# Research Article

# The Use of Mobile Phones by Microentrepreneurs in Kigali, Rwanda: Changes to Social and Business Networks

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#### **Abstract**

A survey in Kigali, Rwanda, suggests that mobiles are allowing microentrepreneurs to develop new business contacts. The results detail the impact of mobile ownership on the social networks of microentrepreneurs in lowteledensity areas, focusing on the evolving mix of business and personal calls made by users. The study differentiates between the contacts amplified through mobile ownership (friends and family ties) and those enabled by mobile ownership (new business ties). The article discusses applicability of the results to settings beyond Rwanda.

# Introduction

James is a baker in Kigali, Rwanda. Working from his home, he makes bread for nearby shops and restaurants. Recently, James<sup>1</sup> purchased a mobile phone—his first telephone of any kind. Now, customers call him to place orders, he calls suppliers to order flour and other materials, and he and his employee stay in touch no matter where they are in the city. He now can respond to orders from throughout the country, not just in his neighborhood. He has begun to branch out, taking phoned-in requests to prepare wedding cakes for clients throughout Rwanda. He estimates that his business has increased 30% due to the mobile, so much so that he has been



able to move his family into a larger and more comfortable home. At the same time, he can use the mobile to speak to his wife, to check on the kids, or to send a text message to a friend to plan an evening visit.

Throughout the developing world, millions of people are purchasing mobiles. Eighty percent of the world's population lives within range of a mobile/cellular network (World Bank Global ICT Department 2005);

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<sup>1.</sup> James is a pseudonym.

2 billion mobiles are currently in use (ITU 2006), with hundreds of millions more soon to follow. Although overall adoption in developing nations still lags well behind that of richer ones, current growth rates in the developing world are astounding. This rapid adoption, particularly in urban areas, has raised hopes within the economic development community that people in the developing world will benefit from the technology (Gamos 2003). Some of this hope, shared also by the popular press (*Economist* 2005; LaFraniere 2005) and the telecommunications industry (Vodafone 2005), focuses on the way the smallest and most numerous businesses, called microenterprises, are using mobiles.

This study, based on a survey in Kigali, Rwanda, uses two analyses to further advance our understanding of how microentrepreneurs are using mobiles. First, it looks at the evolution of mobile ownership over time, exploring how a device first used by the elites for business purposes has found wider acceptance and a greater range of uses. Second, it explores how mobile use is associated with changes in the social networks of microentrepreneurs, by analyzing patterns of calls with people who are new to the users' social networks. The results of both analyses suggest that mobiles are allowing microentrepreneurs—particularly those for whom the mobile is the first and only telephone—to develop new business contacts.

# **Background**

# Microentrepreneurs and Microenterprises

Businesses with five or fewer employees, called microenterprises, support households in developing nations around the world, and are a critical part of their economies (Mead and Leidholm 1998; Santos 1979). These enterprises are found in urban and rural areas alike and include trading stalls and retail stores, small manufacturers, transport providers, and services such as tailors and plumbers. Small-scale agricultural enterprises (family farms) are considered a distinct category by most researchers and develop-

ment agencies. Some microenterprises are homebased or have no fixed location, such as hawkers who sell their wares on the streets. Thus, the degree of permanence, productivity, and formality varies considerably between microenterprises. Some are indeed "entrepreneurial," growing firms with skilled owners and productive business models (Duncombe and Heeks, 2001), but the majority are simply selfemployed and often struggling to get by and will never grow their businesses into larger enterprises (Mead and Leidholm 1998). Because barriers to starting these enterprises are generally low, households or individuals may engage in more than one microenterprise or may use a microenterprise to augment or temporarily replace wage salaries. Nevertheless, even if the majority of microenterprises are not sources of phenomenal growth, any gains in productivity, profitability, and even basic stability are of the utmost importance to the livelihoods of the households involved.

# Mobiles in Rwanda: A Growing Community of First-Time Telephone Owners

Home to roughly 8 million people, Rwanda is a small, densely populated, landlocked nation in central Africa. In 1994 Rwanda descended into civil war and genocide, an unimaginable tragedy even for a part of the world that has seen more than its share of political, economic and environmental upheaval. Thus, in many ways, Rwanda's path is unique: its struggles with civil war, genocide, resettlement, and reconciliation still pervade society. Yet, a decade later, daily life in Rwanda also shares much in common with that in other sub-Saharan nations. Most of its population is rural and remains guite poor, getting by on small-scale agriculture. The capital, Kigali, is small but increasingly vibrant, with about 400.000 residents. Thus, it is not unreasonable to observe how Rwandan microentrepreneurs such as James are using mobiles and identify patterns that might apply to microentrepreneurs in other countries with low but rising teledensities.<sup>2</sup>

<sup>2.</sup> One of the initial reviewers of this article asked whether it was appropriate to generalize from Rwanda to other developing nations, given the impact of the 1994 genocide. For some topics, the answer might be no—for example, generalizing insights from Rwanda about the dynamics of land ownership or civil service reform would be very difficult. In this case, however, the study focuses on livelihoods, telecommunications, and daily life, and all the data pertain to postgenocide conditions. (The first mobiles arrived in Rwanda in 1998.) Nevertheless, Rwanda's unique experiences did influence the research design. One question in the original design asked whether, "generally speaking, the call partner was 'a lot like you,' 'somewhat like you,' or 'not at all like you.'" It was removed after feedback from the multiethnic interview team made it clear that this question would place interviewers and subjects in an uncomfortable situation. Rwandans are now discouraged from openly acknowledging ethnic differences, and this question might be interpreted

Table 1. Fixed (Landline) and Mobile Lines in Rwanda, ITU estimates

	Thousands of lines				
	1998	2000	2002	2004	2005
Fixed lines	10.8	17.6	25.1	23	23
Mobile lines	5	39	82.4	138.7	290

Note: Estimates from ITU online statistics (ITU 2006).

As in all the nations in the region, mobile penetration in Rwanda is a fraction of that in higherincome nations. The ITU (2006) estimates that in 2004 there were 16 mobile users per 1,000 people, roughly 139,000 subscribers. By comparison, in 2004 there were 431 users per 1,000 people in South Africa, 621 in the United States, and 1,382 in Luxemburg, that year's global leader in mobile penetration. As Table 1 illustrates, because mobiles were introduced to Rwanda in 1998, their adoption has eclipsed that of landlines. By 2004, MTN RwandaCel, the monopoly mobile provider, supplied cellular coverage to roughly 50% of the population (ITU 2006), though mobile ownership and use remains too expensive for the majority of rural Rwandans. Instead, most mobile users in Rwanda are concentrated in Kigali and in other cities. In these areas, mobiles are perhaps the single most advertised product. In Rwanda, as elsewhere throughout the developing world, prepay cards (Beaubrun and Pierre 2001; Minges 1999), low-priced text messages, and (relatively) inexpensive used handsets have brought mobile ownership within the reach of a greater proportion of its citizens, including many of its microentrepreneurs (Shanmugavelan and Wariock 2004). Although calls remain expensive, with a local off-peak mobile-to-mobile call costing 125 Rwandan francs (about 25 cents) per minute, mobile use is becoming a fixture of daily life for an increasingly wide range of urban users, not just the elites.

In Rwanda, as in other parts of the developing world, many mobile users do not own a landline at home or at work. This is not to say that landline phones are unavailable in the urban areas—anyone in Kigali with a few francs and the patience for a short walk can visit a public phone shop—but mobile ownership offers obvious advantages over pub-

lic phone use: mobile owners have a number where they can always be reached as well as an outgoing line always at their fingertips. Thus, there is an important difference between the function of the mobile phone in the wealthier countries, where it is often a complement to a landline, and in the developing world, where it is often a substitute (Hamilton 2003; Hodge 2005).

Even though (or perhaps because) it predates the introduction of mobiles in the developing world, the established literature on information and communication technologies (ICTs) and economic development is the most logical source for a theoretical underpinning for our exploration of mobile use by microenterprises. Saunders, Warford, and Wellenieus's (1994) broad review is particularly helpful. Their overview of studies from the academic and development communities concludes that telecommunications contributes to economic development by providing better market information; improved transport efficiency and more distributed economic development; reduced isolation and increased security for villages, organizations, and people; and increased connectivity to (and coordination with) international economic activity.

This body of studies contains at least two broad approaches to the role of ICTs in development. Some studies emphasize *productivity*—the ability to do the same or similar things faster, more frequently, or at lower cost thanks to the introduction or use of ICTs. Substitution of phone calls for costly and time-consuming trips is one example of this approach (James 2002; Norton 1992). Other studies emphasize structural or social *change*, where new patterns of ICT use are associated with significant transformations in the availability of information, suppliers, or customers and in the constitution of communities, networks, or organizations. For example,

in this way. So, although both interview team and the set of participants represent a wide range of experiences with the conflict, it would have been difficult and perhaps inappropriate to track these differences.

Eggleston, Jensen, and Zeckhauser (2002) found that the addition of even a single phone in a village could reduce costly price uncertainty, about both the crops the village had to sell and the foodstuffs the village wished to consume.

# Microentrepreneurs and ICTs

Studies of telecommunications use by microenterprises are rare.<sup>3</sup> One reason for this might be that their small size and limited resources precludes the use of most ICTs (Duncombe and Heeks 2002). A second reason is that microenterprises are often lumped together for discussion purposes with "small and medium-sized enterprises" (SMEs), which are generally considered to have between 5 (or 10) and 100 employees, and are more likely to be stable, formal, and productive (Stork, Esselaar, Ndiwalana, and Deen-Swarra 2006). There has been more research on the ICT needs and behaviors of SMEs (la Rovere 1996; Lind 2000; Matambalya and Wolf 2001; Müller-Falcke 2002; Stork, Esselaar, Ndiwalana, and Deen-Swarra 2006) than of microentrepreneurs.

Duncombe and Heeks's work with SMEs (1999, 2001) and microenterprises (2002) in Botswana is especially helpful. Their findings for both groups emphasize the relative appeal and utility of the telephone, particularly the shared telephone in the case of microenterprises. Like Kenny (2002), they are more enthusiastic about the power of basic voice connectivity for small enterprises than about the Internet, which has received the lion's share of recent attention from the ICTs for development (ICTD) literature. Invoking both the change and productivity frames introduced above, they explain that the telephone is

the information-related technology that has done the most to reduce costs, increase income and reduce uncertainty and risk. Phones support the current reality of informal information systems, they can help extend social and business networks, and they clearly substitute for journeys and, in some cases, for brokers, traders and other business intermediaries. They therefore work "with the grain" of informality yet at the same time help to eat into the problems of insularity that can run alongside. Phones also meet the priority information needs of this group of communication rather than processing of information. (Duncombe and Heeks 1999: 18)

Duncombe and Heeks did not differentiate between landline and mobile telephony. Other, more recent research, however, has turned to mobile use by microentrepreneurs. Samuel, Shah, and Hadingham (2005) highlight the importance of mobiles to microenterprises in South Africa, Tanzania, and Egypt: roughly 60% of the microentrepreneurs surveyed in each country reported that the mobile had increased the profitability of the business. Molony (2005) is more muted in his assessment, highlighting the continued importance of interpersonal trust when considering the appeal of mediated (mobile) communications relative to face-to-face meetings among Tanzanian microentrepreneurs.

# Integrating Personal and Business Uses of the Mobile

In light of the informality of many microenterprises, the distinctions between the ICT use of the enterprise and those of the individual/household can be blurry. This blurring is compounded by the nature of the mobile phone as an object that is linked to a person, not a place; like other mobile owners, microentrepreneurs carry their mobiles with them from their workplace to the home and/or use the same device for both work and personal reasons. This variety of uses is reflected in the attitudes they hold toward the devices. An earlier study in Rwanda (Donner 2004) looked at the mix of instrumental and intrinsic elements structuring microentrepreneurs' attitudes toward their mobiles. Some reported using the phone to improve firm productivity or for personal convenience, others valued the status and intrinsic returns of mobile use, and still others simply considered the mobile indispensable. Initial (descriptive-only) results from the survey discussed here appear in Donner (2005). They indicate that roughly two thirds of calls on microentrepre-

<sup>3.</sup> No discussion of mobile phones and microentrepreneurs is complete without a mention of Bangladesh's Grameen Village Phone program, famous for developing a financial and technological model to empower thousands of women entrepreneurs to act as "phone ladies" for a village (Bayes 2001; Richardson, Ramirez, and Haq 2000). Grameen is replicating the model in Uganda and Rwanda and similar ventures, both formal/franchised (Reck and Wood 2003) and informal/independent (Sey 2006), have sprung up wherever there are large populations of people who are unable to afford their own mobiles.

neurs' call logs had to do with personal issues—calls to friends and family—whereas one-third of calls were business-related. These proportions, mixing business and personal motivations, were broadly similar to those observed in earlier studies of public phone users in rural areas in Ghana (Bertolini 2002), Costa Rica (Saunders, Warford, and Wellenieus 1994), India (Blattman, Jenson, and Roman 2003), Bangladesh (Richardson, Ramirez, and Haq 2000) and elsewhere in sub-Saharan Africa (Gamos 2003). Recent work on rural users in Africa and India showed an even more pronounced skew toward personal and emergency calls versus calls for business purposes (Souter et al. 2005).

To understand the nonbusiness calls made by microentrepreneurs, it is useful to look beyond the ICT for development literature and draw on recent discussions about the role of ICTs, particularly mobile phones by users in their daily lives. Although this literature is certainly too broad to summarize in this article (for details on mobile phones see Castells, Qiu, Fernández-Ardèvol, and Sey [2007]; Katz and Aakhus [2002]; and Ling [2004]), the same distinction between approaches emphasizing *change* and those emphasizing *productivity* is present.

Harper (2003) focuses specifically on this distinction between change and productivity. He points to Wellman (2002) as an example of the change approach, in which ICT and mobile use are assumed to lead to new, more specialized networks of weak ties, and to relationships that are less geographically defined. However, Harper argues that mobile phone use is better interpreted as "invigorating" existing social relationships, allowing users another means to do the kinds of things that they do with the people already in their social network (see also de Gournay and Smoreda [2003]; and Kim, Kim, and Park [2006]). From the developing world, Goodman (2005) interprets self-report survey data from mobile users in South Africa and Tanzania in this way, observing that mobiles are being used more frequently to manage strong ties, particularly family, than for maintaining or adding weak ties.

The current incarnation of this discussion has antecedents in earlier examinations of the effects of landlines, for example on the redistribution and specialization of personal relationships at the expense of face-to-face interactions (Ball 1968) and the amplification of existing social ties (Thorngren 1977). Depending on what part of the phenomenon

is most interesting to the researcher, mobile communication, like the Internet and landlines before it, can be seen as a system that changes and creates new relationships and networks or as one that amplifies and strengthens existing ones.

This article carries both change and the productivity frames forward into the analysis, suggesting that both frames help describe microentrepreneurs' use of mobiles. In doing so, it takes as given that attributes of the technology enable users to act in some ways and not in others and, in turn, alter both their environment and the conventions of use of technologies themselves (Orlikowski 2000; Poole and DeSanctis 1990). For this approach, detailed studies of what users actually *do* with the technologies at their disposal are important building blocks in any larger discussion of social or technological change (Fischer 1992).

# **Research Questions**

Amid the enthusiasm surrounding the spread of mobiles in the developing world and against the background of the theoretical complexity described above, it is important to assess the way microentrepreneurs are actually using mobiles. Duncombe and Heeks's (1999) comments about the basic impact of the telephone on SMEs in Botswana point the way, suggesting we explore how mobiles, like landlines, might "extend business and social networks." This study examines actual calling behavior by analyzing recent calls and text messages made and received on users' mobile phones. A record of these calls is routinely saved on the "call log" feature of mobiles, which presents a particularly easy and reliable way of sampling calling behavior. This study examines call patterns from two perspectives: the mix of business versus personal uses for the mobile and the availability of a landline to the microentrepreneur. By isolating these factors, the study will be able to assess impacts of mobile ownership on microentrepreneurs' communication networks, with an eye toward differentiating between the change and the productivity/amplification frames introduced above.

# Migration from Business to Personal Use

The first analysis treats the mix of business versus personal use as dynamic over time. Early adopters (Rogers 2003) of personal communication devices are likely to be business people, whereas later adopters may use the devices to pursue personal goals (Wei and Lo 2006). Katz (1999) reports that primary cellular use in the United States crossed from business to personal functions as early as 1992. In Hong Kong, Leung and Wei (1998) found that later adopters of pagers were more motivated by intrinsic factors than for instrumental factors. Conventional wisdom suggests we should find a similar pattern vis-à-vis mobile phones in Rwanda that a shift is underway from business-focused uses of mobiles to more of a mix of personal and business uses. It is possible that mobile owners' usage patterns evolve: both the relative proportion and the overall number of business calls made by users could rise or fall over time. Without multiple measures of the proportion or number of calls made by users over time, however, this change cannot be observed. Nevertheless, latitudinal survey data are potentially valuable, because earlier adopters of the technology might be expected to retain a more business-focused approach over the years of their mobile use. Thus.

Hypothesis 1: Earlier adopters of the mobile will have a higher proportion of business-related calls on their mobile

#### Network Change

An individual's network represents the sum of interactions with a variety of different people, about different subjects, using different channels (face-to-face, landline, mobile, mail, and so forth). Thus, establishing the impact of mobile use on the totality of an individual's network is difficult. One approach is to observe the relative *frequency of new ties* in the network—those people whom the participant reports meeting after he or she purchased the mobile. This allows a comparison of the strength of the *change* lens to that of the *amplification* lens: the higher the proportion of new entrants observed on a call log, the more it can be argued that the mobile is facilitating a change in network structure, rather than an amplification of an existing structure.

In business relationships, microentrepreneurs can be expected to behave as Wellman (2002) describes, and as much of the telecommunications and development literature would suggest, using the mobile to *change* their network by adding new customers and suppliers. When it comes to personal matters, however, they will behave as Harper (2003) describes, using the mobile to *amplify* (deepen,

strengthen) ties they already have established. Part of this is common sense, because the composition of family ties in a network is certain to change more slowly, whereas business ties (particularly customers and suppliers) can easily be made, particularly if the opportunity for new communication ties exists.

Hypothesis 2: New entrants found on mobile call logs are more likely to be business-related ties than friends or family

The final hypotheses (3a and 3b) about network change are the most central to the analysis. The presumption is that the purchase of the *first* telephone presents the best opportunity to change the shape of a network by allowing for new contacts, whereas the purchase of subsequent telephones are more likely to afford additional productivity (amplification) benefits. Thus, we expect to see a higher proportion of new entrants on the mobile logs of those without landlines of their own. Recall James, whose business went up 30% after he purchased his first phone; we should be able to see similar examples in the aggregated call data of the microentrepreneurs in the survey.

Hypothesis 3a: New entrants are more likely to be found on the call logs of those without a business landline

Hypothesis 3b: New entrants are more likely to be found on the call logs of those without a home landline

#### Methods

The survey was conducted in Kigali in December 2003. Six trilingual Rwandan interviewers gathered respondents by visiting businesses in markets and on streets throughout the city. Screener questions ensured each respondent had a mobile, was at least eighteen years old, and owned a small business with no more than five employees. Random recruitment is preferable, but many businesses in Kigali are informal, and almost all use prepay cards, so no list of users was available. Recruitment was instead by face-to-face requests and visits, which captured shops, market stalls, and roaming vendors. Homebased manufacturing and food production enterprises were missed. Similarly, interviews were conducted on weekdays, so weekend and evening calls may be underrepresented.

The survey had two primary components: demo-

graphic and profile information about the microentrepreneur and his or her business (kind of business, age, gender, level of education, landline ownership, etc.) and an analysis of the last ten calls on the microentrepreneur's call log. Although respondents were generally willing to share details of their calling behavior with the Rwandan interviewers, three potentially sensitive themes were not addressed: in the profile section, income/revenue of the business and ethnicity; in the call log section, extramarital romance. It is always a difficult decision to exclude information from a survey that might be relevant, but all three of these topics would be better addressed with a different/complementary research design that allowed for longer-term cultivation of trust between respondent and interviewer (Christensen 1993).

The survey asked about three types of calls recorded on the mobiles' call logs: outgoing voice, incoming voice, and SMS. For each type, the interview proceeded through the log, starting with the most recent call, until five unique callers were identified or ten calls had been reviewed. Interviewers skipped calls the respondent could not recognize. In this way, the interviews captured actual call behavior, rather then relying on recall or self-report mechanisms (Cohen and Lemish 2003).

Similar to Bertolini (2002), the survey recorded the type of person—the "call partner"—with whom each call was made (spouse, friend, business partner, and so forth), what the call was about, and where it was made to/from. The questionnaire design allowed for and encouraged multiple answers for the "who and what" questions, so a call partner could be classified as both "friend" and "business partner."<sup>4</sup>

There are two primary dependant variables under review: proportion of business calls observed on the call log, and the call partner's status as "new to the network." For the proportion of business calls observed, the analysis sums across three kinds of calls:

outgoing voice, incoming voice, and SMS.<sup>5</sup> Because of time constraints, and to work with the structure of the call logs on the mobile phones, which often do not simultaneously display calls of all kinds, participants were randomly assigned to one of three conditions: incoming call plus outgoing call, incoming call plus SMS, or outgoing call plus SMS. Each condition asked about two of the three kinds of calls. In each case, the most recent five calls of each kind were sampled; calls to voicemail or to the telecommunications provider to add airtime were excluded, as were incoming SMS advertisements. A call was coded as a business call if the relationship was described as "customer," "employee," "colleague/partner," or "supplier." The proportion is simply the count of calls coded as "business," divided by the number of calls with a description of the relationship. The elements for this analysis are the 277 observations of call logs, one per interview participant.

For the second dependant variable, new to network, another analysis treats each call as an element, drawing on a created binary variable "new entrant." Call partners are coded as new (or not new) to the respondent's network, relative to the time the respondent purchased his or her mobile. For each partner, the variable is constructed using participant's responses to the items "before getting the mobile, how often did you communicate with this person, overall?" and "since getting the mobile, how often do you communicate with this person, overall?" Response options for both items were: "never," "less than once a month," "monthly," "weekly," "daily," and "more than once a day." Only partners in the "never" category for the "before" question were coded as new entrants. To calculate communication change, the difference between the two items was used—partners whom respondents reported more frequent contact with after purchasing the mobile were coded as "increased." For this analysis, mobile purchase date is

<sup>4.</sup> An earlier analysis of the amount of overlap between the personal and business categories (calls to cousins about business, calls to suppliers to chat about holiday greetings, and so forth) is also detailed in Donner (2005), mentioned above. A surprisingly small proportion of calls were classified as both business and personal. Of 570 call partners described by the mobile-only users as a business contact (colleague, employee, supplier, customer), only 20% were also described as something else: 15% as "friend," 3% as "family/spouse," 2% as "other." Similarly, only 12% of the 866 alters described as a "friend" were also described as something else: 10% as "business contacts," 2% as "other," and less than 1% as "family/spouse."

<sup>5.</sup> Compared to voice calls, SMS was used relatively more frequently to communicate with friends and less so with customers. Further analyses could be undertaken to isolate effects and patterns for voice versus text calls.

Table 2. Profile and Calling Behavior of Respondents, by Year of Mobile Purchase

		Landline owners			
Relationship with call partner (check all that apply)	Total (n = 277)	$   \begin{array}{r}     \hline     1997 - 1999 \\     (n = 71)   \end{array} $	2000-2001 (n = 124)	2002-2003 (n = 82)	
Demographic profile:					
Gender (% Male)	69	65	71	71	
Age (mean, years)	33	35	34	30	
Education (% beyond secondary school)	20	29	21	8	
Business Size (% Sole Proprietor)	37	25	29	59	
Telecommunications:					
Owns a landline (% home or work)	33	56	32	14	
Percent prepay account	94	82	98	100	
Mean spending per month (Rwandan Francs)	14,245	19,619	14,840	9,037	
Business Calling:					
Percentage of business calls on call log	31	41	29	23	
Open end response—listed business as a reason (%)	62	71	66	48	

Notes: percentages are calculated on valid responses per question. Thus, the n for individual rows are lower than the total column n, due to missing data and refused responses. Age and contract versus prepay had the highest incidences of missing cases (30 missing cases each).

entered as a control variable. This frequency of communication item was asked for five of the ten call partners, bringing the total number of calls (elements) for some analyses down to 1,293.

# Results

Of 502 people approached, 125 refused, 87 screened out and 13 stopped partway, resulting in 277 (55%) completed interviews, providing detail on 2,700 discrete calls. The final respondent sample was 69% males, with a median age of 32 years. Most had completed primary (26%) or secondary (54%) school; some (20%) had postsecondary or university certificates. Their businesses included retail (32%), services (15%), food sales (8%), construction/trades (7%), and transport (6%).

Because of the screener, all 277 respondents had mobile telephones. Fifty-four (20%) had a landline at home, and 57 (21%) had a landline at work. Landline ownership often overlapped: in all, 32% of respondents had a landline at work or at home.

Table 2 serves two purposes. The first column details the demographic profile and calling behavior of the total set of respondents. However, because respondents were recruited by using an intercept methodology, and only in Kigali, the table is not rep-

resentative of Rwandan mobile phone users as a whole. The remaining columns report demographic and behavioral variables by year of mobile purchase. The descriptive cuts illustrate differences between early and later adopters within the set of respondents, beyond the proportion of business calls tested in hypothesis 1. Earlier adopters were older, more educated, spent more on their mobile, and were more likely to have employees, a contract account, and a landline.

# Descriptive Results on Call Profiles

Respondents had no difficultly recognizing the numbers on their call log; 80% of the calls had names programed into the SIM card. Of those not programed, roughly 80% were also recognizable.

As Table 3 indicates, call partners were most frequently categorized as friends (45%), followed by business contacts (32%) and family members (26%). Customers were the most frequent form of business contact. The proportion of calls made with business partners is the subject of analysis 1.

Table 4 illustrates the general change in communication, across all partners, for each of the telephone ownership categories. Respondents reported communication increases with roughly 40% of call partners, whereas new entrants comprised roughly

Table 3. Relationship of call partners to interview participants, across all sampled calls

Relationship with call partner (check all that apply)	Total (2,676 calls by 277 respondents)	Mobile only (1,817 calls by 197 respondents)	Landline owners (859 calls by 90 respondents)
Friend	45	49	37
Business:	32	31	32
Customer	17	18	16
Partner/colleague	7	7	7
Supplier	5	6	5
Employee	3	2	4
Family member:	26	22	35
Nonspouse	23	19	30
Spouse	3	3	5
Other	6	6	6

Notes: Other category includes supplied options: "Government, health or NGO worker" and "Company representative," as well as open-ended responses. All data are percentages. Proportions sum to more than 100% due to "all that apply" option.

Table 4. Change in overall communication with call partners

Change in overall communication with partner after mobile purchase	Total (1,291 calls by 277 respondents)	Mobile only (894 calls by 197 respondents)	Landline owners (397 calls by 90 respondents)
Decreased	5	5	4
No change	35	36	34
Increased	40	38	46
New entrant	20	22	16

Note: Total number of partners in this table is smaller than in Table 2, since the communication change items were only asked for five (not ten) partners per respondent. All data in percentages.

20% of all partners. The distribution of that 20% of partners classified as new entrants is the subject of analysis 2. The units of analysis for Tables 3 and 4 are individual calls, rather than the 277 mobile phone owners who placed them.

# Analysis 1: Migration from Business to Personal Use

To examine the proportion of business-related calls appearing on each participant's call logs, a quasi-likelihood regression model was employed, following Papke and Wooldridge (1996) and McDowell and Cox (2004). This model is most appropriate for proportional (fractional) dependent variables, particularly those with observations taking the extreme

values of zero or one, since the zeros would have to be dropped as missing cases by a conventional logit transformation approach.<sup>6</sup>

Controls were used for *mobile spending per month* (recoded as a four-category variable with cuts at approximately \$10, \$20, and \$40 per month); *gender, age, education level,* and *number of employees. Landline ownership* was also a control in this analysis.

As the results in Table 5 indicate, there was a significant inverse relationship between level of education and the proportion of business calls on the mobile. Owning a landline at home was also associated with lower levels of business calls. The control

<sup>6.</sup> The procedure can be applied in the Statistical Package Stata, using a General Linear Model with the family(binomial), link(logit), and robust options selected (McDowell and Cox 2004).

Table 5. Fractional logit model results for proportion of business calls on call log

	Coefficient	Robust standard error	
Control Variables:			
Spending per month	0.34	.082	
Gender (male)	-0.011	.178	
Age	002	.011	
Education	2748***	.094	
Number of employees	.013	.068	
Has landline at home	622***	.201	
Has landline at work	008	.178	
Research variable:			
Year purchased mobile	-0.13***	.059	
Constant:	261.4**	118.7	
Number of cases	215		

Note: \*, \*\*, \*\*\* represent significance at p<.1, .05, and .01 respectively.

for spending per month is particularly important, because it excludes the possibility that the results are due to large differences in the overall number/frequency of calls between early and later adopters.

There was a significant inverse relationship between the year the mobile was purchased and the proportion of business calls on the mobile's call log. Newer phones had a lower proportion of business calls, supporting hypothesis 1.

# Analysis 2: Network Change

Table 6 details the results of the second analysis, which uses a logistic regression to predict the likelihood that a call partner was new to a respondent's network. Two variables were entered to control for the effects of time. Both were significant in ways that could be expected. First, there was a significant inverse relationship between the age of the user and the likelihood that a call partner was new to the user's network. Similarly, the longer a user had owned a mobile, the higher the likelihood that he or she first met the partner after purchasing the mobile.

Two other control variables in the model were significant. Level of education was significant: a call partner was significantly more likely to be a new entrant among those users with higher education. Similarly, monthly spending was significant: a call partner was significantly more likely to be a new entrant among those users spending more per month on their mobile (and making more calls).

In terms of the research variables, the relationship between the call partner and the user strongly influenced the likelihood that the partner was new to the network. Business-related partners were more likely to be new entrants, whereas family relationships were less likely to be new entrants. Hypothesis 2 is supported.

Of the two landline ownership variables, a user's ownership of a work landline was associated with a lower likelihood that the call partner was new to the network. Home landline ownership was not significant in the model. Thus, hypothesis 3a is supported, and 3b is not. For easier interpretation, Figure 1 presents the predicted likelihoods, from the logistic regression model, that a call partner was new to a network, for each of the combinations of the independent variables.

# Discussion

The analyses provide some insight into what Rwandan microentrepreneurs do with their mobiles, and into how their networks might be changing as a result.

# Migration to Personal Uses

The first set of findings reveal a difference between the call profiles of those microentrepreneurs who purchased a mobile early in its availability in Rwanda and those of more recent buyers. It appears that newer users complete a lower overall proportion of business calls than do early users. It is possible, of

Table 6. Logistic regression results for call partner as new entrant to user's network

	Beta	SE	Wald	Exp(B)
Controls for owner attributes:				
Gender (male)	0.086	0.208	0.171	1.090
Age	-0.026**	0.011	5.507	0.974
Education	0.228**	0.101	5.130	1.256
Year purchased mobile	-0.163**	0.064	6.569	0.850
Number of employees	-0.044	0.070	0.394	0.957
Spending per month	0.155*	0.094	2.723	1.168
Research variables:				
Business relationship	0.948***	0.179	28.103	2.580
Family/spouse relationship	-1.326***	0.286	21.564	0.265
Has landline at home	-0.280	0.263	1.131	0.756
Has landline at work	-0.621**	0.264	5.541	0.538
Constant	324.367**	127.270	6.496	0.000

Notes: Nagelkerke  $R^2 = .165$ ; 1,019 call partners captured on call logs of 216 mobile owners. \*,\*\*,\*\*\* represent significance at p < .1, .05, and .01 respectively.

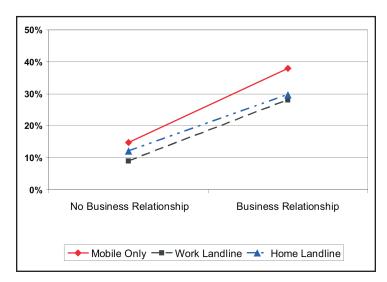


Figure 1: Predicted probabilities that a call partner is new to the user's network

course, that this difference is the result of a distinction in the kind of businesses, or in the success of the businesses, between early and late adopters. The earliest adopters could find their businesses are more demanding, or perhaps more successful, than more recent adopters. It is also possible that the cross-sectional comparison masks a change in user behavior over time—that mobile users begin by using the device for a mix of business and personal

calls, but then slowly shift to a greater proportion of business calls. Additional studies, designed to capture within-subjects time series data, would shed further light on the adoption process and on the evolution of mobile use over time.

It is likely, however, that the results identify new users who are more interested in using the phone for maintenance of friendships and family ties than for business purposes. Further evidence for this assertion can be found in a the analysis of open-ended survey responses. Respondents were asked to say, in their own words, why they purchased the mobile in the first place: 71% of respondents who purchased their first mobile

between 1997 and 1998 mentioned business purposes in their open-ended responses, compared with 66% of those purchasing between 2000 and 2001 and 48% between 2002 and 2003.

Both analyses of the call mix underscore a fundamental point, also made in earlier papers (Donner 2004, 2005) that even in Rwanda, where calls are relatively expensive compared to total purchasing power of their users, and even among microentre-

preneurs, who might be expected to be particularly business focused, the mobile is already a personal device. Two-thirds of calls were not business related, and if patterns observed elsewhere in Africa (Souter et al. 2005) hold in Rwanda, that proportion might be growing. This will make it harder, not easier, to identify the overall microeconomic impact of the mobile on microenterprises and on the households they support. In addition, it underscores how personal (household) and business uses of the mobile are blurred (Gant and Kiesler 2001: Peters and Allouch 2005). Although researchers (and journalists) interested in the economic impacts of the mobile may be tempted to ignore the personal calls, and although researchers (and journalists) concerned with the evolution of a mobile society may be tempted to focus on personal calls, each kind of call is important—and each is facilitated with the purchase of the same \$2 prepay airtime card. Future study designs should account for both kinds of behaviors.

# Change

The second set of findings concerns changes to microentrepreneurs' social and economic networks, facilitated by mobile phone ownership and use: 20% of all the call partners (individuals appearing on respondents' mobile phone call logs) were new to respondents networks, and, of the 80% whose relationships predated the mobile, half showed an increase in overall frequency of contact; the other half showed unchanged or decreased frequency. The study compared respondents who owned only a mobile phone with those who also owned a landline. Not surprisingly, for both landline owners and mobile-only users, new entrants were concentrated in business calls. What is more interesting—and more important for discussions about the role of mobiles in economic development—is that the proportion of new entrants was highest (a predicted 38%) among the business-related call partners of those who own only a mobile phone. This difference was particularly strong relative to the group which owned a landline at their workplace.

Returning to Duncombe and Heeks's (1999) comment on the impact of phones on entrepreneurs, they explain that phones "help extend social and business networks." This study modifies and deepens that assertion. The evidence from Kigali presented here modifies that assertion by strengthening

the case for stable, not changing networks: (1) two-thirds of calls are to friends and family; (2) 80% of call partners observed had their names entered on the address books; and (3) only 20% of call partners were new to the network, arriving after the purchase of the mobile phone. At the same time, it deepens the assertion by suggesting that microentrepreneurs use their mobile phones to increase the frequency of their contact with friends, family, and existing business contacts and to facilitate new contacts with business partners, suppliers, and customers.

The fact that there was a significantly higher proportion of new entrants on the call logs of microentrepreneurs who own only a mobile phone illustrates a dynamic that is unique to the developing world. All across the developing world, people like James the baker are finally able to own a telephone line of their own. This is not to say that mobiles do not provide complementary benefits to those who own landlines. Landline and nonlandline owners alike share in the ease of constant. reachability, safety, and convenience that mobiles provide. However, the more sudden changes to the network—the introduction of new weak ties (Granovetter 1973) and the expansion of a network—are being experienced by those who are purchasing phones for the first time in their lives. Those phones are overwhelmingly mobile handsets, not landlines.

The observations from this study are quasi-experimental, not randomized. There are likely to be substantial differences between the businesses of those who can afford landlines and many of the new mobile owners who cannot. For example, data from 13 African countries suggest that formal SMEs are more likely to own landlines than informal SMEs (Stork et al. 2006). At this moment of rapid change in the telecommunications landscape in the developing world, however, these substantial differences are the key to the story, not a complication. The call logs of the new mobile owners, with a high proportion of new business contacts, may provide evidence for businesses that are growing or changing more rapidly. The mobile enables this growth partially by enabling new contacts (an effect unique to the lowteledensity developing world) and partially by amplifying communication with repeat customers (an effect shared in the low- and high-teledensity regions of the world).

#### Further Research

This article has not delved deeply into the shape of the networks or in their actual economic value to microentrepreneurs. Instead, it has used "new entrants" as a rough proxy for business growth. There is, however, a research tradition that looks at these networks in more detail, using the lens of informal relationships and/or social capital (Coleman 1988) to assess their impact on enterprise health and growth (Barr 2002; Fafchamps 2001; Geertz 1978). The technique of call log analysis used in this study may be a way to reveal these networks in more detail.

Certainly, it is worth further exploring this population's use of mobile telephony, perhaps with longterm evaluation studies, which would capture change in networks over time, as well as with other research designs that would capture "return on investment" more directly by asking difficult questions about profits and revenues. Similarly, although they are difficult to field, studies that gather a more comprehensive view of microentrepreneurs' networks (including both mediated and face-to-face communication) would be very helpful. A design that captures not only the timing of a call partner's entry into a network, but also the method of that entry (via word of mouth, advertising, walk-ins, and so forth) would help contextualize the impact of mediated communication relative to other environmental and network factors. Finally, replication and expansion of this line of inquiry into other populations and cultural contexts, for example in the growing mobile markets in South and East Asia, would be helpful. Within Africa, it would be helpful to move beyond Rwanda to include a greater variety of social and economic situations.

The call log analyses suggest that home landline ownership is associated with a lower proportion of business calls (and a higher proportion of calls to friends and family). This raises interesting questions about the influence of other, complementary communication technologies accessible to mobile users—in this case, the landline in the home environment. There is an ongoing discussion about whether mobiles are best understood as substitutes for (Hodge 2005) or complements to landlines in the developing world (Hamilton 2003). This microlevel data are one indication of possible complementarity among that segment of the population prosperous enough to afford a landline as well as a mobile. Further analysis should seek to understand

microlevel mobile use in the context of other devices (landlines, other mobiles, Internet use), rather than in isolation.

# **Concluding Thoughts**

It is interesting to look at the behavior of a set of users who, initially, were not the intended market for the technology. Mobiles started as a tool for roaming business professionals (Roos 1993), and moved into the mainstream (Katz 1999) and then on to the youth (Castells et al., 2007). Yet the take-up by the developing world has exceeded all expectations, and has resulted in significant new investments in infrastructure, marketing, and R&D to serve the surprising demand. This evolution is strong evidence for the power of the user in the technology-adoption process.

That said, we can consider actions at a number of levels that could help further increase mobile telephone use by microentrepreneurs. At the regulatory level, policy makers should continue to look at ways to reduce mobile tariffs, particularly through encouraging rigorous competition between mobile providers (Wallsten 2001). At the market level, telecommunications providers should continue to find ways to expand the ways in which people can use mobiles, such as the "Smart Load" system—the cardless, small-denomination, top-off services offered by Smart Communications in the Philippines (Smith 2004). At the local level, NGOs and donors may want to look at ways to enable phone ownership, such as designing microloans specifically to reduce the impact of the purchase of the handset or insurance to guard against its theft or loss. Finally, at the technological level, entrepreneurial companies and engineering teams should continue to push for new innovations, such as voice-over-Internet protocol, and wireless local loop solutions (O'Neill 2003), which could further reduce the cost of connectivity.

As the analysis suggests, this pattern—enabling new business contacts and amplifying existing social relationships—may not apply to users in other contexts, including users in the developing world who already own landlines. The evidence for this pattern, however, raises a more general issue, one that will become increasingly salient as the mobile is adopted by millions more users across the developing world. For those users with easy access to landlines, the most important benefits of the mobile may be a mixture of mobility, constant availability, and display/

status. Those whose first and only phone is the mobile may experience all these same benefits, but they will also experience a dramatic increase in the ease and affordability of basic mediated communication. Even if the bulk of calls ends up being with friends and family, it is difficult to underestimate the importance to an entrepreneur of simply having a reliable and affordable telephone connection, which is what the mobile finally brings.

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