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Reaching the Unreached: The Role of Information Communication Technologies on Agency of Women in India

Suvena Yerneni

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Claremont McKenna College

**Reaching the Unreached: The Role of Information Communication
Technologies on Agency of Women in India**

Submitted to
Professor Jeffrey Flory

By
Suvena Yerneni

For
Senior Thesis
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Abstract

In this paper, I analyze the impact of Information Communication Technologies (ICTs) on female empowerment in India. In defining female empowerment, I consider the three dimensions of agency: social autonomy, economic autonomy, and mobility. Using nationally-representative data of 2012 from the Indian Human Development Survey (IHDS), I find that these information communication technologies, measured by ownership and use, have positive and significant impacts on female agency and decision-making abilities. I extend my analysis to two types of media: computers and mobile phones. These results persist even after accounting for the effects of education, income, and age of women.

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I. Introduction

In 2000, the United Nations outlined gender equality and female empowerment as one of its eight Millennium Development Goals (MDGs). A critical base for female empowerment is agency. A woman's decision-making agency, both in the household and outside of it, and her sense of personal freedom and autonomy can be the driving forces for not only improving gender relations, but also furthering development (Duflo 2012). In fact, Amartya Sen (1999) maintains, “[the] extensive reach of women’s agency is one of the more neglected areas of development studies, and most urgently in need of correction.”

What factors impact this exact notion of ‘agency’? Many studies suggest education and employment (Jayaweera 1997), region and religion (Jejeebhoy and Sathar 2001), and wealth (Acharya et al. 2010) as factors impacting women’s decision-making abilities. A few scholars touch upon the role of technology on female empowerment. However, there are insufficient empirical studies to formalize the conclusion that technology impacts, specifically the decision-making abilities of women. Further, little to no literature illustrates this effect on women, specifically in India. India is unique in that it is a developing country with a surprisingly rapid growth in ICTs (Section II). Therefore, India serves as a particularly interesting backdrop to examine this question.

This paper conducts empirical analysis to determine whether technology plays a role in female empowerment, specifically ‘agency’ of women. I then re-evaluate this effect, controlling for variables such as education, income, and the number of adult women in a household. While there are many *qualitative* studies that discuss the impact of technology

on development and gender equality, there is a limited amount of conclusive *quantitative* evidence of such a trend.

I hypothesize that the ownership and usage of technology will positively impact the agency of women. This hypothesis is fairly intuitive as familiarity with technology enables women to access a robust bank of knowledge, which provides them with information, validation, and ultimately the confidence to make informed decisions.

I find evidence suggesting that both i) use of computers and ii) ownership of mobile phones by women have significant impacts on all three dependent variables in the estimated models. These results are even more positive and significant when the use of computers and mobile phones by women, specifically for the purposes of internet access and email are considered. My hypothesis holds true even when I control for variables such as total income, highest education level of any female in a household, and number of adult women in a household.

The paper is divided into eight sections. Section II provides some background information on the definitions of ‘agency’ and ‘information communication technology’. In Section III, I summarize relevant previous literature on the subject and highlight gaps in existing research that the paper addresses. Section IV and Section V focus on the data and methodology respectively. I introduce the variables used, highlight the specific tests I employ, and discuss data limitations that could not be accounted for. Section VI provides a detailed account of the regression results, specific to the mode of communication. In this section, I also discuss my findings. I summarize the research and results of my paper in Section VII. Finally, Section VIII includes tables and figures, illustrating my empirical analysis.

II. Background Information

Female Empowerment and its Indicators

What is ‘empowerment’? There lies a universal lack of clarity in its definition amongst academics. Various conceptualizations of ‘empowerment’ include terms such as choice, freedom, power, consciousness, control, autonomy, agency, and ownership. Furthermore, feminists often debate its nature as a process or an outcome (Bernstein et al. 1994). In the field of developmental economics, the quantification and measurement of empowerment is essential for the purposes of study and research.

According to social economist Naila Kabeer (1996), empowerment entails a *process* of change. She defines empowerment to be the “processes by which those who have been denied the ability to make choices acquire such an ability” (Kabeer 1996). Within this, the ability to exercise choice incorporates three interrelated dimensions: resources (defined broadly to include not only access, but also future claims, to material, human, and social resources); agency (including processes of decision making, as well as less measurable manifestations of agency such as negotiation, deception, and manipulation); and achievements (well-being outcomes) (Kabeer 1996).

Safilios-Rothschild (1982) suggests her own indicator of empowerment, ‘autonomy’: the ability to access and use resources to inform the decision-making processes for personal matters. Equal autonomy amongst males and females implies equal decision-making powers (Safilios-Rothschild 1982). Here, it is important to clarify that ‘power’ is not to be confused with ‘status’. ‘Status’ refers to a woman’s position in society,

while ‘power’ refers a woman’s ability to influence at an interpersonal level (Safilios-Rothschild 1982).

Amartya Sen defines empowerment as an expansion of ‘agency’ (Ibrahim and Alkire 2007). In his Capabilities Approach theory, Sen (1992) describes capabilities as combinations of “beings and doings” that are feasible for a person to achieve in her life. In other words, a person’s capability set represents their freedom of choice or ability to choose, and hence, empowerment. Agency constitutes capabilities. According to Sen (1985), ‘agency’ is, “what a person is free to do and achieve in pursuit of whatever goals or values he or she regards as important.” Sen (2002) believes that the procedure of free decision by the person herself is an important prerequisite of empowerment.

Understanding Information Communication Technologies

What are ‘ICTs’? The World Bank (2003) defines ICTs as, “the hardware, software, networks, and media for collection, storage, processing, transmission, and presentation of information in the form of voice, data, text, and images.” ICTs include the internet, but also connective technologies such as radios, telephones, mobile phones, televisions, and local area networks (Nath 2001). ICTs are the technological tools that impart knowledge to societies, by transforming the way information is organized and shared globally. According to Silverman et al (1992), ICTs are, “not just objects: they are media.” To further understand the social influence of technology, Silverman et al (1992) devised a framework of four phases: appropriation (possession and ownership), objectification (use within a spatial environment), incorporation (manner of functionality), and conversion (relationship between household and the outside world). The MDGs underline the urgency of ensuring

that benefits of Information and Communication Technologies (ICTs) are made available to all. Every year, developing economies spend in excess of US\$800bn on ICTs (Heeks, 2009a).

With their lack of geographical bounds and low-access costs, ICTs have sparked a so-called ‘Knowledge Revolution’ globally (Nath 2001). Through this revolution, ICTs prompt the formation of a new class: The Knowledge Society (Nath 2001). ICTs meld local knowledge across communities, contributing to a global pool of knowledge. This encourages ‘knowledge networking’ or interaction of individuals through a wider social domain (Nath 2001).

Why India?

India is a useful case study for exploring the impact of ICTs on the agency of women in ways that other countries are not. India simultaneously i) has a large population of individuals living in poor conditions across all dimensions of poverty; and ii) has a strong Information Technology (IT) sector that has been around for some time. This is unusual for most developing countries, and grants a unique opportunity to study the questions of interest in this paper.

India, ironically referred to as ‘Mother India’¹, ranks 125th out of 149 countries on the Gender Inequality Index (GII), a composite measure of reproductive health, labor market participation, and political empowerment (Daniyal 2017; UNDP 2015). According to Ghosh and Roy (1997), historically the Indian woman was, “largely denied the role as

¹ India is referred to as ‘Mother India’, the English translation of the Hindi term ‘Bharat Mata’. Bharat Mata refers to the national personification of India as a mother goddess.

an individual with an identity, aspiration, or right of her own.” Presently, demographic and socio-economic indicators of women such as: higher literacy rates (illustrated in Figure 1), improving sex ratios, and increases in the female labor participation rates in India suggest an improving situation. However, social attitudes, especially with regards to decision-making amongst women have been slow to change.

The application of ICTs to India is unique. Although it is a developing nation, India has been acquainted with ICTs for quite some time. Due to economic liberalization, the software industry in India has emerged as one of the fastest growing sectors, initially valued at \$170mn from 1991-92 to \$8.8bn from 2003-04 (Heeks and Nicholson, 2004). The impact of the growth of the software industry can be felt in the comfort and adoption of ICTs, encouragement of technical training, and efforts of the government to push ICTs to rural areas (Heeks 1996; Bhatnagar and Schware 2000). Therefore, India, a developing country on its journey towards becoming an “information society”, proves to be an interesting case to study (Van Dijk 2005).

III. Literature Review

Current literature assigns a number of definitions to female empowerment. It is a heavily debated term, which has been ascribed a wide variety of definitions and meanings in various socio-economic contexts (Malhotra et al. 2002). According to Mehta (1997), empowerment refers to four key indicators: life expectancy, female enrollment in primary education, fertility rates, and access to contraception. Narayan (2005) associates empowerment with agency, autonomy, self-direction, self-determination, liberation, participation, mobilization, and self-confidence. As mentioned in Section II, this paper focuses on the agency of women.

Scholars suggest that education, employment, wealth, age (Acharya et al. 2010), region and religion (Jejeebhoy and Sathar 2001) are factors affecting female empowerment, specifically agency or autonomy, to some degree.

Educated women are more likely to take part in decision-making. The intuition here is that education may impart feelings of self-worth and self-confidence in women, enabling them to make more self-assured decisions. Income and wealth as indicators of autonomy are a bit more nuanced. According to Acharya et al. 2010, the relationship between wealth and decision-making is unclear. The study posits that women's economic status in the household was more strongly tied to decision-making than wealth (Acharya et al. 2010). There is a significant positive relationship between the age of women and their autonomy. With age, women attain a deeper sense of security, a waning fulfillment of sexual desire and a higher status within the household, enabling them to gain autonomy in household decision-making (Acharya et al. 2010).

In the opinion of Jejeebhoy and Sathar (2001), socio-cultural context is an important factor that determines female autonomy. The study suggests that Hindu women have more decision-making powers, freedom for mobility, and security from threat than Muslim women. Furthermore, women residing in the southern part of India experience a higher degree of autonomy than those in the north (Jejeebhoy and Sathar (2001). This can be explained by the differing social systems of the two regions (Jejeebhoy and Sathar (2001).

Jayaweera (1997) conflates empowering women with, “widening their knowledge and skills” and this, in her opinion, “contributes more effectively to increase women’s self-reliance and capacity to control their lives.” This involves bringing women into Nath’s (2001) conception of the ‘Knowledge Society’. Therefore, the access and distribution of knowledge in, “an absorbable and usable form” is quintessential to the furthering of the decision-making abilities of women (Nath 2001). This can be done through a pervasive feature of modern life: technology, specifically Information Communication Technologies (ICTs). A few scholars imply that the expansion of ICTs plays a role in empowering women (Arun et al. 2004; Chen 2004; Nath 2001; World Bank 2003; Hafkin 2003). In the World Bank’s study on *Engendering ICT*, Hafkin (2003) claims that women need ICTs to find resources for themselves, their families, their work, and their communities. More importantly, women need ICTs to have an influence in their own lives, which extends to their community, government, and the surrounding world. Apart from the increased flow of information and access to knowledge, ICTs can offer a way out of isolation, by overcoming geographical boundaries (Chen 2004). This extends a certain, “flexibility of time and space”, inspiring a feeling of being empowered (Hafkin 2003). Needless to say,

these features of ICTs are most invaluable to women in developing countries who, for social, political, or economic reasons are constrained in space and time. These women suffer from social isolation and the inability to access or use knowledge (Hafkin 2003). Figure 2 illustrates the ICT-women empowerment framework (Nath 2001). In this framework, Nath (2001) describes how ICTs provide access to strategic information, enabling contact and communication with relevant parties. This leads to a better understanding of information, allowing women to have greater control and capacity to act. This very notion of control is the definition of empowerment.

This paper will focus on this exact concept of the influence of information and communication technologies on decision-making, encapsulated in the term: *agency*, specifically in the subcontinent of India.

The study seeks to fill three key gaps in existing literature. Existing literature relies on *qualitative* analyses to explain the role of technology on female empowerment. First, I build on existing intuition and conceptual frameworks, by showing, *quantitatively* that ICTs impact the decision-making abilities of women. Second, I control for socio-economic and demographic factors, such as education, income, and the number of adult women in a given household, which were considered as main regressors in prior studies. This shrinks the effect of biases due to unobservable variables in the error term and reduces the likelihood of reverse causality. Third, this paper examines the relationship between ICTs and the agency of women in India, as a whole. Previous literature examines a similar relationship either within individual states in India such as Kerala (Arun et al. 2004) or in other developing countries like Nepal (Acharya et al. 2010) and Uganda (Masika and Bailur 2015) or continents like Asia (Jayaweera 1997).

IV. Data

In order to test the relationship between the use of ICTs by women and the agency or decision-making powers of women in India, I use data from the Indian Human Development Survey (IHDS)². The IHDS surveyed 42,152 households in 1,420 villages and 1,042 urban neighborhoods across 33 states in the Indian subcontinent. This dataset includes over 2,500 variables, ranging across a multitude of topics, which focus on social and economic conditions. These topics include caste and community; consumption and standard of living; income; employment; education; social and cultural capital; household and family structure; marriage; gender relations; and health. The first round of survey data was collected in the 2004-05 period, followed by a subsequent round of interviews in 2011. In this paper, I use the data from the second round of interviews (IHDS-II) from 2011-2012 for my analysis.

Variable Use and Construction

a. Agency

The primary focus of this study is the impact of technologies in information communication on the agency of women in India. The outcome variables thus attempt to capture key dimensions of decision-making power in women. I use three measures of agency: i) Decision: Number of Children, ii) Decision: Purchase Land or Property, and iii) Visit Health Center Alone. Decision: Number of Children indicates whether or not there is at least one eligible woman in a given household who has the most say in the decision of

² This survey can be accessed via Claremont Mckenna College's affiliation with the Inter-university Consortium for Political and Social Research (ICPSR).

how many children to have. Decision: Purchase Land or Property indicates the presence of at least one eligible woman in a household who has the most say in purchasing land or property. Visit Health Center Alone indicates whether there is at least one eligible woman in a household who can visit the local health center alone.

These three dependent variables capture the three dimensions of autonomy: social decision-making, economic decision-making, and mobility (Jejeebhoy and Sathar 2001). The decision-making variables are from the ‘Eligible Women’ dataset, one of the fourteen datasets of the IHDS-II data. It is important to note that to be considered an ‘eligible woman’, an individual has to be an ‘ever-married’ woman between the ages of fifteen and forty-nine years. ‘Ever-married’ means that a woman is either married, married with an absent spouse, widowed, or separated/divorced. The definition of ‘eligible women’ could contribute to some potential data limitations. The data points of single women are omitted from the dataset. The current dataset provides information on agency of women in their post-marital and/or joint household, however, it fails to offer insight on the agency of unmarried women of marriageable age within those households. Additionally, this dataset omits the data associated with *all* women over the age of forty-nine years. This significant chunk of data relating to older women could have been interesting to consider in the context of decision-making.

b. ICT Penetration

The objective of this study is to capture the effect of the use of communication technologies and how they empower women. In order to do this, this study uses proxies for access to information through hardware and software. In this paper, I focus on two media

of communication: computers and mobile phones. Traditionally, computers are seen as the primary vehicles of information access and communication. However, more recently mobile phones have been deemed as the bright stars for the explosive growth of ICTs (Rao n.d.). The reach and penetration of mobile phones in India is impressive with nearly 67% of the 1.2 bn population, owning at least one mobile phone (Rao n.d.).

I look at variables, describing the use and ownership of computer and mobile phones. For the use of computers, I use a proxy variable that indicates whether anyone in a given household *knows* how to use a computer. This may not be a perfect measure of computer use, but I assume that if an individual knows how to use a computer, then she uses one. For the ownership of mobile phones, I use a variable that indicates whether anyone in a household owns a mobile phone. Using these two aforementioned variables, I generate female-specific variables for the use and ownership of computer and mobile phones respectively to further supplement the analysis. These variables provide a more nuanced view of the female interaction with ICTs and the subsequent impact of this interaction on their agency. I also look at the effect of the use of these two media, specifically for the purposes of internet and email to further investigate the impact of the *communication* aspect of these technologies on the agency of women.

The analysis of the broader impact of ICT use would be more relevant at a household level than at an individual level. As I pulled the ICT indicator variables from the ‘Individual’ dataset of the IDHS, I collapsed these variables to their mean by household ID. Next, I merged these newly household-level ICT variables with the variables of interest in the ‘Eligible Women’ dataset to ensure consistency and accuracy in my study. This

collapsed 204,569 individual observations into 42,152 observations per variable, which matches the number of households surveyed in IHDS-II.

c. Controls

I use a scaled version of the variable, Total Income to control for income levels. Total Income is a constructed variable, calculated by IHDS which sums all the possible income from wages, salaries, agriculture, remittances, property, public benefits, and businesses, and subtracts expenditures like business or agriculture-related expenses, pensions, government transfers and interest from the aforementioned sum (Desai et al. 2011). Therefore, if the expenditures exceed the inflow of money, Total Income will take on a negative value. I scale Total Income by Rs. 100,000 to create Income100K, which represents the income data in a much smaller and more readable form. I also use QtyFemAdults, another variable calculated in IHDS. Adult females are defined to be women twenty-one years or older. This variable was constructed by counting the number of women of twenty-one years or older in the ‘Individual’ dataset, and collapsing these values to the household level. Additionally, I consider the highest educational attainment among adult women, which is calculated within IHDS. Similar to QtyFemAdults, the educational attainment of an individual (HighestEdFem) is taken from the ‘Individual’ dataset and collapsed to the household level. Finally, I also control for the effect of the use of computers and mobile phones for purposes other than internet and email. I also create FemCompNoIE and FemMobNoIE, which represent the use of these two media of communication for purposes other than internet and email to supplement my study of the

isolated effect of internet and email on the agency of women. Table 1 includes a list of these variables and their definitions.

Summary Statistics

All variables have 42,152 observations. This is consistent with the number of households surveyed for the IHDS. Interestingly, nearly 75% of the households surveyed in the ‘Eligible Women’ questionnaire responded that there is at least one eligible woman in those households who on average had the most say in the decision of how many children to have. 64% of those same households, responded that there is at least one eligible woman in the household who has the most say in the decision-making process of whether to purchase property or land or not. 61% of the households surveyed responded that there is at least one eligible woman in the household who can visit the local health center alone. What’s more, only 23% of households have at least one individual who knows how to use a computer, of which 47% have at least one *woman* who knows how to use a computer. On the flipside, 81% of households have at least one individual who owns at least one mobile phone, of which 62% have at least one woman who owns a mobile phone herself. 17% of total households in the sample, on average, have an individual that uses a computer for internet and email. Only 7% of total households have at least one woman in the household who knows how to use a computer *and* also uses the computer for internet and email. In the mobile phone case, 6% of all surveyed households have at least one woman in the household who owns a mobile phone *and* uses the mobile phone for internet and email.

Looking at the control variables, it is surprising that in over 15,000 households (37% of the sample), the highest education level of the household is ‘No Education’. The

median income in the sample households is Rs. 73,500 (\$1,126 present-day). Meanwhile, the mean income is Rs. 127,759.8 (\$1,957 present-day). This represents a 74% increase from the median to the mean, indicating an uneven distribution of income amongst the households surveyed. The 1st percentile is at -Rs. 700 (\$10.50 present-day), indicating some type of debt or net loss owed by the household. The reason for the existence of a negative value for Total Income is explained in the prior subsection on 'Controls'. Table 2 includes the summary statistics for all the variables used in this study.

V. Methodology

For the purposes of my analysis, I consider eight models to study the impact of ICTs on the agency of women in India. The basic model of this study, represented by equation 1, is a single variable linear regression of the outcome variable, Y_i , on the main regressor, X_{1i} . Y_i is the measure of agency of women in India across the dimensions of social and economic autonomy and mobility. In this paper, Y_i represents Decision: Number of Children, Decision: Purchase Land/Property, or Visit Health Center Alone (Table 1). X_{1i} is the proxy for the the use and ownership of ICTs, represented by FemComp and FemMob in my analysis (Table 1).

$$Y_i = B_0 + B_1X_{1i} + \varepsilon_i \quad (1)$$

Control Variables

I use control variables in my regressions in order to get a more accurate estimate of the true relationship between women's decision-making abilities and the use of ICTs. The main reason I add these specific control variables is because I believe that these three variables could be correlated with both: i) Y_i and ii) X_{1i} , which can cause my estimate for X_{1i} to be biased.

Specifically, I focus on three different indicators: income, education, and the number of adult women in a household. Income of a household is a clear candidate for a control variable as the ability of a household to afford these technologies such as computers and mobile phones could affect FemComp and FemMob (Equation 2). A wealthier household will likely be more inclined to use these devices for internet and email. Additionally, income can impact Y_i or the agency of women. According to Samari and Pebley (2015), wealthier households have more access to information and resources

through education that can affect female empowerment. Richer families are more likely to encourage women to get an education, which empowers women with knowledge and self-esteem (Samari and Pebley 2015). Meanwhile, some scholars suggest that women in wealthier households are less likely to work or contribute to the family income, favoring seclusion, making them less empowered (Speilman et al. 2016). I use the variable of *Income100K*, a scaled form of Total Income of a household, constructed by IHDS.

$$Y_i = B_0 + B_1X_{1i} + B_2Income100K_i + \varepsilon_i \quad (2)$$

I also control for the number of adult females in a household (Equation 3). The existence of an increased number of adult females is likely to affect the perception and status of women in a given household, and therefore, the agency of women (Y_i) in that household. Additionally, amongst an increased pool of adult females there is a greater chance that at least one of these females knows how to use a computer and/or owns a mobile phone by virtue of probability.

$$Y_i = B_0 + B_1X_{1i} + B_3QtyFemAdults_i + \varepsilon_i \quad (3)$$

In addition, I control for the highest educational attainment of a woman in a given household (Equation 4). This variable denotes the highest education level completed by a female in a household. My hypothesis is that if women in a given household are more educated, the household might value the voice or the opinions of those educated women in social and economic situations. Moreover, more educated women could be better at asserting themselves or at bargaining within the household to have more power. Therefore, *HighestEdFemale* could impact Y_i .

India recognized the importance of ICTs in education as early as 1984-85 when it launched the Computer Literacy and Studies in Schools (CLASS)³. Since then, the Indian government has launched a number of SMART⁴ schools and Computer Learning Programs (CLPs), particularly targeting women, in secondary schools to promote digital literacy. Given these initiatives, the higher the education level of a woman, the more likely it is that she knows how to use a computer or own a mobile phone. Thus, HighestEdFem could influence the estimates of FemComp and FemMob.

$$Y_i = B_0 + B_1X_{1i} + B_4HighestFemEd_i + \varepsilon_i \quad (4)$$

In Equation 5, x_{5i} represents the variables, FemCompIE or FemMobIE. FemCompIE accounts for whether there is at least one female in a given household who uses a computer for internet or email. FemMobIE captures whether there is at least one female in a given household who uses a mobile phone for internet or email. The inclusion of this more refined version of the computer (or mobile) variable along with the general one helps differentiate between i) the impact of using (or owning) a computer (or mobile) in general; and ii) the impact of using computers (or mobiles) specifically, for internet and email. As defined in Section II, ICTs include internet, which can be used to transmit or communicate information. Therefore, it would be interesting to isolate the effects of simply

³ This was introduced as a pilot project with the introduction of micro-computers in 1984. 12,000 computers were received and distributed to secondary and senior secondary schools through State Governments (World Bank n.d.).

⁴ These schools emphasize Information Technology in Schools. They also focus on the use of skills and values that will be important in the future (World Bank n.d.).

owning a mobile phone or knowing how to use a computer from the use of these two media for the purpose of accessing internet.

In Equation 6, it is important to note that I use FemCompNoIE as the main regressor instead of FemComp. I do this to avoid multicollinearity. Only the respondents who answered “Yes” to the question, “Does anybody in your household *know how to use* computers?” are asked if they use computers for internet or email. Hence, FemComp and FemCompIE are highly correlated and move together. FemCompNoIE indicates whether there is at least one woman in a household who knows how to use a computer, but *does not* use it for internet or email. The values captured in FemCompNoIE are a subset of those in FemComp, but are not related to FemCompIE at all.

$$Y_i = B_0 + B_1X_{1i} + B_5X_{5i} + \varepsilon_i \quad (5)$$

I observe the estimates on X_{1i} , controlling for all three control variables at once to further isolate the effect of FemComp or FemMob on the three outcome variables in Equation 6. In Equation 7, I analyze whether using computers or mobile phones for internet and email creates any additional effect above or below the impact of computers or mobile phones in general, whilst eliminating the bias associated with all three controls.

$$Y_i = B_0 + B_1X_{1i} + B_2Income100K_i + B_3QtyFemAdults_i + B_4HighestFemEd_i + \varepsilon_i \quad (6)$$

$$Y_i = B_0 + B_1X_{1i} + B_2Income100K_i + B_3QtyFemAdults_i + B_4HighestFemEd_i + B_5X_{5i} + \varepsilon_i \quad (7)$$

Finally, I analyze the relative effectiveness of the two media of communication in furthering the agency of women in India. Do computers play a larger role in affording

women a greater say in economic and social household decisions than mobile phones or vice versa? Equation 8 studies the impact of one main regressor on Y_i , holding the other main regressor equal or constant.

$$Y_i = B_0 + B_1FemComp_i + B_2FemMob_i + \varepsilon_i \quad (8)$$

Potential Limitations

a) Omitted Variable Bias

To avoid Omitted Variable Bias, I intentionally chose controls which previous studies have used and literature has referenced. In accounting for a few important control variables, the error term in the regressions absorb the rest of the error for the controls not considered in this study. However, it is still possible that there are omitted variables that I did not account for. This is a limitation and concern in any empirical study.

b) Reverse Causality

Reverse causality could be a cause for concern in this study. Duflo (2012) discusses the concept of reverse causality in the study of female empowerment in the context of developmental economics. In one direction, development plays a significant role in closing the gap of inequality between the two sexes. In the other direction, she believes that empowerment of women can *accelerate* development.

In this study, I consider a similar relationship between development and female empowerment. Specifically, the use of ICTs and agency of women in India are proxies for economic development and female empowerment respectively. In this paper, reverse causality would mean that the agency of females or their ability to make decisions within a household may have an impact on their use of ICTs. In other words, there is a possibility

that women who exercise more power within a household are more likely to use computers or own mobile phones. This is a valid possibility. However, this paper will focus on the impact of ICTs on the agency of women, rather than the other way around.

Hypothesis

The hypothesis of this study is that there is a positive relationship between the use of ICTs and decision-making abilities of women. This is both intuitive and proven in previous literature. The intuition is that the use of these ICTs enables women to access and become a member of a 'Knowledge Society' (Nath 2001). These technologies have the potential to link women across the world to both communicate and disseminate information to people. This mechanism forms the skeleton through which women can be empowered. Empowerment of women through knowledge enables them to develop the abilities and skills to gain insight on their surroundings, build the capacity to get involved, voice their concerns, and make informed decisions (Nath 2001). Therefore, I hypothesize that a general increase of ownership and use of ICTs, especially by women, leads to an increase in decision-making power or agency among women.

VI. Results and Discussion

My findings suggest that, in all estimated models, the proxies for the use of ICTs, specifically computers and mobile phones have a statistically significant impact on all the variables representing female decision-making power or agency.

a) Computers

In Tables 3, 4, 5, and 6, the use of computers by females is significant at the 99% confidence level for all three dependent variables.

Table 3 reports the results from the regression equation 1 in Section V. It shows the effects of the indicator for the use of computers by women on each of the three outcome variables: Decision: Number of Children, Decision: Purchase Land/Property and Visit Health Center Alone. In column 1, the coefficient on FemComp indicates that households that have at least one woman who knows how to use a computer have an 8.2 percentage point higher probability of having at least one eligible woman who has the most say in the decision of how many children to have over those households that do not have at least one woman who knows how to use a computer. In column 2, the coefficient on the same regressor indicates that households that have at least one woman who knows how to use a computer have a 7.9 percentage point higher probability of having at least one eligible woman who has the most say in the decision of whether to purchase land or property than households that do not have at least one woman who knows how to use a computer. Similarly, in column 3 the results show that households that have at least one woman who knows how to use a computer have a 14 percentage point higher probability of having at

least one eligible woman who can visit a local health center alone than those households without at least one woman who knows how to use a computer. These findings support my hypothesis, that the use of computers positively impacts the agency of women.

These regression results suggest that the indicator for use of computers by women has the most substantial impact on the dependent variable for mobility, Visit Health Center Alone. I speculate that the agency of a woman, especially with regards to her mobility, hinges upon the assurance of her well-being and safety. Among females in a household, the use of computers may instill a sense of confidence in family members about their safety beyond the confines of their residence. A woman who knows how to use a computer could access and gather information, and/or communicate with others in a given situation that necessitates those abilities.

It is important to note that there could be unobservable variables in the error term affecting both FemComp and the three dependent variables. Therefore, it is difficult to determine a causal effect between the predictor and the outcome variables. The regressions in Table 4 and 5 control for education, income, the number of adult females in a household using binary variables, helping to remove any endogeneity of my initial regressions.

Also, in column 1 of Table 3, the coefficient of the constant term is 0.740. This indicates that 74% of the households have at least one woman who has the most say in making the decision of how many children to have. Similarly, in columns 2 and 3 for Decision: Purchase Land or Property and Visit Health Center Alone, the coefficients of the constant terms are 0.626 and 0.590, respectively. These estimates are absurdly high. This would mean that India has a pro-woman culture, which is not true. One reason for these high estimates could be the possibility of skewed data from the IHDS. This data could have

response bias associated with the survey, in particular acquiescent bias and social desirability bias. Acquiescent bias is a tendency causing an individual to respond positively or in agreement with the interviewer (Cronbach 1946). Social desirability bias is a tendency causing an individual to respond in a manner that will be viewed favorably (Edwards 1957). In the IDHS, respondents may have answered “Yes” either due to the repetitive nature of questions in the survey or due to a pressure to answer the questions on decision-making abilities favorably. Another reason for these high estimates could be measurement error. The survey instruments were translated into 13 Indian languages and were administered by local interviewers, then translated back into English. The nuances of the questions may have been distorted in the translation process. However, given this information, these errors or biases do not differentially impact ICT and non-ICT users. Therefore, there is no reason to believe that the estimates of FemComp on the three outcome variables would be affected.

Table 4 shows the results of the regressions in which education, income and number of adult females are controlled for individually, for each dependent variable (Equations 2, 3, and 4). Income100K, QtyFemAdults, and HighestFemEd almost always have a statistically significant and positive impact on the outcome variables representing female autonomy.

In column 1, the coefficient estimate on Income100K indicates that when income rises by Rs. 100,000, the probability of having any female in the household who has the most say in the decision of how many children to have rises by 0.006 or just over half a percentage point, holding the indicator for use of computers by females constant. Similarly, in column 7, a one-unit increase in Income100K raises the probability of Y_i by almost one percentage point. Although small, these numbers imply that an increase in household

income could raise the social autonomy and mobility of women. This could be due to the fact that households with higher total incomes are more likely able to afford contraceptives. These contraceptives offer women the ability to exercise control over how many children they have, thereby allowing them to make the decision of how many children to have. Additionally, wealthier households are likely able to afford homes in safer neighborhoods. A higher assurance of safety could possibly increase the likelihood of women being able to travel alone. In column 4, the coefficient estimate on Income100K takes on a negative, but insignificant value. Therefore, it is unclear as to whether income influences Decision: Purchase Land or Property.

The results for the effect of QtyFemAdults on the three dependent variables, holding use of computers by females constant, are all highly significant and positive. The coefficient estimates of the effect of QtyFemAdults on Decision: Number of Children, Decision: Purchase Land/Property and Visit Health Center Alone are 0.0760, 0.144, and 0.0617 respectively (Table 4 columns 2, 5, and 8). These numbers indicate that as QtyFemAdults increases by 1 unit, the probability of Y_i increases by the aforementioned coefficient estimates, holding the indicator for use of computers by females constant. For example, a 1-unit increase in the number of adult females in a given household increases the probability of there being at least one female in a household who can visit the local health center alone by 6.17 percentage points, holding use of computers by females constant (Table 4 column 8). As explained in Section V, this seems logical because an increase in the number of adult females in a given household could shape the perception of women. There is power in numbers, i.e., more women in a given household could mean

that there are more women who can assert themselves or bargain for more decision-making power.

In column 3 of Table 4, the coefficient estimate on HighestFemEd suggests that a 1-unit increase in the highest educational attainment of a female in a household increases the probability of there being at least one female who makes the decision of how many children to have in a household by 1.14 percentage points, holding the indicator for use of computers by females constant ($p < 0.01$). Similarly, for Decision: Purchase Land/Property and Visit Health Center Alone, the results are highly significant and positive. My predication is that the more educated a woman is the more likely it is for her thoughts and judgements to be valued. Better educated women may have more knowledge, information and experiences that enable them to make personal decisions more confidently.

In general, Table 4 suggests that the proxies for education, income and number of adult females in a household (HighestFemEd, Income100K, and QtyFemAdults) have an influence on Y_i . This is consistent with the evidence in other studies (Acharya et al. 2010) which indicate that education and income affect the decision-making powers of women. For the most part, the inclusion of control variables in the estimated models decreases the coefficient estimates for FemComp. In column 3, controlling for the highest education level of a woman in a household in fact renders the effect of FemComp insignificant. This indicates that in Equation 1 (Table 3) FemComp picks up the impact of FemComp *and* the controls, Income100K, HighestFemEd, and QtyFemAdults. Therefore, in the initial regressions of Table 3, the estimates for FemComp are biased upward.

Table 5 shows the results from regression equation 6. This equation includes the three control variables for education, income, and number of adult women in a household

all together. In column 1, I find that FemComp has a positive but insignificant effect for Decision: Number of children; households that have at least one female who knows how to use a computer are 0.7 percentage points more likely to have at least one woman who has the most say about the decision of how many children to have. A similar pattern is seen for the other two outcome variables; households that have at least one female who knows how to use a computer are 3.45 percentage points more likely to have at least one woman who has the most say about the decision about buying land and 5.3 percentage points more likely to have at least one woman who can visit a local health center alone. These effects are highly significant. The inclusion of the control variables together shows that 1) an increase in FemComp still positively influences Y_i , however only significant for Decision: Purchase Land or Property and Visit Health Center Alone; and 2) the magnitude of the coefficient estimates of FemComp decreases for all Y_i , compared to values in Table 3 and Table 4. For example, for Visit Health Center Alone, the coefficient estimate for FemComp decreases from 0.140 in Table 3 to 0.053 in Table 5. This suggests that FemComp was originally biased upward in equations 1, 2, 3, and 4, and equation 6 helps eliminate omitted variable bias.

Table 6 shows the results from the regressions in which the control variable for the use of computers by women, but *not* for internet and email (FemCompNoIE) is included (Equations 5 and 7). It is important to note that in Equations 5 and 7, I use FemCompIE instead of FemComp as the main regressor.

In Table 6, most of the coefficient estimates of FemCompIE are still highly significant and positive at the 99% confidence level, even when I control for the use of computers by females, but not for the purposes of internet or email. In column 1, the results

indicate that having at least one female who uses a computer, specifically for internet or email raises the probability of there being at least one woman in a household who makes the decision about the number of children to have by almost 8 percentage points, holding the use of computer for internet or email constant. Columns 3 and 5 show a similar trend. The coefficients on FemCompIE suggest a 7.3 and 13 percentage point increase in the probability of Decision: Purchase Land/Property and Visit Health Center Alone, holding FemCompNoIE constant. This means that the use of computers by women, specifically for email or internet, has an additional effect on the agency variables over and above the impact of the use of computers by women for purposes other than internet or email. This is an interesting, yet fairly logical result. In the definition of ICTs, internet and email comprise the ‘communication’ aspect of the term. Individuals communicate and share information *through* internet and email *using* devices such as computers. Therefore, it is the access to internet and email, which ultimately enables women to access this ‘Knowledge Society’ to retrieve and disseminate information (Nath 2001). This offers women a more informed perspective, shaping their ability to make decisions or have agency.

Columns 2, 4, and 6 of Table 6 show the impact of the use of computers for internet or email by women on the agency variables, holding the control variables constant all together. In column 2, the coefficient estimate on FemCompIE for Decision: Number of Children takes on a negative, but insignificant value. This is surprising as it challenges my hypothesis that the use of computers, specifically for internet and email positively impacts the social autonomy of women. However, my hypothesis still holds for the measures of economic autonomy and mobility. In columns 4 and 6, the coefficients on the indicator for use of computers by women, specifically for internet or email for Decision: Purchase

Land/Property and Visit Health Center Alone are positive and highly significant. The coefficients of FemCompIE for these two dependent variables are 0.0216 and 0.0301, respectively. This suggests that households in which at least one woman uses a computer, specifically for internet or email have a 2.2 percentage point higher probability of having at least one woman who has a say in the decision to buy land or property, over and above those households that have at least one woman who uses a computer for purposes other than for email and internet access; and a 3 percentage point higher probability of having at least one woman who can visit the local health center alone, over and above those households that have at least one woman who uses a computer for purposes other than for email and internet access, holding income, education and number of adult women in a household constant. In other words, when I isolate the the effects of the use of computers by women for the purpose of internet from the simple use of a computer, whilst holding education, income and number of women in a household constant, I still see a positive and significant effect on these two agency variables.

b) Mobile Phones

Similarly, in the case of mobile phones, my findings suggest that the ownership of mobile phones has a statistically significant impact on all the variables representing female decision-making power or agency. As seen in Table 7, 8, 9, and 10, FemMob is significant at the 99% confidence level for all three dependent variables.

In column 1 of Table 7, the coefficient on FemMob indicates that households that have at least one woman who owns a mobile phone have a 10.8 percentage point higher probability of having at least one woman who has the most say in making the decision

about the number of children to have than households that do not have at least one woman who owns a mobile phone. In Table 7 column 2, the coefficient on the same regressor indicates that households that have at least one woman who owns a mobile phone have an 8.2 percentage point higher probability of having at least one woman who has the most say in deciding whether to purchase land or property than those households without at least one woman who owns a mobile phone. Similarly, in Table 7 column 3, the results show that households that have at least one woman who owns a mobile phone have a 14.5 percentage point higher probability of having at least one woman who can visit the health center alone than households that do not have at least one woman who owns a mobile phone. These results, once again, support my hypothesis that the ownership of mobile phones by women positively impacts the agency of women.

The results of Table 7 suggest that the indicator for ownership of mobile phones by women has the most considerable impact on the dependent variable for mobility, Visit Health Center Alone, similar to the results for computers. My initial speculation still holds true; a woman's freedom to travel could depend on the confidence in her safety. A woman who owns a mobile phone could possibly call for help in the event of an emergency. Her ownership of a mobile phone may instill a sense of assurance in her family, entitling her to a greater degree of freedom.

In Tables 8 and 9, I once again control for education, income, the number of adult females in a household to help eliminate omitted variable bias and inch closer to seeing a causal relationship between FemMob and the outcome variables.

Table 8 shows the results of the regressions in which education, income and number of adult females are controlled for individually, for each dependent variable (Equations 2, 3,

and 4). Similar to computers, in the estimated models for mobile phones Income100K, QtyFemAdults, and HighestFemEd almost always have a statistically significant and positive impact on the outcome variables representing female autonomy.

In column 1, the coefficient estimate on Income100K indicates that when income rises by Rs. 100,000, the probability of having at least one female in the household who has the most say in the decision of how many children to have rises by half a percentage point, holding the indicator for ownership of mobile phones by females constant. Similarly, in column 7, a one-unit increase in Income100K raises the probability of Y_i by 0.850 percentage point. However, similar to the case of computers, in column 4, the coefficient estimate on Income100K takes on a negative, but insignificant value. Therefore, as seen earlier, it is unclear as to whether income influences Decision: Purchase Land or Property.

The results for the effect of QtyFemAdults on the three dependent variables, holding use of computers by females constant, are all highly significant and positive. The coefficient estimates of the effect of QtyFemAdults on Decision: Number of Children, Decision: Purchase Land/Property and Visit Health Center Alone are 0.0698, 0.109, and 0.0613, respectively (Table 8 columns 2, 5, and 8). These numbers indicate that as QtyFemAdults increases by 1 unit, the probability of Y_i increases by the aforementioned coefficient estimates, holding the indicator for ownership of mobile phones by females constant. For example, a 1-unit increase in the number of adult females in a given household increases the probability of there being at least one female in a household who has a say in the decision of whether to buy land or property by almost 11 percentage points, holding ownership of mobile phones by females constant (Table 8 column 5).

In column 3 of Table 8, the coefficient estimate on HighestFemEd suggests that a 1-unit increase in the highest educational attainment of a female in a household increases the probability of there being at least one female who makes the decision of how many children to have in a household by 0.893 percentage points, holding the indicator for ownership of mobile phones by females constant. As seen in the case for computers, for Decision: Purchase Land/Property and Visit Health Center Alone, the results are highly significant and positive.

In general, Table 8 suggests that the proxies for education, income and number of adult females in a household (HighestFemEd, Income100K, and QtyFemAdults) have an influence on Y_i . For the most part, the inclusion of control variables in the estimated models decreases the coefficient estimates for FemMob. As seen previously, this could mean that FemMob was initially picking up the impact of FemMob *and* the impact of these control variables on the dependent variables, therefore reflecting biased estimates.

Table 9 shows the results from regression equation 6. This equation includes the three control variables for education, income, and number of adult women in a household all together. In column 1, I find that FemMob has a positive and highly significant effect for Decision: Number of children, unlike in the case of computers; households that have at least one female who owns a mobile phone are 7.2 percentage points more likely to have at least one woman who has the most say about the decision of how many children to have. A similar pattern is seen for the other two outcome variables; households that have at least one female who owns a mobile phone are 5.89 percentage points more likely to have at least one woman who has the most say about the decision about buying land and 10.4 percentage points more likely to have at least one woman who can visit a local health center

alone. The inclusion of the control variables together shows that an increase in FemMob still positively influences Y_i and a decrease in the magnitude of the coefficient estimates of FemMob for all Y_i , compared to values in Table 7 and Table 8. For example, for Decision: Number of Children, the coefficient estimate for FemMob decreases from 0.108 in Table 7 to 0.0723 in Table 9. This suggests that FemMob was originally biased upwards and equation 6 helps eliminate omitted variable bias.

Table 10 shows the results from the regressions in which the control variable for the use of mobiles by women, but *not* for internet and email (FemMobNoIE) is included (Equations 5 and 7). It is important to note that in Equations 5 and 7, I use FemMobIE instead of FemMob as the main regressor.

In Table 10, all of the coefficient estimates of FemMobIE are still highly significant and positive at the 99% confidence level, even when I control for the use of mobiles by females, but not for the purposes of internet or email. In column 1, the results indicate that having at least one female who uses a mobile phone, specifically for internet or email raises the probability of there being at least one woman in a household who makes the decision about the number of children to have by almost 11 percentage points, holding the use of mobile phones for internet or email constant. Columns 3 and 5 show a similar trend. The coefficients on FemMobIE suggest a 9 and 16.3 percentage point increase in the probability of Decision: Purchase Land/Property and Visit Health Center Alone, holding FemMobNoIE constant. Analogous to the case of computers, the use of mobiles by women, specifically for email or internet, has an additional effect on the agency variables over and above the impact of the use of mobiles phones by women for purposes other than internet or email.

Columns 2, 4, and 6 of Table 10 show the impact of use of mobile phones for internet or email by women on the agency variables, holding the control variables constant all together. The coefficient estimates on FemMobIE for Decision: Number of Children, Decision: Purchase Land/Property, and Visit Health Center Alone are all positive and highly significant. The coefficients of FemMobIE for these three dependent variables are 0.0238, 0.0409 and 0.0650. This means that households in which at least one woman uses a mobile phone, specifically for internet or email have a 2.4 percentage point higher probability of having at least one woman who has a say in the decision of how many children to have, over and above those households that have at least one woman who uses a mobile phone for purposes other than for email and internet access. Similarly, these households have a 4.1 percentage point higher probability of having at least one woman who has a say in the decision of whether to purchase land or property and 6.5 percentage point higher probability of having at least one woman who can visit the local health center alone, holding income, education and number of adult women in a household constant. Identical to the results for computers, when I isolate the the effects of the use of mobile phones by women for the purpose of Internet from the simple use of a mobile phone, whilst holding education, income and number of women in a household constant, I still see a positive and significant effect on these two agency variables.

c) Relative Impact of Mobile Phones and Computers

In Table 11, I analyze the relative effectiveness of each mode of communication in furthering female agency. Interestingly, in all the estimated models, FemComp and FemMob are statistically significant at the 99% confidence level. The coefficient estimates

for FemComp (Table 11 column 1) indicate there is a 4.07 percentage point higher probability of having at least one eligible woman who has the most say in deciding the number of children to have, in a household that has at least one woman who knows how to use a computer than in a household that does not have at least one such woman, regardless of whether or not there is at least one woman who owns a mobile phone in that household. It is important to note that here the coefficient estimate drops nearly 4 percentage points from an estimate of 0.0820 on FemComp for Decision: Number of Children, seen in the results from the initial regression equation 1 in column 1 of Table 3. This is another indication of Omitted Variable Bias. The results in Table 11 show that the inclusion of FemMob as a control for the effect of use of mobile phones removes bias from our estimate of FemComp.

Conversely, the same model indicates there is a 10.2 percentage point higher probability of having at least one eligible woman who has the most say in deciding the number of children to have, in a household that has at least one woman who owns a mobile phone, regardless of whether or not there is at least one woman who knows how to use a computer. FemMob has a higher coefficient estimate than FemComp. This shows that having at least one woman who owns a mobile phone in a household is more effective in impacting the agency variable than having at least one woman who knows how to use a computer in a household. This trend is consistent across the other two dependent variables, Decision: Purchase Land/Property and Visit Health Center Alone. Additionally, the coefficient estimates for FemMob on the three outcome variables are larger than those for FemComp across the same variables of interest (Tables 3-10). This may indicate that

mobile phones have a greater impact than computers do on this aspect of female empowerment.

There is a higher probability of an individual *using* a communication technology if she has *access* to that technology. The more accessible ICTs are; the more likely individuals are to use them. The relative effectiveness of the use of an ICT can therefore be attributed to the relative access to that ICT. An experiment conducted by Jain et al. (2012) explored the relative access of various types of ICTs in rural areas of the Sonipat District of Harayana. Radios and televisions were the most accessible with nearly 33% of the women in their sample having access to these technologies. 10% of these women had access to any type of phone, including mobile phones. Access to computers was essentially zero.

There are three possible explanations for this phenomenon. One, mobile phones are more accessible than computers as they require far less infrastructure and do not require a constant source of electricity or maintenance. Two, they are more comfortably adopted as they are far cheaper than computers. Three, mobile phones have a shorter learning curve compared to that of computers. Mobile phones require less skill to use with more reliance on voice than text.

Given these results and their context, it is important to note that the relative effectiveness of mobile phones over computers is not conclusive in this study. In my analysis, I compare the *use* (proxied by women saying they know how to use a computer) of computers with the *ownership* of mobile phones. This is not a perfect comparison. A more apt comparison would be between the ownership of computers and the ownership of mobile phones or the difference between the estimates of individuals knowing how to use

computers and those knowing how to use mobile phones. However, my analysis is limited by the data provided by the IDHS, which does not include any information about ownership of computers or individuals knowing how to use mobile phones.

VII. Conclusion

The agency of women, defined by the decision-making abilities and mobility of women, can be attributed to a number of factors. Existing literature points to education, income level, age, religion and region of residence of women as some important contributing factors. In this paper, I consider another factor, infrequently studied in the context of female empowerment: the use of ICTs, specifically computer and mobile phones. While Chen (2004) does look at this very factor in the context of gender inequality and development, a few papers explore the impact of this factor on agency of women in India, specifically. India makes for an interesting case to study as it is a developing country with a booming IT sector, thereby giving rise to the unprecedented expansion of ICTs.

My analysis shows that the empirical evidence is consistent with the intuition; increasing use and ownership of computers and mobile phones amongst women leads to an increased independence in women, witnessed in their mobility and their ability to make personal and economic decisions, indicating an increased sense of agency. I delve deeper into the effect of these communication technologies by also considering the impact of these communication technologies when they are used specifically for the purposes of internet and email. My results show an even more positive and highly significant effect of the use of ICTs for internet and email on these agency variables. Further, these results are consistent, even when the aforementioned factors such as education, income and number of adult females in a household are controlled for. I also examine the relative effectiveness of the two media of communication. At first glance, the results suggest that the use of mobile phones is more effective in furthering the agency of women than the use of

computers. However, this result cannot be confirmed because the measure for the use of computers and the measure for the use of mobile phones are not perfect comparisons.

That being said, it is important to acknowledge some of the limitations of my analysis. FemComp measures whether a woman in a given household knows how to use a computer. I use this variable as a proxy for measuring the *use* of computers by females. This may not be a perfect indicator for the use of ICTs as a woman who knows how to use a computer does not necessarily use it regularly. Therefore, the utilization of this variable may introduce noise in this analysis. Additionally, the coefficient of the constant terms in each regression for the three dependent variables are absurdly high. These numbers seemingly suggest that India has a pro-woman culture, which it does not. These high estimates may stem from measurement error and/or response bias in the data from the IHDS survey. Finally, for the decision-making and mobility variables, the IHDS only targets eligible women. Eligible women are comprised of women between the ages of fifteen and forty-nine who have been ‘ever-married’. This excludes two groups of women who are extremely important to study in the context of agency, and more broadly development: single or ‘never-married’ women, and women over the age of forty-nine.

This paper points to the importance of ICTs in the context of development, especially in the sphere of female empowerment. In order to encourage women to use ICTs, these women need access to ICTs. In developing countries like India, the access to ICTs is limited by the digital divide. As more women have access to ICTs, more of these women will use them. In developing countries like India, as a greater percentage of women use ICTs, a more significant number of women have access to a deep bank of knowledge and information. This knowledge enables women to make well-informed decisions, which

gives them the confidence to assert themselves within the household. Therefore, policy-makers and world leaders should focus on improving the access to ICTs for women in developing countries. This could involve increased investments and government efforts targeted at fulfilling the United Nation's Sustainable Development Goals of achieving universal affordable internet, and ensuring equal access to basic technology amongst men and women (United Nations n.d.).

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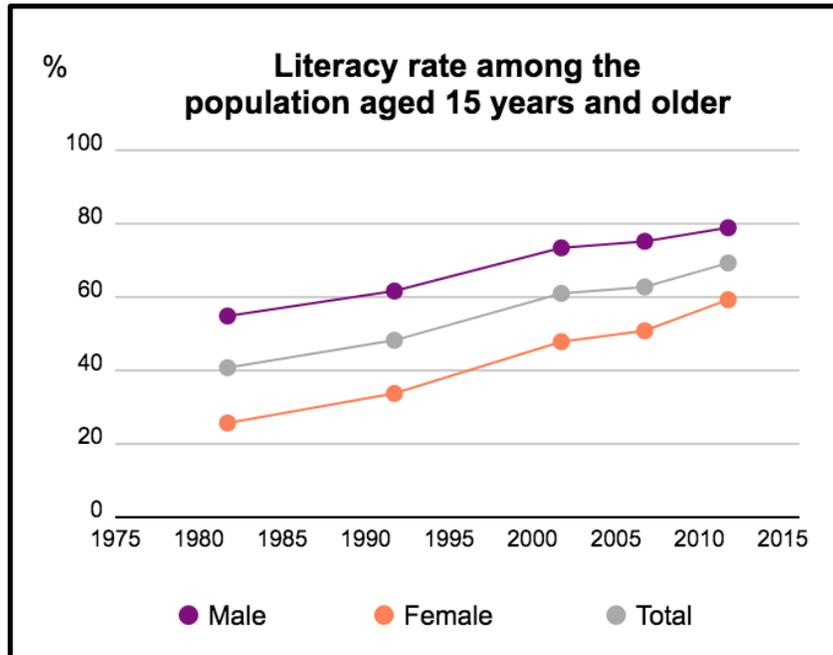
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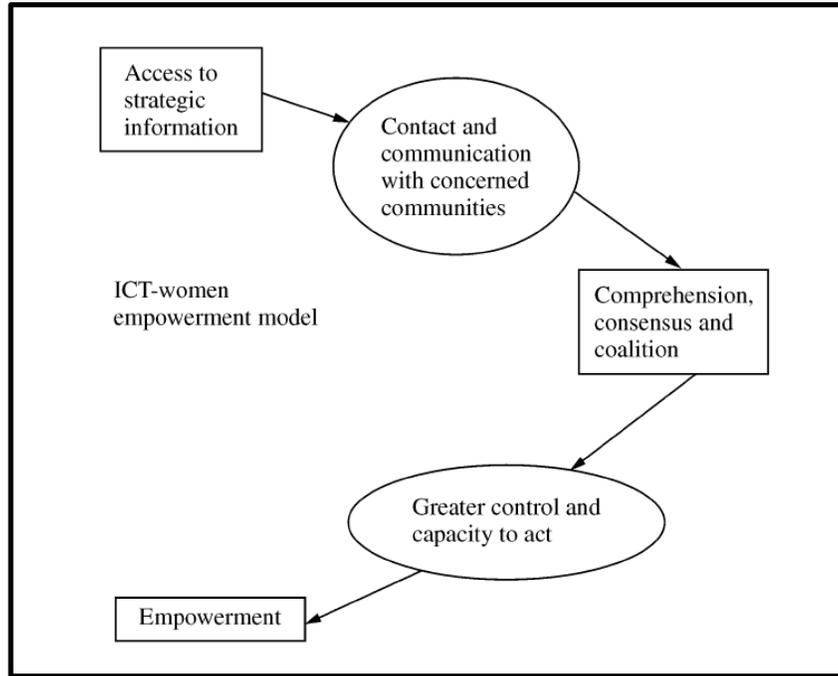
VIII. Figures and Tables

FIGURE 1: LITERACY RATES FOR INDIVIDUALS OF AGES 15+ IN INDIA



Source: UNESCO Institute of Statistics

FIGURE 2: ICT-WOMEN EMPOWERMENT MODEL



Source: Nath (2001)

TABLE 1: VARIABLE LIST AND DEFINITIONS

VARIABLE NAMES	ORIGINAL QUESTION	VARIABLE CONSTRUCTION	CODE
OUTCOME VARIABLES			
Decision: Number of Children	Who has the most say in the decision? How many children you have?*	Did the respondent have the most say in the decision of how many children she has?	0 = No 1 = Yes, there is at least 1 eligible woman in a given household who has the most say in the decision of how many children she has
Decision: Purchase Land/Property	Who has the most say in the decision? Whether to buy land or property?*	Did the respondent have the most say in the decision of whether to buy land or property?	0 = No 1 = Yes, there is at least 1 eligible woman in a given household who has the most say in the decision of whether to buy land or property
Visit Health Center Alone	Can you go alone to the local health center?*	Can the respondent go to the local health center alone?	0 = No 1 = Yes, there is at least 1 eligible woman in a given household who can go to the local health center alone
*Question asked to Eligible Women (Ages 15-49 years, who are married or have been married)			

TABLE 1: VARIABLE LIST AND DEFINITIONS (CONTINUED)

VARIABLE NAMES	ORIGINAL QUESTION	VARIABLE CONSTRUCTION	CODE
MAIN REGRESSORS			
FemComp	Does anybody in your household <i>know how to use</i> computers?	Does any female in your household know how to use a computer?	0 = No 1 = Yes, there is at least 1 female in a given household who knows how to use a computer
FemMob	Does anybody in your household <i>have</i> a mobile phone?	Does any female in your household own a mobile phone?	0 = No 1 = Yes, there is at least 1 female in a given household who owns a mobile phone
FemCompIE	For those who responded ‘yes’ to knowing how to use a computer: <i>Use internet or email on computer?</i>	Does any female in your household use a computer for internet or email?	0 = No 1 = Yes, there is at least 1 female in a given household who uses a computer for internet or email
FemMobIE	For those who responded ‘yes’ to having a mobile phone: <i>Use internet or email on mobile?</i>	Does any female in your household use a mobile for internet or email?	0 = No 1 = Yes, there is at least 1 female in a given household who uses a mobile phone for internet or email

TABLE 1: VARIABLE LIST AND DEFINITIONS (CONTINTUED)

VARIABLE NAMES	ORIGINAL QUESTION	VARIABLE CONSTRUCTION	CODE
CONTROL VARIABLES			
QtyFemAdults	What is the number of 21+ women in a household?	Variable used as in dataset	Numeric
Income100K	What is the total income for a household?	Total Income/100000	Numeric
HighestFemEd	What is the highest education completed of any adult female in a household?	Variable used as in dataset	Scale of 0 through 16. 0 = No education completed 16 = Education beyond Bachelors completed
FemCompNoIE	Constructed	Does any female in your household know how to use a computer, but does not use it for internet or email?	0 = No 1 = Yes, there is at least 1 female in a given household who knows how to use a computer, but does not use it for internet or email
FemMobNoIE	Constructed	Does any female in your household own a mobile, but does not use it for internet or email?	0 = No 1 = Yes, there is at least 1 female in a given household who owns a mobile phone, but does not use it for internet or email

TABLE 2: SUMMARY STATISTICS FOR VARIABLES

	N	Mean	S.D.	Min.	Max.
	(1)	(2)	(3)	(4)	(5)
OUTCOME VARIABLES					
Decision: Number of Children	42,152	0.749	0.433	0	1
Decision: Purchase Land/Property	42,152	0.635	0.481	0	1
Visit Health Center Alone	42,152	0.605	0.489	0	1
MAIN REGRESSORS					
FemComp	42,152	0.109	0.312	0	1
FemMob	42,152	0.505	0.500	0	1
FemCompIE	42,152	0.0709	0.257	0	1
FemMobIE	42,152	0.0569	0.232	0	1
CONTROL VARIABLES					
Income100K	42,152	1.278	2.167	-10.37	113.6
QtyFemAdults	42,152	1.490	0.780	0	9
HighestFemEd	42,152	5.553	5.277	0	16
FemCompNoIE	42,152	0.0384	0.192	0	1
FemMobNoIE	42,152	0.448	0.497	0	1

TABLE 3: EFFECT OF USE OF COMPUTERS BY WOMEN ON THEIR AGENCY

	(1) DECISION: NUMBER OF CHILDREN	(2) DECISION: PURCHASE LAND/PROPERTY	(3) VISIT HEALTH CENTER ALONE
FemComp	0.0820*** (0.00675)	0.0799*** (0.00751)	0.140*** (0.00760)
Constant	0.740*** (0.00223)	0.626*** (0.00248)	0.590*** (0.00251)
Observations	42,152	42,152	42,152
R-squared	0.003	0.003	0.008

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 4: EFFECT OF USE OF COMPUTERS BY WOMEN ON THEIR AGENCY
(INCLUDING CONTROLS INDIVIDUALLY)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	DECISION: NUMBER OF CHILDREN			DECISION: PURCHASE LAND/PROPERTY			VISIT HEALTH CENTER ALONE		
FemComp	0.0723*** (0.00694)	0.0515*** (0.00678)	0.00574 (0.00729)	0.0815*** (0.00771)	0.0741*** (0.00760)	0.0299*** (0.00815)	0.124*** (0.00780)	0.115*** (0.00766)	0.0553*** (0.00821)
Income100K	0.00612*** (0.000999)			-0.000988 (0.00111)			0.00967*** (0.00112)		
QtyFemAdults		0.0760*** (0.00271)			0.0144*** (0.00304)			0.0617*** (0.00306)	
HighestFemEd			0.0114*** (0.000431)			0.00748*** (0.000482)			0.0126*** (0.000485)
Constant	0.734*** (0.00249)	0.631*** (0.00450)	0.685*** (0.00304)	0.627*** (0.00277)	0.605*** (0.00505)	0.590*** (0.00339)	0.579*** (0.00280)	0.501*** (0.00509)	0.529*** (0.00342)
Observations	42,152	42,152	42,152	42,152	42,152	42,152	42,152	42,152	42,152
R-squared	0.004	0.022	0.020	0.003	0.003	0.008	0.010	0.017	0.024

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**TABLE 5: EFFECT OF USE OF COMPUTERS BY WOMEN ON THEIR AGENCY
(INCLUDING CONTROLS ALL TOGETHER)**

	(1) DECISION: NUMBER OF CHILDREN	(2) DECISION: PURCHASE LAND/PROPERTY	(3) VISIT HEALTH CENTER ALONE
FemComp	0.00682 (0.00732)	0.0347*** (0.00821)	0.0533*** (0.00826)
Income100K	-0.00202** (0.00102)	-0.00532*** (0.00114)	0.00173 (0.00115)
QtyFemAdults	0.0580*** (0.00292)	-0.00188 (0.00327)	0.0372*** (0.00329)
HighestEdFem	0.00823*** (0.000470)	0.00814*** (0.000527)	0.0102*** (0.000531)
Constant	0.619*** (0.00455)	0.596*** (0.00510)	0.485*** (0.00514)
Observations	42,152	42,152	42,152
R-squared	0.029	0.009	0.027

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 6: EFFECT OF USE OF COMPUTERS FOR INTERNET AND EMAIL BY WOMEN ON THEIR AGENCY

	(1)	(2)	(3)	(4)	(5)	(6)
	DECISION: NUMBER OF CHILDREN	DECISION: NUMBER OF CHILDREN	DECISION: PURCHASE LAND/PROPERTY	DECISION: PURCHASE LAND/PROPERTY	VISIT HEALTH CENTER ALONE	VISIT HEALTH CENTER ALONE
FemCompIE	0.0783*** (0.00822)	-0.00785 (0.00883)	0.0725*** (0.00914)	0.0216** (0.00991)	0.130*** (0.00925)	0.0301*** (0.00997)
Income100K		-0.00182* (0.00102)		-0.00514*** (0.00115)		0.00205* (0.00115)
QtyFemAdults		0.0580*** (0.00292)		-0.00186 (0.00327)		0.0373*** (0.00329)
HighestEdFem		0.00831*** (0.000471)		0.00821*** (0.000528)		0.0104*** (0.000531)
FemCompNoIE	0.0889*** (0.0110)	0.0315*** (0.0111)	0.0936*** (0.0122)	0.0566*** (0.0124)	0.158*** (0.0124)	0.0923*** (0.0125)
Constant	0.740*** (0.00223)	0.619*** (0.00455)	0.626*** (0.00248)	0.595*** (0.00511)	0.590*** (0.00251)	0.484*** (0.00514)
Observations	42,152	42,152	42,152	42,152	42,152	42,152
R-squared	0.004	0.029	0.003	0.009	0.008	0.027

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

TABLE 7: EFFECT OF OWNERSHIP OF MOBILE PHONES BY WOMEN ON THEIR AGENCY

	(1)	(2)	(3)
	DECISION: NUMBER OF CHILDREN	DECISION: PURCHASE LAND/PROPERTY	VISIT HEALTH CENTER ALONE
FemMob	0.108*** (0.00419)	0.0818*** (0.00467)	0.145*** (0.00471)
Constant	0.695*** (0.00298)	0.594*** (0.00332)	0.532*** (0.00335)
Observations	42,152	42,152	42,152
R-squared	0.016	0.007	0.022

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**TABLE 8: EFFECT OF OWNERSHIP OF MOBILE PHONES BY WOMEN ON THEIR AGENCY
(INCLUDING CONTROLS INDIVIDUALLY)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	DECISION: NUMBER OF CHILDREN			DECISION: PURCHASE LAND/PROPERTY			VISIT HEALTH CENTER ALONE		
FemMob	0.105*** (0.00425)	0.0907*** (0.00421)	0.0730*** (0.00450)	0.0828*** (0.00474)	0.0790*** (0.00474)	0.0575*** (0.00503)	0.139*** (0.00477)	0.131*** (0.00475)	0.105*** (0.00505)
Income100K	0.00452*** (0.000980)			-0.00143 (0.00109)			0.00850*** (0.00110)		
QtyFemAdults		0.0698*** (0.00270)			0.0109*** (0.00303)			0.0554*** (0.00305)	
HighestFemEd			0.00893*** (0.000426)			0.00613*** (0.000477)			0.0101*** (0.000479)
Constant	0.690*** (0.00311)	0.599*** (0.00472)	0.663*** (0.00333)	0.595*** (0.00347)	0.579*** (0.00530)	0.572*** (0.00372)	0.524*** (0.00349)	0.456*** (0.00532)	0.496*** (0.00374)
Observations	42,152	42,152	42,152	42,152	42,152	42,152	42,152	42,152	42,152
R-squared	0.016	0.031	0.026	0.007	0.008	0.011	0.023	0.030	0.032

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

**TABLE 9: EFFECT OF USE OF COMPUTERS BY WOMEN ON THEIR AGENCY
(INCLUDING CONTROLS ALL TOGETHER)**

	(1) DECISION: NUMBER OF CHILDREN	(2) DECISION: PURCHASE LAND/PROPERTY	(3) VISIT HEALTH CENTER ALONE
FemMob	0.0723*** (0.00448)	0.0589*** (0.00504)	0.104*** (0.00506)
Income100K	-0.00281*** (0.00101)	-0.00545*** (0.00114)	0.00137 (0.00114)
QtyFemAdults	0.0574*** (0.00291)	-0.00239 (0.00327)	0.0364*** (0.00328)
HighestEdFem	0.00595*** (0.000467)	0.00690*** (0.000525)	0.00789*** (0.000526)
Constant	0.598*** (0.00472)	0.577*** (0.00530)	0.453*** (0.00532)
Observations	42,152	42,152	42,152
R-squared	0.035	0.012	0.035

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 10: EFFECT OF USE OF MOBILE PHONES FOR INTERNET AND EMAIL BY WOMEN ON THEIR AGENCY

	(1)	(2)	(3)	(5)	(6)	(7)
	DECISION: NUMBER OF CHILDREN		DECISION: PURCHASE LAND/PROPERTY		VISIT HEALTH CENTER ALONE	
FemMobIE	0.109*** (0.00927)	0.0238** (0.0100)	0.0899*** (0.0103)	0.0409*** (0.0113)	0.163*** (0.0104)	0.0650*** (0.0113)
Income100K		-0.00213** (0.00102)		-0.00520*** (0.00114)		0.00191* (0.00115)
QtyAdultFem		0.0576*** (0.00291)		-0.00233 (0.00327)		0.0365*** (0.00328)
HighestEdFem		0.00645*** (0.000476)		0.00708*** (0.000535)		0.00829*** (0.000537)
FemMobNoIE	0.108*** (0.00432)	0.0756*** (0.00452)	0.0808*** (0.00482)	0.0602*** (0.00509)	0.143*** (0.00485)	0.106*** (0.00510)
Constant	0.695*** (0.00298)	0.595*** (0.00474)	0.594*** (0.00332)	0.576*** (0.00533)	0.532*** (0.00335)	0.451*** (0.00534)
Observations	42,152	42,152	42,152	42,152	42,152	42,152
R-squared	0.016	0.035	0.007	0.012	0.022	0.036

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

TABLE 11: RELATIVE EFFECTIVENESS OF COMPUTERS AND MOBILE PHONES AS ICTs

	DECISION: NUMBER OF CHILDREN (1)	DECISION: PURCHASE LAND/PROPERTY (2)	VISIT HEALTH CENTER ALONE (3)
FemComp	0.0407*** (0.00693)	0.0500*** (0.00774)	0.0863*** (0.00779)
FemMob	0.102*** (0.00433)	0.0739*** (0.00483)	0.132*** (0.00486)
Constant	0.693*** (0.00298)	0.592*** (0.00333)	0.529*** (0.00335)
Observations	42,152	42,152	42,152
R-squared	0.016	0.008	0.025

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

