HEDG Working Paper 10/08

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June 2010

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Abstract

In this paper we focus on the inequalities in utilization of maternal care and the associations between a macroeconomic policy and the use of maternal health care services in Bangladesh. We use four waves of a repeated cross-section dataset: the Bangladesh Demographic and Health Survey 1997, 2000, 2004 and 2007. We specify the utilization of maternal health care services as a set of three binary variables representing utilization of antenatal care, skilled attendance at birth and giving birth in a health facility. Although the use of maternal care services increased over time, less than one-quarter of mothers used a skilled attendant or gave birth in a health facility in the most recent period. We find that the circumstance factors of respondents, for example, their religion, location, education and household asset had significant associations with their choice of utilization. We observe that horizontal inequity in utilization decreased over time; yet, inequalities in the utilization of maternal care remained large in the most recent period. In addition to these issues, we assess the impacts of the Rights-Based Comprehensive Maternal Care Policy which was implemented in 2001, in response to the Millennium Development Goals in the health sector. We measure the impacts of the policy using the simple difference-in-differences method and inequality indices based difference-in-weighted-differences method. Both approaches find that the policy was effective in promoting utilization of maternal health care services in rural Bangladesh. We find that, in a developing country like Bangladesh, a well-designed health policy that is focused on key circumstance factors of the target group that they cannot control for can increase the use of health care greatly.

Keywords: Difference-in-differences; Prenatal care; Horizontal inequity; Difference-in-weighted-differences

Acknowledgement: I am extremely grateful to Andrew Jones and Nigel Rice for their detailed reading and extensive comments.

1. Introduction

The aim of this paper is to address the inequalities in utilization of maternal health care services and to assess the impacts of a macroeconomic policy, the Rights-Based Comprehensive National Maternal Health Care Policy, on the utilization of maternal health care services in Bangladesh. It is particularly important to assessing the utilization of maternal care because of its significance in determining the health of mothers and children. The published literature advocates that use of prenatal care and delivery care can substantially improve the health of mothers and children (Holian J, 1989; Paul, 1991; P Gertler et al., 1993; Howlader et al., 1999; T Adam et al., 2005). This is one of the areas requiring greater attention in Bangladesh as several studies observe that the state of maternal and child health is severely depressing. For example, among mothers prevalence of malnutrition, inferior Body Mass Index (BMI) during pregnancy and after delivery, night blindness and iron deficiency, etc. are common problems (BDHS, 2007). Furthermore, lifetime risk of dying from pregnancy and birth-related causes, neonatal and under-five mortality rates, and death rates and DALY rates due to maternal and child-cluster diseases are high and major areas of concern (NIPORT, 2004; WHO, 2006; BBS, 2009). There are obviously many reasons behind this poor state of health, and one of the most important factors is that the levels of utilization of maternal health care services are extremely low. To be more specific, more than one-third of mothers do not have accesses to antenatal care services and three-fifths of them do not have access to a skilled attendant at birth (BBS, 2009). The percentage of births attended by a skilled health professional is the second lowest among the countries of South Asia (WHO, 2008). Although there are several supply and demand-side initiatives provided by the Government and non-government organizations and donors, utilization of maternal care services remains well below the desired level, as does the health status of mothers and children.

This continued reliance on traditional practices during pregnancies in Bangladesh suggests that supply-side and circumstance factors have a strong influence on the use of maternal health care services. An understanding of how these factors affect the choice of use of maternal care services provides an opportunity to identify potential areas for health care intervention. This understanding is also important in implementing such interventions on a wider scale. In this

study, we therefore, attempt to assess the factors affecting the choice of utilization and explain the association between the policy and utilization of maternal care services.

In particular, we consider three comprehensive categories of maternal care services, namely, prenatal care, skilled attendance at birth, and giving birth in a health facility. Utilization of these services may have associations with factors such as distance from health facilities, presence of health care services in the community and distance from the nearest skilled attendant. Studies find that limited availability of health care is a key factor for lower utilization of maternal and child care services and consequently a higher maternal and child mortality ((Heaton and Forste, 2003; Lalou and LeGrand, 1997). Several studies find that, in addition to the availability of health care, socioeconomic factors, such as education of a respondent and her husband, religion, location, wealth, etc., also greatly influence maternal care utilization (Navaneetham and Dharmalingam, 2002; Anastasia J., 2007; Say L and Raine R, 2007). In the light of the published literature, we perform a regression analysis to describe the associations of use of maternal care services with these determinants. We then measure the global impact of these factors on inequality in utilization using horizontal inequity indices. Following that we select the Rights-Based Comprehensive Maternal Health Care Policy which is designed to influence the use of maternal care services by mothers in rural areas. The reason for selecting this policy is to test a hypothesis that a policy focused on key circumstance factors is effective in increasing utilization. We use the difference-in-differences method to assess the association between the policy and utilization by target mothers. While the selected policy greatly prioritized the utilization of maternal care services by mothers in rural areas, it might have distributional consequences over and above its average impacts. We, therefore, assess the impact of the policy using the difference-in-weighted-differences method, which creates a link between average outcomes and distributional consequences.

It is worth mentioning that in the context of the policy under scrutiny, the difference-in-differences and difference-in-weighted-differences estimators are likely to suffer from biases because of the non-random, broad nature and other effects of the interventions. We, therefore, interpret the findings of the evaluation as an association between the policy and level of utilization by mothers, instead of interpreting them as rigorous causal impacts.

The broad health policy we consider in this study is the Rights-Based Comprehensive Maternal Care Policy in Bangladesh. This policy was a national initiative officially launched in 2001. The policy prioritized the utilization of maternal care by mothers in rural areas. The focus of the policy was to help attain the Millennium Development Goals regarding maternal and child health by providing high quality and accessible maternal care, especially in rural areas where utilization of maternal care was extremely low. This policy was first included in the Health and Population Sector Program (HPSP, 1998-2003), followed by the Health, Population and Nutrition Sector Program (HPNSP, 2003-2011).

This paper is organized as follows. The regression models used to describe the inequality in utilization and the use of difference-in-differences to assess the broad health policies are described in Section 2. Section 3 describes the data, variables and macroeconomic health policy selected for this study. Section 4 presents the results of descriptive analysis of the utilization of maternal care services in Bangladesh. Section 5 is devoted to the effects of the policy studied. Section 6 contains the summary and concluding remarks.

2. Econometric Models

2.1 Descriptive Analysis

We specify the utilization of maternal care as a set of three binary variables representing the utilization of prenatal care, whether there was a skilled attendant at birth and whether the birth took place in a health facility. We begin by describing inequalities in accessing care through the use of concentration curves. A concentration curve can give a complete picture of variation in utilization across the full distribution of a rank variable (Kakwani et al., 1997). We use the asset index factor scores to rank the respondents from the poorest to the richest. Several studies use an asset index or other measures to rank respondents when income or expenditure data are not available (Montgomery et al., 2000; Wagstaff and Watanabe, 2003).

2.2 Regression Analysis

We apply regression techniques to investigate the potential determinants of utilization. These models should include both supply-side (S) and socioeconomic factors in the set of regressors.

The problem is that only the BDHS 2004 wave contains information on the supply-side factors. All four waves have information on the socio-economic factors of mothers, including circumstance factors (X). We treat the vector of socio-economic factors as the vector of circumstance factors for the mothers, as in the socio-economic setting in Bangladesh those factors, for example religion, location, wealth and education, are largely beyond their control.

As the BDHS 2004 wave gives an opportunity to include both supply-side and circumstance factors in the set of regressors we start the regression analysis using that wave:

$$M^j = \alpha + \beta X + \delta S + \varepsilon \quad (1)$$

Where, j indicates the type of maternal care services and β and δ are the gradient vectors. Since we specify the utilization variables as binary, we choose the Logistic functional form for M( ) to constrain the estimated probabilities to lie in the (0,1) range. We use a latent variable M^{j*}, probability of use maternal health care services of type j, as a linear function of the observable and unobservable factors:

$$M^{j*} = \alpha + \beta X + \delta S + e \quad (2)$$

We then use the logistic distribution of the error term to estimate the coefficients.

In addition to whether a mother visited a health facility, information on the number of prenatal visits during their last pregnancy is available in the BDHS 2004. This offers us opportunities to apply relevant regressions for count data such as negative binomial regression (NegBin) and truncated NegBin, to assess the importance of circumstance factors conditional on supply-side factors (See Jones, 2000; Wooldridge, 2002 for details of logistic and count data regressions).

We apply regression models that deal with the count dependent variables, and use the NegBin II and Truncated NegBin II models (for more details of NegBin II and Truncated NegBin II, see Cameron and Trivedi, 1986; Pohlmeier and Ulrich, 1995). The count data model is the Poisson model where the dependent variable M_i^{av} is assumed to follow a Poisson distribution, with mean λ_i , which is a function of covariates x_i that include both supply-side and circumstance factors. Then the model is obtained by

$$P(M_i^{av}) = \frac{e^{-\lambda_i}\lambda_i^{M_i^{av}}}{M_i^{av}!} \quad (3)$$

Here λ_i is the conditional mean which is usually defined as

$$\lambda_i = E[M_i^{av}|x_i] = \exp(x_i\beta) \quad (4)$$

Cameron and Trivedi (1998) point out that the Poisson model fails to account for the unobserved heterogeneity in the data. Following Cameron and Trivedi, we therefore model heterogeneity as a Poisson mixture:

$$\exp(x_i\beta + \mu_i) = [\exp(x_i\beta]\,\eta_i \quad with \;\; E[\eta_i] = 1 \quad (5)$$

Here the η_i is gamma distributed.

The associated probability of observing the count M_i^{av} in our case is:

$$P(M_i^{av}) = \left\{\frac{\Gamma\,(M_i^{av} + \psi_i)}{\Gamma\,(\psi_i)\,\Gamma\,(M_i^{av} + 1)}\right\}\left(\frac{\psi_i}{\lambda_i + \psi_i)^{\psi_i}}\right)\left(\frac{\lambda_i}{\lambda_i + \psi_i)^{M_i^{av}}}\right) \quad (6)$$

Where $\Gamma\,(.)$is the gamma function. In our analysis we consider $\psi = (\frac{1}{\alpha})\lambda^k$ where k=0 to get the NegBin 2 (NB2) model where the variance is a quadratic function of the mean.

Following NB2 regression we apply truncated NB2 regression assuming that the count measure of antenatal care utilization is a result of two different decision processes: the decision to take care and the decision to take number of visits. We estimate the first part using a logit model and then apply NB2 over the observations with positive antenatal visits.

Apart from BDHS 2004, other waves of data do not have information on supply-side variables (S). For these waves, we therefore use only circumstance factors (X) in the regression models.

$$M^{j*} = \alpha + \beta X + e \quad (7)$$

2.3 Horizontal Inequity in the Provision of Maternal Care

The regression analysis provides an indication of the potential sources of inequality in utilization, whereas the concentration index can be used to calculate horizontal inequity in the utilization of maternal care that can estimate the global impact of all these variables on the inequality in utilization. In health care, the horizontal equity principle is described as “equal care for equal need irrespective of other characteristics such as income, race, religion, location, education, etc." (Wagstaff and van Doorslaer, 2000). If health care need variables are available, it is possible to calculate the horizontal inequity in health care using the standardization of concentration index.

However, the concept of need is illusive and has many dimensions (Culyer, 1995). Many researchers use demographic and morbidity variables to proxy need. In our study need variables are not that important as we use the samples of women who gave birth within the three years preceding the survey. We proceed from the right-based perspective that for each pregnant mother the need for maternal care is equal regardless of her other characteristics. The unstandardized concentration indices, therefore, are assumed to adequately measure horizontal inequity in maternal care. We predict the horizontal inequity index for each type of maternal care considered from this perspective.

We compute the horizontal inequity indices using the cumul test regression approach:

$$2\hat{\sigma}_r^2\left(\frac{M}{\mu}\right) = \hat{\beta}_0 + \hat{\beta}_r r + e \qquad (8)$$

here, M^j, r, σ^2_r are the utilization variable, fractional rank variable and variance of the fractional rank respectively and μ is the mean utilization. The estimated coefficient of rank variable is the horizontal inequity index in our case.

As a measure of sensitivity analysis, we also calculate the standardized concentration indices for two types of maternal care: utilization of skilled attendance at birth and use of health facilities when giving birth. For these we use height-for-age of respondents and major complications at birth such as prolonged labour, excessive bleeding, high fever, convulsions, and problems in hands and feet, to standardize for need.

2.4 Impact of the Macroeconomic Policy

We also aim to describe the association of the Rights-Based Comprehensive Maternal Health Care Policy with the utilization of maternal health care services. The policy prioritized the utilization of maternal care by mothers in rural areas.

We apply the difference-in-differences method in order to assess the association of the policy with utilization of services. A number of studies in economics and health economics use the difference-in-differences analysis to evaluate the impact of programs (Ashenfelter, 1978; Heckman and Rob, 1985; Card, 1990; Card and Krueger, 1994; Jones, 2009). To perform the difference-in-differences analysis, we differentiate the respondents between the target and

control groups based on the weight placed on them in the policy considered. The target and comparison respondents were not randomized in our chosen policy. We indicate the choice of maternal care utilization as M. We face the typical evaluation problem as expressed by Rubin (1974) that a respondent cannot be observed to be under the treatment and under the control at the same time. The problem is even greater as particular respondents are not observed in both periods. Another problem is that despite the policy initiatives, many treatment mothers may not use maternal care services due to a range of socioeconomic reasons. To deal with the above constraints, we apply the difference-in-differences analysis using repeated cross-section datasets.

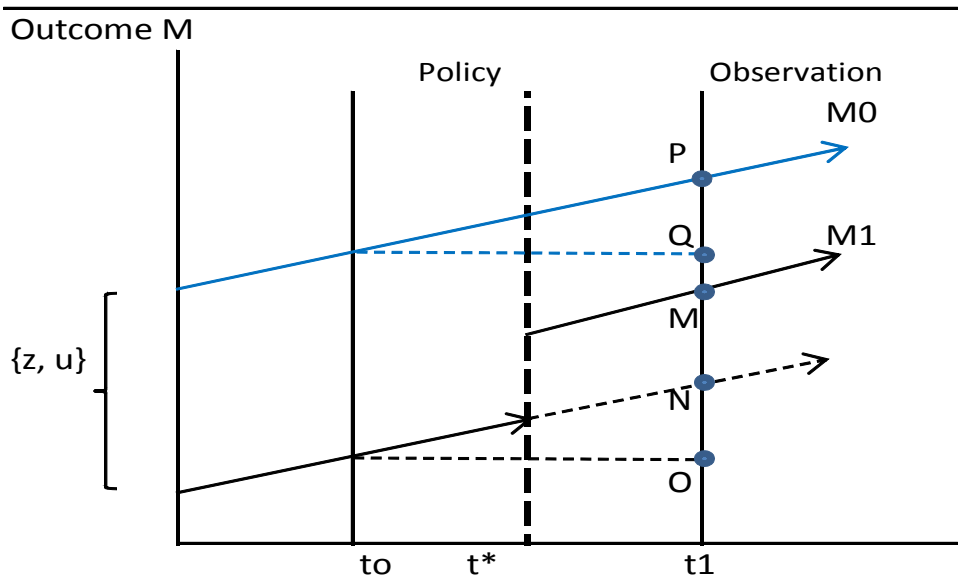


Figure 1: A simple example of potential outcomes
[Group difference favouring control]

Figure 1 plots the potential average outcomes for the treated (M^1) and control (M^0) respondents plotted against time by assuming a common linear trend over time. The policy is applied at the time t* and t_0 and t_1 denote the pre-policy and post-policy periods respectively. There is a potential outcome gap between the groups due to observed and unobserved factors prior to the policy. A simple comparison of the mean outcomes for the treated and controlled respondents using a cross-section dataset at time t_1 will underestimate the true treatment effect due to the selection bias. On the other hand, a 'before and after' comparison using repeated cross section datasets for only the treated respondents will overestimate the true treatment effect by the vertical distance ON.

The difference-in-differences analysis in this case, can overcome the selection biases resulting from a 'before and after' comparison within a group and a simple comparison between the groups. Graphically this estimates the treatment effect by taking the difference between the change over time for the treated (MO) and the difference over time for the control (PQ=NO). In the presence of a parallel trend between the groups, the resulting difference-in-differences, MN (=MO-PQ=MO-NO) is the true treatment effect of the policy (Jones and Rice, 2009).

More formally, the treatment effect is

$$\tau = E[M^1 - M^0|R = 1] - E[M^1 - M^0|R = 0] \quad (9)$$

We use repeated cross-section datasets to obtain data for the post-policy (t_1) and pre-policy (t_0) periods on treated (R_1) and control (R_0) groups. Assuming the additive structure of the model and no correlation of the error term with other variables, expected outcomes are:

$$E[M|t_0, R_0] = \alpha \quad (10)$$

$$E[M|t_0, R_1] = \alpha + \gamma \quad (11)$$

$$E[M|t_1, R_0] = \alpha + \beta \quad (12)$$

$$E[M|t_1, R_1] = \alpha + \gamma + \beta + \tau \quad (13)$$

Here γ, β, and τ stand for the group difference, common time trend and treatment effect respectively. Then the difference-in-differences estimator is:

$$E[M^1 - M^0|R_1] - E[M^1 - M^0|R_0] = \{[\alpha + \gamma + \beta + \tau] - [\alpha + \gamma]\} - \{[\alpha + \beta] - \alpha\} = \boldsymbol{\tau} \quad (14)$$

We estimate the difference-in-differences estimator, $\hat{\tau}$, using the Ordinary Least Square (OLS) approach:

$$M_i = \alpha + \beta t_i + \gamma R_i + \tau W_i + e_i \quad (15)$$

Where W_i is the interaction term between the group indicator R_i and the time indicator t_i.

2.5. Distributional Impact of the Macroeconomic Policy

One downside of the difference-in-differences analysis is that it fails to account for the distributional impact of the policy. One way to address the distributional impact of a policy

intervention is to calculate the horizontal inequity in utilization for the given groups and periods. Then a differential-in-total-differentials estimator can be computed using the horizontal inequity indices. This approach is an extension of the total-differential approach which is proposed by Wagstaff, van Doorslaer and Watanabe (2003). Horizontal inequity in delivery given the group and period can be computed as follows:

$$2\sigma_r^2\left(\frac{M}{\mu}\right)|R,t = \beta_0 + \beta_1 r + \varepsilon|R,t \qquad (16)$$

Sample analog of the above equation is:

$$2\hat{\sigma}_r^2\left(\frac{M}{\mu}\right)\big|R,t = \hat{\beta}_0 + \hat{\beta}_1 r + e\big|R,t \qquad (17)$$

The estimated coefficient of rank variable, $\hat{\beta}_1$, is the horizontal inequity index given R_i and t_i. If the horizontal inequity indices are significantly different from zero, the simple differential-in-total-differentials estimator can describe the changes in distribution after the policy.

2.6. The Link between the Average Utilization and the Distribution of Utilization

It is important to create a link between the average outcome and distributional impact because of the failure of OLS based difference-in-differences and the inequality indices based simple difference-in-differences to account for the average and distributional impacts together. This can be done by calculating the difference-in-weighted-differences estimator. To calculate the estimator, firstly the difference in average utilization by groups for a given period is adjusted for the inequality indices, the proportion of groups and the mean of utilization of that period. This is the weighted-difference estimator which is calculated for both pre-policy and post-policy periods. We then calculate the difference between these weighted-difference estimators to estimate the difference-in-weighted-differences estimator. The difference-in-weighted-differences estimator can address the impact of the policy, linking both the average gain and distributional consequences of the policy. The conventional approach that uses health pseudo-Gini indices to adjust for the inequalities (LeFrance et al., 2005) can be used to calculate the weighted-difference estimator between the treatment and control for a given period:

$$[G_i^*|t_i] = 1/\mu \sum\sum \mathrm{f_{R1}} * \mathrm{f_{Ro}}\,[\mu_{R=1}(1 - G_{R=1}) - \mu_{R=0}(1 - G_{R=0})]\ \ |t_i\,; i = 0,1 \qquad (18)$$

Where μ denotes the mean of utilization, f denotes the proportion of the group in total sample and G is the pseudo-Gini coefficient. In the literature this is defined as the opportunity index, which, in our case, is the weighted-difference in utilization between two groups in a particular period. The difference in utilization is weighted by the average utilization, proportion of the groups and inequality indices. Following this approach, the weighted-difference estimators can be derived for the pre-policy and post-policy periods. The difference-in-differences estimator τ_{G*} can then be derived using a 'before and after' comparison, by taking the difference between the weighted-difference estimator in the post-policy period (G_1^*) and the weighted-difference estimator in the pre-policy period (G_0^*):

$$\tau_{G*} = \Delta G_i^* = G_1^* - G_0^* \tag{19}$$

The estimated $\hat{\tau}_{G*}$ is the sample Gini-inequality adjusted treatment effect.

Sample HI adjusted treatment effect can be derived by replacing the pseudo-Gini index in Equation (18) by the horizontal inequity index and then applying a 'before and after' comparison:

$$[HI_i^*|t_i] = [1/\mu \sum\sum \mathrm{f_{R1}} * \mathrm{f_{Ro}} [\mu_{C=1}(1 - HI_{R=1}) - \mu_{R=0}(1 - HI_{R=0})] \ |t_i ; i = 0, 1 \tag{20}$$

$$\tau_{HI*} = \Delta HI_i^* = HI_1^* - HI_0^* \tag{21}$$

In our case a negative weighted-difference estimator implies that lower utilization is concentrated in the rural areas after adjusting for the distributional impacts and vice versa. On the other hand, a positve difference-in-weighted-differences estimator implies that due to policy interventions, utilization of that particulur maternal care service increased in the target area.

3. Data, Variables and Policy

3.1 Bangladesh Demographic and Health Survey (BDHS)

We use data from the Bangladesh Demographic and Health Surveys (BDHS). BDHS's have been an important source of individual and household-level health and health care data since 1993. We use four waves of BDHS datasets, namely, BDHS 1997, BDHS 2000, BDHS2004 and BDHS 2007. Each dataset is nationally representative with a sample size of around 10,000 households. From those households, we selected the mothers who had given birth within the 3

years preceding a survey. The BDHS's are organized by the MEASURE DHS, which has been using a well designed recode file since the very beginning of the DHS to maintain consistency and comparability across the surveys. Information about the data, indicators, quality, etc. can be accessed at http//:www.measuredhs.com.

3.2 Variables: Utilization of Maternal Health Care Services, Socioeconomic Factors, and Supply-Side Factors

It is worth recalling that we analyze three categories of maternal care services: antenatal care, skilled attendance at birth, and giving birth in a health facility. Use of maternal care services is mainly measured by a set of three binary variables indicating whether respondents make use of these services or not. In addition, use of maternal care services is measured by the number of antenatal visits in a number of regression models. We limit the analysis to births within three years of the survey to maintain consistency between the dependent variables and regressors and to minimize the effects of time.

The circumstances of the mothers are a major factor explaining maternal care utilization. Variables such as the religion of the head of the household, education level of the respondent, education and occupation of her husband, location and wealth of the household and administrative region are, therefore, included in this study. A Muslim mother is less likely to use maternal care services due to religious misconceptions (SO Gyimah, BK Takyi and I Addai, 2006). Many religious leaders in rural areas believe that a Muslim woman is not allowed to be seen by a male other than her husband, father and close relatives. Due to this misconception many Muslim households do not seek maternal care services for their household members who are pregnant. Religion is used as a binary variable indicating whether a respondent was Muslim or not, keeping a Muslim mother as the reference. Use of maternal care services also has strong associations with the education level of the respondent, and the education of her husband (S Pallikadavath, M Foss and RW Stones, 2004). We measure the education of a respondent using her years of education. Education of their husband is described by four variables. The first group includes those who have had no education, and constitutes the reference group. The other three groups include those husbands who attended primary, secondary and higher level of education respectively. Location is also a major factor influencing the use of maternal care (C Ronsmans et

al., 2003). We specify the location as a binary variable where 1 stands for a rural area and 0 stands for an urban area. Use of maternal care depends highly on household income, due to several direct and indirect costs of seeking care (M Wirth et al., 2006). Unfortunately, no information on the income or expenditure of the households is available in the datasets. However, the datasets include rich information about the assets, and asset index factor scores of each household. Therefore, the study uses asset index scores, instead of income or expenditure data, to measure the socioeconomic position of households. In terms of asset index scores, households are categorized as: the very poor, poor, middle, rich and very rich. Occupation of a husband is classified as a binary variable where 1 represents a skilled/semi-skilled worker and 0 corresponds to an unskilled/agricultural worker. Regions are also included in our regression models. Dhaka division is the reference division for five other divisions: Rajshahi, Khulna, Barisal, Chittagong and Sylhet.

The BDHS 2004 wave used the Service Availability Questionnaire to collect information about important services in each selected cluster and distance to the nearest services. We use following supply-side variables for the regressions using only the 2004 wave:

S {SSV1: Hours to reach nearest second/upper level provider (public) ; SSV2: Hours to reach first level provider with inpatient service (public); SSV3: Hours to reach private clinic/ hospitals; SSV4: Presence of primary care services (Satellite Clinic/ Community Clinic etc.); SSV5: Healthcare coverage by NGOs; and SSV6: Distance to nearest MBBS/Allopathic Doctors (km.)}

3.3 Policy and Groups for the Difference-in-Differences Analysis

We target one national policy, which focused on the location of the pregnant mothers. In 2001 Bangladesh adopted the Rights-Based Comprehensive National Maternal Health Care Policy, which gave greater importance to the health of mothers living in rural areas. Under this policy, the government has given greater emphasis to providing training for health care providers, more health care centres nearer rural areas, and responsiveness of services. In addition to government initiatives, many bilateral and multilateral organizations and NGOs started placing more importance on rural areas from 2000 onwards to achieve the MDG goals (Nasreen H et al. 2007).

We use repeated cross section datasets to identify treatment and control mothers. Assignment to treatment and comparison groups are associated with the weights given in the policy. We select the respondents after 2001 for the post-treatment period (t1) and the respondents before 2001 for the pre-treatment period (t0). Mothers from those households living in rural areas in the first period are eligible for treatment before the policy and those living in rural areas in the second period are eligible for treatment after the policy. We select mothers from urban areas to constitute the comparison group before and after the policy.

4. Inequality in the Utilization of Maternal Care

4.1 Descriptive Analysis

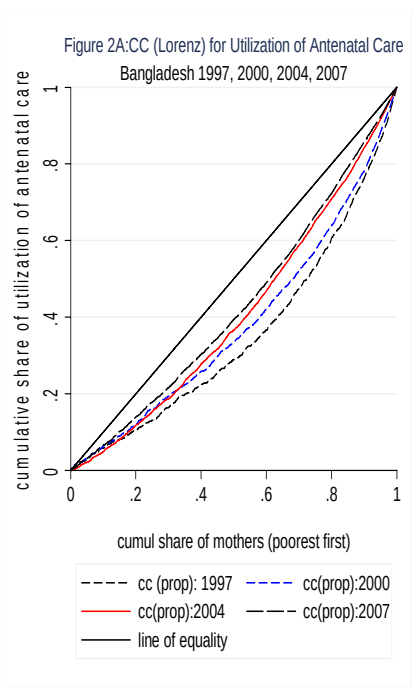
Table 1 gives an overview of the use of maternal health care services in Bangladesh. About one-third of mothers received some kind of prenatal care between 1995 and 1997. The proportion of mothers who received prenatal services increased to approximately two-thirds of the total between 2005 and 2007. Of mothers who gave birth in the three years preceding the survey in 1997, close to 9% received assistance from skilled personnel and only 6% gave birth in health facilities. The proportion of mothers receiving skilled attendance at birth and delivering babies at health facilities increased by almost 300% between 1997 and 2007. However, the proportion of mothers receiving those maternal care services was still very low in 2007. Close to three-quarters of mothers did not use any skilled care during birth and four-fifths of the mothers delivered at home.

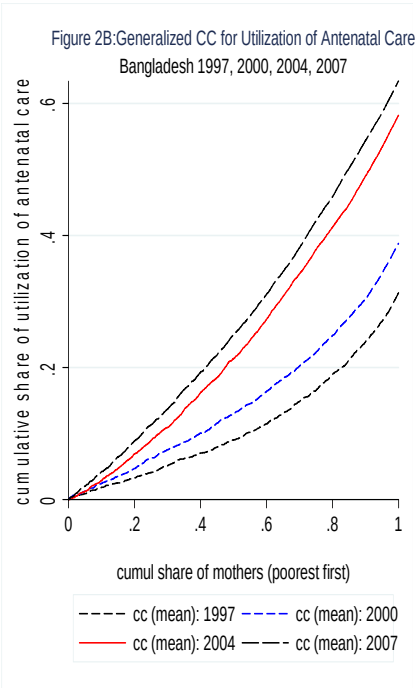
Table 1: Summary of Utilization of Maternal Care
Bangladesh 1997, 2000, 2004, 2007

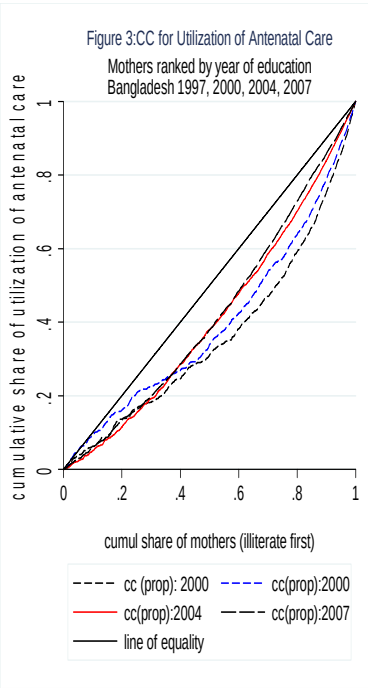
	2007	2004	2000	1997
Antenatal care	64.82	60.18	42.01	31.92
Skilled attendance at birth	23.65	17.48	14.75	8.87
Giving birth in a health facility	20.21	13.62	11.07	5.6

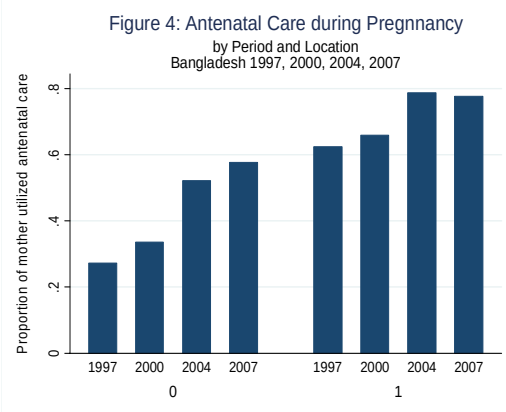
Figure 2-5 displays bivariate associations of the use of prenatal care services with assets, education and location. In Figure 2, we rank the samples of interest by wealth index factor scores. The horizontal axis begins with the poorest mother in terms of household assets and progresses through the asset distribution to the richest mother. We then plot the cumulative proportion of utilization in the vertical axis against the relative asset rank. The 45^0 line represents

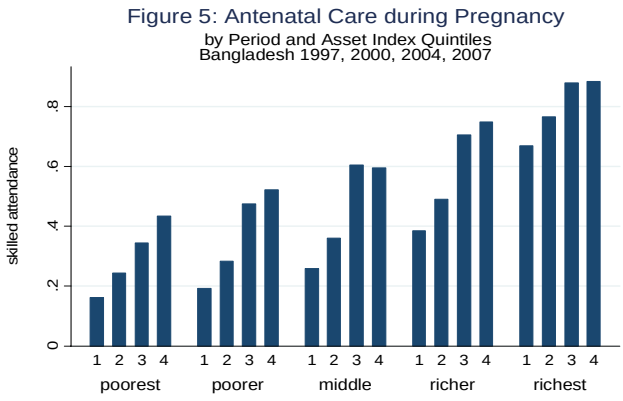
the line of perfect equality. The convex shapes of the concentration curves and generalized concentration curves clearly reveal that there was pro-rich inequality in utilization of prenatal care services in each wave. We apply dominance tests between concentration curve of utilization and line of equality for each survey year, which confirms the existence of pro-rich inequality in the utilization of prenatal care services. We find that both the multiple comparison approach (mca) and intersection union principle (iup) of dominance test that are proposed by Dardanoni and Forcina (1999) confirm that the line of equality dominates the concentration curve at 5% significance level at each wave of the survey.











We draw the concentration curves in Figure 3 in the same way, except that we rank the mothers using years of education in place of asset index scores. The convex shapes of the concentration curves show that educated mothers enjoyed the major share of prenatal services in each wave. The bar diagram in Figure 4 reveals that location was a key source of discrimination even in the most recent survey period. However, the utilization gap between rural and urban locations seems to have been reduced in recent times. Finally, in Figure 5, where respondents are categorized in terms of asset index quintiles, a very unfair gap in utilization is observed between the poorest and richest mothers. Although the figures display only the cases for prenatal services, the shape of the concentration curves and the bar diagrams are more depressing for other forms of maternal care services.

4.2 Regression Estimates Including the Supply-Side Variables

We use regression analysis to provide a description of the association between the use of maternal care services and contributing factors to identify the potential determinants of low use of those services. Table 2 summarizes the regression results using the BDHS 2004 dataset.

The associations between use of maternal care services and some of the supply-side factors are significant. Primary care services were less convincing in influencing the use of maternal care. NGOs were found to provide an influential role for the use of prenatal care services. This is because many NGOs provide maternal and child care in Bangladesh through their own setup and use their health workers at the community level to influence mothers to take maternal care. This is also in line with the evidence that NGOs, in particular those providing health care, effectively increase the utilization of health care by their members (Nasreen H., 2007).

Conditional on supply-side factors, circumstance factors appear to be significantly associated with the likelihood of utilization of maternal care. The probabilities of receiving assistance from a skilled person during birth and delivering in a health facility were lower for a Muslim mother. Results show that the probability of getting maternal care services was higher for more educated mothers. On average, an educated mother received more maternal care services than a non-educated mother between 2001 and 2004. The association was similar though less pronounced between the probability of use of maternal care services by a pregnant woman and level of education of her husband. Mothers in urban areas were more likely to receive all types of

maternal care services than mothers in rural areas. One may then conclude that utilization associated with location requires greater attention. Mothers who resided in households whose asset ownership placed them in the upper quintiles of the distribution of economic status had higher probabilities of accessing maternal care services. Mothers who belonged to households with higher assets were more likely to receive prenatal care services, mothers who belonged to the middle wealth index quintile or above were more likely to receive skilled attendance at birth, and mothers in the top two asset index quintiles were more likely to use health facilities.

Table 2: Estimates from the Regression Models of Utilization of Maternal Care
Bangladesh 2004 [Including supply-side variables]

	Logit M^{ac} dy/dx	Logit M^{sc} dy/dx	Logit M^{pd} dy/dx	NB2 M^{av} dy/dx	TNB2 M^{av} Coef.
Non-Muslim	0.030	0.07**	0.04**	0.29	0.125
Education: respondent	0.03**	0.01**	0.01**	0.09**	0.04**
(a) Husband: Primary	-0.010	-0.016	-0.014	0.04	-0.006
(a) Secondary	0.048	0.007	-0.002	0.32**	0.15*
(a) Higher education	0.13**	*0.040*	0.024	0.49**	0.23*
Location: rural	-0.11**	-0.04**	-0.03*	-0.31*	-0.15*
(b) Wealth Index: Poorer	0.07*	-0.012	0.000	0.34*	0.013
(b) Middle	0.16**	0.05*	0.029	0.75**	0.052
(b) Upper middle	0.18**	0.1**	0.07**	0.91**	*0.156*
(b) Richest	0.27**	0.16**	0.12**	1.44**	0.37**
Occupation of husband	0.019	0.013	0.02*	0.09	0.062
(c) Division: Rajshahi	0.058	-0.015	-0.001	0.22	0.057
(c)Khulna	0.005	-0.001	0.004	-0.09	-0.067
(c) Barisal	-0.12*	-0.006	-0.03**	-0.33*	-0.101
(c)Chittagong	-0.055	-0.05**	-0.03**	-0.19	-0.064
(c)Sylhet	-0.020	-0.012	-0.02**	-0.16	-0.094
Hours to 2nd level : public	-0.04**	-0.01*	-0.01**	-0.16*	-0.07*
Hours to 1st level: public	-0.023	-0.04**	-0.005	-0.03	0.021
Hours to private clinic/ hospital	0.000	-0.002	0.000	-0.04	-0.04**
SC/CC in the cluster	-0.003	-0.012	-0.010	-0.03	-0.011
Coverage by NGO	0.07**	-0.001	0.000	0.29**	0.1*
Miles to MBBS dcotors	-0.003	0.002	0.001	-0.02	-0.01*
n/Left-censored /Uncensored	3356	3626	3627	3356	2018
RESET (chi2)	2.63	0.59	2.61		
Prob > chi2	0.105	0.443	0.107		
mills/ _hatsq				-0.07	#

Reference: (a) Education of Husband: None; (b) Wealth Index Quintile: Poorest;
(c) Administrative Division: Dhaka
M^{ac} : antenatal care; M^{sc}: skilled attendance; M^{pd}: place of delivery
M^{av} : number of antenatal visit NB2: Negative Binomial Regression II TNB2: Truncated NBII
Legend: * significant at 5% level ** significant at 1% level

Table 2 also displays a summary of the count data regressions using BDHS 2004. When NegBin II and truncated NegBin II are applied to the number of prenatal visits as a count variable, the study observes that the number of antenatal visits was higher for more educated mothers, mothers living in an urban location, and mothers belonging to the richest households. The count data models indicate that urban mothers had more antenatal visits than rural mothers. Religious belief has an association with the choice about use of services or not, but has no association with the choice of number of visits.

Information on the supply-side variables is not collected in waves other than 2004. However, the findings of the above models justify the use of the circumstance factors in the regression models if supply-side variables are unavailable. For other survey years, we, therefore, use only circumstance factors as the independent variables affecting the likelihood of use of maternal care.

4.3 *Regression Estimates with only the Circumstance Factors*

Table 3 presents the logistic regression results for each type of maternal care services by survey year. Firstly, the regression results of use of antenatal care service, all the partial effects have the expected sign. On average, a non-Muslim mother is considerably more likely than a Muslim mother to use prenatal care services. Education is a very strong predictor of use of prenatal services. In each survey year, the probability of receiving prenatal services is higher for those with higher education. In 2007, the most recent wave, a respondent with 5 years of education more than the mean years of education had 14% larger probability of receiving antenatal service. The gap is large, and unjustifiable from the standpoint of fairness. Respondents have a greater chance of receiving medical care during pregnancy if their husband has a higher level of education. Education is therefore found as a key source of discrimination in the use of prenatal care. The study also establishes that the location of a respondent is a key source of discrimination in receiving maternal care services. On average, an urban mother is more likely to receive prenatal services during her pregnancy than a rural mother. This is consistent across years 1997 to 2007. On average a mother living in a city area had 15% greater probability than a rural mother to use prenatal care between 1997 and 2004. The gap reduced to 6% in 2007 but was still significant. Mothers in households whose asset ownership placed them in the upper quintiles of

the distribution of economic status have higher probabilities of accessing prenatal services. We observe that the magnitude of partial effects of some circumstance factors are declining over time and the magnitude of marginal effects for others are increasing. However, all the factors remain as significant sources of inequality and discrimination in accessing prenatal care services between 1997 and 2007.

Table 3: Estimates from the Logistic Models of Utilization of Maternal Care

Bangladesh 1997-2007

	2007	2004	2000	1997	2007	2004	2000	1997	2007	2004	2000	1997
	Utilization of antenatal care				Utilization of skilled attendance				Utilization of place of delivery			
	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx	dy/dx
Non-Muslim	0.1*	0.059	0.047	0.10*	0.08*	0.06*	0.03*	0.04**	0.07*	0.04*	0.04**	0.03*
Education: respondent	0.03**	0.03**	0.03**	0.03**	0.02**	0.01**	0.01**	0.01**	0.01**	0.01**	0.01**	0.003*
(a) Husband: Primary	-0.001	-0.009	0.1**	0.024	0.020	-0.012	0.004	-0.003	0.015	-0.012	0.001	-0.01*
(a) Secondary	0.09**	0.044	0.11**	0.032	0.07**	0.009	0.03*	0.004	0.06**	-0.001	0.020	-0.002
(a) Higher education	0.084	0.11*	0.18**	0.14**	0.14**	0.048	0.040	0.027	0.12**	0.027	0.025	0.014
Location: rural	-0.06*	-0.16**	-0.21**	-0.18**	-0.06**	-0.08**	-0.10**	-0.08**	-0.04*	-0.05**	-0.08**	-0.05**
(b) Wealth Index: Poorer	0.028	0.08**	-0.028	0.007	-0.043	-0.008	-0.005	0.008	-0.04*	0.003	0.001	0.004
(b) Middle	0.060	0.17**	-0.025	0.045	0.022	0.07*	-0.02*	0.008	-0.015	0.035	-0.016	0.005
(b) Upper middle	0.13**	0.2**	0.039	0.13**	0.09**	0.12**	0.07**	0.04*	0.033	0.09**	0.05**	0.022
(b) Richest	0.21**	0.28**	0.16**	0.26**	0.26**	0.19**	0.02*	0.07*	0.15**	0.15**	0.01*	0.03*
Occupation of husband	0.07**	0.029	0.040	0.031	0.009	0.014	0.035	0.012	0.010	0.02*	0.03*	0.003
(c) Division: Rajshahi	0.1*	0.074	0.12**	0.061	-0.019	-0.004	0.06**	-0.006	-0.021	0.001*	0.04*	-0.007
(c)Khulna	0.11**	0.021	0.12*	0.010	0.060	0.018	0.000	0.03*	0.048	0.013	-0.02*	-0.002
(c) Barisal	-0.024	-0.1**	0.002	-0.070	-0.021	-0.006	-0.003	-0.005	-0.04*	-0.03*	-0.015	-0.01*
(c)Chittagong	-0.023	-0.066	-0.1**	0.037	-0.03*	-0.04*	0.013	-0.011	-0.035	-0.03*	0.007	-0.02*
(c)Sylhet	0.029	-0.042	-0.021	-0.048	-0.036	-0.005	-0.021	0.000	0.021	-0.02*	-0.021	-0.005
n	3286	3365	3574	3375	3498	3636	3919	3380	3500	3637	3918	3376
RESET (chi2)	3.24	2.87	8.4	1.67	1.63	1.9	20.24	0	0.48	1.56	6.39	0.62
Prob > chi2	0.0728	0.091	0.004	0.1974	0.2027	0.1694	0.01	0.989	0.4884	0.2122	0.0119	0.43

Reference: (a) Education of Husband: None; (b) Wealth Index Quintile: Poorest; (c) Administrative Division: Dhaka

Table 3 also summarizes the partial effects and standard errors for the logistic regressions of receiving a skilled attendant at birth. In comparison with a non-Muslim head of the household, a mother from a household where the head is a Muslim is remarkably less likely to receive services from a skilled attendant. Discrimination due to religious affiliations increased between 1997 and

2007. Women with higher levels of education, as expected, have a greater likelihood of receiving skilled attendance at birth. The findings support that a major source of unfairness is the location of the household. Use of skilled attendance at birth has a significant and negative association with the residence in the countryside. However, discrimination regarding the location of the household decreased between 1997 and 2007.

Turning to the regression results of the choice of delivery place, the marginal effects have the expected sign. Religion is found as a dominant source of inequality from 1997 to 2007. The chances that a non-Muslim mother had access to a health facility to give birth were 2.8%, 4.4%, 4.5% and 7.3% higher than a Muslim mother in 1997, 2000, 2004 and 2007 respectively. In 1997, a mother with one year more education than the mean of education years was 0.3% more likely to give birth in a health facility and this increased to a massive 1.6% in 2007. Educated husbands were more concerned about the importance of giving birth in health facilities than non-educated husbands only in the most recent period. The study finds that on average the probability of giving birth in a health facility for a mother residing in a rural area was significantly smaller by 4.7%, 7.8%, 4.6% and 4.2% than her counterpart living in an urban area in 1997, 2000, 2004 and 2007 waves respectively. The gap between the poorest and the richest mothers giving birth in the health facilities has expanded considerably over time. Occupation of husband was significant only in the most recent period.

In particular, we find that circumstance factors are clearly a significant source of inequalities in the use of maternal care services in Bangladesh even in the recent period. The results, therefore, indicate that linking the supply-side interventions with circumstance factors is essential. This may, in turn, increase the access to maternal care services considerably.

4.4. Horizontal Inequity in Maternal Care Delivery

Table 4 displays the horizontal inequity indices and standard errors for all three categories of maternal care services. Each of the horizontal inequity indices corresponds to a relatively small standard error. The indices, therefore, indicate significant inequalities in the provision of maternal care services in all four waves. The positive values of the horizontal inequity indices show evidence of the asset related inequalities in the provision of maternal care services in

Bangladesh, with lower access concentrated among those having fewer assets. To begin with the provision of prenatal care services, the horizontal inequity in the utilization of services continued to fall between 1997 and 2007. The indices are 0.297, 0.235, 0.182 and 0.146 for 1997, 2000, 2004 and 2007, respectively. In each wave there was a pro-rich inequality in the probability of receiving prenatal care services. Each of these concentration indices shows that, ceteris paribus, a large percentage of total utilization would have to be redistributed from mothers in the richest half of the population to mothers in the poorest half to achieve an equal distribution. This interpretation is reached from the Robin Hood-type interpretation proposed by Koolman and van Doorslaer (2004). Alternatively, more rigorous interventions targeting the mothers in the poorest half could improve the horizontal inequity in the utilization of antenatal care services. Finally, although the horizontal inequity index in 2007 seems to have decreased by 50% compared with the horizontal inequity index in 1997, it is still quite large and significant.

Table 4: Horizontal inequity in the delivery of maternal care
Bangladesh 1997, 2000, 2004, 2007

		2007	2004	2000	1997
Antenatal Care	HI	0.146	0.182	0.235	0.297
	S.E.	[0.008]	[0.008]	[0.012]	[0.014]
Skilled Attendance at Delivery	HI	0.470	0.525	0.514	0.604
	S.E.	[0.020]	[0.024]	[0.027]	[0.041]
	HI (adjusted)	0.474	0.530	0.516	0.600
Giving Birth in a Health Facility	HI	0.467	0.560	0.560	0.636
	S.E.	[0.024]	[0.0295]	[0.035]	[0.056]
	HI (adjusted)	0.471	0.564	0.563	0.633

We measure the horizontal inequity index in the provision of a skilled attendant at birth using the unstandardized inequity index and need-standardized inequity index and observe that the difference between the approaches is marginal. As expected, the horizontal inequity index is found to be positive in each wave, indicating that with or without the need adjustment the better-off mothers do make greater use of doctors/nurses in Bangladesh. Horizontal inequity in accessing a skilled attendant continued to decrease between 1997 and 2007. Although, the inequity index reduced to 0.47 in the most recent period (from 0.6 in 1997), it was massive and highly unjustifiable. Similarly, the horizontal inequity indices for giving birth in health facilities show a decreasing trend over time and are quite large in the recent waves.

To sum up, the findings are indicative that the degree of horizontal inequality in Bangladesh is pro-rich, but modest in size in the provision of prenatal care services. On the other hand, the horizontal inequity indices are very favourable to the rich in accessing a skilled attendant at birth and health facilities when giving birth.

5. Impact of Macroeconomic Policy Interventions

The results of the previous sections are indicative that policies directed at circumstance factors are likely to encourage more mothers by relaxing potential barriers to using maternal care services. Due to their associations with utilization, improvements of the circumstance factors ceteris paribus enable a mother to get greater access to maternal health care services.

Several national policies have been carried out in Bangladesh to increase the use of maternal care, and to reduce horizontal inequity. Some of these are: the Health and Population Sector Programme from 1998 to 2003; the Health, Population and Nutrition Sector Programme from 2003-2011; the Interim Poverty Reduction Strategy from 2003 to 2005; and the Poverty Reduction strategy from 2005 to 2007. Furthermore, bilateral and multilateral organizations and donors have been implementing maternal care interventions individually or in partnership with the government (UNDP 2007). A small number of policies are also undertaken directly or indirectly focusing on the circumstance factors of the mothers. The government of Bangladesh has been providing education about the importance of maternal care in religious institutions. Under the IPRSP and PRSP, the Government provided both direct and indirect support to the poor to improve hardship. The Bangladeshi government has also been providing free education grants and vouchers for girls up to secondary level of education since 1996 (BBS 2009).

In this study we focus on location, which is one of the key circumstance factors for the mothers. The differences in use of maternal care services between mothers in rural and urban areas are dramatic which is still persistent for all forms of maternal health care services. The probability of utilization of any categories of maternal care is substantially lower for mothers in rural areas. Mothers have little or no choice in deciding whether they live in the countryside or the city. However, their opportunities in accessing maternal care services are clearly much less assured in rural than in urban areas. After 2000, due to several initiatives by the World Bank, the World

Health Organization, the United Nations, DFID and other organizations working in the health care sector globally, the government undertook some initiatives to improve utilization of maternal care services in rural areas. One of the policies adopted was the Rights-Based Comprehensive Maternal Care Policy, which was introduced in 2001. The Rights-Based Policy and HPNSP prioritized the use of maternal care services by rural mothers. The objectives of the policies were to provide quality care during pregnancy and family planning, to provide more opportunities to get access and to provide training to health workers working in rural areas. The policies also focused on the wider availability of supervisory nurses and trained midwives in rural areas. In addition to the national policies, many NGOs and bilateral organizations have been providing maternal care in rural areas. One of the aims of this study is to assess whether those policies, along with the Rights-Based Policy, were effective in increasing access to maternal care services in rural areas.

5.1 Difference-in-Differences

In our study, the treatment indicator for the difference-in-differences analysis is the interaction of the time component ($t_i \in \{0, 1\}$; $t_{01} = 0$, $t_{02} = 0$, $t_{11} = 1$, $t_{12} = 1$) and the group component ($Ri \in \{0, 1\}$). Here t_{01}, t_{02}, t_{11} and t_{12} stand for the waves 1997, 2000, 2004 and 2007, correspondingly, whereas, R_0 stands for the urban mothers and R_1 stands for the rural mothers.

Table 5: Results of the Difference-in-Differences Analysis
Impact of the Righst-Based Policy and HPNSP

	A: Antenatal Care			B: Skilled Attendance at birth			C: Giving Birth in a Health Facility		
	Coef.	Std. Err.	t	Coef.	Std. Err.	t	Coef.	Std. Err.	t
t_{02}	0.049	0.012	4.15	0.019	0.007	2.78	0.018	0.006	3.13
t_{11}	0.133	0.02	6.62	0.006	0.019	0.31	0.011	0.018	0.61
t_{12}	0.18	0.02	9.05	0.058	0.019	3.04	0.068	0.018	3.76
R_1	-0.34	0.015	-22.15	-0.28	0.014	-19.89	-0.238	0.013	-17.97
τdid	**0.125**	**0.02**	**6.21**	**0.04**	**0.019**	**2.12**	**0.033**	**0.018**	**1.86**
_cons	0.622	0.016	39.16	0.335	0.015	22.93	0.268	0.014	19.56
n	13839			14679			14677		

To begin with the difference-in-differences analysis for the prenatal services, coefficients of the time indicators are 0.049, 0.133 and 0.180 for t_{02}, t_{11} and t_{12} periods respectively, in comparison

with the reference period t_{01}. As expected, all three coefficients are highly significant, hence, do indicate a positive time trend in utilization. The coefficient of the group component is -0.340 which is statistically significant and in line with the standard hypothesis that in Bangladesh the distribution of antenatal care is highly pro-urban. After the double difference, the regression model removes the biases due to the group difference between rural and urban mothers and time trends unrelated to the policy. It thereby calculates the difference-in-differences estimator, 0.125. The positive value of the difference-in-differences estimator, and a relatively small standard error, 0.016, suggest that policies adopted after 2000 were successful in increasing the use of prenatal care in the countryside. From these findings, a positive association is clearly evident between the policy and the use of prenatal health care services by the target mothers.

Turning to the evaluation of the policy on the use of skilled care during childbirth, significant and positive time trends in the utilization are observed as expected. The coefficient of the group indicator, -0.280, is significant and pro-urban like that of the prenatal care services and in line with the standard hypothesis. The difference-in-differences estimator, 0.04, is significant and positive and indicates that policies adopted after 2000 aimed at rural mothers were effective in improving the use of doctors/trained nurses. Due to the implementation of these policies, the probability of use of skilled care during childbirth in rural areas seems to have increased significantly.

Finally, the evaluation of the policy on the use of health centres to give birth shows significant and positive time trends in utilization between 2000 and 2007 with an exception in terms of significance in the 2004 wave. The group effect shows a significant pro-urban concentration of use of the health facilities. The difference-in-differences estimator, 0.033, is positive but smaller than that of other maternal health care services studied, and weakly significant at a 10% confidence level. Evidently, the policy has a positive association with access to health facilities when giving birth in rural areas.

5.2 Total Differential-in-Differentials

We use the total differential-in-differentials analysis using the waves immediately before and after the policy to describe the distributional consequences of the policy interventions. For the utilization of antenatal care services we observe that in the pre-policy period (t_0) the horizontal

inequity indices are 0.189 (S.E 0.012) and 0.186 (S.E. 0.016) for the control mothers (R_0) and treatment mothers (R_1). The indices are 0.107 (S.E. 0.009) and 0.173 (S.E. 0.011) for the control and treatment mothers in the second period. The total differential-in-differentials estimator, 0.063, is positive which indicates that the richer section of the treatment group has benefitted more from the policy interventions. We derive the total differential-in-differentials estimator for the utilization of a skilled attendant in the same way and observe that the estimator is positive, 0.04, which again indicates that the richer section of the rural areas might have benefitted more from the policy. Similarly the total differential-in-differentials estimator for the utilization of place of delivery is also positive, 0.13, indicating that though average utilization of services among the treatment mothers seems to have increased after the policy, the distribution of utilization has worsened among them.

5.3 Difference-in-Weighted-Differences

The difference-in-differences analysis adjusted by the horizontal inequity indices provides the difference-in-weighted-differences estimator. Table 6 summarizes the findings. A negative weighted-difference estimator for a given maternal health care service utilization shows that lower utilization of the maternal care service after accounting for the inequalities in utilization of that particular service within the groups was concentrated among rural mothers. On the other hand, a positive difference-in-weighted-differences estimator for a given maternal health care service utilization shows evidence of an increase in inequality-adjusted utilization of that service in rural areas after the policy interventions.

To begin with the analysis for the use of prenatal services, the HI-adjusted weighted-difference estimators are -0.084 and -0.127 in the post-policy and pre-policy periods respectively. The indices show evidence of a substantially lower level of inequality-weighted utilization by the treatment mothers compared with the control mothers. However, the HI-based difference-in-weighted-differences is 0.043 and the pseudo-Gini based difference-in-weighted-differences is 0.030. These indices show a positive association between the policy and the inequality adjusted utilization of prenatal services in rural areas. Turning to the analysis for the use of a skilled attendant at birth, the HI-based weighted-difference estimators are -0.166 and -0.219 in the post-policy and pre-policy periods respectively. The indices, again, are not in favour of the treatment

mothers and show a lower level of inequality-weighted utilization by them in both periods. Nevertheless, the difference-in-weighted-differences estimator, 0.051, indicates that utilization by treatment mothers increased due to the policy. The pseudo-Gini based difference-in-weighted-differences estimator, 0.019, also supports the hypothesis that the utilization of a skilled attendant by treatment and Rights-Based Policy might have a positive association. Finally, for access to a health facility for giving birth, the HI and pseudo-Gini based difference-in-weighted-differences estimators are 0.069 and 0.017 respectively and both the estimators are again in favour of the policies.

Table 6: Difference-in-Weighted-Differences Estimators for Utilization of Maternal Care
The impacts the of Rights-based policy and HPNSP

	Post-policy	Pre-policy	Δ[Δ]
Block A: Antenatal Care			
Pseudo-Gini based weighted-difference estimator [Δ]	-0.110	-0.140	**0.030**
HI based based weighted-difference estimator [Δ]	-0.084	-0.127	**0.043**
Block B: Skilled Attendance at Delivery			
Pseudo-Gini based weighted-difference estimator [Δ]	-0.130	-0.149	**0.019**
HI based based weighted-difference estimator [Δ]	-0.166	-0.216	**0.051**
Block C: Giving Birth in a Health Facility			
Pseudo-Gini based weighted-difference estimator [Δ]	-0.114	-0.131	**0.017**
HI based based weighted-difference estimator [Δ]	-0.158	-0.227	**0.069**

6. Conclusion

In this paper we aim to assess the inequality in utilization of maternal care services in Bangladesh over time and evaluate the Rights-Based Comprehensive Maternal Care Policy using data from the BDHS. We observe that factors like education, religion, assets and location are considerable sources of inequality in utilization over the waves. We find that horizontal inequity in utilization is positive and significant for each type of maternal care in each of the waves studied. They are indicative that the better-off mothers did utilize more maternal care services than the worse-off mothers in all four waves including the most recent one. We find that the average utilization and level of inequalities are the worst in the utilization of maternal services at

birth. We observe evidence that the policies implemented after 2000 were successful in increasing the utilization in rural areas.

The study has some limitations. The first issue of concern is that the macroeconomic policy evaluated is very broad and not randomized. Bilateral and multilateral organizations and NGOs might also have contributed to an increase in the utilization, especially to enhancing the use of prenatal health care services in the rural areas. To overcome this, we interpret the results as associations between comprehensive policies and utilization of services in several places. The second issue of concern is that utilization of maternal care is mostly measured by a set of three binary variables. However, a sensitivity analysis using the number of antenatal visits also provides a similar association between the policy and utilization of services in rural areas. Another important concern is that the health care system in Bangladesh is not homogenous, and that the private sector has a substantial contribution in the utilization of services. Though the contribution of the private sector is ignored in this analysis, including it would be more likely to strengthen the findings. This is because the private sectors in Bangladesh are mostly concentrated in the urban areas.

Although there are limitations, our study has several strengths. Firstly, we provide statistical evidence that in a developing country like Bangladesh circumstance factors are significantly associated with the choice of utilization of maternal care services. Secondly, we explain why the unstandardized concentration indices should be used to measure the horizontal inequity indices, especially for maternal care services. Most importantly, we provide a way to identify the associations between a broader health policy and its outcome, applying difference-in-differences and difference-in-weighted-differences analysis. The findings are striking and in favour of the hypothesis that supply-side policy that links circumstance factors would be greatly effective to increase the utilization of maternal health care services. The findings suggest that though significant progress has been made in the utilization of maternal care services by the treatment mothers, strong group differences still prevail in favour of the mothers in urban areas. It is therefore essential to strengthen the policies in the countryside in Bangladesh.

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