

## Research Article

# How Transformational Mobile Banking Optimizes Household Expenditures: A Case Study from Rural Communities in Mexico

Cesar Renteria

Centro de Investigación y Docencia Económicas, A.C. (CIDE), Mexico

### Abstract

*This article presents the results of a quasiexperimental impact evaluation of a mobile banking pilot project led by the Mexican government in a context that portrays the financial inclusion challenges in Mexico and Latin America: highly dispersed populations in rural communities that lack access to a financial system and telecommunication services. The research questions that drive this study are: Do mobile banking and mobile telephony have an impact on households' expenditures? Specifically, what categories of expenditure are affected? The propensity score matching methodology was used to assess the impact on households' expenditures by category (e.g., education, transport, energy, communications, etc.). Results show that mobile banking can reduce spending on communications and public transport, and the main benefits in terms of spending come from the reduction of people's local commuting expenses. Likewise, evidence indicates that a major share of spending reduction is transformed into savings in bank accounts. Finally, the case study presents relevant lessons for mobile banking policy alternatives to promote financial and digital inclusion in rural communities.*

### Introduction

With the burgeoning research in the information and communication technologies for development (ICT4D) community, it seems that an assessment of the performance or impact of ICT-based initiatives on development is taking a central role in academic debate. Most of the existing literature falls in the category of what Walsham (2013) termed *implementation studies*, meaning the study of a particular technology or a particular context. Empirical evidence is still needed for decision makers at the strategic policy level (Duncombe & Boateng, 2009; Walsham, 2013). Research studies that contribute to ICT-based policy formulation or evaluation will improve ICT's position on the public agenda as valuable tools for improving developmental policies or for innovating in policymaking. An accumulation of empirical evidence on the effect of ICT4D initiatives will contribute to moving on from a current myriad of pilot projects around the world to the proliferation of far-reaching public policies.

In particular, the mobile banking field has witnessed an explosive growth worldwide in terms of live platforms. According to GSMA, in 2014 there were 233 existing and 112 incoming platforms. Notwithstanding, mobile banking is not as widespread in developing countries as might be expected (Shaikh & Karjaluo, 2014). According to Diniz, Porto de Albuquerque, and Cernev (2011), this situation may be due to, among other factors, the fact that successful cases are not clearly understood and because of the dearth of assessments of the potential social and economic effects. An important community of researchers and practitioners is engaged in understanding the key factors of successful cases, especially researching the determinants of adoption (Dahlberg, Mallat, Ondrus, & Zmijewska, 2008; Diniz et al., 2011; Duncombe & Boateng, 2009; Pena, 2012; Shaikh & Karjaluo, 2014). To date, few studies have contributed to the assessment of the socio-economic effects of mobile banking.

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## HOW TRANSFORMATIONAL MOBILE BANKING OPTIMIZES HOUSEHOLD EXPENDITURES

Assessing whether an ICT4D initiative contributes to development depends fundamentally on what developmental approach is considered. As documented by Donner (2008) and Duncombe (2011), the benefits observed from not only mobile banking but also the broader uses of ICTs are primarily monetary and they lead, in a broader scope, to a better market coordination. Most of the ICT4D studies realize transaction cost reductions as one of the top benefits, rather than increased earnings (Donner, 2008; Duncombe, 2011). However, further understanding of this reduction is yet to evolve. Many questions exist on which categories of expenditures reflect this reduction. For example, do reduced transaction costs only mean a reduction in traveling costs? Are various expenditure categories reduced? Additionally, there is little understanding about what happens with a reduction of transaction costs; for instance, does this reduction bolster savings? Or is this money spent in other categories such as food consumption? This research seeks to understand which expenditure categories are reduced after the use of mobile banking and mobile telephony services in a rural community. The questions that drive this research are: What expenses are reduced after the joint implementation of mobile banking and mobile telephony services in a rural community? If there are efficiency gains, how is this money spent? Of course, the absence of effect in any expenditure category means that, in fact, the platform had no impact on transaction costs, contrary to what has been found in other studies.

This case study is a transformational mobile banking pilot project implemented by Telecomm, a Mexican state-owned firm established to provide telephony and banking services in rural communities lacking access to either service. Telecomm designed a business model to achieve financial inclusion without incurring monetary losses (as mandated by law) and selected mobile banking to be the key element for its business model.

This case study belongs to the microeconomics stream and contributes empirical evidence on the impact of mobile banking and mobile telephony on household budgets in rural communities. This study also explores mobile banking as a potential policy tool for digital and financial inclusion. With data collected in Santiago Nuyoó, the municipality where the pilot was conducted, impact was estimated with the quasiexperimental method propensity score matching (PSM). Results show statistically significant efficiency gains in two of the eight main expenditure categories in rural and remote Mexican communities.

### Impact Assessment of ICT4D: State of the Art

It is difficult to discuss evaluation solely on the mobile banking branch, since there are few studies that have evaluated the outputs, outcomes, or broader impact of mobile banking. As the most recent literature reviews show, there is more emphasis on understanding the determinants of mobile banking adoption (Diniz et al., 2011; Shaikh & Karjaluoto, 2014). Departing from the limitation of mobile banking evaluations, in this section we show the state of the art in assessing the socioeconomic effects of ICT4D.

Establishing a consensual understanding about evaluation methodologies in the ICT4D community is a work in progress. As remarked by Richard Heeks (2010) and Chrisanthi Avgerou (2010), the development of this community has been driven by scholars from the information systems field, rather than those from the developmental studies field. As a consequence, assessments are loosely based on developmental impacts or outcomes (Duncombe, 2011; Vincent & Cull, 2013). Yet there is no generalized methodology for ICT4D evaluation, as can be observed in analytical compilations from Duncombe (2011) and Heeks and Molla (2009).

With this scenario, the ICT4D impact research has progressed under the umbrella of three main domains of developmental studies: developmental economics, microeconomics, and people-centered frameworks. From the developmental economics perspective many studies have measured the impact of mobile or broadband penetration on traditional development-related indicators such as economic growth, employment rate, and productivity. Outcomes vary depending on the context of each study, but the majority of studies have found a positive impact in such indicators (Gallego & Gutiérrez, 2013; Katz, 2012). For instance, a 10% augmentation in broadband penetration may cause a GDP growth of 0.08% in Brazil (Katz, 2012), but 1.53% in European countries (Czernich, Falck, Kretschmer, & Woessmann, 2011). Based on data from Chile, a study by Raul Katz (2011) shows that an augmentation of 10% in broadband penetration would improve the employment rate by 0.018%. Waverman, Meschi, and Fuss (2005) demonstrated that for an increase of 1% in broadband penetration, the productivity rate would increase by 0.13%.

Other studies have addressed the impact from microeconomics, especially SME outcomes. In his literature

review on the impact of mobiles in SMEs, Donner (2008) remarked that positive outcomes included an increased flow of information about prices and an expansion of interaction with clients. Duncombe (2011) found that the main benefits observed were better market coordination, greater and timelier information flow, as well as reduction of transaction costs and price dispersion. However, arguably the strongest evidence is found in the studies on SMEs and entrepreneurs (Chew, Levy, & Ilavarasan, 2011; Donner, 2008; Donner & Escobari, 2010; Duncombe, 2011). For instance, classic studies by Jensen (2007) and Abraham (2007) in India and Aker (2008) in Niger have shown that mobiles contribute to rectifying information asymmetries and creating more efficient markets.

Another branch of impact studies are the people-centered approaches that are receiving attention. However, this stream currently places more importance on the definition and measurement of concepts, rather than the evaluation of projects (Hatakka & Lagsten, 2012; Heffernan, Lin, & Thomson, 2012; Kleine, 2013; Zheng, 2009).<sup>1</sup>

In quantitative ITC4D evaluation, the application of rigorous quantitative tests for causality in order to properly demonstrate impact is still a major challenge. Few studies have addressed this challenge, and they have struggled with the problem of the counterfactual. Among other challenges, the studies lacked properly designed treated groups and control groups or the results of the control groups may have been contaminated by the treatment's spillover effects or by a reverse causation (Duncombe, 2011). Looking at those shortcomings, the conditional independence assumption is a compelling component that should be included in evaluations so as to have a better understanding of causal relationships among variables. In the domain of developmental studies, impact evaluation literature has established a set of methods that has been well accepted for policy evaluations (Baker, 2000; Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2011; Khandker, Koolwal, & Samad, 2010). So far, impact evaluation methods have been widely used to inform policy decision making. To assess whether a positive cause-effect relationship exists between mobile banking and efficiency gains in household expenditures and to avoid the evaluation problems outlined above, this study used a quasiexperimental evaluation for the case study described in the following section.

## Case Study

Compared to other countries, Mexico faces a financial inclusion gap. According to the Global Financial Inclusion Database (Demirguc-Kunt, Klapper, Singer & Van Oudheusden, 2015), 62% of the world's adult population has a bank account, and 27% have saved money in a financial institution. In Mexico, those numbers are 39% and 14%, respectively (Demirguc-Kunt et al., 2015). The most critical cases are rural communities: According to the 2010 national census, only 1.6% of the population living in communities of fewer than 2,500 inhabitants had access to financial services.

Population dispersion in Mexico is one of several challenges that impede efforts at financial inclusion. According to the census, approximately 32 million people live in rural communities.<sup>2</sup> Furthermore, these remote rural communities represent a higher percentage of people living in poverty (84%) than the rest of the country.

There is some expectation that mobile and branchless banking could improve financial inclusion, and recently Mexico has been enacting regulatory reforms to encourage the deployment of these financial inclusion models. Mobile banking seems to be particularly useful, considering that 59% of the rural population has access to mobile telephony networks.

This evaluation is based on a pilot program entitled Mobile Money Payments carried out by Telecomm. The goal of the pilot was to test a business model that would allow Telecomm to offer financial services in towns with fewer than 5,000 inhabitants who lacked those services.

The pilot program began in February 2011, aiming to provide financial and telephony services. Mobile banking was offered in January 2012, following the installation of a base transceiver station (BTS) that allowed

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1. Detailed discussion of this topic is beyond the scope of this article, although Kleine (2013) and Hatakka and Lagsten (2012) have proposed different operationalizations of Sen's capabilities approach, while studies by Sundén and Wicander (2007) and Duncombe (2006) are based on the livelihoods approach.

2. Defined as communities with fewer than 5,000 inhabitants.

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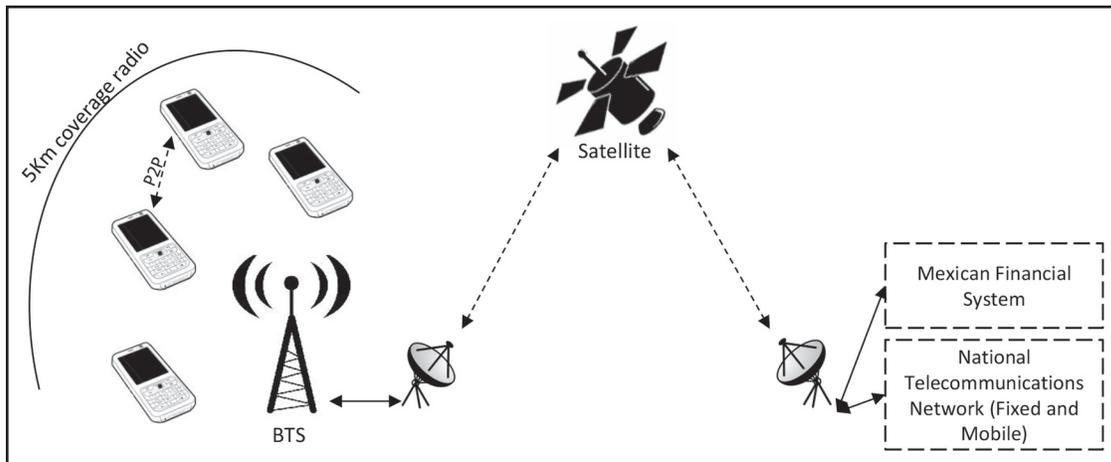


Figure 1. Pilot telecommunications system.

local mobile services and mobile banking transactions by switching transmission between the BTS and a satellite to complete outbound communication (see Figure 1).<sup>3</sup> This system was preferred as it supported low-cost mobile handsets, although its drawback is that given the satellite's scarce transmission capacity, the system does not allow outbound voice calls to a network other than the local BTS.

After the BTS was in operation, Telecommm was able to launch both the mobile banking and mobile telephony services. Financial inclusion via mobile banking started with a public offering of a free mobile handset for residents of the BTS-covered zones, on the condition that the resident own or open a bank account.<sup>4</sup> According to the business model, the costs (installation, operation, free handsets) would be recovered through fees charged for every financial transaction and a steady monthly payment of US\$7.75<sup>5</sup> for a mobile telephony subscription (the service consists of unlimited local voice calls and SMS). Notwithstanding, the pilot program does not provide a complete range of services. In telephony, users cannot connect outside of their local network. Regarding financial services, the pilot program offers basic services: savings accounts, people-to-people (P2P) and government-to-people (G2P) payments, remittances handling, and cash in/cash out. It does not offer microcredits, microinsurance, or similar services. Telecommm started to charge for the telephony service on a monthly basis in May 2013, sixteen months after installing the BTS and initiating the mobile banking service.

The project was implemented in four towns in the municipality of Santiago Nuyoó,<sup>6</sup> with 945 inhabitants, predominantly indigenous, with high rates of poverty and limited availability of public services. Of the municipality's population, 86% live on a daily income of less than US\$9.51; sixty-five percent of households have dirt floors; 22% of adults are illiterate. Prior to Telecommm's intervention, Santiago Nuyoó residents had neither financial nor telecommunication services. Tlaxiaco, the nearest city with financial and telecommunication services, is 52 kilometers away.

### **Evolution of Mobile Banking Adoption**

Since the start of the pilot program, 316 of the 396 adults who live in the four towns (that is, 80% of adults) acquired a mobile handset and opened a bank account. Before Telecommm's intervention, there were 30 account holders in the zone covered by the network; this number expanded to 150 account holders after

3. Outbound communication for financial transactions must comply with Mexican Financial System regulations, which do not allow any transaction without being immediately registered through its digital system.

4. Telecommm has collaboration agreements with seven major banks in Mexico. However, only one bank had a mobile banking platform at the point of implementation; therefore, only account holders of this bank were able to do mobile banking.

5. During the study period, a U.S. dollar was equivalent to 12.9 Mexican pesos (MXN).

6. The towns are Santiago Nuyoó, Tierra Azul, Plan de Zaragoza, and Yucuhtiti.

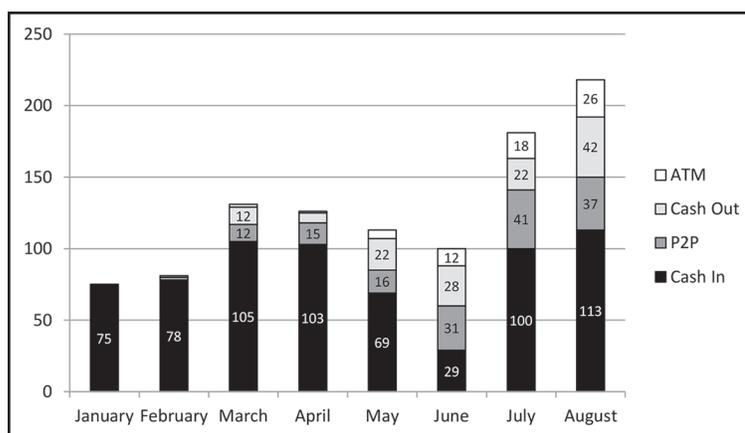


Figure 2. Number of transactions made in Santiago Nuyoó by type in first eight months of 2012.

Source: CGAP, 2012.

August 2012) was 33% (CGAP, 2012), while at the international level, in traditional mobile banking platforms (where normally there are no cellphones given for free), active accounts averaged 30% (Pénicaud & Katakam, 2014).<sup>7</sup>

After the start of mobile banking, the financial transaction pattern has evolved from traditional cash payments only to a combined use based on mobile payments and ATM use (see Figure 2). Until August 2012, forty-seven percent of active account holders were considered savers. Their average savings increased from US\$7.59 to US\$11.60 after the second quarter of 2012.

### Research Method and Data Source

The main challenge in designing an evaluation is addressing the inability of observing and measuring the counterfactual. This means we could not concurrently observe the outcomes from a treated household and the outcomes from the same household which had not been treated. This is expressed in Equation 1. The challenge of the counterfactual is normally solved with a randomized controlled trial (RCT), where treatment group and control group selection is completely random and without selection biases (Baker, 2000; Behrman, Gallardo-García, Parker, Todd, & Velez-Grajales, 2010; Khandker et al., 2010; Todd, 2007). This helps ensure that a counterfactual is properly chosen (as expressed in Equation 2). If this requirement is met, impact can be assessed with methodological robustness by distinguishing the treatment effect in the treatment group minus no treatment effect in the control group (see Equation 3).

1.  $E(\Delta D = 1) = E(Y_1 - Y_0 | X, D = 1)$
2.  $E(Y_0 | X, D = 1) = E(Y_0 | X, D = 0)$
3.  $\text{Impact} = E(Y_1 | X, D = 1) - E(Y_0 | X, D = 0)$

Where:

$Y_1$  is the expected outcome from a household being treated.

$Y_0$  is the expected outcome from the same household, which had not been treated.

$X$  is the set of variables that determines a household's probability of being selected for the pilot project.

$D = 1$  is a household that is part of treatment group.

$D = 0$  is a household that is part of control group.

7. In their international comparison, Pénicaud and Katakam defined active accounts as users who performed at least one transaction within the last 90 days. CGAP in Santiago Nuyoó defined active accounts as users who performed at least one transaction within the last 30 days.

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Apart from random selection, RCT requires data collection at a baseline stage and at following stages in both treated and control households. The first requirement was not met in this study since the pilot project started before a baseline could be collected and because the program design allowed for autoselection bias by the beneficiaries as handsets were available to everyone who wanted one. Given those constraints, a quasi-experimental method was the appropriate alternative for selecting counterfactuals, and the most appropriate technique for this study was propensity score matching (PSM), as this allowed for synthetic counterfactual selection (Baker, 2000; Khandker et al., 2010). The PSM is based on the selection of a set of sociodemographic characteristics (e.g., a household's type of floor, roof materials, equipment, services available, etc.), usually from a data set different than that of the treated group, but where both have the same variables and can be completely comparable. This allows the construction of a synthetic control group from households not among the treated group, but equally measured so counterfactuals could be selected from this synthetic group based on the households that were the most similar possible than the surveyed households, considering a set of sociodemographic characteristics.<sup>8</sup>

It is understood that quasiexperimental methods lack the robustness of an RCT, but for the PSM this method is considered to have a strong statistical robustness as long as its two assumptions are satisfied (Khandker et al., 2010; Todd, 2007):

**Assumption 1.** Conditional independence of the outcomes regarding  $D$ . Potential outcomes are orthogonal to treatment once it is conditioned by a set of observed variables ( $Z$ ).

$$4. Y_1, Y_0 \perp D|Z$$

Where:

$Z$  is the set of variables that determines the possibility of a household being selected for the pilot program

**Assumption 2.** Common support region. For individuals of both treatment and control groups with the same  $Z$  values, there is a positive and nonperfect probability of participating in the program.

$$5. 0 < \Pr(D = 1|Z) < 1$$

These assumptions allow for each treated household to have a control peer that was found within the common support region, with the same conditional characteristics ( $Z$ ). Therefore, once the matching was computed for each treated household, the outcome ( $Y_0|X, D = 0$ ) could substitute the result ( $Y_0|X, D = 1$ ), as in an RCT. Matching estimation requires the careful selection of a set of conditional variables  $Z$ , given that as the number of variables increases, the possibility of finding a peer for each treated household is reduced. On the other hand, the fewer the number of  $Z$  variables, the more imprecise the outcomes tend to be. However, the calculation of a probability score (instead of a precise matching among all  $Z$  variables) allows us to introduce more variables to better match the treated group (Dehejia, 2005; Khandker et al., 2010).

Information from the treatment group was gathered through a survey that shared exactly the same variables and structure with the control's data source. The survey design for the treated households was a replica of the National Survey on Income and Expenditure (ENIGH, its Spanish acronym) carried out by the National Bureau of Statistics and Geography (INEGI, its Spanish acronym) at the national level.<sup>9</sup> The survey had a simple random sample of 100 beneficiary households out of 150 in total; all were chosen from the first wave of handsets delivered in January 2012.<sup>10</sup> Prior to the selection, a beneficiaries' depuration was done to avoid double

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8. For an extended review of the PSM technique, see Dehejia (2005), Dehejia and Wahba (2002), Jalan and Ravallion (2003), Rosenbaum and Rubin (1985), and Todd (2007).

9. However, the survey for the treatment group only used the section regarding the expenditure questions, omitting all sections about income that are part of the ENIGH (Instituto Nacional, 2013).

10. Six months later (in June 2012) more beneficiaries were introduced on a one-by-one basis, amounting to 316 adults. The number of beneficiaries may be higher than number of households for four reasons: (1) the number of households has increased from the 2010 census to the 2013 census, although precise data is unknown; (2) in some households more than one adult acquired the service so there was double-counting; (3) some persons from noncovered localities managed to obtain a handset; and (4) some persons who acquired the handset emigrated.

*Table 1. Types of Expenditures and Research Hypotheses.*

<b>Type of Expenditure and Description</b>	<b>Research Hypothesis</b>
Homecare: Expenditures for goods and services for homecare	No effect
Personal care: Expenditures for goods or services for cleaning and personal care	No effect
Education: Expenditures for education-purposed goods or services	No effect
Recreation: Expenditures for amusement-purposed goods or services	No effect
Communications: Expenditures for mobile and fixed phone calls as well as public telephony services	Expenditure reduction
Vehicle's fuel: Expenditures for fuel, oil, maintenance, parking, and other vehicle services	Expenditure reduction
Energy: Expenditures for electricity and fuel for household purposes	No effect
Public transportation: Expenditures for local and regional public transportation services	Expenditure reduction

surveying households in which there was more than one adult with mobile service. Only the early beneficiaries were selected as this allowed a delimited and homogenous period during which people joined the pilot program and had a relatively matured process of adopting the mobile banking into their lives.

The survey was implemented during three days in June 2012 in the four BTS-covered towns. Survey responses accounted for monthly expenditures by households in May 2012; the vast majority of respondents were heads of household. Local residents were hired as pollsters and were given four hours of training by an INEGI professional trainer. The pollsters returned 78 completed questionnaires, resulting in an attrition of participants for several reasons.<sup>11</sup>

To define the synthetic control group, INEGI's latest ENIGH was used. This database includes 8,939 surveyed households and over 100 variables covering sociodemographics, income, and expenditures. The data collection process for ENIGH 2012 (INEGI, 2013) occurred in May and June 2012, concurrent with the information-gathering period of the study's survey in Santiago Nuyoó. Additionally, no observations in the ENIGH 2012 database were gathered in Santiago Nuyoó or neighboring towns, nor were other mobile banking pilot programs implemented in other areas of the country in that period; therefore, there was no possibility of finding treated households in the control database.

Thirty-one sociodemographic variables were chosen to satisfy Assumption 1 (see Table 2). The selected variables are based on characteristics that cannot be changed by the possibility of being treated (or not) in the pilot program; for instance, the dwelling's age, construction materials, number of bedrooms, etc. Other household characteristics were added to identify potential autoselection biases, such as possession of electronic equipment (PC, radio, TV, etc.).

Impact was assessed for eight expenditure categories. A research hypothesis posited that a reduction in expenses would be expected only in three variables (see Table 1): communication, public transportation, vehicle fuel.

## Survey Analysis

A comparative analysis of survey results for the treated group and statistics from the 2010 Santiago Nuyoó census was necessary to find any potential autoselection bias in independent variables and to assess the survey's quality. Basic sociodemographic descriptive statistics showed no significant differences between the observed survey data and the Santiago Nuyoó census. In the survey, the average number of inhabitants per household was 4.2, while the census found an average of 3.7; average schooling years in the survey were 6.2

11. *The main reasons were that families emigrated, were temporarily out of town, or it was not possible to find adults at home after several interviewer visits.*

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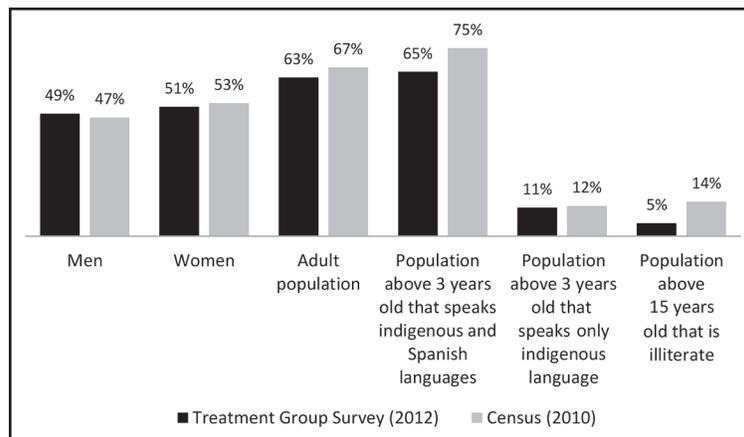


Figure 3. Sociodemographic characteristics of population in Santiago Nuyoó.

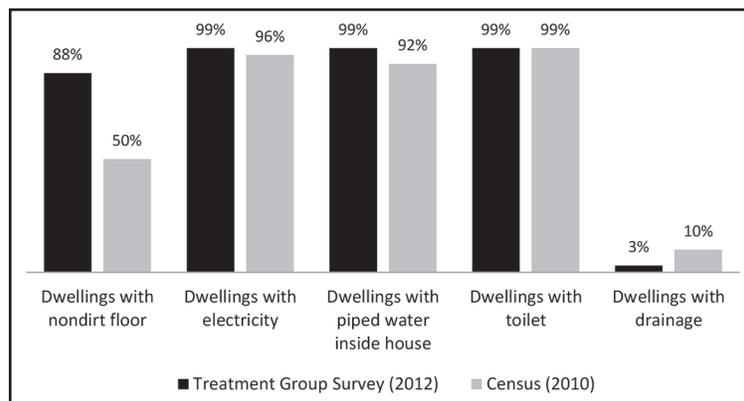


Figure 4. Household characteristics of Santiago Nuyoó.

while the census reported 6.5. Figure 3 shows that the proportion of men and women are similar in both data sets as well as the percentages of adults and indigenous people. However, the survey has a considerably lower percentage of illiterate people than the census, indicative of an autoselection bias.

Regarding household characteristics, in both data sets the percentages of houses with electricity and lavatory are similar (see Figure 4). Nevertheless, the treatment group has a higher percentage of households with a nondirt floor than do census households, but a lower percentage of households with sewage systems.

In terms of ICT access, there was a clear difference between the survey and census households. Seventy-seven percent of treatment households had a television, versus 46% reported in the census. In the treatment group, 96% of households reported having a mobile phone,<sup>12</sup> while in the census no households with a cellular phone were reported in 2010 (which confirms the absence of service prior to Telecomm's intervention).

## Propensity Score-Matching Modeling and Robustness Tests

In computing the matching, four models were considered, each corresponding to a different strategy to identify the best possible counterfactuals. The models' reasoning are described next:

**Model 1.** Includes all 31 sociodemographic variables selected to perform the matching. Thus, this model is a minimum standard and, as such, other models are expected to perform better than Model 1.

**Model 2.** Includes all the variables that could be more affected by the region's geographic and social conditions. This construction departs from the hypotheses positing that Santiago Nuyoó's geographic characteristics differ from the rest of the country as it is deep in the mountains and households share certain habits regardless of income. For instance, both rich and poor households cook with wood, which in other contexts might be characteristic of poverty.

12. This data should have represented 100%, but there was a small percentage that temporarily lacked mobile phones for reasons such as equipment loss or breakdown.

**Model 3.** Includes variables that explain household conditions related to the families' economic situation. This model is related to the variations among houses with differing levels of income and independent of the geographic context.

**Model 4.** A version of Model 2, but applied to a subset of ENIGH 2012 households in towns of fewer than 2,500 inhabitants. The process of applying a subset aims to optimize the probability of selecting individuals living in areas similar to Santiago Nuyoó.

A logistic regression helped determine which model had the highest association level between the dependent dichotomous variable (treated/controls) and the set of independent variables. According to the results, Model 2 best suited the data, so this model was used (see Table 2).

In the analysis of common support region, Model 2 obtained better results than the other models. Additionally, the fact that the ENIGH database (INEGI, 2013) contains a large number of observations allowed us to find a great quantity of possible counterfactuals in the first eight balancing blocks, according to their score (see Table 3).

## Results

The results of Model 2 show that the pilot program has only one observed variable that was affected: public transportation. However, there is also a reduction in communication expenditures, but those gains were re-assigned to pay the monthly subscription for Telecom's mobile service, which accounts for US\$7.75. In public transportation, the pilot program led to statistically significant savings of US\$10.54/month. It was found through survey qualitative analysis and the fieldwork that these savings led to a decrease in commuting frequency when the purpose of the travel was to obtain information. This fact indicates that if the program could add outbound calls, expenditures for public transportation to the nearest city would be reduced. In communications, putting aside the monthly mobile subscription fee, there is a statistically significant savings of US\$10.15 per month (see Table 4). These findings imply that the cost of Telecom's services are not an additional spending burden on consumers, since savings gained through using the service are roughly equal to the monthly subscription fees.

One constraint of this pilot program is that Telecom offers only local telephony service. Prior to this program, there was no local telephony service, so previous spending on local calls was zero; no expenditures could be saved compared with the previous condition. Thus, lack of access to toll calls still represents a lost opportunity for beneficiaries to optimize their expenditures, since even after the pilot 19% of the families used public telephony services (via satellite) for toll calls. This service costs US\$0.38/minute, and families spend an average of US\$3.95/month on this service, which represents 1.5% of their monthly budget. Another 5% of beneficiaries had an additional mobile handset from a commercial mobile operator, which they used in travels to the nearest city, costing them an average of US\$22.09/ month (mainly to purchase prepaid minutes), equivalent to 7.8% of their budget. Given those facts, it is probable that if mobile telephony services included outbound calls, expenditures on communication would decrease.

As shown in Table 4, expenses in homecare, education, fuel, and energy were unaltered. However, other relevant expenses such as food, clothing, rent, and savings were not measured. The unmeasured saving require special consideration, since according to the literature, any improvement in spending efficiency would allow families to improve their saving capability, especially after policies that reduce the costs of entering the formal financial system. In fact, there is indicative but inconclusive evidence that a major share of the efficiency gains have been channeled into greater savings. According to CGAP, 47% of new mobile banking accounts are considered savers, with a monthly average saving of US\$5.19 (CGAP, 2012). These new account holders had no prior bank account, so a simple transfer of savings can be discarded as a possible explanation. Other possible explanations are that increased savings may be attributed to a hypothetical increase of about 2% in the average household's income during the period of intervention or that beneficiaries reduced expenditures in unmeasured areas. If those alternative reasons do not explain the increased savings, then the pilot program would explain the increased savings.

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Table 2. Logistic Regression Models to Estimate Propensity Scores.

Variables <sup>1</sup>	Model 1	Model 2	Model 3	Model 4
Wall materials	-0.374** (0.0583)	-0.0949 (0.0583)		-0.114* (0.0672)
Roof materials	-0.158* (0.0833)	-0.0613** (0.0266)		-0.0620** (0.0278)
Floor materials	-0.252 (0.499)	-0.324* (0.173)		-0.324 (0.202)
Dwelling age	-0.0563*** (0.0171)		-0.0245*** (0.00613)	
Kitchen used as bedroom	1.170 (0.724)			
Number of bedrooms	0.577 (0.372)		0.309*** (0.118)	
Number of rooms	-0.175 (0.291)		0.0766 (0.0880)	
Clean water availability	0.557 (0.534)	0.457*** (0.167)		0.443*** (0.140)
Frequency of water availability	-0.121 (0.195)	-0.133* (0.0743)		-0.124 (0.0764)
Shared lavatory	-0.568 (0.551)			
Means of lavatory water supply	-1.024** (0.502)	-0.0356 (0.135)		-0.105 (0.134)
Public sewer connection	1.117*** (0.280)	0.516*** (0.0660)		0.468*** (0.0693)
Number of spotlights	-0.147 (0.107)		-0.0847** (0.0392)	
Most frequently used fuel for cooking	2.713** (1.074)			
Stove with chimney	-0.950*** (0.281)		-0.434*** (0.0959)	
Means of garbage disposal	0.405*** (0.148)			
Sink	-0.253 (0.574)		0.119 (0.228)	
Shower unit inside the building	-1.118** (0.481)		-0.653*** (0.209)	
Water tank on roof	1.117* (0.624)		0.784*** (0.248)	
Water tank	0.457 (1.151)		0.157 (0.427)	
Water tank for hand-washing	1.202*** (0.376)		0.635*** (0.145)	
Boiler	-0.711 (0.683)		-0.352 (0.264)	
Gas tank	-0.653 (1.157)		-0.684 (0.475)	
Number of household inhabitants	-0.0819 (0.107)		-0.0589 (0.0368)	
Fixed (landline) telephony	-1.231** (0.609)	-0.0762 (0.200)		

Table 2. (Continued).

Variables <sup>1</sup>	Model 1	Model 2	Model 3	Model 4
Mobile telephony	-3.223*** (0.774)	-1.810*** (0.260)		-1.900*** (0.267)
Paid TV	-1.592*** (0.421)			
Internet	0.477 (1.082)			
Connection to public service electricity		-0.672** (0.296)		-0.669** (0.306)
Lavatory inside house			-0.922** (0.400)	
Constant	4.997 (4.003)	0.552 (0.869)	0.125 (1.428)	1.196 (0.878)
Observations	803	7,796	1,919	2,447
Pseudo R <sup>2</sup>	0.7046	0.4716	0.1956	0.3873
Treated	37	74	52	76
Controls	56	1,583	1,641	987
Balancing condition	Yes	Yes	No	Yes

Note: Standard errors in parentheses.

\*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$

<sup>1</sup>A full definition of variables can be found in INEGI (2013).

Table 3. Common Support Region for Model 2.

Blocks according to lower edge score	Control	Treatment	Total
0.0023914	1,256	13	1,269
0.025	122	6	128
0.05	42	5	47
0.1	66	7	73
0.2	87	28	115
0.4	10	15	25
Total	1,583	74	1,657

## Conclusions

Among beneficiaries, this pilot program triggered a reassignment of resources with positive outcomes. The study showed efficiency improvements in public transportation and communications categories of households' monthly expenditures; therefore, this study empirically supports the argument that a combined set of mobile banking and mobile telephony contributes to households' improved well-being.

However, the study did not demonstrate conclusively where this efficiency improvement was transferred. The evidence is conclusive that these efficiency improvements in public transportation and communications were not transferred into any of the remaining six measured expenditure categories. Evidence from CGAP on savings behavior from Santiago Nuyoó beneficiaries showed that after the pilot program, people increased their savings, suggesting that a share of the efficiency gains was transferred into savings, if they could not be explained by an increase in household income during program implementation or by a significant expenditure reduction in an unmeasured category. The introduction of local mobile telephony allows people to reduce

Table 4. Differences in Expenditures Among Treatment and Control Groups Under Model 2, by Type.

	Homecare	Education	Communications	Communications (without Telecomm subscription)	Fuel	Energy	Public transportation
Expenditures of treatment group	20.54	39.14	20.23	12.63	18.8	21.24	13.17
Expenditures of control group	20	33.41	22.86	22.86	19.92	22.63	23.72
Differences (in US\$)	0.54	5.65	-2.63	-10.15	-1.08	-18	-10.54
Standard error (in US\$)	3.17	10	4.65	4.41	4.65	3.48	3.72
Observations	7,792	7,792	7,792	7,792	7,791	7,792	7,792
z-value*	0.17	0.57	-0.56	-2.28	-0.23	-0.39	-2.79
p-value	0.862	0.572	0.573	0.023	0.820	0.694	0.005

Note: Standard errors and z-value estimations are based on the bootstrapping method.

travel expenses as they could reduce travel time related to acquiring information or making payments. Travel can represent the loss of a half or an entire working day so there are additional savings, according to the ways in which someone values his or her time.

The municipality of Santiago Nuyoó is representative of areas of Mexico that fall into the access gap of the digital divide and that, given the huge costs associated with providing telecommunications services, it is unlikely that in the future these communities could be served by telecommunication and banking firms. The positive reaction in the demand for these services communicates the success of this pilot program in terms of adoption; observable by the high frequency of use of mobile banking and by people's willingness to pay monthly mobile subscription fees for the service at prices that represent, on average, 2.7% of their budget.

It is important to remark that this study's outcomes are not particular to mobile banking intervention, but a combination of mobile banking and mobile telecommunications services. Thus, these results can only be generalized regarding the introduction of these services in rural communities. Moreover, this experience suggests that mobile banking models should look forward to strategies that could increase their *transformational* capability. For this to occur, a fundamental issue is how to proactively reduce the telecommunications access gap rather than rely solely on existing penetration levels. Considering current governments' involvement in broadband deployment around the world (regardless of political vision), further research may contribute to information on whether government engagement is a plausible alternative to improving the *transformational* capability of a mobile banking platform. ■

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**Cesar Renteria**, Associate Professor, Centro de Investigación y Docencia Económicas, A.C. (CIDE), Mexico. cesar.renteria@cide.edu

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