: An empirical framework to assess pricing effects on mobile data usage

Ava Chen<sup>a,\*</sup>, Nick Feamster<sup>a,\*</sup>, Enrico Calandro<sup>b</sup><sup>a</sup> Princeton University, Centre for Information Technology Policy, 303 Sherrerd Hall, Princeton, NJ 08544, USA<sup>b</sup> Research ICT Africa, 409 The Studios, Old Castle Brewery, 6 Beach Road, Woodstock, 7925, Cape Town, South Africa

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### ABSTRACT

This paper performs an exploratory study of mobile usage patterns over three years (2013–2015) in the context of pricing practices such as zero-rating. In recent years, there has been heated ongoing debate regarding whether offering different pricing plans, such as zero-rated services and applications, might slant user behavior toward certain content on the Internet. Our study gathers empirical measurements of mobile application usage to address this research question. We shed light on this issue by performing an exploratory analysis of the effects of different data plans and connection types on mobile data usage, as well as measuring quantitative and qualitative pricing effects of zero-rating on mobile data usage.

First, we perform a longitudinal exploratory study using data collected from the MySpeedTest application. We analyze differences in usage behavior between the top five most used applications in the United States (US) and South Africa (ZA), comparing usage on different connection types (Wi-Fi vs. cellular) as well as for devices on different data plans (prepaid vs. postpaid limited monthly data cap vs. uncapped).

Our findings show that US users consume slightly more cellular data than Wi-Fi data for most of the US top five most used applications, while South African users generally prefer Wi-Fi connections (with the notable exception of Facebook). Further, US users on postpaid plans display much higher average monthly mobile data usage than those on prepaid plans, while South African users on prepaid plans generally display much higher usage than those on postpaid plans.

Next, we perform a deeper analysis into the possible behavioral effects of zero-rating in South Africa. We find in one case that zero-rating WhatsApp on Cell-C's network increases overall usage of the application, regardless of connection type. In the case of zero-rating Twitter on MTN network, we observe increased mobile data usage of the zero-rated application during and immediately after the promotion, but not in the long term. Some of our results yield striking patterns, yet point to the need for richer datasets to confirm these initial findings.

Finally, to gain further insights into the user motivations behind our empirical observations, we implement a mobile-based survey among a randomly selected group of individuals in South Africa and Kenya. We observe that use of zero-rating services is actually quite low among respondents. Further, zero-rating seems to serve more as a popular method for data conservation—an effort toward which respondents show a strong dedication—than as a walled garden that would otherwise discourage users from venturing beyond zero-rated applications.

\* Corresponding authors.

E-mail address: [avac@alumni.princeton.edu](mailto:avac@alumni.princeton.edu) (A. Chen).

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## 1. Introduction

Recent years have seen heated ongoing debate regarding whether offering different pricing plans might slant user behavior toward certain content on the Internet (A4AI, 2015; Leidel, 2015; Shearsl, 2014; van Schewick, 2015). Of particular interest is the practice of zero-rating, which allows Internet service provider (ISP) customers to access and use certain mobile applications or services without incurring data usage charges. The practice is increasingly popular in both developed and developing countries, but it has stimulated a vociferous debate, especially in developing countries (Bathia, 2016; De Guzman, 2014) where the costs of mobile data services are higher relative to per capita incomes (Eisenach, 2015).

Critics of zero-rating cite that the practice may violate the principle of net neutrality, which states that service providers should treat all bits of traffic flow equally, regardless of payment to the service provider (Drossos, 2015; The Centre for Internet & Society, 2014; van Schewick, 2015). A similar argument from consumers claims that zero-rating creates a walled garden that discourages users from venturing beyond the limited array of applications dictated by a zero-rating service provider (van Schewick, 2015; Malcom et al, 2016). The other side of the debate, whose advocates include Mark Zuckerberg and Facebook, insists that zero-rating can provide initial connectivity to consumers who otherwise would not have connectivity at all (Shearsl, 2014). According to proponents of this argument, zero-rated applications and services can serve as a gateway that encourages users to ultimately use a broader range of Internet services (Nowak, 2015).

This paper offers empirical data to address some of the main concerns on the zero-rating debate by investigating how various pricing-related features affect mobile data usage. The study first investigates behavioral discrepancies between users on different data plans and connection types, as well as taking into account pricing practices such as zero-rating. Second, to understand users' motivations on zero-rating usage, it explores the effects of zero-rating practices on mobile Internet usage for a simple random sample of the South African and Kenyan populations.

Obtaining empirical evidence on the relationship between mobile data usage behaviors and mobile data pricing practices such as zero-rating can benefit all stakeholders involved in the ongoing debate. Our study can help network carriers and regulators determine which data plans elicit different types of data usage and whether introducing zero-rated services may affect user behavior. From a policy perspective, better data may dissuade policy makers from making decisions that negatively affect competition in a dynamic telecommunications and Internet services market. Along with network carriers, regulators, and policy makers, mobile applications and organizations alike can benefit from understanding possible behavioral effects of zero-rating to plan future pricing strategies to increase connectivity.

Our research makes three contributions:

- 1) We compare mobile data usage in the United States vs. South Africa, focusing on the top five used apps in each country and measuring the effects of connection type and data cap on mobile usage behavior;
- 2) We study the effects of zero-rating pricing on mobile data usage in South Africa; and
- 3) We perform a qualitative study to investigate the motivations behind zero-rating usage in South Africa and Kenya.

Our study first explores longitudinal mobile usage patterns in South Africa as compared to the United States, the former as a precursor to our pricing analysis on zero-rating and prepaid data pricing, and the latter as a baseline point of comparison with a high-income country where uncapped plans are prevalent. To analyze the effects of zero-rating on mobile usage, we focus on South Africa because zero-rating has become a popular and established practice in the country (Chair, 2015), and we have a significant number of South African users (249) on MySpeedTest. We investigate different zero-rating practices across the main carriers in South Africa and search for any changes in usage breakdowns that may have resulted from these pricing practices. Finally, to understand user motivations behind the behavioral patterns that we observe, we perform a qualitative comparative analysis on zero-rating between South Africa and Kenya by administering a mobile-based survey to users in the two countries. We introduce Kenya into this portion of the study because of the prevalence of zero-rating data plans in the country (Walubengo, 2016). Although the Kenyan and South African economies may vary, Kenya serves as a good point of comparison in our survey analysis because, similar to South Africa, the country has one of the biggest telecommunications markets in Africa (ITU, 2016). This set of users thus serves as an important baseline for comparison against zero-rating in South Africa, since the other countries for which we have data (e.g., the US) do not have extensive zero-rating practices.

## 2. Prior and related work

We summarize four previous studies investigating data usage practices and patterns: the first two studies analyze behavioral trends on a macro scale, and the last two attempt to understand user behavior at a micro (i.e., per-user) level.

In 2014, the Sandvine Global Internet Phenomena Report (Sandvine Intelligent Broadband Networks, 2014) published findings on fixed and mobile Internet access in various continental regions around the world. Most relevant to this study are mobile access trends prevalent in North America and Africa. The 2014 report claims real-time entertainment and social networking applications dominate peak period mobile traffic in North America. The former accounts for 36.5% of aggregate traffic on the network, while the latter accounts for 26.36%. The high representation of social network traffic, coupled with the fact that social applications typically generate much less traffic than entertainment streaming applications, speaks to the popularity of social networking applications among users. With regard to traffic trends in Africa, the report finds that peak-period mobile traffic is dominated by web-browsing (34.85%) and communications (28.92%) applications. In addition, Africa is the only region in which Opera Mini, a web browser focused on data efficiency, is among the top-ten most popular applications, which may suggest that users in this region are more dedicated to conserving

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