

Having access to a cell phone increases women's empowerment in rural Bangladesh.



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Abstract

This paper investigates the effect of access to cell phone on one dimension of women's empowerment, women's involvement in group activities in a developing country, Bangladesh. Bangladesh experiences a reduction in gender gap reflected in its improved ranking in Global Gender Gap ranking from 82 in 2010 to 64 in 2015. Simultaneously, coverage of access to cell phone has grown from 46% in 2010 to 84% in 2015. This provides an ideal setting to test whether access to cell phone impacts women's empowerment. Recent empirical literature (e.g., Rotondi et al. 2020, Hossain and Samad (2021)) does provide some evidence. The paper builds upon that literature by using the Bangladesh Integrated Household Surveys, a panel dataset conducted on a representative sample of 6,500 households in 2012 and 2015. This research improves on prior research by using the number of cell towers in a sub-district to instrument the effect of cell phone on women's empowerment. The instrumental variable approach is required as Women's empowerment, and access to cell phone are endogenous: it is possible that empowered women have a greater probability of having access to a cell phone. Hence, the observed positive relationship could be because of this reverse causation. I find that women having access to a cell phone increases woman's participation in group activities. This result is further robust when using alternative specifications. The effect of access to a cell phone on women's leadership role in group activities is not statistically significant.

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I. Introduction

Access to a cell phone may have significant impact on the advancement of women’s empowerment. Cell phones allow women to communicate with their relatives as well as business networks more easily, they provide a device to use internet for greater access to information, and they enable women to access government, financial, medical, educational,

and other services more conveniently, especially as these services are becoming more remotely available. All these factors associated with access to cell phone may in turn empower women. The World Development Report 2016 highlights various impacts of access to cell phone on women's socio-economic status including greater labor market participation, access to medical services and digital financial services by enabling mobile money and increased entrepreneurial activities by facilitating social media presence.

In this paper, I investigate the effect of cell phone access on various dimensions of women's empowerment, and I endeavor to establish a causal relationship. I use the Bangladesh Integrated Household Survey (BIHS) conducted by the International Food Policy Research Institute (IFPRI) that conducted two rounds of surveys on a representative sample of 6,500 households in 2012 and 2015 in rural Bangladesh. The survey collects detailed data on several dimensions of women's empowerment, and it holds data on income, asset, livelihoods, food security, education, health, financial services, time use etc.

I use these data to construct a variable to measure a specific dimension of women's empowerment. Participation in various social and economic groups is often considered as a measure of women's empowerment through its contribution as social capital (Narayan (2002), Alkire et al. (2013)) and the enhancement of collective agency (Malapit et al. (2019), Yount et al. (2019)). I use the survey data to calculate the number of groups a woman respondent has participated in the past year leading to the survey. In addition, I also calculate the number of groups in which a women respondent played a leadership role.

Women's empowerment is considered an essential component for the economic growth and social development of a country (UNHLP (2017), Lagarde (2019)).¹ The UN, for example, has announced gender equality as the fifth Sustainable Development Goal (SDG) for 2030.² The targets under this goal include the elimination of violence, provision of equal rights to economic resources, access to ownership and control over land and other assets, financial services, inheritance, and natural resources, by national laws. The goal 5.5, in particular, targets to "ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life." UN also recognizes the role of ICT, especially access to cell phone, as an important tool to promote women's empowerment (Target 5.b). To what extent access to cell phone can empower women deems to be an important research question.

Bangladesh provides an ideal setting to test this hypothesis. Women, despite their contribution to the formal economy, are not empowered: in 2015, less than 20% of women in Bangladesh can make a financial decision regarding daily purchases, household finances, and assets solely by themselves (World Bank (2019), pp: 108-109). Yet, Bangladesh experiences a considerable reduction in gender gap reflected in its improved ranking in Global Gender Gap ranking from 82 in 2010 to 48 in 2018 (World Economic Forum: Global Gender Gap Index). On the other hand, access to a cell phone has risen significantly, from less than 20% in 2006 to close to 100% in 2017 (World Bank, 2019). Has this growth in access to cell phone brought changes in women's empowerment in Bangladesh? To test this hypothesis using IFPRI's BIHS

¹ <https://hlp-wee.unwomen.org/en/reports-toolkits>

² See Goal 5: Achieve gender equality and empower all women and girls.
<https://sdgs.un.org/goals/goal5>

data, I acknowledge the possibility that access to cell phone and women's empowerment are endogenous. Whereas the positive impact of access to cell phone on women's empowerment is well recognized, it is also possible that women who are empowered are more likely to have greater access to a cell phone. To resolve this endogeneity, I take three strategies. First, the panel nature of the BIHS data allows me to control for individual fixed effects, which enable me to control for all factors related to the respondent's empowerment that do not change over time. Second, I control for several socio-economic variables that can change over time and can affect both accesses to cell phone and women's empowerment. For example, both income and assets can positively affect cell phone and woman empowerment, and if these factors are not included, one could observe a positive relationship between cell phone access and woman empowerment even if there is not any such relationship. Finally, and most importantly, I use an instrumental variable approach to identify the effect of cell phone access on women's empowerment. More specifically, I instrument the variable indicating a woman's access to a cell phone by the number of cell phone towers located in the subdistrict, hypothesizing that a higher number of cell phone towers in a subdistrict is correlated with access to the cell phone in that area but not with women's empowerment.

I find that access to cell phone affects women's participation in group activities. More specifically, I find that access to cell phone has increased women's participation in groups as members. However, when I consider women's leadership role in these groups, I find no statistically significant effect of access to the cell phone. I conclude that cell phone has initiated a considerable change in group involvement of women, but three years (between the two

surveys) may not be enough to see them emerging in leadership roles. It may take a few years to see these women leading various groups.

The rest of the paper is organized as follows. Section II describes the literature on the concept and measurements of women's empowerment as well as the literature on relationship between access to cell phone and women's empowerment. Section III presents a simple conceptual framework linking access to cell phone and women's group participation. Section IV presents the institutional background. Section V describes the key characteristics of the data used in this paper. Section VI outlines how I measure the main variables from the survey. Section VII provides an overview of the estimation techniques employed to identify the effect of cell phone on various 's empowerment measures. Section VIII presents the descriptive statistics of the data used. Section IX describes the key results. Section X finally concludes.

II. Women's empowerment: Concept and Measurement

This section discusses the literature on women's empowerment. In the following subsections, I first present a brief discussion about how various scholars define women's

empowerment and how its multidimensionality is measured through multiple indicators. I then focus on the literature that presents group participation as a component of one of the dimensions of women's empowerment and how it influences other dimensions. Finally, I review the empirical literature that investigates the effect of cell phone on various dimensions of women's empowerment.

Women's Empowerment: Theory and Measurement

The economic and social development literature provides several yet similar definitions of empowerment (Ibrahim and Alkire (2007)). The literature grew from several pioneering works of Sen, who links empowerment with agency freedom. Sen defines *agency* as "what a person is free to do and achieve in pursuit of whatever goals or values he or she regards as important" (Sen (1985), p. 206). Empowerment, therefore, requires expanding one's agency in various domains (World Development Report 2000-01, Narayan (2002), Alkire (2005), Ibrahim and Alkire (2007)). Women's empowerment then is defined as a process through which women can make strategic choices to realize their potential and ability to make decisions freely, which are not possible to achieve and do in their current situation (Kabeer (1999), Mosedale (2003)). This ability to exercise choices has three inter-related and indivisible dimensions: resources, agency, and achievements (Kabeer 1999).

The multiple domains in which empowerment is required to be achieved bring about the recognition that empowerment is multi-dimensional (Narayan (2005), Alkire (2005), Alsop and Heinsohn (2006), Ibrahim and Alkire (2007)). This multidimensionality has made scholars introduce innovative questions in a survey questionnaire to measure women's empowerment (Ibrahim and Alkire (2007)). For example, Alkire et al. (2012, 2013) use the IFPRI's datasets to

create a five-dimensional Women's Empowerment in Agriculture Index (WEAI). These five dimensions or domains are (1) decisions about agricultural production, (2) access to and decision-making power about productive resources, (3) control of the use of income, (4) leadership in the community, and (5) time allocation. Malapit et al. (2019) and Yount et al. (2019) measure a project level WEAI (pro-WEAI) which considers Kabeer's (1999) agency theory more explicitly and design their measurements of three women empowerment dimensions founded in agency: i. intrinsic agency (power within); ii. Instrumental agency (power to); and iii. collective agency (power with). The Intrinsic Agency is measured by three indices: women's perceived right to bodily integrity, women's perceived self-efficacy and women's perceived social and economic rights; The Instrumental Agency is measured by two indices, women's influence in household decisions and women's freedom of movement; The collective agency is measured by two indices: women's participation in a group and women's participation in an influential group (Malapit et al. 2019).

Women's Empowerment and Group Participation

Organizing and participating in local organizations are often considered as one domain for women's empowerment. Narayan (2002) argues that people organizing themselves to work together towards a common cause in either informal or formal ways, i.e., the local organizational capacity, is a crucial element to empowerment. Grootaert (2005) operationalizes these concepts into a few macro-indicators that includes memberships in voluntary associations. Applying Narayan's (2002) argument to women's empowerment, Alkire et al. (2013) consider participation in an economic or social group as an indicator of leadership, one of the five domains of women's empowerment. Group participation helps women develop

social networks and build and access social capital, which can improve the economic well-being and affect other women's empowerment indicators. A woman's ability to tap into such social networks and social capital, which was not available to her before and is not available to many others, captures an essential dimension of women's empowerment. On the other hand, Yount et al. (2019) consider group membership as one of the components in measuring their third dimension, collective agency. In this paper, I consider women's participation in a group as a component of leadership dimension (in Alkire et al. (2013)'s terminology) or of collective agency (Malapit et al. (2019)'s terminology).

There is also a growing body of literature that presents empirical evidence to the link between participation in socio-economic groups and various other indicators of women's empowerment. Brody et al. (2015, 2017) systematically review 22 quantitative and 11 qualitative studies between 1999 and 2015 to synopsise the relationship between participation in a self-help group and women's empowerment. Their review of quantitative studies concludes that participation in self-help groups has positive effects on economic and political empowerment, women's mobility, and women's control over family planning. The review of qualitative studies reveals the importance of various mechanisms, including social networks, to materialize these effects. Recent studies confirm these findings (Kumar et al. (2019), Kumar et al. (2021)). Given the significance of group participation, it is important to learn about its determinants. As access to cell phone has significant economic impact, its role in women's empowerment and facilitating group participation needs to be empirically tested.

Effect of access to cell phones on women's empowerment

The women's empowerment literature recognizes the role of ICT, particularly access to cell phones, in empowering women. Rotondi et al. (2020) study both at a macro-level and micro-level to understand this relationship among other sustainable development indicators. Using 200+ country data, their cross-country study concludes that access to cell phones is associated with lower gender inequality. For their individual level study, they use cross-sectional survey data from Sub-Saharan Africa and identify the effect of the cell phone by instrumenting it with geo-spatial data on total lightning flash rates and cell phone coverage. They find that access to cell phones empowers women to make decisions independently. Hossain and Samad (2021) use household survey data from rural Bangladesh to analyze the effects of mobile phone use on women's empowerment. They apply propensity score-based weighted regressions and find that mobile phone use increases women's labor force participation, mobility, and ability to decide alone on various aspects of family life.

My approach to assessing the effect of access to cell phones on women's empowerment builds upon Rotondi et al. (2020) and Hossain and Samad (2021). I choose a different dimension, the leadership (Alkire et al. 2013) or collective agency (Yount et al. 2019). My approach has a resemblance to Rotondi et al. (2020) in the sense that I also consider an instrumental variable approach, and one of their instruments (cell phone coverage) is similar to mine (Location of towers). I, however, use balanced panel data that allows me to control for individual fixed effects and hence, minimizes the tower effects on group participation through other women's empowerment dimensions. In other words, the individual fixed effects further validate the use of the instrument.

III. Cell phone and group engagement: A Conceptual Framework

Figure 1 shows the conceptual framework illustrating the relationship between access to cell phone and group engagement. In creating this framework, I have used the literature

reviewed in Section II (most notably Kabeer, 1999, Narayan, 2002, Hossain and Samad, 2021). Access to cell phone facilitates women's social and economic life in many ways, four of which may contribute towards participating in group activities.

First, as a communication device, a cell phone allows women to contact with their friends, families, and relatives via phone calls, text messaging, and social media platforms. Second, the cell phone allows women to communicate effectively with their business associates in a similar way and, occasionally, e-businesses, assisting in the development and maintenance of a business network (The world bank, 2021).³ Third, cell phone provides access to information via social and business networks and internet access.⁴ Fourth, a cell phone is a gateway to several cell phone-based services, for example, financial services. The cell phone-based financial services, such as money transfer services and mobile banking services, help a woman have an account and ease transfers of money from the government (for example, social safety-net programs) and NGO (for example, to obtain and repay microfinance loans).⁵

[Figure 1 here]

All these benefits of cell phone access contribute towards three types of group engagement.

First, social and business networks and internet access provide greater access to information,

³ Mobile Phones, Household Welfare and Women's Empowerment : Evidence from Rural Off-grid Regions of Bangladesh
<https://openknowledge.worldbank.org/handle/10986/35875>

⁴ Mobile phones empower women in developing world - Oxford study.
<https://www.ox.ac.uk/news/2020-06-08-mobile-phones-empower-women-developing-world-oxford-study>

⁵ Closing the Gender Gap: Opportunities for the Women's Mobile Financial Services Market in Bangladesh
<https://documents1.worldbank.org/curated/en/821571530794259536/pdf/Closing-the-gender-gap-opportunities-for-the-Womens-Mobile-Financial-Services-Market-in-Bangladesh.pdf>

increasing the possibility of a group membership. Having access to cell phone-based financial services further enhances a woman's eligibility to be a member of several governmental (e.g., Participatory Budgeting in Local Government Institutions) and non-governmental programs (e.g., Grameen Bank's Microfinance program) that rely on group participation. Second, access to a cell phone can help a woman build, nurture, and grow her social and business networks through better communication, information, and support through financial services. This elevates the social status of a woman, which enables her to provide more input in the decision-making in a group. Finally, to take this argument further, a stronger social and business network, as well as improved access to information and financial services, may help women gain leadership roles in groups.

IV. Institutional Background

Bangladesh is a country in South Asia and bordered with India and Myanmar on all sides except for a small border with Burma. There are eight divisions, 64 districts, 491 subdistricts

and roughly 68,000 villages with a total population of 164 million. According to World Bank, about 62% of people live in rural areas in 2020⁶ with 70% Bangladeshis rely upon agriculture.⁷

Bangladesh is a low-income country with substantial poverty, inequality, and deprivation. An estimated 60 million people (24.5%) live below the poverty line in 2016 (Poverty assessment report, The World Bank, 2019),⁸ with a 15.8% living in female-headed households (The World Bank, World Development Indicator, 2018).⁹ The female labor force participation is 36% nationally with 38% in rural areas and most of the labor force is engaged in informal (Bangladesh Poverty assessment report, The World Bank, 2019, p-59), low-productivity, and low-income jobs. Access to secondary and tertiary education is limited, and the quality of education at all levels is deficient (The World Bank, 2019).¹⁰ The poor, and especially women and children, are severely disadvantaged in terms of ownership of assets and access to finance as well as to basic services including education, health care, water, and sanitation. For example, Of all the rural women, 12 percent own agricultural land solely or jointly and 7 percent own non-agricultural land, in comparison to 69 percent and 86 percent of rural men, respectively (World Bank 2019, p xix).

Bangladesh experiences significant growth in access to cell phone over the past two decades. Figure 1 plots cell phone subscription per 100 people in Bangladesh since 2000 until 2019. It shows a significant and steady surge of cell phone subscription from 2004. For my study

⁶ <https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS?locations=BD>

⁷ <https://www.worldbank.org/en/news/press-release/2021/03/09/world-bank-helps-bangladesh-improve-irrigation-based-agricultural-productivity#:~:text=%E2%80%9CIn%20Bangladesh%2C%20more%20than%2070,Director%20for%20Bangladesh%20and%20Bhutan.>

⁸ <https://data.worldbank.org/indicator/SI.POV.NAHC?locations=BD>

⁹ <https://data.worldbank.org/indicator/SP.HOU.FEMA.ZS?locations=BD>

¹⁰ <https://blogs.worldbank.org/endpovertyinsouthasia/girls-education-bangladesh-promising-journey>

period, cell phone subscription is 56.5 per 100 individuals in 2011 which increased to 82.1 per 100 individuals in 2014. This change amounts to a 45% growth in cell phone subscriptions between the two years. It is important to note that this growth may not have distributed equally among different groups of people (for example, man vs woman, rich vs poor, urban vs rural), but it is likely that cell phone access for rural women of Bangladesh also increased significantly.

[Figure 2 here]

V. Data

I use the Bangladesh Integrated Household Survey (BIHS) conducted by the International Food Policy Research Institute (IFPRI).¹¹ The BIHS is a panel dataset conducted in 2011 and 2015 from a representative sample of roughly 6,500 households and 27,285

¹¹ For details on the sampling methodology, see Sraboni, Esha, Agnes R. Quisumbing, and Akhter U. Ahmed, Results from the 2011-2012 Bangladesh Integrated Household Survey Report, (April 14, 2013), USAID, Page-1-3.

individuals. The sample is representative at the following levels: (1) nationally representative of rural Bangladesh and (2) representative of rural areas of each of the seven administrative divisions of the country: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet.

There seems to be some attrition in the data between the 2012 and 2015 waves. The survey in 2012 was conducted on 6,503 female respondents. However, the survey data of 2015 indicate that 5,989 (92%) of the 2012 respondents were surveyed in 2015. An additional 394 respondents were interviewed to make up for the lost observations. This implies that the largest set of balanced panel data involve 5,989 respondents.

There are missing observations even within this balanced set of respondents since some questions are not relevant to them in both the years and they have not provided any response. As a result, the number of missing observations in balanced panel varies from variable to variable. For my three dependent variables, my balanced panel dataset consists of 5,727 respondents and 11,454 observations. However, as I include the control variables, the number of observations fall further. Eventually, when I consider all the variables, I have a total of 9,624 observations from 4,812 respondents. This is the sample used for analysis.

VI. Measuring Group Engagement

Woman empowerment is multi-dimensional and therefore, one often needs and investigates multiple measures to capture this variety of dimensions. There has been extensive research on how these various dimensions can be captured individually and eventually towards a single index. Alkire et al. (2013), for example, explore the BIHS 2012 data in details and

estimates ten dimensions of women's empowerment and construct the Woman Empowerment in Agriculture Index (WEAI).

For this paper, I consider group engagement as a measure of women's empowerment. Group engagement as a measure of women's empowerment is important for various reasons. First, the literature investigating effect of access to cell phone on women's empowerment focus on other measures of women's empowerment (Women's labor force participation and women's ability to make decisions independently). Studies focusing on women's group participation look into how group participation affects other dimensions of women's empowerment. I consider women's group participation as my dependent variable. Second, the literature provides considerable evidence that group participation affects other dimensions of women empowerment. Third, there are various governmental (e.g., various local government initiatives such as participatory budgeting) and non-governmental (e.g., Microfinance programs) programs that use group participation as a tool for development and empowerment.

I consider two measures of group engagement. The first measure is women's group participation, a measure of leadership and social capital (Alkire et al. 2013) and also, collective Agency (Yount et al. 2019, 2020). The second measure is looking at the leadership role in these groups.

Group Participation as a member

One of the Women's Empowerment modules in the BIHS survey asks questions related to woman's leadership and influence in the community. In one set of questions, the survey asks the respondents, "Are you an active member of any [GROUP]?" The ten groups considered are

- i. Agricultural / livestock/ fisheries producer's group (including marketing groups)
- ii. Water users' group
- iii. Forest users' group
- iv. Credit or microfinance group (incl. ROSCAs/merry-go-rounds)
- v. Mutual help or insurance group (including burial societies)
- vi. Trade and business association
- vii. Civic groups (improving community) or charitable group (helping others)
- viii. Local government
- ix. Religious group
- x. Other women's group (only if it does not fit into one of the other categories)

I create a dummy variable for participating in each group:

$$y_{ijt} = \begin{cases} 1 & \text{if the respondent } i \text{ is an active member of group } j \text{ in period } t \\ 0 & \text{otherwise.} \end{cases}$$

I then create two variables to measure group participation. First, I create a dummy variable for group participation in any group:

$$Y_{1it} = \begin{cases} 1 & \text{if the respondent } i \text{ has participated in any group in period } t \\ 0 & \text{otherwise.} \end{cases}$$

Second, I sum all the dummy variables to find the number of groups the respondent i has participated as a member:

$$Y_{2it} = \sum_{j=1}^{10} y_{ijt}$$

Where y_{1ijt} is participation of individual i in group j in year t .

Leadership role in groups

In the same women's empowerment module, the respondents are asked, "Do you have a leadership position in this [GROUP]?" This question is asked for all the ten groups listed above. I create a dummy variable from this set of questions:

$$Y_{3it} = \begin{cases} 1 & \text{if the respondent } i \text{ has played a leadership role in any group in period } t \\ 0 & \text{otherwise.} \end{cases}$$

VII. Estimation Strategy

To estimate the effect of access to cell phone on women's empowerment, I recognize that access to cell phone and women's empowerment are endogenous. More specifically, it is possible that empowered women have greater access to cell phone than disempowered women. A positive coefficient of cell phone may capture this relationship between access to cell phone and women's empowerment. To solve this problem of reverse causality, I take an

instrumental variable approach. My instrument for access to cell phone is the number of towers in a subdistrict. I hypothesize that the greater the number of towers in a subdistrict, the greater the probability of a woman to own a cell phone. For cell phone towers to qualify as an instrument for access to cell phone, women's empowerment can not be correlated to cell phone towers through any other channel.

There are however a few other ways that cell phone towers and women's empowerment can be correlated. First, it is possible that telecommunication companies may want to serve neighborhoods and subdistricts where they can target a greater number of wealthy clients. Since income and wealth are often positively correlated with women's empowerment, number of cell phone towers can be positively correlated with women's empowerment through this income and wealth channel. Second, cell phone towers often take significant space and therefore could be very costly to mount in richer neighborhood and subdistricts and cheaper in poorer neighborhoods and subdistricts. Third and finally, telecommunication companies often follow an optimal location choice model to generate maximum geographic coverage. This may result in cell phone tower locations completely uncorrelated to economic outcomes of the neighborhood within a subdistrict. To sum up, women's empowerment, through its potential linkage with economic outcomes like income and assets, may be correlated with number of towers in a sub-district.¹²

In order to rule out these other linkages between cell phone towers and women's empowerment, I require to control for various subdistrict- and neighborhood-level economic

¹² See, for example, Buys et al 2009, Determinants of a Digital Divide in Sub-Saharan Africa: A Spatial Econometric Analysis of Cell Phone Coverage, World Development, for a discussion on relationship between tower location and economic development.

outcomes in my first stage regression. I, therefore, control for individual-level socio-economic outcomes and individual fixed effects since the individual-level socio-economic outcomes are eventually reflected in the subdistrict- and neighborhood-level socio-economic outcomes. I expect that controlling for these variables will most likely eliminate any other channels through which cell phone towers correlates with women’s empowerment. In other words, the only way cell phone towers can affect women’s empowerment, in my specifications, is by making cell phone more accessible.

I therefore estimate the effect of cell phone on women’s empowerment indicators following a two-stage least square model:

$$Y_{it} = \alpha + \beta_1 \hat{X}_{1it} + \beta_2 X_{2it} + \gamma_i + \delta_t + \epsilon_{it} \dots (1)$$

Where \hat{X}_{1it} is estimated from a first stage regression using the following Ordinary Least Square regression model:

$$X_{1it} = \theta + \pi_1 Z_{it} + \pi_2 X_{2it} + \gamma_i + \delta_t + \vartheta_{it} \dots (2)$$

In equation 1, Y_{it} in equation 1 is one of the women’s empowerment variables of respondent i in time t , X_{1it} in equation 2 is the dummy variable representing whether the respondent has a cell phone and \hat{X}_{1it} in equation 1 is the estimated value of X_{1it} from equation 2. As \hat{X}_{1it} represents estimated access to cell phone, I am interested in its coefficient, β_1 . My hypothesis is that access to cell phone will increase my dependent variable, Y_{it} , my women’s empowerment variables. Hence, I expect that $\beta_1 > 0$. Among the other variables, γ_i in equation 1 and 2 presents individual fixed effect, δ_t in equation 1 and 2 is the year fixed effect and ϵ_{it} and ϑ_{it} are error terms for equation 1 and 2, respectively.

Finally, X_{2it} in equation 1 and 2 represents a vector of control variables. The control variables are monthly household expenditure per capita, total household assets, dietary diversity score, electricity bill and number of hours worked. Monthly household expenditure per capita and total assets are important since both are correlated with access to cell phone and women's empowerment indicators (Duflo, 2012). Monthly household expenditure per capita is measured as sum of food and non-food expenditure divided by number of household members and total assets is calculated as sum of value of all the assets owned by the household. Both of these variables are deflated to reflect constant price. I also control for dietary diversity due to its association with women's empowerment (Sraboni and Quisumbing, 2018). Electricity is important control variable since access to electricity may improve women's empowerment (Samad and Zhang, 2019) and it is also correlated to access to cell phone since electricity is required to charge cell phone. Hence, if electricity is not included in the analysis, access to cellphone may capture some of the effects of access to electricity. Since amount of electricity used is also important, I measure it by the electricity bill paid by the household.

VIII. Descriptive Statistics

Table 1 presents descriptive statistics of the variables considered in this paper. Table 1 presents changes in means of the three dependent variables, my main independent variable, the instrumental variable and all the control variables over time. It turns out that changes in all the three variables of group engagement varies. For example, proportion of female respondents participating in any group falls from 28% in 2012 to 24% in 2015 and the difference is statistically significant at 1% level. Considering the number of groups participated, the

difference between the two years is negligible and the difference is not statistically significant. This implies that a larger proportion of women are now participating in more than one groups. Indeed, about 4.4% of female respondents participate in at least two groups in 2015 compared to 0.7% in 2012 and the difference is statistically significant at 1% level. The proportion of female respondents who is playing a leadership role changes moderately from 1.7% in 2012 to 2.3% to 2015 and the difference is statistically significant at 5% level. The percentage of women having access to cell phone increases from 13% in 2012 to 26% in 2015. Finally, the average number of towers in a subdistrict in 2012 was approximately 23 which went up in 2015 to approximately 29 and the difference is statistically significant at 1% level.

[Table 1 here]

Table 1 also presents descriptive statistics of all the control variables. It turns out that changes in all the control variables over time are also statistically significant. For example, the total monthly household expenditure per capita in 2012 was 1,335 Taka which goes up in 2015 to 1,524 Taka. The value of household assets also increases from 28 thousand Taka in 2012 to 31 thousand Taka in 2015 after adjusting for inflation. The dietary diversity score increases from 4.27 in 2012 to 4.56 in 2015. The electricity bill has also gone up significantly from 85.51 Taka in 2012 to 140.06 Taka in 2015. Woman's participation in labor force in terms of number of hours employed in income generating activities goes up from 0.36 hours per day to 1.1 hours per day. Whereas this may seem negligible, it is important to note that most women in rural Bangladesh are housewives and many of the within-household income generating activities are considered as household work which cause considerable

underreporting. Besides, whenever the women engage market-oriented income generating activities, the number of hours employed in such work are low.

IX. Research Findings

The results of the econometric models are presented in this section. I discuss the first stage results in sub-section i. I then present the second stage results in sub-section ii. The results are presented in table 2.

i. First Stage Result: Access to Cell phone and Cell phone Towers expansion

As mentioned above in the estimation strategy section, the dependent variable in the first stage is whether a woman respondent has a cell phone or not. I instrument it using the number of cell phone towers in the sub-district where the respondent resides. The result is

presented in column 1 of table 2. I find that an increase in number of cell phone towers increase the probability of having a cell phone and the coefficient is statistically significant at 1% level. In order to test the strength of my instrument, I check the F statistic and find that it is 10.06, higher than the cut-off of 10 for robust standard errors (Andrews, Stock and Sun (2019)). In addition, I also find that if monthly household expenditure per capita or total asset increases, access to cell phone increases and the coefficients are statistically significant at 1% level.

[Table 2 here]

ii. The Second Stage: Effect of Access to Cell phone on Women's Empowerment

Participation in group activities

The results are presented in columns 2 to 5 in table 2. All the specifications controls for individual fixed effects, year fixed effects and other socio-economic variables. Columns 2 and 3 in table 2 presents results of whether a women respondent participates in group activity or not. In column 2, I first consider the results from the Fixed Effects (FE) Panel Regression. I find that access to cell phone has no effect on participation in group activities. In column 3, I present results from the Fixed Effects Instrumental Variable (IV) estimation. I find that women with access to cell phone has a higher probability of participating in group activities and the coefficient is statistically significant at 1% level.

When I consider number of groups participated, I observe a similar pattern. Column 3 describes the results from the Fixed Effect (FE) Panel Regression. I find that the coefficient of access to cell phone does not have a statistically significant coefficient. The result from FE-IV estimate, as column 4 shows, indicates that as women gets access to cell phone, their

participation in number of groups increases and the coefficient is statistically significant at 1% level.

Column 3 and column 5 also highlights significant role of household expenditures and assets. I find that, controlling for access to cell phone and other socioeconomic factors, increase in monthly per capita household expenditure or household assets lowers women's participation in various groups and the coefficient is statistically significant at a minimum 10% level. There could be two reasons for this. First, women from richer households may not need to participate in group participation since they are already well off. Second, their opportunity cost of participating in groups is higher, making them less interested in group participation. Putting differently, there is a positive correlation between economic outcomes and empowerment (Narayan (2002)), which is reflected in their lower group participation.

Women's role in leadership

Columns 6 and 7 displays the effect of access to cell phone on women's participation as a leader in any group. The Fixed Effect Panel Regression estimate in column 6 indicates that access to cell phone is positively associated with women's participation in leadership roles in a group, and the coefficient is statistically significant at 10% level. However, the positive coefficient may also capture the reverse causation that women who can lead a group are more likely to have access to a cell phone. Column 7 presents the FE-IV estimate where such reverse causation is expected to be absent. I find that access to a cell phone does not affect women's participation in leadership roles in a group. Recognizing that leadership roles require greater empowerment than simple membership in a group, this seems to be a plausible result since three years may not be long enough to bring significant changes in women's empowerment.

X. Conclusion

This paper empirically investigates the effect of access to cell phone on three measures of women's empowerment. In order to identify the effect of cell phone, I instrument cell phone with the number of cell phone towers in the subdistrict and control for a number of socio-economic factors as well as individual-level fixed effects. I find that access to cell phone increases participation in group activities in the community but does not have any significant impact on women's participation in leadership roles in those groups. My findings are consistent with findings in Sub-Saharan Africa (Rotondi et al. 2020) and Bangladesh (Hossain and Samad

(2021)), which present evidence of the effect of cell phone on other dimensions of women's empowerment (women's labor force participation and ability to make decisions independently).

The paper can be taken forward in two directions. First, there are many other dimensions of women's empowerment, and one can investigate the effect of cell phone on those other dimensions. Second, I only look at access to a cell phone and not other associated services that come with it, for example, access to the internet and mobile financial services. These services depend on the quality of the network (e.g., 4G, LTE networks). One can use this qualitative information to instrument further and investigate the effect of access to cell phone as well as access to the internet, and financial and other cell-phone services on other women empowerment indicators.

Appendix

Figure 1: A Framework to link access to cell phone and group engagement.

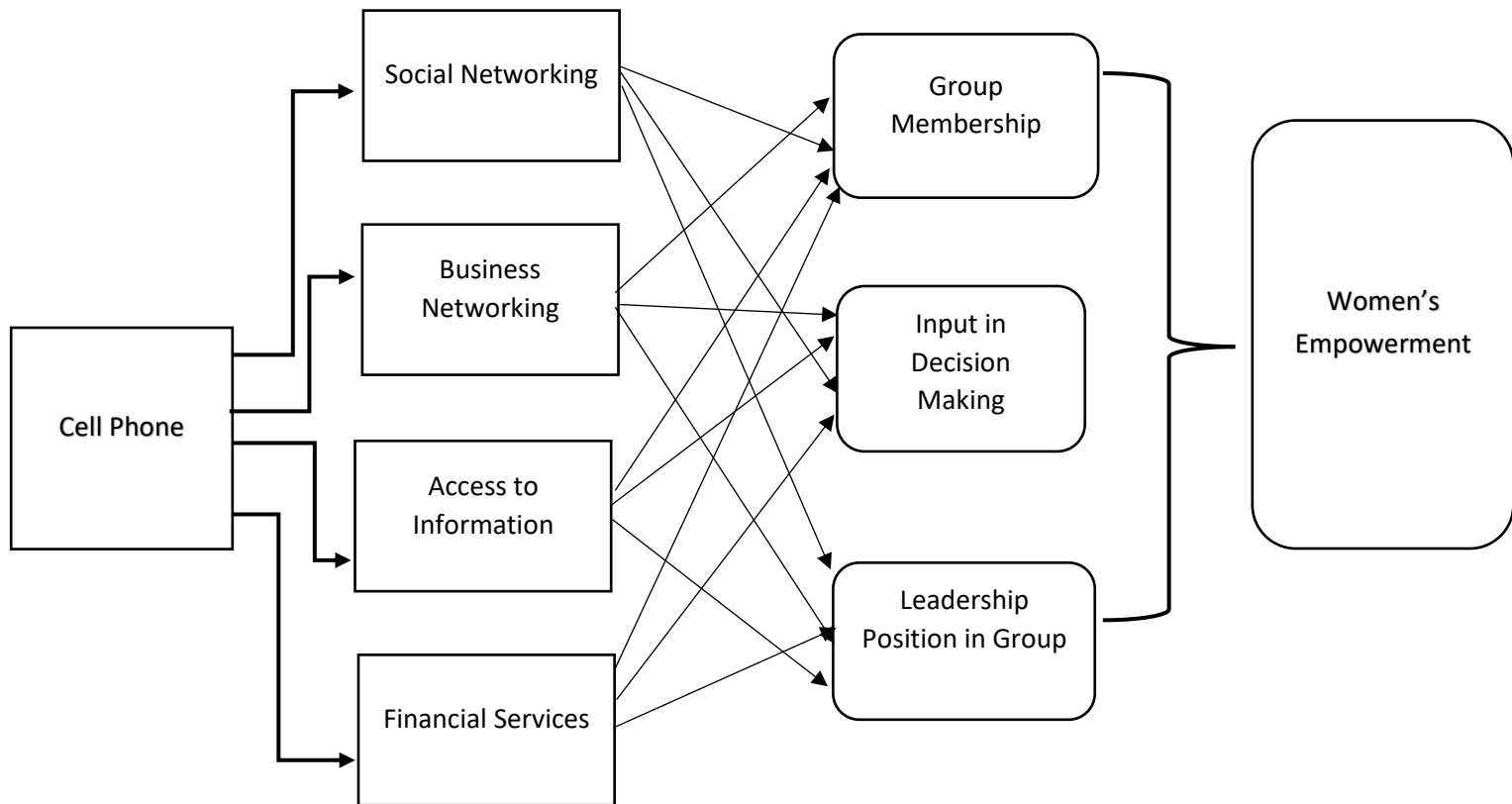
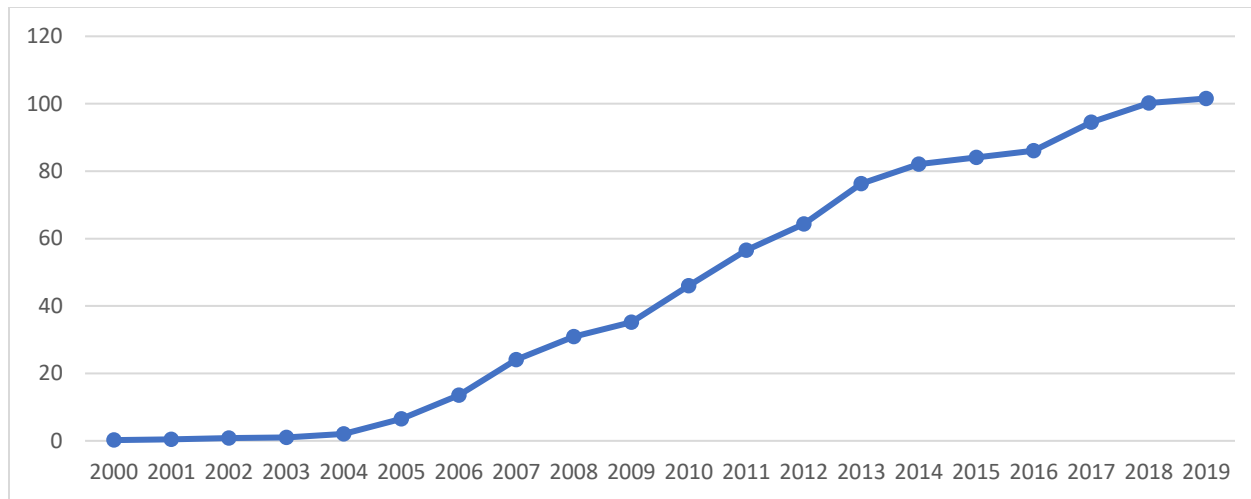


Figure 2: Cell phone subscription in Bangladesh over time



Data: World Bank.

Table 1: Descriptive statistics on the main variables

Year	2012		2015		N	Mean	
Variable	Mean	SD	Mean	SD		Difference	t-statistic
Whether the respondent participated in a group	0.2733	0.4457	0.2408	0.4276	11,454	-0.1072	-12.8002
Number of groups participated	0.2818	0.4697	0.2888	0.5570	11,454	0.1252	17.0038
Whether the respondent played a leadership role	0.0203	0.1493	0.0272	0.1762	11,454	0.1195	13.35
Whether the respondent has a cell phone	0.1383	0.3452	0.2603	0.4389	11,454	0.1221	16.5418
Number of towers in the subdistrict	21.6776	17.4427	27.9389	21.4524	11,454	5.6927	15.5813

Table 2: Descriptive statistics

Year	2012		2015		Mean	
Variable	Mean	SD	Mean	SD	Difference	t-statistic
Whether the respondent participated in a group	0.2832	0.4506	0.2423	0.4285	-0.0410	-4.354
Number of groups participated	0.2901	0.4687	0.2903	0.5572	0.0002	0.0208
Whether the respondent played a leadership role	0.0172	0.1299	0.0233	0.1510	0.0062	2.0506
Whether the respondent has a cell phone	0.1293	0.3355	0.2567	0.4369	0.1274	15.2947
Number of towers in the subdistrict (in Hundreds)	0.2295	0.1799	0.2912	0.2215	0.0617	14.2989
ln (Electricity Bill)	1.0621	3.6645	2.0520	3.7800	0.9899	12.431
Dietary Diversity Score	4.2702	1.1219	4.5262	1.1294	0.2560	10.6325
ln (Monthly Household Expenditure per cap Deflated)	7.0762	0.4724	7.1967	0.4926	0.12	11.6759
ln (Total Assets - Deflated)	9.5214	1.2939	9.7145	1.1768	0.19	7.2992
Total time worked (in Hours)	0.3644	1.4644	1.1055	2.0367	0.7411	19.5316

Note: The number of observations is 8,742 with number of respondents in each round of survey is 4,371.

Table 3: First Stage Regression: Effect of Tower expansion on Cell phone Access

VARIABLES	First Stage	Second Stage					
	Access To	Participated in Groups				Played Leadership	
	Cell FE (1)	FE (2)	FE - IV (3)	FE (4)	FE - IV (5)	FE (6)	FE - IV (7)
Number of Towers in a Subdistrict (in Hundreds)	0.2414*** (0.0761)						
Whether the individual has a cell phone		0.0187 (0.0203)	2.6787*** (0.9145)	0.0290 (0.0239)	2.7368*** (1.0063)	0.0136* (0.0071)	0.1959 (0.1509)
Ln(Electricity Bill + 0.1)	0.0007 (0.0021)	-0.0013 (0.0028)	-0.0036 (0.0062)	-0.0001 (0.0033)	-0.0024 (0.0065)	0.0011 (0.0008)	0.0009 (0.0009)
Dietary Diversity Score	0.0069 (0.0052)	0.0160** (0.0067)	-0.0013 (0.0169)	0.0137* (0.0078)	-0.0039 (0.0179)	0.0017 (0.0023)	0.0005 (0.0027)
Ln(Monthly Household Expenditure-Deflated)	0.0681*** (0.0176)	0.0148 (0.0225)	-0.1818** (0.0848)	0.0401 (0.0262)	-0.1601* (0.0916)	0.0120* (0.0068)	-0.0015 (0.0133)
Ln(Total Assets - Deflated)	0.0220*** (0.0075)	0.0095 (0.0099)	-0.0514* (0.0300)	0.0074 (0.0115)	-0.0546* (0.0318)	-0.0005 (0.0034)	-0.0047 (0.0050)
Total time worked in hours	0.0034 (0.0031)	0.0007 (0.0041)	-0.0076 (0.0096)	0.0028 (0.0047)	-0.0057 (0.0101)	-0.0017 (0.0019)	-0.0023 (0.0020)
Constant	-0.6487*** (0.1310)	0.0183 (0.1711)	1.7249** (0.6995)	-0.1270 (0.1992)	1.6104** (0.7559)	-0.0720 (0.0515)	0.0450 (0.1114)
Observations	8,742	8,742	8,742	8,742	8,742	8,742	8,742
R-squared	0.0806	0.0068		0.0022		0.0038	
Number of wa01	4,371	4,371	4,371	4,371	4,371	4,371	4,371
Individual FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

Note: The dependent variables: Column 1: a dummy variable equals 1 if the respondent has access to cell phone and 0 otherwise. Column 2: a dummy variable equals 1 if the respondent has participated in a group and 0 otherwise. Column 3: Number of groups the respondent has participated. Column 4: a dummy variable equals 1 if the respondent has played leadership role in a group and 0 otherwise. The standard errors are robust. ***, ** and * represents 1%, 5% and 10% degree of statistical significance respectively.

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Syntax

```
/***/ November 22, 2020 ***/  
/***/ This variable is whether a female respondent owns the cell phone or not  
***/  
gen fem_cell = 1 if b1_01==2 & (mid==d1_06_a|mid==d1_06_b|mid==d1_06_c)  
replace fem_cell=0 if b1_01==2 & fem_cell==.  
  
/***/ Generating diff-in-diff variables ***/  
bysort a01: egen treat=sum(fem_cell) /***/ treat can be equals to 0, 1 and 2  
***/  
  
gen treat_year=1 if year==2015  
replace treat_year=0 if year==2012  
  
gen did=treat* treat_year  
gen total_exp = exp( lnpcm_exp_d)  
gen total_asset=exp(lntotasset1_d)  
  
/***/ Income decision variables generated from Alkire et al. (2012) ***/  
gen id_food=1 if wb01_1==1 & wb03_1>=3 & year==2012  
replace id_food=0 if wb01_1==1 & wb03_1<3 & year==2012  
replace id_food=1 if we2_01_1==1 & we2_03_1>=2 & year==2015  
replace id_food=0 if we2_01_1==1 & we2_03_1<2 & year==2015  
replace id_food=. if wb01_1==1 & wb03_1==6 & year==2012  
replace id_food=. if we2_01_1==1 & we2_03_1==4 & year==2015  
  
gen id_cash=1 if wb01_2==1 & wb03_2>=3 & year==2012
```

```

replace id_cash=0 if wb01_2==1 & wb03_2<3 & year==2012
replace id_cash=1 if we2_01_2==1 & we2_03_2>=2 & year==2015
replace id_cash=0 if we2_01_2==1 & we2_03_2<2 & year==2015

gen id_livestock=1 if wb01_3==1 & wb03_3>=3 & year==2012
replace id_livestock=0 if wb01_3==1 & wb03_3<3 & year==2012
replace id_livestock=1 if we2_01_3==1 & we2_03_3>=2 & year==2015
replace id_livestock=0 if we2_01_3==1 & we2_03_3<2 & year==2015

gen id_fish=1 if wb01_6==1 & wb03_6>=3 & year==2012
replace id_fish=0 if wb01_6==1 & wb03_6<3 & year==2012
replace id_fish=1 if we2_01_6==1 & we2_03_6>=2 & year==2015
replace id_fish=0 if we2_01_6==1 & we2_03_6<2 & year==2015

gen id_salary=1 if wb01_5==1 & wb03_5>=3 & year==2012
replace id_salary=0 if wb01_5==1 & wb03_5<3 & year==2012
replace id_salary=1 if we2_01_5==1 & we2_03_5>=2 & year==2015
replace id_salary=0 if we2_01_5==1 & we2_03_5<2 & year==2015

gen id_non_farm=1 if wb01_4==1 & wb03_4>=3 & year==2012
replace id_non_farm=0 if wb01_4==1 & wb03_4<3 & year==2012
replace id_non_farm=1 if we2_01_4==1 & we2_03_4>=2 & year==2015
replace id_non_farm=0 if we2_01_4==1 & we2_03_4<2 & year==2015

egen id_prodl = rowtotal(id_food id_cash id_livestock id_fish id_salary
id_non_farm)
egen id_prodm = rowmean(id_food id_cash id_livestock id_fish id_salary
id_non_farm)

```

/** Decision making in expenditure*/

A What inputs to buy for agricultural production?

B What types of crops to grow for agricultural production?

C When or who would take crops to the market?

D Livestock raising?

E Your own wage or salary employment?

G Minor household expenditures?

gen ag_input = 0 if (wg02_b==1|wg02_b==2) & year==2012

replace ag_input = 1 if (wg02_b==3|wg02_b==4) & year==2012

replace ag_input = 0 if (we5a_02_a==1|we5a_02_a==2) & year==2015

replace ag_input = 1 if (we5a_02_a==3|we5a_02_a==4) & year==2015

gen ag_crop = 0 if (wg02_c==1|wg02_c==2) & year==2012

replace ag_crop = 1 if (wg02_c==3|wg02_c==4) & year==2012

replace ag_crop = 0 if (we5a_02_b==1|we5a_02_b==2) & year==2015

replace ag_crop = 1 if (we5a_02_b==3|we5a_02_b==4) & year==2015

gen market = 0 if (wg02_d==1|wg02_d==2) & year==2012

replace market = 1 if (wg02_d==3|wg02_d==4) & year==2012

replace market = 0 if (we5a_02_c==1|we5a_02_c==2) & year==2015

replace market = 1 if (we5a_02_c==3|we5a_02_c==4) & year==2015

gen ls_rais = 0 if (wg02_e==1|wg02_e==2) & year==2012

replace ls_rais = 1 if (wg02_e==3|wg02_e==4) & year==2012

replace ls_rais = 0 if (we5a_02_d==1|we5a_02_d==2) & year==2015

replace ls_rais = 1 if (we5a_02_d==3|we5a_02_d==4) & year==2015

gen wage = 0 if (wg02_g==1|wg02_g==2) & year==2012

```

replace wage = 1 if (wg02_g==3|wg02_g==4) & year==2012
replace wage = 0 if (we5a_02_e==1|we5a_02_e==2) & year==2015
replace wage = 1 if (we5a_02_e==3|we5a_02_e==4) & year==2015

gen minor_exp = 0 if (wg02_h==1|wg02_h==2) & year==2012
replace minor_exp = 1 if (wg02_h==3|wg02_h==4) & year==2012
replace minor_exp = 0 if (we5a_02_g==1|we5a_02_g==2) & year==2015
replace minor_exp = 1 if (we5a_02_g==3|we5a_02_g==4) & year==2015

egen personal_dec = rowtotal(ag_input ag_crop market ls_rais wage minor_exp)

gen ag_input1 = ag_input if year==2012 & wg01_b~=98
replace ag_input1 = 1 if year==2012 & wg01_b==2
replace ag_input1 = ag_input if year==2015 & we5a_01a_a~=98
replace ag_input1 = 1 if year==2015 & we5a_02_a==. & we5a_01a_a~=98

gen ag_crop1 = ag_crop if year==2012 & wg01_c~=98
replace ag_crop1 = 1 if year==2012 & wg01_c==2
replace ag_crop1 = ag_crop if year==2015 & we5a_01a_b~=98
replace ag_crop1 = 1 if year==2015 & we5a_02_b==. & we5a_01a_b~=98

gen market1 = market if year==2012 & wg01_d~=98
replace market1 = 1 if year==2012 & wg01_d==2
replace market1 = market if year==2015 & we5a_01a_c~=98
replace market1 = 1 if year==2015 & we5a_02_c==. & we5a_01a_c~=98

gen ls_rais1 = ls_rais if year==2012 & wg01_e~=98
replace ls_rais1 = 1 if year==2012 & wg01_e==2
replace ls_rais1 = ls_rais if year==2015 & we5a_01a_d~=98

```

```

replace ls_raisl = 1 if year==2015 & we5a_02_d==. & we5a_01a_d~=98

gen wage1 = wage if year==2012 & wg01_g~=98
replace wage1 = 1 if year==2012 & wg01_g==2
replace wage1 = wage if year==2015 & we5a_01a_e~=98
replace wage1 = 1 if year==2015 & we5a_02_e==. & we5a_01a_e~=98

gen minor_exp1 = minor_exp if year==2012 & wg01_h~=98
replace minor_exp1 = 1 if year==2012 & wg01_h==2
replace minor_exp1 = minor_exp if year==2015 & we5a_01a_g~=98
replace minor_exp1 = 1 if year==2015 & we5a_02_g==. & we5a_01a_g~=98

egen personal_decl1 = rowmean(ag_input1 ag_crop1 market1 ls_raisl wage1
minor_exp1)

gen per=1 if wg01_b==98 & wg01_c==98 & wg01_d==98 & wg01_e==98 & wg01_g ==98
& wg01_h==98

/*** Wage ***/
gen wage_own=1 if wg02_g>1 & wg02_g~=. & year==2012
gen wage_own=0 if wg02_g==1 & year==2012

gen wage_own=1 if wg02_g>1 & wg02_g~=. & year==2012
gen wage_own=0 if wg02_g==1 & year==2012

/*** Leadership in terms of membership in community groups***/
/** Agricultural producers' groups ***/
gen group_a= 1 if e07_a==1 | we4_08a==1
replace group_a= 0 if e07_a==2 | we4_08a==2

```

```

/** Water Users' group */
gen group_b= 1 if e07_b==1 | we4_08b==1
replace group_b= 0 if e07_b==2 | we4_08b==2

/** Forest Users' group */
gen group_c= 1 if e07_c==1 | we4_08c==1
replace group_c= 0 if e07_c==2 | we4_08c==2

/** Water User's group */
gen group_d= 1 if e07_d==1 | we4_08d==1
replace group_d= 0 if e07_d==2 | we4_08d==2

/** Microdredit User's group */
gen group_e= 1 if e07_e==1 | we4_08e==1
replace group_e= 0 if e07_e==2 | we4_08e==2

/** Insurance User's group */
gen group_f= 1 if e07_f==1 | we4_08f==1
replace group_f= 0 if e07_f==2 | we4_08f==2

/** Trade and Business Association group */
gen group_g= 1 if e07_g==1 | we4_08g==1
replace group_g= 0 if e07_g==2 | we4_08g==2

/** Civic group */
gen group_h= 1 if e07_h==1 | we4_08h==1
replace group_h= 0 if e07_h==2 | we4_08h==2

```

```

/** Local Government */
gen group_i= 1 if e07_i==1 | we4_08i==1
replace group_i= 0 if e07_i==2 | we4_08i==2

/** Number of memberships for each person */
egen group=rowtotal(group_a group_b group_c group_d group_e group_f group_g
group_h group_i)

egen group2=rowtotal(group_a group_b group_c group_d group_e group_f group_g
group_h group_i)

gen group_dummy=1 if group2>0 & group2~=.
replace group_dummy=0 if group2==0

/** Leadership */
/** Agricultural producers' leaders */
gen leader_a= 1 if e08_a==1 | we4_09a==1
replace leader_a= 0 if e08_a==2 | we4_09a==2

/** Water Users' leader */
gen leader_b= 1 if e08_b==1 | we4_09b==1
replace leader_b= 0 if e08_b==2 | we4_09b==2

/** Forest Users' leader */
gen leader_c= 1 if e08_c==1 | we4_09c==1
replace leader_c= 0 if e08_c==2 | we4_09c==2

/** Water User's leader */
gen leader_d= 1 if e08_d==1 | we4_09d==1

```

```
replace leader_d= 0 if e08_d==2 | we4_09d==2
```

```
/** Microcredit User's leader **/
```

```
gen leader_e= 1 if e08_e==1 | we4_09e==1
```

```
replace leader_e= 0 if e08_e==2 | we4_09e==2
```

```
/** Insurance User's leader **/
```

```
gen leader_f= 1 if e08_f==1 | we4_09f==1
```

```
replace leader_f= 0 if e08_f==2 | we4_09f==2
```

```
/** Trade and Business Association leader **/
```

```
gen leader_g= 1 if e08_g==1 | we4_09g==1
```

```
replace leader_g= 0 if e08_g==2 | we4_09g==2
```

```
/** Civic leader **/
```

```
gen leader_h= 1 if e08_h==1 | we4_09h==1
```

```
replace leader_h= 0 if e08_h==2 | we4_09h==2
```

```
/** Local Government **/
```

```
gen leader_i= 1 if e08_i==1 | we4_09i==1
```

```
replace leader_i= 0 if e08_i==2 | we4_09i==2
```

```
/** Generating leadership indicator ***/
```

```
egen leader=rowtotal(leader_a leader_b leader_c leader_d leader_e leader_f  
leader_g leader_h leader_i)
```

```
* Rescaling variables */
```

```
gen tower_hund_hund = tower/100
```

```
gen lfp_hour = lfp_mins/60
```

```
xtset wa01
```

```
xtreg fem_cell tower_hund y2015 lectric1 pr_dietscore9 lnpcm_exp_d  
lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (tower_hund  
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)  
addtext(Individual FE, YES, Year FE, YES)
```

```
xtreg group_dummy fem_cell y2015 lectric1 pr_dietscore9 lnpcm_exp_d  
lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell  
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)  
addtext(Individual FE, YES, Year FE, YES)
```

```
xtivreg group_dummy (fem_cell = tower_hund) y2015 lectric1 pr_dietscore9  
lnpcm_exp_d lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell  
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)  
addtext(Individual FE, YES, Year FE, YES)
```

```
xtreg group2 fem_cell y2015 lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d  
lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)
addtext(Individual FE, YES, Year FE, YES)
```

```
xtivreg group2 (fem_cell = tower_hund) y2015 lectric1 pr_dietscore9
lnpcm_exp_d lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)
addtext(Individual FE, YES, Year FE, YES)
```

```
xtreg leader fem_cell y2015 lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d
lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)
addtext(Individual FE, YES, Year FE, YES)
```

```
xtivreg leader (fem_cell = tower_hund) y2015 lectric1 pr_dietscore9
lnpcm_exp_d lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)
addtext(Individual FE, YES, Year FE, YES)
```

```
xtreg leader_dummy fem_cell y2015 lectric1 pr_dietscore9 lnpcm_exp_d
lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell  
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)  
addtext(Individual FE, YES, Year FE, YES)
```

```
xtivreg leader_dummy (fem_cell = tower_hund) y2015 lectric1 pr_dietscore9  
lnpcm_exp_d lntotasset1_d lfp_hour if bal_pan_al==2, fe vce(robust)
```

```
outreg2 using group_8JJUL21.xls, dec(4) stats (coef se) keep (fem_cell  
lectric1 pr_dietscore9 lnpcm_exp_d lntotasset1_d lfp_hour)  
addtext(Individual FE, YES, Year FE, YES)
```