DISSERTATION

ACCESS TO HEALTH FACILITIES AND MATERNAL HEALTH: A TALE OF TWO COUNTRIES IN EAST AFRICA

by

Fredrick Manang

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Access to Health Facilities and Maternal Health: A tale of two countries in East Africa

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Abstract

Access to Health Facilities and Maternal Health:

A tale of two countries in East Africa

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August, 2015

Diseases and poor health have long been recognized as barriers to economic development (Bleakley, 2007). Poor health hinders development of human capital and reduces total amount of time to participate in economic activities (Grossman, 1972). Thus investing on health to improve the lives of the poor is a viable means to achieve economic development (WHO, 2001). In this dissertation I investigate the impact of improving physical access to health facilities on maternal care use and health outcomes in Uganda and Ethiopia. In the early 2000s, each of the two countries launched ambitious health facility construction programs. The objective was to improve access to health services in the rural areas with particular attention paid on maternal and child health care.

Only a handful of studies have attempted to provide rigorous assessment of the impact of access on use of maternal care (Admassie et al., 2009, Frankenberg et al., 2009, Valente, 2014). The set of two studies covered in this thesis represents an initial attempt to exploit long-term variation in access using individual-level longitudinal data in the Sub-Saharan. The main challenge to identify the impacts is endogenous placement of the health facilities since the placement is likely to be influenced by some unobserved factors. To minimize the endogeneity problem, I employ the mother fixed effect model which control for

unobservable factors at the community and individual level that may be correlated with facility placement. I use data from the RePEAT surveys of the rural communities. The data shows a significant improvement in access to health facilities in the communities over the last decade.

The findings indicate that improvement in access to the facilities led to a significant increase in maternal care use in Uganda. Use of delivery care increase by about 18 percent for an additional facility that provides maternal care. The improvement in the use of the care was associated with reduction of travel time for antenatal care and transportation fees. Access improvement was also associated with reduction in the cases of pregnancy complication at births. In Ethiopia, the program of improving access to the facilities only increased utilization of antenatal care. There was no evidence to suggests that use of delivery care improved, nor reduction in pregnancy complications.

The findings suggests that while improving physical access to health care can increase use of maternal care this relationship may not prevail in every setting. Health policies advocated by the governments and development agencies need to take into account the contextual factors which may influence the effectiveness of the policies.

Dedication

To my parents

Ndeonika

and

Emiliano.

Summary of the Dissertation

Maternal mortality and morbidity pose a substantial health burden in developing countries. Over 200,000 mothers die annually due to pregnancy complications mainly in the Sub-Saharan Africa and East Asia (WHO, 2014). Empirical evidence indicates that poor health is a major constraint for economic development and for individuals to realize their full potential (Bleakley, 2010, The World Bank, 1993).

Although historically high maternal mortality was a global phenomena, a group of European countries and Japan experienced a significant decline in maternal mortality by the late 19th century. Experts on public health evidence attribute the low mortality levels in these countries (and the sharp decline in the 1930s in all industrialized countries) to improvements in access to maternal care services as well as quality of obstetric care (De Brouwere et al., 1998, Högberg, 2004). Borrowing from the experience in these countries, the Safe Motherhood Initiative which began in late 1980s seeks to improve the reproductive health of women in developing countries. Improving access to maternal care is among the central strategies of the initiative.

This dissertation represents one of the initial attempts to examine the impact of improving access to health services on utilization of maternal care and health outcomes. Majority of existing studies point to positive statistical association between availability of health services and use of maternal care (Abbas and Walker, 1986, Do, 2009, Gage and Calixte, 2006, Hazarika, 2011). Three studies attempted to establish a causal relationships (Admassie et al., 2009, Frankenberg et al., 2009, Selamawit, 2013, Valente, 2014). The general take-away from these studies is that improving access to health facilities has little impact on use of maternal care, especially delivery care. For instance Frankenberg et al.

(2009) investigates the impact of the Indonesian midwifery program which led to a significant improvement in access to midwifery services in rural Indonesia. The program led to a marginally significant increase in use of skilled birth attendants. The studies by Admassie et al. (2009), Selamawit (2013) which looked at the impacts of the health facility construction program in Ethiopia did not find any impacts on use of maternal care.

This dissertation offers the following contributions to the literature. First it extends the literature on access and use of maternal care by providing rigorous evidence of the impact of access on maternal care use in the lines of (Admassie et al., 2009, Frankenberg et al., 2009, Valente, 2014). Moreover, to my knowledge, this is the first attempt to employ the individual-level longitudinal data to provide evidence on the relationship between access and maternal care in the Sub-Saharan. This data allows controlling for unobserved individual heterogeneity, and hence it is more appealing than the longitudinal data at a more aggregate level (i.e. community level) used in the literature. Lastly, unlike existing studies which examine the short/medium term variation in access improvement, the data used in this paper allows exploiting long term variations of up to a decade.

To examine the impact of access I use data from Uganda and Ethiopia, two countries in the East Africa region. Both countries have high maternal mortality ratios (MMR) although the MMR in Ethiopia (673 per 100,000 live births) is much higher and among the highest in the World. Although the two countries are situated in the same region, they have markedly different level of maternal care use (CSA and ICF International, 2012, UBOS and ICF International, 2012). Less than half of pregnant women use antenatal care at least once in Ethiopia compared to 90 percent in Uganda. Only 10 percent of the women use skilled care during delivery in Ethiopia while in Uganda it is more than half. To increase use of health care, and particularly maternal care, both countries initiated ambitious programs to improve physical access to health facilities in the early 2000s. In

Uganda, the number of facilities that provide maternal care increased by more than 70 percent between 2002 and 2012. In Ethiopia the number of health posts more than doubled between 2004 and 2014. The number of Health Extension Workers (HEW) deployed increased 12 times reaching 34,000 by 2014.

Data comes from the Research on Poverty, Environment and Agricultural Technologies (RePEAT) surveys which covered about 940 and 1358 households Uganda and Ethiopia respectively. I also use the health facility inventory data of the Ministry of Health to capture availability of health services in Uganda. The main challenge of identifying the impacts is that the placement of the facilities is likely to be influenced by unobservable factors that are correlated with usage of health care. These may include prevailing health status of the communities or health consciousness of the political leadership. To estimate the impact of access to health facilities I employ the mother fixed and location/community fixed effect models which control for time invariant unobserved factors at individual and community level respectively. Where data allows, I conduct a number of robustness checks such as the parallel trends assumption. A dynamic panel model is also estimated to examine and control for any effect of past birth experience with maternal care use.

The findings indicate that the program in Uganda was effective in improving the use of maternal care while that of Ethiopia had limited impacts. In Uganda, deliveries at the facility by skilled practitioners increase by 18 percent for each additional higher level facility that was opened. The proportion of infants weighed at birth increased supporting the finding that utilization of facilities for delivery increased. The improvement in access to the care was associated with reduction of travel time for antenatal care and transportation fees. Access improvement was also associated with reduction in the cases of pregnancy complication at births. In Ethiopia on the other hand, the findings suggest that the program improved use of antenatal care but had no impact on use of delivery or postnatal care. An additional facility

led to about 23 percent increase in the proportion of mothers who make the recommended four antenatal care visits. No impact was found on reduction of pregnancy complications.

Despite the fact that the two programs led to a substantial improvement in access to health services, the impacts on maternal care use were strikingly different. In the conclusion of this dissertation I provide some suggestive evidence from the Demographic Health Survey's (DHS) of the two countries which indicate that, while distance is considered a key barrier to use of maternal care in Uganda, the barrier in Ethiopia may lie on the traditions and customs of giving birth. Basing on the evidence from similar context, there is potential for improving the effectiveness of the program in Ethiopia by offering small financial incentives and education (Basinga et al., 2011, World Bank Group, 2013). Both countries could maintain the quality of the care in the facilities by instituting community monitoring schemes (Björkman and Svensson, 2009).

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Tokyo, Japan — Fredrick Manang

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Chapter 1

INTRODUCTION

Health is at the core of development of any society. It is one of the central components of human capital, vital both as a consumption and investment good (Bleakley, 2010, Grossman, 2000). Health contributes to economic development by improving individual's economic productivity and maximize the total amount of time available to pursue economic activities. It is on this premise that investment on health is advocated as means of liberating the underdeveloped world from the poverty trap (Bleakley, 2007, WHO, 2001).

While developing nations are plagued by a host of infectious and non-communicable diseases, the striking difference between the these nations and the developed ones lies on the reproductive health of their women. A woman's lifetime risk of maternal death[1] in rich countries is about 1 in 3700. That risk is more than 20 times higher in poor nations (at 1 in 160). Moreover, the average maternal mortality ratio (MMR) in developing countries is about 230 per 100,000 live births, compared to 16 in developed countries. Such a high MMR in developing countries prompted world leaders in 2000 to pledge to reduce MMR by three quarters of 1990 level by 2015, as the fifth goal of the Millennium Development (MDGs) (UN, 2013).

The major causes of maternal deaths are largely preventable. Haemorrhage, hypertensive disorders and sepsis are responsible for more than half of maternal deaths (Say et al., 2014). These causes can be prevented or kept in check by ensuring that pregnant women get proper maternal care during pregnancy, at delivery and after delivery.

[1] The probability that a 15 years old woman will eventually die from a maternal cause-pregnancy complications.

For that reason, ensuring that the woman is attended by a skilled practitioner at birth is enshrined in the MDGs as the key strategy to achieve the reduction in MMR (Starrs, 1997). This strategy was adopted based on epidemiological and historical evidence from countries in Europe and transition economies like China and Malaysia (Graham W et al., 2001, Loudon, 2000).

A focus towards improving utilization of maternal care, and especially skilled birth attendance entailed directing substantial investments to improve physical access to these services in developing countries. In particular, the rural areas where majority of the population are living and where availability of services is limited (Sabine and Oona, 2009, Thaddeus and Maine, 1994). The key assumption being that uptake of maternal care will increase once the services are brought closer to the communities.

However, despite the calls to invest in health infrastructure (WHO, 2001) there has been limited rigorous evidence on the impact of improving access to health services on maternal care use (Admassie et al., 2009, Frankenberg et al., 2009, Selamawit, 2013, Valente, 2014). The general conclusion from these studies is not encouraging. They suggest limited or not impact of improving access on use of maternal care. However, these studies exploit the short to medium term variations in the improvement of access to facilities. It is possible that substantial improvements in access take time, and hence by exploiting long term variations positive impacts may be uncovered. These studies do not control for the individual level unobserved heterogeneity and hence are prone to endogeneity stemming from unobserved individual characteristics. This dissertation is an attempt to fill the gap by providing rigorous evidence of the impacts of improving access to health facilities by exploiting long term variations in access improvement while controlling for unobserved heterogeneity at individual level.

Objectives of the thesis

The objective of this thesis is to evaluate the impact of improving access to health facilities on utilization of maternal care. Specifically I analyze the impact on use of antenatal care, delivery in the facility, skilled birth attendants (nurses, midwives or doctors) and postnatal care. I will also investigate the pathways through which access improvement affect the outcomes. And finally examine the impacts on health of the mother and their infants.

This thesis therefore seeks to address three specific research questions:

1. What is the impact of establishing an additional health facility on utilization of maternal care?
2. How does improving access to facilities improve use of maternal care?
3. What is the impact on the health of the mothers and their infants?

The context and data

To answer those questions I use data from two countries in the East Africa region: Uganda and Ethiopia. The region is of interest because of its high maternal mortality and fertility rate. The average MMR is about 550 per 100,000 live births[2], above the average for the Africa region which stands at 480 per 100,000 live births (World Bank, 2015). Fertility rate is also high -an average of five children- entailing a high risk of maternal death. Ethiopia has one of the highest MMR in the World, standing at 673 per 100,000 live births, while in Uganda the MMR is 438. The two countries provides a contrasting picture in terms of use of maternal care. While in Uganda more than 90 percent of mothers use antenatal care at least once during pregnancy, the antenatal care use is less than half in

[2]With markedly wide variation ranging from about MMR of 438 to 1000.

Ethiopia. In addition, more than half of all deliveries in Uganda are attended by skilled practitioners, that figure is only about 10 percent in Ethiopia (CSA and ICF International, 2012, UBOS and ICF International, 2012).

In the early 2000s the governments of both Uganda and Ethiopia initiated ambitious programs to improve physical access to health facilities with the focus being the rural areas. In both countries improving maternal health outcomes featured high on the public health agenda. In Uganda, the number of facilities that provide maternal care increased by more than 70 percent between 2002 and 2012. Similarly, in Ethiopia all communities had a health post by 2014, representing more that a double in number health posts between 2004 and 2014. The program in Ethiopia went hand in hand with training and deploying Health Extension Workers (HEW). By 2010 more than 34,000 HEW were deployed and stationed in the health posts, which is more than a 12 fold increase from 2004. The two countries offer interesting cases by comparing the impacts of rather similar interventions in two different contexts which differ remarkably in the utilization of maternal care. The usefulness of this comparison is not limited to academic work. It is equally important to health policy making as it sheds light on what may or may not work in different contexts.

The data comes from the Research on Poverty, Environment and Agricultural Technologies (RePEAT) surveys of Uganda and Ethiopia. The surveys cover about 940 households and 1358 households in Uganda and Ethiopia respectively. In the surveys women reported about the pregnancy cases they had experienced up to 10 years prior to the survey. The women provided information such as where they went for antenatal care, delivery care and who attended their deliveries. Data about availability of health services in the communities where the households live came from varied sources. For the Uganda study, I use the health facility inventory data of the Ministry of Health. The inventory data is a census of health facilities in the country which contain information such as the number

of facilities in a community, ownership (public or private), the level (higher or lower)[3] and whether the facilities are functional. For the Ethiopia study, the data was collected as part of the RePEAT survey. The data included information such as the number of facilities in the community, ownership and the years the facilities started to provide: general care, antenatal care and delivery care. The data on availability of health facilities and utilization of maternal care are combined to estimate the impact of access to the facilities on use of the care.

The model and findings

The main challenge of identifying the impact is that the placement of the facilities is likely to be influenced by unobservable factors that are correlated with usage of health care. These may include prevailing health status of the communities or health consciousness of the political leadership. To estimate the impact of access to health facilities I employ the mother fixed model[4]. The impact is identified from the group of mothers who changed their use of maternal care once an additional facility was introduced in the community. The model controls for potential endogeneity of health facility placement due to time invariant unobserved characteristics of the mother or the community. I also estimate the dynamic panel model to examine and control for any effect of past experience with use of maternal care.

Although similar programs were implemented in Uganda and Ethiopia the findings suggest that the impacts were different. The results indicate that the program in Uganda was effective in increasing utilization of maternal care. Deliveries at the facility by a skilled practitioner increase by 18 percent for each additional higher level facility that was

[3] Higher-level facilities provide comprehensive maternal care. Lower-level facilities in principle do not provide maternal care, although they may offer basic antenatal care and attend emergency deliveries.

[4] In some cases I also estimate and report results from the location fixed effect model, either because of limited sample size or for illustrative purposes.

opened. The lower level facilities increased use of regular antenatal care in every trimester. They also improve use of delivery care likely by facilitating referrals to higher level facilities. The improvement in access to the facilities was correlated with reduction of travel time for antenatal care and transportation fees. Access improvement was also associated with reduction in the cases of pregnancy complication at births. The last encouraging finding is that mothers who have used maternal care in the past, are likely to use it in their future pregnancies. This is a desirable finding especially in the context with high fertility rate since it indicates that mothers who have interacted with the health system in the past, are more likely to continue doing so and hence continue to face low likelihood of suffering from maternal morbidity or death in their future pregnancies.

On the other hand, the findings from evaluation of the Ethiopia program were not encouraging. Despite the massive investment in expansion of the health infrastructure, the findings suggest that the program had limited impact on use of maternal care. I did not find any impact on use of facilities for delivery or skilled birth attendants, although an additional facility led to about 23 percent increase in the proportion of mothers who make the recommended four antenatal care visits. No impact was found on reduction of pregnancy complications. These findings are in line with those reported by several studies which have investigated the impact of the Ethiopia program (Admassie et al., 2009, Karim et al., 2013, Selamawit, 2013).

Implication for policy

While the program to improve access to health facilities was effective in Uganda, a similar program in Ethiopia showed little impact on use of delivery care. To policy makers, these findings suggests that a one-size-fits-all policy may not be effective in every context. They point to the need of taking into account the contextual factors in designing and

executing health policies. I document findings from the Demographic Health Survey's (DHS) of Uganda and Ethiopia which indicate that, while women consider distance to be a key barrier to use of maternal care in Uganda, for Ethiopia the key barrier appears to stem from the long held traditional customs of giving birth (CSA and ICF International, 2012, UBOS and ICF International, 2012). In Ethiopia, majority of women who did not health facility for delivery[5] mentioned that it was not necessary or not customary to use the facilities for delivery. This suggests that to increase use of delivery care, attention should be paid to disseminate knowledge about the risks of going without proper delivery care. The fact that the health facility expansion program is inducing expecting mothers to use antenatal care, presents an opportunity to disseminate the knowledge during the antenatal visits.

Organization of the thesis

This thesis is organized in five chapters. The preceding chapter provided an introduction which covered the objectives and the research questions. It also highlighted the methodology followed in the analysis of the data, the findings and policy implications. The next chapter presents the overview of the literature linking development economics and health, and maternal health in particular. It also provides a brief history of the Safe-Motherhood Initiative which has been central in improving maternal health in developing countries. It also describes an analytical model which aids in interpreting the estimates from the empirical model. Chapter three and four covers the two studies from the two countries starting with that of Uganda. Each of these two chapters is further subdivided into sections covering: Introduction, Literature review, Empirical model, Data, Results, Robustness checks and Conclusion. The last chapter presents the conclusions and policy implications from the two studies.

[5] Representing almost 90 percent of all pregnant women covered in the survey

Chapter 2

Review of the Literature

Health is an important input in the fight against poverty and achieve economic development. This chapter begins by reviewing recent evidence linking economic development and health. The second part provides a brief history of the Safe-motherhood initiative that has been central in improving reproductive health of women. Lastly, I conclude by discussing an analytical model that describes the role of physical access on improving use of health care and health outcomes.

2.1 Health and Development

Pioneering work by Grossman (1972) formalized the contribution of health on human development.[6] In the Grossman's model health is considered a durable capital which yields utility and healthy time that can be used for leisure or productive activities. Health is thus demanded as an end to itself and means to achieve other objectives. A drop in health capital will thus not only reduce individual's utility but also his ability to engage in income generating activities. An individuals inherit a stock of health which depreciates overtime and can be "re-stocked" by health investments (healthy goods) like health care, exercises, nutrition. The model predicts that in general the reduction in the price of health investments will increase demand for health and healthy goods.

The body of empirical research that ensued Grossman's work has largely vindicated the predictions of the Grossman's model (Leibowitz, 2004, Wagstaff, 1986). For instance Rosenzweig and Schultz (1983) using a health production function they show that a woman's delay in using antenatal care (a health investment) during her pregnancy led to a

[6] Grossman's work was influenced by earlier works on human capital by (Becker, 1962) and (Becker, 1965).

decline in birth-weight of her infant.[7] Strauss and Thomas (1998) notes that although there is large body of evidence showing the impact of income on health, a growing body of evidence is emerging which points to the impact of health on income via improvements in productivity.

A strand of research has identified a causal relationship between health and macroeconomic development. For example Arora (2001) examines the role of health on growth of output per capita in ten industrialized countries. The paper finds that changes in the health status of the population (as captured by changes in life expectancy and stature at adulthood, an anthropometric measure) can explain up to 40 percent of the increase in the growth rate over the last 100 to 125 years. Gallup and Sachs (2001) shows that income per capita of countries with high Malaria burden grow 1.3 percent less compared to countries which have low burden. Their finding remain unchanged even after controlling for variables like the initial level of poverty, life expectancy.

Recent evidence indicates that individual's productivity and income can be improved significantly by investing on simple, inexpensive preventative health technologies. Fink and Masiye (2015) report the impact of distributing bed nets on agriculture productivity in a randomized control trial in rural Zambia. They find that yield increase by about 15 percent or around US$ 76. The suggestive pathway of the impact was through reduction in number of days sick.

Bleakley (2007) looks at the impact of a massive hookworm eradication campaign in the American South which began around 1910 to 1915. An initial survey of the affected regions found high rates of infections of up to 40 percent. The campaign led to a substantial reduction in the rates of infections with impact extending on schooling and labor market outcomes. Eradication of the disease increase school enrollment by about 20 percent and

[7] Birth-weight captures the in utero health of the infant which is influenced by health investments of the mother.

adulthood wages by about 40 percent. He finds that about 22 percent of the gap in income between the South and North America in 1900 could be attributed to the prevalence of hookworms in the South.

Similar findings are reported by Baird et al. (2011) for a follow-up study on the long-run impacts of the now famous deworming program[8] in Kenya. With a good tracking rate of 83 percent the study was able to look at the impacts on self reported health, education and labor market outcomes almost a decade after the initial intervention. They find that the program increased adult earnings by over 20 percent for the treatment group, increased hours worked by 12 percent and reduce sick days. Significant spillover effects were reported for the group of people that lived close to the treatment group, for which by themselves could justify full subsidization of the deworming program.

Although there is scarcity of evidence which examine the causal relationship between maternal health and economic development (Gill et al., 2007), the brief discussion of the studies above which link health and economic development points to a negative relationship between poor health, productivity and economic growth. Estimates of the cost of maternal mortality and morbidity by international organizations suggests that the problem pose a major barrier to development in poor countries. For instance Islam and Gerdtham (2006) estimate the cost of maternal and new-born ill health using loss in productivity due to maternal/newborn death or complications. They find that annual per capita productivity loss is about US$ 1.5 in Ethiopia and US$ 3 in Uganda. The annual total loss in productivity amount to US$ 95 million and US$ 102 for Ethiopia and Uganda respectively. Lastly, a cross-sectional study of 45 countries in the Sub-Saharan regions by Joses M et al. (2006) estimates that per capita GDP declines by about US$ 0.36 for an additional increase in MMR (deaths per 100,000 births). Their estimates suggest that at

[8] Miguel and Kremer (2004)

the regional average MMR of about 480, the per capita GDP of an average country in the region is about US$ 173 less than in an ideal state of zero MMR.

In summary, there is sufficient evidence in the literature which shows that poor health is detrimental not just to individuals quality of life, but also to his ability to engage in productive economic activities. Hence investing on health is also viewed as means of breaking the vicious circle of poverty in developing countries and is advocated by development economists (Behrman and Rosenzweig, 2004, The World Bank, 1993). In the mid to late 1980s the Safe-Motherhood initiative was born out of the joint efforts of the World Bank, the World Health Organization (WHO) and United Nations Population Fund (UNFPA). The primary objective of the initiative is to improve the reproductive health of women mainly in the developing countries. The main strategy advocated by the initiative was through improving access to maternal care - which is the focus of this thesis. The subsequent section provides a brief history of the initiative.

2.2 A brief History of the Safe-Motherhood Initiative

High maternal mortality has been the experience of all countries in the world until as recent as 1930s (Loudon, 2000). In the late 1880s England for instance, Maternal Mortality Ratio (MMR) was hovering above 400[9], at times reaching as high as 700. The United States had the highest ratio among the advanced countries, which was above 600 for much of the beginning of the 20th century until early 1930s. The scandinavian countries of Sweden, Norway and Denmark together with Japan were the only ones which enjoyed a significant decline in maternal deaths before 1900s (Van Lerberghe and De Brouwere, 2001). For example MMR in Sweden was as high as 600 in the 1850-70s, but dropped sharply to less than 200 by 1900. After the mid 1930s, however, all of the advanced countries experience a sharp decline in maternal deaths to levels below 60 by 1990. Why did the sharp drop begin

[9]Deaths per 100,000 live births

in the mid 1930s? Why did the Scandinavian countries together with Japan enjoy levels of MMR much lower than elsewhere before 1930s?

Public health historians[10] attribute the low and the sharp decline in MMR in those countries to improvements in access to midwifery care and in standards of obstetric care. Moreover, introduction of better medicines such as sulfonamides and penicillin to deal with bacterial infections played a pivotal role in accelerating the decline of mid 1930s (Van Lerberghe and De Brouwere, 2001). For instance Sweden started to promote use of professional midwives for delivery as early as mid 1700s. This came about after the first national statistics on maternal mortality of 1751 revealed a MMR of about 900. The Health Commission estimated that 61 percent of maternal deaths could have been prevented had there been enough midwives. Concerted efforts by the government and medical schools increased the number of midwives such that by 1861 about 40 percent of the births were attended by skilled practitioners. This figure raised to more than 80 percent by 1895. The MMR also declined substantially from 600 in the 1850s to below 200 at the turn of 20th century (Högberg, 2004). Similar initiatives were undertaken by countries such as England, Netherlands, and later Japan and United States. Even with advent of new medical technologies, public health experts have noted that the technologies would have limited impact without the will to improve access to midwifery services (AbouZahr, 2003).

Borrowing from successful cases in advanced countries, public health experts pioneered a series of interventions to combat the high maternal mortality in developing countries (De Brouwere et al., 1998). However, prior to late 1980s the issue of high MMR in poor countries had little traction in the public policy discourse. This was partly because of lack of reliable data on the magnitude of the problem, and partly because issues of women health

[10] Experimental or quasi-experimental evidence is lacking.

were subsumed by those of infant health and hence never gained prominence in their own right (AbouZahr, 2003).

The year 1987 marked a turning point. The World Health Organization (WHO) produced the first estimates of maternal deaths from studies initiated in 1985. The studies concluded that about half a million maternal deaths occur annually[11] with 99 percent of them in developing countries. The WHO, World Bank and UNFPA convened the first Safe motherhood conference in Nairobi in 1987 with the aim of increasing awareness about the plight of mothers in developing countries. The conference was successful in advocating the issue of maternal deaths as a problem that deserve immediate attention. It was in this conference that the term "Safe-Motherhood" was invented to mean maternal health (FCI, 2007). Among the agreements was the goal of reducing maternal deaths by 50 percent by year 2000. Improving access to maternal care was considered central to reach the goal. This involved strengthening community-based health care including training of Traditional Birth Attendants (TBAs) to attend deliveries, and improving referral system to health facilities.

The late 1980s and the 1990s saw a rise of maternal health in the international agenda. A series of conferences such as the Children's Summit of 1989, the International Conference on Population and Development (ICPD) of 1994 brought significant attention to the problem of maternal death. These meetings served to reinforce commitments made in the Nairobi conference to improve access to maternal care. The tenth anniversary of the Safe-Motherhood Initiative of 1997 which involved technical consultative meetings in Sri Lanka and a World Health Day media event in 1998 is regarded as the "biggest effort to promote Safe-motherhood" (FCI, 2007) in the international community. The meeting

[11] This estimated proved to be a significant underestimation as better statistical data in the later years indicated the problem to be much bigger.

culminated with a ten priority action message which outlined the key strategies for reducing maternal mortality and morbidity for the first decade of the initiative.[12] The Initiative stressed on the need to ensure every women get skilled care during pregnancy and at delivery. This was a major shift from strategies adopted in the 1987 meeting which advocated the use of TBAs in screening of women for pregnancy complications and attend normal deliveries. Based on a decade long experience a consensus was reached among the experts that involvement of TBAs had not been effective as envisioned. They pointed to evidence which showed that TBAs were delaying to refer mothers with pregnancy complications to seek care in formal health facilities.[13] Much of the Safe-motherhood strategies that have either been advocated or adopted in the 2000s revolved around the improving access to skilled care of one form or another (Campbell and Graham, 2006, Ronsmans et al., 2006).

In 2000 the world leaders endorsed a set of eight Millennium Development Goals (MDGs) to be achieved by the year 2015. The goals are aimed to streamline efforts to improve health, education and reduce poverty and hunger. Through the advocacy of the Safe-Motherhood Inter-Agency Group (IAG)[14] reducing maternal mortality (reduce MMR by 75 percent of the 1990 level by 2015) was featured among the development priorities of the Millennium Declaration. This placed maternal health in the context of development agenda both as an input and outcomes poverty reduction initiatives. Improving access to skilled birth attendance was adopted a channel to reduce maternal mortality as well as an indicator for tracking progress in attaining the goal (Vukovich, 1997). For countries with

[12]The actions messages were: 1. Advance Safe Motherhood Through Human Rights 2. Empower Women, Ensure Choices 3. Safe Motherhood Is a Vital Economic and Social Investment 4. Delay Marriage and First Birth 5. Every Pregnancy Faces Risks 6. Ensure Skilled Attendance at Delivery 7. Improve Access to Quality Reproductive Health Services 8. Prevent Unwanted Pregnancy and Address Unsafe Abortion 9. Measure Progress 10.The Power of Partnership

[13]TBAs were later prohibited from conducting deliveries in some of the East African countries such a Uganda, Kenya and Tanzania. Ethiopia does not prohibit the practise of TBAs.

[14]IAG was formulated in the Nairobi meeting of 1987 to promote awareness of maternal health issues. It's founding members were: The World Bank, WHO, UNFPA, UNICEF and UNDP. Other organizations such as Family Care International (FCI), International Confederation of Midwives (ICM) and the International Federation of Obstetrics and Gynecology (FIGO) joined the IAG in the 2000s.

high maternal mortality, the target was set to achieve 60 percent skilled birth attendance by 2015. Globally, the target was to attain 90 percent by 2015.

This thesis focuses on one of the major strategies of the Safe-motherhood Initiative that is increasing usage of maternal care by improving access to health facilities. Increasing utilization of maternal care is considered crucial to reduce the MMR in developing countries. A number of studies are pointing to a negative association between availability of health services and usage of the care (Abbas and Walker, 1986, Gage and Calixte, 2006, Tsegay et al., 2013). In addition, recent evidence from Tanzania suggests that availability of the services is crucial for reducing maternal deaths. Hanson et al. (2015) found that long distance to health facilities is associated with high level of maternal mortality. This thesis is an attempt to provide more rigorous evidence on the linkage between availability of health services and utilization of maternal care as well as health of women.

2.3 Analytical model

The analytical model of this study follows the standard household production models from which the demand for health inputs can be derived (Rosenzweig and Schultz, 1983). The following is the simplified version of the model.

$$U = u(H, F; Z_1) \quad \text{(i)}$$

$$H = h(M; Z_2) \quad \text{(ii)}$$

$$I = MP_m + FP_f \quad \text{(iii)}$$

An individual chooses level of health (H) and consumption good (F), to maximize utility (i) subject to health production function (ii) and budget constraint (iii). Z_1 are individual characteristics that affect utility level. Health is produced by health inputs (M) and individual characteristics (Z_2). Health inputs (such as medication or doctor visits) affect

utility only through their impact in the production of health (Grossman, 2000). In this study health inputs includes maternal health care such as antenatal care use, facility delivery and use of skilled birth attendants. Z_2 consist of individual characteristics that affect production of health. The income (I) is assumed to be exogenous and heterogenous across individuals. The P_m and P_f are the exogenous prices for M and F respectively.

Substituting (ii) into the utility function (i) and by solving the following system of equations:

$$\begin{aligned}
\mathscr{L} &= u(F, h(M; Z_2); Z_1) + \lambda(I - MP_m - FP_f) && \text{(iv)} \\
\frac{\partial \mathscr{L}}{\partial M} &= u_M(M, F; Z_1, Z_2) + \lambda(-P_m) = 0 && \text{(v)} \\
\frac{\partial \mathscr{L}}{\partial F} &= u_F(M, F; Z_1, Z_2) + \lambda(-P_f) = 0 && \text{(vi)} \\
\frac{\partial \mathscr{L}}{\partial \lambda} &= I - MP_m - FP_f = 0 && \text{(vii)}
\end{aligned}$$

Yields the reduced-form demand function for health input (M), and consumption good (F), as the function of prices, income and the characteristics (Z_1, Z_2). The focus of this paper is on the demand functions for health input (M) and health outcome (H) which can be expressed as:

$$M^* = m^*(P, I, Z_1, Z_2) \quad \text{(viii)}$$

$$H^* = h^*(M^*, Z_2) = h^*(P, I, Z_1, Z_2) \quad \text{(ix)}$$

The model predicts that reduction in price P_m will increase the demand for maternal care. To capture the cost of maternal care, I follow the approach by Acton (1975) in which the cost of seeking health care is approximated by availability of the health services. This approach is motivated by the fact that in settings where direct fees for the health care are zero or very low, other types of cost of care -physical accessibility of those services- play a

more prominent role in influencing utilization of the care[15]. In my analysis the availability of maternal care services is captured by measures of access to health facilities. The availability is considered exogenous after controlling for some observable and unobservable time invariant characteristics. The main hypothesis is that: Improvement in access to health facilities reduces the cost of seeking maternal care and improve utilization of the care.

The individual characteristics are captured by age and education variables. Note that although income is treated as exogenous in the above model, the income information from the data is likely to reflect labor supply decisions. Therefore a more flexible model would allow income to be a choice variable influenced by the trade-off between labor and leisure. Available data does not allow us to consider labor supply decisions. Instead the economic capability variables (value of assets and land size) are used to approximate the exogenous income. To the extent that maternal care is a normal good, the model predicts that utilization will increase with increase the in economic capability.

[15]In both Uganda and Ethiopia some women report paying for maternal care even in public facilities despite the care being "officially" free in both countries. These fees are likely to be endogenous as they may reflect the particular need, awareness or bargaining power of the woman, and therefore cannot be used as exogenous prices for the care.

Chapter 3

Access to Health Facilities and Maternal Health: Case of Uganda

3.1 Introduction

Maternal death, which is the death during her pregnancy or within 42 days after that, poses a serious risk to women of reproductive age. In 2013, 289,000 mothers lost their lives, with 99 percent of them occurring in developing countries and 62% in sub-Saharan Africa (WHO, 2014). In order to reduce maternal mortality, it is considered most crucial that women deliver at formal facility, attended by skilled health practitioners such as midwives (Campbell and Graham, 2006, Filippi et al., 2006).[16] Most complications cannot be predicted or prevented (Ronsmans and Graham, 2006), and if a complication happens without the presence of a skilled practitioner, delay in the diagnosis and referral of the complication could result in maternal mortality or morbidity.[17] Reflecting this importance, deliveries attended by a skilled birth attendant (SBA) has been one of the Millennium Development Goal indicators. However, the average rate of utilization is still low in developing countries. Only 53% of pregnant women deliver with the help of a skilled attendant(WHO, 1999). One of the major causes of poor use of SBA is physical accessibility to health facilities. They are considered to be too far for mothers to walk to in many Sub-Saharan African countries (Sabine and Oona, 2009, Thaddeus and Maine, 1994).

[16] A skilled attendant refers to individuals with midwifery skills who have been trained to manage normal pregnancies, childbirth and the immediate postnatal period, as well as to identify and refer complications in women and newborns. They include a midwife, doctor and nurse (WHO, 2004). While home deliveries attended by a skilled practitioner might be another option (or the only option in some areas), home conditions can be extremely basic and the skilled attendant will not have the support of other skilled practitioners or equipment in the case of complications (Campbell and Graham, 2006).

[17] In addition to antenatal and delivery care, reducing the number of unwanted pregnancies and lowering the costs of safe abortion are alternative ways to improve maternal health because unsafe abortion is one of the causes of maternal deaths. In fact, new clinics offering family planning services are found to have modestly reduced fertility in Iran (Hashemi and Salehi-Isfahani, 2013) based on the district fixed effects model. Openings of legal abortion centers in Nepal are shown to have decreased the probability of live birth given conception using the mother fixed effects model (Valente, 2014). While these services are for women in general or pregnant women who prefer abortion, this paper focuses on services for pregnant women who prefer giving birth.

This paper investigates how improved access to health facilities can affect the utilization of SBA and other maternal care as well as maternal and child health status. While many studies examine the cross-sectional relationship between these outcomes and access to health facilities, there is scarcity of rigorous evidence on their causal relationship. Also, available few studies use a relatively short panel data. More importantly, to our knowledge, no panel study has been conducted for Africa, even though the majority of maternal deaths occur in the continent. I fill these gaps in the literature by investigating the effect of new openings of health facilities on maternal health care usage and outcomes in Uganda, using the decade-long panel data which distinguish the level and ownership of health facilities. More specifically, I utilize the new panel data on the availability of health facilities between 2002 and 2012, which is constructed based on the administrative data of the Ministry of Health in Uganda. Merging this with the rich panel data on maternal care utilization enables us to investigate how an increase in the availability of health facilities is associated with changes in a range of maternal care use behavior such as SBA, delivery at a formal facility, and timely and regular antenatal care visits. In order to address the endogenous placement of health facilities, I employ the subcounty-level and mother-level fixed effects models, controlling for the district-level time trends. Furthermore, I conduct a number of robustness checks to address the plausibility of the parallel trends assumption and the possibility of reverse causality. Finally, I also shed light on the mechanism through which better access to health facility improves health investment by addressing how new health infrastructure change transportation patterns and health expenditures.

Results indicate that an opening of health facility providing comprehensive maternal care increases delivery with SBA at a facility by 18 percent. The opening of a lower-level facility that does not provide delivery care or detailed tests for pregnant women still increases the probability of delivering at a facility with SBA. It additionally induces

expecting women to receive regular antenatal care in every trimester. The improvement in access to facilities care was correlated with reduction of travel time for antenatal care and transportation fees. Access improvement was also associated with reduction in the cases of pregnancy complication at births. Albeit the findings on mechanism of the impact and health outcomes may not represent causal relationship. Moreover, communities with roads of good condition are likely to benefit more from the improvement in access to facilities. These findings imply that expanding the coverage of health facilities, particularly community-level facilities, is effective in promoting the utilization of maternal care and improving maternal health.

These results are related to the literature on the impact of access to health facilities in general. While the expansion of health system or a reduction in the distance to the nearest facility is likely to increase the demand for health care, the closure of nearby hospitals and living away from a health facility can negatively affect health care utilization and health outcomes. In the U.S., each additional mile from the health facility is found to be associated with three percent decline in health check up for black children (Currie and Reagan, 2003). Also, communities experiencing an increase in the distance to the nearest facility (due to the closure of some of the public facilities in Los Angeles) exhibit a larger increase in deaths due to heart attacks and unintentional injuries, but not in deaths due to long term chronic diseases such as cancer (Buchmueller et al., 2006). This is likely to be due to the delay in reaching care as found in Wilde (2013), who investigates the impact of response time of emergency medical services on mortality in Utah. Hospital closures are also found to increase travel distance for hospital visitors, particularly among a group of pregnant women (Bazzoli et al., 2012). Similar adverse effects on health care usage and health status are found in the study comparing a group of medical inpatients in California whose hospital was closed with another group of inpatients in a similar hospital which did not close down

(Bindman et al., 1990).[18]

However, regarding maternal care utilization and maternal health, there is a paucity of rigorous evidence on the impact of health facilities. While many studies look at the relationship between the availability of health facilities and maternal care use and maternal health outcomes, most of them are based on cross-sectional data (for example, Do (2009), Gage and Calixte (2006), Overbosch et al. (2004), Yanagisawa et al. (2006)). Though the majority of these studies find access to health facility to be positively associated with care utilization, it is unclear whether their estimates are free from a possible bias due to endogenous placement of health facilities. For example, public facilities might target areas with worse outcomes, which creates a negative bias in the OLS estimates as in Rosenzweig and Wolpin (1982), Pitt et al. (1993) and Frankenberg et al. (2005).[19] On the other hand, remote areas might not be able to attract a health facility due to high construction costs and preferences of health practitioners. If those areas also have individuals of poorer health, OLS estimates are likely to be positively biased.

The available rigorous evidence includes Frankenberg et al. (2009), which assess the effect of the presence of village midwives in Indonesia, using the panel data with two waves of 1993 and 1997. The government of Indonesia recruited, trained and allocated a large number of midwives to disadvantaged areas in the 1990s. Their findings based on the mother fixed effects model suggest that this midwifery program significantly increased the probability for pregnant mothers of receiving iron tablets during pregnancy. It also increased SBA, albeit the estimates based on the mother fixed effects are marginally significant. The presence of a village midwife is also shown to have improved the health status of women

[18] Buchmueller et al. (2006) uses the ZIP code fixed effect model, while Currie and Reagan (2003) employs mother fixed effects model. Wilde (2013) analyzes the impact of the time ambulance takes to respond to accidents on the probability of hospital admission and mortality, using the distance between the incidence and ambulance garage as an instrument.

[19] For instance, Rosenzweig and Wolpin (1982) finds that an additional family planning clinic increased child height by 12 percent in India using the child fixed effect model. However, their 'naive' cross-sectional estimates suggest no significant impact.

of reproductive age and children.[20] While these studies inform us of the roles played by midwives, the impact is still unknown of health facility which includes health practitioners, medical supplies, and testing and operating equipment.

The rest of the chapter is organized as follows: The next section presents the institutional background and the literature review. Section three describes the data used for this analysis. The analytical and empirical models are presented in section four. Section five and six presents the findings and the robustness checks. Section seven concludes.

3.2 Background

3.2.1 Context

Uganda is one of the low income countries with per capita GDP of about $1300 in 2012 based on purchasing power parity. The country however is growing rapidly. Its average growth rate over the last decade exceeded seven percent. During this period, health indicators improved appreciably. Infant mortality decreased from 88 to 54 deaths per 1000 live births, and the maternal mortality ratio declined from 524 to 438 deaths per 100,000 live births between 2000-01 and 2011 (UBOS and ICF International, 2012).

Beginning from 2000, the government of Uganda strengthened its development of health services. The first national health policy of 1999 stipulated the expansion of national health infrastructure, to be implemented jointly with the district administration and the private sector (Ministry of Health, 1999). The goal was to bring health care closer to the public in order to improve the utilization of health services. The guideline for establishing new facilities required that the facilities (both public and private) be placed in under-served locations (Ministry of Health, 2004). It also specified the target population size and geographic unit that is meant to be served by each facility level. For example, a

[20] Children who are fully exposed to this midwifery program are found to have significantly gained in terms of height-for-age compared to the cohort which was not exposed to the program (Frankenberg et al., 2005). Birth weight and body mass index among women ages 20-45 also significantly increased in those communities which gained midwives Frankenberg and Thomas (2001).

village is supposed to have Health Center I (HCI), which is to cover 1000 individuals. A parish, which includes several villages, is supposed to have a Health Center II (HCII) covering 5000 individuals. A HCI comprises of a team of community health workers who provide community-based health care services. The health facility of the lowest administration level with physical establishment therefore is a HCII. This level of facility provides simple preventive and curative care, and outreach services to promote healthy lifestyle. It is not supposed to provide delivery care or comprehensive antenatal care, though sometimes HCII may receive emergency cases and provide partial antenatal care which does not require laboratory testing.[21] The lowest level of facility which provides delivery and comprehensive antenatal care is a Health Center III (HCIII), which is expected to serve 20,000 individuals. Every sub-county is supposed to have one HCIII. The facilities of higher levels all provide comprehensive maternal care. They include a Health Center IV which should be built in every county, and a Health Center V (or hospital) for every district, serving 100,000 and 500,000 individuals, respectively. On top of these levels, there are regional referral hospitals which are expected to cover 2 million individuals and the national referral hospital in the capital city (Ssengooba et al., 2003). In the analysis, I distinguish HCII and the facilities above HCII as they provide comprehensive maternal care, and refer them "lower-level facilities" and "higher level facilities".

3.3 Data

Our analysis draws on the Research on Poverty, Environment and Agriculture Technologies (RePEAT) survey for 2003, 2005, 2008 and 2012 as well as the Uganda health facility inventory. The RePEAT survey is the longitudinal survey of about 900 households from 94 communities in rural Uganda. The communities (or "Local Council

[21] HCII does not have a laboratory, and thus cannot conduct the tests required in comprehensive antenatal care such as urine and blood tests. However, health workers at HCII can examine body size, blood pressure, and also provide those with existing diseases with drugs and treatment.

1") are scattered in three regions (Central, East and West) as shown in figure 3.1.[22] In the initial year, ten households were randomly sampled from each of the 94 communities. The attrition rate has been low at 6 percent between 2003 and 2012, leaving 889 out of the original 940 households. The main outcomes for this study, maternal care utilization and maternal health, are based on the retrospective questions on past pregnancies collected in the second (2005) and fourth (2012) waves. In 2005, each household was asked whether there was a woman who became pregnant in the past five years, including unsuccessful cases. For those households reporting a pregnancy, detailed questions were asked on each pregnancy. In 2012, the presence of a woman aged 15-56 (women ages 50-56 are included as they were aged 49 or below in 2005) was asked first, then the number of pregnancies by type (live birth, still birth, miscarriage and abortion) was verified. For women who provided pregnancy information in 2005, subsequent pregnancy experience was asked, while women who did not provide pregnancy information in 2005 were asked about pregnancy experience since 2001. When there were more than two women who reported pregnancy in the relevant years, I randomly selected two women and recorded all the pregnancy cases for the two women. However, there were only seven households bound by this constraint. Out of the original 940 households, 893 remained in the second wave, of which 539 had at least one pregnancy in the past five years reported by 609 women. Seventy-nine percent of these women were re-interviewed in the fourth wave, providing the full pregnancy history between 2001 and 2012. The remainder of women attrit between the second and fourth waves, but their pregnancy histories between 2001 and 2005 are used for our analysis. In addition to these 609 women, in the fourth wave, 339 women who joined the sample households or became of reproductive age reported pregnancies between 2001 and 2012. Altogether, these 948 women reported 2408

[22]The Northern region was not covered because of political instability that existed at the beginning of the survey.

pregnancies.

[INSERT FIGURE 3.1 ABOUT HERE]

The health facility inventory is an administrative list of health facilities for the whole Uganda for the years 2002, 2004, 2006, 2010, 2011 and 2012.[23] For each facility, the list indicates its level (such as HCI and HCII), ownership (public, private or non-governmental-not-for-profit organization (NGO)) and status (whether or not it is operational). I count the number of operating facilities for each year and sub-county. A sub-county is likely to approximate the area individuals travel to antenatal care. As discussed in the previous section, every sub-county is supposed to have one HCIII, which is the most basic level of facility providing comprehensive antenatal care. Also, a sub-county is not too large with the average population size being 25,261 in 2002 (UBOS, 2006). Since there are very few private or NGO facilities, to improve the precision of the estimates, these two types of facilities are combined into one group labeled as "non-public facilities," including both higher-level and lower-level facilities.[24] This health facility inventory data was merged across years using sub-county names as in 2002.[25]

As figure 3.2 indicates, there has been a massive increase in the number of health facilities in Uganda. Between 2002 and 2012, the total number of facilities has increased by more than two folds from about 2500 to 5000. While the increase has by large been driven by an increase in the number of HCIIs, the higher-level facilities have also increased. The average annual growth rate was 5% for higher-level facilities and 13% for

[23]The administrative data was collected once in two years between 2002 and 2010, and annually from 2010 onwards. The 2008 inventory data was not found at the Ministry of Health.

[24]In particular, only one sub-county had private health facilities functioning by 2012 in the RePEAT survey area.

[25]Between the analysis period of 2002-2012, some administrative areas split into multiple new administrative areas, some parishes were promoted to become sub-counties, and some parishes were assigned to new sub-counties. I traced the names of the parishes and their sub-counties over the years, using the crosswalk data provided from the Uganda Bureau of Statistics (UBOS). The resulting data are organized in the way that the same parishes that are identified within one sub-county as in 2002 are contained in that sub-county throughout the analysis period.

HCII.[26] I examine how the massive investment in health infrastructure has affected a range of maternal care utilization.

[INSERT FIGURE 3.2 ABOUT HERE]

After I divide the number of health facilities by the number of parishes as in 2002,[27] the number of health facilities per parish still shows an increasing trend (figure 3.3). The top panel indicates that, while the average number of facilities per parish was about a half in 2002, by 2012 it rose to almost one. In particular, the number of lower-level facilities rose disproportionately.

[INSERT FIGURE 3.3 ABOUT HERE]

This increase in the availability of health facility is likely to have affected maternal care usage. According to our survey data, access to health facilities was the most cited reason for choosing a particular facility for delivery, followed by quality of care (Table 3.1).[28]

[INSERT TABLE 3.1 ABOUT HERE]

Indeed, the increase in the availability of health facilities was accompanied by the increase in the number of the sample mothers in the RePEAT delivering at facility using SBA (figure 3.4). The SBA indicates deliveries attended by a skilled attendant both inside and outside of formal health facility, while facility delivery refers to deliveries taking place at a health facility regardless of who attended delivery. Both increased from about 40% to

[26] There is a slight decline between 2004 and 2006. Our interviews with officials at the Ministry of Health suggest that this was mainly due to the campaign to close private facilities that either failed to renew the permits to operate, or did not have permit to operate at all. Since these facilities were largely located in Kampala, the capital city, once it is excluded, the Graph .7 in the appendix shows a consistent upward trend.

[27] Ideally, we would like to adjust our measure of facility availability for population size. However, unfortunately data on population at the sub-county level is unavailable. Since the number of parishes in a sub-county is proportional to the population size of the sub-county, this is likely to approximate the availability of health facilities adjusting for population size at the initial period.

[28] This is based on the responses to the following question: "What factors led you to choose this delivery site/attendant?" This was asked only in the 2012 RePEAT, and thus the number of observations is smaller (1379) compared to the total sample size used in the analysis of this paper (2015).

68% between 2000 and 2012.[29]. Antenatal care utilization remains high around 95% throughout the period. However, regular antenatal care usage, which refers to pregnancy cases in which the mother made at least one antenatal care visit in every trimester,[30] is much lower averaging 43%. There is also no indication of improvement over time.

[INSERT FIGURE 3.4 ABOUT HERE]

In order to merge the RePEAT data and the facility data for each sub-county and year, I filled missing values in the facility data mostly using the information on pre-determined availability. That is, since data on facility are unavailable for 2007-2009, the availability as in 2006 was assigned to observations (pregnancy cases) between those years. The availability in 2002 and 2004 were assigned to observations in 2003 and 2005, respectively. Only for observations before 2002, the availability in 2002 was assigned because pre-2002 facility data are unavailable. Excluding the observations before 2002 from the analysis does not alter the main findings.

[INSERT TABLE 3.2 ABOUT HERE]

[INSERT TABLE 3.3 ABOUT HERE]

3.4 Empirical model

The increasing trends in both access to health facility and maternal care usage suggest that maternal health investment might be partly explained by the improvement in access to facility. In order to more rigorously investigate this possibility, I employ sub-county fixed effects model and mother fixed effects model. First, sub-county fixed effects model is formalized as follows:

[29] A small proportion of mothers reached health facilities but were not assisted by skilled attendants. Thus, I also created the indicator for skilled birth attendance at formal facility (SBA at a facility). It averages 53% - three percentage points lower than the proportion of all deliveries which took place in the facilities. While facility delivery only reflects the demand-side behavior, the difference between facility delivery and SBA at a facility is likely to be due to the absence of health practitioners. SBA at a facility is not included in the figure 3.4 because its trend almost coincides with the trends of SBA and facility delivery.

[30] Regular antenatal care is recommended by WHO and the Ministry of Health of Uganda. This variable can be defined only for pregnancies terminated in 2005-2012.

$$M_{ijhkt} = \beta_1 * Access_{kt} + \beta_2 * Z_{jhkt} + \mu_k + \lambda_{rt} + \nu_{ijhkt} \quad \text{(i)}$$

M_{ijhkt} indicates the outcome of interest for pregnancy i of woman j in household h, living in sub-county k in year t. $Access_{kt}$ is the vector of three variables which indicate the per-parish availability of the three types of health facilities (public higher-level, public lower-level, and non-public) within sub-county k in year t. Z_{jhkt} is a set of control variables.[31] μ_k are unobserved time-invariant characteristics of sub-county k. These characteristics can include for instance local terrain. Communities in remote and rugged areas are less likely to have a health facility, and also have residents suffering from poor health due to less preferable sanitary condition. However, to the extent such unobserved characteristics do not change in the short run, it is likely to be captured by the sub-county fixed effects. (λ_{rt}) is a set of dummy variables defined for each district and year (year dummies and district-year interactions) which controls for the annual nation- and district-wide shocks/events that might have affected the availability of health facilities and utilization of health care. These include natural calamities such as floods, outbreak of diseases and fluctuations in the governmental expenditures on health. For the regression of regular antenatal care usage (Regular care), I control for regional- instead of district-year interactions as the sample size is small. ν_{ijhkt} is the idiosyncratic standard errors clustered at the sub-county level. Clustering corrects the standard errors for potential correlation of outcomes for women within the sub-county over time, including those with repeated births.

The linear probability model (LPM) is used to estimate equation i since the estimates from the conditional logit model, a non-linear model which incorporates fixed effects, are

[31] These consist of: maternal age at delivery, its square term, four dummy variables indicating maternal education, a set of dummy variables indicating parity, per capita household land size and the three dummy variables indicating quartiles in terms of assets (livestock and durables).

difficult to interpret, and in our case, the fixed effects can be included only at a much more aggregated administrative level than the sub-county level. As the results based on the conditional logit model are generally similar to the findings based on the LPM, in this paper I mainly discuss the LPM results.

The sub-county fixed effects assumes that, controlling for the district-specific year effects, individual- and household-level characteristics, there is no unobserved heterogeneity that affect growth in outcomes and changes in access to health facility. However, the composition of mothers could change over time within a sub-county. For instance, mothers who delivered in later years in the analysis period might have been more aware of the importance of maternal care than mothers who delivered in earlier years. If this tendency is particularly strong in areas that gained a new facility, it could positively bias the impact of the availability of health facilities on the utilization of SBA and facility delivery. In order to assess whether this issue matters, I also utilize the mother fixed effects model, which replaces the sub-county fixed effects with mother fixed effects. It controls for the mother-specific unobserved characteristics such as awareness of the importance of maternal care, innate health and other characteristics which may affect their preferences towards health care. Thus, the mother fixed effect model is our preferred specification. This model assumes that pregnant women in sub-counties which gain a health facility would not have changed unobserved factors like attitudes or innate health disproportionately compared to pregnant women in other sub-counties which experience no change in access to health facility.

3.5 Results

Table 3.4 reports result for maternal care utilization. For comparison, the OLS estimates are reported in the first four columns. They suggest that an increase in the number of higher-level public facilities is associated with an increase in regular antenatal

care visits. However, better access to health facility has no correlation with facility delivery and SBA. Columns 5-8 show the results of estimating the equation i. The results suggests that sub-counties experiencing a gain in access to public higher-level facilities exhibit an increase in the probability of facility delivery and SBA. Sub-counties gaining better access to public, lower-level facilities also show an increase in the probability of facility delivery. These results suggest the OLS estimates largely underestimate the impact of access to health facilities on the utilization of facility delivery and SBA. This is consistent with the previous studies which do not find significant effect of health programs in cross sectional estimates but do find a significant impact in fixed effects models (Frankenberg et al., 2005, Pitt et al., 1993, Rosenzweig and Wolpin, 1982). It is likely that the government's guideline to target unserved areas causes a downward bias in the OLS estimates. On the other hand, the OLS estimates overestimate the effect of access to health facility on regular antenatal care visits. An explanation for this positive bias might be that sub-counties which already had a public high-level facility (which was less likely to open a new facility) had women who were more likely to regularly take antenatal care, and sub-counties which gained a new facility did not undergo an increase in the likelihood of regular antenatal care. As shown in Figure 3.4, this likelihood did not change very much over time.

[INSERT TABLE 3.4 ABOUT HERE]

The fixed effects results however may still be biased if the composition of mothers changed within sob-counties. The results based on the mother fixed effects model are shown in Columns 9-12. They are qualitatively consistent for the impact of public, higher-level facilities. That is, given the same woman, a delivery which occurred after the opening of a new higher-level facility is more likely to be conducted at a formal facility with SBA. The estimated coefficient for the use of SBA at facility implies that, an additional higher-level facility in a sub-county induces a 10-percentage-point increase in

the probability of SBA at facility. This is equivalent to an 18-percent increment compared to the mean.[32]

Interestingly, the mother fixed effects results also show that improved access to public lower-level facilities increases delivery at health facility and SBA at delivery, though the magnitude of the effect is less than half of that of higher-level facilities. The estimates imply that an additional public lower-level facility leads to a 7-percent increase in the use of SBA at a facility. A possible explanation for the differences between the sub-county and mother fixed effects models is that relatively urban sub-counties which are unlikely to have gained lower-level facility experienced disproportionate changes in unobserved factors affecting facility delivery and SBA, such as willingness to deliver at formal facility, possibly due to the influence of media. For non-public facilities, no significant impact is found, perhaps due to its limited presence and growth in the survey areas as shown in Figure 3.3. The estimated coefficients for the control variables (not shown) suggest the usage of SBA and facility delivery is associated with economic status.[33] For example, the results based on the mother fixed effects model suggest that mothers in the richest two quartiles are 12-14 percentage points more likely to use facility for delivery and 8-11 percentage points more likely to have SBA at delivery compared to those in the poorest quartile.

3.6 The Impact on Maternal and Child Health

The analyses thus far suggest the improved access to health infrastructure promotes regular antenatal care visits, delivery at a formal facility with a skilled birth attendant. A natural next question is whether this increase in maternal care utilization also influences maternal and child health outcomes. In order to address this issue, I now examine the

[32] A new high-level facility in somewhere in a sub-county is equivalent to about a one-sixth increase in the number of that facility per parish, as there are about six parishes on average. This can be a newly established facility or upgrading of an existing lower-level facility. It leads to a $1/6 \times 0.60 = 10$-percentage-point increase in the outcome, or a 18-percent increase relative to the mean ($0.1 \div 0.53$).

[33] See table 10 in the appendix for a full set of results.

impact on the incidence of complications mothers experience during pregnancy and delivery, as well as the birth weight of their children. The 2012 RePEAT asked whether a woman experienced any complication or health problems during pregnancy and child birth. Among the pregnancy observations, 16 percent of them report some problems during labor. Common responses include severe bleeding and being labor for more than a day.[34] The 2012 RePEAT also asked mothers whether they think their babies are bigger, smaller, or similar in size compared to other infants, whether their weights were measured right after birth, and if so, how many kilogram they were.

The results for these outcomes are shown in Table 3.5. Interestingly, the opening of the lower-level public health facility is accompanied by a reduced risk of complications for mothers during childbirth (Column 1). Though lower-level health facilities are not supposed to provide comprehensive maternal care, they examine expecting mothers having general health problems. Combined with their positive impact on SBA and facility delivery shown above, these lower-level facilities might have expedited the diagnosis and referral of possibly serious cases to higher-level health facilities. Non-public facilities indicate a similar impact. Since most of these non-public facilities are of lower level in terms of their functions, they are also likely to have facilitated early diagnosis and referral. These results suggest the rapid expansion of lower-level facilities have reduced the incidence of maternal complication.

The results for child health outcomes on the other hand provide more nuanced evidence. An increase in the number of higher-level public facilities is associated with an increase in the probability for babies of being weighted (Column 2). This is consistent with Table 3.4 which suggests that new openings of higher-level facilities increased delivery at a formal facility, where newborn babies are regularly weighted and checked.

[34]The common complications that can be life-threatening include severe bleeding and infections (particularly after childbirth), high blood pressure during pregnancy (which can lead to pre-eclampsia and eclampsia), and other indirect causes due to worsening medical disorders.

However, the improvement in access to higher-level facilities do not seem to bring about babies of larger size. If anything, it is accompanied by a small (insignificant) reduction in the birth weight among those who were weighed (Columns 3 and 4) and the size of children (regardless of whether they were weighed or not) evaluated by their mothers (Column 5). Since this negative association is observed among all the babies not only among those who were weighed, it is unlikely to be due to the negative selection of children into being weighed. A possible explanation might be selective survival. That is, the opening of higher-level facilities saves more newborn lives, and those who would not have saved without facilities tend to have small sizes. Alternatively, it might be that mothers with weak innate health (who are likely to have low weight infants) became more likely to deliver at a higher-level facility once it is available in the sub-county, and they become more aware of the relatively small size of their children whereas they would not have realized without the facility. To the extent that these are due to unobserved heterogeneity across mothers, the mother fixed effects would control for them, which however is not feasible due to the limited sample size.

[INSERT TABLE 3.5 ABOUT HERE]

3.7 The Impact on Travel and Expenditure Patterns

Thus far, I have argued that the improvement of the access to health facility increases maternal health utilization and improves maternal and child health. In order to see if these advantages are in fact due to better access to health facilities, I now examine the effects on travel and expenditure patterns. On one hand, if a new facility reduces the distance to the nearest facility, this can reduce the time to reach facility and transportation costs, given the mode of transportation remains unchanged. On the other hand, one might stop using a relatively expensive mode of transportation such as motorcycle or bus and start choosing a less expensive option such as walking. In this case, transportation time might increase

while transportation costs decline. The data on the transportation time and cost spent are available in the 2005 and 2012 RePEAT survey for mothers who visited antenatal care and delivery.

Table 3.6 indicate the results based on the same specification as in table 3.4. They suggest that the openings of lower-level public facilities and non-public facilities in every parish lead to a reduction in the transportation time to antenatal care by half an hour and one hour, respectively. The increase in the number of lower-level public facilities was also accompanied by the reduction in the transportation costs to antenatal care by 1642 shillings.On the other hand, the opening of a new public, higher-level facility in the sub-county reduced the costs for transportation for delivery, but increased the time taken to get there. This is likely to be because mothers who used to take some transportation means quit using those or began to use less expensive means as the facility became closer to home. These results confirm that the improvement of access to health facility indeed made it easier for mothers to visit it for both antenatal care and delivery.[35]

[INSERT TABLE 3.6 ABOUT HERE]

3.8 Robustness checks

3.8.1 Trends of outcomes before health facility openings

The main results in tables 3.4-3.5 suggest that improving access to health facilities leads to a significant increase in the usage of maternal health care and enhancement of maternal and child health. However, some of these results rely on sub-county fixed effects, which might reflect pre-existing increasing trends in the outcomes for the sub-counties where new facilities were constructed. For instance, these sub-counties might have had a faster growth in maternal care usage even prior to the establishment of the new facility.

[35]Note that table 3.4 indicates the expansion of non-public facilities does not led to an increase in SBA and facility delivery, while they reduce travel costs. A possible explanation might be that mothers who would have used antenatal care at some other facility even if the new non-public facility had not opened started to take advantage of the new non-public facility which is closer to them. This is consistent with the idea that non-public facilities are likely to open in areas with unmet demand.

The outcomes of interest (which have so far relied on sub-county fixed effects) in this analysis are: travel time, transportation fees, Complication at birth and the measures of birthweight. I examine whether the trends for the outcome are different prior to the opening of a new facility between sub-counties where a new facility is established some time later in the analysis period (here after "*Treated in the future*"), and those where no new facility is built ("*Untreated*").[36]

More specifically, I use the following regression model to test for the differential trends at the sub-county level:

$$M_{jkt} = \alpha_1 * Year_t + \alpha_2 * \text{“}Treatedinthefuture\text{”}_k + \alpha_3 * Year_t * \text{“}Treatedinthefuture\text{”}_k + \alpha_4 * X_j + \lambda_{rt} + \nu_{jkt}. \quad \text{(ii)}$$

M_{jkt} is the outcome for woman j in sub-county k in year t. α_1 indicates the difference in the average outcomes between the benchmark year of 2000 and a particular year for the "untreated" sub-counties. The coefficient α_2 indicate the difference in the average outcome between sub-counties which were "treated in the future" and "untreated" for the year of 2000. The coefficient of interest is α_3, which indicates the average difference in the outcome between sub-counties that are "untreated" and those that are "treated in the future" for the years prior to the opening of the new facilities. X includes a set of individual and household control variables and λ_{rt} is the district trend.

I first focus on the trends before the opening of higher-level or lower level public facilities as these are the ones which have shown to influence use of maternal care. The results are shown in tables 3.7 to 3.10. The p-values of the joint significance test for the coefficient of the "Treated in the future" and its interactions with the $Year$ dummies are reported on

[36] In other words, I use the data for all the years for sub-counties that do not receive a facility throughout the analysis period. This is pooled with the data for years before the opening of a facility for sub-counties that receive a facility in the analysis period. I do not use the data for years after the opening of a facility for these sub-countries.

the last row of the tables. On table 3.7, the p-values of the joint test for the travel time for antenatal care and delivery outcomes are not significant. This indicates that, before new higher level facilities were established in the sub-counties that were "treated in the future", the trends in the travel time in these sub-counties were not different from that in the "untreated" sub-counties. And hence any effect of improved access to higher level facilities on travel time as seen in table 3.6 is likely to be causal. The p-values of the joint test for the outcomes on transportation fees are significant pointing to differential trends between the "Treated in the future" and "untreated" sub-counties. Results of table 3.8 show that before new lower level public facilities were opened up in the sub-counties which were "Treated in the future", the trends in the transportation fees were not different between the "treated in the future" and the "untreated" sub-counties. This suggests that improving access to lower level public facilities is likely to have reduced the transportation fees to antenatal care services.

Tables 3.9 and 3.10 present the results of the trend robustness check for health outcomes. Generally, there is evidence suggesting that the increase in weighing of infants after birth driven by improvements in higher level facilities is likely to represent causal relationship. The results also suggest that the impact on pregnancy complication observed in table 3.5 should be interpreted with caution because of differential trends between the "treated in the future" and "untreated" sub-counties.

[INSERT TABLE 3.7 ABOUT HERE]

[INSERT TABLE 3.8 ABOUT HERE]

[INSERT TABLE 3.9 ABOUT HERE]

[INSERT TABLE 3.10 ABOUT HERE]

3.8.2 Initial changes in outcomes and subsequent facility openings

Another concern in interpreting table 3.4 is reverse causality. For example, increasing demand for facility delivery can put pressure on local authorities, which decide to act on the local needs and establish a health facility. In this case, it will be misleading to claim that the improvement in physical access to health facility leads to an increase in the utilization of maternal care. Also, areas which initially had a lower level of maternal care utilization might take a while to receive a new facility. In order to investigate the possibility of reverse causality, I test whether initial changes in the outcomes influence the subsequent openings of new facilities between 2004 and 2012. Specifically, the following regression model is estimated:

$$Access_{k2012} - Access_{k2004} = \theta_1 * (M_{k2003} - M_{k(t)}) + \theta_2 * Access_{k2002} + \theta_3 * M_{k(t)} + \theta_4 * X_{k2003} + (\psi_{k2012} - \psi_{k2004}). \quad \text{(iii)}$$

The outcome represents the change in the access measure (per parish availability of health facilities) between 2004 and 2012 in sub-county k. $(M_{k2003} - M_{k(t)})$ is the main variable of interest, which captures the changes in the maternal care utilization outcomes between 2003 and the earliest year available for sub-county k.[37] The outcome in the earliest available year is also included in the regression. If the coefficient θ_1 is significant, it will indicate that changes in past demand influenced the future supply of health facilities. On the other hand, a significant correlation between the initial level of outcomes and the subsequent openings of health facilities does not bias the results in table 3.4 since I use either the sub-county fixed effects model or mother fixed effects model in the main

[37] The earliest year is 2000 for most sub-counties. For a small number of sub-counties which had no birth in 2000, it is 2001 or 2002.

analysis. Due to strong correlation between SBA and facility delivery, I show the results which include only the changes and initial level of SBA. Results remain similar when those variables for SBA are replaced with those for facility delivery. $Access_{k2002}$ is included to control for the initial level of access to of health facility in 2002 (the earliest year in which data is available) as the government had the policy to prioritize areas with fewer than the recommended number of the health facility. X_{k2003} includes other sub-county characteristics such as the average altitude above the sea level, population, malaria incidence, distance to the nearest district town (both in dry and rainy season) and the log of average household land size.

[INSERT TABLE 3.11 ABOUT HERE]

[INSERT TABLE 3.12 ABOUT HERE]

As table 3.11 indicates, none of the coefficients of the initial changes or level of maternal care usage (skilled birth attendance and antenatal care use) are significant. These results suggest that reverse causality is unlikely to explain the impact found in table 3.4. Similar results for regular use of antenatal care and measures of birthweight are reported in table 3.12. Change in travel time for antenatal care and delivery care are significantly correlated with change in number higher level public facilities, suggesting a possibility of reverse causality. And hence the effect of improvement in access to higher level facilities on travel time to delivery is likely to represent associations.

The coefficient for the initial level of access to public health facilities are negative and significant, which is consistent with the governmental policy trying to attain an equitable

distribution of public health facilities. That is, sub-counties which initially were under-served by public health facilities experienced fewer openings of public facilities in the subsequent analysis period. The coefficient of the initial level of SBA indicates a weak, positive correlation with the subsequent openings of non-public health facilities. This might reflect the possibility that NGO and private facilities tend to locate themselves in areas with a high level of initial demand.

In this section, I have shown that initial demand growth does not predict the subsequent openings of public health facilities (table 3.11 and table 3.12).[38] I have shown that, between sub-counties that did and did not gain a health facility in the analysis period, the trends in the level of maternal care utilization may or may not have differed prior to its opening (tables 3.7 to 3.10). As a result, some of the findings should be cautiously interpreted. For instance, the positive impact of improving access to higher level facilities on weighing of infants is likely to be causal. Whereas positive effect of the higher level facilities on travel time to delivery is likely to represent statistical associations.

3.9 Effect of past experience with using maternal care

Lastly I examine whether any persistence in usage of maternal care exists once a mother starts using the care. This is of interest because in the context with high fertility rate it is desirable from the policy stand point to exploit the initial interactions the mother has with the health care system, in order to encourage future use of the care. Mothers who had a good experience with health care providers in their past pregnancies are likely to use the care in the future and vice versa. In addition, those who had an experience with using maternal

[38] Except for the initial growth in travel time for antenatal and delivery care.

care may be better aware of the necessary preparations (such as fees, transportation means) to access the care compared to mothers with no experience. In addition, we may be worried that the positive impacts on maternal care use reported in the main results may not be due to the improvement in access per se but because of women who experienced bad pregnancy outcomes in their previous pregnancies as a result of not using maternal care. If the bad outcome in the previous pregnancy motivated them to seek maternal care in their current pregnancy (and this happen to be at the same time when a new facility is opened-up), then impacts on maternal care us may not represent a causal relationship. Controlling for use of maternal care in the previous pregnancy helps to account for this possibility.

To examine the effect of the past experience of using maternal care I employ a dynamic panel model in which a lagged outcome (maternal care use) variable is introduced as a regressor in the model. The lag is meant to capture the effect of past use on current use of the care. The model is formalized as follows:

$$M_{sjhkt} = \beta_1 * M_{s-1jhkt} + \beta_2 * Access_{kt} + \beta_3 * Z_{jhkt} + \mu_{jhk} + \lambda_{rt} + \nu_{sjhkt} \quad \text{(iv)}$$

- M_{sjhkt} : 1 if she used the care in the birth round s.
- t = 2000, 2001 ..., 2012
- s (birth round) = 1, 2, 3, 4

M_{sjhkt} is an indicator of maternal care use in birth round s of mother j in household h in sub-county k in the year t. The description of the other variables used in the model is

similar to that in section 3.4. One lag[39] ($M_{s-1jhkt}$) is introduced into the model hence the model is estimated on a sample of mothers who had at least two pregnancy cases, similar to that of mother fixed effect model i.[40] The main threats of identification stems from correlation between the regressors and the unobservables μ_{jhk} and ν_{sjhkt}. This is possible because allocation of health facilities might have been influenced by unobserved factors such as the initial health status of the community. Also past use of maternal care might be correlated with mother's innate health or or changes in perceptions towards modern health care by the individuals.

To estimate the model I use an extension of the Arellano-Bond estimator (Arellano and Bover, 1995, Blundell and Bond, 1998) in which the model is estimated in first differences to eliminate μ_j. Then lags and lagged first differences of the outcome variable are used as instruments for the potentially endogenous lagged variable in the model. The main identification assumption is therefore that there is no serial correlation in the error term. If there is serial correlation, then the lags of the outcome variable will be correlated with the error term and hence cannot be used as instruments. I will use the autocorrelation test to test the assumption of no serial correlation. The Sargan test will also be used to test the validity of the over-identifying restrictions as the model is over-identified (more instruments than parameters to be estimated). The estimation results are presented in table 3.13.

[INSERT TABLE 3.13 ABOUT HERE]

The results suggest that there is persistence in use of delivery care (table 3.13). Mother

[39] The sample is reduced significantly once two or three lags are introduced.

[40] The regional trend (λ_{rt}) instead of district trend is fitted because of the limited number of observations.

who have delivered at a facility or by a skilled practitioner in the past are more likely to use the care in their future pregnancies, compared to those who have not used the care. For instance, a mother who delivered at a health facility in her previous pregnancy is 26 percentage points more likely to use the care in her current pregnancy, relative to a mother who did not use the care. These findings are encouraging. They suggest that mothers who have interacted with the health system are likely to continue using the services rather than dropping out.

Moreover, consistent with the results from the sub-county and mother fixed effect models (table 3.4), access to higher level facilities leads to an increase in utilization of facility delivery and skilled birth attendants. Neither access to health facilities nor lagged antenatal care use has an effect on current use of antenatal care. This is possibly due to the fact that antenatal care usage is already at high level (more than 90 percent).[41]

3.10 Heterogenous effects

Lastly, I investigate whether impact of improvement in access to the facilities had a disproportionate effect on some groups of the sample. For example, it is reasonable a new facility is likely to benefit more communities which have good road conditions than those which have bad road conditions. Table 3.14 shows the heterogenous effect by condition of the road to the nearest district town. Conditions of roads are categorized as those which are all-weather and those which are seasonal. The results show that areas which have good all-weather condition benefit from improvement of access to higher level facilities more than those with seasonal roads. In fact the quality of the road appear to explain most of the impact

[41] The sample is too small to estimate the dynamic panel model with other outcomes related to antenatal care use such as regular use of care. These outcomes are available only from the last wave of the RePEAT survey.

of improving access to higher level facilities. The quality of road infrastructure have a strong complementary effect on access to health infrastructure as expected. No heterogeneous effects by the education of the mother or the economic status of the household were found (results not shown).[42]

[INSERT TABLE 3.14 ABOUT HERE]

3.11 Conclusion

At the turn of the 21st century, the world leaders pledged to reduce the maternal mortality ratio by three quarters of the 1990 level by 2015. However, successful stories have been limited, and the goal is unlikely to be met by the majority of Sub-Saharan countries. This paper has investigated the impact of the availability of health facilities on maternal care utilization and maternal health. I have also analyzed the impact on the patterns of travel and expenditure at the facilities.

Applying the sub-county fixed effects and mother fixed effects models to the decade-long panel data from Uganda, I have demonstrated that the improvement in access to public health facility leads to a substantial increase in delivery at formal facility with SBA. In particular, an additional higher-level public health facility brings about an 18-percent increase in delivery with SBA at a formal facility. It has also increased the likelihood that a newborn baby is weighed immediately after birth-consistent with the fact that a new facility promotes delivery at a formal facility where birth weight is regularly measured. However, no positive impact is found for birth weight and the estimates are not

[42] I also attempted to estimate the long term impacts on maternal care utilization by using the lagged variables of measures of access. No long term impact were found (results not shown).

precisely estimated. This might reflect the possibilities that better access to health facility has weakened the degree of selective survival and thus decreased the average size of surviving babies. Analysis of heterogenous effects suggest that areas with good roads (all weather roads) enjoying most of the benefits of improving access to higher level facilities.

Another major finding is that an additional lower-level public health facility also increases the utilization of SBA by seven percent. It further raises the probability of regular antenatal care in every trimester. Since the lower-level facility is not supposed to handle delivery or provide comprehensive antenatal care, these results indicate that the likelihood of delivery with SBA increased probably through early diagnosis and referral, as well as the influence on women's awareness about the importance of maternal care. The analysis of the mother health outcome (complication at birth) and patterns of travel time and expenditures points to a reduction the complication, travel time and fees. However, the robustness checks suggest that these findings are likely to be correlational and not causal.

The impact found in this study compares favorably to a number of other interventions applied elsewhere. For example, the program combining the conditional cash transfer and incentives for practitioners in Nepal (Safe Delivery Incentives Program(SDIP)), provided about $15 to a mother, $5 to health workers and $16 for each facility delivery. As a result, facility delivery increased by about 17%, starting from a low base of about 16% in the control group (Powell-Jackson and Hanson, 2012). A similar program in India (Janani Suraksha Yojana) has raised facility delivery by about 17.5% (Sumit et al., 2011), and a Pay-For-Performance (P4P) scheme which provided incentives to health workers increased facility delivery by 23% in Rwanda (Basinga et al., 2011). One of the limitations in CCT

programs is that they cannot be offered in areas with no formal health facility. This underscores the importance of having minimum health infrastructure in order to provide basic maternal care. Beyond that, it is also crucial to sustain the quality of health services offered at the facility and to increase awareness for the importance of maternal care and health care in general on the demand side in order to ensure sustainable returns from the infrastructure. For example, Björkman and Svensson (2009) shows that community monitoring of health services increase accountability and improve health outcomes. The basis of all these possibilities is the existence of a health facility in the community.

Our results reveal the wide range of returns a health facility can brings about. In particular, the results are indicative of the roles played by community-level facilities which have been reaching out to a wider population in rural Uganda, and linking them with the network of more equipped higher-level health facilities. These results underscore the importance of universal health coverage or the coverage of lower-level health facilities which connect mothers in remote areas with the national health service network.

Chapter 4

Access to Health Facilities and Maternal Health: Case of Ethiopia

4.1 Introduction

WHO estimates that over 200,000 mothers die every year due to pregnancy complications (WHO, 2012). Access to maternal care during pregnancy and at birth is considered essential to reduce maternal deaths. However, even the basic form of access to maternal care (availability of those services) is still a challenge particularly in the rural settings of developing countries. Indeed, reviews on maternal health studies have placed physical accessibility (distance to facilities) among the most critical barrier to utilization of maternal care, and hence an obstacle to reducing maternal deaths (Sabine and Oona, 2009).

Nevertheless, despite calls to invest on health and health infrastructure (WHO, 2001), few rigorous studies have examined whether improving physical access to health facilities improve use of maternal care and maternal health in developing countries (Admassie et al., 2009, Frankenberg et al., 2009, Valente, 2014). The findings from these three studies generally points to a minimal role of access on use of delivery care. Among the three studies, only one examined the issue in the context of Sub-Saharan region, the region with highest burden of maternal mortality (Admassie et al., 2009). The study by Admassie et al. (2009) looks at the short to medium run impact of an ambitious program

to construct health facilities and training health extension workers in rural Ethiopia. They found that while the program increased vaccination of the children, it had no effect on antenatal or delivery care use among pregnant women. This study examine the long run impacts of the program on maternal care usage in rural Ethiopia.

Ethiopia is an interesting case study because of its surprisingly low levels of use of facilities and skilled birth attendants for deliveries, and high maternal mortality. With maternal mortality ratio (MMR) of about 676[43] (CSA and ICF International, 2012), Ethiopia has one of the highest maternal mortality ratios in Sub-Saharan. The country also has one of the lowest levels of maternal care utilization, with only about 10 percent of all births being attended by a skilled practitioner (nurse, midwife, doctor)(CSA and ICF International, 2012). Maternal deaths accounts for about 30 percent of all deaths of women of reproductive age in the country. Moreover, unlike many other countries in the region which experienced a decline in MMR over the last decade, MMR has essentially remain stagnant over the same period in Ethiopia.

In 2003 the government initiated an ambitious Health Extension Program (HEP) to construct health posts in all communities (Kebeles) in Ethiopia by 2010. The objective of the program was to improve access to health services particularly in the rural areas. HEP paid special attention on the needs for mother and children health care. The program also sought to train and deploy over 30,000 health extension workers (HEW) to be stationed in the health posts and serve the community. By 2014, the targets set by the government had all been attained. Using data of about 1358 households from 100 rural communities in

[43]Deaths per 100,000 live births

three regions of the country, this paper investigate the impact of improving access to health facilities on utilization of maternal care, which is considered the main channel for reducing maternal mortality (Starrs, 1997).

The main challenge of identifying the impacts is the well known issue of endogenous placement of the health facilities (Angeles et al., 1998, Rosenzweig and Wolpin, 1986). That is placement of the facilities may be influenced by the communities' unobserved factors which also affect usage of maternal care. Moreover, individual unobserved characteristics such as innate health or perception towards health care may influence her decision to use the care. To control for the impacts I use the mother fixed effects model. The impact is thus identified by comparing the health care choices of the mother before and after an increase in the number of facilities. The model controls for any time invariant characteristics of the mother (such as unobserved innate health), or the community (pre-existing levels of health care use that may influence allocation of health resources.).

From 2004 through 2014, the study areas experienced a massive increase in number of health facilities. In 2004 only 20 percent of the communities had a facility that provide general and antenatal care. By 2014 that figure had grown to 90 percent. Facilities providing delivery care increased from less than 20 percent to about 70 percent over the same period. Results suggest that the improving access to the facilities increased significantly use of antenatal care. Each additional facility increased the proportion of mothers who use antenatal care at least once by nine percentage points, or 13 percent. The proportion of mothers who completed the recommended four antenatal visits increased by 24 percent. However, there is no evidence to suggest any impact on use of

facilities for delivery care or skilled birth attendants. Moreover, no impact was found on reduction of pregnancy complications.

The remaining part of this chapter is organized as follows. Section two presents the background consisting of the literature review and the description of the settings of the study. Section three details the data used and the summary statistics. The empirical model and description of the variables used in the model are explained in section four. Section five presents the results and section six concludes.

4.2 Background

4.2.1 The Literature

Physical access to facilities has long been recognized as a critical barrier to health care use in both developing and developed countries' settings. For example Acton (1975) investigates the impact of travel distance on demand for medical services in New York, a setting where the municipal clinics and hospital provide free outpatient care. Distance was found to serve as price in determining the demand for health care. In addition, distance elasticity of demand for care was found to be similar to price elasticity found in other similar studies.

Also in the United States, Almond et al. (2006) reported that a significant reduction in infant mortality rates among blacks in the 1960s in the rural parts of southern states could be attributed to the improved access to health facilities. Their study examined the impact of a civil right act which mandated racial desegregation for hospitals that received federal funds. The desegregation meant that black people could access health facilities with good

quality of care. Using a community fixed effects model, their finding suggest that about 5000 to 7000 additional black infants are estimated to have survived through their first year of life between 1965-75.

Although physical access may be a crucial determinant of health care usage in developed countries (Buchmueller et al., 2006), it is in the developing countries where it considered to be critical (Stock, 1983, Thaddeus and Maine, 1994). Especially the rural areas where the availability of health facilities is likely to be limited coupled with poor transportation networks. Improving the access could lead to a substantial reduction of infant, child and maternal deaths. For example Frankenberg (1995) examined the impact of access to health facilities and health professionals in Indonesia. The study report about 43 percent increase in number of maternity clinics between 1983-86, a significant improvement in access to health facilities. Using the village fixed effect model, the study found that an additional maternal clinic reduced the odds of death of an infant by about 15 percent, compared to an infant born before the clinic was established.

Wilson (2015) examines the impact of expansion of prevention of mother-to-child transmission of HIV (PMTCT) care on fertility and child mortality risk in Zambia. Between 2000 and 2006 the number of health facilities providing PMTCT care increased by six times to about 600, a significant improvement in access to PMTCT. Using the difference-in-differences approach the study finds that introduction of the care within 20kms of a respondent reduced pregnancy rates by about 10 percent. Breastfeeding rates also improved significantly which contributes to healthy children.

However, for maternal care outcomes, there is a dearth of rigorous evidence on the

impact of access to health facilities. Majority of existing studies rely on cross-sectional comparisons without adequately controlling for endogenous placement of the facilities (Abbas and Walker, 1986, Afework et al., 2014, Do, 2009, Karim et al., 2010, Tsegay et al., 2013). In a review of barriers to utilization of maternal care, Sabine and Oona (2009) also raises concerns about interpretation of the findings from such studies (Medhanyie et al., 2012). Only four studies (Admassie et al., 2009, Frankenberg et al., 2009, Selamawit, 2013, Valente, 2014) which investigate the impact of access on maternal care use adequately controlled for the non-random placement of the facilities.

Frankenberg et al. (2009) evaluates the Indonesia midwifery program in which about 50,000 midwives were trained and placed in communities areas from late 1980s to 1998. The communities were selected on being poor and distant from health facilities. The activities of the midwives involve providing health and family planning care, collaborate with traditional birth attendants in referring pregnant mothers to get proper medical care. They use data from the Indonesia Family and Life Survey (IFLS) which shows that between 1993 and 1997 the percentage of communities with midwives increased from 9.6 percent to 46.3 percent. Mother fixed effect model is employed in evaluating the impact of having a midwife in the community. They also include some time varying characteristics at community level: road pavement, phone availability and household expenditure per capita within the community to reduce endogeneity due to time varying community factors. The results indicate that the program had a significant effect on improving the use of iron tablets during pregnancy. There was some indication of positive impact of the program on antenatal care use, although the coefficient was not significant at conventional levels

(likely due to imprecise estimation). The impact on using modern delivery care (medically oriented delivery) was positive although marginally significant.

The next study by Valente (2014) looked on the impact of access to legal abortion centers in Nepal on abortion and maternal care health inputs. The study uses Demographic Survey Data (DHS) and mother fixed effect model to estimate the impact. A linear trend specific to each community is included to control for unobserved time-varying characteristics within the community. The results indicate that although access to the centers reduced the likelihood of a live birth condition on conception by about 7.4 percentage points, there was no significant effect on use of maternal care inputs such as antenatal care or skilled birth attendants. Surprisingly, the centers appear to have increased deliveries at home, although the author did not attempt to explain this result.

The last set of papers by Admassie et al. (2009), Selamawit (2013) evaluates the impact of the Health Services Extension Program (HEP) in Ethiopia[44] which involved construction of health facilities and training and deployment of health extension workers (HEW). Admassie et al. (2009) investigates the impact in three regions of the country.[45] between 2003 and 2007. The evaluation method employed is the propensity matching method in which treatment villages (those that have been affected by HEP) were matched with control villages based on observable characteristics. The findings suggest that the program improved child immunization against major diseases by about 16 percent. However, they do not find any impact on usage of antenatal care, skilled birth attendants or postnatal care, albeit there was significant impact on reduction of time (months) the

[44]The program will be described in detail in section 4.2.3

[45]Amhara, Oromia and Southern Nations, Nationalities and Peoples (SNNP)

mother delays to make the first antenatal care visit. Selamawit (2013) looks at the impact of coverage of HEW in the region of Tigray between 2004 and 2010. Using a district fixed effect model the study found an increase in immunization of children but no effect on use of skilled practitioners for delivery.

In addition to the two studies above, Karim et al. (2013) also evaluates the HEP in Ethiopia with an additional layer of intervention. The study evaluates two years of an intervention to improve the ability of the HEW to provide essential newborn care in 101 districts. They use data from 117 communities (Kebeles) collected before and after the intervention. The measure of program intensity used in this study is potentially endogenous, since it is derived from the responses of some members of the communities regarding their exposure to/use of the program services.[46] Using the community fixed effect model, the study report an increase in use of antenatal care and postnatal care. However no effect was found on use of facilities for delivery.

The preceding review indicates that while it is considered that improving physical access to health services will generally improve uptake of all types maternal care, the evidence suggests that this may not hold in all settings. In addition, there is limited evidence to suggest that use of facilities or skilled birth attendants for delivery indeed improves. Nevertheless, it is possible that some of there programs might have impacts in the long term. In that regard, this study offers the following contributions to the existing literature. First it extend the literature on access and use of maternal care by provides

[46]The measure of program intensity is computed from a separate group of respondents, not the ones whose outcomes of interest would finally be analysed. This fact is used by the authors to suggest that the measure is unlikely to be endogenous. However, to extent that there is correlation in the unobservable characteristics with in the community, this measures is unlikely to be exogenous. Although the study evaluates the two years of the intervention to strengthen HEP the measure of intensity is derived from activities that are indicated in the original HEP.

rigorous evidence of the impact of access on maternal care use in the spirit of (Admassie et al., 2009, Frankenberg et al., 2009, Selamawit, 2013, Valente, 2014). Secondly, to my knowledge, this (together with the case study of Uganda) are the first set of individual-level longitudinal studies to provide evidence on the relationship between access and maternal care in the Sub-saharan. This allows controlling for individual level unobserved heterogeneity, a potential source of bias. Lastly, unlike existing studies which examine the impact of access by exploiting a short to medium term variations in access, the data used in this paper exploits a long term variation of access of up to a decade after full implementation of the program.

4.2.2 The context

Although Ethiopia is among the poorest nations in the world, the country has registered remarkable economic development over the last 15 years (World Bank Group, 2015). The Gross Domestic Product (GDP) grew at an annual rate of eight to 14 percent and the annual per capita growth averaged 8.3 percent between 2000 and 2011. The growth has contributed to poverty reduction. Over 50 percent of the population in the country were living under US$1.25 PPP a day in 2000. By 2011, that number had gone down to under 30 percent.

The recent improvement in standard of living has also been reflected in improvement some health outcomes. Between 2000 and 2011 under five mortality declined by about 42 percent from 166 to 88 per 1000 live births (CSA and ICF International, 2012). In 2000 about 58 percent of children under five years were stunted, an indicator of chronic malnutrition. By 2011 stunting had declined appreciably to about 44 percent of children

under five.

Despite the achievements, however, Ethiopia is facing a heavy burned of maternal morbidity and mortality. Maternal mortality accounts for about a third of all deaths of women of reproductive age (15-49years) (CSA and ICF International, 2012). Maternal mortality ratio (MMR) has remained high and stagnant. Figure 4.1 shows MMR estimates and their 94 percent confidence intervals from the available Demographic Health Surveys (DHS). The graph shows that MMR not declined significantly between 1993 and 2011. This experience is in contrast to that of the majority of other countries in the East Africa region which have experienced a significant decline in maternal mortality over the last 10 to 15 years.[47]

[INSERT FIGURE 4.1 ABOUT HERE]

The high maternal maternal deaths and morbidity in the country can partly be explained by the low usage of maternal care. Less than half of pregnant women attend antenatal care at least once. Only about 10 percent deliver at a health facility, and similar figure for those who are attended by a skilled birth practitioner. These figures implies that over 2.2 million babies are born annually without assistance of a skilled birth attendant.[48] Maternal care usage in the country is low by far even by Sub-Saharan standards (Wamai, 2009).[49]

A wide dispersion exists in maternal care usage across the eleven geographical regions.[50] For example use of skilled birth attendants in Gembela, Harari, Dire Dawa regions is at least

[47]Excluding Ethiopia and Somalia, the MMR for the other countries in the East Africa region ranges between 440 to 500 for the data as recent as 2011. Data for the war torn Somalia is only available in 2006 showing an MMR of 1000 (World Bank, 2015).

[48]Author's calculations based on the World Bank population data. With a population of about 94.1 million growing at a natural rate of about 2.6, number of births not attended by a skilled birth attendant is: $94.1\text{million} \times 0.026 \times 0.9 = 2201940$

[49]The Sub-Saharan region average use of antenatal care (at least one visit during pregnancy) is 77 percent, and about 49 percent for use of skilled birth attendants (World Bank, 2015).

[50]Ethiopia has 11 geographic/administrative regions (nine regional states and two city administrations).

27 percent, and in the capital Addis Ababa is around 83 percent. However in the other regions the usage ranges between six and 11 percent (CSA and ICF International, 2012). One of the central challenges to improve use of maternal care in the country has been access to these services especially in the rural areas where about 81 percent of the population live. To improve access to health care, and maternal care in particular a number of strategies have been taken by the government. Central among them is the community based Health Services Extension Program (HEP) initiated in 2003.

4.2.3 The Program

The HEP was part of the initiatives under the Health Sector Development Program (HSDP) which covered the period between 2002 and 2005. HEP has two key components: Construction of health posts in the villages; training and deployment of health extension workers (HEW).

The first key component of HEP involve construction and equipping health posts (HPs) in the villages where HEW would be stationed. The health post serve between 3,000 and 5,000 people (Ministry of Health, 2010). Above the health posts is the health center which serves about 15,000 to 30,000 people. The health center and the health posts are connected by a referral system to a primary hospital,[51] and the three levels of facilities form a Primary Health Care Unit (PHCU).[52] The cost of construction of the health posts was mainly financed by the local governments although communities also contributed by offering labor and construction materials. As seen in graph 4.2, the number of HPs has

[51] Primary hospital covers about 60,000 to 100,000 people.

[52] Above the PHCU are the general hospitals and specialized hospitals offering special types of health care such as reproductive care, mental care. General hospital covers 1 to 1.5 million people, and specialized hospitals covers 3.5 to 5 million people.

more than doubled between 2004 and 2014. The government planned to construct and equip 16,253 HPs by 2010, which represented 100 percent of all communities. However, this target was reached in 2014.

[INSERT FIGURE 4.2 ABOUT HERE]

The second component is training of the HEW. The government set a target of training and deploying 30,000 HEW by 2010 who were to be stationed in the HPs (Ministry of Health, 2010). The need for training new calibre of health workers arose due to a critical shortage of health workers especially in the rural areas. The pre-existing training of health workers produced clinically-oriented nurses, midwives and doctors who preferred to stay in urban areas for better professional opportunities. HEP sought to train rural-oriented community health workers who were recruited from the villages and more likely to remain there after the graduating (Nejmudin et al., 2011).

The candidates for the training are 18 years old female-members of the village with at least 10th grade education (secondary school). Female members are selected because most of the HEP health packages deal with issues affecting women and children. The selection is done by a committee nominated by the local community and representatives from the district offices. The candidates undergo a 12 month theoretical and practical training on managing the health posts, promoting preventive care, provide contraceptive, conduct safe and clean deliveries and refer cases to higher level health facilities. Upon graduation the HEW are recruited by the government and posted in the villages. The cost of training HEWs is covered by the federal government while the regional governments are responsible for the salaries of the deployed HEWs. As graph 4.3 shows, there has been a

significant increase in the number health workers overtime. Between 2004 and 2010 the number of HEW increased by more than 12 fold, surpassing the target of 30,000 HEWs set by the government.

[INSERT FIGURE 4.3 ABOUT HERE]

The roll-out of HEP was influenced by several factors ranging from availability of resources to health conditions of the communities. Admassie et al. (2009) note their discussion with health officials which suggested that communities which could raise necessary resources for construction of HPs were more likely to get the facility and the HEW earlier. Other factors included availability of female secondary school graduates with in the community, availability of other health centers near the community. Also communities with a history of poor health outcomes (including maternal outcomes) were prioritized.

While HEP has been successful in constructing HPs and deploying HEW, the services that could be offered at the HPs has been limited by the availability of necessary equipment. For example an evaluation of implementation of the HEP (Center for National Health Development in Ethiopia, and Columbia University, 2011) found that only 12 percent of the HPs were fully equipped with the minimum[53] set of supplies for provision of delivery and newborn care services. Seventy one percent of the HPs had only 40 percent of the minimum set. Because of lack of equipment, nurses or midwives certain services such as antenatal care or delivery services cannot be provided in some of the HPs.

[53]The minimum set comprise of: Blood pressure apparatus, adult weighing scale, fetoscope, delivery bed, neonatal resuscitation mask and bag, home delivery kits.

Therefore the effective provision of services may not be realized until the necessary inputs are in place. Hence the number of facilities per se might not indicate effective availability of services. The data used for this study contains specific years when the facility actually started to provide general care, antenatal and delivery care. This helps, to some degree, capture the precisely the services available at a facility in a particular year. The next section contain a detailed discussion of the data used in this study.

4.3 Data

Data for this study comes from the 2014 Ethiopia Research on Poverty, Environment and Agriculture Technologies (RePEAT) survey. The survey covered 100 communities (also known as Kebeles in Ethiopia) from three regions of Amhara, Oromiya and SNNP (Southern Nations, Nationalities and Peoples'). Approximately 14 households were randomly sampled from each of the village, making a total of 1358 households who were interviewed. RePEAT is a longitudinal survey with three waves of data (2004, 2006 and 2014). However, because of the high attrition in the first two waves, this study uses the data from only the new households that were randomly sampled in 2014.

Women aged 15 to 49 provided information about their delivery history up to ten years prior to the survey. A total of 746 women had at least one pregnancy case over the last ten years. This group of women provided information related to their health seeking behavior during pregnancy. Specifically they provided information about: where they went to receive maternal care, who attended them, modes of travel, fees for the care, travel time and transportation cost to seek the care. Because this information is asked retrospectively, there is a concern is that it may be prone to recall bias (Das et al., 2012, Ravallion,

2014).[54] However, as found by Beckett et al. (2001, 2000) on the study of the quality of retrospective data found, salient events such as births are easily and correctly recalled. Nevertheless, the exact date of birth (day, month) may not be correctly reported. The fact that the RePEAT survey asked for the year of birth helps to mitigate the recall bias.

[INSERT FIGURE 4.4 ABOUT HERE]

Figure 4.4 plots the annual average maternal care use between 2007 and 2014 for the primary outcomes of interest; antenatal care use, facility delivery and skilled birth attendance. The trends of the outcomes on the figure suggest a positive increase in utilization of maternal care particularly for antenatal care use. The proportion of mother who made at least one antenatal care visit increased from about 41 percent in 2007 to 80 percent in 2014, a 95 percent increase. Skilled birth attendance and facility delivery more than doubled from around 17 percent in 2007, to about 38 percent in 2014. The average utilization of maternal care is indicated in table 4.1. In 67 percent of all pregnancy cases mothers made at least one antenatal care visit to a health facility. However in about six percent of the cases, mothers reported visiting a health facility for antenatal care but not receive antenatal care from a skilled practitioner.

The positive trends suggests an improvement in utilization of maternal care overtime. Whether and to what extent this improvement can be attributed to better access to health services is the question that this study is aimed to address.

[INSERT TABLE 4.1 ABOUT HERE]

[54] This may be more of a concern for the Ethiopia study which employs the 10 years recall period, longer than conventional five years employed in the Uganda case and Demographic Health Surveys.

The RePEAT survey collected historical information about availability of health facilities within the community. Specifically, the community questionnaire asked about health facilities which are available, the year the facilities started providing: general health care, antenatal care and delivery care. This information was provided by the community's development agents[55] or health workers in the community. Additional phone calls were made to other community leaders to insure reliability of the information. Then I categorized facilities into three types depending on the year they started to provide each of the three types of care. Those that provide general health care (general care facilities), those that provide antenatal care (antenatal care facilities), and those that provide delivery care (delivery care facilities).

A typical facility in the community started by providing general care, then proceeded to provide antenatal care after two or three years, and initiate delivery care services about two years after starting to provide antenatal care. Therefore these categories are not mutually exclusive. A facility may provide all three types of health services and hence it will be counted in all of the three categories.

Figure 4.6 plots the yearly average number of facilities (of each category) per community from 2004 to 2014. The average number of facilities per community of all three categories has grown rapidly over the ten years period, starting from a low level in the initial years. By 2014, on average, each community had a facility that provides both general and antenatal care. The average number of delivery facilities also rose sharply from less than 0.2 to about 0.8 by 2014. Table 4.2 indicates that the overall number of

[55] Government employees stationed in the community to oversee agricultural and other development activities.

general facilities per community was 0.77, while that for antenatal care and delivery care facilities were 0.68 and 0.5 respectively. The empirical model in the next section will exploit the variation in availability of health services across communities in estimating the impact of increase in availability of the services on use of maternal care.

[INSERT FIGURE 4.6 ABOUT HERE]

[INSERT FIGURE 4.6 ABOUT HERE]

[INSERT TABLE 4.2 ABOUT HERE]

4.4 Empirical model

To investigate the impact of the increase in number of facilities (access to maternal care) I use the mother fixed effects model. In this model the impact is identified by comparing the health care choice of the mother before and after an increase in the number of facilities. The model control for time-invariant unobserved (community or individual) factors that are correlated with both health facility placement and use of maternal care. A regional time trend is also included to control for time-varying factors are regional level. The following empirical model is estimated:

$$M_{ijhkt} = \beta_1 * Access_{kt} + \beta_2 * Z_{jhkt} + \eta_{jhk} + \mu_k + \lambda_{rt} + \nu_{ijhkt} \quad \text{(i)}$$

M_{ijhkt} represents the outcome of interest for pregnancy i of mother j in household h, living in community k in year t. *Access* is the explanatory variable of interest which

captures availability of health services within the community in a particular year. Specifically, *Access* is number of facilities providing a particular type of maternal care service in the community. The *Access* also include measures of availability of general care services to account for the fact that these services might influence utilization of maternal maternal care through provision of health education or information about where the mother may go for maternal services.

Z_{jhkt} is a set of control variables consisting of Mother's age in the year of delivery and Parity of the pregnancy. They control for any experience with pregnancy that might comes with age. The age variable also controls for any birth cohort effects. The parity is constructed from all the pregnancies that the mother has experienced in her life and not just in ten years prior to the survey.

Maternal education is the highest grade attended by the mother at the year of the survey. The role of maternal education on reproductive and maternal health has well been documented in the literature Glewwe (1999). Women who have attended formal schooling have higher propensity of using modern care including maternal care. [56] The household economic wellbeing is controlled using per capita household land size and per capita value of assets. Per capita household land size is computed by dividing the yearly-total household land size by the number of household members. RePEAT data contains information on the year when each of the household land parcel was purchased or sold. We use that information to construct the total household land size available to the household for each particular year. Per capita value of assets variable is generated from

[56] Because grade attainment does not change overtime in the data used in this study, the coefficient of this variable is not estimated in the mother fixed effect model but rather in the community fixed effect model which I did as part of the robustness checks.

the total value of assets (physical assets and livestock) owned by the household at the time of survey.[57]

η_{jhk} represents unobserved characteristics peculiar to the mother such as mother's innate health. For example, it is possible that mother's with weak innate health, which is not observed by researchers, may be more pro-active in seeking health care merely because of their poor innate health and not improvement in availability of health care. Similarly, μ_k are the unobserved characteristics peculiar the community k which influence allocation of health facilities as well as utilization of health care. They include for instance bargaining power of political leaders and the community. A leader/community which is more "health conscious" and has strong bargaining power is likely to have a higher number of facilities than otherwise. The mother fixed effect model eliminate biases introduced by such individual or community's time-invariant factors.

λ_{rt} is the regional-year trend which controls for regional wide changes in factors that may affect both utilization and availability of maternal care such as changes in quality of transportation, road networks and region's economic performance. ν_{ijhkt} is the error term clustered at community level to take into account of intra-community correlation of the error terms. I use the linear probability model to estimate equation i. The next section presents results from estimation of the mother fixed effect model for the outcomes on utilization of maternal care, health status and expenditures.

[57] This information does not vary over time and hence not estimable in the mother fixed effects.

4.5 Results

The results from the estimation of the mother fixed effect are presented in tables 4.3 to 4.6. Table 4.3 shows the impact of access to antenatal care facilities on antenatal care usage.

4.5.1 Antenatal care use

Overall the results suggests that improving access to antenatal care facilities leads to an increase in utilization of antenatal care. Column one indicates that an additional antenatal care facility leads to a nine percentage points increase in the share of women who make at least one antenatal care visit. The proportion of those who make at least four antenatal visits[58] increase by 10 percentage points. The share of women who attend facility for antenatal and were received the care from the skilled practitioner also increased although the coefficient is precisely estimated. The other control variables are not significantly associated with use of antenatal care.

[INSERT TABLE 4.3 ABOUT HERE]

4.5.2 Delivery care use

Unlike the results for antenatal care, there is no evidence to suggest that improvement in access to delivery facilities (Table 4.4). The coefficients and their respective t-statistics are too small to suggest any meaningful relationship between access to delivery facilities and utilization of delivery care. These results suggest that the increase in delivery care use

[58] Recommended by the World Health Organization (WHO)

noted in graph 4.4 -though not as large as increase in antenatal care use- was primarily driven by some other factors apart from improvement in access to health facilities.

Parity is the only correlate that is significantly associated with use of facility delivery. Parity dummies indicate that mothers who had delivery before are less likely to use delivery care compared to those who were experiencing pregnancy for the first time. For the 2nd birth for example, mothers are about 13 percentage points less likely to use delivery care relative to those who are giving birth for the first time.

[INSERT TABLE 4.4 ABOUT HERE]

4.5.3 Complications and postnatal care

Similar to the findings on delivery care use, there is no evidence to suggest that access to delivery facilities reduced incidences of pregnancy complications or use of postnatal care (Table 4.5). These results are not surprising given that there was no improvement in use of delivery care. Nevertheless, in a separate analysis (results not shown) no significant relationships was found between access to antenatal care, or general care on those outcomes. Thus although the share of women who attend antenatal care increased, these women were still less likely to use postnatal or delivery care. This suggests that while non-availability of services may be a barriers to use of antenatal care, a different set of barriers may prevent use of delivery and postnatal care.

Again, higher parity is associated with less occurrence of complication, less likelihood of the mother or their baby to receive postnatal care. Surprisingly, household wealth in terms of assets is positively associated with reports of occurrence of pregnancy complication.

[INSERT TABLE 4.5 ABOUT HERE]

4.5.4 Fees and expenditures

The increase in utilization of antenatal care reported in table 4.3 might be driven by reduction in travel time[59] to the health facilities as they become more available. Moreover, although in Ethiopia maternal care in public facilities is officially "free", in practise mothers still reported paying some amount for the care at the facilities. The cost of the care may decline if more services becomes available.

However despite the increase in antenatal care use, there is no evidence to suggest that this was driven by the reduction in travel time or fees (Table 4.6). It is important to note that the sample size in this analysis is reduced by almost 43 percent because it involve mothers a fraction of mothers who have sought some formal antenatal care (typically at a health facility). The small sample size may have led to a low statistical power to detect an effect.

[INSERT TABLE 4.6 ABOUT HERE]

4.5.5 Effect of past experience with using maternal care

I extend the analysis of this study by investigating the effect of past experience with usage of maternal care. Past experience with using maternal care can influence mother's current behavior towards the care in a number of ways. Those who have used the care in the past and had good experience with the care providers may be more likely to use the it in the future possibly because of personal relationships established with the care provider,

[59]The travel time examined is for those who walked to the facilities for antenatal care. Majority of the pregnancy cases (81 percent) mothers walked to the antenatal facilities.

who might encourage their clients to use the care in their future pregnancy cases. Also, after the first visit, the mother may be better aware of the requirements, location, means of transport, and thus can better prepare when the need arise. On the other hand, an unpleasant experience with the care provider in her past pregnancy cases may discourage her to use maternal care in future pregnancy cases. Moreover, similar to the Uganda case study, controlling for the use of the care in the previous pregnancy helps to account for the possibility that the increase in use of antenatal care may be driven by poor pregnancy outcomes in previous pregnancies.

To introduce the effect of the past experience in the model, I estimate a dynamic panel model. A lag of the outcome variable is introduced as one of the regressors in the model.[60] Therefore only mothers who had at least two pregnancy cases are included in the analysis, this explains the drop in sample size. The following model is estimated:

$$M_{sjhkt} = \beta_1 * M_{s-1jhkt} + \beta_2 * Access_{kt} + \beta_3 * Z_{jhkt} + \mu_{jhk} + \lambda_{rt} + \nu_{sjhkt} \quad \text{(ii)}$$

- M_{sjhkt} : 1 if she used the care in the birth round s.
- t = 2000, 2001 ..., 2012
- s (birth round) = 1, 2, 3, 4

M_{sjhkt} is an indicator of maternal care use in birth round s of mother j in household h in community k in the year t. The description of the other variables used in the model is similar to that in section 4.4. Apart from the introduction of the lagged outcome as a

[60] I also attempted to introduce two lags, however the sample was too small to estimate the model precisely as only mothers who reported at least three pregnancy cases in the last ten years (Only 35 percent of the mothers) were included.

regressor, the variables used are similar to those described in section 4.4. Clearly if the error terms are correlated then the lagged variable will be correlated with the error term and therefore β_1 will not be consistently estimated without appropriate instruments. We can test the assumption of serial correlation using the autocorrelation test.

The method used to estimated the model follows an extension of Arellano-Bond estimator (Cameron and Trivedi, 2010). The model is estimated in first differences which eliminates μ_j. The estimator is based on the assumption that:

$$E(M_{(s-L)jhkt} \triangle \nu_{sjhkt}) = 0 \qquad \text{for L} > 1. \qquad \text{(iii)}$$

This allows lags $M_{s,t-2}$, $M_{s,t-3}$ ...to be used as the instruments in the first-difference of equation ii. Blundell and Bond (1998) and Arellano and Bover (1995) suggest an extension of Arellano-Bond estimator utilizing an additional condition that:

$$E(\triangle M_{(s-L)jhkt} \nu_{sjhkt}) = 0 \qquad \text{for L} > 2. \qquad \text{(iv)}$$

which allows lagged first differences ($\triangle M_{(s-1),jht}$) to be used additional instruments. Because naturally the model is over-identified (more instruments than parameters to be estimated), we can test the validity of the over-identifying restrictions using Sargan test. Tables 4.7, 4.8 and 4.9 presents the results from the estimation of the linear dynamic model.

Table 4.7 shows the effects of access and the previous use of antenatal care. As seen on the table, the results from the Sargan tests suggest that we cannot reject the null hypothesis that the over-identifying instruments are valid. The autocorrelation tests indicate that the error terms are not correlated.[61] The results show that mothers who have used antenatal care in their previous pregnancies are more likely to use the care in their current ones as well. A mother who attended antenatal care at a facility in her previous pregnancy is 48 percentage points more likely to use care in her current pregnancy, compared to the one who did not. Those who completed at least four recommended visits in their previous pregnancies are also more likely to do the same in their current pregnancies. Moreover, access to antenatal care facilities improve the likelihood of receiving antenatal care from a skilled provider[62].

[INSERT TABLE 4.7 ABOUT HERE]

Table 4.8 shows the results of the effect of access and previous use of delivery care. The Sargan test and autocorrelation tests reported on the table suggests that the instruments are valid and no autocorrelation in error terms respectively. The results show that mothers who delivered at a facility or by a skilled practitioner in their previous pregnancy, are no more likely to use the care in the care in the current pregnancy, relative to those who did not use the service in their previous pregnancy. Consistent with the main results in table 4.4 there is no effect of improving access to delivery facilities on use of delivery care.

[61] Cannot reject the null hypothesis of no autocorrelation at conventional significance levels. The differenced-error terms should not exhibit autocorrelation of order above one (order two, three etc) for the assumption of no correlation in error terms to be valid.

[62] There is high correlation between the measures of access to general care and antenatal care facilities, making it difficult to identify the effect of each variable separately When the two access measures are entered into the model one at a time, the results suggest that the effect is driven by antenatal care facilities. See the appendix tables 11 and 12.

[INSERT TABLE 4.8 ABOUT HERE]

Table 4.9 shows the results of the effect of access and previous use of postnatal care (for the mother or the child). Usage of postnatal care for the child in the previous pregnancy is associated with current usage of the care. Moreover, the results do not suggest any statistically significant association between access to facilities and usage of postnatal care, echoing the mother fixed effect results in table 4.5.

[INSERT TABLE 4.9 ABOUT HERE]

To conclude, the results from the dynamic panel model estimation are to a good degree in line with the main results of from the mother fixed effect model. They suggest that improvement in access led to an increase in antenatal care use, and this was not merely driven by mothers who opt to use the care because of the poor pregnancy outcomes in their previous pregnancies. Also, there is generally no impact of access on the other types of maternal care.

4.6 Discussion and conclusion

This paper looks at the impact of access to health facilities on use of maternal care in rural Ethiopia. The country has one of the lowest usage of formal delivery care in the Sub-Saharan and a high maternal mortality ratio. Since 2003 the government of Ethiopia has embarked on an ambitious program of expanding the coverage of the health posts (HPs) and deploying health extension workers(HEW). By 2014 more than 30,000 HEW had been deployed and over 16200 HPs built. Using data from 100 communities in three regions of

Ethiopia, I employ mother fixed effect model to study the impact of the program on usage of antenatal care, facility delivery and skilled birth attendants. The results suggest that the program improved the use of antenatal care by about 13 percent for each additional facility. The proportion of mothers who completed the recommended four antenatal care visits increased by about 24 percent. However, no impact was found on use of skilled birth attendants or facilities for delivery.

With over $1.3 billion[63] spent on construction of the HPs and training HEW, these results are not encouraging for a country that is striving to reduce maternal deaths. My findings on use of skilled birth attendants resonates with those of Admassie et al. (2009) which evaluated short or medium term impact of the HEP. It is useful to note that, while there has been massive investment on the health infrastructure and workforce over the last decade, the use of skilled birth attendants rose from only six percent in 2000 to 10 percent in 2011 (CSA and ICF International, 2001, 2012), which was far less compared to the government's target of 27 percent skilled attendance by 2011.

Why no impact in the use of formal delivery care? One reason could be that a large proportion of women do not fully comprehend the risks of not delivering by a skilled practitioner. While I do not have data to check this possibility, the Demographic Health Survey of Ethiopia (CSA and ICF International, 2012) asked mothers who did not deliver at the health facilities - who represent about 90 percent of all delivery cases reported in the nationally representative survey- the reasons behind their choice of delivery care. Sixty one percent of the mothers said that it was not necessary, and 31 percent mentioned that it

[63]The cost of constructing one HP is estimated to be about $75,000 (Admassie et al., 2009). The HEW training costs around $3,300, comprising of: 12 months $83 stipend; $234 for three months theoretical training; and $178 nine months practical training (Nejmudin et al., 2011).

was not customary.[64]

Given the high prevalence of maternal morbidity in the country, it will be interesting to examine why such a large fraction of mother think that delivering at a facility was not necessary. However, their feedback provides a useful starting point for considering the policy implications and recommendations from the findings of this study. While HEP was to a good degree successful in increasing investment in the health infrastructure, the findings from this study suggests that health policies in Ethiopia will need pay close attention on other barriers to utilization of maternal care. These may include dissemination of knowledge about the importance of using maternal care.

In a setting in which health infrastructure is present but utilization of maternal care is low, small financial incentives may help to increase demand for the care (World Bank Group, 2013). The incentives can be on both health care providers and users. This policy has been experimented in settings similar to those of Ethiopia -where the infrastructure is available- in: Rwanda (Basinga et al., 2011), Nepal (Powell-Jackson and Hanson, 2012) and India (Sumit et al., 2011).

This study, however, is not without caveats. The measure of access to health facilities used is this study is less precise as it does not take into account the distance actually the mother has to travel to the facility. Also, although the data indicates which services are available at a facility in a particular year, the quality of that service is not captured. Despite these caveats, the findings of this study may open a policy dialogue about measures that can be taking under the HEP, to improve use of maternal care. Future

[64] In Amhara region, 56 percent said it was not necessary and 36 percent said it was not customary. The figures for Oromiya region were 64 percent and 29 percent respectively. Those of SNNP region were 65 percent and 26 percent respectively.

research may also investigate other interventions that may complement HEP to improve the program's effectiveness in serving mothers.

Chapter 5

Conclusion and Policy Implications

This thesis sets out to investigate the impact of improving physical access to health facilities on use of maternal care. This is an important issue because, while over 200,000 mothers loose their lives annually due to pregnancy complication (WHO, 2014), these deaths could easily be averted by ensuring that expecting women use proper maternal care. Maternal care, especially use of skilled practitioners is considered vital for reducing the burden of maternal deaths (Starrs, 1997). Investing in health infrastructure is viewed as essential to improve use of health care and maternal care in particular (WHO, 2001). This view has led government and development agencies to invest considerable amount of funding to expand health services with the aim of improving use of maternal care and eventually health outcomes (Ministry of Health, 2010).

A number of papers have studied the impact of access on the use of maternal care (Abbas and Walker, 1986, Do, 2009, Gage and Calixte, 2006, Overbosch et al., 2004, Tsegay et al., 2013). However, majority of these studies do not adequately control for endogenous placement of the health facilities. As a result, it is not clear how their estimates should be interpreted since placement of the health facilities is unlikely to be random, and likely to be correlated with usage of maternal care services in the communities.

My review of the literature found only three studies which attempted to control for the endogenous placement of the facilities (Admassie et al., 2009, Frankenberg et al., 2009, Valente, 2014). These studies look on the impact of the short to medium term changes in access to health facilities, and only one of them in the Sub-Saharan region (Admassie et al., 2009). The findings from these studies suggests little or no impact of use of maternal care. This thesis contributes in the literature in the following ways. First it extend the literature on access and use of maternal care by provides rigorous evidence of the impact of access on maternal care use in the direction of (Admassie et al., 2009, Frankenberg et al., 2009, Valente, 2014). Secondly, to my knowledge, this is the first longitudinal study to provide rigorous evidence on the relationship between physical access and maternal care use in Sub-saharan Africa, the region with the highest maternal morbidity and lowest maternal care use. Lastly, unlike existing studies which examine the short/medium term variation in access to the facilities, the data used in this paper allows exploring the long term variations spanning more than a decade.

I examine the impact of access in the context of Uganda and Ethiopia. The two countries are of interest because of their remarkable differences in terms of utilization of maternal care. While in Uganda over 90 percent of pregnant women attend antenatal care at least once, less than half do so in Ethiopia. Also, only about 10 percent of deliveries in Ethiopia are attended by skilled practitioners while in Uganda at least half of the deliveries are attended by skilled practitioners. The other interesting feature of these countries is that in the early 2000s both countries initiated similar programs to expand the health system especially rural areas, with special attention given to the mother and child health care. As a results of the

programs there was substantial improvement in terms of access to maternal care in both countries over the last decade.

Using RePEAT data from about 87 communities and 100 communities in Uganda and Ethiopia respectively, I employ the mother fixed effects model to evaluate the impact of the programs on use of antenatal care, delivery care and skilled birth attendants. The findings indicate that while in Uganda the program was effective in increasing utilization of these services, the impact of the program in Ethiopia was only limited to use of antenatal care. The program in Ethiopia did not have any impact on use of health facilities for delivery or skilled birth attendants, although the proportion of mothers who make at least one antenatal care visit increased by about 13 percent for each additional facility opened. In Uganda on the other hand, use of facility delivery and skilled birth attendants increase by at least 18 percent for an additional higher level facility. Utilization of regular antenatal care increased significantly. Improvement in access to higher level facilities increased the proportion of infants who are weighed at birth, reinforcing the finding that access improvement has increased facility deliveries.

The size of the positive effects in both studies are considerable, nevertheless they explain only a fraction of the increase in maternal care observed during the analysis period in the study area. For example, in the case of Uganda, although facility delivery increased by about 60 percent (about 25 percentage points) between 2000 and 2012, only about 28 percent of this increase can be explained by the total increase in number of higher level health facilities.[65] In Ethiopia, of the 86 percent (about 37 percentage points) increase in the use

[65]Fifty nine new higher level facilities were established in the survey communities over the period of analysis. Given that the total number of parishes in all the sub-counties of the study area is 513, the increase in higher level facilities represented a 0.115 increase in number of higher level facilities per parish (0.115=59/513). From the table 3.4, an additional increase in number of higher level

of antenatal care (at least once during pregnancy) observed over the analysis period, only 20 percent can be attributed to the improvement in access.[66] This suggests that other factors that may influence utilization of maternal care should not be overlooked in formulating strategies to improve health of women.

A natural question from these findings is why did the program in Uganda have a significant impact on maternal care use and the one in Ethiopia did not? While these programs were not identical, they were arguably similar in terms of the goals and investments that were made. In both cases the data shows the programs were, to a good degree, successfully implemented as indicated by the substantial increase in the number of operating health facilities. The fact that supply of health care was indeed achieved suggests that we should look for other barriers perhaps on the demand side.

Although I do not have sufficient data to analyse the demand side constraints, the nationally representative Demographic Health Surveys (DHS) (CSA and ICF International, 2012, UBOS and ICF International, 2012) of the two countries provide detailed account of barriers to utilization of maternal care that were cited by women. In Uganda for instance the most cited barriers were: Lack of money, distance to the health facilities and quality of the care[67]. In Ethiopia on the other hand, majority of mothers indicated that they did not use health facilities for delivery because it was not necessary (61 percent) or it was not

facilities per parish led to a 0.6 increase in use of skilled birth attendants at a facility. This translates to about 7 percentage points in skilled attendance attributed to total increase in higher level facilities (0.6×0.115). The 7% increase attributable to the increase in higher level facilities represents 28% (7 percentage points ⁄ 25 percentage points) of the overall increase in use of skilled birth attendance observed.

[66]The average number of antenatal care facilities in a Kebele increase by 0.81 from 2005 to 2014. From table 4.3, the impact of antenatal care facilities is about 9 percentage points, which translates to about 7.29 percentage points increase in antenatal care use over the analysis period (9 percentage points × 0.81). This accounts for about 20% (7.29%⁄37%) of the overall increase in antenatal care use between 2005 and 2014.

[67]Two of these commonly cited barriers (distance and quality of care) are in fact supply side issue that the program in Uganda was addressing. Note that these two were also cited as factors that determine place of delivery by mothers in the RePEAT survey.

customary (31 percent). Less than 15 percent cited distance to the facilities or problems in transportation. One of the implications from these responses is that a significant proportion of women in Ethiopia do not fully comprehend the risks associated with giving birth without assistance of a skilled practitioner, despite the prevailing high maternal deaths in the country.

In addition to the demand side challenges discussed above, two other technical reasons may also explain the difference in the results of the Uganda and Ethiopia cases, albeit to a lesser extent. The first one is related to the imprecision the measure of access employed which captures only the availability of services within a geographical location and not the actual distances from the household to the facilities. This is a greater challenge in the case of Ethiopia because Kebeles are generally of smaller area size (relative to Sub-counties in Uganda), hence increasing the likelihood that the members of the community could be accessing the services outside the Kebele. This imprecision of the measurement leads to the attenuation bias which biases our estimates toward zero. The bias may partly explain the insignificance of the impact on delivery care outcomes in the Ethiopia study. Overall, the estimates reported in the two studies should be interpreted as lower-bound estimates in the light of potential attenuation bias.

The second is the issue of migration which might have taken place before the commencement of the surveys. This is potentially a more concern in the Ethiopia case because the data comes from the newly sampled households in only the last wave of the RePEAT survey.[68] Indeed the latest Ethiopia census shows an average of 15 percent female

[68]For the case of Uganda, I use data from all available four waves of the RePEAT beginning with the initial wave of 2003.

migration rate for the three regions studies in the Ethiopia case (CSA , 2007).[69] Although I do have data to ascertain whether the woman was living in the Kebele as of 2005, -the earliest year of analysis- the mother fixed model purge the estimates from bias due to endogenous migration related to unobserved fixed characteristics of the mother. Selective migration that might have taken place before 2005 will only affect the external validity of the results. For example if women of certain characteristics migrated out of the communities which also experienced an increase in number of facilities, then the findings of this study will be applicable to the group of women who remained in the communities over the period of analysis (2005 and 2014).

The last caveat is related to the measure of complication employed in both Uganda and Ethiopia. This variable is derived from the following question: "At the time that you gave birth to (name of the child) were you experiencing any complications?" The responses included No complication, excessive bleeding, ectopic pregnancies, fever, headache and so on. Some of these complications could be identified more precisely if the mother was assisted by a skilled practitioner during birth i.e. whether bleeding was excessive. This implies that there may be under reporting of pregnancy cases for women who were not assisted by the practitioners. As a result of the under reporting, the impact of access on complication at birth may be biased towards zero and hence could be considered lower bound estimates.

The way forward for Ethiopia may lie on increasing awareness of the importance of using skilled attendants for deliveries to reduce the risk of maternal deaths. We have seen

[69]The ratios of female migrants to female population size for Amhara, Oromiya and SNNP are 14%, 17% and 14%.

that the program in Ethiopia at least induced mothers to use antenatal care. This presents an opportunity to provide the knowledge about the potential risks by reaching out to mothers during the antenatal care period. Specific public health policies may be designed to disseminated knowledge about the importance of using delivery care.

Moreover, both countries may benefit by designing some financial incentives on the demand or supply side to boost use of maternal care (Basinga et al., 2011, Sumit et al., 2011, World Bank Group, 2013). These kind of interventions may perform better where health infrastructure is available as is already the case in some parts of Uganda and Ethiopia (Powell-Jackson and Hanson, 2012). However, whether financial incentives complement substantially improvements in access to the facilities in the East Africa region is a question of future research.

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Tables and figures

TABLE 3.1: REASON FOR CHOOSING A PARTICULAR PLACE FOR DELIVERY.

Reason	No.	%
Better access	544	39.4
Good quality of service	385	27.9
Less waiting time	196	14.2
Cheaper	140	10.2
No need(was confident that everything was fine)	78	5.7
Harassment by medical personnel	15	1.1
Lack of transport	11	0.8
Medical attendant nearby	10	0.7
Total	1,379	100

Source:RePEAT data.

TABLE 3.2: SUMMARY STATISTICS: HOUSEHOLD DATA

Variable	Obs	Mean	Std. Dev.
A.Outcome variables			
1 if Antenatal care	2397	.93	.25
1 if Facility delivery	2335	.57	.5
1 if Skilled birth attendance (SBA)	2294	.56	.5
1 if Regular antenatal care	1300	.43	.5
1 if SBA at a facility	2335	.53	.5
1 if baby weight was measured	1359	.57	.5
Baby's birthweight	703	3.44	.81
1 if birthweight is < 2.5Kgs	703	.08	.26
1 if Big baby(perceived to be bigger than others)	1302	.48	.5
1 if Complication(during delivery)	1366	.16	.37
Travel time for Antenatal Care	2394	47.08	44
Travel time for Delivery	2352	21.15	37.05
Transportation fee for Antenatal care	1453	1275.88	2862.55
Transportation fee for Delivery	906	3249.33	7771.87
1 if paid for transport(Antenatal)	1510	.48	.5
1 if paid for transport(Delivery)	1127	.63	.48
1 if paid for Antenatal care	2257	.51	.5
1 if paid for delivery care	1918	.66	.48
Fee for Antenatal care	2257	1717.69	6342.27
Fee for delivery care	1918	12063.6	26676.03
B.Mother variables			
Age (at pregnancy)	2399	28.09	7.34
Mother's education (grades completed)	2374	4.9	3.28
No formal education	2374	.16	.37
Some primary education	2374	.51	.5
Completed primary education	2374	.18	.39
More than primary education	2374	.15	.35
1th quartile	2406	.26	.44
2th quartile	2406	.27	.44
3th quartile	2406	.24	.43
4th quartile(richest)	2406	.23	.42
Altitude in 1000mts	2404	1.31	.28
log household landsize (per capita acres)	2385	-1.08	.95

Source:RePEAT data.

Quartile indicators computed based on values of Assets and Livestock.

TABLE 3.3: SUMMARY STATISTICS:ACCESS MEASURES

Variable	Obs	Mean	Std. Dev.
Number of higher level facility per parish(Public)	1131	.22	.15
Number of level 2 facility per parish(Public)	1131	.27	.29
Number of facilities per parish (Non Public)	1131	.17	.22
1 if road to nearest district town is all-weather	1131	.85	.35

Source:Uganda health facility inventory data.
All-weather roads include tarmac and paved ones.

Table 3.4: Impact of improving access to health facilities

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS				Sub-county Fixed effects				Mother Fixed effects			
	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA
Number of higher level facility per parish(Public)	0.34***	0.16	0.22	0.21	0.15	0.50**	0.54***	0.54***	0.13	0.53**	0.60***	0.54**
	(2.83)	(0.94)	(1.34)	(1.29)	(0.94)	(2.45)	(2.76)	(2.74)	(0.77)	(2.30)	(2.82)	(2.51)
Number of level 2 facility per parish(Public)	0.07	-0.07	-0.06	-0.06	0.06	0.09*	0.09	0.06	0.18*	0.23**	0.25**	0.20**
	(1.24)	(-0.83)	(-0.70)	(-0.85)	(1.15)	(1.78)	(1.54)	(1.15)	(1.80)	(2.22)	(2.47)	(1.99)
Number of facilities per parish (Non Public)	0.03	0.11	0.15	0.14	0.16	0.22	0.23	0.24	-0.17	0.03	0.15	0.18
	(0.26)	(0.66)	(0.89)	(0.89)	(0.85)	(1.05)	(1.09)	(1.15)	(-0.99)	(0.11)	(0.54)	(0.73)
Observations	1,125	2,275	2,275	2,237	1,125	2,275	2,275	2,237	934	1,992	1,992	1,964
R-squared	0.10	0.33	0.31	0.31	0.08	0.25	0.25	0.25	0.06	0.43	0.43	0.44
Subcounty FE	No	No	No	No	No	Yes	Yes	Yes	No			
Year × Region	Yes				Yes				Yes			
Year × District		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes
Number of Mothers									456	808	808	804
Mother FE										Yes	Yes	Yes
Number of Sub-counties					86	87	87	87				

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at sub-county level. All regressions include a constant.
4). Regressions for the Regularcare outcome includes region-year interaction because of limited sample size. The regressions for the remaining outcomes include year-district interaction.

TABLE 3.5: IMPACT ON HEALTH OUTCOMES

VARIABLES	(1) 1 if Complication(during delivery)	(2) 1 if baby weight was measured	(3) Baby's birthweight	(4) 1 if birthweight is < 2.5Kgs	(5) 1 if Big baby
Number of higher level facility per parish(Public)	-0.04	0.81***	-1.16	0.72	-0.39
	(-0.26)	(4.47)	(-1.46)	(1.61)	(-1.66)
Number of level 2 facility per parish(Public)	-0.22**	0.02	-0.45	0.39	-0.19
	(-2.11)	(0.19)	(-1.06)	(1.42)	(-1.02)
Number of facilities per parish (Non Public)	-0.60**	0.29	-0.79	0.33	-0.14
	(-2.02)	(1.01)	(-0.74)	(0.72)	(-0.25)
Observations	1,340	1,334	689	689	1,276
R-squared	0.36	0.36	0.46	0.49	0.36
Number of Sub-counties	86	86	81	81	86
Subcounty FE	Yes	Yes	Yes	Yes	Yes
Year × Regional	Yes	Yes	Yes	Yes	Yes

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at sub-county level. All regressions include controls for age education parity log of household land size indicator for poverty quartile year-district interaction and a constant

TABLE 3.6: EFFECTS OF ACCESS TO HEALTH FACILITY ON TRAVEL TIME AND COSTS TO MATERNAL CARE

VARIABLES	(1) Travel time for Antenatal Care	(2) Travel time for Delivery	(3) Transportation costs for Antenatal care	(4) Transportation costs for Delivery
Number of higher level facility per parish(Public)	-19.44	33.32***	-438.99	-21,207.59*
	(-0.57)	(3.07)	(-0.34)	(-1.84)
Number of level 2 facility per parish(Public)	-24.60*	2.84	-1,641.72**	-3,814.38
	(-1.89)	(0.37)	(-2.01)	(-0.68)
Number of facilities per parish (Non Public)	-68.10*	11.44	-964.30	-2,948.20
	(-1.94)	(0.57)	(-0.60)	(-0.32)
Some primary education	-3.90	2.41	-55.82	-784.21
	(-0.46)	(0.49)	(-0.12)	(-0.67)
Completed primary education	-5.41	11.99*	-37.77	-1,184.55
	(-0.55)	(1.84)	(-0.09)	(-0.94)
More than primary education	-15.75	7.26	21.43	1,976.91
	(-1.61)	(1.28)	(0.04)	(1.08)
Age (at pregnancy)	3.56**	-0.09	-11.68	96.72
	(2.23)	(-0.07)	(-0.07)	(0.25)
Age^2	-0.06**	0.00	0.13	-1.12
	(-2.14)	(0.08)	(0.05)	(-0.16)
log household landsize (per capita acres)	-1.00	0.61	272.77	-15.61
	(-0.37)	(0.28)	(1.13)	(-0.04)
2nd quartile	-0.70	1.43	144.30	-596.57
	(-0.10)	(0.26)	(0.71)	(-0.54)
3rd quartile	-8.16	0.91	680.42**	241.14
	(-1.20)	(0.18)	(2.12)	(0.22)
4th quartile(richest)	-5.67	0.63	249.69	2,365.82*
	(-0.75)	(0.11)	(0.69)	(1.87)
altitude	-0.00	0.01	-0.37	1.15
	(-0.20)	(0.32)	(-0.46)	(0.51)
Observations	1,379	1,379	1,200	888
R-squared	0.24	0.25	0.45	0.27
Number of Sub-counties	86	86	86	84
Subcounty FE	Yes	Yes	Yes	Yes
Year × Regional	Yes	Yes	Yes	Yes

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at sub-county level. FE regressions include sub-county's fixed effects. All regressions include year-regional interaction and a constant

TABLE 3.7: TRENDS ROBUSTNESS CHECK:BEFORE OPENING OF A NEW HIGHER LEVEL PUBLIC FACILITY

VARIABLES	(1) Travel time for Antenatal Care	(2) Travel time for Delivery	(3) Transportation fee for Antenatal care	(4) Transportation fee for Delivery
Year_2001	11.64	19.92**	-439.08	-785.53
	(1.07)	(2.50)	(-0.35)	(-0.31)
Year_2002	86.91***	19.63**	-2,897.90*	-4,416.28
	(8.37)	(2.47)	(-1.88)	(-1.29)
Year_2003	-15.93	15.63**	-3,455.69***	-5,255.53*
	(-1.61)	(2.60)	(-3.44)	(-1.70)
Year_2004	-10.39	3.95	-2,393.57**	2,646.65
	(-1.21)	(0.60)	(-2.56)	(0.25)
Year_2005	-24.19**	5.10	-1,382.12*	-7,007.36***
	(-2.53)	(0.63)	(-1.86)	(-3.34)
Year_2006	-73.49***	-4.72	-2,392.33***	-770.40
	(-4.38)	(-0.58)	(-2.91)	(-0.29)
Year_2007	-2.77	13.81	-2,915.56***	1,624.66
	(-0.37)	(1.56)	(-2.93)	(0.46)
Year_2008	123.42***	169.94***	-2,954.62	-10,136.60
	(14.89)	(19.65)	(-1.38)	(-1.43)
Year_2009	29.64**	-1.76	-2,200.61**	-2,298.37
	(2.14)	(-0.23)	(-2.45)	(-0.71)
Year_2010	-13.55*	46.02***	-2,163.51*	-6,989.95*
	(-1.72)	(5.53)	(-1.97)	(-1.95)
Year_2011	-49.32***	-12.14	-2,264.34**	-9,711.25
	(-5.38)	(-1.35)	(-2.28)	(-1.20)
Year_2012	-36.12***	-6.78	-2,951.16***	-2,833.70
	(-4.41)	(-0.85)	(-3.28)	(-0.63)
Treated in the future	-19.85**	4.57	-1,204.16*	-6,318.63***
	(-2.29)	(0.64)	(-1.79)	(-3.13)
2001xTreated in the future	6.55	-3.79	2,052.87*	4,564.13
	(0.59)	(-0.37)	(1.87)	(1.43)
2002xTreated in the future	11.53	-5.57	2,940.45**	5,881.36
	(1.29)	(-0.62)	(2.39)	(1.56)
2003xTreated in the future	21.17**	-10.99	2,476.92***	
	(2.21)	(-1.55)	(2.82)	
2004xTreated in the future	8.52	-7.55	1,622.69*	-2,897.17
	(0.78)	(-0.92)	(1.78)	(-0.28)
2005xTreated in the future	7.69	-15.93	602.21	4,925.56
	(0.65)	(-1.38)	(0.60)	(1.52)
2006xTreated in the future	27.62*	-6.50	-9.59	5,010.36*
	(1.91)	(-0.52)	(-0.01)	(1.78)
2007xTreated in the future	14.74	-10.25	320.84	6,376.64***
	(1.26)	(-1.14)	(0.45)	(2.72)
2008xTreated in the future	16.56	-7.99	2,492.74	11,857.06*
	(1.23)	(-1.26)	(1.24)	(1.72)
2009xTreated in the future	18.39	-21.86**	719.96	3,037.26
	(1.43)	(-2.32)	(0.86)	(1.06)
2010xTreated in the future	14.48	-0.68	1,436.95*	5,964.38**
	(0.68)	(-0.07)	(1.78)	(2.32)
2011xTreated in the future	23.97	-14.95	812.10	16,992.78**
	(0.58)	(-1.39)	(1.09)	(2.13)
Constant	-11.47	40.58	2,651.29	-2,481.71
	(-0.40)	(1.54)	(1.23)	(-0.36)
Observations	2,008	1,978	1,197	714
R-squared	0.29	0.24	0.38	0.46
Joint test (p.value)- Ho: The access coefficients are jointly equal to zero	0.573	0.263	0.000148	0.0297

Notes:
Robust t-statistics in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All regressions include control for Age at pregnancy Age squared Parity Education Altitude Per capita household landsize poverty quartile and a district trend.

TABLE 3.8: TRENDS ROBUSTNESS CHECK:BEFORE OPENING OF A NEW LOWER LEVEL PUBLIC FACILITY

VARIABLES	(1) Travel time for Antenatal Care	(2) Travel time for Delivery	(3) Transportation fee for Antenatal care	(4) Transportation fee for Delivery
Year_2001	-6.57	39.74***	-781.26	-5,814.60
	(-0.32)	(3.61)	(-0.53)	(-1.19)
Year_2002	14.79	2.16	-988.61	-3,424.79
	(1.16)	(0.14)	(-0.58)	(-0.85)
Year_2003	-4.29	37.13***	-1,627.89	-6,015.31
	(-0.30)	(3.38)	(-1.09)	(-1.29)
Year_2004	24.65*	18.15	-721.10	8,345.24*
	(1.83)	(1.52)	(-0.56)	(1.95)
Year_2005	-20.84	11.92	-992.46	-4,084.24
	(-1.14)	(1.14)	(-1.00)	(-1.29)
Year_2006	55.55**	20.59*	-265.28	-3,651.87
	(2.46)	(1.90)	(-0.16)	(-0.87)
Year_2007	29.68**	56.93***	-737.10	11,274.22***
	(2.56)	(3.74)	(-0.71)	(2.75)
Year_2008	-6.56	127.93***	313.78	2,107.18
	(-0.38)	(8.73)	(0.21)	(0.50)
Year_2009	63.20***	22.38	-773.76	-2,971.03
	(3.39)	(1.20)	(-0.74)	(-0.67)
Year_2010	1.14	2.17	-1,552.33	-4,394.14
	(0.09)	(0.19)	(-1.50)	(-1.64)
Year_2011	44.20***	51.62***	-2,425.52	-1,077.95
	(3.03)	(3.28)	(-1.60)	(-0.47)
Year_2012	-5.83	29.60***	1,601.72	
	(-0.45)	(2.67)	(1.65)	
Treated in the future	17.80*	18.81**	-67.43	-3,413.44
	(1.67)	(2.30)	(-0.08)	(-1.41)
2001xTreated in the future	-7.44	-21.92***	1,199.92	4,613.03
	(-0.47)	(-3.15)	(1.02)	(1.05)
2002xTreated in the future	-6.83	-10.10	-2,051.99	2,821.33
	(-0.63)	(-0.73)	(-1.06)	(0.74)
2003xTreated in the future	-19.45	-16.51*	292.13	3,436.03
	(-1.65)	(-1.89)	(0.28)	(0.85)
2004xTreated in the future	-17.03	-17.07	-2,896.38**	-45.46
	(-1.60)	(-1.57)	(-2.02)	(-0.02)
2005xTreated in the future	-26.44*	-7.27	846.72	1,979.02
	(-1.97)	(-0.64)	(0.79)	(0.93)
2006xTreated in the future	-47.45**	-26.92***	238.27	2,562.86
	(-2.14)	(-2.71)	(0.22)	(0.66)
2007xTreated in the future	-2.70	-30.61**	-340.09	4,749.37
	(-0.16)	(-2.35)	(-0.41)	(1.48)
2008xTreated in the future	-10.53	-16.31	133.37	-1,133.40
	(-0.66)	(-1.43)	(0.13)	(-0.27)
2009xTreated in the future	-59.44***	-27.33	226.80	2,258.38
	(-3.86)	(-1.62)	(0.20)	(0.75)
2010xTreated in the future	32.14**	58.34***	1,241.44	17,797.72***
	(2.41)	(5.97)	(1.00)	(5.59)
2011xTreated in the future	4.86	-20.96**	1,445.20	
	(0.35)	(-2.28)	(1.06)	
Constant	13.84	42.44	302.15	-1,082.87
	(0.47)	(1.30)	(0.07)	(-0.15)
Observations	1,405	1,381	769	432
R-squared	0.32	0.28	0.43	0.71
Joint test (p.value)- Ho: The access coefficients are jointly equal to zero	0	0	0.215	1.30e-08

Notes:
Robust t-statistics in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All regressions include control for Age at pregnancy Age squared Parity Education Altitude Per capita household landsize poverty quartile and a district trend.

TABLE 3.9: TRENDS ROBUSTNESS CHECK:BEFORE OPENING OF A NEW HIGHER LEVEL PUBLIC FACILITY

VARIABLES	(1) 1 if Complication (during delivery)	(2) 1 if baby weight was measured	(3) Baby's birthweight	(4) 1 if birthweight is < 2.5Kgs	(5) 1 if Big baby
Year 2006	0.15	1.02***	-0.54	-0.10	-0.27
	(1.23)	(14.75)	(-0.92)	(-0.82)	(-1.15)
Year 2007	0.21	0.89***	-0.15	-0.19	-1.15***
	(1.61)	(5.26)	(-0.29)	(-1.38)	(-5.42)
Year 2008	0.03	0.04	-0.28	-0.19	-0.04
	(0.20)	(0.43)	(-0.40)	(-1.23)	(-0.23)
Year 2009	0.05	0.88***	-0.77	-0.11	-0.58***
	(0.38)	(4.31)	(-1.31)	(-0.66)	(-2.97)
Year 2010	1.14***	1.01***	-0.97	-0.00	-0.09
	(10.23)	(6.65)	(-0.94)	(-0.01)	(-0.51)
Year 2011	0.12	1.05***	-0.53	-0.03	-1.30***
	(1.29)	(11.43)	(-1.21)	(-0.32)	(-9.43)
Year 2012	0.18	0.87***	-0.13	-0.01	-1.07***
	(1.44)	(6.85)	(-0.99)	(-0.32)	(-8.28)
Treated in the future	0.12	0.06	0.19	-0.09	-0.01
	(1.33)	(0.50)	(0.67)	(-1.05)	(-0.04)
Year 2006 × Treated in the future	-0.17	0.01	-0.16	0.02	0.20
	(-1.52)	(0.06)	(-0.35)	(0.22)	(1.24)
Year 2007 × Treated in the future	-0.25**	-0.00	-0.38	0.09	0.03
	(-2.00)	(-0.01)	(-0.68)	(0.54)	(0.24)
Year 2008 × Treated in the future	-0.08	-0.12	0.22	0.09	0.14
	(-0.51)	(-0.80)	(0.49)	(0.85)	(1.01)
Year 2009 × Treated in the future	-0.16	-0.05	0.40	0.08	0.41**
	(-1.04)	(-0.23)	(1.23)	(0.97)	(2.55)
Year 2010 × Treated in the future	-0.11	-0.04	0.28	-0.01	-0.00
	(-0.92)	(-0.22)	(0.36)	(-0.11)	(-0.01)
Year 2011 × Treated in the future	0.03	-0.20	0.26	-0.12	0.10
	(0.19)	(-1.46)	(0.44)	(-0.80)	(0.42)
Constant	0.05	0.09	2.74**	0.13	0.55
	(0.17)	(0.24)	(2.29)	(0.52)	(1.50)
Observations	1,007	1,003	508	508	956
R-squared	0.29	0.39	0.37	0.42	0.28
Joint test (p.value)- Ho: The access coefficients are jointly equal to zero	0.0699	0.503	0.193	0.508	0.0481

Notes:
Robust t-statistics in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All regressions include control for Age at pregnancy Age squared Parity Education Altitude Per capita household landsize poverty quartile and a district trend

TABLE 3.10: TRENDS ROBUSTNESS CHECK:BEFORE OPENING OF A NEW LOWER LEVEL PUBLIC FACILITY

VARIABLES	(1) 1 if Complication (during delivery)	(2) 1 if baby weight was measured	(3) Baby's birthweight	(4) 1 if birthweight is < 2.5Kgs	(5) 1 if Big baby
Year 2006	-0.10	-0.96***	0.01	0.08	-0.12
	(-0.52)	(-4.31)	(0.02)	(0.52)	(-0.36)
Year 2007	1.00***	-0.31	0.62	-0.10	0.10
	(7.55)	(-1.62)	(0.71)	(-0.49)	(0.94)
Year 2008	0.02	0.12	0.41	-0.04	-1.23***
	(0.12)	(0.60)	(0.62)	(-0.27)	(-7.00)
Year 2009	0.90***	-0.98***	0.76	0.09	-0.00
	(6.02)	(-5.14)	(1.40)	(0.49)	(-0.01)
Year 2010	0.91***	-0.85***	0.96	0.72***	-0.93***
	(5.78)	(-4.27)	(1.57)	(3.69)	(-6.19)
Year 2011	1.93***	-0.05	-0.16	-0.00	0.07
	(10.88)	(-0.21)	(-0.32)	(-0.03)	(0.33)
Year 2012	0.92***	0.03	0.97*	-0.11	-0.02
	(6.48)	(0.17)	(1.98)	(-0.93)	(-0.16)
Treated in the future	0.02	-0.10	0.08	0.06	0.13
	(0.14)	(-0.73)	(0.28)	(1.00)	(0.63)
Year 2006 × Treated in the future	0.00	-0.03	0.01	-0.10	-0.30
	(0.00)	(-0.16)	(0.01)	(-1.38)	(-1.44)
Year 2007 × Treated in the future	-0.23**	0.12	0.13	-0.00	0.02
	(-2.26)	(0.97)	(0.20)	(-0.08)	(0.05)
Year 2008 × Treated in the future	-0.11	0.22	-0.06	-0.04	-0.02
	(-1.02)	(1.36)	(-0.13)	(-0.52)	(-0.09)
Year 2009 × Treated in the future	-0.02	0.10	0.26	-0.07	-0.03
	(-0.17)	(0.49)	(0.90)	(-0.92)	(-0.09)
Year 2010 × Treated in the future	-0.28	0.87***	0.63	-0.73***	0.57*
	(-0.89)	(4.54)	(1.10)	(-3.85)	(1.81)
Year 2011 × Treated in the future	-1.06***	-0.03	1.84***	-0.08	-0.16
	(-6.07)	(-0.20)	(2.78)	(-0.40)	(-0.60)
Constant	0.21	0.83*	2.76**	0.03	0.44
	(0.61)	(1.72)	(2.08)	(0.08)	(0.92)
Observations	679	674	344	344	641
R-squared	0.35	0.46	0.48	0.48	0.35
Joint test (p.value)- Ho: The access coefficients are jointly equal to zero	0	0.000164	0.159	0.000358	0.249

Notes:
Robust t-statistics in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. All regressions include control for Age at pregnancy Age squared Parity Education Altitude Per capita household landsize poverty quartile and a district trend

TABLE 3.11: REVERSE CAUSALITY : ANTENATAL AND DELIVERY CARE USE

VARIABLES	(1) Change in Number of higher level facilities per parish(Public)	(2) Change in Number of level 2 facilities per parish(Public)	(3) Change in Number of facilities per parish (Non Public)
Change in Skilled birth attendance	0.0808	-0.239	0.0155
	(1.072)	(-1.423)	(0.205)
Change in Antenatal care use	-0.0613	0.188	0.0949
	(-0.692)	(0.932)	(1.055)
Change in travel time for Antenatal care	0.00233***	-0.00172	0.000367
	(3.147)	(-1.050)	(0.499)
Change in travel time for Delivery care	-0.00417**	0.00280	-0.00143
	(-2.539)	(0.765)	(-0.867)
Number of higher level facilities per parish as of 2002 (Public)	-0.182		
	(-1.354)		
Number of level 2 facilities per parish as of 2002 (Public)		-0.478***	
		(-3.438)	
Number of facilities per parish as of 2002 (Non Public)			0.243**
			(2.120)
Initial level of Skilled birth attendance	0.0335	-0.281	-0.0619
	(0.348)	(-1.334)	(-0.648)
Initial level of Antenatal care use	-0.0861	0.0645	0.197*
	(-0.747)	(0.248)	(1.670)
Initial travel time for Antenatal care	0.00176*	-0.000757	2.03e-05
	(1.975)	(-0.381)	(0.0225)
Initial travel time for Delivery care	-0.00290	0.00336	0.000502
	(-1.448)	(0.756)	(0.250)
Drive time to nearest district town on dry season as of 2003 (in 100mins)	0.0115	0.203**	-0.0343
	(0.258)	(2.055)	(-0.775)
Drive time to nearest district town on rainy season as of 2003 (in 100mins)	0.0144	0.0932	0.0443
	(0.457)	(1.301)	(1.361)
Altitude (in 1000 meters)	50.98	-93.75	-88.39
	(0.649)	(-0.537)	(-1.125)
Distance to district town (in 100kms)	0.000113	-0.114	0.169
	(0.000783)	(-0.347)	(1.145)
Community population as of 2003 (in 100 persons)	0.00145	0.00276	0.00168
	(0.647)	(0.545)	(0.728)
Malaria incidence as of 2003 (ratio)	0.0354	-0.0658	0.0397
	(0.528)	(-0.434)	(0.576)
Log average household land size in a subcounty as of 2003	-0.0307	0.0361	-0.0192
	(-1.018)	(0.529)	(-0.623)
Constant	0.0635	0.317	-0.0427
	(0.364)	(0.807)	(-0.240)
Observations	82	82	82
R-squared	0.278	0.304	0.227

Notes:
1). t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1

TABLE 3.12: REVERSE CAUSALITY: REGULAR ANTENATAL CARE USE AND HEALTH OUTCOMES

VARIABLES	(1) Change in Number of higher level facilities per parish(Public)	(2) Change in Number of level 2 facilities per parish(Public)	(3) Change in Number of facilities per parish (Non Public)
Change in use of Regular care	0.0129	0.145	-0.0115
	(0.149)	(1.013)	(-0.176)
Change in incidence of Complications at birth	-0.0622	-0.172	0.144
	(-0.495)	(-0.829)	(1.511)
Change in proportion of infants weighed	0.215	-0.261	0.185
	(1.422)	(-0.948)	(1.605)
Change in birthweight	-0.0201	0.104	-0.00944
	(-0.251)	(0.780)	(-0.153)
Change in incidence of low birthweight(<2.5Kgs)	0.0873	-0.0650	-0.0122
	(0.426)	(-0.188)	(-0.0786)
Change in size of the baby(1 if big baby)	0.132	0.111	0.0966
	(1.079)	(0.566)	(0.970)
Number of higher level facilities per parish as of 2002 (Public)	-0.457*		
	(-2.011)		
Number of level 2 facilities per parish as of 2002 (Public)		-0.517**	
		(-2.728)	
Number of facilities per parish as of 2002 (Non Public)			0.184
			(1.124)
Initial level of Regular care use	0.0826	0.368*	-0.120
	(0.747)	(1.999)	(-1.440)
Initial level of prevalence of complications at birth	-0.0268	0.204	0.00162
	(-0.181)	(0.842)	(0.0146)
Initial proportion of infacts weighed	0.250	-0.294	0.369**
	(1.364)	(-0.963)	(2.627)
Initial level of birthweights	-0.0526	0.264	0.0133
	(-0.610)	(1.646)	(0.207)
Initial proportion of low birthweights (<2.5Kgs)	0.0815	0.219	-0.203
	(0.333)	(0.483)	(-1.109)
Initial proportion of babies of Big size	0.327*	-0.0747	0.138
	(1.797)	(-0.252)	(0.877)
Drive time to nearest district town on dry season as of 2003 (in 100mins)	-0.124	0.364***	-0.0775
	(-1.565)	(2.900)	(-1.379)
Drive time to nearest district town on rainy season as of 2003 (in 100mins)	0.0319	0.0371	0.0387
	(0.586)	(0.418)	(0.932)
Altitude (in 1000 meters)	794.4***	-587.1	130.6
	(3.071)	(-1.495)	(0.678)
Distance to district town (in 100kms)	0.205	-0.605	0.475**
	(0.785)	(-1.413)	(2.434)
Community population as of 2003 (in 100 persons)	0.000332	0.00668	0.00327
	(0.0941)	(1.157)	(1.237)
Malaria incidence as of 2003 (ratio)	0.0746	-0.543*	-0.0828
	(0.444)	(-2.035)	(-0.689)
Log average household land size in a subcounty as of 2003	0.0561	0.0394	0.103**
	(0.873)	(0.360)	(2.154)
Constant	-1.174*	0.423	-0.589
	(-2.054)	(0.468)	(-1.308)
Observations	47	47	47
R-squared	0.400	0.577	0.560

Notes:
1). t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1

TABLE 3.13: ACCESS AND DELIVERY CARE USE: A DYNAMIC PANEL MODEL

VARIABLES	(1) 1 if Facility delivery	(2) 1 if Skilled birth attendance (SBA)
1 if Facility delivery lag 1	0.31***	
	(3.29)	
1 if Skilled birth attendance (SBA) lag 1		0.24***
		(2.58)
Number of higher level facility per parish(Public)	0.44*	0.59***
	(1.69)	(2.89)
Number of level 2 facility per parish(Public)	0.09	0.05
	(1.04)	(0.57)
Number of facilities per parish (Non Public)	-0.21	-0.27
	(-0.88)	(-1.14)
Parity	0.00	0.01
	(0.12)	(0.95)
Age (at pregnancy)	0.04	0.02
	(1.39)	(0.80)
Age^2	-0.00	-0.00
	(-1.53)	(-0.71)
2nd quartile	0.05	-0.04
	(0.49)	(-0.44)
3rd quartile	-0.02	-0.00
	(-0.17)	(-0.01)
4th quartile(richest)	-0.02	-0.00
	(-0.11)	(-0.00)
log household landsize (per capita acres)	-0.01	0.03
	(-0.14)	(0.50)
Observations	1,362	1,327
Number of Mothers	603	592
Year × region	Yes	Yes
Mean of the outcome	0.568	0.557
Sargan test (p.value)	0.540	0.572
Autocorreration test (p.value)Order 1	3.19e-06	8.24e-05
Order 2	0.584	0.785
Order 3	0.895	0.406

Notes:
z-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Z-stat presented on the table are computed from the heteroskedasticity robust standard erros. All regressions include a constant and region-year interaction. Controls: Parity Age Age^2 Poverty quartile log of household land size.
4). Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation.

TABLE 3.14: IMPACT OF IMPROVING ACCESS TO HEALTH FACILITIES-ROAD QUALITY HETEROGENEITY

VARIABLES	(1) 1 if Regular antenatal care	(2) Facility delivery	(3) 1 if SBA at a facility	(4) SBA	(5) 1 if Regular antenatal care	(6) Facility delivery	(7) 1 if SBA at a facility	(8) SBA
Number of higher level facility per parish(Public)	-0.26	0.10	-0.02	-0.02	0.18	-0.05	0.01	-0.12
	(-0.85)	(0.27)	(-0.05)	(-0.05)	(0.86)	(-0.10)	(0.01)	(-0.27)
Road × Number of higher level facility per parish(Public)	0.43*	0.38	0.54*	0.55	-0.04	0.58*	0.61*	0.66*
	(1.73)	(1.22)	(1.76)	(1.50)	(-0.21)	(1.69)	(1.81)	(1.97)
Number of level 2 facility per parish(Public)	-0.08	0.01	0.03	-0.03	0.18	0.22	0.26	0.23
	(-0.55)	(0.08)	(0.13)	(-0.18)	(1.61)	(1.24)	(1.41)	(1.28)
Road × Number of level 2 facility per parish(Public)	0.14	0.05	0.03	0.08	0.02	-0.03	-0.02	-0.03
	(1.11)	(0.27)	(0.17)	(0.43)	(0.15)	(-0.18)	(-0.11)	(-0.17)
Number of facilities per parish (Non Public)	0.04	0.07	0.15	0.17	-0.25	-0.16	-0.02	0.02
	(0.17)	(0.31)	(0.65)	(0.65)	(-0.87)	(-0.49)	(-0.06)	(0.07)
Road × Number of facilities per parish (Non Public)	0.21	0.20	0.15	0.15	0.13	0.28	0.29	0.26
	(1.02)	(1.37)	(0.90)	(0.84)	(0.54)	(1.00)	(0.95)	(0.81)
1 if all weather Road	-0.14	-0.05	-0.07	-0.14	-0.02	-0.07	-0.11	-0.14
	(-1.59)	(-0.32)	(-0.47)	(-0.81)	(-0.16)	(-0.42)	(-0.55)	(-0.74)
Observations	1,104	2,208	2,208	2,173	921	1,933	1,933	1,908
R-squared	0.09	0.26	0.26	0.26	0.07	0.44	0.45	0.46
Number of Sub-counties	86	87	87	87				
Subcounty FE	Yes	Yes	Yes	Yes				
Year × Region	Yes				Yes			
Joint test (p.value)- Ho: The Road and Road-Higher level public facility interactions are jointly equal to zero	0.219	0.137	0.0348	0.186	0.828	0.0897	0.0350	0.0410
Joint test (p.value)- Ho: The Higher level public facility and Road-Higher level public facility interactions are jointly equal to zero	0.112	0.0256	0.00525	0.00582	0.638	0.0123	0.00169	0.00281
Year × District		Yes	Yes	Yes		Yes	Yes	Yes
Number of Mothers					452	784	784	781
Mother FE					Yes	Yes	Yes	Yes

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at sub-county level. All regressions include a constant term.
4). Regressions for the Regularcare outcome includes region-year interaction because of limited sample size. The regressions for the remaining outcomes include year-district interaction. Road condition takes one if the road to the district town is all weather.
5). Other included covariates are: Age at pregnancy and its squared term Parity Education Household landsize poverty quartile and Altitude.

TABLE 4.1: SUMMARY STATISTICS

Variable	Obs	Mean	Std. Dev.
1 if attended antenatal care at a facility	1568	.67	.47
1 if received ANC at facility by a skilled practitioner	1568	.61	.49
Total number of ANC visits	1568	3.36	3.16
1 if visited in the 1st trimester	1568	.4	.49
1 if visited in the 1st trimester and checked by skilled practitioner	1568	.39	.49
1 if deliver at a health facility	1568	.14	.35
1 if deliver at a health facility and assisted by a skilled practitioner	1568	.12	.32
1 if attended by a skilled practitioner	1568	.15	.36
Travel time (walking) to Antenatal care (mins)	837	47.38	39.5
1 if paid for antenatal care at a facility	953	.08	.27
Fee for antenatal care (Birr)	953	9.03	137.46
Travel time (walking) for Delivery care (mins)	45	54.22	58.07
1 if paid for delivery care at a facility	233	.27	.45
Fee for delivery care (Birr)	233	83.58	262.86
1 if suffered compication at birth	1568	.1	.3
1 if child received postnatal care from a skilled person	1542	.48	.5
1 if mother received postnatal care from a skilled person	1563	.45	.5
Years of education	1568	1.83	2.91
No education	1568	.64	.48
Some primary school (grade 1-7)	1568	.3	.46
Completed primary school (grade 8)	1568	.03	.17
Above primary school (grades 8+)	1568	.02	.16
Mother's age at delivery	1568	27.46	6.4
under 19	1568	.07	.26
19-25	1568	.33	.47
26-30	1568	.27	.44
31-35	1568	.21	.41
above 35	1568	.12	.32
Parity of the pregnancy	1568	4.26	2.37
Per capita household landsize (acres per capita)	1568	.89	.95
Value of household assets per capita (Birr)	1568	3968.13	5360.43
1st quartile(poorest)	1568	.26	.44
2nd quartile	1568	.25	.43
3rd quartile	1568	.25	.43
4th quartile(richest)	1568	.25	.43

TABLE 4.2: AVERAGE NUMBER OF FACILITIES PER COMMUNITY(KEBELE)

Variable	Obs	Mean	Std. Dev.
General care facilities (numbers per Kebele)	1100	.77	.57
Antenatal care facilities (numbers per Kebele)	1100	.68	.59
Delivery care facilities (numbers per Kebele)	1100	.5	.57

TABLE 4.3: IMPACT OF IMPROVING ACCESS TO ANTENATAL CARE FACILITIES

VARIABLES	(1) 1 if attended antenatal care at a facility	(2) 1 if received ANC at facility by a skilled practitioner	(3) Total number of ANC visits	(4) 1 if at least 4 antenatal visits
Antenatal care facilities (numbers in Kebele)	0.09*	0.10	0.42	0.10*
	(1.74)	(1.65)	(1.54)	(1.86)
General care facilities (numbers in Kebele)	0.02	0.01	-0.22	-0.09
	(0.29)	(0.11)	(-0.75)	(-1.48)
19-25	-0.09	-0.09	-0.51	-0.05
	(-1.42)	(-1.63)	(-1.65)	(-0.89)
26-30	-0.07	-0.08	-0.48	-0.06
	(-0.83)	(-1.07)	(-1.21)	(-0.71)
31-35	-0.07	-0.10	-0.40	-0.02
	(-0.61)	(-0.95)	(-0.75)	(-0.22)
above 35	-0.15	-0.16	-0.35	0.07
	(-1.02)	(-1.07)	(-0.47)	(0.43)
Per capita household landsize (acres per capita)	0.02	0.01	0.10	0.05
	(0.45)	(0.28)	(0.54)	(0.98)
2nd parity	-0.01	-0.01	0.07	0.01
	(-0.26)	(-0.27)	(0.33)	(0.26)
3rd parity	-0.02	-0.02	-0.08	0.01
	(-0.40)	(-0.41)	(-0.28)	(0.10)
4th+ parity	-0.05	-0.04	-0.47	-0.06
	(-0.62)	(-0.51)	(-1.10)	(-0.68)
Observations	1,070	1,070	1,070	1,070
R-squared	0.23	0.20	0.20	0.11
Number of Mother	409	409	409	409
Mother fixed effects	Yes	Yes	Yes	Yes
Year × region	Yes	Yes	Yes	Yes
Mean of the outcome	0.678	0.611	3.381	0.422

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grade.

TABLE 4.4: IMPACT OF IMPROVING ACCESS TO DELIVERY CARE FACILITIES

VARIABLES	(1) 1 if deliver at a health facility	(2) 1 if deliver at a health facility and assisted by a skilled practitioner	(3) 1 if attended by a skilled practitioner
Antenatal care facilities (numbers in Kebele)	-0.02	-0.03	-0.04
	(-0.67)	(-0.89)	(-1.12)
General care facilities (numbers in Kebele)	0.03	0.03	0.02
	(0.85)	(0.96)	(0.61)
19-25	-0.01	-0.01	-0.02
	(-0.10)	(-0.26)	(-0.53)
26-30	0.04	0.02	0.01
	(0.58)	(0.36)	(0.12)
31-35	0.03	0.02	-0.00
	(0.38)	(0.31)	(-0.02)
above 35	-0.01	-0.01	-0.05
	(-0.12)	(-0.10)	(-0.46)
Per capita household landsize (acres per capita)	0.01	0.01	0.01
	(0.34)	(0.19)	(0.32)
2nd parity	-0.08**	-0.07*	-0.05
	(-2.04)	(-1.91)	(-1.60)
3rd parity	-0.10**	-0.09*	-0.07
	(-2.10)	(-1.95)	(-1.63)
4th+ parity	-0.13**	-0.10*	-0.10*
	(-2.24)	(-1.98)	(-1.98)
Observations	1,050	1,050	1,050
R-squared	0.10	0.09	0.08
Number of Mother	409	409	409
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	0.121	0.104	0.135

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grades.

TABLE 4.5: IMPACT OF IMPROVING ACCESS ON HEALTH OUTCOMES

VARIABLES	(1) 1 if suffered compication at birth	(2) 1 if child received postnatal care from a skilled person	(3) 1 if mother received postnatal care from a skilled person
Delivery care facilities (numbers in Kebele)	-0.04	-0.01	-0.01
	(-1.40)	(-0.27)	(-0.16)
General care facilities (numbers in Kebele)	0.02	0.01	0.00
	(0.49)	(0.35)	(0.08)
19-25	0.01	0.03	-0.01
	(0.11)	(0.56)	(-0.09)
26-30	-0.02	0.10	0.00
	(-0.28)	(1.29)	(0.01)
31-35	-0.00	0.12	0.01
	(-0.02)	(1.09)	(0.07)
above 35	-0.08	0.16	-0.01
	(-0.76)	(1.19)	(-0.08)
Per capita household landsize (acres per capita)	0.05**	-0.00	-0.01
	(2.00)	(-0.09)	(-0.29)
2nd parity	-0.06	-0.02	-0.05
	(-1.48)	(-0.69)	(-1.58)
3rd parity	-0.09*	-0.07	-0.09*
	(-1.88)	(-1.33)	(-1.81)
4th+ parity	-0.11*	-0.09	-0.09
	(-1.76)	(-1.13)	(-1.18)
Observations	1,036	1,036	1,036
R-squared	0.08	0.10	0.10
Number of Mother	408	408	408
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	0.0753	0.496	0.460

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grade.

TABLE 4.6: POTENTIAL PATHWAYS

VARIABLES	(1) Travel time (walking) to Antenatal care (mins)	(2) 1 if paid for antenatal care at a facility	(3) Fee for antenatal care (Birr)
Antenatal care facilities (numbers in Kebele)	0.95	0.01	0.48
	(0.26)	(1.16)	(0.88)
General care facilities (numbers in Kebele)	1.58	0.02	-0.08
	(0.45)	(1.47)	(-0.11)
19-25	8.73**	0.02	-0.13
	(2.03)	(0.84)	(-0.39)
26-30	15.33**	0.02	0.98
	(2.55)	(0.76)	(1.18)
31-35	19.45**	0.05	1.54
	(2.05)	(1.36)	(1.42)
above 35	18.31	0.05	1.60
	(1.28)	(1.18)	(1.33)
Per capita household landsize (acres per capita)	-7.59	0.03	0.89*
	(-1.06)	(1.23)	(1.97)
2nd parity	-5.56	-0.03	0.40
	(-1.35)	(-1.11)	(0.93)
3rd parity	-5.12	-0.04	0.50
	(-0.76)	(-1.23)	(0.99)
4th+ parity	-4.39	-0.04	0.62
	(-0.47)	(-1.13)	(1.09)
Observations	588	588	588
R-squared	0.15	0.15	0.08
Number of Mother	270	270	270
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	47.04	0.0459	1.068

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grades.

Table 4.7: Access and antenatal care use: A dynamic panel model

VARIABLES	(1) 1 if attended antenatal care at a facility	(2) 1 if received ANC at facility by a skilled practitioner	(3) 1 if at least 4 antenatal visits
1 if attended antenatal care at a facility lag 1	0.48***		
	(3.34)		
1 if attended antenatal care at a facility lag 1_Policy		0.52***	
		(2.94)	
1 if at least 4 antenatal visits lag 1			0.23**
			(1.97)
Antenatal care facilities (numbers in Kebele)	0.09	0.18**	0.11
	(0.91)	(2.32)	(1.34)
General care facilities (numbers in Kebele)	0.07	0.02	0.00
	(0.75)	(0.30)	(0.01)
19-25	0.12	0.13	-0.20**
	(1.07)	(1.04)	(-2.32)
26-30	0.21	0.20	-0.23*
	(1.27)	(1.14)	(-1.70)
31-35	0.19	0.15	-0.23
	(0.88)	(0.66)	(-1.34)
above 35	0.15	0.17	-0.27
	(0.60)	(0.65)	(-1.37)
Per capita household landsize (acres per capita)	-0.09*	-0.15**	-0.02
	(-1.91)	(-2.11)	(-0.22)
2nd parity	0.01	0.03	-0.03
	(0.13)	(0.48)	(-0.33)
4th+ parity	-0.05	0.03	-0.02
	(-0.80)	(0.42)	(-0.30)
Observations	683	683	683
Number of Mother	406	406	406
Year × region	Yes	Yes	Yes
Mean of the outcome	0.677	0.611	0.425
Sargan test (p.value)	0.884	0.935	0.228
Autocorreration test (p.value) Order 2	0.355	0.147	0.838
Order 3	0.707	0.696	0.235

Notes:
1). z-statistics in parentheses. Significance level: *** p<0.01, ** p<0.05, * p<0.1. T-stat presented on the table are computed from robust standard erros. All regressions include a constant and region-year interaction. The base category for age is those under 19 years. The base category for education is those with no formal schooling-zero grade. Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation. [1 if deliver at a health facility lag 1_Policy] stands for [1 if deliver at a health facility and assisted by a skilled practitioner in her previous birth]

TABLE 4.8: ACCESS AND DELIVERY CARE USE: A DYNAMIC PANEL MODEL

VARIABLES	(1) 1 if deliver at a health facility	(2) 1 if attended by a skilled practitioner	(3) 1 if deliver at a health facility and assisted by a skilled practitioner
1 if deliver at a health facility lag 1	-0.08		
	(-0.57)		
1 if attended by a skilled practitioner lag 1		0.11	
		(0.68)	
1 if deliver at a health facility lag 1_Policy			-0.02
			(-0.32)
Delivery care facilities (numbers in Kebele)	0.05	-0.02	-0.00
	(0.29)	(-0.43)	(-0.08)
General care facilities (numbers in Kebele)	0.01	0.00	-0.00
	(0.03)	(0.03)	(-0.01)
19-25	-0.04	-0.03	-0.04
	(-0.36)	(-0.61)	(-0.91)
26-30	0.15	0.09	0.07
	(0.43)	(0.70)	(0.71)
31-35	0.17	-0.08	-0.07
	(0.39)	(-0.59)	(-0.62)
above 35	0.14	-0.20	-0.18
	(0.27)	(-0.77)	(-1.07)
2nd parity	0.01		0.12*
	(0.11)		(1.89)
3rd parity		-0.12	
		(-1.25)	
4th+ parity	-0.06	-0.24	-0.10**
	(-1.29)	(-1.63)	(-2.07)
Per capita household landsize (acres per capita)	-0.05	-0.02	-0.02
	(-0.38)	(-0.34)	(-0.33)
Observations	674	674	674
Number of Mothers	408	408	408
Year × region	Yes	Yes	Yes
Mean of the outcome	0.119	0.133	0.102
Sargan test (p.value)	0.170	0.365	0.402
Autocorreration test (p.value) Order 2	0.800	0.471	0.417
Order 3	0.245	0.525	0.392
Joint test (p.value)- Ho: The access coefficients are jointly equal to zero	0.735	0.915	0.996

Notes:
z-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). T-stat presented on the table are computed from robust standard erros. All regressions include a constant and region-year interaction.
4). The base category for age is those under 19 years. The base category for education is those with no formal schooling-zero grade.
5). The indicator for 2nd parity was dropped because of collinearity in column two.
6). Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation.
7). [1 if deliver at a health facility lag 1_Policy] stands for [1 if deliver at a health facility and assisted by a skilled practitioner in her previous birth]

TABLE 4.9: ACCESS, POSTNATAL CARE USE : A DYNAMIC PANEL MODEL

VARIABLES	(1) 1 if child received postnatal care from a skilled person	(2) 1 if mother received postnatal care from a skilled person
Postnatalcare for child lag 1	0.70***	
	(3.17)	
Postnatalcare for mother lag 1		0.48
		(1.55)
Delivery care facilities (numbers in Kebele)	0.07	0.09
	(0.80)	(1.09)
General care facilities (numbers in Kebele)	0.13	0.04
	(1.33)	(0.45)
19-25	-0.06	-0.01
	(-0.55)	(-0.11)
26-30	0.10	0.27
	(0.51)	(0.91)
31-35	0.02	0.20
	(0.13)	(0.49)
above 35	-0.03	0.20
	(-0.13)	(0.47)
Per capita household landsize (acres per capita)	0.06	-0.01
	(1.21)	(-0.07)
2nd parity	0.05	0.03
	(0.93)	(0.64)
4th+ parity	0.01	0.03
	(0.10)	(0.52)
Observations	648	648
Number of Mother	395	395
Year × region	Yes	Yes
Mean of the outcome	0.496	0.461
Sargan test (p.value)	0.709	0.985
Autocorreration test (p.value)Order 1	0.593	0.434
Order 2	0.153	0.602
Order 3	0.722	0.489

Notes:
z-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). T-stat presented on the table are computed from robust standard erros. All regressions include a constant and region-year interaction.
4). The base category for age is those under 19 years. The base category for education is those with no formal schooling-zero grade.
5). Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation.
6). [1 if deliver at a health facility lag 1_Policy] stands for [1 if deliver at a health facility and assisted by a skilled practitioner in her previous birth]

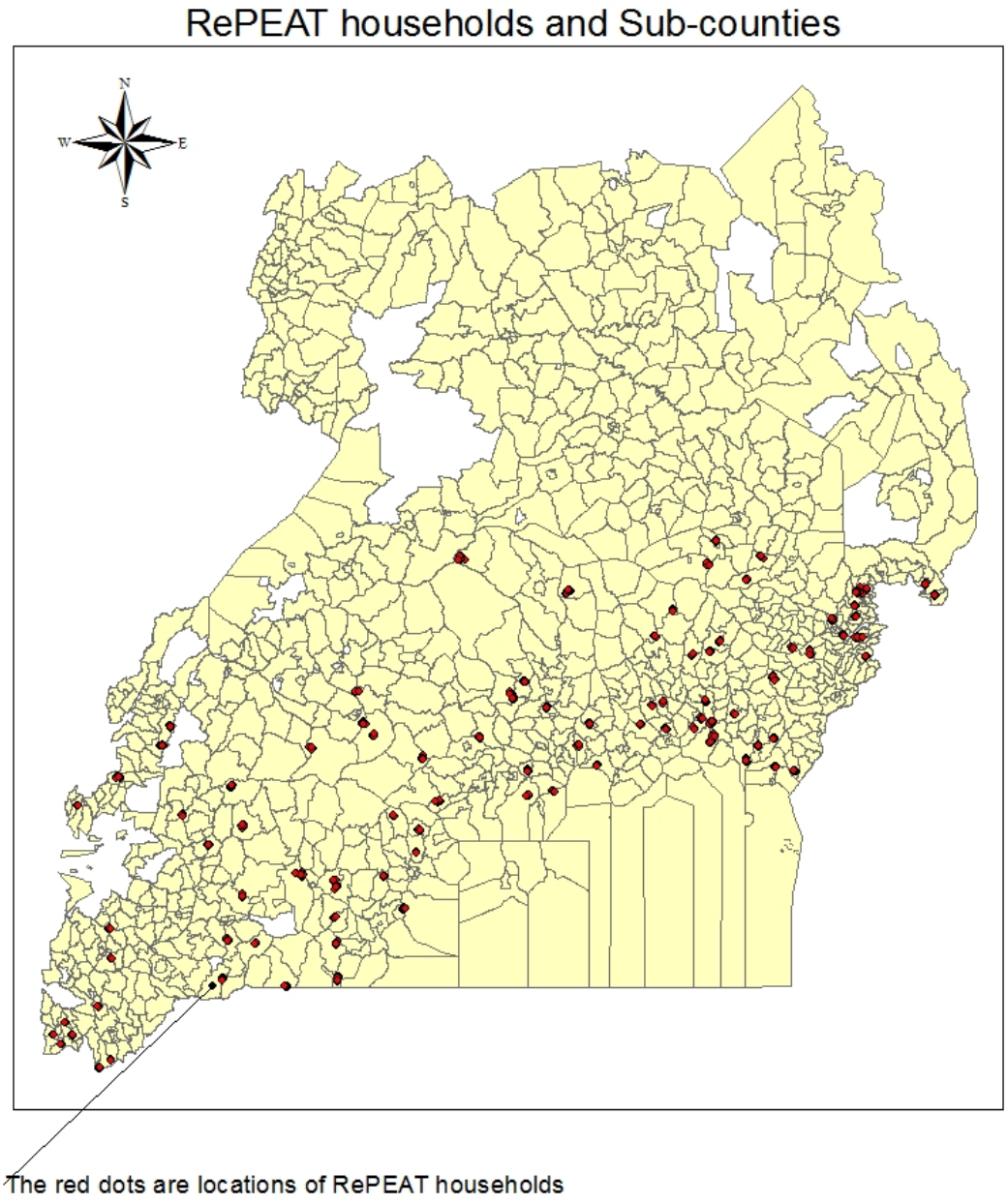


FIGURE 3.1: LOCATION OF REPEAT COMMUNITIES (LOCAL COUNCIL 1)

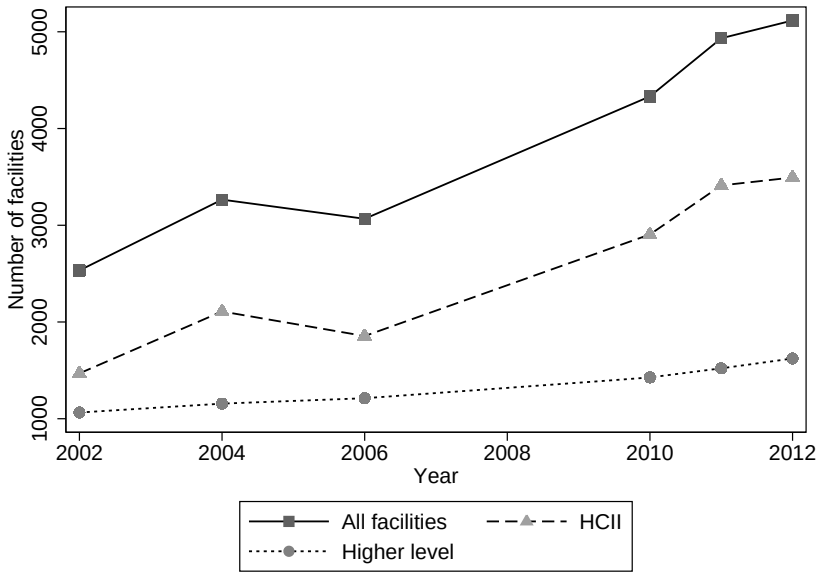
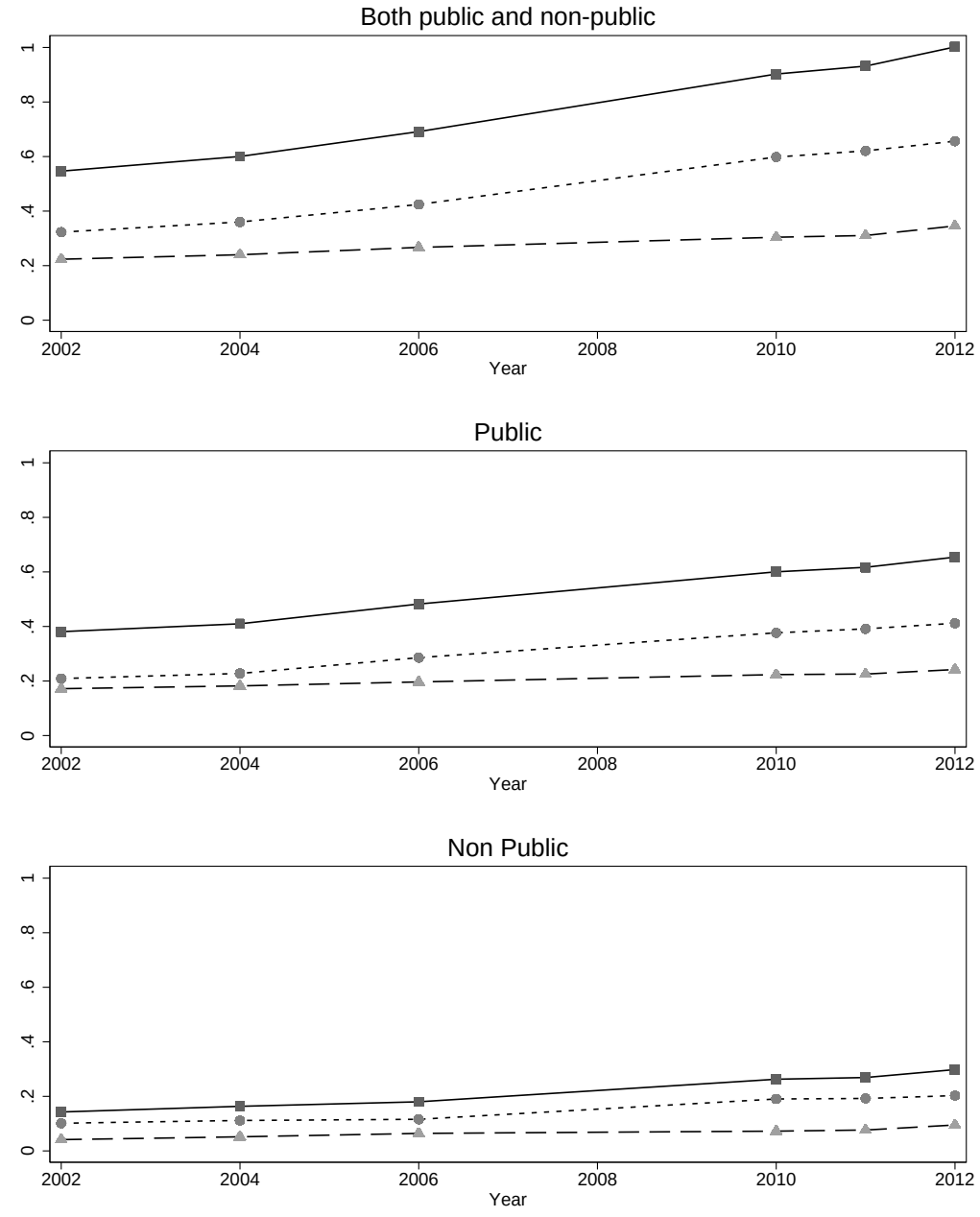


FIGURE 3.2: TRENDS OF TOTAL NUMBER OF FACILITIES BY TYPES

FIGURE 3.3: NUMBER OF FACILITIES PER PARISH BY LEVEL AND OWNERSHIP IN RURAL UGANDA



Source:Author, computed from inventory data.

FIGURE 3.4: MATERNAL CARE UTILIZATION

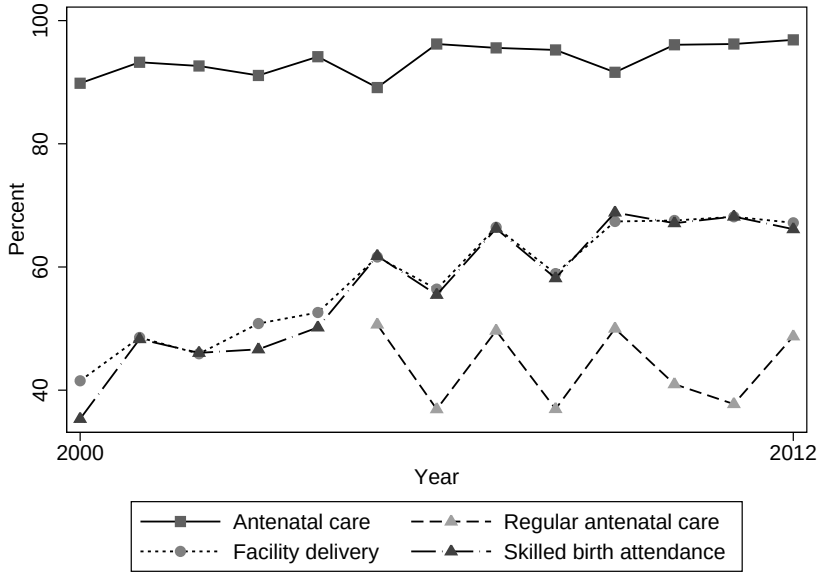
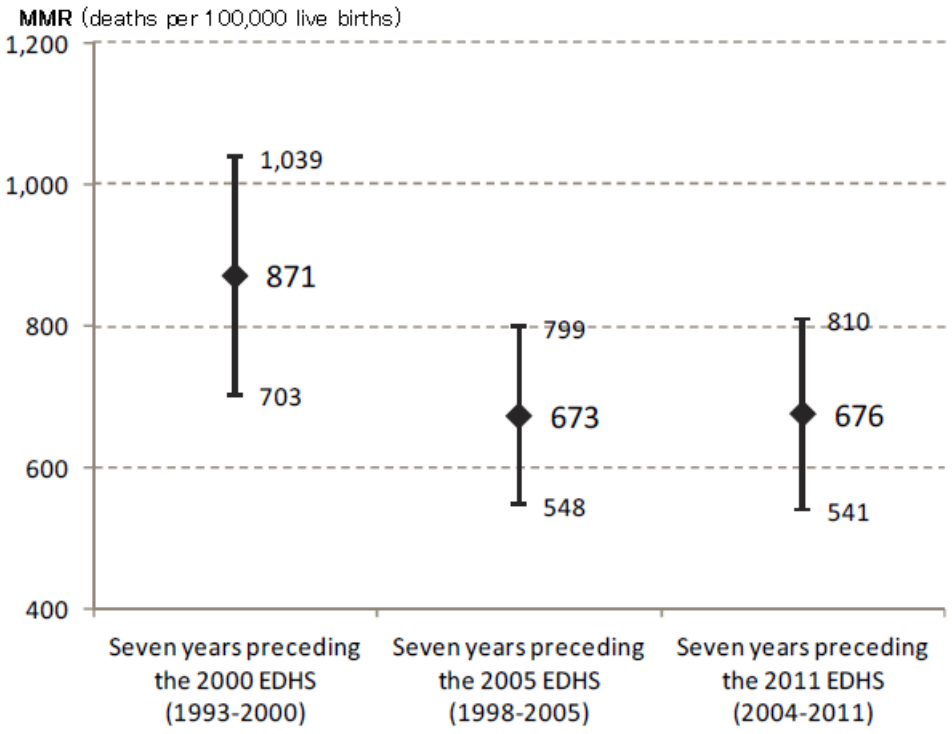
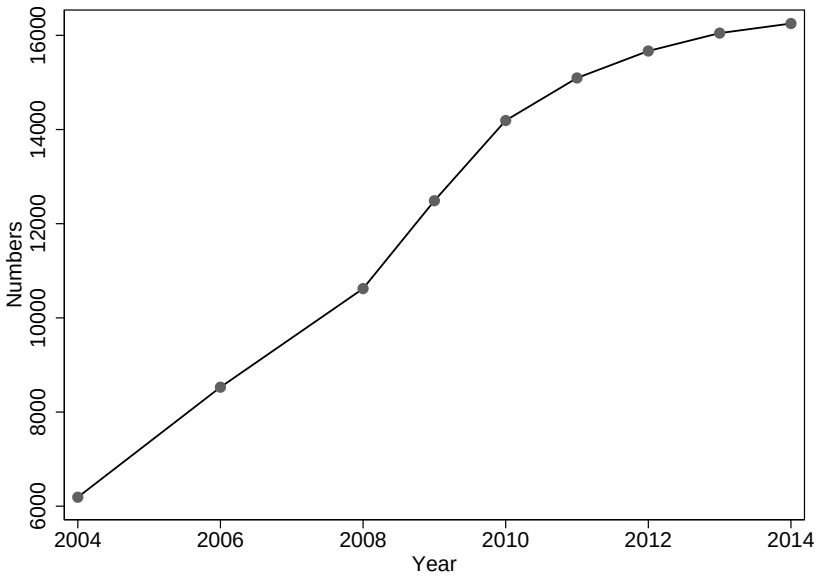


FIGURE 4.1: STAGNANT MATERNAL MORTALITY RATIO (MMR)

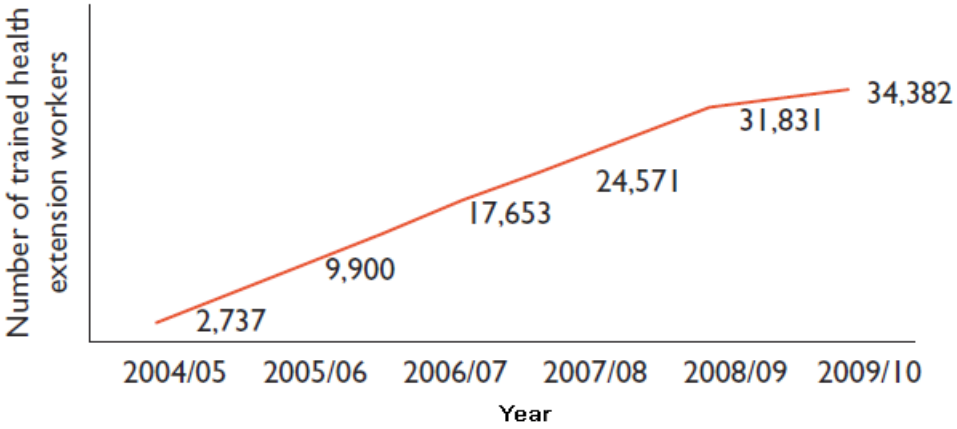


Source:Adopted from (CSA and ICF International, 2012)



Source:(Ministry of Health, 2014)

FIGURE 4.2: A SIGNIFICANT INCREASE IN THE NUMBER OF HEALTH POSTS.



Source:Adopted from (Nejmudin et al., 2011)

FIGURE 4.3: A SIGNIFICANT INCREASE IN THE NUMBER OF HEW

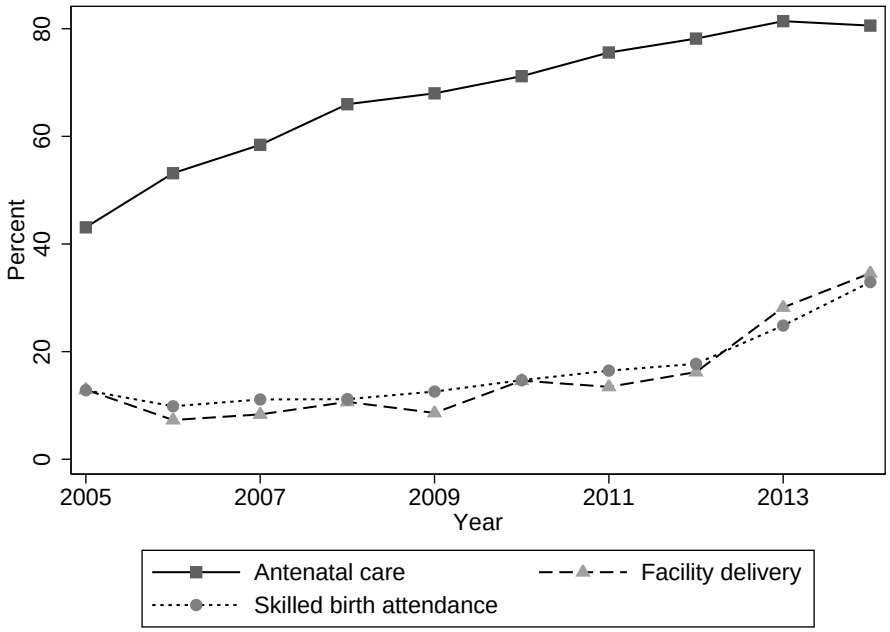
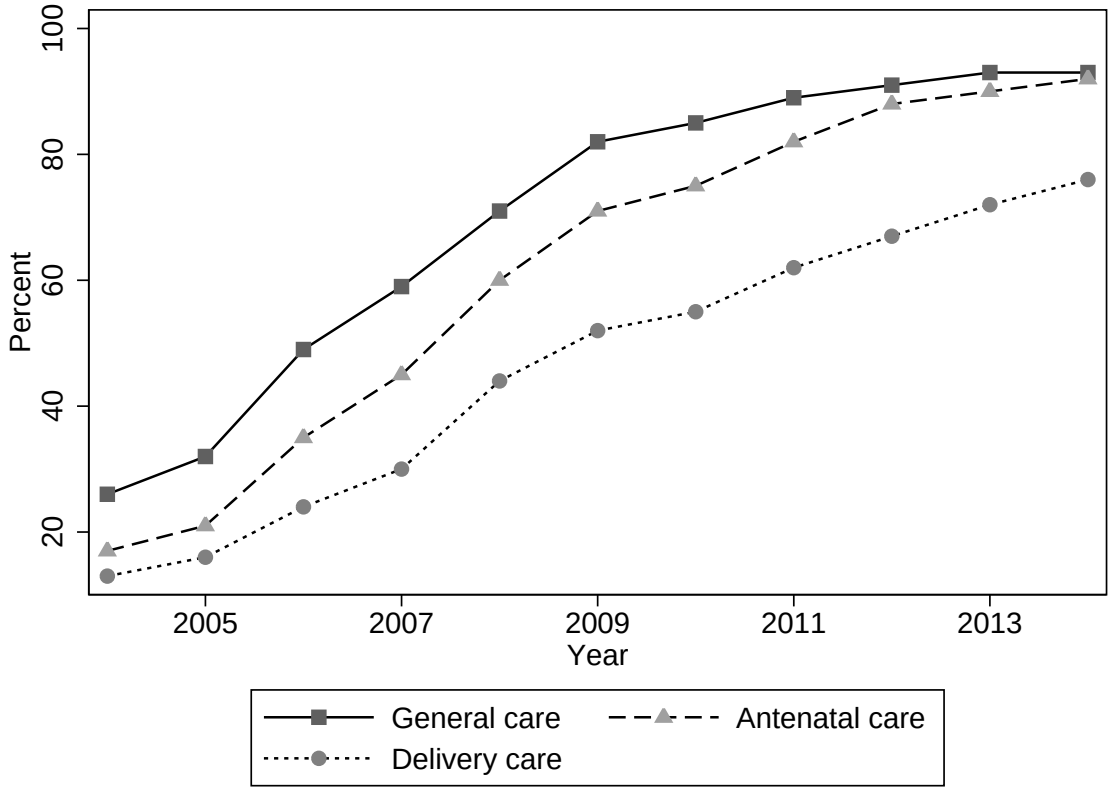
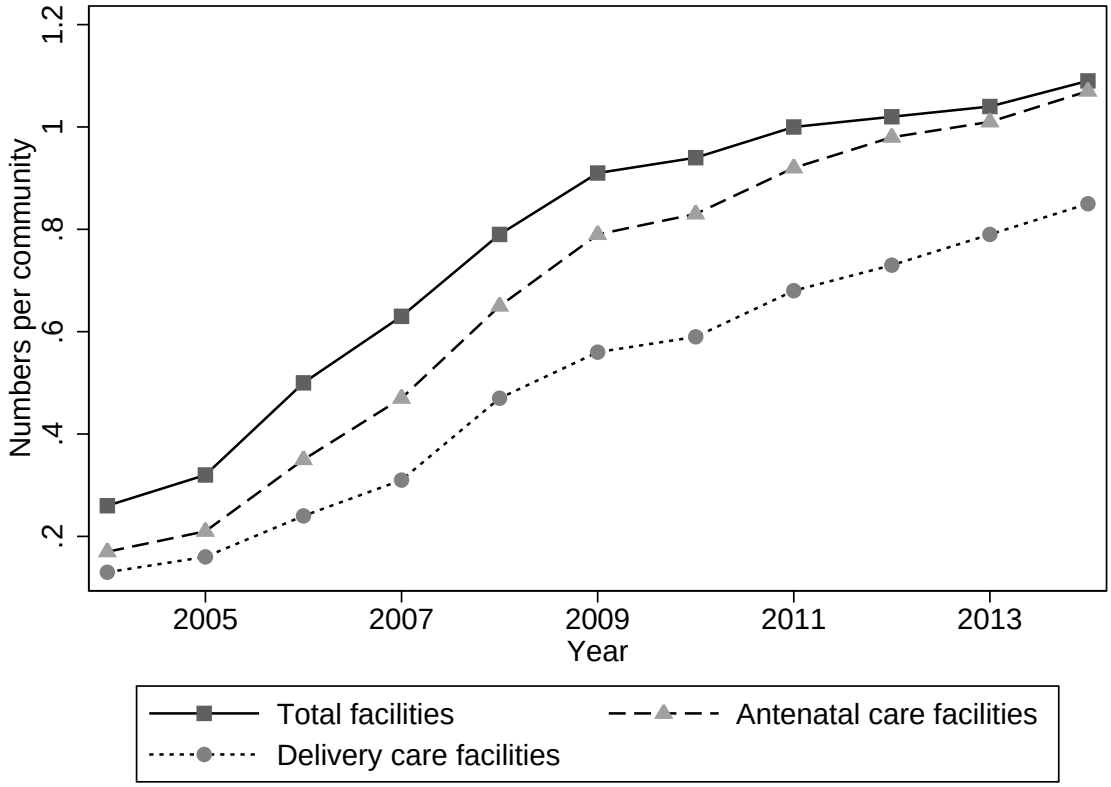


FIGURE 4.4: INCREASING UTILIZATION OF MATERNAL CARE



Source: Author's computation from the RePEAT data.

FIGURE 4.5: PERCENT OF VILLAGES WITH FACILITIES



Source: Author's computation from the RePEAT data.

FIGURE 4.6: INCREASING NUMBER OF HEALTH FACILITIES

Appendices

0.1 Appendix

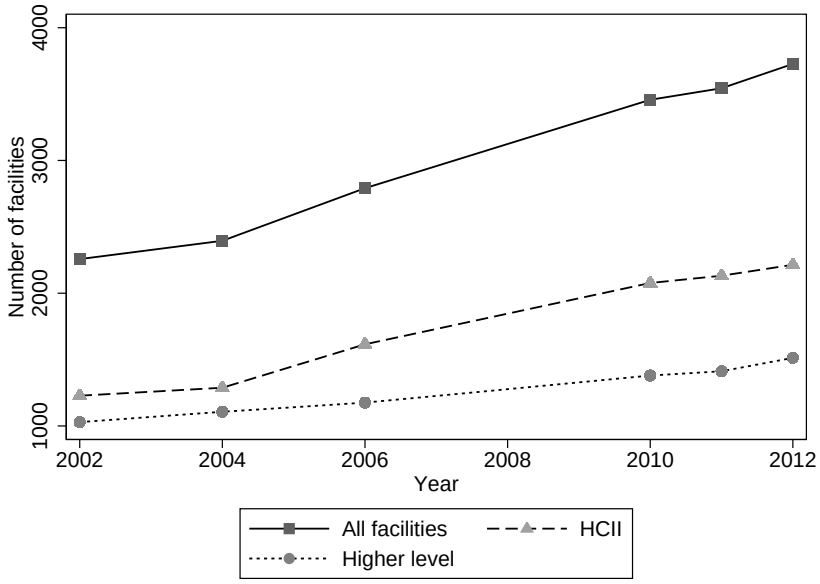


FIGURE .7: THE TRENDS OF THE TOTAL NUMBER OF HEALTH FACILITIES IN UGANDA EXCEPT FOR THE CAPITAL CITY (KAMPALA): 2002-2012

Table 10: Impact of improving access to health facilities

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS				Sub-county Fixed effects				Mother Fixed effects			
	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA	1 if regular care	1 if facility delivery	1 if SBA at a facility	1 if SBA
Number of higher level facility per parish(Public)	0.34***	0.16	0.22	0.21	0.15	0.50**	0.54***	0.54***	0.13	0.53**	0.60***	0.54**
	(2.83)	(0.94)	(1.34)	(1.29)	(0.94)	(2.45)	(2.76)	(2.74)	(0.77)	(2.30)	(2.82)	(2.51)
Number of level 2 facility per parish(Public)	0.07	-0.07	-0.06	-0.06	0.06	0.09*	0.09	0.06	0.18*	0.23**	0.25**	0.20**
	(1.24)	(-0.83)	(-0.70)	(-0.85)	(1.15)	(1.78)	(1.54)	(1.15)	(1.80)	(2.22)	(2.47)	(1.99)
Number of facilities per parish (Non Public)	0.03	0.11	0.15	0.14	0.16	0.22	0.23	0.24	-0.17	0.03	0.15	0.18
	(0.26)	(0.66)	(0.89)	(0.89)	(0.85)	(1.05)	(1.09)	(1.15)	(-0.99)	(0.11)	(0.54)	(0.73)
Age (at pregnancy)	-0.02	-0.00	-0.01	-0.02	-0.01	0.01	0.00	-0.01	-0.01	-0.02	-0.00	-0.01
	(-1.59)	(-0.16)	(-0.49)	(-1.25)	(-1.02)	(0.41)	(0.13)	(-0.67)	(-0.33)	(-1.27)	(-0.23)	(-0.61)
Age^2	0.00	-0.00	0.00	0.00	0.00	-0.00	-0.00	0.00	0.00	0.00	0.00	0.00
	(1.23)	(-0.10)	(0.18)	(0.91)	(0.63)	(-0.64)	(-0.39)	(0.40)	(0.40)	(1.38)	(0.34)	(0.71)
log household landsize (per capita acres)	0.04*	0.00	0.00	0.01	0.04	0.00	-0.00	0.00		0.01	-0.00	0.01
	(1.81)	(0.27)	(0.10)	(0.26)	(1.36)	(0.22)	(-0.11)	(0.14)		(0.44)	(-0.05)	(0.23)
2nd quartile	0.18***	0.04	0.03	0.04	0.17**	0.05	0.04	0.06		0.06	0.03	0.05
	(3.15)	(1.12)	(0.70)	(0.99)	(2.55)	(1.36)	(1.09)	(1.34)		(1.19)	(0.70)	(1.19)
3rd quartile	0.15**	0.08*	0.08*	0.10**	0.13	0.11**	0.10**	0.12**		0.14***	0.08*	0.11**
	(2.17)	(1.98)	(1.86)	(2.29)	(1.64)	(2.54)	(2.36)	(2.58)		(2.77)	(1.71)	(2.24)
4th quartile(richest)	0.21***	0.14***	0.14***	0.16***	0.20**	0.16***	0.16***	0.17***		0.12*	0.08	0.08
	(3.31)	(3.66)	(3.39)	(3.68)	(2.51)	(3.86)	(3.54)	(3.56)		(1.88)	(1.20)	(1.24)
Altitude in 1000mts	0.08	-0.06	-0.06	-0.05	0.35***	0.13	0.11	0.14				
	(0.85)	(-0.38)	(-0.39)	(-0.35)	(3.00)	(0.86)	(0.73)	(0.94)				
Some primary education	-0.12**	-0.04	-0.02	-0.02	-0.12**	-0.02	-0.00	0.00				
	(-2.04)	(-0.98)	(-0.39)	(-0.33)	(-2.04)	(-0.60)	(-0.03)	(0.07)				
Completed primary education	-0.10	0.03	0.05	0.04	-0.04	0.02	0.03	0.03				
	(-1.30)	(0.61)	(0.77)	(0.62)	(-0.53)	(0.30)	(0.49)	(0.43)				
More than primary education	-0.12	0.07	0.08	0.08	-0.10	0.05	0.07	0.07				
	(-1.49)	(1.23)	(1.33)	(1.16)	(-1.13)	(0.89)	(1.03)	(0.97)				
Observations	1,125	2,275	2,275	2,237	1,125	2,275	2,275	2,237	934	1,992	1,992	1,964
R-squared	0.10	0.33	0.31	0.31	0.08	0.25	0.25	0.25	0.06	0.43	0.43	0.44
Subcounty FE	No	No	No	No	No	Yes	Yes	Yes	No			
Year × Region	Yes				Yes				Yes			
Year × District		Yes	Yes	Yes		Yes	Yes	Yes		Yes	Yes	Yes
Number of Mothers									456	808	808	804
Mother FE										Yes	Yes	Yes
Number of Sub-counties					86	87	87	87				

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at sub-county level. All regressions include a constant.
4). Regressions for the Regularcare outcome includes region-year interaction because of limited sample size. The regressions for the remaing outcomes include year-district interaction.

Table 11: Access and antenatal care use: A dynamic panel model

VARIABLES	(1) 1 if attended antenatal care at a facility	(2) 1 if received ANC at facility by a skilled practitioner	(3) 1 if at least 4 antenatal visits
1 if attended antenatal care at a facility lag 1	0.22		
	(1.11)		
1 if attended antenatal care at a facility lag 1_Policy		0.73***	
		(4.16)	
1 if at least 4 antenatal visits lag 1			0.23**
			(1.97)
Antenatal care facilities (numbers in Kebele)	0.21**	0.12	0.11
	(2.28)	(1.61)	(1.51)
19-25	0.15	0.14	-0.21**
	(1.34)	(1.19)	(-2.36)
26-30	0.30	0.12	-0.23*
	(1.64)	(0.74)	(-1.71)
31-35	0.15	-0.10	-0.23
	(0.74)	(-0.57)	(-1.33)
above 35	0.25	-0.07	-0.27
	(0.94)	(-0.32)	(-1.36)
Per capita household landsize (acres per capita)	-0.20**	-0.18**	-0.02
	(-2.20)	(-2.25)	(-0.23)
2nd parity	-0.02	0.13**	-0.03
	(-0.40)	(2.22)	(-0.34)
4th+ parity	-0.06	-0.05	-0.02
	(-1.04)	(-0.88)	(-0.29)
Observations	683	683	683
Number of Mother	406	406	406
Year × region	Yes	Yes	Yes
Mean of the outcome	0.677	0.611	0.425
Sargan test (p.value)	0.939	0.829	0.234
Autocorreration test (p.value)Order 2	0.975	0.175	0.843
Order 3	0.584	0.545	0.233

Notes:
z-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). T-stat presented on the table are computed from robust standard erros. All regressions include a constant and region-year interaction.
4). The base category for age is those under 19 years. The base category for education is those with no formal schooling-zero grade.
5). Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation.
6). [1 if deliver at a health facility lag 1_Policy] stands for [1 if deliver at a health facility and assisted by a skilled practitioner in her previous birth]

TABLE 12: ACCESS AND ANTENATAL CARE USE: A DYNAMIC PANEL MODEL

VARIABLES	(1) 1 if attended antenatal care at a facility	(2) 1 if received ANC at facility by a skilled practitioner	(3) 1 if at least 4 antenatal visits
1 if attended antenatal care at a facility lag 1	0.57**		
	(2.15)		
1 if attended antenatal care at a facility lag 1_Policy		0.52*	
		(1.77)	
1 if at least 4 antenatal visits lag 1			0.23**
			(1.98)
General care facilities (numbers in Kebele)	0.13	0.12	0.06
	(1.44)	(1.34)	(0.74)
19-25	0.08	0.12	-0.21**
	(0.68)	(0.88)	(-2.36)
26-30	0.04	0.08	-0.25*
	(0.24)	(0.36)	(-1.78)
31-35	-0.01	-0.07	-0.24
	(-0.08)	(-0.34)	(-1.37)
above 35	-0.06	-0.06	-0.29
	(-0.26)	(-0.22)	(-1.43)
Per capita household landsize (acres per capita)	-0.04	-0.12*	-0.03
	(-1.09)	(-1.68)	(-0.40)
2nd parity	0.04	0.09	-0.02
	(0.84)	(1.29)	(-0.23)
4th+ parity	-0.03	-0.04	-0.02
	(-0.29)	(-0.36)	(-0.24)
Observations	683	683	683
Number of Mother	406	406	406
Year × region	Yes	Yes	Yes
Mean of the outcome	0.677	0.611	0.425
Sargan test (p.value)	0.351	0.471	0.223
Autocorreration test (p.value)Order 2	0.235	0.247	0.740
Order 3	0.767	0.740	0.244

Notes:
z-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). T-stat presented on the table are computed from robust standard erros. All regressions include a constant and region-year interaction.
4). The base category for age is those under 19 years. The base category for education is those with no formal schooling-zero grade.
5). Sargan test: H_0: Over identifying instruments are valid. Autocorrelation test: H_0: No autocorrelation.
6). [1 if deliver at a health facility lag 1_Policy] stands for [1 if deliver at a health facility and assisted by a skilled practitioner in her previous birth]