



Airtime transfers and mobile communications: Evidence in the aftermath of natural disasters[☆]



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ARTICLE INFO

Article history:

Received 2 January 2014

Received in revised form 8 January 2016

Accepted 12 January 2016

Available online 22 January 2016

Keywords:

Mobile phones

Natural disasters

Informal insurance

Favor exchange

Risk sharing

Mobile money

Rwanda

ABSTRACT

We provide empirical evidence that Rwandans use the mobile phone network to transfer airtime to those affected by unexpected shocks. Using an extensive dataset on mobile phone activity in Rwanda and exploiting the quasi-random timing and location of natural disasters, we show that individuals make transfers and calls to people affected by disasters. The magnitude of these transfers is small in absolute terms, but statistically significant; in response to the Lake Kivu earthquake of 2008, we estimate that roughly US\$84 in airtime was transferred to individuals in the affected region, that 70% of these transfers were immediately used to make outgoing calls, and that US\$16,959 was spent calling those near the epicenter. Unlike other forms of interpersonal transfers, mobile airtime is sent over large geographic distances and in response to covariate shocks. Transfers are more likely to be sent to wealthy individuals, and are sent predominantly between pairs of individuals with a strong history of reciprocal favor exchange.

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1. Introduction

In the aftermath of unexpected economic shocks, people often rely on friends and family for support in cash and in kind. In developing countries, support has historically been limited by weak infrastructure for communicating with and assisting others. As a result, most empirical evidence indicates that assistance and favors are primarily exchanged within small, geographically-defined communities (Udry, 1994; Fafchamps and Gubert, 2007; de Weerd and Fafchamps, 2010).

In recent years, the proliferation of mobile phones and of phone-based financial services has provided billions of individuals in developing countries with a new mechanism for communication and interpersonal transfers. With roughly 250 deployments in the global south, such “branchless banking” systems allow individuals to transfer money from one phone to another at a fraction of the cost of existing alternatives (McKay and Pickens, 2010; GSMA, 2014). In Kenya, for instance, where over US\$50 million is transferred over the system per day, individuals with access to the mobile money network are better

able to smooth consumption than those without (Suri et al., 2012; Jack and Suri, 2014; Pulver, 2009).

We exploit a novel source of data on mobile phone use to better understand how individuals use the mobile phone network to cope with unexpected shocks. We observe the entire universe of mobile phone-based communications in Rwanda from 2005 to 2009, including transaction logs that contain detailed information on millions of interpersonal transfers of mobile airtime and billions of phone calls. Our primary results are identified by a magnitude 6.0 earthquake in the Lake Kivu region of Rwanda, which left 43 dead and 1090 injured, and caused significant disruption in public utilities and other local infrastructure. While Rwanda did not have a functioning mobile money system at the time of this earthquake, we observe that in the earthquake's immediate aftermath, individuals living across Rwanda transferred airtime and initiated phone calls to individuals living close to the epicenter. We estimate that an additional US\$84 in airtime was transferred, and that US\$16,959 was spent making phone calls, to affected individuals. The economic significance of the airtime transfers was thus modest, though this is due in part to the fact that only 1400 individuals in the region had ever used the airtime transfer service prior to the earthquake, creating a small population of potential recipients. The value of the phone calls was much higher, though more difficult to interpret. Since in Rwanda the caller bears the full cost of making a phone call, this may represent an implicit transfer of communication costs, but more likely it simply expresses the desire of the calling party to communicate in a time of crisis. Our empirical results are robust to the inclusion of dyad fixed effects,

[☆] The authors are grateful for thoughtful comments from Alain de Janvry, Stefano DellaVigna, Federico Finan, Mauricio Larrain, Ethan Ligon, Jeremy Magruder, Edward Miguel, Alex Rothenberg, Elisabeth Sadoulet, and seminar participants at NEUDC, PACDEV, MWIEDC, and the Berkeley Development Lunch. We gratefully acknowledge the financial support of the International Growth Center, the National Science Foundation, the Institute for Money, Technology and Financial Inclusion, and the NET Institute. All errors are our own.

time dummies, and time-varying controls. We further provide several robustness checks and placebo tests to show that the results are not simply driven by the large number of observations in our dataset.

Our analysis reveals significant heterogeneity in the nature of transfers sent in response to unexpected shocks. Using several different proxies for socioeconomic status based on follow-up interviews with a representative sample of mobile phone subscribers, we find that while wealthier individuals are more likely to receive transfers under normal circumstances, they are even more likely to receive transfers after natural disasters. The recipients of shock-induced transfers also have larger social networks, and are more centrally positioned within their network. Along several additional dimensions, it is the historically privileged strata of Rwandan society who appear to benefit most from access to mobile phone-based transfers.

Finally, we analyze the pattern of interpersonal transfers to shed light on the motives that cause people to make transfers to those impacted by covariate shocks. Our goal is to test whether the observed transfers are more consistent with a model of giving based on pure charity (Becker, 1974; Andreoni and Miller, 2002) or with a model of conditional reciprocity where individuals give because they wish to receive in the future (e.g., Ligon et al., 2002; Foster and Rosenzweig, 2001; Falk and Fischbacher, 2006). While our ability to cleanly differentiate between these models is limited by the observational data at our disposal, three stylized facts in our data appear broadly consistent with a model based on reciprocity. First, there is a strong history-dependence of transfers sent in response to large shocks, in that after the earthquake people are more likely to send funds to people from whom they have received in the past. Second, it is the wealthier individuals who receive the largest volume of transfers in the immediate aftermath of the earthquake, not the poorer individuals that one would expect in a naive model of charity. Third, post-quake transfers decrease with the geographic distance between individuals, even when controlling for social distance and unobserved, time-invariant dyadic heterogeneity.

To summarize, the evidence indicates that Rwandans use airtime transfers to help each other cope with large economic shocks, that benefits from these transfers are not uniformly distributed, and that the pattern of transfers is consistent with conditional reciprocity. To the extent that airtime transfers can be interpreted as a form of favor exchange, there are two features that distinguish the mobile phone-based response from much of the evidence on favor exchange, especially traditional risk sharing. First, whereas traditional risk sharing networks are constrained by geography (Udry, 1994; Fafchamps and Gubert, 2007), transfers sent over the mobile phone network are sent over large distances, often in excess of 100 km. Second, these transfers are sent in response to large, covariate shocks, rather than the geographically isolated, idiosyncratic shocks that are the focus of much of the existing risk sharing literature (Townsend, 1994; De Vreyer et al., 2010; Gine and Yang, 2009).

These findings complement recent work by Jack and Suri (2014), who use consumption data to show that Kenyans with access to mobile money are better able to smooth consumption than those without. It also relates closely to a growing body of research concerned with understanding the economic impact of mobile phones and other information and communication technologies (ICTs) in developing economies. Recent work in this area describes how mobile phones can, under certain conditions, reduce information asymmetries and search costs in agricultural markets (Jensen, 2007; Aker, 2008; Fafchamps and Minten, 2012; Aker and Fafchamps, 2014), lower transaction costs (Jack and Suri, 2014), and potentially provide an alternative device for savings (Mbiti and Weil, 2011; Mas and Mayer, 2011; Blumenstock et al., 2016).

We also make two methodological contributions that we hope can help facilitate the use of large-scale, network-based datasets in applied microeconomic and development research. First, we develop an approach to inferring the relative wealth of mobile phone subscribers from their history of mobile phone use. We use this measure of inferred wealth as a proxy for the relative wealth of transfer recipients at a particular point in time. Second, we describe an algorithm for locational

inference that allows us to continuously impute the location of an individual based on her intermittent sequence of phone calls. We use this method to determine whether or not a subscriber is affected by a regional disaster, but the algorithm could be implemented more broadly to identify individuals in need of help.

2. Background and context

The context for our study is Rwanda, a small, landlocked nation of 10 million people, where roughly 90% of the population survives on subsistence agriculture. We focus our analysis on the period from 2005 to 2009, a period during which mobile phone penetration increased from roughly 2.5% to 33.4% – a compound annual growth rate of roughly 74%. Such rapid growth has been common in many sub-Saharan African nations, where landlines are rare and the cost of owning a mobile phone is falling quickly. The cost of mobile telephony during this period represented a significant portion of household expenditures (Ureta, 2005), with the ITU estimating that the monthly “price basket” for mobile service was \$12.30 per month, or \$147.60 per year¹. At the time of our study in Rwanda, it cost roughly \$50 for the phone, and an additional \$0.20 per minute and \$0.10 per SMS (Republic of Rwanda, 2010; Donner, 2008).

Our empirical analysis focuses on interpersonal transfers of airtime funds between mobile subscribers. These transfers were made possible by a rudimentary precursor to “mobile money” that was launched in Rwanda in late 2006 by the monopoly mobile phone operator at the time. In Rwanda, where nearly all phone usage is prepaid and all incoming calls are free, the system works much like a debit card. To make a transfer, individuals buy airtime scratch-cards, ranging from US\$0.10 to US\$20, from thousands of stores and street vendors throughout the country. The purchased balance is deposited on the prepaid mobile phone account, and can then be used to make phone calls, to send text messages, or to use other mobile services. Using the transfer service, one subscriber can transfer an arbitrary balance, instantaneously and free of charge, to another subscriber. The transferred balance can then be used by the recipient to make calls, or re-transferred to another subscriber or vendor. During the period of time we analyze (2005–2009), there was no formal “cash-out” policy that guaranteed that the recipient could resell airtime to a vendor, but informal cashing-out was commonplace, with vendors typically charging 10–20% for the transaction.² In 2010, the phone company launched a fully fledged mobile money service that, among other features, made it possible to cash out airtime at fixed tariffs.

In the past several years, similar systems have become popular in developing countries, where over 1.7 billion people own a mobile phone but do not have a bank account (CGAP and GSMA, 2009). The airtime transfer service we focus on was a common antecedent to most modern mobile money deployments (Aker and Mbiti, 2010). Compared to alternative mechanisms for sending money available to Rwandans, sending airtime was considerably cheaper, faster, and more convenient (Table 1). Other options included MoneyGram, Western Union, or the Post Office, but transaction costs across these services ranged from 10 to 100% and, at the time of our study, none of these services permitted a transfer of less than US\$10. Rwandans could also send money through a bus or taxi driver, but these transfers were contingent on bus schedules and road conditions – and much slower than airtime transfer.

¹ The price basket is based on the prepaid price for 25 calls per month spread over the same mobile network, other mobile networks, and mobile to fixed calls and during peak, off-peak, and weekend times. The basket also includes 30 text messages per month (http://devdata.worldbank.org/ict/rwa_ict.pdf).

² Based on conversations with Rwandan informants at the time. In a 2009 survey of 910 Rwandans, respondents were asked to list “the preferred method for sending money to a friend or family member.” 28% listed “Airtime Transfer” as their preferred method (Blumenstock and Eagle, 2012). This suggests that, prior to 2010, mobile airtime was perceived as relatively liquid.

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