

Research Article

The Limited Impact of ICTs on Microenterprise Growth: A Study of Businesses Owned by Women in Urban India¹

Han Ei Chew

chewhan@msu.edu
Doctoral Student
Department of
Telecommunication
Information Studies & Media
Michigan State University
409 Communication
Arts & Sciences
East Lansing, MI 48824-1212
USA

Mark Levy

mlevy@msu.edu
Professor
Department of
Telecommunication
Information Studies & Media
Michigan State University
402 Comm Arts & Sciences
East Lansing, MI 48824-1212
USA

Vigneswara Ilavarasan

vignesh@hss.iitd.ac.in
Assistant Professor
Dept. of Humanities &
Social Sciences
Indian Institute of
Technology Delhi
Hauz Khas,
New Delhi 110 016
India

Abstract

This article is presented as a response to the increasing need for rigorous impact assessment in ICT4D. The research reported here empirically examines whether ICTs enable microenterprise growth, to what degree, and under what conditions. We created two theoretical models that predict relationships between selected antecedents of ICT access, ICT use, and business growth. Using data collected through a multistage probability survey of women micro-entrepreneurs in Mumbai, India, we tested the models by structural equation modeling (SEM). Both models predicted a statistically significant, but limited causal relationship between access to ICTs (as the independent variable) and business growth (as the dependent variable). The theoretical model and the analytical techniques suggest that future research should pay greater attention to the specific factors that mediate the impact of ICTs on the growth of very small businesses.

Introduction

Challenging the long-running claim that information and communication technologies (ICTs) enable development is now a central premise of ICT for development (ICT4D) scholarship. Indeed, numerous researchers have called for rigorous studies that examine the impact of increasingly diffused ICTs (Donner, 2008; Donner & Escobari, 2010; Duncombe, 2009; Heeks, 2010a; Heeks & Molla, 2009). The research reported here is a partial response to the need for studies that investigate whether, to what degree, and under what conditions ICTs enable microenterprises to grow.² We chose a research site that we believed would be especially fruitful for probing the role of ICTs—namely, microenterprises owned by women in Mumbai, India. With data collected through a multistage probability design, we tested two models of ICT impact on business growth using structural equation modeling (SEM). Both models predicted a statistically significant, causal relationship between access to ICTs (as an independent variable) and business growth (as the dependent variable). However, the set of independent variables investigated could explain only a small amount of the variance in business growth. Thus, these findings offer one

1. This research was carried out with the aid of a grant from the International Development Research Centre, Ottawa.
2. There is no consensus in the research literature about the definition of a “microenterprise” (Donner & Escobari, 2010). Indeed, in India the National Survey Sample Organization (NSSO, 2000) categorizes very small businesses by the number of workers, while the Indian Ministry of Micro, Small, & Medium Enterprises (2007) bases its definition on the value of the physical plant and machinery.

context-specific example of the limited impact of ICTs on microenterprise growth and thereby provide a more nuanced picture of ICTs as enablers of development.

Literature Review

ICTs and Economic Development

From a macroeconomic perspective, ICTs have been shown to have positive consequences for the economies of developing nations. In the countries of Africa, for example, a 10% increase in the availability of mobile phones resulted in a 0.59% increase in per capita GDP (Waverman, Mesci, & Fuss, 2005), while across the Global South, a 10% increase in broadband penetration was projected to produce a 1.38% increase in per capita GDP (Qiang & Rossoto, 2009).

At the micro level, there is little evidence about the impact of computers on microenterprises, largely because rates of computer and Internet diffusion are low, and the costs of computer use make it an economically unattractive option for most microentrepreneurs (Chinn & Fairlie, 2010). Mobile phones, on the other hand, do appear to effect microenterprises in ways that might be economically beneficial. Two wide-ranging reviews of the literature (Donner, 2008; Donner & Escobari, 2010) conclude that mobile phones may facilitate the search for price information, reduce business-associated travel, and aid in communication with existing suppliers and customers, but evidence that mobile phones also make it possible for microentrepreneurs to expand their base of suppliers and customers—key components of economic growth—is mixed.

The strongest evidence that mobile phone use by microentrepreneurs helps correct information asymmetries and creates more efficient markets comes from Abraham (2006), Jensen (2007), and Aker (2008). These studies demonstrate how information acquired by participants in the fishing industry in Kerala, India (Abraham and Jensen), or by grain traders in Niger (Aker), reduces producer risk, price variability, and cost to consumers. However, while Jensen and Aker report increased producer profits, Aker found that economic benefits did not accrue equally across the fishing industry, with most gains going to the better-off in the supply chain.

Urban Women Microentrepreneurs

Because of their ubiquity and potential as a path toward alleviating poverty, microenterprises have

long been of interest to the development community (Mead & Liedholm, 1998; Nichter & Goldmark, 2005). Moreover, various estimates, both country-specific and regional, suggest that women own upward of half of all microenterprises in the developing world (Chen, 2001; National Sample Survey Organization [NSSO], 2000; Peebles, 2006; Wasihun & Paul, 2010). However, most enterprises owned by women are classified as sole proprietorships and/or home-based businesses (Mead & Liedholm, 1998; Nichter & Goldmark, 2005). In India, for example, at one time 69% of urban microenterprises owned by women were home-based and had no hired workers (NSSO, 2000). Recent research has questioned the potential of sole proprietorships to increase revenues or create jobs (Gelb, Mengistae, Ramachandran, & Shah, 2009; International Labor Organization [ILO], 2009; LaPorta & Shleifer, 2008). Therefore, sole proprietorships and home-work microenterprises are excluded from this study. This approach, it is hoped, enriches our sample with greater numbers of microenterprises that are not “livelihood” or “survivalist” enterprises and that might exhibit ICT-enabled growth (Duncombe & Heeks, 2005).

Several factors make urban settings a strategic research site. First, much previous research on microenterprises has focused solely on rural development. While not ignoring the need for rural development, we contend that the increased urbanization of the developing world provides a largely overlooked locus in which ICTs might be successfully leveraged to support economic growth. Second, with regard to the availability of ICTs, it is clear that mobile phones and even the Internet have diffused earlier and with higher subsequent penetration in the urban areas of developing nations than they have in the countryside (Castells, Fernandez-Ardevol, Qiu, & Sey, 2007; Mariscal, 2005). Thus, access to ICTs, which is a necessary but not sufficient condition for demonstrating ICT impact, is by and large met in urban settings.

Third, compared to very small businesses in the countryside, urban microenterprises have an almost 25% greater chance of surviving beyond their first year (Mead & Liedholm, 1998). Whether urban microenterprises remain in business after a year as a function of ICT use remains a largely unexplored phenomenon, as does the related, possibly recursive relationship between business growth and ICT use. Fourth, cities are generally home to large numbers of microenterprises—the target population of this

research. According to the NSSO (2000), for example, the greatest number of “establishments” (in practice, microenterprises)—some 4.2 million—are found in the cities of India, a figure that is three times that of the number located in India’s vast rural areas. In Mumbai, for instance, the informal sector accounts for two-thirds of total employment (Srivastava, 2005).

Assessing the Impact of ICTs

A variety of theoretical and methodological strategies have been used to examine the effects of ICTs on development (for critical compilations, see Duncombe, 2009; Heeks, 2007; Heeks & Molla, 2009). Duncombe acknowledges the strengths and weaknesses of both qualitative and quantitative methods, but suggests that quantitative analysis is more likely to provide the more rigorous tests of causality required to demonstrate ICT impact. One such strategy is the “LISREL-facilitated approach” (Heeks, 2007). LISREL is a software program for structural equation modeling that is widely used (as is a closely related software known as SPSS AMOS) used in communication research (Kotz, Krishnan, & Wickersham, 2007) and by information systems researchers, especially for testing models of technological adoption (Lee, Kozar, & Larsen, 2003).³

Structural equation software allows researchers to model relationships between variables pictorially and thereby understand the relationships of model variables more clearly. In SEM, all variables in the proposed model are simultaneously tested to assess the degree to which they are collectively consistent with the data. Moreover, unlike regression models, SEM simultaneously takes into account collinear relationships between predictor variables. Finally, as Bentler (1980) observes, “If the model cannot be rejected statistically, it is a plausible representation of the causal structure” (p. 420).

Method

Sample Design

Research for this study was carried out in Mumbai, India, in May and June 2009. As India’s largest city,

Mumbai had the greatest number of Internet-connected computers in India at approximately 3.3 million (India Broadband Forum, 2008), the most mobile phones nationwide at 20 million (Telecom Regulatory Authority of India, 2009), and approximately 2,000 Internet cafés (“Cyber Cafés,” 2009).

GNN Market Research Pvt. Ltd. of Mumbai conducted in-person interviews with women who owned microenterprises with between one and 19 hired workers. We set the upper boundary at 19 hired workers to try to capture “growth” enterprises—those microenterprises with potentially greater business communication needs that might “show a greater business focus and which deliver broader/longer term benefits of competitiveness, innovation and exports” (Duncombe & Heeks, 2005, p. 5).

Data were collected using a three-stage random cluster probability design. The first stage of the sample consisted of 34 “investigative units” (IVs) chosen by circular systematic random sampling from the 900 IVs in the NSSO Urban Survey Frame for Mumbai city. The NSSO further subdivides every IV unit into a variable number of “blocks,” made up of one or two roughly square city blocks or similar areas circumscribed by other geographic features. All blocks (usually between 15 and 20) in each IV selected in stage 1 were numbered, and for stage 2 of the sample, we selected one block in each IV by simple random sampling. Each corner of every block chosen in stage 2 was numbered, moving clockwise around the block from a starting point at its uppermost left corner. In the final stage of the sample, one corner of each block was selected by simple random sampling and became the starting point for interviews.

Interviewers were instructed to seek eligible respondents at each starting point. A snowball approach was used to locate subsequent respondents. Within each of the sampled IV units, we established the following quotas: one business with 1–6 hired workers; four businesses with 6–9 hired workers each; one with 10–19 hired workers; and one from any of the three preceding categories. These quotas reflect the approximate distribution of

3. A search of the three top-ranked ICT4D journals (Heeks, 2010b)—Information Technologies & International Development, The Electronic Journal of Information Systems in Developing Countries, and Information Technology for Development—found only two papers that tested a model using SEM. We believe this is unfortunate. Short of difficult-to-fund experimental designs or longitudinal studies, structural equation modeling offers ICT4D scholars an important method to probe causal impacts.

urban microenterprises by number of hired employees (NSSO, 2000). In six investigative units, interviewers were unable to locate eligible respondents within the IV boundaries and were instructed to move slightly outside the IV to complete the quotas. Since contiguous IVs shared similar social and economic characteristics, this procedure, we believe, had no serious implications for the integrity of the sample.

Interviews generally required 30–40 minutes to complete. A cash incentive of Rs. 600 (approximately US\$12 at the time and equal to four days' wages for a semi-skilled urban worker in India) was offered to respondents. We obtained 231 completed interviews. Dividing the number of completed interviews by the number of encounters with eligible respondents yielded a completion rate of 67%.

For the sake of convenience, a draft questionnaire was pilot tested on seven respondents in the Chandni Chowk area of New Delhi, a neighborhood that approximates Mumbai both in density and type of microenterprises. The revised questionnaire was prepared in English and translated into Hindi. The original English text and a back-translated version of the Hindi questionnaire were found to be in substantial agreement, indicating that a culturally and linguistically acceptable text in Hindi had been created. On the advice of the survey research firm, it was decided to use the Hindi version of the questionnaire, with the English version as a backup.

Sample Characteristics

Taking the microenterprise as the unit of analysis, the modal number of hired workers was six (range = 1–15). Consistent with the sample design, about one-third of the microenterprises (31.6%) had between one and five hired workers, 51.9% employed between six and nine paid workers, and 14.4% had 10 or more. More than three-quarters (77.5%) of microenterprises sampled had a business landline; 87.9% of the women who owned those very small businesses had at least one mobile phone. Only 10.4% had a computer in the workplace, and only half of those computers had Internet access.

A majority of female-owned microenterprises (55.7%) were in the trading sector. As reported by respondents, typical businesses in trade included sellers of clothing, groceries, small electronics, dress materials, or jewelry. Some 42.6% of the micro-

enterprises were service sector businesses. Examples of services offered by respondents included medical care by general physicians, taxicabs and tours, academic tutoring, beauty parlors, and data entry. Only 1.7% of the microenterprises were in the manufacturing sector, including tailoring, dressmaking, or low-end leather work. The average microenterprise had been in business for a decade (mode = 10 years, range = 2 months–60 years), and only 5.6% had been started within a year of the survey. While 61.5% of microenterprise customers came from the "neighborhood," more than one-third (38.5%) came from other parts of Mumbai, with 14.3% of sales resulting from phone calls.

Of the 231 women microentrepreneurs sampled, 86.5% were married and had an average of two children (mode = 2.0, range = 0–9). Indeed, given the patriarchal nature of Indian society, which prescribes home-based roles for women, ownership of a microenterprise must be understood in the context of dual home-work challenges. Women who own and run a microenterprise are not free from domestic work. Nevertheless, 42.4% had part-time domestic help, and a surprising 19.9% said their husband shared in the work of maintaining the home. More than 8 out of 10 (83.5%) businesswomen had a personal bank account from which they could make withdrawals or payments on their own. Education levels of respondents were high, with 51.9% having a high school or higher secondary school education and 41.1% having earned a bachelor's degree or higher.

All respondents said they speak, read, and write Hindi. More than half (56.3%) spoke English, 70.1% could read English, and 67.5% could write it. More than half (56.3%) of respondents said they could calculate taxes or interest, another 39.8% said they could do simple arithmetic, while only 3.9% said they could recognize or write numbers but could not do calculations. In sum, the probability-based survey generated a sample with generally high levels of human capital—a cluster of skills, experiences, and social contexts that are acquired prior to (and are necessary for) ICT access and use (van Dijk, 2005).

Testing the Models

We examined the question of ICT impact on microenterprise growth by using SEM (Byrne, 2010). The first step in the process is to specify all inde-

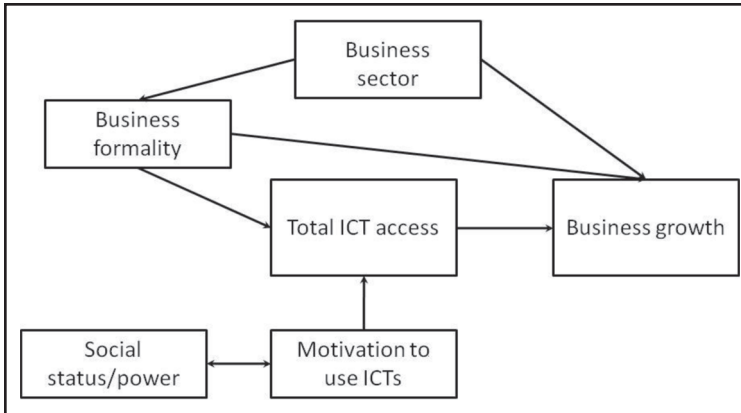


Figure 1. Model of Microenterprise Growth (Ilavarasan & Levy, 2010, p. 61).

pendent (predictor) and dependent variables in the model and to depict hypothesized relationships between the variables in the form of a path diagram. A correlation matrix of all variables is then created to determine the nature of the relationships between pairs of variables and to eliminate hypothesized variables that are not significantly correlated with other variables. Regression analyses are then carried out to determine whether the hypothesized paths are statistically significant and to determine how much variance in the dependent variables is predicted by the antecedent variables. Finally, the entire structure of variables is tested using a path analysis to evaluate the degree to which the data are consistent with the model, an assessment known as “testing goodness-of-fit.” The use of path analysis—a specific type of SEM—allows researchers to analyze all the variables in the model simultaneously instead of separately in different regression models (Chin & Newsted, 1999; Fornell, 1984). A model that has a good fit with the data supports the plausibility of the postulated relationships in the model.

Initial Model

The initial model tested is called the “Model of Microenterprise Growth” (Ilavarasan & Levy, 2010, p. 61; see Figure 1). The dependent variable in the

model is economic growth, with total ICT access, microenterprise, and owner characteristics as antecedent, independent variables. The wording of most questionnaire items and the internal consistency coefficients (Cronbach’s alpha) for the multi-item additive indices can be found in the appendix.⁴ The dependent variable, business growth, was operationalized as the sum of (a) the owner-estimated percentage change in the income of the microenterprise “compared to a year ago,” and (b) the respon-

dent’s assessment of the effects on her business of the Mumbai terrorist attacks in November 2008 (0 = less business; 1 = no change in amount of business; 2 = more business). None of the microenterprises in the sample were targets of those attacks. We did not ask respondents about actual income, but inquired instead about “percentage change,” because we had found in the pilot study that businesspeople were unwilling to share that information. Coupled with similar experiences reported by the survey interviewers, we decided that an indirect approach to this sensitive subject would yield more valid data (de Mel, McKenzie, & Woodruff, 2009).

Total ICT access was constructed from 10 items that measured ownership of mobiles, phones, personal computers, laptop computers, and availability of the Internet, both in the respondent’s home and at the workplace.⁵ A logarithmic transformation was performed on the final total ICT scores. If ownership of ICTs improves the economic well-being of microenterprises owned by women, we would expect to find a positive relationship between total ICT access and business growth.

While microenterprises are generally considered part of the informal economy, it is also true that microenterprises may vary considerably across a dimension of informality–formality (Becker, 2004;

4. The appendix contains descriptions of the variables used in the final structural model. Most of these variables were retained from Ilavarasan and Levy, 2010. Revisions to the variables are described in the Methods section.

5. Access to a workplace landline was excluded in the final index of ICT access, because, with its inclusion, the Cronbach’s alpha for the index fell to an unacceptable level ($\alpha=0.53$). Based on open-ended questions in the survey, we found that many respondents believed that a microenterprise needed to have a landline to remain visible in the business space, even though the landline was rarely used.

Chen, 2007). To capture this characteristic, the business formality variable was constructed from items that measured whether the business was registered with the government, whether it had a business bank account, and what bookkeeping practices it followed. Some development economists contend that informal enterprises can be productive, but are often hampered by unfair taxes, cumbersome government regulations, and limited access to capital (de Soto, 1989). By staying in the unregulated, unlicensed, and untaxed sector of developing economies, microenterprises can remain economically viable and may even thrive (Portes & Haller, 2005). Therefore, we hypothesized that there would be a negative relationship between microenterprise formality and microenterprise growth.

Two psychological variables were also created. The first was an index of motivation to use mobile phones for business with eight operational measures (e.g., "My mobile phone helps me keep informed about prices and other business news" or "Using my mobile helps me stay in touch with current customers") that are roughly similar to indicators of "relative advantage" found in the diffusion of innovation literature (Rogers, 2003). We assumed that female microentrepreneurs who saw potential economic benefits in applying mobile phones to their business practices would be more inclined to use them, which could, in turn, lead to business growth.

The second psychological variable was labeled "social status/power" in the initial model and was constructed from self-reported measures of perceived increases in status and power. We hypothesized that to the extent female microentrepreneurs acquire and use ICTs as a means to achieve business growth and, in turn, to the degree that others perceive the microenterprise to be a "success," then the women who own such microenterprises would garner increased respect from family and the community, as well as a greater say in making family decisions.

Correlation coefficients for all variables in the "Model of Microenterprise Growth" and results of a standard multiple regression analysis of all hypothesized paths in the model were previously reported in Chew, Ilavarasan, & Levy (2010). As a next step, therefore, the AMOS software package was used to examine the goodness-of-fit of the initial model. To reiterate, when a model is tested for goodness-of-

fit, all the hypothesized relationships in the theoretical model are simultaneously examined for the extent to which they are supported by the data. A model that has good fit with the data supports the plausibility of the postulated relationships in the model. Four measures of goodness-of-fit are commonly used: the overall chi-square test of fit; a minimum discrepancy statistic $\hat{C}$ (CMIN) as Byrne cited (1989); the root mean square error of approximation (RMSEA) as Browne and Cudeck noted (1993); and a comparative fit index (CFI/df) as Hu and Bentler discussed (1999).

Results from the initial model showed that the minimum chi-square value was achieved, meaning that the software succeeded in estimating the model parameters and produced a convergent solution for the model. However, the model failed the test for goodness-of-fit on three of its four measures: minimum discrepancy statistic ($\hat{C} > 2.00$); the root mean square error of approximation (RMSEA = 0.08), and the comparative fit index (CFI/df < 0.90). Given that the chi-square test of fit only indicates that the model was correctly specified in terms of the relationships between variables (Byrne, 2010, p. 102) and that the data were judged to be a poor fit on three other more robust measures, we concluded that the data did not provide plausible support for the relationships specified in the initial model.

Revising the Model

To find a structure that offered a better fit for the data and that also might overcome some of the shortcomings of the initial model, we created a revised model that retained only two unchanged variables (business formality and total ICT access) from the initial model.

1. To create a more generalizable measure of business growth, we deleted the measure referring to the terrorist attacks in Mumbai as an operational indicator and restructured the business growth variable as the sum of (a) the owner-estimated percentage change in the annual income of her microenterprise compared to a year earlier and (b) the change in the number of hired workers over the same period. The two component items of the revised business growth variable were positively correlated ($r=0.38$, $p<0.01$) and the revised variable itself was now based on

two of the most common indicators of business performance (Delmar, 2006).

2. The variable motivation to use ICTs was renamed "perceived usefulness of mobile phones" and "perceived usefulness of work computers." The items comprising the perceived usefulness of mobile phones variable point to information-seeking behaviors regarding prices, business news more generally, and possible feedback on the viability of the microenterprise. One additional item points to the dual business-personal dimension of mobile use and recognizes that conversations with family and friends might have business content (Donner, 2009). For the perceived usefulness of work computers, the items comprising this variable suggest information-seeking behaviors also regarding prices and include the affordances of work computers for improving work efficiency and for keeping the microentrepreneurs up to speed with technological advancements.
3. An education variable was reintroduced to the revised model, as more formal education has been consistently associated with higher income for women in developing countries. Additionally, by enhancing cognitive skills and knowledge, education can be seen as promoting an individual's "power to" make and act on significant social and economic life-choices (Kabeer, 2003, p. 175). The new education variable combined a respondent's level of formal education—already shown to be correlated with ICT access—with a dichotomous measure of whether the female microentrepreneur had done any formal computer training. The two components of the expanded education variable were correlated, $r=0.41$, $p<0.001$. With this new indicator, we would expect to see an even stronger positive relationship between education and total ICT access than we found in the initial model.
4. The social status/power variable from the initial model continued to be constructed as in the initial model, but was renamed "perceived empowerment" to clarify its meaning and highlight its association with gender

theories of ICTs and development (Gill, Brooks, McDougall, Patel, & Kes, 2010; Gurumurthy, 2004, 2006). More specifically, the items that make up the perceived empowerment variable can be thought of as tapping into "transformative forms and . . . achievements [that] suggest a greater ability on the part of poor women to question, analyse and act on the structures of patriarchal constraint in their lives" (Kabeer, 2003, p. 174). We predict that the more empowered a female microentrepreneur feels in running her business, the more she will be motivated to own and use ICTs in support of that enterprise.

5. Finally, a measure of mobile phone use for business purposes was added to the model. We included this new variable to possibly strengthen the causal link between mobiles and microenterprise growth, since it is logically necessary to show that female microentrepreneurs indeed use their mobiles to conduct business. A composite index—total mobile use—was formed from three items measuring whether respondents used a mobile phone to call customers, suppliers, or employees. Index scores ranged from 1 to 3 and had a mean of $M=1.14$, $SD=0.36$.

The revised model is pictured in Figure 2. The signs on the paths indicate whether the variables are hypothesized to be positively or negatively correlated. Pearson product-moment correlations between variables in the revised model were first calculated using the Predictive Analytics Software (PASW) Statistics 18 software package. Regression analyses were then run to determine the statistically significant paths in the model. Two versions of this analysis were carried out. In the first, business growth was run as the dependent variable, and in the second, total ICT access was considered to be the dependent variable. This procedure allowed us to test the hypothesis that increased business growth is the cause of increased ICT access as opposed to the predicted direction of the relationship in which ICT access predicts business growth. Then, with AMOS 18.0, using maximum likelihood estimation, a path analysis was performed to test the proposed model.

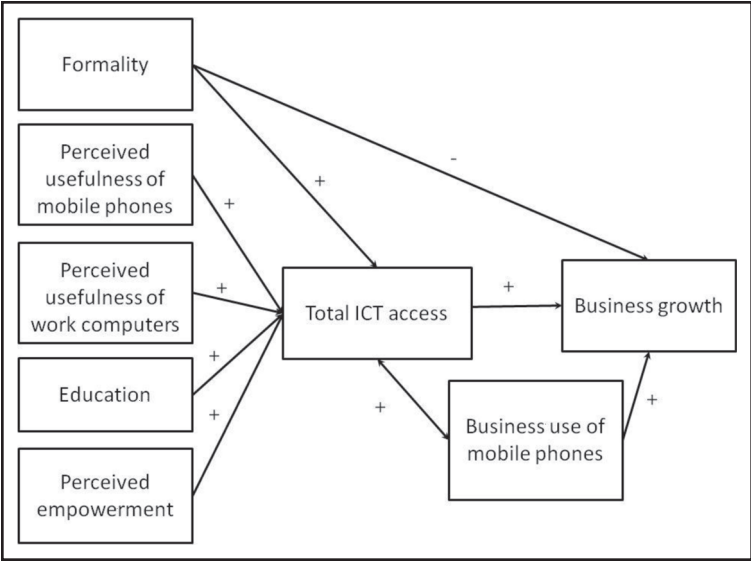


Figure 2. Revised Model for Microenterprise Growth.

Note: In developing this revised model, we examined a number of ICTs that respondents might wish to use in various business processes. We found, however, such limited ownership of workplace computers and such limited use of Internet cafés that operational measures of those two technologies were not statistically related to the other variables in the model. Therefore, the model only included the variable “Business use of mobile phones.”

Results

Table 1 shows the Pearson product-moment correlations among the all variables in the model. Business growth is positively associated only with total ICT access ($r_{\text{growth}}=0.12, p<0.05$, one-tailed) and negatively associated with business formality ($r_{\text{formality}}=-0.16, p<0.05$). The negative correlation between microenterprise growth and business formality adds support to the notion that microenterprises might have greater economic success by remaining in the informal sector (Portes & Haller, 2005). Business growth is not related to education ($r=0.09$, n.s.), raising the possibility that the quality of education received might be more important than is the number of years spent in school (Hanushek & Woessmann, 2007).

Total ICT access is positively associated with business formality ($r_{\text{formality2}}=0.22, p<0.01$), positively associated with both measures of perceived usefulness ($r_{\text{usefulnessMP}}=0.18, p<0.01$,

$r_{\text{usefulnessCOMP}}=0.21, p<0.01$), with respondent education ($r_{\text{education}}=0.36, p<0.01$), and with perceived empowerment ($r_{\text{empower}}=0.20, p<0.01$). The nature of all relationships is consistent with those predicted in Figure 2.

To verify the paths hypothesized in the model, three standard multiple regressions were conducted. The first regression focused on total ICT access, since it was hypothesized to be a major predictor of business growth. Total ICT access was set as the dependent variable and all other variables, except business growth, were entered as independent variables. The results of the regression (Table 2) show that the set of independent variables account for a moderate amount of variance in total ICT access ($R^2=0.29, F(6,192)=14.39, p<0.001$). Only business formality

is unrelated to total ICT access. This regression analysis suggests that about 29% of the variance in total ICT access among female microentrepreneurs can be accounted for by a combination of business use of mobile phones, perceived usefulness of mobile phones, education, and perceived empowerment.⁶ Moreover, both the correlations in Table 1 and the beta weights here point to the possibility that female microentrepreneurs who feel a greater sense of empowerment from owning businesses are also somewhat more likely to have a greater repertoire of ICTs.

The second regression tested business use of mobile phones as the dependent variable, and total ICT access, business formality, and the characteristics of the entrepreneurs were entered as the independent variables. As shown in Table 3, the significant predictors of business use of mobile phones are total ICT access ($\beta=0.155, p<0.05$, one-tailed) and perceived empowerment ($\beta=0.246, p<0.01$). The

6. The t-tests for the standardized beta weights for “business use of mobile phones” and “perceived usefulness of mobile phones” were significant at the 0.05-level of significance, one-tailed, and considered as contributing to the regressions being tested.

Table 1. Pearson Product-Moment Correlation Matrix.

	1	2	3	4	5	6	7	8
1. Business growth	1							
2. Total ICT access	0.123*	1						
3. Business use of mobile phones	-0.078	0.179**	1					
4. Formality	-0.163*	0.218**	-0.058	1				
5. Perceived usefulness of mobile phones	0.149*	0.182**	0.120	-0.178**	1			
6. Perceived usefulness of work computers	0.106	0.206**	0.078	-0.001	0.066	1		
7. Education	0.091	0.356**	-0.062	0.198**	0.015	-0.060	1	
8. Perceived empowerment	0.030	0.195**	0.279**	-0.061	0.333**	-0.068	-0.018	1

*Correlation is significant at the 0.05 level

** Correlation is significant at the 0.01 level

Table 2. Regression of Business and Entrepreneur Characteristics on Total ICT Access.

	Model	Standardized Beta	t	Sig.
	(Constant)		-3.120	0.002
Characteristics of businesses	Formality	0.104	1.672	0.096
	Business use of mobile phones	0.120	1.909	0.058
Characteristics of entrepreneurs	Perceived usefulness of mobile phones	0.123	1.858	0.065
	Perceived usefulness of work computers	0.236	3.906	0.000
	Education	0.377	6.173	0.000
	Perceived empowerment	0.183	2.732	0.007

$F(6, 192)=14.39$; $p<0.001$; Adjusted $R^2=0.289$.

positive relationship between perceived empowerment and business use of mobile phones was not previously posited in the revised model. Further, the beta weights here reinforce the relationship in Table 2 between perceived empowerment and total ICT access, and they further suggest that for female microentrepreneurs a greater sense of self-efficacy and self-esteem from owning a microenterprise is also associated with using mobile phones for business purposes.⁷

The third regression tested business growth as the dependent variable and the characteristics of the businesses and of the women who own them as independent variables. As illustrated in Table 4, the results of the regression show that the set of independent variables we examined account for a small,

but statistically significant amount of variance in business growth, $R^2=0.075$, $F(6,191)=3.267$, $p<0.01$. Consistent with previous analysis and the correlation matrix, the only statistically significant predictors of business growth are business formality ($\beta = -179$, $p<0.05$) and total ICT access ($\beta=0.155$, $p<0.05$, one-tailed). Surprisingly, the business use of mobile phones is not a significant predictor of business growth. We had conducted the previous regression with the view that the business use of mobile phones is an important mediating variable between total ICT access and business growth. As it turns out in the path analysis that follows, the very limited effect of ICTs on business growth appears not to require a direct relationship between business use of mobile phones and the dependent variable.

7. We are more fully investigating the antecedents of perceived empowerment and its causal relationship with total ICT access and microenterprise growth in the study of female microentrepreneurs, ICT, and empowerment currently under way in Chennai, India.

THE LIMITED IMPACT OF ICTS ON MICROENTERPRISE GROWTH

Table 3. Regression of Business Characteristics, Entrepreneur Characteristics, and Total ICT Access on Business Use of Mobile Phones.

Model		Standardized Beta	t	Sig.
(Constant)			-3.120	0.002
Formality		-0.047	-0.656	0.513
Characteristics of entrepreneurs	Perceived usefulness of mobile phones	-0.010	-0.137	0.892
	Perceived usefulness of work computers	0.039	0.542	0.589
	Education	-0.115	-1.514	0.132
	Perceived empowerment	0.246	3.258	0.001
	Total ICT access	0.155	1.909	0.058

$F(6, 192)=3.894$; $p=0.001$; Adjusted $R^2=0.081$.

Table 4. Regression of Business Characteristics, Entrepreneur Characteristics, and Total ICT Access on Business Growth.

Model		Standardized Beta	t	Sig.
(Constant)			-3.120	0.002
Characteristics of businesses	Business use of mobile phones	-0.127	-1.753	0.081
	Formality	-0.179	-2.501	0.013
Characteristics of entrepreneurs	Perceived usefulness of mobile phones	0.045	0.588	0.557
	Perceived usefulness of work computers	0.158	2.196	0.029
	Education	0.067	0.880	0.380
	Perceived empowerment	0.003	0.032	0.974
	Total ICT access	0.154	1.861	0.064

$F(6, 191) = 3.267$; $p<0.01$; Adjusted $R^2 = 0.075$.

That is, the use of the mobile phone for business purposes did not lead to an increase in business growth directly. Instead, mobile phone use for business contributes to an increased repertoire of ICTs, which, in turn, leads to business growth (see Figure 3). Figure 3 displays the standardized path coefficients for the final structural model. Inter-item correlations between the independent variables are not shown in the model. All path coefficients are in line with predicted relationships except for the path between business use of mobile phones and business growth, which is not statistically significant and, indeed, produces a model of poor fit when it is included in the path analysis ($\chi^2=32.30$, $df=17$, $p=0.014$, $CMIN=1.90$, $CFI=0.880$, $RMSEA=0.063$). However, when business use of mobiles is excluded from the analysis and business growth is treated as the dependent variable, the final model has a good fit with the data ($\chi^2=26.727$, $df=17$, $p=0.062$, $CMIN=1.572$, $CFI=0.924$, $RMSEA=0.050$). Finally,

and most important in terms of the goals of this article, the model predicts that the antecedent variables have a direct but small impact on business growth based on the amount of variance explained ($R^2=0.075$, $p<0.01$).

It is possible, of course, that relatively larger microenterprises (five or more hired workers) might have greater information and communication needs and perhaps seek to satisfy some of those needs by increased access to and use of ICTs. If that were the case, then perhaps the impact of ICTs on microenterprise growth would also be greater. We tested for this possibility by a regression analysis with the enterprise size entered as a dummy variable (larger microenterprises with five or more hired employees equal to 1; microenterprises with fewer than five hired workers equal to 0). The beta coefficient for enterprise size in this regression analysis is not statistically significant and the total variance explained differs from the variance explained in the final

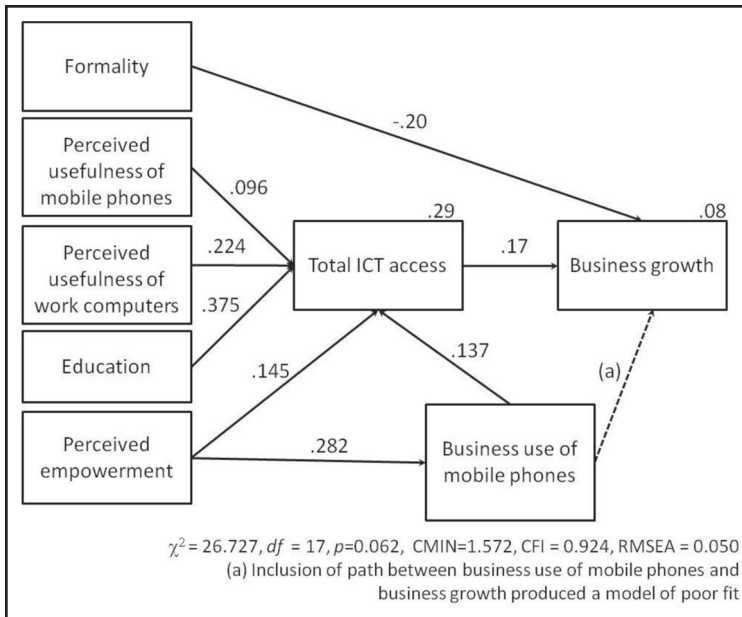


Figure 3. Final Structural Model for Microenterprise Growth.

model by a minute amount. This suggests, therefore, that the size of the microenterprise in this data set does not influence business growth, and the statistical significance of the other predictor variables remain unchanged.

We also investigated whether the relationship between total ICT access and business growth might be recursive—that is, whether more successful microentrepreneurs might have the capital to acquire more ICTs, which, in turn, might promote business growth. To test for this possibility of endogeneity, we reversed the direction of causality between total ICT access and business growth in the final structural model, making business growth the predictor variable and ICT access the dependent variable. However, the path coefficient of the reversed causal link turned out to be nonsignificant ($\beta = 0.056, n.s.$), suggesting that the relationship between ICT access and microenterprise growth, at least in this data set, is not recursive.

Conclusions

The statistical analyses yield several potentially significant insights regarding business growth in female-owned urban microenterprises. First, we found that only business formality and total ICT

access have a direct impact on business growth. Moreover, an examination of the regression analyses disclosed that business formality contributes about 4% of the variance in business growth, while ICT access accounts for only 2%. In other words, access to ICTs predicts only half the already meager variance in business growth explained by the model. Still, the small, albeit statistically significant, relationship between total ICT access and business growth demonstrates there is a plausible causal link between access to a greater repertoire of ICTs and the economic well-being of a microenterprise. To summarize, adding mobile phones, computers, and Internet access to a microenterprise might increase

the profits and the number of hired workers, but only minimally.

Attempting to demonstrate a causal link between business use of mobile phones and microenterprise growth produces a poor-fitting model, suggesting that mobile phone access alone does not necessarily produce business growth. Indeed, fewer than 10% of women who owned microenterprises consistently used their mobiles to conduct business. For the impact of ICTs (and mobile phones specifically) to show up on the business growth variable, it might at the very least be necessary for female microentrepreneurs to use ICTs much more frequently and extensively in their businesses. Succinctly put, our data support a notion of limited impact from limited use.

The final model clearly indicates the directionality of the path between the antecedent variables, ICT access, and microenterprise growth. Education, perceived usefulness of mobile phones, perceived empowerment, and business use of mobile phones all exercise indirect impact on business growth. The advantage of the path analysis is that we now have a more complete understanding of the relationship between those antecedents and the dependent variable of business growth. In short, we found that these four antecedents predict total ICT access,

which, in turn, increases business growth directly. The directionality of the causation is another important finding from the analysis. We tested the plausibility of a recursive relationship between ICT access and business growth and found that a causal path from business growth to total ICT access is improbable. Thus, the data support the notion of a positive impact of total ICT on business growth rather than the other way around. Having greater ICT access appears to be the driver of microenterprise growth.

The findings of this study are, of course, limited by the nature of the respondents (women who own microenterprises) and by geography (Mumbai, India). While our probability-based sample closely reflects the very small business economy of Mumbai, it is composed almost entirely of microenterprises in the trade and service sectors. The results of our analysis might have been different if the sample had included microenterprises owned by women in the manufacturing sector, especially microenterprises at or near the bottom of global value chains. To the extent that participation in global value chains might be facilitated by ICTs, it might be possible to discern a greater impact of mobile phones and computers on microenterprise growth (Goldmark & Barber, 2005; Nichter & Goldmark, 2009).

Moreover, many of the gains from the use of ICTs, be it the telegraph or the mobile phone, have come from the decoupling of communication from transportation. In an urban setting, productivity losses from transportation-related issues are often much lower than they are in far-flung rural areas where distance imposes significant transaction costs.⁸ Still, since more than one-third of customers in our sample came from other parts of Mumbai, we might have expected, but did not find, mobiles playing such a role, depending on the products and services rendered.

The primary aim of this article was to test a causal model of ICTs and economic development and, by using the powerful statistical technique of SEM, to examine the unique contribution of ICTs to the economic growth of microenterprises. Given the substantial social, economic, and cultural constraints on women who own microenterprises (Dejene, 2007; Mitra, 2005; Wasihun & Paul, 2010), it is scarcely surprising that ICTs, even the ubiquitous mobile phone, might have scant impact. These

findings might lead some to erroneously conclude that ICT-based development strategies no longer have much of a role as facilitators of microenterprise growth. We would caution against such a hasty judgment. The relationship we found among perceived empowerment, ICT access, and microenterprise growth holds some promise, we believe, for programs with goals of poverty reduction and greater empowerment of women. Moreover, most respondents in this study held generally positive attitudes about how mobiles could help meet business communication needs, even if actual use for business purposes in the microenterprise context was limited. Regulators and providers of mobile services might be able to build on these positive perceptions. Keeping the cost of mobiles affordable, creating relevant mobile applications, and encouraging female microentrepreneurs to find their own business uses for mobiles might lead to greater mobile use and, in turn, to more marked microenterprise growth.

In the long run, it might well be true that the productivity gains of ICTs, especially computing resources, are likely to be greater in the small and medium enterprise sector than they would be for microenterprises (Esselaar, Stork, Ndiwalana, & Deen-Swarray, 2007; Legatum Institute, 2011). Nevertheless, our research did find some positive consequences of ICTs on the economic growth of microenterprises, and that finding should challenge policymakers, practitioners, and ICT4D researchers to continue exploring how ICTs might improve the lives of the women who own some of the smallest businesses in developing economies. ■

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8. We are grateful to one of the anonymous referees for suggesting this point.

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Appendix

Survey Items and Reliabilities Index	Questionnaire Items	Scoring	Alpha
Business growth	Compared to a year ago, has the annual income of this business: Compared to a year ago, has the number of hired workers:	Change in percentage Change in number	$r=0.38$
Total ICT access	Do you have/own a mobile phone; personal computer; laptop; Internet connection; Do you ever use external PCOs/STD booths for this business; Have you ever given mobile phones to your employees to use for business purposes; Do they ever use their personal mobile phones for business purposes; Does this business have computers in the workplace; Does the business have an Internet connection; Have you provided computers for the employees to use at work?	1=Yes	0.61
Formality	Is this business registered with the government; Does this business have a bank account; For maintaining the financial and business records of this business, which of the following statements is most applicable?	1=yes; 1=yes; 0=no records, .5=written records, 1=accountant	0.64
Perceived usefulness of mobile phones	Mobile phones help keep me informed of prices; help me be more confident that the business will survive; help me stay in touch with friends and relatives; help me stay connected to businesses in other parts of Mumbai.	1=strongly disagree	0.73
Perceived usefulness of work computers	My work computer helps me keep informed about prices and other business news; helps me come and go without worrying about missing important business phone calls; Having a work computer makes me feel up-to-date.	1=strongly disagree	0.67
Education	Formal education Have you undertaken any formal computer education training?	0=never been to school; 5=master's degree 1=yes	$r=0.41$
Perceived empowerment	Because of my business, I am feeling more confident; Because of my business, I have gained respect among my friends and in my neighborhood; Despite my business, my parents do not feel especially proud of me (reversed); Because of my business, my parents-in-law are proud of me; Despite my business, my parents do not feel especially proud of me (reversed); Despite my business, my opinions are not considered to be important in family decisions (reversed).	1=strongly disagree	0.70
Business use of mobile phones	How often do you use the mobile to call customers; How often do you use the mobile to call employees? How often do you use the mobile to call suppliers?	1=Rarely, 4=Very Often	0.64