# CONTRACTING-OUT OF PRIMARY HEALTH CARE SERVICES IN CONFLICT-AFFECTED SETTINGS: THE CASE OF SOUTH SUDAN

by
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A dissertation submitted to The Johns Hopkins University
in conformity with the requirements for the degree of
Doctor of Philosophy

Baltimore, Maryland
October, 2019

# Abstract

South Sudan introduced a nation-wide geographically focused contracting approach with funding from 3 main donors, to rapidly scale-up access to health services starting mid-2012. The overall aim of the thesis is to assesses its effect and impact on maternal and child health. In the first paper, I provide extensive background on the history of health services delivery in South Sudan prior to assessing progress in increasing health facility utilization among women and children under-five, using routine health facility data. I thus compare the period (2011-2013) to the policy period (2013-2015) at national and sub-national level using Prais-Winsten and Cochrane-Orcutt regression and find significant increases in health facility utilization. Given the overall increase in health facility utilization, the second paper assesses impact of the policy on child mortality using a novel approach to construct a synthetic South Sudan from a panel of lower- and middle-income countries (LMICs), and using data from the World Bank Developmental Indicators (WDI) database. On average, contracting out had a negative effect on the rate of decline of U5MR during the policy period. These findings suggest limitations in the approach implemented in South Sudan. The third paper further evaluates the contracting intervention by evaluating three contracting approaches in Jonglei and Upper Nile States; contracting-out (C-O) using non-governmental organizations (NGOs), contracting-in (C-I) using county health departments (CHD) and performance-based contracting (PBC) in select counties. Using difference-in difference (DD) and DD with propensity score matching. I hypothesized that contracting-out to NGOs leads to higher performance relative to contracting-in with CHDs, that performance-based contracting incentivizes health workers, hence PBC counties have higher utilization relative to non-PBC counties. Results are not as straightforward; there are no significant differences in the double differences for ANC 4th visits, health facility deliveries, DPT 1, DPT 3 and diarrhoea and PBC had no effect on utilization.

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# Acknowledgements

I would like to extend my gratitude to the Ministry of Health, Republic of South Sudan without whom this work would not be possible. Specifically, Dr. Samson Baba, Dr Alexander Dimiti and Dr. Richard Laku, who not only encouraged me to undertake this evaluation but also wrote letters of recommendation when I was applying to graduate programs. Dr. Laku was kind enough to extend access to the District Health Information System (DHIS) database which underpins this research.

Dr. William Clemmer and Dr. Mounir Lado from IMA World Health provided key project documents. Special thanks to Dr. Clemmer for his continuous encouragement, feedback and guidance with the initial proposal and throughout this process. I would also like to extend my thanks to Mr. James Amum, from the County Health Department (CHD) in Manyo who was kind enough to provide CHD contract documents. Dr. Augustino Ting Mayai who gave critical feedback to the initial draft of this thesis – which meant many more days of additional analysis, but without which this thesis would be weaker.You all significantly extended the scope of this work, and as a result, I was able to improve on the third paper.

To my colleagues over the years in South Sudan, Drasiga, Amule, Nellie, Keji, Trueman, Juac, Fadil, Ibra, Koma, Dr Kenyi, Dr.Edward, and so many others. You enriched my time in South Sudan. See you soon!

To Dr. Felix Loro Lado, who taught me what it means to be passionate about the work that we do, to always keep in mind the people whom we serve, and to passionately advocate for the least among us. I will be forever grateful for the lessons you taught me, Dr. Felix. You were always the best of us, travel well to the ancestors. May you rest in peace.

To my colleagues at the Dept. of International Health and the Dept. of Health Policy, and specifically Ashley Sheffel, Ilona Varallyay, Amy Margolis, Jaya Gupta, Katharine Shelley, Dolapo Fekeye, Jean Oliver, Prof. Darrel Gaskin, Felicia Roane,

Prof. Janice Bowie, Prof. Courtland Robinson, without whom my academic experience would have been less rewarding. Cristina Salazar who was a strong advocate on my behalf. Thank you so much!

My social support network during my time in Baltimore; Judy Njuguna, Camille Brown, Deryck Pearson, Susan Aura, Patrick Huntley, Sarah Michaels, Alonzo Howard. My Mt. Vernon crew; Alex Egner and Willa, meadow, Noah Patterson, Grace Smith, Marta Spangler. My home will always be your home.

My cousins, Lalam, Orlando and Chacha. You have always been there throughout all the good and the bad. I appreciate you all.

Alsarah- I am so proud of you and always in awe of your awesomeness. Your friendship means the world to me.

My thesis committee; Profs. Gerard Anderson, Krishna Rao and M.E. Hughes. Thank you for your feedback and support. I am lucky to have had you as part of this process. Special thanks to my thesis chair, Prof Anderson, for the extensive and crucial feedback, guidance, for making time to meet with me starting from when I first wrote the proposal, to the thesis. I aspire to be like you.

Last but not least- and it is hard to express my gratitude in words- my advisor, Prof. Antonio Trujillo. I consider you a friend and more importantly, a mentor. I have learned so much from you, you inspired me to think outside the box, you pushed me to be a better researcher, to take classes outside of the School of Public Health, you always made time to meet with me, and you shaped this thesis into what it is. The best decision I made was to ask to be your advisee. I hold the advice you give- to always ensure that your work is accessible, "so that my grandmother can understand" and "always remember that the method is the servant not the master" very close to my heart.

This thesis is dedicated to the women and children of South Sudan.

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# Introduction

. . . technical progress is more than just changes in the sophistication of drugs, devices and techniques of medicine. It includes improvements in public health provision and private health practices which affect the adoption of the best techniques. Recent research has either given little emphasis to technical progress — in part simply because much of the research is cross-sectional and therefore ignores developments over time — or it has assumed the rate of technical progress to be constant across countries. But countries differ in how close their health systems come to utilizing the best technology or practice available: the catch-up with the technical frontier may be country-specific (Jamison et al., 2016).

# Summary

Numerous studies suggest that contracting increases health facility utilization, with the underlying implication that this may also lead to improved health outcomes (Lagarde and Palmer, 2009; Odendaal et al., 2018). This strategy is increasingly used by governments in fragile and conflict-affected settings to rapidly accelerate access to basic health services. This thesis provides a comprehensive history of the emergence of the health system in South Sudan between 2005 and 2011. It also provides an analysis of the effect of a nationwide contracting approach implemented after independence in 2011 on health facility utilization and health outcomes. As far as I am aware, this is the first evaluation of the contracting approach implemented in the country.

The first paper describes the effect of a nation-wide contracting intervention on health facility utilization by mothers and children, finding overall increases, with variation at the sub-national level. This provides initial evidence of whether the contracting intervention in South Sudan, which was largely implemented in two phases, increased health facility utilization. The first phase of contracting (2005-2011) had limited geographical scope and I compare results from the first South Sudan Health and Household Survey (SHHS) conducted in 2006 to the 2010 survey. The second phase, expanded the contracting intervention nation-wide. Due to lack of subsequent surveys, I use routine health facility utilization data from the district health information system (DHIS) to describe longitudinal trends in maternal and child health facility utilization using time series graphs and ordinary least squares

regression with panel corrected standard errors to account for the time-series nature of the data.

In the two subsequent papers, I explore the causal mechanism. The second paper assesses the overall impact of contracting on under-five mortality using the synthetic control method- a comparative case-study methodology used in the field of political science - to construct a counterfactual South Sudan from a multi-country panel. Results show that the rate of decrease of under-five mortality falls during the contracting period, implying that improvements in health outcomes may not necessarily follow observed increases in utilization, or a limitation in the implementation of the approach.

In the third paper, I explore the mechanism by which contracts were designed and implemented in one region, extending elements of contract theory, developed in the field of economics to describe the within-country variation in its effect. This paper seeks to resolve the question of whether the contracting intervention had limitations in how it was implemented. Results suggest limited difference in health facility utilization comparing contracting using government agencies relative to the private sector. This is surprising as contracting with the private sector presumes increased productivity within the health sector. My conclusion is that while contracting may increase health facility utilization, further research is needed to understand how contracts are designed and implemented in fragile and conflict-affected settings, if we are to also achieve meaningful reductions in mortality. There is also need to explore innovative ways of increasing the capacity and involvement of governments in health services delivery. This is increasingly critical due to the increase in number of countries in conflict and often resultant lack of competition in the selection of private providers.

# Thesis Overview

In the past decade, there has been a growing number of armed intrastate conflicts, which have increasingly been concentrated in lower- and middle-income countries. In 2014, for example there were 40 reported active conflicts with 30% (n=12) in Africa, increasing to 52 in 2015 prior to reducing to 49 in 2016, 35% (n=17) of which were in Africa (Allansson et al., 2017). Given current trends, it is estimated that by 2030, more than half of the world's poor will be living in countries affected by conflict (OECD, 2015).

War and conflict negatively impact every facet of society and predominantly the health system and health status of the affected population. The World Bank estimated that fragile and conflict-affected countries experience one third higher infant mortality rate, a life-expectancy that is shorter by 12 years and 20% higher maternal mortality compared to other low-income countries (Carvalho, 2006). During the Millennium Development Goals (MDG) period (2000-2015), nearly two-thirds of these countries failed to meet global goals to halve poverty and infant mortality, despite simultaneously experiencing the highest burden (OECD, 2015).

This portends negative implications for meeting the 2030 Sustainable Development Goals (SDGs) to reduce poverty, ensure healthy lives and promote well-being for all, unless increasing attention is paid to the health systems in fragile and conflict-affected states. Governments in these settings encounter significant challenges in providing basic services to their populations, being constrained in financial and technical capacity.

Health system strengthening and reconstruction in post-conflict settings has primarily involved decentralizing the health sector, establishing a basic package of primary healthcare services, and governments contracting out the delivery of health services to non-governmental organizations in public-private partnerships, with financing from external donors (Newbrander et al., 2011). Public-private partner-

ships are often the only feasible approach by governments seeking to expand access to health services in these settings.

Focusing on South Sudan, I present a comprehensive case-study of a country transitioning from long-term conflict to post-conflict reconstruction and development and building a health system from scratch, in hope that it may offer lessons for other settings. This thesis is also grounded on my personal experience working with health system strengthening programs in South Sudan both during the transition period as well as post-independence. Thus, it is also driven by my own personal motivation to understand the effect of these efforts on health facility utilization, and specifically for women and children in South Sudan.

The experience of South Sudan is unique as the country has experienced three distinct periods; the conflict period during which humanitarian aid was the only source of basic services, a transitional period of reconstruction which also correlated with an emergence from relief to developmental aid, and the period after independence in 2011 which consolidated the gains of the transition period. During the post-independence period there was a return to conflict in certain regions of the country, allowing an analysis of the effect of conflict on health facility utilization.

The aim of the first paper is to provide a comprehensive case-study of the health system in South Sudan, describing the emergence of a health system where none previously existed, and describing the specific contract modalities implemented. The post-independence period saw a nationwide implementation of a geographically-financed aid architecture with three main programs funded by USAID, the World Bank and a health pooled fund of primarily European Union countries. These three programs relied on contracting the provision of a basic package of health services to non-governmental organizations, essentially establishing three health systems. For example, per capita spending for health ranged from USD$ 4.9 to US$ 10.4 and the three programs also had differential implementing modalities.

Overall, antenatal care first visits increase by 3,465 mean monthly visits per year, (or 30% increase on average) between 2011-2015. However, contacts with the health facility is not sustained; there is a drop-off in women completing their fourth antenatal care visit or delivering in the health facility, both of which increase by 18% and 24% respectively suggesting either additional incentives may be necessary, or that the quality of care dissuades women from further contacts.

Among children, the overwhelming reason for health facility utilization is for malaria treatment, with fewer children completing the immunization protocol for diphtheria, pertussis and tetanus (DPT). Between 2011 and 2015, malaria and diarrhoea cases increase by 11,632, and 5,77 per month representing relative increases of 36% and 38% respectively whereas mean monthly DPT 1st and 3rd dose, increase by 4,153 and 3,528 (46% and 50%) from the 2011 baseline. The increase in number of children receiving treatment for malaria and diarrhoea, which are major causes of morbidity and mortality in South Sudan, coupled with increasing immunization coverage may result in observable decrease in under-five mortality.

As paper 1 is mainly descriptive, I then explore the causal mechanism. Paper two uses the synthetic control method (SCM) to estimate the effect of the geographically-focused contracting-out policy on the under-five mortality rate (U5MR) in South Sudan. SCM is a comparative case study methodology used in the fields of political science and economics with limited application in health to date (Abadie et al., 2010, 2015). SCM is used to construct a counterfactual, referred to as a synthetic South Sudan, from a balanced multi-country panel of similar lower-and middle-income countries. Data is obtained from the World Bank Developmental Indicators (WDI) database, which represents the most accurate global development data for 217 countries, and covers 2000 to 2016 to assess progress over time.

During the pre-intervention period (pre-2013), U5MR for South Sudan and synthetic South Sudan fall from a high of approximately 180 under-five deaths per 1,000

live births to a low of 102 under-five deaths per 1,000 live births. This largely follows the overall drop in U5MR observed in Sub-Saharan Africa during the MDG period. The U5MR for synthetic South Sudan begins to diverge from that of South Sudan mid- 2011; the percentage difference between South Sudan diverges from synthetic South Sudan by 6% to 18% between 2012-2016, suggesting that the rate of decline in U5MR slows post-independence. This is surprising given the observed increase in children utilizing the health facility observed in paper 1. This further implies that while health facility utilization increases as a result of the contracting policy, these gains were not high enough to impact the overall U5MR.

In the first paper, I also observed that improvements in health facility utilization differs across the three health programs and by type of health facility. Of the three programs, the health pooled fund regions have the highest observed increases in maternal and child health facility utilization while the World Bank sites, which are also the most conflict-affected, have similar utilization to that of the USAID sites, which are the least conflict-affected. This implies that while there may be observable increases in utilization due to contracting nationally, within-country variation in program implementation and contract design matters in curtailing child mortality. It may also suggest that the contracting approach in South Sudan may require a redesign in order to attract competition among providers, improved incentives for health workers and providers to achieve noticeable gains in health outcomes. Understanding the existing contracting modalities in South Sudan may provide additional lessons in future designs of contracts.

The third paper therefore delves into the contracting approach in South Sudan, using contract-theory to assesses the effect of three contracting modalities; contracting-out to NGOs, contracting-in with a government agency- the county health department (CHD) - and performance-based contracting (PBC). Contract-theory suggests that the provider or agent, in this case the CHDs and NGOs - must be adequately incentivized and also recommends appropriate monitoring controls to

reduce the problem of moral hazard (Smith et al., 1997; Committee et al., 2016). As performance also depends on factors that may be largely beyond the provider's control (for example conflict), well-drawn contracts must also balance compensation against risk-sharing. Hart and Holmström therefore recommend that contracts be based not only on measurable outcomes *ex post*, but also on the providers' effort with compensation tied to level of effort.

The motivation behind this paper is that applying principles from contract-theory to the contracting-out approach in lower- and middle-income settings may illuminate effective ways of improving the delivery of health services, by taking into consideration the environment in which contracts are drawn. I focus on the most conflict-affected states (Upper Nile and Jonglei) as the contracting agency overseeing this region has the most experience working in South Sudan, under the assumption that the variation in contract types takes into consideration this experience. Using difference-in difference (DD) and DD with propensity score matching, I hypothesize that contracting-out to NGOs leads to higher performance relative to contracting-in with CHDs, and that performance-based contracting incentivizes health workers, hence PBC counties have higher utilization relative to non-PBC counties.

Results suggest that this is not as straightforward; there are no distinct differences in performance comparing CHDs and NGOs. For example, while mean antenatal care first visits falls by almost 50% in CHD counties, there are no significant differences in ANC 4th visits and health facility deliveries. Similarly, there are no statistically significant differences in the double differences for immunization and diarrhoea treatment comparing the two sites. PBC also had no effect on utilization relative to counties with no PBC incentive, perhaps due to inadequate incentives or the design of the PBC approach overall. Thus, there is need to identify contextual factors, the specific implementation activities of providers to identify ways of tying compensation to level of effort, and appropriate incentives (reward) and penalty mechanisms for both providers and health workers to effectively incentivize perfor-

mance. While this may also be due to the conflict, the fact that the World Bank program achieves similar health facility utilization relative to USAID sites suggests that overall these approaches may have limited the effect of conflict. These results also strengthen the case of utilizing government agencies in contracting as this may be more cost-effective in the long run.

The thesis is important for several reasons. Humanitarian assistance provided by non-governmental organizations (NGOs) is often the only source of health services for most of the population in conflict-affected settings. This is often delivered in form of vertical or disease-specific programs which have an immediate impact on mortality and morbidity, are often limited in scope and impact, but which also contribute to the fragmentation of the health sector (Waters et al., 2007; Kruk et al., 2010; Philips and Derderian, 2015). There is growing recognition that health service delivery in conflict-affected settings requires a longer-term approach to external aid, and therefore a shift from short-term humanitarian approaches to longer-term developmental aid. This requires strengthening the capacity of government institutions to deliver health services even in presence of conflict. This paper provides an example of a country that made tremendous gains in establishing a health sector.

There has also been growing recognition by multilateral and bilateral donors that achieving complex and global progress on health and non-health goals necessitates increasing investment in fragile and conflict-affected states (Andrew, 2005). This was the basis of the New Deal for Engagement in Fragile States (2011) which promoted cooperation between donors, governments of fragile states (referred to as the g7+) and civil society organizations to improve the effectiveness of aid. This necessitates increasing investment in the health sector, guaranteeing financial resources through a longer-term approach to donor funding and establishing monitoring and accountability mechanisms (Newbrander et al., 2011; Haar and Rubenstein, 2012; Kruk et al., 2010; Philips and Derderian, 2015). The health sector has the potential of providing immediate observable benefits, often referred to as peace dividends,

to conflict-affected populations which may promote peace and stability (Nussbaum et al., 2012).

The New Deal prioritized building the capacity of government institutions to deliver public services as a means of increasing trust and legitimacy of governments. South Sudan, as one of the founding countries of the g7+ and one of seven pilot countries that volunteered to implement the New Deal, affords an opportunity to assess one aspect of its implementation, adding to the existing evaluations of the New Deal process. The thesis also compares the effect of contracting using a government agency and thus may contribute to further discussions on the need to expand contracting approaches to the public sector, regardless of sources of funding.

There have also been calls for adding on to the existing evidence-base on health systems reconstruction to inform future policy and practice specific to fragile and conflict-affected settings (Bornemisza et al., 2009; Kruk et al., 2010; Witter, 2012). By extending principles from contract-theory to the contracting-out approach in lower- and middle-income settings, I hope to motivate discussions around the environment in which contracts are drawn, the incentives mechanism underlying these contracts in hope of increasing the efficiency of the contracting approach.

Lastly, I argue that as provider effort is directly tied to meeting performance targets, understanding specific implementation modalities, coupled with the proper design of the incentives structure and a flexible contracting design may allow for innovative service delivery models especially in conflict-affected settings. Technical progress would therefore include improvements in public health provision and facilitate adoption of the best techniques.

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# Paper 1: Rebuilding health-systems to improve maternal and child health in post-conflict countries.

**Abstract**

South Sudan introduced a nation-wide geographically focused contracting approach with funding from 3 main donors, to rapidly scale-up access to health services starting mid-2012. I provide extensive background of health services delivery during the conflict and post-conflict prior to assessing progress in increasing health facility utilization among women and children under-five, after the implementation of the policy using routine health facility data. I compare the period (2011-2013) to the policy period (2013-2015) at national level and sub-national using Prais-Winsten and Cochrane-Orcutt regression, accounting for the time-series nature of the data. During the policy period mean monthly antenatal care (ANC) 1st and 4th visits increase by 8,011 and 2,799, IPT-2 by 3,475 and facility deliveries by a mere 980 (all $p<0.01$), relative to the pre-policy, representing increases of 30%, 17%, 24% and 16% respectively. Mean monthly utilization among children also increased significantly; DPT 1 and DPT3 by 8,657 and 7,196, malaria and diarrhoea by 26,164, and 13,903 respectively, representing increases of 26% for immunization and 22% and 27% for malaria and diarrhoea relative to pre-policy. Utilization patterns varied by level of health centers and units (PHCCs/Us); pregnant women preferred their 1st ANC visit at PHCCs, and whereas PHCUs received more children with malaria, and diarrhoea, DPT immunization was higher at PHCCs. Mothers thus preferred PHCUs for care for their children but tended to receive services at the PHCCs themselves. Conflict-affected areas experience reduced utilization with a dose-response related to level of conflict; the higher the level of conflict, the higher the drop-in utilization and immunization services more heavily impacted. Lastly, there are regional variations in utilization at the donor level.

**Keywords**— Health system strengthening; Primary health care services; Contracting; Conflict-affected settings; Lower-and-middle-income countries; South Sudan

## 1.1 Introduction

War and conflict significantly impacts all facets of society and results in large numbers of civilian casualties. Conflict also limits progress towards attaining health targets and poverty reduction. In the past decade, armed intrastate conflict has increasingly been concentrated in lower- and middle-income countries, which are often least capable of mitigating the effects of conflict. In 2014, for example there were 40 reported active conflicts with 30% (n=12) in Africa, increasing to 52 in 2015 prior to reducing to 49 in 2016, 35% (n=17) of which were in Africa (Allansson et al., 2017).

In conflict - affected settings, the health sector is often a casualty; conflict accompanies the destruction of health facility infrastructure, interruption of the supply of drugs and essential medicines, and loss of human resource capacity (Waters et al., 2007; Witter, 2012; Rutherford and Saleh, 2019). The resultant excess morbidity and mortality is caused by the direct effects of the conflict, for example war-related deaths and injuries and higher susceptibility to communicable diseases due to mass displacement, and indirect causes from lack of access to preventive and curative health services, medicines and equipment

and breakdown in water and sanitation infrastructure (Waters et al., 2007; Kruk et al., 2010). Higher rates of maternal and child mortality frequently portend the destruction of the health system with the highest rates observed in countries with a long history of conflict. The breakdown in basic services overall is also a contributory factor; excess child mortality for example, is exacerbated by food insecurity and lack of access to clean water and sanitation in addition to lack of treatment for diseases such as malaria, pneumonia and diarrhoea.

During the post-conflict period, reducing morbidity and mortality is a priority for both donors and newly established governments as this is perceived to provide a 'peace dividend' to the affected population. Stronger health systems may also increase the trust and legitimacy of post-conflict governments through the accelerated provision of health services and may thus improve the chance for sustainable peace. Identifying the successes and limitations of health system strengthening approaches in post-conflict settings is thus critical for policy and practice, especially given the increase in the number of global conflicts and as countries emerge from conflict.

Using South Sudan as a case-study, I provide a comprehensive description of the health system strengthening experience of a fragile and conflict-affected country. South Sudan has had three distinct periods of health services provision; the conflict period during which humanitarian aid was the only source of basic services, a transitional period of reconstruction which also correlated with an emergence from relief to development, and the period after independence in 2011 which consolidated the gains of the transition period. I provide extensive contextual background on the health system approaches implemented across the three periods with the objective of informing future policy and practice.

In fragile and conflict-affected settings, humanitarian assistance provided by non-governmental organizations (NGOs) is often the only source of health services for most of the population. One of the primary goals of humanitarian aid is to reduce excess mortality and morbidity therefore service delivery is often in form of vertical or disease-specific programs which have an immediate impact on mortality. Humanitarian services are often limited in scope; to specific geographical regions, defined by short-term funding and with

limited resources for efforts that contribute toward health systems development (Waters et al., 2007; Kruk et al., 2010; Philips and Derderian, 2015). Research suggests that vertical programs and project-specific interventions contribute to the continuing fragmentation of health systems, further weakening government capacity to play a stewardship role, and also distorting national health priorities by prioritizing disease specific interventions. These programs also place undue burdens on reporting and coordination in the public sector in low income countries (Hafner and Shiffman, 2012). In fragile and conflict-affected settings, the fragmented health sector is an additional challenge for governments' efforts to coordinate and provide stewardship to the health sector especially with financial and human resource constraints.

The Millennium Development Goals (MDGs) established in 2000 shifted global focus from disease-specific interventions to population-based reductions in morbidity and mortality (Philips and Derderian, 2015). Two of the MDG goals, (MDG4 & MDG5) targeted improvement of health outcomes for women and children; MDG4 to reduce child mortality by two thirds and MDG5 to reduce maternal mortality ratio by three quarters between 1990 and 2015 (UNGA, 2000). There was recognition that this required strengthening health systems to expand coverage of evidence-based interventions and additional investment in the health sector. For example, during the MDG period, estimates for scaling up essential interventions for newborn and child health ranged from US$5·1 billion annually or $1·23 per head to save 6 million child lives (Bryce et al., 2005), to $13.6 billion investment over ten years for maternal and newborn health interventions (WHO, 2005) in additional funding from external donors.

In 2005, donors and governments from developing and developed countries endorsed the Paris Declaration on Aid Effectiveness in 2005 to improve the quality of aid and its impact on development to accelerate progress toward the MDGS. Key commitments such as ensuring country ownership of development policies and strategies, alignment of donor priorities to these strategies, harmonization of donor funding, results-based management of funds and mutual accountability were identified (OECD, 2008). By 2010, there was also increasing acknowledgement that conflict and fragility were major obstacles to achieving

the MDGs and that external aid should expand to strengthening the capacity of governments to deliver health services even in fragile and conflict-affected settings. This led to the first International Dialogue for Peacebuilding and Statebuilding (IDPS) meeting, held in Dili, Timor-Leste in 2010. This meeting brought together donors and countries affected by conflict and fragility to establish principles for donor engagement and transition from relief to development.

The Dili Declaration (2010) outlined peacebuilding and state-building stepping stones to achieving progress on development, and as means to end or prevent conflict (Dili, 2010). These included developing effective and accountable government institutions to facilitate service delivery and prioritizing the needs of women and children. The declaration included commitments from the g7+ countries[1] to prioritize good governance specifically decentralization aimed at bringing services closer to populations in-need, and expanding basic services in for example education, health, water and sanitation, in addition to addressing and resolving internal conflict. The declaration implies that strengthening the capacity of governments contributes to development and thus to safeguarding peace and stability.

Stronger health systems have been tied not only to improvements in population health, but also to increasing trust and legitimacy of governments in the post-conflict period (Newbrander et al., 2011; Haar and Rubenstein, 2012; Kruk et al., 2010; Philips and Derderian, 2015). This occurs through involving government and civil society organizations in health services delivery, in ensuring equitable access to health services, and guaranteeing financial resources through longer-term donor funding. As the number of conflict-affected countries continues to grow, and with larger investments going to reconstruction and re-establishment of essential services in fragile and conflict-affected settings, the need for empirical evidence on transitions from relief to development remains increasingly pertinent (Kruk et al., 2010).

Health system strengthening in fragile and conflict-affected settings has involved es-

[1]The g7+ is an open group of countries experiencing conflict and fragility. It was established in 2008 and formalized in 2010 and comprises the following countries: Afghanistan, Burundi, Central African Republic, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Haiti, Liberia, Nepal, the Solomon Islands, Sierra Leone, South Sudan and Timor-Leste

tablishing a decentralized health system, pooling donor funds, implementation of a basic (or minimum) package of health services (BPHS) through contracts with non-state actors. South Sudan provides an interesting case-study to describe the health system of a country transitioning from conflict and from relief to developmental aid having applied lessons from other post-conflict settings, primarily Afghanistan. The country emerged from almost thirty years of conflict and the health system had to be built from scratch. Starting in 2005, a nascent primary health care system emerged with the newly established government contributing to health-care funding, strengthening its stewardship role of the health-sector and essentially creating the building blocks of the health system with the support of bilateral and multilateral donors.

Similar to other post-conflict settings, South Sudan has a decentralized health system and has contracted-out health services delivery to NGOs using a basic package of health services as the basis of contracts. The country implemented a geographically focused health financing architecture with donors supporting distinct geographical areas and therefore provides a unique opportunity to compare program implementation modalities and the effect on health facility utilization across the main donors involved in health system strengthening efforts in fragile and conflict-affected settings. The experience of South Sudan thus provides additional lessons for future efforts to rebuild health systems.

This paper is a descriptive case-study of health system development in South Sudan and includes an analysis of the health gains post conflict. There are two main sections; the first section is the pre-independence period which provides a comprehensive background of the health sector prior to the conflict and during the transition from conflict and the post-independence period which prioritized expanding access nationwide to consolidate gains from the transition period. The paper proceeds as follows; I first provide the history of South Sudan during the period of conflict and the effect of the conflict on health outcomes, after which I describe the health programs established immediately after the signing of a comprehensive peace agreement and during the transition from relief to development. This essentially describes the emergence of a health system, where none previously existed. I compare results from two national surveys in 2006 and 2011 to provide estimates of the

effect of the transition period.

I then describe the period after the independence of South Sudan in 2011, which corresponded to the implementation of a geographically-focused health funding architecture with three main donors to expand access to care. This period consolidates the gains of the transition period with the design of a health financing architecture based on lessons learned from that period. Finally, I analyze health facility utilization data between 2011-2015 to describe the effect of the post-independence health system expansion using key maternal and child health indicators due to lack of national level survey data. I hypothesize that post-independence, there was a rapid acceleration of health facility utilization that is observable using data from health facility reporting. In addition, I compare health facility utilization across the three main donor-funding mechanisms comparing the period before and after independence under the assumption that differences in program implementation modalities may result in differential rates of utilization across the three programs. Understanding program specific differences in program design and implementation and their effect on improving access to health services is critical because how programs are implemented has implications for the resultant efforts to accelerate health facility utilization.

## 1.2 Background on South Sudan

Health services in South Sudan have primarily been provided by non-state actors with funding from international donor agencies. There have been three distinct periods; 1) A humanitarian phase, 1983-2005, whereby non-government organizations (NGOs) provided ad hoc health services to individual health facilities in limited geographical areas, often achieving highly fragmented coverage. Types of services were determined by donor priorities, availability of funds, and were often based on short-term contracts (typically one to two years); 2) A transition from relief to development phase (2005-2011) whereby contracts were often of a longer duration (3 to 5 years), and for individual health facilities. Health services were provided following a basic package of health and nutrition services (BPHNS) developed by the nascent Ministry of Health (MoH). Humanitarian and developmental assistance was provided concurrently, and was inequitably distributed hence some health facilities received assistance from both types of donors while some facilities received no

funding. Coverage was low, with health services reaching only 25% of the population. In addition, there was little to no oversight from government, and the extent to which the BPHNS was implemented remains unclear.; and 3) A third phase of consolidation (2012 to date), whereby the health financing architecture was streamlined, geographically focused, there was consolidation of relief and developmental assistance and the government sought to establish greater stewardship of the health sector.

Waters et al identifies a useful health system strengthening framework for analysing the inputs and policies of post-conflict rehabilitation programs using three inter-related approaches that cross the pre-conflict, conflict and post-conflict periods (Waters et al., 2007). The framework (1.1) assesses the initial response to immediate health needs, the restoration and establishment of a basic package of essential health services and the rehabilitation of the health system itself.

Critically, the framework acknowledges that post-conflict reconstruction is influenced by the pre-conflict infrastructure and health system development as well as the economic and political context therein. Post-conflict reconstruction must therefore not only address immediate efforts to restore basic services but also the medium to longer term goals to address the destroyed infrastructure and interruption of services. I use the Waters framework to describe the rebuilding of the health system in South Sudan, due to the unique history of conflict in South Sudan which was precipitated by lack of development, the importance of its political and economic history and the priorities of the post-conflict reconstruction in the transition from relief to development.

### 1.2.1 Pre-Conflict and Conflict

Sudan gained independence from the British in 1956, after more than 55 years of colonialism, during which the southern region was socially and economically underdeveloped. The country soon entered a protracted period of conflict between the northern and southern regions - the 1st Sudan civil war- caused by the historical underdevelopment and political grievances among southern Sudanese, who had expected to become an independent state (Johnson, 1994; Kasfir, 1977; WB and UN, 2005).

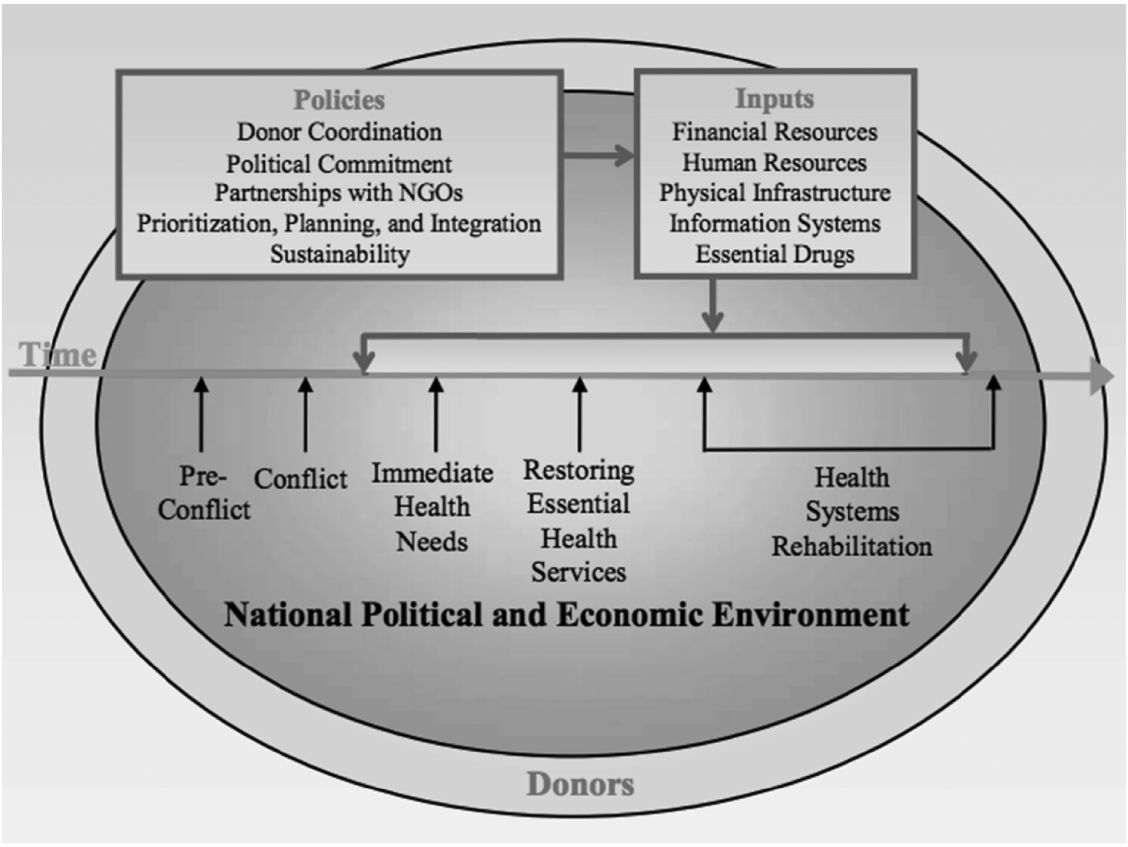


*Figure 1.1:* ***A framework for post-conflict health systems rehabilitation.***

The 1st Sudan civil war lasted until 1972, ending with the Addis Ababa peace agreement which established an autonomous region in the south consisting of 3 administrative provinces; Equatoria, Bahr el Ghazal and Upper Nile. The agreement ushered a decade of peace during which several development projects were undertaken in the south by government, non-governmental and international agencies. Development projects focused on improving infrastructure and services, including health sector improvements. However, most projects were concentrated in Equatoria with limited development in the rest of the country (Johnson, 1994). In addition, these developmental initiatives were limited in scope due to inadequate financial resources availed for reconstruction and development (Kasfir, 1977).

The 2nd Sudan civil war led by the Sudan People's Liberation Movement and Army (SPLM/A) based in the southern region, begun in 1983 and lasted until 2005. This conflict is estimated to have caused the deaths of over two million people and significant destruction of the already limited infrastructure in the South. In 1989, drought and the cumulative effect of war resulted in famine in the Bahr el-Ghazal region of Sudan, resulting in approximately 250,000 deaths and displacing over one third of the civilian population (Africa Watch). It also led to the first major international response to the conflict in Sudan, Operation Lifeline Sudan (OLS).

OLS started as a short-term and temporary humanitarian response to provide emergency assistance and food to the famine-affected population (in both south and north Sudan). To reach the conflict-affected population, OLS negotiated access with the actors directly involved in the conflict; the Government of Sudan (GoS) and the SPLM/A and was essentially a tripartite agreement between these two parties and the United Nations, led by UNICEF. The OLS agreement was the only legal means for approximately 40 NGOs to operate in non-government-controlled areas and was the start of a long-term engagement in service provision by non-state actors (Bradbury et al., 2000).

Between 1986 – 2005, there was no formal administrative government in most parts of southern Sudan, and limited to non-existent social and economic development. In 1993, the main actors involved in OLS recognized the need for more development-oriented activ-

ities e.g. food security, support for livelihoods and capacity-building of civic institutions, in efforts to strengthen local involvement in the relief efforts (Macrae et al., 1997; Harmer, 2004). Capacity building was to include administrative and programmatic support to the humanitarian wings of the key actors involved in the war, and to encourage the participation of Sudanese Indigenous NGOs (SINGOs). Concurrently, the SPLM/A formed the Sudan Relief and Rehabilitation Commission (SRRC), with a Secretariat of Health (SoH) as a department tasked with the responsibility of overseeing the provision of health services in areas controlled by the SPLM/A[2]. This was effectively the first attempt to regulate the health sector.

### 1.2.2 Effect on the health system

Between 1983-2005, basic health services were largely non-existent for over 80% of the population; health services provided by the Government of Sudan (GoS) was limited to 11 garrison towns[3] and covered a mere 14% of all health facilities in the southern region (Cometto et al., 2010). Remaining health facilities in SPLM/A controlled areas, were managed by non-governmental organizations (NGOs) with humanitarian funding primarily from USAID (through the Office of US Foreign Disaster Assistance (OFDA), the European Commission Humanitarian Aid Office (ECHO), the United Kingdom's Department for International Development (DFID) and the Norwegian Agency for Development Cooperation (NORAD). Funding was primarily short-term (1-2years), with NGOs typically serving overlapping catchment areas, had limited geographic scope (NGOs were mainly concentrated in areas that were less hard-to-reach and less affected by conflict) and were organized by vertical or disease specific programs (Cometto et al., 2010; Rietveld and Waldman, 2006).

By 2003, there were an estimated 19 hospitals, 103 primary health care centers (PHCCs) and 551 primary health care units (PHCUs) in SPLM/A controlled areas whereas in the garrison towns, there were approximately 10 hospitals and 20 health centers. Most health facilities had inadequate capacity for providing basic or comprehensive health services (Ri-

[2]The SoH evolved to become the Ministry of Health of the Government of Southern Sudan (MoH GoSS) in 2005

[3]11 small- and medium-sized towns in southern Sudan, including Juba the southern capital, and controlled by Khartoum throughout the war

etveld and Waldman, 2006; WB and UN, 2005). There was also considerable geographical inequity in the distribution of health facilities; the majority were in the Equatoria region and the fewest in the Bahr el Ghazal region. Some rural areas had one health facility per 75,000 people, whereas in Bahr el Ghazal there were as many as 160,000 people per health facility (Rietveld and Waldman, 2006).

In 2005, 20% of the health facilities in the southern region were non-functional either due to lack of staff, lack of infrastructure (many facilities were nothing more than traditional huts), and lack of essential equipment and commodities. In more isolated areas over 40% of health facilities were non-functional. Of the functional facilities, only 35% provided immunization services, less than 20% had laboratories and 50% experienced regular drug stock-outs. Only about 44% of the population lived within a 5 km radius of a health facility and utilization rate was estimated at less than 0.2 contacts per person per year (Cometto et al., 2010; Rajkotia and Pressman, 2007). Indeed, by 2005, less than 25% of the population had access to some form of health services. The southern region also had an acute shortage of skilled health workers; approximately 3,600 health workers with nine-months training, 36 doctors, 200 clinical officers and 670 nurses. For a population of approximately 8 million people, the limited skilled workforce (doctors, clinical officers and nurses) resulted in an estimated physician-population ratio of 0.5 per 100,000 (Rietveld and Waldman, 2006).

During this period, there was limited access to health data to assess the health status of the conflict-affected population. Table 1.1 shows the best known estimates drawn from several sources including UN and WHO estimates and communicable disease surveillance reports, and provides a comparison with the more reliable national (Sudan) average. As expected, southerners had poor health status; coverage of diphtheria, pertussis and tetanus vaccines was at 15% of the population compared to 78% nationwide, infant and under-five mortality was estimated at 140 and 250 deaths per 1,000 live births compared to 62 and 90 for Sudan and maternal mortality was estimated at 2,037 per 100,000 live births compared to 590.

Using the six WHO health system building blocks (leadership and governance, service

delivery, health system financing, health workforce, medical products, vaccine and technology and health information systems), one can argue that the southern region essentially had no health system prior to 2005. Government involvement in the health sector was limited to the garrison towns and limited to only 30 health facilities or approximately 14% of all health facilities. The remaining 86% of health services were delivered by non-governmental actors in highly fragmented and disease-specific humanitarian interventions with limited coordination by United Nations agencies (Cometto et al., 2010). Service provision focused on primary health care (e.g. immunization and nutrition) and specific communicable diseases, there was no centralized mechanism for the purchase of drugs and supplies, and limited health workforce training. Lastly, there was no national health status data in the southern region; existing baseline data are drawn from a variety of sources which are restricted in geographical scope. The transition period therefore was an opportunity to establish a functioning health system.

*Table 1.1:* ***Key health and socio-economic and health indicators, Southern Sudan***

| | **Sudan** | **Southern Sudan** | **Sub-Sahara Africa (avg)** |
|---|---|---|---|
| **Key health indicators** | | | |
| Population (million) | 38 | 8- 12 million (estimate) | 15 |
| Life expectancy at birth (years) | 57 | 42* | 48.45 |
| Physicians (per 100,000 population) | 2 | 0.5 | 2 |
| DPT3 coverage | 78% | 15% | 67%** |
| Under 5 mortality rate (per 1,000) | 90 | 250 | 151 |
| Infant mortality rate (per 1,000) | 62 | 150 | 93 |
| Measles immunization (% 12-23 months) | 67 | 25 | n/a |
| Maternal mortality rate (per 100,000 live births) | 590 | 2,037 | 855 |
| Fertility rate | 4.2 | 6.7* | 5.19 |
| Births assisted by skilled attendant | 57% | 6% | 51.70% |
| **Socio-economic indicators** | | | |
| Annual population growth (%) | 2.1 | 3 (2003)* | |
| Urban population (%) | 24 | 2% (2003)* | |
| Poverty rate (%) | 60-75 | 90 (2003)* | |
| School enrollment, primary (%) | 60.4 | 20 (2000)** | |
| Primary school completion (grades 1-5), total (%) | 49.7 | 28 (2000)** | |
| Ratio of girls to boys in primary school | 89 | 40 (2003)** | |
| Literacy rate, adult total (% 15 years and over) | 60.9 (2000) | 31.0** | |

: Sources health indicators: (MOH/GoSS, UNICEF 2006, World Bank 2006, UNICEF 2007, WHO 2006a) and National Health Assembly presentations *SPLM, MoH/GoSS, USAID, JSI (2006), **WHO/AFRO
Sources socio-economic: WHO Core Health Indicators (2007), latest data, except where noted. * MoH/GoSS (2007). ** SPLM and The New Sudan Centre for Statistics and Evaluation (2004)

## 1.3 The Comprehensive Peace Agreement transition period

In 2005, a Comprehensive Peace Agreement (CPA) between Sudan's National Congress Party (NCP) and the SPLM/A ended the longest running conflict in Africa. The CPA provided for a six-year interim period during which governance in Sudan would consist of a Government of National Unity (GNU) based in Khartoum, Sudan and a semi-autonomous region in the south, administered by the Government of Southern Sudan (GoSS) (CPA 2005). The transition period would allow for a redress of the historical inequities in economic and social development between the north and south, prior to a referendum in Southern Sudan to determine the future relationship; continued unity of Sudan or secession and establishment of a separate state.

The GoSS established state-level governments and legislative chambers where previously none existed in a decentralized governance structure that accorded to the Dili declaration and formalized in the CPA and the 2005 Interim Constitution of Southern Sudan. Southern Sudan consisted of 10 States[4] 79 counties, 514 administrative payams and 2,159 bomas[5]. The health system was also decentralized, with a central/national ministry of health, state ministries of health and county health departments (Ministry of Health Republic of South Sudan, 2010).

The CPA protocol on wealth sharing[6] provided for equal sharing of oil-revenues, the main source of income in the south and this amounted to approximately US$ 7 billion for the GoSS. The CPA also established the Southern Sudan Reconstruction and Development Fund (SSRDF) for the reconstruction and rehabilitation in the south and a Multi-Donor Trust Fund for Southern Sudan (MDTF-SS) administered by the World Bank and into which 14 major donors pooled funds to support the SSRDF. MDTF-SS would support priority areas of capacity building, institutional strengthening and quick start/impact pro-

[4] Western Equatoria, Central Equatoria, Eastern Equatoria, Northern Bahr el Ghazal, Western Bahr el Ghazal, Lakes, Warrap, Jonglei, Unity and Upper Nile

[5] Bomas are the smallest administrative unit in government, consisting of clusters of households or villages; several bomas form a payam, and several payams form a county (and so forth)

[6] chapter 3 - Wealth Sharing Protocol, clause 15.5

grams to include health, water and education sectors. External contributions into the MDTF was US$526 million with the GoSS committing to spending 2$ for every 1$ of donor funding. However, as almost 98% of the government revenue was derived from oil, making South Sudan the most oil-dependent economy in the world, government funding was entirely dependent on a single volatile commodity, which had implications for longer-term planning.

### 1.3.1 Establishing a health system in the transition period

The Secretariat of Health (SoH) established during OLS was formally incorporated as the Ministry of Health (MOH- GoSS) in 2005 and an Interim Health Policy (IHP) was developed. The IHP outlined the structure and key functions of the Ministry of Health which was decentralized to four levels; central, state, county and community. Primary healthcare was endorsed as the cornerstone for the health system ( MoH, GoSS, 2007). The central MoH was to provide overall stewardship and guidance to the health sector and had primary responsibility for setting health sector policies and guidelines, monitoring and evaluation, and health financing and partner coordination to facilitate the transition from humanitarian to developmental assistance. The MoH was also responsible for supervising ten State Ministries of Health (SMoH) with the SMoHs supervising the 79 county health departments (CHDs). County health departments directly supervised the primary health care centers (PHCCs), primary health care units (PHCUs) and health services provided at the community level.

Despite delineated roles for state and county-level structures, these were virtually non-existent in practice. In addition, at the central level, MoH-GoSS severely lacked the capacity to provide stewardship to a health sector which consisted of more than six UN agencies, WHO, the World Bank, the Global Fund to Fight AIDS, TB and Malaria (GFATM), bilateral donors (USAID, DFID and NORAD), humanitarian aid partners (USAID/OFDA, DFID, ECHO) and over 70 NGOs. The central MoH had between 5-20 staff, limited to non-existent management systems and inadequate capacity for administering financial resources (Cometto et al., 2010). This effectively meant that WHO and the World Bank played a fiduciary role, developing the three main documents that influenced the IHP;

World Bank/UN Joint Assessment Mission "Framework for Sustained Peace, Development and Poverty Eradication (JAM, 2005), World Bank/AFTH[7] "Sudan Health Status Report" (World Bank, 2003), and WHO's Health Sector Recovery Strategic Framework (WHO, 2003) and the World Bank managed the MDTF.

WHO and the World Bank recommended investment in financial and management systems, human resources and infrastructure and contracting NGOs to deliver health services. Given that NGOs had provided the bulk of health services during the period of conflict, contracting-out was the only feasible model for expanding health services. However, given that CHDs were directly responsible for the implementation of the basic package of health services (BPHS), this also effectively meant that CHDs would have direct oversight of over 70 local and international NGOs managing the health facilities, despite being poorly staffed, and lacking in technical capacity. As noted in Waters et al. this meant that while in principle, the government retained oversight of the policy and planning process despite not providing any services, it might also suggest that the government could have been bypassed by donors contracting directly with NGOs due to the insufficient capacity.

### 1.3.2 Basic Package of Health and Nutrition Services (BPHS)

The Basic Package of Health and Nutrition Services (BPHS) was developed as a medium-term strategy to guide implementation of the Interim Health Policy (IHP) and as the basis of service-delivery contracts with NGOs (BPHS, 2009). The development of a basic package of health services as the mechanism to align government priorities, donor financing and to prioritize health services delivery was initially developed in Afghanistan (Roberts et al., 2008; Newbrander et al., 2011) and was adapted to the southern Sudan context. Thus, South Sudan's package closely mirrors Afghanistan's in prioritizing maternal and newborn health, immunization and integrated management of childhood illnesses (IMCI). To improve access and quality of services, the BPHS delineated the following key objectives; i) to increase access to primary healthcare services from 25% to 50% by 2010; ii) to improve the quality of care through the delivery of specified norms and standards of services; iii) to strengthen the management of health services through capacity strengthening

[7]Africa Region Technical Human Development Unit 3

for State Ministries of Health, County Health Departments, and Payam Health Departments.

### Southern Sudan Umbrella Program for Health System Development (UPHSD)

The Southern Sudan Umbrella Program for Health System Development (UPHSD) was established under MDTF-SS to provide financial and technical support to the Ministry of Health by developing core health sector systems and capacities, and to rapidly expand access to basic health services and high impact interventions (World Bank IEG, 2012, 2013). The UPHSD was initially designed as a three-phased, 3-year US$225 million project operative in all 10 states, with donors financing US$75 million and the GOSS US$150 million, as per the 2 to 1 ratio of domestic to international funding that underpinned the MDTF. Phase I was estimated to cost US$60 but the government only provided US$28 million of its US$40 million obligation due to volatility in oil prices, while donor funding increased to US$32 million to meet the gap in financing.

Phase II & III were combined into one US$63 million[8] project, (UPHSD-II) covering only 6 counties in the 4 states of Upper Nile, Jonglei, Central Equatoria, and Eastern Equatoria. These counties were selected as a result of delays in the disbursement of MDTF-SS funds and difficulty in attracting competitive bids from NGOs which delayed contracts with NGOs. The first contracts were signed in 2009 with IMA World Health (Upper Nile and Jonglei), Norwegian People's Aid (Central Equatoria) and Health and Life Sciences Partnership in Eastern Equatoria, a delay of almost 3 years. The reduction in funding further restricted the geographical scope of the two projects, to the 6 counties.

Therefore, health sector funding under MDTF decreased from a planned US$225 million to US$131 million. This had implications for the implementation of the BPHS; funding for contracting with NGOs to implement the BPHS, fell from a planned US$28.8 to US$12.6 million under UPHSD I, although disbursements for high impact interventions delivered through community programs (e.g. mass campaigns for measles immunization and vitamin A supplementation, distribution of long-lasting insecticide bed nets, distribution of potable

[8] An additional US$7 million was later approved for procurement of drugs and US$ 1.5 million as contingent funds and for procurement of ARVs, resulting in a final total of US$71.5 million

water treatment products and community-based treatment of malaria, pneumonia and diarrhoea) increased from US$8.4 to US$11.9 million. Funding to improve the capacity of the Ministry of Health at the central, state, and county levels decreased from US$4.5 to US$0.2 million. By the end of UPHSD I, the national ministry had successfully developed a health sector strategy and other policies and established eleven directorates, but there was inadequate capacity at state and county level. UPHSD also successfully piloted a national health information system- the district health information system database (DHIS) that was later expanded to all ten states.

Among the program achievements noted in evaluations of UPSHD were forty primary health facilities rehabilitated (half of the target), training of 235 mid-cadre staff and 18 doctors provided with scholarships for surgery training in phase I. Phase II prioritized short-term training for health workers, most lasting one-week. Therefore, notwithstanding the low number of skilled health workers in the country, there were limited long-term training opportunities to increase the number and quality of skilled health workers, despite initial ambitious targets to train approximately 23,000 new health workers (Cometto et al., 2010). An additional limitation noted was inadequate capacity of NGOs to implement the BPHS in addition to low capacity of the MoH itself to oversee the implementation process.

UPHSD was intended to consolidate health programs from the OLS period and to be the primary mechanism to build and strengthen the South Sudan health system. However, due to the delays noted above, several developmental partners formed other mechanisms to support the health sector, contributing to the fragmentation of the health system. These mechanisms included the Basic Services Fund (2005-2008) established by DFID and supported by Canada, Netherlands, Norway, Sweden and the European Union, as a short-term bridging fund for service delivery and a USAID-funded Sudan Health Transformation Project (SHTP) which was implemented in two phases.

### The Basic Services Fund (BSF)

The Basic Services Fund (BSF) was established in 2005 as a short-term bridging fund to facilitate the transition from relief and humanitarian programs prior to the establishment of the MDTF (Johnson et al., 2013). The BSF had three main programs implemented

through contracts with NGOs; education, health (health facility construction and rehabilitation, health worker training and provision of basic health services) and water (provision of improved water facilities and community-based environmental health and water management).

BSF was projected to run until 2008, but due to delays in the start of MDTF-SS, it was extended until 2010 and finally, to 2011 due to financial and capacity constraints of the GoSS and uncertainty surrounding MDTF funding. BSF was operational in 35 counties, supporting 37 NGOs who were responsible for 121 health facilities in total. BSF also constructed 57 additional health facilities. NGOs supported individual health facilities as opposed to entire counties and it is unclear the mechanism under which the facilities were selected. BSF also prioritized short-term training for health-workers and thus did little to contribute to increasing the number of qualified health workers in southern Sudan. Similar to the UPHSD, there was limited capacity-building for the state ministries of health and county health departments.

### Sudan Health Transformation Project (SHTP)

SHTP-I was a 5-year US$39.5 project implemented between 2004-2009 which provided primary health services through grants to international NGOs in 6 counties[9] and to strengthen the capacity of county health departments and state MoH to manage the health system (Neuse et al., 2008). NGOs were responsible for implementing seven high impact interventions[10] in 99 health facilities. There was, however, limited capacity development of the state MoH and county health departments, and the program mainly supported short-term training for health workers.

SHTP-II was US$ 58.5 million project funded over 3 and 1/2 -years (2009-12) to support 166 health facilities across 14 counties in the 10 states in provision of the seven high impact services from SHPT I[11]. The project included funding to improve the county-health department's management of the health system by working with the CHDs to

[9] It was originally planned to cover 20 counties.

[10] immunizations, Vitamin A, antenatal care (ANC), treatment of diarrheal disease with oral rehydration therapy (ORT), Long-Lasting Insecticide Treated Bed Nets (LLITNs), case management of malaria, and case management of acute respiratory infection (ARI)

[11] I worked for SHTP-II between 2011-2012

develop county health plans and budgets and conduct joint supervision visits (Hughes and Ali, 2008). The program utilized a performance-based contracting (PBC) approach that was based on financial incentive on achievement of targets, with a penalty on NGOs for failing to do so.

The SHTP-II final evaluation found that NGOs were primarily motivated to achieve targets to maintain their reputations and only smaller NGOs that had limited sources of funding were motivated by the financial necessity to cover operating costs. NGOs with other sources of funding reported that PBC made little difference in the quality of their programming. This suggests that the PBC program may have had limited effect and in addition may have primarily penalized smaller NGOs. For example, for NGOs with fewer sources of funding, the penalty may have reduced their operating capacity and further exacerbated their ability to meet their targets. PBC bonuses were also not paid to project staff, health service providers or community-based volunteers who were directly responsible for meeting the targets. Toward the end of the project, the penalty was dropped from the PBC scheme. As with other programs, SHTP-II did not prioritize training new health workers, and instead conducted short-term training.

*Table 1.2:* ***USAID / OFDA / ECHO / BSF support as of December 2010***

| (All costs in USD) | Grand Total | BSF | SHTP II | OFDA | ECHO |
|---|---|---|---|---|---|
| Annual total | 48.5m | 18.1m | 12.9m | 10.3m | 7.1m |
| Primary health facilities supported (N=962) | 544 | 193 | 164 | 161 | 26 |
| Primary care facilities supported (%, n:962)* | 57% | 20% | 17% | 17% | 3% |
| Estimated beneficiaries served* | 4.8m | 1.7m | 1.4m | 1.4m | 0.23m |
| No. of counties | 35 | 15 | 26 | 10 | |

Notes: *Modelled on proportion of total clinics served applied to total population 8.5m Source: MoH health facility mapping survey

### 1.3.3 Health and demographic indicators

The first Sudan Health and Household Survey (SSHS-I) was conducted in 2006 and was the first ever national assessment of the health status of the southern region. The main objective of the survey was to "collect core baseline social indicators for the principle purpose of informing public policy formulation and planning; and providing a starting point from which progress towards MDGs and other quality of life indicators can be measured (SHHS,

2006)." Due to lack of census and geographical data in the southern region, population estimates were based on the World Health Organization's list of villages and population estimates from the National Immunization Days (NIDs) campaign.

The second survey, SHHS-II was conducted in 2010 to measure progress of the CPA period with subsequent surveys planned for 2013 and 2016. The sample for SHHS-II was based on population estimates from the census conducted in 2008. SHHS-II noted disparities in the population composition compared to the first SHHS specifically, under-reporting of children aged 0-4 years, and women 15-49 years. While this makes it difficult to directly compare the SHHS-I to SHHS-II, the results do provide a useful estimate of progress made during the transition period. The Southern region population was estimated at 8.26 million, covering an area of 644,329 square kilometers, with 83% living in rural areas. Population density varied from 3.7 to 25.6 per sq. km. Over 72% of the population was below age 30, with 51% under 18 years, and 16% under 5 years (SSNBS, 2009).

SHHS-I confirmed the dire condition of southerners; only 16% of children had ever attended primary school, less than a third the national average. Primary school completion was one of the lowest in the world at 2%, with a female completion rate of 0.8% (lower even than Afghanistan when it was under Taliban rule) and only 3% mean secondary school net attendance ratio. Adult literacy was 27%, with a female literacy rate of 16% and youth literacy of 31%. The SHHS estimates that only 2.5% of women aged 15-24 years of age were literate, compared to national average of 45.8%. In terms of water and sanitation, 48.3% of the population had access to improved sources of drinking water [12] with 6.4% using improved sanitation facilities and over 80% lacking access to any toilet facility. Water and sanitation improved during the 5 years of the transition period with use of improved sources of drinking water increasing to 68% and improved sanitation facilities to 15.4% by 2010.

The maternal mortality ratio (MMR) in 2006 was 2,054 deaths per 100,000 live births, one of the highest in the world, and almost double the Sudan average of 1,107 per 100,000 live births. MMR varied widely across the 10 states, for example Western Equatoria

[12]Piped water (into dwelling, yard or plot), public tap/standpipe, tube-well/borehole, protected well, protected spring, and rainwater collection

(2,327), Lakes (2,243), and Western Bahr El Ghazal (2,216), compared to Central Equatoria (1,867), Eastern Equatoria (1,844) and the lowest rate in Unity State (1732). MMR was not estimated in SHHS-II. In 2006, only 26% of pregnant women received any form of antenatal care in the two years preceding the survey; antenatal care coverage improved by 3.8% to 30% by 2010. In 2006, a meagre 10% of births were attended by a skilled health-provider, over 36% were assisted by a relative or friend and 30% of mothers *gave birth without any attendant whatsoever*. By 2010 however, skilled attendant deliveries improved to 14.7% but overall, deliveries at health facilities (regardless of attendant health worker) decreased by 1.3% from 13.6% to 12.3% comparing 2006 to 2010. This suggests that more women delivering in a health facility were seen by a skilled birth attendant despite a slight decrease in women choosing to deliver in the health facility. Overall, these results show limited progress in improving reproductive health care coverage during the transition period

In 2005, infant and under-five mortality was estimated at 102 and 135 per 1,000 live births respectively. The under-five mortality rate was approximately 25% higher than the Sudan estimate of 101.6 deaths per 1000 live births, and 7% higher than UNICEF estimates for Sub-Saharan Africa (120.8) for the same year. This also varied widely across the country; under-5 mortality rate was 192.1 in Western Equatoria, 175.6 in Warrap, 141.4 in Central Equatoria and lowest in Unity State (82.2). In SHHS-II, childhood mortality estimates were calculated using direct estimation methods instead of the Brass and Coale indirect estimation methods used in the 2006 survey. Thus the 2010 survey provides estimates of proportion of children dying computed from respondents' birth histories, while the 2006 estimates probabilities of dying by exact ages of childhood. Neonatal mortality was estimated at 43 per 1,000 live births, infant mortality was 79 per 1,000 and under-five mortality was 108 per 1,000 live births in the 5 years preceding the survey. This represented an increase from the period 5-9 years preceding the 2010 survey where neonatal mortality, infant mortality and under five mortality was estimated at 29, 55 and 84 deaths per 1,000 live births respectively. While this may be affected by recall bias, it may also suggest that the health status of children under five worsened comparing the period ten years, to five years prior.

*Table 1.3:* ***Early Childhood Mortality Rates, South Sudan***

| Survey | Neonatal mortality | Infant mortality | Under-five mortality |
|---|---|---|---|
| 2006 SHHS (indirect) | 52 | 102 | 135.3 |
| 2010 SHHS (direct) | | | |
| 2006 - 2010 | 43 | 79 | 108 |
| 2001 - 2005 | 29 | 55 | 84 |
| 1996 - 2000 | 33 | 75 | 121 |

The leading causes of deaths among children under-five in Sub-Saharan Africa include complications during pregnancy exacerbated by limited access to skilled health providers, infectious diseases including malaria, pneumonia and diarrhoea as well as deaths caused by vaccine preventable diseases (Black et al., 2010), with inadequate nutrition being an underlying factor. In 2006, only 21% of children were exclusively breastfed in the first six months of life, improving to 45.1% by 2010. Overall however, the nutritional status of children remained poor; proportion of children who were moderately and severely underweight was 32.8% in 2006 and 30.3% in 2010, 33.4% were moderately and severely stunted in 2006 compared to 25% in 2010 and 22% compared to 21% had moderate or severe wasting in 2006 compared to 2010. This also varied regionally. In 2010 for example, for severely underweight children Unity State reported the highest levels (22%), Western Bahr El Ghazal (18%), Upper Nile and Jonglei (17%) and Central Equatoria and Lakes had the lowest levels (5% and 6% respectively).

Prevalence of the three major causes of childhood morbidity and mortality in the two weeks preceding the survey was high; malaria (45.5%), diarrhoea (42.9%) and pneumonia (13.6%) in 2006 compared to 32% with malaria, 34.4% with diarrhoea and 31.7% with suspected pneumonia in 2010. In 2010, among those with malaria, diarrhoea and pneumonia, 9%, 22.7% and 32%, received treatment. Southern Sudan also lagged in the goal to immunize at least 80% of children to achieve herd immunity; the proportion of children fully immunized[13] was 2.7% in 2006 and 1.8% in 2010, while the proportion of children who did not receive any vaccinations increased from 42.5% to 46% between 2006 and 2010. For specific vaccines, immunization coverage seems to have dropped between 2006 and 2010;

[13]Children aged 12-23 months receiving BCG, DPT 1-3, OPV 1-3 and measles vaccines before their first birthday

the proportion of children with tuberculosis immunization was 43%, compared to 35%, polio immunization dropped from 25% to 14%, DPT immunization from 20% to 14% and measles immunization from 28% to 21% comparing 2006 to 2010. These reductions may be as a result of the differences in how the samples were selected in both surveys, but they are also indicative of the lack of progress in expanding immunization coverage overall. Table 1.4 compares selected indicators from SHHS-I and SHHS-II.

*Table 1.4:* ***Comparison of select indicators, SHHS 2006 2010.***

| Indicator | SHHS 2006 | SHHS 2010 |
|---|---|---|
| Population, millions (census 2009) | | 8.26 |
| Literacy rate among women | 2.5% | 14.5% |
| Primary school net attendance ratio, female (adjusted) | 15.8% | 16.7% |
| **Mortality** | | |
| Maternal mortality ratio (per 100,000) | 2054 | |
| Under-five mortality rate (per 1000 live births | 135 | 106 |
| Infant mortality rate | 102 | 84 |
| **Water and Sanitation** | | |
| Use of improved drinking water sources | 48.3% | 68.0% |
| Water treatment | 13.1% | 9.9% |
| Use of improved sanitation facilities | 6.4% | 15.4% |
| **Reproductive Health** | | |
| Antenatal care coverage (by skilled attendant)* | 26.2% | 30.0% |
| Antenatal care coverage (4+ visits) | | 9.5% |
| Skilled attendant at delivery | 10.0% | 14.7% |
| Institutional deliveries | 13.6% | 12.3% |
| Deliveries at home | | 87.0% |
| Exclusive breast-feeding | 21.2% | 45.1% |
| **Nutrition** | | |
| Underweight prevalence (moderate and severe) | 32.8% | 30.3% |
| Underweight prevalence (severe) | 14.1% | 12.0% |
| Stunting prevalence (moderate and severe) | 33.4% | 25.0% |
| Stunting prevalence (severe) | 18.0% | 13.8% |
| Wasting prevalence (moderate and severe) | 21.9% | 20.9% |
| Wasting prevalence (severe) | 7.0% | 7.6% |
| Exclusive breastfeeding under 6 months | 21.2% | 45.1% |
| **Child Health** | | |
| DPT immunization coverage (12-23 months) | 20.2% | 13.8% |
| Measles immunization coverage (12-23 months) | 27.7% | 20.6% |
| Fully immunized children** | 2.7% | 1.8% |
| Proportion children U5 who had diarrhoea | 42.9% | 34.4% |
| Oral rehydration therapy with continued feeding | 57.7% | 22.7% |
| Proportion children who had cough | 13.6% | 31.7% |
| Antibiotic treatment of suspected pneumonia | | 31.6% |
| Proportion children U5 who had fever- malaria | 45.5% | 32.0% |
| Anti-malarial treatment of children under age 5 | 47.0% | 9.0% |

*Skilled attendant namely doctor, midwife, or nurse-midwife **Children aged 12-23 months receiving BCG, DPT 1-3, OPV 1-3 and measles vaccines before their first birthday

### 1.3.4 Summary of the transition period

Using the Water's framework, we can summarize that while there was political commitment to building the health system in South Sudan, limited government capacity effectively meant that the government may have had limited influence over donor coordination. The out-sourcing of management of the MDTF also meant that government had limited control over health sector financing. While financial resources increased compared to the conflict period, reductions in planned commitments limited the extent to which the BPHS could have been implemented, which also had an impact on strengthening state and county ministries of health. Delays in MDTF-SS may also have contributed to the continued fragmentation of the health sector with the creation of additional mechanisms for health services delivery. In addition, during this period, humanitarian programs continued in parallel, for example the Office of US Foreign Disaster Assistance (OFDA) and the European Commission Humanitarian Aid Office (ECHO), which funded health facilities in 36 counties, providing US$ 10.3million and 7.1 million respectively.

All three funding mechanisms, MDTF, BSF and USAID utilized local and international NGOs for implementation of the BPHS, effectively building the capacity of NGOs, noted as a limitation in Water's et al.. As NGOs delivered services to specific geographical areas, service delivery remained a "patchwork of programs offered through different channels" (Waters et al., 2007). The Ministry of Finance estimated that during the transition period 27% (n=21) of the counties in South Sudan did not receive any external financing at all while some facilities received funding from more than one donor, further exacerbating existing geographical inequities (MoFEP, 2012).

One of the key inputs of the health system is human resources for health. Despite the existing health-worker shortages, none of the programs invested in training new health-workers, and instead relied on short-term in-service training. The information system was however established with the district health information system (DHIS) funded by MDTF-SS. As tt was initially used by health facilities in the MDTF counties, with slower uptake in other counties, it is difficult to do a comparative assessment of routine health facility utilization across all programs during this period. Lastly, while all three programs

prioritized strengthening the capacity of the state MoH and county health departments to manage and provide oversight to the health facilities, there was limited capacity-building overall.

It is therefore not surprising that by 2011, the contracting approach had relatively few successes in improving health outcomes and might have resulted in increased fragmentation of the health system. The experience of health system reconstruction during the transition period indicates that while contracting can be a successful approach for rapidly expanding services in post-conflict countries, this success is dependent on *how* it is implemented and the capacity of the implementing partners that is donors, the government and NGOs. During the post-independence period, some of the lessons of the transition period were applied to the design of a health system architecture.

## 1.4 Post-Independence Period

Southern Sudan gained independence from Sudan on 9th July 2011, after a referendum on self-determination where southern Sudanese overwhelmingly voted to become a separate country. During the referendum campaigns, the SPLM/A raised expectations of the people, promising a period of renewed focus on nation-building, basic services provision, infrastructural development and resource distribution. The health sector was identified as one of the key priority areas for development, and a Health Sector Development Plan (HSDP) covering 2011-2015 developed (SSHSDP, 2010). The HSDP provides the strategic direction for the health sector and has the overall objective of expanding coverage and utilization of health services, improving the quality of services and strengthening the health system overall. The HSDP further identified a common set of indicators to track progress across all partners working in the health sector, aligned with MoH goals and priorities, to include support for capacity-building of the MoH at central, state and county level to strengthen the government's ability to manage the health system.

The cost of implementing the HSDP was estimated to be SDG 5.1 billion/US$1.8[14] over the 5-year period, with costs allocated to operational costs, capital costs and governance

[14]Exchange Rate: 1USD =2.9 SDG

and management costs. It also included costs for infrastructure development of new and existing health facilities. The GoSS estimated that 11% (SDG 392 million/US$135 million) of the total cost of the HSDP would be apportioned to health system strengthening and capacity-building of the MoH, to strengthen its ability to oversee the health system. For the first time, the government would gradually take over payment of all health-worker salaries (estimated to cost SDG 221 million/US$76 million) and procurement of pharmaceuticals and medical supplies, whereas this was done by specific donor-funded programs during the transition period. In addition, increasing the human resource base was prioritized with SDG 12 million/US$ 4 million allocated for development of training facilities and SDG 50 million/ US$17 million for external recruitment of especially nurses and midwives to reduce critical staffing gaps in the health system.

### 1.4.1 Contracting out Intervention in South Sudan

To harmonize and coordinate financial and technical assistance to the health sector, the GoSS established a geographically focused aid financing architecture in 2012 with three service delivery projects financed by USAID, the World Bank and a DFID-led Health Pooled Fund (MoFEP, 2012). Unlike during the transition period, the government did not commit funds to the primary health care system, limiting its support to the secondary and tertiary sector. This may have had implications on the ability of the government to assert control of the health sector at the primary level.

The three donor partners were to fund specific states in a county-wide contracting approach (instead of contracting NGOs to support individual health facilities, as during the transition period) to reduce overlap in funding and ensure that all health facilities across the country received technical and financial support. This was to address the inequitable funding during the transition period where some counties and health facilities received neither technical nor financial support. The BPHS was also revised and streamlined, and an agreement reached with the donors on a minimum 'essential' package of services that formed the basis of service-delivery contracts with NGOs. The contracting approach was closely modelled on Afghanistan's; with the same donors (the World Bank, USAID and a consortium of primarily European Union donors) involved in funding the health system,

the geographically focused approach, and contracting to NGOs to deliver the BPHS in defined geographic areas of operation (Newbrander et al., 2011).

Three health programs were established; the World Bank Rapid Results for Health Project (RRHP) (World Bank, 2012), DFID-led Health Pooled Fund (HPF) (DFID, 2012) and USAID's Integrated Service Delivery Program (ISDP) (Jhpiego, 2012) as observed in table 1.5.

*Table 1.5:* ***Geographically-Focused Financing***

| | RRHP | ISDP | HPF |
|---|---|---|---|
| Donor | World Bank | USAID | DFID-UK, EU, AusAID, CIDA, SIDA |
| Total funds | US$28 | US$85 | US$186 |
| Population (millions) | 2.7 | 2.0 | 5.1 |
| Per-capita* | US$4.9 | US$8.5 | US$10.4 |
| Counties | 24 | 16 | 40 |
| States | Jonglei, Upper Nile | Central Equatoria, Western Equatoria | Eastern Equatoria, Northern Bahr-el-Ghazal, Western Bahr-el-Ghazal, Warrap, Unity, Lakes |

Notes: *Estimated based on the population in the states in 2012.

All 3 programs are managed by international NGOs (hereby referred to as lead agencies), which provide technical and financial oversight of the health programs on behalf of the MoH at the state level and which subsequently contract local and international NGOs to directly manage the health facilities at the county level. This essentially resulted in a three-tiered health system. The programs varied in terms of population, health infrastructure, and baseline health status as well as per capita funding for health. In addition, some states and counties have also been more conflict-affected than others after independence. Understanding whether this variation was accounted for in the design and funding of the health programs is critical as this has implications in reducing health inequities that have persisted from the conflict and post-conflict transition period.

### Rapid Results for Health Project (RRHP)

The World Bank provided US$ 28 million to establish the rapid results for health project (RRHP), for the 24 counties of Upper Nile and Jonglei States, which were previously funded by the MDTF-SS. The RHHP contract was a fixed-price contract between the MoH and the lead agency selected to manage the project, IMA World Health. Unique to the

three health programs, project funds were directly managed by the Ministry of Finance and Economic Planning (MoFEP) through a project financial management unit (PFMU). The RHHP consisted of 2 key components; delivery of high impact primary healthcare services (US$ 23 million) and capacity development of the MoH though strengthening grant and project management capacity and strengthening monitoring and evaluation at the national level (US$ 5 million) (World Bank, 2012). Upper Nile and Jonglei are the two largest and most populous states, with estimated populations of 1,135,682 and 1,589,377 respectively, based on 2012 mid-year projections from the 2008 South Sudan Census. The RRHP therefore covers 2.7 million people, 27% of the population of South Sudan, a direct per capita spending for health – excluding the US$5 million- of US$ 4.05 and USD$ 4.93 inclusive, the lowest among the three health programs.

Upper Nile and Jonglei, despite being contiguous states vary; the literacy rate among 15-24-year old's is 65% in Upper Nile but only 25% in Jonglei. Populations in both states have limited access to health facilities, with 54% and 73% of the population in Upper Nile and Jonglei respectively living more than 30 minutes from the nearest health facility. Upper Nile and Jonglei are also the most conflict affected states in South Sudan; there have been frequent inter-ethnic clashes and outbreaks of violence primarily affecting Jonglei State since 2011. As a result, none of the other donors were willing to operate in the two states, according to the World Bank (World Bank, 2012). This suggests that there would be difficulty attracting NGOs to the two states, potentially limiting the competitiveness of the contract bidding process. While this may be an issue, it is worth noting that lead agency selected for the RHHP has the most experience working in South Sudan, having worked in Upper Nile and Jonglei state since 2008, under the MDTF. This experience may mean that IMA is better adapted to the context and has developed mechanisms for successful implementation even in a conflict-affected area of the country and has existing partnerships with NGOs from the MDTF.

Of the three partners, the RHHP has unique implementation modalities for example performance-based contracting to provide bonuses to contractors and performance-based financing at the health facility level to increase the motivation of health providers in sev-

eral counties. The RHHP also contracts with the MoH county health departments in select counties, a contracting-in approach that had not been utilized in South Sudan. The RHHP project also has the most developed health management information system (HMIS) system, with electronic submission of results to the DHIS from the counties which started with funding from the UPHSD. The RRHP thus has the potential to exceed expectations, despite the lower per capita spending in health, and the contextual challenges. It also provides a unique opportunity to assess the different contracting approaches (performance-based contracting and contracting with a government agency versus an NGO), in future research.

### Integrated Service Delivery Program (ISDP)

USAID established the US$85 million Integrated Service Delivery Program (ISDP), a five-year program covering 16 counties in Central Equatoria State (CES) and Western Equatoria State (WES). ISDP started in June 2012, and the lead agency was Jhpiego[15], which had no prior experience in South Sudan. The populations in Central Equatoria and Western Equatoria in 2012 were 1, 302, 446 and 697, 814 respectively, thus the ISDP covered a total population of approximately 2 million people, or 20% of the population. Estimated per capita spending for the ISDP is US$8.5 per annum.

The USAID program consolidated health programs supported under SHTP-II, BSF, and OFDA in the two states. The primary objectives of the ISDP was to increase access to high-quality primary health care services, developing training and supportive supervision mechanisms at the facility level, staffing health facilities, and improving community-based delivery of maternal, child, and new-born health care services. Health services delivery would be implemented by NGOs, in a similar model to that used in SHTP-II but did not include performance-based contracting. NGOs were expected to progressively expand support to all health facilities in their counties and were thus not expected to support all health facilities in the county at the start of the project. The project also had no explicit objective of strengthening the capacity of state and county ministries of health.

[15] I was hired by Jhpiego/ISDP at the start of the project (June 2012) and was the quality advisor until August 2014.

The two states have been relatively peaceful since independence and due to the relatively high per capita spending for health, I assume that the ISDP program should have the highest acceleration in health facility utilization across the three programs. In addition, Central and Western Equatoria have populations that are relatively more educated compared to the rest of the country; literacy rates among 15-24-year olds were 55% and 43% in Central Equatoria and Western Equatoria respectively. There are contextual challenges however, for example access to health facilities is limited, with 72% in Central Equatoria and 77% in Western Equatoria living greater than 30 minutes from the nearest health facility, although the two states have the highest concentration of health facilities in southern Sudan.

### Health Pooled Fund

The Health Pooled Fund (HPF) was designed as a 3.5 years GB£120 million (US$ 186 using 2012 exchange rates of 1GP£ = 1.55US$) fund supported by the Australian Agency for International Development (AusAid), the Canadian International Development Agency (CIDA), the United Kingdom's Department for International Development (DFID), and the Swedish International Development and Cooperation Agency (SIDA). HPF supports 40 counties in six states (Eastern Equatoria (EES), Unity, Western Bahr-el-Ghazal (WBeG), Northern Bahr-el-Ghazal (NBeG), Lakes and Warrap). The total population covered by the HPF is 5.1 million (52% of the South Sudan population), resulting in per-capita annual health expenditure of approximately US$ 10. Unlike the RRHP and ISDP, the HPF supports delivery of essential primary health care services and funding for county and state hospitals, as well as health system strengthening at the national, state, county and facility/ community levels (HPF, 2012).

The HPF was launched in October 2012 and consolidated service delivery contracts previously funded through the Basic Services Fund (BSF), European Community Humanitarian Office (ECHO), the U.S. Office for Disaster Assistance (OFDA) and the Common Humanitarian Fund (CHF). The lead agency is a consortium led by Crown Agents which is new to the South Sudan context. However the HPF established a steering committee chaired by the MoH, with membership from the ministry of finance, ministry of labour,

public service and human resource development and other partners as the overall governance and decision-making body, as well as established state oversight committees across all six states to oversee program implementation.

The main challenge for the HPF would be managing and overseeing implementing partners as it carries the largest number of states and counties. There is also greater variation in health and demographic characteristics of the states that would need to be accounted for in program design. Of the six states, the most populous is Warrap (1,149,135), followed by Eastern Equatoria (1,109,339), Northern Bahr-el-Ghazal (860,322), Lakes (837,363), Unity (709,045) and lastly, Western Bahr-el-Ghazal (393,217). The states differ in literacy rates among those 15-24 year old, ranging from 50% in Western Bahr-el-Ghazal, 44% in Unity, 40% in Northern Bahr-el-Ghazal, 30% in Lakes, 27% in Warrap, to 26% in Eastern Equatoria. There is differential access to health facilities, with 70% and 73% of the population living more than 30 minutes' walk from the health facility in Warrap and Unity, 67%, 65% and 63% in Lakes, Western Bahr-el-Ghazal and Northern Bahr-el-Ghazal respectively, and 57% in Eastern Equatoria. Thus, there are differences within the states that may provide additional challenges in implementing the HPF and that may also affect health facility utilization.

## 1.5 Methodology

### 1.5.1 Outcome measures

Outcome measures are selected from the Ministry of Health's core performance monitoring indicators[16], intended to assess trends in utilizing the health facility (see appendix table A1). Maternal health outcome measures are number of women attending the health facility for the 1st and 4th antenatal care visit, number of women receiving two or more doses of intermittent preventive treatment of malaria during pregnancy with sulfadoxine-pyrimethamine (IPTp-SP), provided during antenatal care and number of deliveries occurring in health facilities and attended by health workers, regardless of cadre.

[16]The core performance indicators are a common set of 13 indicators used to across the three 3 health programs

Antenatal care provides pregnant women an opportunity to receive health information related to their pregnancy, health interventions to improve pregnancy outcomes and to promote health facility delivery (WHO, 2016). Four antenatal care visits are recommended during pregnancy however, in sub-Saharan Africa, most women often go to the health facility once and often late in the pregnancy period. An increase in ANC 4th visits may suggest improvements in the quality of antenatal care and this should also presumably accompany an increase in facility deliveries. Hence as ANC 1st visits increase, IPTp-SP, ANC 4th visits and facility deliveries should increase and converge over time. In malaria-endemic countries, IPTp-SP is recommended for all pregnant women starting in the second trimester, hence IPTp-SP may be considered a proxy indicator for subsequent ANC visits and quality of care as it captures the availability of preventive medicines at the health facility.

Skilled and unskilled deliveries are combined mainly because preliminary data analysis indicated that trends were similar across the years and also because the total number of women delivering in the facility is relatively fewer than the other maternal health indicators. Deliveries in the community are excluded; while it is probable that health workers also attend deliveries within their communities, the data does not disaggregate deliveries by cadre of health worker hence including community deliveries would also capture deliveries by traditional birth attendants, who have no formal training and function independently of the health system. An assumption I make is that any increase in facility deliveries partially occurs as a result of a trend towards delivery in a health facility with a health care professional and hence gains in facility delivery should accompany declines in community deliveries over time.

For children under five years of age, I selected children receiving their third dose of diphtheria, pertussis and tetanus (DPT) vaccinations (DPT3) from the core indicators, and number of children observed with malaria, and diarrhoea at the health facility. DPT3 is often used as a proxy indicator of how well countries manage routine immunization services as it requires three separate contacts with health care providers and the availability of vaccines. I combine DPT vaccinations provided at both the health facility and at outreach

sites, regardless of age of administration (the database captures vaccines provided between 0-11 months and 12-23 months). Improvements in immunization coverage should result in a convergence of the trends in DPT 1 and DPT 3 vaccinations should it result in more children completing the DPT vaccination protocol, while a divergence would be a cause for concern. Malaria, pneumonia and diarrhoea are the leading killers of children under five in South Sudan, and hence malaria and diarrhoea indicators are also selected, despite not being among the 13 core indicators, which instead aggregates the total number of curative consultations for children under five years. The malaria outcome measure combines both clinically diagnosed malaria and malaria cases confirmed with a rapid diagnostic test or laboratory testing. Note that confirmation is not differentiated based on test in the database, nor in analysis.

Outcome measures are disaggregated by level of health facility, that is by primary health care centers (PHCCs) and primary health care units (PHCUs). PHCUs are the closest point of contact for most people in South Sudan, while PHCCs are a higher level of care relative to the PHCUs and serve as referral points for PHCUs. Services provided at outreach sites are combined with PHCU data by recoding these sites as PHCUs. This mainly affects immunization data, and largely in Upper Nile and Jonglei State where the RHHP program has immunization catch-up campaigns during the dry season due to challenges in accessing health facilities during the rainy season. While there may be concerns with using utilization data, I argue that since this represents women and children receiving services at the health facility, this may come closest to assessing the effect of policies whose primary objective is to increase access to or utilization of health services. Other measures (for example mortality) may be affected by factors independent of the heath system (e.g. improvements in education, water and sanitation) that are difficult to control for in the South Sudan context, due to limited availability of data.

### 1.5.2 Data Source(s)

#### District Health Information Database (DHIS)

The primary data source comprises of a panel of health facilities reporting monthly to the national District Health Information Database (DHIS). Health facility data can be

aggregated to the payam, county, state and finally national level for example by summing up results from all health facilities within a county to form a county-level dataset. The DHIS was initially piloted in two States, Upper Nile and Jonglei between 2009 and 2010, and adopted in all 10 states by 2012. In 2009, only 53 facilities were reporting to the DHIS, but by 2011 1,053 facilities had submitted reports, hence data from 2009 – 2010 will not be utilized as this represents fewer than 20% of all primary health care facilities nationwide.

Data at the health facility level is entered into standardized paper-based registries and aggregated in a monthly report form containing priority indicators and submitted to the County Health Department (CHD). The CHD is responsible for entering the data into the DHIS database and these reports are then submitted to State Ministries of Health (SMoH) electronically or using external flash drives. The SMOH database aggregates data from the counties within the state and submits these to the centralized DHIS which aggregates data nationally (MOH, 2015). These different levels of data-entry and aggregation provide additional levels for errors in data-entry, and the quality of DHIS data will be a challenge. However, these are the best estimates of health facility utilization available in South Sudan.

In addition, facilities may fail to submit monthly reports to the CHD; monthly reporting rates range from 47% in 2012, 76% in 2013, 74% in 2014, 85% in 2015, and 68% in 2016, with rates denoting facilities submitting reports in all 12 months. National reporting fails to account for the variation in reporting across States, for example, reporting rate in Upper Nile State (35%), Jonglei State (51%), Unity (61%), and Eastern Equatoria State (64%) compared to Warrap and Western Bahr-el-Ghazal (90% and 89% respectively) (MOH, 2013, 2014, 2015). Health facility reporting affects utilization indicators at the state or county level, and it may be necessary to adjust estimates based on facilities submitting reports to obtain a valid estimate of county-level performance. Health facility reporting may also be directly associated with conflict affecting specific areas with Jonglei, Upper Nile and Unity States primarily being affected since 2013. This strongly suggests that variation in utilization may be related to health facility closures that are independent of program implementation hence it is imperative to assess the effect of conflict.

The full DHIS database was received from the MoH in February 2018, covering the

period January 2010 to December 2017. The DHIS also contains data from the 3 tertiary hospitals in South Sudan (Juba, Malakal and Wau Teaching Hospitals), 8 state hospitals, 15 County Hospitals, 45 Hospitals (denoted as special, mission or other hospitals), 33 sites serving internally displaced populations (IDPs), 20 outreach sites and 7 sites serving police and other uniformed personnel. Analysis is restricted to the primary health centers and primary health units as the analysis focuses on the primary healthcare level and it is this level where most donor funding is concentrated. Data will be aggregated at the national and the donor level and by primary health care centers and primary health care units, to understand overall trends in health facility utilization.

### Population Data

Population data were obtained from the National Bureau of Statistics' population projections which are based on the 2008 5th Sudan Population Census and mid-year population distributions (SSNBS, 2009). Projections for 2009 and 2010 were based on the census and were adjusted for the influx of returnees to South Sudan following the signing of the CPA in 2005 until 2011, using estimates obtained from the International Organization of Migration (IOM). The largest number of returnees were estimated to have returned between 2008 and 2011 and the data was dis-aggregated by counties and states and distributed over the four-year period. Projections done after 2010 were based on estimates from the SHHS 2010 (SSNBS, 2009; South Sudan National Bureau of Statistics(SSNBS), 2015). No additional migration data was used to adjust the population after 2011, hence it is possible that population estimates are under-reported. In addition, the projections do not account for internal migration, and the population that has left the country due to the conflict in 2013 affecting primarily Upper Nile, Jonglei and Unity states.

### Conflict Data

South Sudan conflict data was obtained from The Armed Conflict Location & Event Data Project (ACLED) downloaded from Humanitarian Data Exchange website (HDX). ACLED provides the most up-to-date data on location, fatalities and characteristics of political and violence events as well as non-violent events. Conflict data is not integrated with other datasets, although this is recommended (Donnay et al., 2019) as I am mainly

interested in the presence of conflict and its effect on utilization, and not the specific details of the conflict itself. Fatalities (number of people who died as a result of the conflict event) are aggregated to define a conflict indicator. At the county level, areas with no fatalities are coded as experiencing no conflict, 1-50 fatalities as low-level conflict, 50-100 as mid-level conflict and higher than 100 as high-level conflict. ACLED data is geo-coded and hence can be used for spatial analysis and this may be an area of additional research.

## 1.6 Empirical Strategy

### Exploratory Data Analysis

The dataset consists of 1,596 health facilities with monthly data from 2011-2015; 372 primary health care centers (PHCCs) and 1,224 primary health care units (PHCUs). As a result of widespread conflict starting in 2016, the number of PHCCs and PHCUs drops to 302 and 287 PHCCs and 966 and 884 PHCUs in 2016 and 2017 respectively, hence the analysis will focus on the period 2011-2015, which also corresponds to the period covered by the health sector development plan. National level analysis aggregates data from all health facilities reporting to the DHIS, while donor level analysis aggregates data based on the specific donor supporting the states. Thus, for example, World Bank data consists of data from Jonglei and Upper Nile state.

Longitudinal trends in key maternal and child health indicators are illustrated with empirical time-series line graphs covering the periods January 2011 to December 2015, representing 60 data points. This provides a visual representation of the data allowing us to identify how trends are changing across time. Time series graphs also compare utilization at the primary health care centers and primary health care units and between the three donor regions.

Empirical analysis is conducted at the national level, donor level and disaggregated by facility type (PHCC or PHCU). At the national level, the following model estimated;

$$Y_t = \beta_0 + \beta_1 time + \beta_2 Population + \beta_3 Conflict + \epsilon_{it} \tag{1.1}$$

Where; $Y_t$ is the health utilization measure (e.g. ANC 1, IPTp-SP, DPT3, or malaria);
$\beta_1$ is the average monthly increase in utilization between 2011-2015;
$\beta_2$ is the effect of population on utilization and;
$\beta_3$ is the effect of conflict, by level of conflict.

To assess the effect of the contracting policy, a policy dummy variable is created for year 2013. The above model is slightly modified to include the policy variable and the coefficient thus compares utilization after 2013 to before 2013 as illustrated below;

$$Y_t = \beta_0 + \beta_1 Policy + \beta_2 Population + \beta_3 Policy * Conflict + \epsilon_{it} \tag{1.2}$$

As specified in equations (2.1) and (2.2), $\epsilon$ is assumed to be independently and identically distributed (i.i.d) normal with mean 0 and variance $\sigma^2$. However, as the data consists of a panel of health facilities, I relax the assumption that the observations are independent and allow for intra-group correlation, assuming that health facilities within a county for example, are more similar than those in other counties. The equations are estimated using ordinary least squares (OLS) regression with robust standard errors clustered at the facility. An additional model is fitted with year fixed effects.

To assess the robustness of the results and account for the time-series nature of the data, I extend equations (2.1) and (2.2) using Prais –Winsten and Cochrane –Orcutt regression (Prais and Winsten, 1954) which estimates the generalized least-squares method. This assumes that the errors follow a first-order autoregressive process (AR1). In this extension, the error terms satisfy;

$$\epsilon_{it} = \rho \epsilon_{t-1} + \epsilon_{it} \tag{1.3}$$

and the $\epsilon_{it}$ are independent and identically distributed as N (0, $\sigma^2$).

Lastly, in order to allow for a comparison of these results to extant findings, I estimate the natural logarithm of health facility utilization, estimating the semi-elasticity of health facility utilization with respect to time. This has the added advantage of allowing for the

calculation of the annual rate of increase [17]. Estimating elasticities also reflects the idea that increasing health facility utilization by a given absolute amount is also dependent on its baseline levels (Jamison et al., 2016). For national level estimates, these results are shown in the appendix.

Data is also aggregated by health facility type (PHCC and PHCU) and by supporting donor (World Bank, USAID and HPF). To allow for comparison between facility type and donor, I estimate the natural logarithm of health facility utilization as in the below equations.

For facility type;

$$Log(Y_t) = \beta_0 + \beta_1 time + \beta_2 Facility + \beta_3 Facility * Conflict + \beta_4 Population + \epsilon_{it} \quad (1.4)$$

For donor type;

$$Log(Y_t) = \beta_0 + \beta_1 time + \beta_2 Donor + \beta_3 Donor * Conflict + \beta_4 Population + \epsilon_{it} \quad (1.5)$$

Similar analysis is conducted to assess the relative health facility utilization and comparing utilization during the period policy (2013-2015) relative to before the policy. Thus, I estimate the following equation;

$$Log(Y_t) = \beta_0 + \beta_1 Donor + \beta_2 Donor * Year + \beta_3 Donor * Conflict + \beta_4 Population + \epsilon_{it} \quad (1.6)$$

For equations (1.4), (1.5) and (1.6), I estimate a linear regression model using Prais–Winsten regression with panel-corrected standard error (PCSE) estimates (Beck and Katz, 1995) to account for the time-series nature of the data. In addition, I specify a panel-specific AR(1) process with panel-level heteroskedastic errors. Analysis results with the raw levels is shown in the appendix. All the above analysis is conducted using Stata version 13.

[17] The effective annual rate formula is $[1 + (i/n)]^{n} - 1$

## 1.7 Results

Results from the analysis are presented in this section starting with a description of maternal health outcomes followed by child health outcomes. Analysis is first done at the national level aggregating data from all states and is further disaggregated by health facility type therefore comparing utilization at the primary health care centers and units. To understand national-level health facility utilization, results from data analysis conducted at the donor level and comparing the three health programs funded by the World Bank, USAID and the Health Pooled Fund are presented. The underlying assumption of the donor level analysis is that higher per-capita spending for health, experience of the implementing lead agencies and the differences in program design described above may have implications in improvement of health facility utilization.

### 1.7.1 Maternal health

Maternal health results are graphically illustrated in figure 1.2 which shows trends in antenatal care 1st and 4th visits, IPT-Sp 2 or more doses and delivery at the health facility between 2011-2015. There is a relatively big gap between antenatal first and fourth visits throughout the observation period, with the gap increasing over time. This suggests that health facilities are successful in attracting women to attend the health facility for their first antenatal care visit, but are less successful in encouraging subsequent visits. IPTp-Sp is primarily provided during antenatal care visits and hence increase in proportion of women attending antenatal care should result in a concurrent increase in proportion of women attaining the minimum recommended doses (two or more doses) of IPTp-Sp. However, we observe a relatively lower uptake of two or more IPT-Sp doses, which closely follows ANC 4th visits. Health facility delivery across the observation period barely improves over time. The low uptake of subsequent antenatal care visits, IPT-Sp and health facility delivery indicates limited progress in increasing the average number of contacts with the health system by pregnant women, one of the key goals of all three health programs, despite more women attending the health facility at least once during their pregnancy, overall.

Table 1.6 presents analysis results for the same outcome measures, with year centered

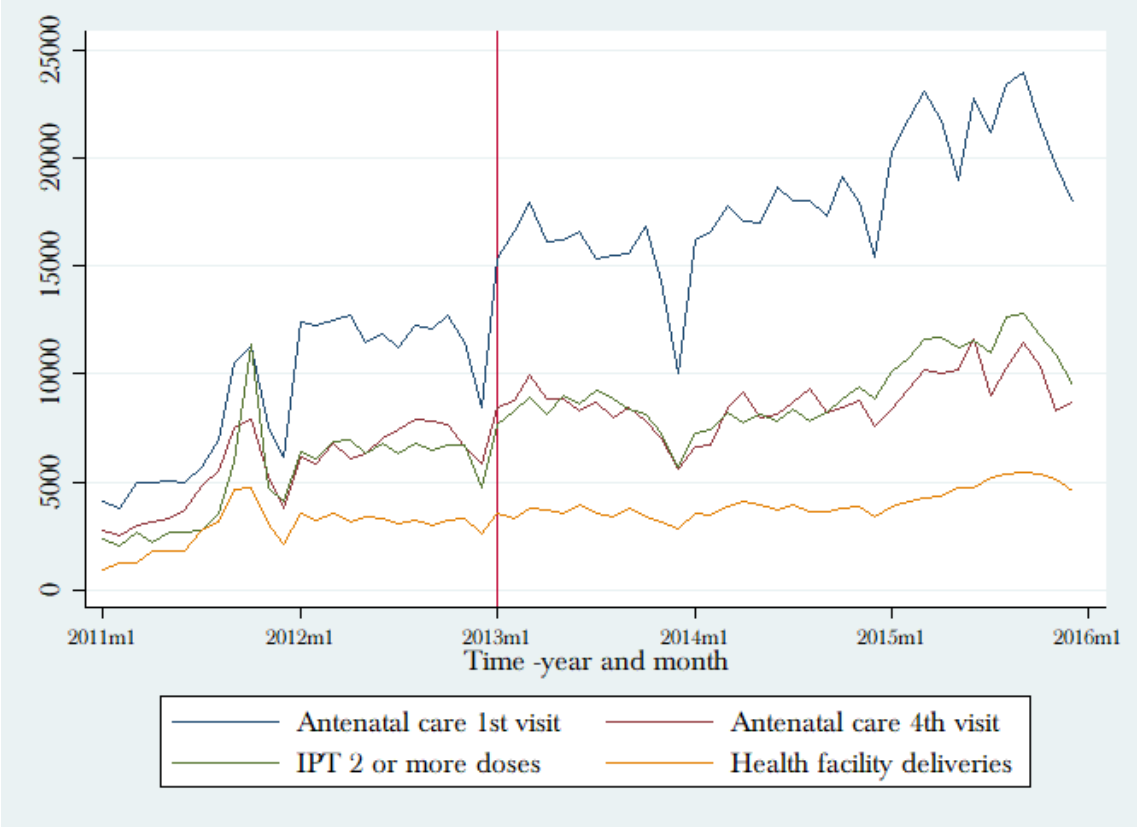


*Figure 1.2:* ***Trends in maternal health indicators, 2011-2015 Sudan.***

on 2011 so that the constant term represents a 2011 baseline, and controlling for population and level of conflict. Two models are presented; ordinary least squares (OLS) regression with robust standard errors and Prais-Winsten and Cochrane-Orcutt regression where the errors are assumed to follow a first-order auto-regressive process and adjusted for 1,508 clusters at the facility level for comparison. The Prais-Winsten regression results are of similar magnitude and direction as OLS and are the focus of the below discussion.

Between 2011-2015, mean monthly ANC 1st visits increased by 3,465 visits while ANC 4th visits increased by 1,118 ($p<0.01$) monthly reflecting the drop between 1st and 4th visits observed in figure 1.2. In addition, the number of women receiving two or more IPT-Sp doses increased by 1,556 ($p<0.01$) monthly, slightly higher than ANC 4th visits suggesting that there are women who do attend the health facility for at least two antenatal care visits, but have fewer than four visits. Deliveries at the health facilities increased by a mere 515 ($p<0.01$)deliveries per month from their 2011 baselines. Overall, there is an increase in the number of women receiving maternal health services across South Sudan,

*Table 1.6:* ***Maternal Health Indicators***

| Models | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
|---|---|---|---|---|---|---|---|---|
| Variables | ANC1 | ANC1 | ANC4 | ANC4 | IPT2 | IPT2 | Delivery | Delivery |
| **Panel A** | | | | | | | | |
| Year | 3,366*** | 3,465*** | 1,086*** | 1,118*** | 1,553*** | 1,556*** | 480.2*** | 514.9*** |
| | (6.801) | (7.541) | (4.619) | (5.328) | (6.031) | (6.268) | (2.793) | (3.223) |
| conflict = Low | -190.2*** | -140.9*** | -141.3*** | -81.82*** | -268.8*** | -129.4*** | -70.93*** | -19.65*** |
| | (34.04) | (38.18) | (22.14) | (24.37) | (23.81) | (33.65) | (9.616) | (6.347) |
| conflict = Mid | -296.5*** | -250.6*** | -253.2*** | -122.5*** | -665.9*** | -399.0*** | -219.8*** | -70.06*** |
| | (34.30) | (51.51) | (24.14) | (35.80) | (24.29) | (48.89) | (7.870) | (8.003) |
| conflict = High | -673.5*** | -584.2*** | -532.1*** | -392.8*** | -1,135*** | -801.5*** | -316.3*** | -139.3*** |
| | (66.54) | (60.24) | (54.77) | (56.63) | (40.23) | (54.46) | (14.23) | (31.41) |
| Constant | 7,939*** | 7,654*** | 5,412*** | 5,285*** | 4,601*** | 4,567*** | 2,600*** | 2,532*** |
| | (21.98) | (24.60) | (15.03) | (17.65) | (19.32) | (20.99) | (8.625) | (10.63) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.866 | 0.756 | 0.606 | 0.532 | 0.701 | 0.533 | 0.550 | 0.588 |
| **Panel B** | | | | | | | | |
| Year = 2012 | 5,004*** | 4,997*** | 1,985*** | 1,961*** | 2,051*** | 2,042*** | 539.7*** | 748.9*** |
| | (34.59) | (27.92) | (25.48) | (20.25) | (37.50) | (29.35) | (16.94) | (15.17) |
| Year = 2013 | 8,804*** | 8,821*** | 3,476*** | 3,541*** | 3,836*** | 3,857*** | 800.4*** | 1,088*** |
| | (36.65) | (31.97) | (26.01) | (22.47) | (37.99) | (31.60) | (16.97) | (16.77) |
| Year = 2014 | 10,608*** | 10,876*** | 3,392*** | 3,675*** | 3,794*** | 4,110*** | 1,044*** | 1,525*** |
| | (34.25) | (30.08) | (25.56) | (22.27) | (37.58) | (31.66) | (16.90) | (16.77) |
| Year = 2015 | 14,573*** | 14,618*** | 5,029*** | 4,931*** | 6,904*** | 6,726*** | 2,057*** | 2,167*** |
| | (36.17) | (29.38) | (26.02) | (21.71) | (37.95) | (31.34) | (17.39) | (16.50) |
| conflict = Low | -15.04 | -3.400 | 1.584 | 30.70** | -12.56 | 18.66 | -14.34* | -15.27** |
| | (31.77) | (22.30) | (20.27) | (13.68) | (17.15) | (11.98) | (8.029) | (7.325) |
| conflict = Mid | -21.13 | -76.65*** | -8.789 | -41.01*** | -15.80 | -34.62*** | -2.587 | -15.39** |
| | (31.63) | (17.23) | (21.76) | (13.07) | (17.27) | (9.685) | (6.653) | (7.123) |
| conflict = High | -15.50 | -113.9** | 0.953 | -102.1* | -16.86 | -117.4*** | 5.893 | -62.94** |
| | (66.74) | (50.36) | (55.06) | (52.68) | (40.28) | (43.76) | (14.17) | (30.50) |
| Constant | 6,783*** | 6,681*** | 4,749*** | 4,676*** | 4,343*** | 4,291*** | 2,670*** | 2,447*** |
| | (33.83) | (29.09) | (24.94) | (21.65) | (37.17) | (31.20) | (16.92) | (16.34) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.886 | 0.800 | 0.669 | 0.564 | 0.768 | 0.604 | 0.605 | 0.593 |
| **Panel C** | | | | | | | | |
| Policy | 8,419*** | 8,011*** | 2,811*** | 2,799*** | 3,699*** | 3,475*** | 1,007*** | 980.1*** |
| | (29.31) | (33.42) | (14.80) | (16.12) | (19.31) | (20.13) | (7.935) | (8.020) |
| conflict = Low | 1,805*** | 1,713*** | 756.8*** | 735.5*** | 701.3*** | 685.6*** | 174.7*** | 159.0*** |
| | (88.15) | (64.65) | (49.04) | (39.85) | (45.59) | (30.54) | (18.64) | (14.93) |
| conflict = Mid | 2,099*** | 1,436*** | 901.4*** | 629.4*** | 898.9*** | 631.1*** | 255.0*** | 200.8*** |
| | (113.4) | (198.3) | (74.97) | (65.65) | (59.47) | (61.50) | (25.68) | (18.60) |
| conflict = High | -896.7*** | -212.1 | -632.9*** | -333.8*** | -1,183*** | -452.7*** | -290.1*** | -21.84 |
| | (68.16) | (129.9) | (54.96) | (72.18) | (41.04) | (73.69) | (14.55) | (30.85) |
| Policy#Low | -1,503*** | -1,071*** | -790.5*** | -617.3*** | -722.9*** | -442.1*** | -140.6*** | -50.75* |
| | (106.4) | (182.9) | (56.52) | (60.51) | (59.60) | (83.13) | (23.76) | (28.78) |
| Policy#Mid | -3,010*** | -2,301*** | -1,401*** | -945.8*** | -1,826*** | -1,117*** | -518.4*** | -307.2*** |
| | (123.2) | (227.5) | (79.00) | (71.01) | (65.80) | (73.89) | (27.67) | (24.74) |
| Constant | 9,620*** | 9,526*** | 5,889*** | 5,800*** | 5,492*** | 5,499*** | 2,962*** | 2,926*** |
| | (31.31) | (50.06) | (16.00) | (21.67) | (20.77) | (29.52) | (8.549) | (12.80) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.632 | 0.504 | 0.471 | 0.483 | 0.464 | 0.388 | 0.286 | 0.491 |

Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
(1) Pooled OLS with robust std errors
(2) Prais-Winsten and Cochrane-Orcutt AR(1) regression

however as previously noted, the number of health facilities reporting to the DHIS also increases over time, so it may be argued that this reflects increased reporting. However, I

argue that the increase in number of health facilities after 2011 is not substantial enough to make a huge difference in average utilization.

As expected, conflict negatively affects health facility utilization; areas with low level conflict had 141, 82, 129 and 20 fewer ANC 1, ANC 4, IPT 2 and deliveries respectively, while areas with high level conflict had 584, 393, 802 and 139 fewer ANC 1, ANC 4, IPT 2 and deliveries respectively all statistically significant results. Note that as the level of conflict increases, so does the reduction in health facility visits, indicative of a dose response. Level of conflict is determined by number of fatalities, hence higher level conflict (greater than 100 deaths) is likely to be accompanied by population displacement, and this result is therefore not surprising. The results may also suggest that DHIS data is sensitive to the context and may therefore be of adequate quality.

Panel B adjusts for year fixed effects. Mean monthly ANC 1st visits increased by 4,997 in 2012, 8,821 in 2013, 10,586 in 2014 and 14,548 in 2015 from the 2011 baseline of 6,813. The highest increase is observed between 2011-2012 (75%) with subsequent year by year increases of 43% (2012-2013), 17% (2013-2014) and 37% (2014-2015). There is a noticeable drop-off in the number of women who complete ANC 4th visits compared to those who have ANC 1st visits. When we compare across the years; while we see relatively large increase in ANC 1st visits between 2011-2015, there is neither a comparable increase for ANC 4th visits nor for IPTp-Sp. ANC 4th visits increase by 41% between 2011-2012 (n=1,978), 43% (2012-2013), by -1.83% (2013-2014) and 33% (2014-2015). Therefore, while ANC 1st visits were increasing, the proportion of pregnant women completing the recommended 4 ANC visits does not increase at a similar rate, and thus ANC 1st and ANC 4th visits were in fact diverging during that period.

For IPT-Sp, we observe a similar trend to that of ANC 4th visits, with a slower year by year increase in number of women receiving IPTp-Sp during that same period (46%, n=2,02; 47%,n=3,792; -2.06%, n=3,763; 83%, n=6,875), from a relatively lower 2011 baseline of 4,374 mean monthly visits. Thus while health facilities successfully attract women for their first visit antenatal care visit, they are less successful in retaining women for care as previously noted. This may be evidence of low quality antenatal care services, or ex-

ternal factors such as difficulty in accessing health facilities or cultural practices whereby women come for ANC merely to confirm progress of their pregnancy, not for care-seeking.

Antenatal care provides an opportunity to advice pregnant women on the importance of delivering with a skilled health-care provider and thus similarly to IPTp-Sp, increase in ANC visits is presumed to correlate with increases in facility deliveries. The results suggest that while ANC visits and IPTp-Sp increase, the increase in facility deliveries was much slower. Between 2011-2015, mean monthly facility deliveries increased by 481 mean monthly deliveries ($P<0.01$) on average, starting from a relatively low 2,594 deliveries per month in 2011. Annually, mean monthly increases were 531, 787, 1,036, and 2,048 in 2012, 2013, 2014 and 2015, albeit statistically significant increases.

The effect of the geographically - focused health financing strategy on health utilization is presented in Panel C, which compares maternal health utilization before to after 2013, that is comparing 2011-2012 to the period 2013-2015, henceforth referred to as the policy period. During the policy period there were statistically significant monthly increases in utilization across all indicators. Mean monthly ANC 1st visits increase by 8,011, mean monthly ANC 4th visits by 2,799, IPT-2 by 3,475 and deliveries by 980.1 compared to the period prior. Once again women do come to the health facility for their first antenatal care visit but fewer return to receive a second IPT2 dose, meaning even fewer complete the antenatal care protocol. Antenatal care therefore does not act as a vehicle to promote additional maternal health services for women in South Sudan.

The effect of conflict is unclear as the results suggest that areas with low level and mid level conflict have increases in utilization of maternal health services, while high level conflict reduces health facility utilization. While this may be indicative of displacement; women moving from areas with higher to lower level conflict hence these areas showing increased utilization, it may be worthy of further research.

To allow for comparison with extant findings, I estimate the natural logarithm of health facility utilization in appendix table A2. In summary, monthly ANC 1st and 4th visits and IPT-Sp increase by 30%, 17% and 24% during the observation period, while facility deliveries increase by a mere 16%. During the policy period, monthly increases in ANC 1st

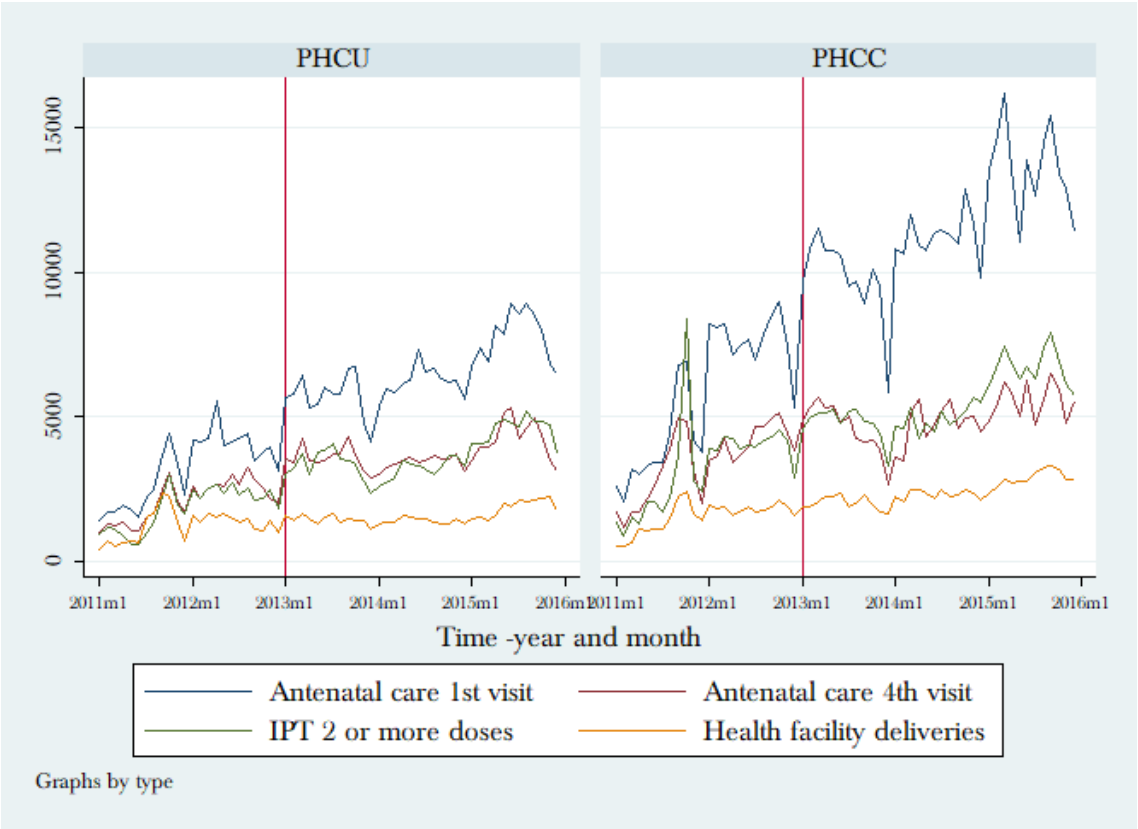


*Figure 1.3:* ***Trends in maternal health indicators, by facility type.***

and 4th visits and IPT-Sp are 66%, 42% and 56% while deliveries increase by 34% relative to the period prior. These increases are however relative to low baselines in 2011.

### Maternal health by Facility Type

Figure 1.7 illustrates maternal health outcomes disaggregated by health facility type. The trends suggest that both primary health care centers and primary health care units increase health facility utilization across all 4 indicators. However, similar to the aggregated results presented above, ANC 1st visits are much higher than ANC 4th visits, and IPT two or more doses closely mirrors ANC 4th visits. Number of women delivering in the health facility does not show much improvement in both types of health facilities.

Analysis results are presented in Table 1.7 comparing utilization at primary health care centers relative to primary health care units. PHCCs serve a larger catchment population than PHCCs (approximately 30,000 compared to 10,000) and provide a higher level of services than PHCUs. They are also more likely to be located in more urbanized settings

than PHCUs and thus should have a higher utilization.

This is observed in the analysis results, with ANC 1 and 4 visits, IPT-Sp second dose and delivery all being higher at the PHCCs relative to PHCUs by 56%, 34%, 44% and 35% respectively. Relative to PHCUs, areas with low conflict experience statistically significant reductions of 2% in ANC 4th visits but have 11% higher deliveries. Similarly, areas with mid conflict have statistically significantly higher ANC 1st visits, and deliveries by 4%, and 10% relative to PHCUs respectively. These results suggest that PHCUs are more affected by conflict than the PHCCs, suggesting that conflict may be primarily located in less urban settings.

Panel B compares annual increase in health facility utilization. Overall, results suggest that while women prefer to attend their 1st ANC visit at the PHCCs, they are more likely to return for subsequent antenatal care visits when they attend PHCUs. Thus, PHCCs have higher ANC 1st visits by 13%, 4%, 10% and 8% in 2012, 2013, 2014 and 2015 relative to the PHCUs, however, ANC 4th visits, are lower in 2013, 2014 and 2015 by 24%, 15% and 19% with a similar trend observed for IPT-Sp.

This suggests that while PHCCs attract a larger share of women for their 1st antenatal care visit, they are less successful in getting women to come for subsequent antenatal care visits compared to PHCUs. PHCCs however have higher increase in monthly deliveries by 8%, 12%, 32% and 26%, suggesting that across the years, women who deliver in health facilities may increasingly prefer giving birth with skilled providers, who are more likely to be at PHCCs. Overall however, fewer women deliver at the health facility than attend antenatal care services.

Panel C assesses health facility utilization by mothers during the policy period. The results largely confirm previous results; health facility utilization is significantly higher during the policy period. For PHCCs, percent increase in monthly ANC 1st visits are higher by a moderate 1% relative to PHCUs during the policy period whereas deliveries are significantly higher by 16%. The converse is true for ANC 4th visits and IPT-Sp with both significantly lower at PHCCs relative to PHCUs by 20% and 10% once again emphasizing that PHCUs perform better in encouraging return visits.

*Table 1.7:* ***Maternal Health Indicators by Facility Type***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery |
|---|---|---|---|---|
| **Panel A** | | | | |
| PHCC | 0.560*** | 0.340*** | 0.436*** | 0.350*** |
| | (0.00280) | (0.00334) | (0.00372) | (0.00309) |
| Year | 0.255*** | 0.178*** | 0.235*** | 0.131*** |
| | (0.000886) | (0.000945) | (0.00115) | (0.00111) |
| Conflict = Low | -0.0233*** | -0.0235*** | -0.0315*** | -0.0577*** |
| | (0.00545) | (0.00562) | (0.00640) | (0.00730) |
| Conflict = Mid | -0.00150 | -0.00915 | -0.0517*** | -0.0744*** |
| | (0.00689) | (0.00686) | (0.00802) | (0.00978) |
| Conflict = High | -0.0247 | -0.0394* | -0.0995*** | -0.120*** |
| | (0.0198) | (0.0203) | (0.0249) | (0.0254) |
| PHCC#Low conflict | 0.00410 | -0.0208* | -0.0166 | 0.107*** |
| | (0.0101) | (0.0117) | (0.0131) | (0.0111) |
| PHCC# Mid conflict | 0.0394*** | -0.00472 | 0.0310* | 0.0984*** |
| | (0.0130) | (0.0155) | (0.0177) | (0.0160) |
| PHCC#High conflict | 0.0249 | -0.0163 | -0.000206 | 0.138*** |
| | (0.0321) | (0.0372) | (0.0410) | (0.0400) |
| Constant | 7.985*** | 7.640*** | 7.463*** | 6.985*** |
| | (0.00295) | (0.00316) | (0.00388) | (0.00361) |
| R-squared | 0.992 | 0.990 | 0.989 | 0.984 |
| **Panel B** | | | | |
| PHCC | 0.488*** | 0.476*** | 0.525*** | 0.186*** |
| | (0.00656) | (0.00799) | (0.00911) | (0.00836) |
| PHCC#2012 | 0.130*** | 0.00373 | 0.00113 | 0.0811*** |
| | (0.00782) | (0.00947) | (0.0106) | (0.00965) |
| PHCC#2013 | 0.0421*** | -0.243*** | -0.158*** | 0.120*** |
| | (0.00770) | (0.00948) | (0.0105) | (0.00963) |
| PHCC#2014 | 0.0971*** | -0.151*** | -0.0924*** | 0.320*** |
| | (0.00768) | (0.00950) | (0.0105) | (0.00971) |
| PHCC#2015 | 0.0801*** | -0.191*** | -0.132*** | 0.256*** |
| | (0.00760) | (0.00938) | (0.0104) | (0.00966) |
| PHCC#Low conflict | 0.00401 | 0.0121 | 0.00204 | 0.0202** |
| | (0.00815) | (0.0100) | (0.0103) | (0.00999) |
| PHCC#Mid conflict | 0.00333 | -0.00561 | 0.00144 | -1.53e-05 |
| | (0.0115) | (0.0144) | (0.0156) | (0.0149) |
| PHCC#High conflict | -0.00407 | -0.0171 | -0.00536 | -0.0106 |
| | (0.0284) | (0.0349) | (0.0397) | (0.0363) |
| Constant | 7.780*** | 7.413*** | 7.238*** | 6.936*** |
| | (0.00396) | (0.00396) | (0.00508) | (0.00560) |
| R-squared | 0.993 | 0.989 | 0.990 | 0.985 |
| **Panel C** | | | | |
| Policy#PHCC | 0.0143* | -0.199*** | -0.101*** | 0.160*** |
| | (0.00770) | (0.00691) | (0.00904) | (0.00754) |
| Policy | 0.651*** | 0.538*** | 0.620*** | 0.235*** |
| | (0.00390) | (0.00341) | (0.00470) | (0.00422) |
| PHCC | 0.546*** | 0.479*** | 0.503*** | 0.236*** |
| | (0.00663) | (0.00597) | (0.00772) | (0.00641) |
| Conflict = Low | 0.149*** | 0.112*** | 0.161*** | -0.00686 |
| | (0.0140) | (0.0124) | (0.0152) | (0.0142) |
| Conflict = Mid | 0.245*** | 0.165*** | 0.221*** | 0.144*** |
| | (0.0285) | (0.0286) | (0.0361) | (0.0306) |
| Conflict = High | -0.0131 | -0.0495** | -0.0797*** | -0.0422* |
| | (0.0225) | (0.0212) | (0.0284) | (0.0229) |
| Policy#Low conflict | -0.105*** | -0.0969*** | -0.120*** | 0.0232 |
| | (0.0155) | (0.0138) | (0.0172) | (0.0161) |
| Policy#Mid conflict | -0.284*** | -0.213*** | -0.300*** | -0.204*** |
| | (0.0296) | (0.0294) | (0.0373) | (0.0318) |
| Constant | 8.093*** | 7.661*** | 7.543*** | 7.101*** |
| | (0.00402) | (0.00354) | (0.00488) | (0.00423) |
| R-squared | 0.990 | 0.990 | 0.988 | 0.983 |
| Number of facility | 1,508 | 1,508 | 1,508 | 1,508 |

Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses

As noted previously, there is a dose-response of utilization and level of conflict, with fewer health facility visits the higher the level of conflict across all indicators. For example, low and mid level conflict reduces ANC 1st visits by 10% and 28% while mid-level conflict reduces facility deliveries by 20% during the policy period.

In summary, while there are significant increases in health facility utilization by pregnant women, this may not result in increasing the number of contacts with the health facility as observed in the drop off in completion of ANC 4th visits and women receiving their second IPT-Sp dose. In addition, given the relatively lower rate of increase in health facility deliveries, this suggests slow progress in reducing the high maternal mortality ratio in the country. This also implies that current programs may need to identify additional ways to attract women to the health facility, perhaps by understanding and addressing barriers to access and/or providing incentives at the community level (for example vouchers for women delivering at the health facility). As expected, conflict negatively impacts health facility utilization, with the higher the level of conflict, the higher the drop in utilization. The observed dose response also suggests that DHIS data may be a robust way of assessing health facility utilization as it is responsive to contextual factors. This also gives some confidence in the quality of the data collected by the DHIS.

### Maternal health by Donor

Results for the World Bank, USAID and Health Pooled Fund) are illustrated in figure 1.4 and table 1.8. Due to the variation in population across the three donors, maternal health indicators are standardized by the population of women of reproductive age (WRA), 15-49 years in each of the states. Based on the graphs, the best performing donor is the Health Pooled Fund. Surprisingly, USAID sites have much lower performance than the HPF sites, and are relatively similar to the World Bank sites. USAID states have been relatively peaceful during the period of observation (compared to both the World Bank and HPF sites) and also have higher per capita funding than the World Bank thus it is surprising that the performance is not similar to that of the Health Pooled Fund. This may be due to differences in the specific contracting approaches and may be worthy of a future research.

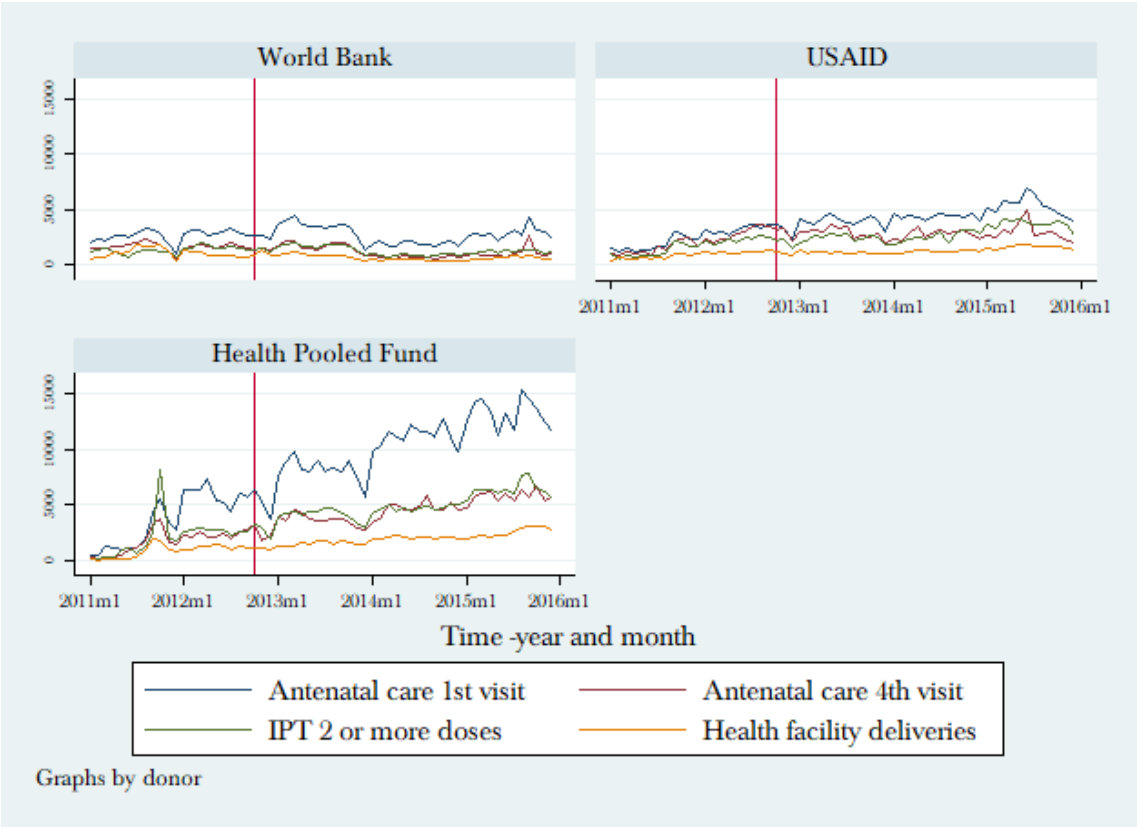


*Figure 1.4:* ***Maternal health indicators, by donor.***

Comparison of health facility utilization by facility type is illustrated in figure 1.5. As noted from the prior results, World Bank sites have relatively lower performance, but note that PHCUs in USAID sites have similar levels of health facility utilization as the World Bank sites. The PHCCs however, have much higher utilization relative to the PHCUs, hence performance appears largely driven by the PHCCs. This may indicate that the USAID intervention primarily focused on the PHCCs, at the expense of PHCUs or there may be a higher preference for PHCCs in Central and Western Equatoria. This is worth exploring further. In contrast, Health Pooled Fund sites have observed increases in health facility utilization in both PHCCs and PHCUs, suggesting a more balanced implementation approach. Due to the higher performance of HPF sites, it may also be necessary to identify the specific contract modalities that have been successful for implementation in these six states.

Empirical estimates are presented in table 1.8 with the World Bank sites as the reference. Panel A shows that USAID, and Health Pooled Fund sites had higher increases

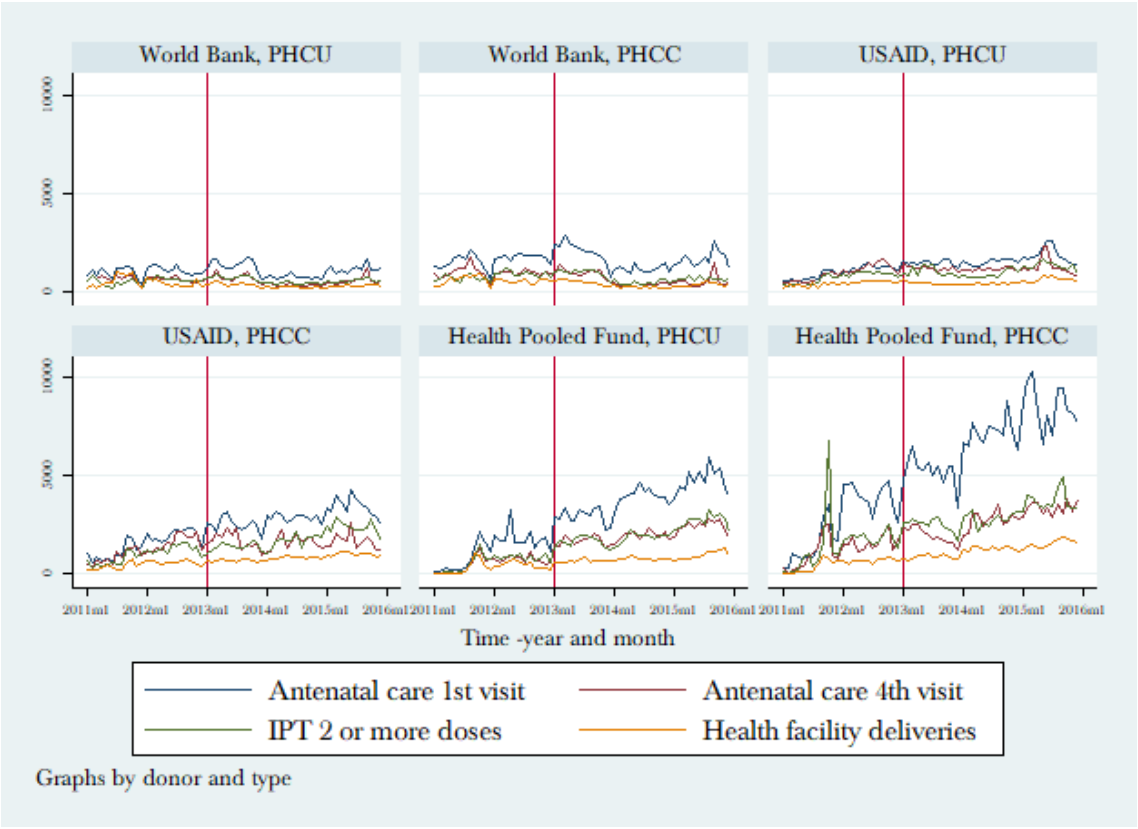


*Figure 1.5:* ***Maternal health indicators, by donor and health facility type.***

in health facility utilization, relative to World Bank sites. For USAID, ANC 1st and 4th Visits, IPT-Sp and delivery had higher increases by 20%, 57%, 47% and 24% respectively while HPF sites are higher by 95%, 88%, 95% and 54% respectively, relative to the World Bank sites. As previously noted, I adduce from these results that HPF sites perform much better compared to USAID, during the period of observation.

In areas of low conflict, USAID sites perform relatively worse than comparable World Bank sites, with ANC 1st and 4th visits, IPT-Sp and delivery declining by 9%, 11%, 2% and 5% relative to World Bank sites, albeit only ANC declines are statistically significantly different. This also implies that World Bank sites are relatively better able to continue service provision in presence of conflict, possibly due to the longer experience with conflict or due to the specific differences in contract design. Overall, HPF sites have higher utilization relative to World Bank sites affected by similar levels of conflict.

Panel B compares within year differences in utilization relative to World Bank sites. In both USAID and HPF sites, utilization increases relative to the World Bank, with a larger

*Table 1.8:* ***Maternal Health Indicators by Donor Type***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery |
|---|---|---|---|---|
| **Panel A** | | | | |
| USAID | 0.199*** | 0.567*** | 0.470*** | 0.242*** |
| | (0.00759) | (0.00944) | (0.00762) | (0.00958) |
| Health Pooled Fund | 0.953*** | 0.881*** | 0.951*** | 0.539*** |
| | (0.00784) | (0.00990) | (0.00804) | (0.0105) |
| Year | 0.272*** | 0.174*** | 0.244*** | 0.194*** |
| | (0.00131) | (0.00181) | (0.00166) | (0.00176) |
| USAID#Low conflict | -0.0873* | -0.113* | -0.0214 | -0.0475 |
| | (0.0462) | (0.0607) | (0.0465) | (0.0532) |
| HPF#Low conflict | 0.123*** | 0.174*** | 0.0606 | 0.0794 |
| | (0.0460) | (0.0603) | (0.0466) | (0.0544) |
| HPF#Mid conflict | -0.00391 | -0.0230 | -0.107*** | 0.117*** |
| | (0.0253) | (0.0311) | (0.0243) | (0.0371) |
| HPF#High conflict | 0.667*** | 0.830*** | 0.585*** | 0.711*** |
| | (0.0546) | (0.0689) | (0.0548) | (0.0799) |
| Constant | 7.410*** | 6.873*** | 6.758*** | 6.358*** |
| | (0.00771) | (0.00960) | (0.00787) | (0.0101) |
| R-squared | 0.992 | 0.981 | 0.988 | 0.983 |
| **Panel B** | | | | |
| USAID#2012 | 0.317*** | 0.562*** | 0.201*** | 0.460*** |
| | (0.00855) | (0.0110) | (0.00889) | (0.0125) |
| USAID#2013 | 0.392*** | 0.609*** | 0.257*** | 0.622*** |
| | (0.00858) | (0.0110) | (0.00886) | (0.0124) |
| USAID#2014 | 1.065*** | 1.379*** | 0.935*** | 1.280*** |
| | (0.00904) | (0.0116) | (0.00920) | (0.0132) |
| USAID#2015 | 0.877*** | 1.094*** | 0.982*** | 1.274*** |
| | (0.00875) | (0.0115) | (0.00902) | (0.0127) |
| HPF#2012 | 0.797*** | 0.534*** | 0.292*** | 0.672*** |
| | (0.0121) | (0.0146) | (0.0159) | (0.0191) |
| HPF#2013 | 0.993*** | 0.963*** | 0.650*** | 1.123*** |
| | (0.0119) | (0.0145) | (0.0156) | (0.0191) |
| HPF#2014 | 1.866*** | 2.040*** | 1.426*** | 1.999*** |
| | (0.0122) | (0.0149) | (0.0158) | (0.0198) |
| HPF#2015 | 1.677*** | 1.903*** | 1.403*** | 1.879*** |
| | (0.0118) | (0.0146) | (0.0154) | (0.0193) |
| USAID | -0.243*** | -0.0473*** | 0.116*** | -0.353*** |
| | (0.00671) | (0.00855) | (0.00717) | (0.00961) |
| Health Pooled Fund | -0.119*** | -0.172*** | 0.249*** | -0.529*** |
| | (0.0106) | (0.0128) | (0.0144) | (0.0168) |
| Constant | 7.797*** | 7.386*** | 7.014*** | 6.908*** |
| | (0.00496) | (0.00613) | (0.00439) | (0.00881) |
| R-squared | 0.990 | 0.983 | 0.979 | 0.981 |
| **Panel C** | | | | |
| Policy#USAID | 0.435*** | 0.525*** | 0.396*** | 0.659*** |
| | (0.00866) | (0.0114) | (0.0100) | (0.0111) |
| Policy#HPF | 0.819*** | 1.105*** | 0.782*** | 1.059*** |
| | (0.0108) | (0.0127) | (0.0124) | (0.0142) |
| Policy = 1 | 0.104*** | -0.270*** | 0.0358*** | -0.311*** |
| | (0.00702) | (0.00980) | (0.00762) | (0.00988) |
| USAID# Low conflict | 0.173*** | 0.0848 | 0.244*** | 0.143*** |
| | (0.0444) | (0.0559) | (0.0437) | (0.0468) |
| HPF#Low conflict | 0.126*** | 0.150*** | 0.0595 | 0.0574 |
| | (0.0447) | (0.0558) | (0.0444) | (0.0480) |
| HPF#Mid conflict | -0.0328 | -0.155*** | -0.162*** | 0.000557 |
| | (0.0225) | (0.0258) | (0.0236) | (0.0303) |
| HPF#High conflict | 0.456*** | 0.498*** | 0.345*** | 0.421*** |
| | (0.0464) | (0.0534) | (0.0524) | (0.0617) |
| Constant | 7.829*** | 7.319*** | 7.127*** | 6.834*** |
| | (0.00566) | (0.00757) | (0.00650) | (0.00805) |
| R-squared | 0.985 | 0.979 | 0.982 | 0.978 |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 |
| Number of facility | 1,508 | 1,508 | 1,508 | 1,508 |

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

Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses

gap with every year increase. This difference is much higher in HPF sites; for example in 2014, increases in ANC 1st and 4th visits and facility deliveries are double that of the World Bank. This once again shows that HPF sites have much higher performance compared to USAID sites.

During the policy period, USAID sites have 44%, 53%, 40% and 66% higher monthly increases in ANC 1st and 4th visits, IPT-Sp and facility deliveries relative to World Bank sites. Once again, the HPF sites have markedly higher increases in utilization with ANC 1st and 4th visits, IPT-Sp and facility deliveries experiencing monthly increases of 82%, 110%, 78% and 106% relative to the World Bank sites.

### 1.7.2 Child health

I now shift focus to the child health indicators and analyze results following a similar format as that of the maternal health indicators. Figure 1.6 is a graphical illustration of trends in DPT 1st and 3rd dose and malaria and diarrhoea treatment while table 1.9 presents empirical results at the national level.

DPT 1 dose is presented to assess the gap in completion of the DPT schedule which recommends 3 doses. Between 2011 and 2015, mean monthly DPT 1st and 3rd dose, increase by 4,153 and 3,528, all statistically significant increases. However, DPT 1 starts at a higher baseline relative to DPT 3 and hence the difference between the first and third dose is evidence of divergence. This also suggests that immunization programs may be failing to expand coverage rate for DPT3. Treatment for malaria, and diarrhoea cases at health facilities increased by 11,632, and 5,779 all statistically significant increases from 2011 baselines of 32,368 and 15,171. Health facility utilization is much higher for treatment, compared to that for immunization. This suggests that women in South Sudan take their children to the facility when they fall sick, but are less likely to go to the health facility for preventive measures.

All levels of conflict negatively impact utilization of health facilities by children under five years, except for malaria cases in areas of low conflict where the effect is not significant. Conflict primarily affects immunization and treatment seeking for diarrhoea, with all levels

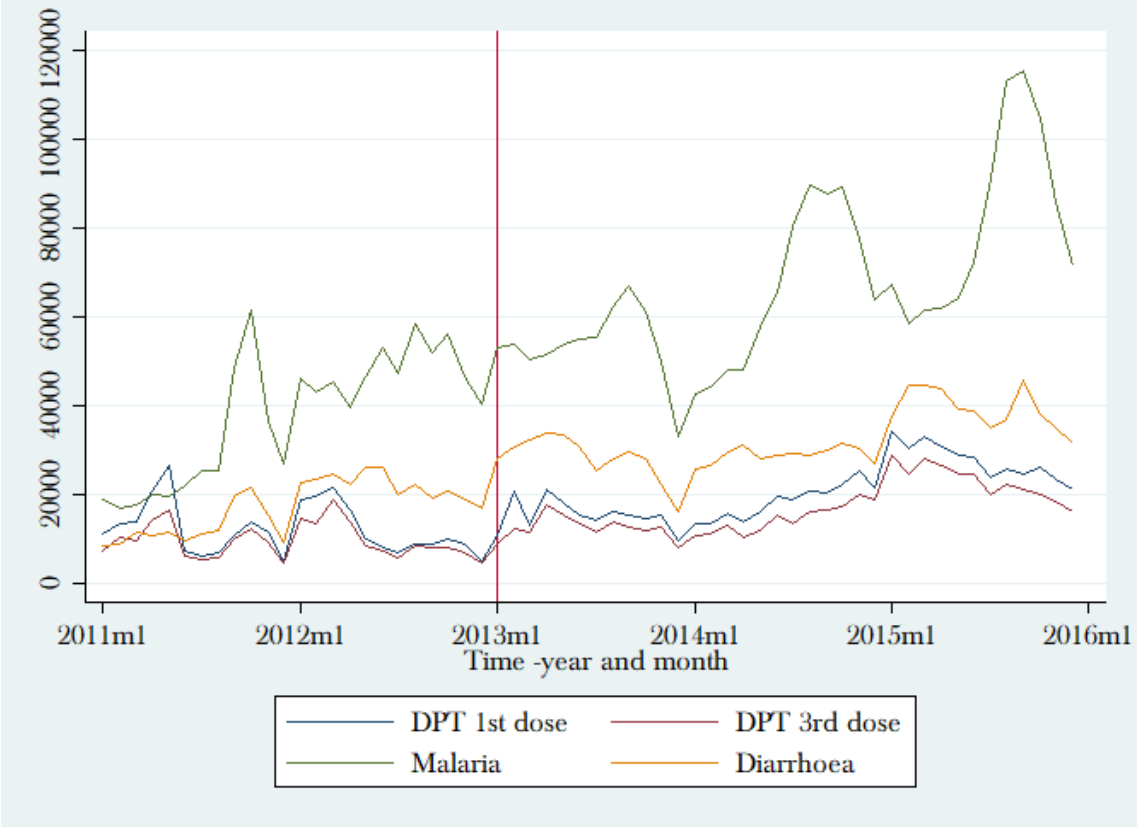


*Figure 1.6:* ***Trends in child health indicators, 2011-2015 Sudan.***

of conflict significantly reducing immunization and diarrhoea cases. Once again there is an observed dose-response, with higher levels of conflict associated with higher reductions.

Panel B presents annual increases; in 2012, 2013, 2014 and 2015, malaria cases saw year on year increases of 36% (n=11,632, p<0.01), 38% (n=23,121, p<0.01), 54% (n=35,252, p<0.01) and 40% (49,339, p<0.01), while diarrhoea cases increased by 66%, 72%, 3% and 67%. The mean number of children seen for malaria is considerably higher than for diarrhoea indicative of the high burden of malaria incidence in South Sudan. Fewer children are seen for immunization; mean monthly first dose of DPT vaccines administered increased by 1%, 27%, 92% and 142% between 2012 and 2015. While there is a gap between children receiving their first and 3rd DPT doses in 2011, mean monthly increases across the years are relatively similar signifying improvements in the immunization program. Statistically significant increases in DPT immunization are observed beginning in 2013 (for DPT 1st dose) and 2012 (for DPT 3rd dose). Thus prior to the health financing strategy, there were existing improvements in immunization programs that may have been strengthened

*Table 1.9:* ***Child Health Indicators***

| VARIABLES | (1) DPT1 | (2) DPT1 | (1) DPT3 | (2) DPT3 | (1) Malaria | (2) Malaria | (1) Diarrhoea | (2) Diarrhoea |
|---|---|---|---|---|---|---|---|---|
| **Panel A** | | | | | | | | |
| Year | 4,153*** | 4,314*** | 3,528*** | 3,659*** | 11,632*** | 10,795*** | 5,779*** | 6,190*** |
| | (18.53) | (20.25) | (13.92) | (15.70) | (33.01) | (49.98) | (11.78) | (14.93) |
| Conflict = Low | -367.4** | -576.1*** | -416.8** | -569.0*** | 414.2* | 901.7*** | -880.7*** | -650.1*** |
| | (177.0) | (214.8) | (171.8) | (192.7) | (240.7) | (215.4) | (183.4) | (130.9) |
| Conflict = Mid | -2,048*** | -2,599*** | -2,025*** | -2,290*** | -1,297*** | 1,219*** | -2,010*** | -1,717*** |
| | (115.5) | (205.8) | (120.7) | (202.3) | (139.7) | (148.5) | (216.6) | (186.1) |
| Conflict = High | -2,765*** | -3,197*** | -2,829*** | -2,853*** | -2,020*** | -783.7 | -3,506*** | -2,668*** |
| | (156.2) | (240.3) | (133.2) | (261.3) | (700.9) | (901.2) | (46.84) | (224.1) |
| Constant | 8,975*** | 8,739*** | 6,998*** | 6,776*** | 32,368*** | 33,619*** | 15,171*** | 14,136*** |
| | (62.70) | (71.04) | (47.38) | (55.33) | (107.4) | (169.3) | (41.84) | (51.56) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.564 | 0.395 | 0.583 | 0.409 | 0.520 | 0.368 | 0.764 | 0.627 |
| **Panel B** | | | | | | | | |
| Year = 1, 2012 | 119.5* | 2,688*** | 680.3*** | 3,275*** | 16,697*** | 17,383*** | 8,815*** | 9,147*** |
| | (63.89) | (104.5) | (38.74) | (82.67) | (173.8) | (136.8) | (47.15) | (54.11) |
| Year = 2, 2013 | 3,341*** | 5,186*** | 3,144*** | 5,116*** | 23,042*** | 27,445*** | 15,174*** | 15,213*** |
| | (48.69) | (85.66) | (26.55) | (67.76) | (173.8) | (170.7) | (53.29) | (61.37) |
| Year = 3, 2014 | 6,408*** | 7,522*** | 5,208*** | 6,582*** | 35,119*** | 38,303*** | 15,598*** | 16,917*** |
| | (50.58) | (85.35) | (28.17) | (66.23) | (175.3) | (187.9) | (46.02) | (57.43) |
| Year = 4, 2015 | 15,489*** | 17,305*** | 13,615*** | 15,055*** | 49,239*** | 45,424*** | 26,017*** | 26,245*** |
| | (50.71) | (85.68) | (29.99) | (66.68) | (183.1) | (200.3) | (48.33) | (54.75) |
| Conflict = Low | 116.2** | -51.56 | 84.01* | -45.04 | 431.7* | 495.4*** | -79.51** | -70.36 |
| | (53.98) | (68.15) | (45.85) | (61.24) | (226.4) | (158.7) | (38.69) | (58.96) |
| Conflict = Mid | -91.84*** | -157.5*** | -73.59*** | -94.26* | -266.7*** | -149.2 | -52.06*** | -237.0*** |
| | (26.60) | (50.84) | (21.74) | (48.22) | (97.53) | (139.2) | (15.95) | (56.03) |
| Conflict = High | -160.2 | -51.86 | -136.2 | -29.47 | -615.2 | -2,165*** | -6.213 | -267.4 |
| | (155.8) | (182.8) | (132.8) | (174.2) | (704.4) | (832.2) | (43.82) | (163.4) |
| Constant | 12,348*** | 10,647*** | 9,620*** | 7,850*** | 30,735*** | 29,751*** | 13,405*** | 12,874*** |
| | (49.79) | (85.51) | (27.41) | (65.76) | (179.8) | (191.3) | (47.63) | (52.86) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.653 | 0.465 | 0.689 | 0.484 | 0.529 | 0.372 | 0.823 | 0.686 |
| **Panel C** | | | | | | | | |
| Policy | 8,657*** | 7,458*** | 7,196*** | 5,664*** | 26,164*** | 19,179*** | 13,903*** | 12,967*** |
| | (43.36) | (47.78) | (34.72) | (37.74) | (158.2) | (142.9) | (63.62) | (58.22) |
| Conflict = Low | -336.1 | 255.6 | -171.2 | 390.8** | 6,569*** | 6,309*** | 2,842*** | 2,484*** |
| | (209.1) | (218.7) | (155.6) | (171.5) | (251.7) | (211.7) | (130.6) | (130.1) |
| Conflict = Mid | -87.83 | 22.27 | 216.7 | 280.9 | 8,048*** | 4,781*** | 3,664*** | 2,394*** |
| | (240.4) | (207.7) | (174.5) | (231.0) | (251.4) | (1,170) | (119.1) | (297.9) |
| Conflict = High | -2,521*** | -2,760*** | -2,575*** | -2,379*** | -1,914*** | 320.5 | -3,725*** | -1,732*** |
| | (158.1) | (286.1) | (135.4) | (306.9) | (710.0) | (810.6) | (62.94) | (257.3) |
| Policy#low conflict | 1,181*** | 191.0 | 777.2** | -246.3 | -3,904*** | -3,811*** | -2,840*** | -1,784*** |
| | (437.8) | (494.9) | (382.0) | (409.5) | (735.3) | (418.5) | (426.1) | (401.2) |
| Policy#mid conflict | -2,198*** | -3,322*** | -2,435*** | -3,164*** | -10,747*** | -5,400*** | -6,674*** | -5,114*** |
| | (340.8) | (322.8) | (276.1) | (307.4) | (620.5) | (1,160) | (278.2) | (368.8) |
| Constant | 12,175*** | 12,582*** | 9,813*** | 10,228*** | 40,037*** | 42,046*** | 18,397*** | 18,258*** |
| | (60.92) | (81.09) | (51.61) | (73.60) | (197.5) | (242.3) | (83.66) | (98.22) |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |
| R-squared | 0.292 | 0.210 | 0.288 | 0.216 | 0.311 | 0.262 | 0.515 | 0.422 |

Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
(1) Pooled OLS with robust std errors
(2) Prais-Winsten and Cochrane-Orcutt AR(1) regression

further as a result of the approach. Comparing mean monthly utilization during the policy period, DPT 1 and DPT3 are 8,657 and 7,196 higher during the policy period compared to the 2011-2012 period and malaria and diarrhoea are 26,164, and 13,903 statistically

significantly higher as well.

To allow for comparison with extant findings, I once again estimate the natural logarithm of health facility utilization in appendix table A2. In summary monthly DPT immunization increases by 26% during the period of observation while malaria and diarrhoa increase by 22% and 27%. However, by 2015, monthly DPT immunizations and malaria treatments are 100% higher relative to 2011, while diarrhoea treatment is 116% higher. During the policy period monthly increases in immunization are about 60% higher than prior to the policy period, while malaria and diarrhoea treatment are 42% and 58% higher. This results show substantial increases in child health service provision nationwide.

### Child health by Facility Type

Child health pattern of utilization differs from that of pregnant women, as visually depicted in figure 1.7. PHCUs receive more children with malaria, diarrhoea compared to PHCCs, however DPT 1st and 3rd dose are slightly higher at the PHCCs. This suggests that mothers have a strong preference for PHCUs compared to PHCCs, which might be due to convenience; PHCUs tend to be closer to the village than PHCCs which are primarily in more urban areas.

Analytical results are in table 1.10 with PHCUs as the reference. Monthly increases in DPT 1st and 3rd doses at the PHCCs are higher relative to the PHCUs by 23%, and 14%. This may reflect availability of vaccines at the PHCCs due to existence of cold chain (refrigerators and cold boxes which are less likely to be available at the PHCUs, which typically rely on a supply of cold boxes from PHCCs). The lower gap in DPT 3rd doses relative to PHCUs suggests that PHCUs may have a higher completion rate for the DPT immunization protocol relative to the PHCCs, whereas the gap in DPT 1 and DPT 3 at the PHCCs shows evidence of divergence.

Malaria and diarrhoea cases are higher at the PHCUs relative to the PHCCs overall; PHCCs have 20% and 37% lower utilization relative to the PHCUs. Once again this may be evidence that mothers prefer taking their children to the PHCUs, possibly due to their being relatively closer compared to the PHCCs. Therefore, there is reason to recommend that child health interventions in South Sudan prioritize the provision of child health

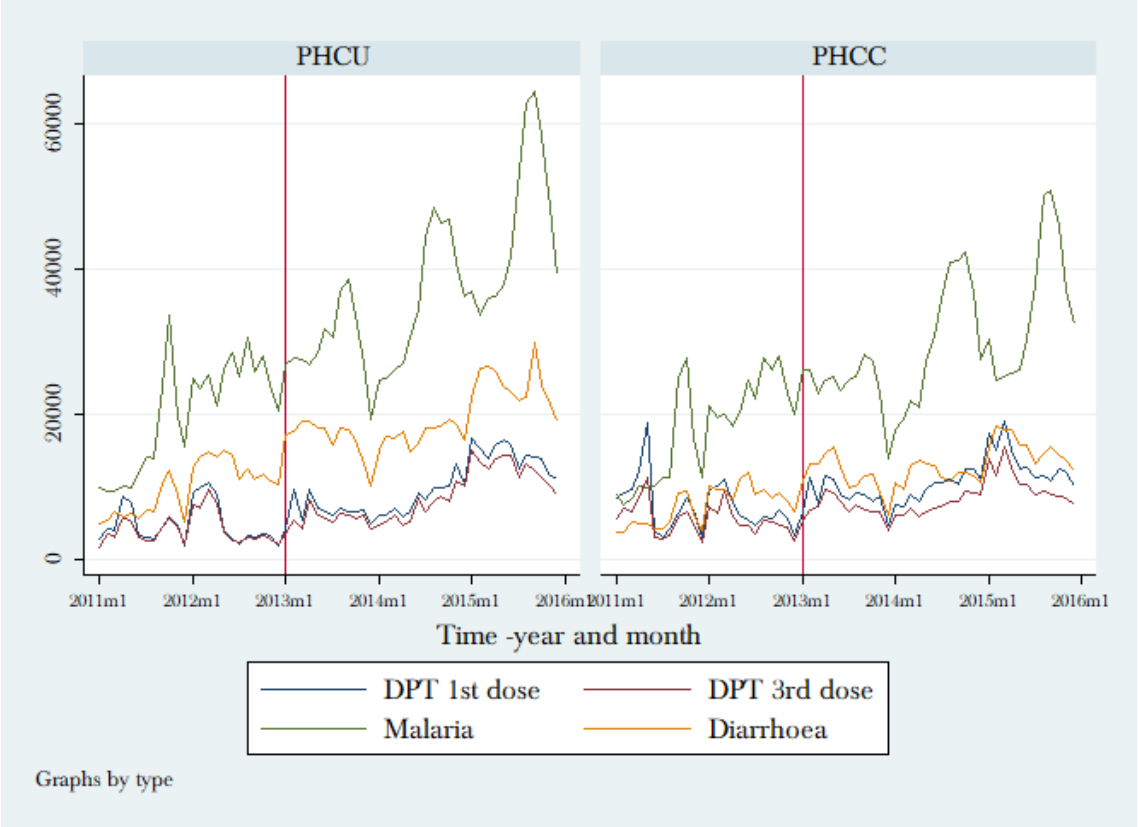


*Figure 1.7:* ***Child health indicators, by Facility Type.***

services at the PHCUs.

Conflict primarily affects children attending the health facility for DPT immunization, and diarrhoea, with less effect on malaria cases. There are statistically significant reductions in DPT immunization and diarrhoea treatment in presence of conflict, with a similar dose response observed as noted previously; the higher the level of conflict is associated with a larger drop in utilization. However, this is different in the case of malaria treatment where there are observed increases in malaria cases seen at the health facility by 2%, 3% and 1% in areas with low, mid and high-level conflict respectively. While this may be due to the high number of malaria cases seen at the health facilities overall, it may also be due to urgency in treatment seeking due to severity of malaria cases.

Comparing the policy period, there are statistically significant increases in child health indicators across all health facility sites. DPT increases by 73%, DPT 3 by 64%, malaria by 49%, and diarrhoea treatment by 62% relative to the period prior. These increasing gains in health facility utilization among children overall may be adequate to reduce child

mortality and assessing the impact of health facility utilization on under-five mortality may therefore be worthwhile for further evaluation, given the lack of national survey data for the period of observation.

PHCUs perform better than the PHCCs during the policy period. Relative to the PHCUs, PHCCs have lower DPT immunization by 30% and 20% for first and 3rd dose and lower malaria and diarrhoea treatment by 17% and 32%, further bolstering the recommendation to expand child health services to the PHCUs, due to the strong preference among mothers. The difference in utilization patterns comparing pregnant women and children may also indicate that while there may be barriers to health facility utilization, for example distance, there is adequate room for improvement in efforts to encourage women to also attend the health facility in similar rates as children.

### Child health by Donor

Child health utilization results comparing donors are illustrated in figure 1.8 with results standardized by the population of children under 5 years of age and table 1.11. Figure 1.8 shows that malaria is the leading cause of health facility visits by children across all donor sites. This is clearly evident in the health pooled fund sites and USAID sites and less so in the World Bank sites. Health pooled fund sites show much higher increases in child health facility utilization similar to the observed trend in maternal health. Once again, Health Pooled Fund sites have higher performance compared to World Bank and USAID sites.

Table 1.11 presents empirical results relative to World Bank sites. USAID sites have statistically significantly higher monthly increases in DPT 1st and 3rd dose and malaria treatment by 14%, 42% and 18% but lower treatment for diarrhoea by 50% relative to the World Bank. Once again, HPF sites have the highest performance overall, with monthly increases in DPT 1st and 3rd dose and malaria and diarrhoea treatment by 61%, 70%, 83% and 57% relative to the World Bank. Areas with low conflict have similar performance in USAID sites relative to World Bank in DPT immunization but significantly lower treatment for malaria and diarrhoea by 21% and 16% while HPF sites have similar performance. Once again this suggests that World Bank sites may be better able to continue health

*Table 1.10:* ***Child Health Indicators by Facility Type***

| VARIABLES | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|
| PHCC | 0.226*** | 0.135*** | -0.197*** | -0.366*** |
| | (0.00499) | (0.00494) | (0.00471) | (0.00321) |
| Year | 0.293*** | 0.280*** | 0.223*** | 0.248*** |
| | (0.00162) | (0.00159) | (0.00133) | (0.000915) |
| conflict = Low | -0.0270** | -0.0108 | 0.0162** | -0.0209*** |
| | (0.0112) | (0.0113) | (0.00794) | (0.00569) |
| conflict = Mid | -0.0707*** | -0.0878*** | 0.0322*** | -0.0523*** |
| | (0.0145) | (0.0141) | (0.0103) | (0.00667) |
| conflict = High | -0.133*** | -0.156*** | 0.0108 | -0.0775*** |
| | (0.0471) | (0.0434) | (0.0305) | (0.0192) |
| PHCC#Low conflict | -0.0842*** | -0.0949*** | -0.0436*** | -0.0364*** |
| | (0.0181) | (0.0183) | (0.0164) | (0.0120) |
| PHCC#Mid conflict | -0.0161 | -0.00874 | 0.0130 | 0.0291* |
| | (0.0253) | (0.0241) | (0.0211) | (0.0151) |
| PHCC#High conflict | -0.0153 | -0.0145 | -0.0513 | -0.00969 |
| | (0.0674) | (0.0615) | (0.0507) | (0.0331) |
| Constant | 8.259*** | 8.132*** | 9.792*** | 9.088*** |
| | (0.00544) | (0.00536) | (0.00436) | (0.00314) |
| R-squared | 0.969 | 0.969 | 0.991 | 0.992 |
| PHCC | 0.544*** | 0.405*** | -0.184*** | -0.283*** |
| | (0.0116) | (0.0107) | (0.0101) | (0.00679) |
| PHCC#2012 | -0.199*** | -0.211*** | 0.0629*** | -0.0340*** |
| | (0.0146) | (0.0135) | (0.0119) | (0.00842) |
| PHCC#2013 | -0.296*** | -0.187*** | -0.00730 | -0.100*** |
| | (0.0140) | (0.0132) | (0.0123) | (0.00838) |
| PHCC#2014 | -0.375*** | -0.337*** | -0.0427*** | -0.0993*** |
| | (0.0142) | (0.0133) | (0.0130) | (0.00840) |
| PHCC#2015 | -0.602*** | -0.564*** | -0.0616*** | -0.143*** |
| | (0.0140) | (0.0131) | (0.0131) | (0.00829) |
| PHCC#Low conflict | 0.0153 | 0.00832 | 0.00619 | -0.000118 |
| | (0.0163) | (0.0164) | (0.0162) | (0.0103) |
| PHCC#Mid conflict | -0.00861 | -0.00651 | 0.00114 | 0.00808 |
| | (0.0222) | (0.0211) | (0.0207) | (0.0133) |
| PHCC#High conflict | 0.0147 | 0.0203 | -0.0243 | -0.00702 |
| | (0.0595) | (0.0550) | (0.0488) | (0.0310) |
| Constant | 8.250*** | 8.114*** | 9.630*** | 8.867*** |
| | (0.00752) | (0.00704) | (0.00584) | (0.00363) |
| R-squared | 0.969 | 0.967 | 0.991 | 0.989 |
| Policy = 1 | 0.734*** | 0.642*** | 0.488*** | 0.612*** |
| | (0.00737) | (0.00727) | (0.00499) | (0.00428) |
| Policy#PHCC | -0.290*** | -0.196*** | -0.0605*** | -0.0846*** |
| | (0.0111) | (0.0107) | (0.00967) | (0.00789) |
| type = 1, PHCC | 0.410*** | 0.254*** | -0.169*** | -0.318*** |
| | (0.00927) | (0.00887) | (0.00818) | (0.00669) |
| Policy#Low conflict | 0.107*** | 0.0399 | -0.138*** | -0.113*** |
| | (0.0330) | (0.0319) | (0.0207) | (0.0180) |
| Policy#Mid conflict | -0.118** | -0.152*** | -0.229*** | -0.295*** |
| | (0.0479) | (0.0434) | (0.0375) | (0.0299) |
| Constant | 8.385*** | 8.287*** | 9.927*** | 9.208*** |
| | (0.00720) | (0.00712) | (0.00523) | (0.00438) |
| R-squared | 0.966 | 0.971 | 0.990 | 0.989 |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 |
| Number of facility | 1,508 | 1,508 | 1,508 | 1,508 |

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

Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses

services delivery in areas of low conflict compared to USAID sites. DPT immunization is significantly lower in HPF sites (by 28% and 34%) experiencing mid-level conflict relative to the World Bank sites, but provide higher rates of treatment for malaria and diarrhoea with the difference being less than 10%.

As with maternal health utilization, health utilization among children under five is distinctly lower in World Bank sites relative to the two donor sites starting in 2014 as observed in panel B. This suggests that the effect of conflict on health facility utilization in the World Bank sites was significant starting in 2014. USAID sites have double the DPT immunization rates of World Bank sites, while HPF sites have approximately 2.5 higher immunization in 2014 and 2015. In addition, while the USAID sites have significantly higher utilization across all child health indicators relative to the World Bank sites in 2012 and 2013, the HPF sites start with significantly lower DPT immunization (by approximately 30%) relative to the World Bank in 2013 suggesting that the World Bank had higher provision of DPT immunization during that period. The gap in 2014 and 2015 is therefore further evidence that the effect of the policy intervention was markedly higher in the HPF sites, relative to both USAID and World Bank interventions, but suggest that the drop in World Bank performance may be primarily due to conflict.

During the policy period, USAID sites have relatively higher DPT immunization rates by 84% and 81% and malaria and diarrhoea treatment by 21% and 37% compared to the World Bank Sites. The effect of the policy intervention is once again markedly higher in the HPF sites; DPT immunization rates increase by 152%, and malaria and diarrhoea treatment by 63% and 80% relative to the World Bank sites.

Comparison of health facility utilization across donor and facility type is shown in figure 1.9 This graphical illustration offers additional evidence that Health Pooled Fund sites perform better overall, relative to USAID and World Bank sites. It remains surprising that World Bank sites remain competitive with USAID with regards to performance given the difference in per-capita health spending and the higher levels of conflict observed in World Bank sites.

*Table 1.11:* ***Child Health Indicators by Donor Type***

| VARIABLES | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|
| **Panel A** | | | | |
| USAID | 0.140*** | 0.423*** | 0.176*** | -0.504*** |
| | (0.0166) | (0.0175) | (0.00739) | (0.00753) |
| Health Pooled Fund | 0.610*** | 0.693*** | 0.834*** | 0.571*** |
| | (0.0175) | (0.0184) | (0.00843) | (0.00761) |
| Year | 0.250*** | 0.233*** | 0.202*** | 0.263*** |
| | (0.00203) | (0.00225) | (0.00194) | (0.00142) |
| USAID#Low conflict | 0.0899 | 0.0806 | -0.206*** | -0.160*** |
| | (0.114) | (0.108) | (0.0419) | (0.0457) |
| HPF#Low conflict | 0.126 | 0.0944 | 0.0666 | 0.0309 |
| | (0.114) | (0.108) | (0.0426) | (0.0452) |
| HPF#Mid conflict | -0.275*** | -0.342*** | 0.0950*** | 0.0790*** |
| | (0.0634) | (0.0613) | (0.0276) | (0.0259) |
| HPF#High conflict | 1.181*** | 1.132*** | 0.745*** | 0.565*** |
| | (0.140) | (0.141) | (0.0669) | (0.0589) |
| Constant | 7.689*** | 7.376*** | 8.933*** | 8.398*** |
| | (0.0169) | (0.0178) | (0.00780) | (0.00763) |
| R-squared | 0.972 | 0.971 | 0.988 | 0.991 |
| **Panel B** | | | | |
| USAID#2012 | 0.329*** | 0.405*** | 0.105*** | 0.515*** |
| | (0.0260) | (0.0266) | (0.0117) | (0.0106) |
| USAID#2013 | 0.430*** | 0.399*** | 0.133*** | 0.536*** |
| | (0.0248) | (0.0254) | (0.0119) | (0.0106) |
| USAID#2014 | 1.866*** | 1.992*** | 0.726*** | 1.050*** |
| | (0.0268) | (0.0270) | (0.0124) | (0.0110) |
| USAID#2015 | 1.792*** | 1.982*** | 0.419*** | 0.816*** |
| | (0.0257) | (0.0262) | (0.0124) | (0.0105) |
| HPF#2012 | -0.310*** | -0.282*** | 0.368*** | 0.645*** |
| | (0.0272) | (0.0272) | (0.0171) | (0.0132) |
| HPF#2013 | 0.359*** | 0.305*** | 0.535*** | 0.964*** |
| | (0.0259) | (0.0259) | (0.0174) | (0.0132) |
| HPF#2014 | 2.326*** | 2.376*** | 1.485*** | 1.618*** |
| | (0.0278) | (0.0274) | (0.0180) | (0.0134) |
| HPF#2015 | 2.463*** | 2.730*** | 1.238*** | 1.468*** |
| | (0.0266) | (0.0264) | (0.0177) | (0.0128) |
| USAID | -0.506*** | -0.304*** | 0.0194** | -0.969*** |
| | (0.0189) | (0.0195) | (0.00923) | (0.00822) |
| Health Pooled Fund | -0.151*** | -0.124*** | 0.184*** | -0.333*** |
| | (0.0203) | (0.0202) | (0.0150) | (0.0112) |
| Constant | 8.307*** | 8.018*** | 9.107*** | 8.726*** |
| | (0.0177) | (0.0179) | (0.00662) | (0.00627) |
| R-squared | 0.955 | 0.954 | 0.989 | 0.989 |
| **Panel C** | | | | |
| Policy#USAID | 0.841*** | 0.807*** | 0.212*** | 0.364*** |
| | (0.0222) | (0.0237) | (0.0105) | (0.0102) |
| Policy#HPF | 1.524*** | 1.518*** | 0.632*** | 0.785*** |
| | (0.0241) | (0.0252) | (0.0136) | (0.0113) |
| Policy = 1 | -0.313*** | -0.323*** | 0.0916*** | 0.104*** |
| | (0.0212) | (0.0226) | (0.00866) | (0.00816) |
| USAID#Low conflict | 0.314*** | 0.272*** | 0.0168 | 0.0913** |
| | (0.108) | (0.0999) | (0.0407) | (0.0438) |
| HPF#Low conflict | 0.140 | 0.110 | 0.0673 | 0.0177 |
| | (0.109) | (0.0998) | (0.0417) | (0.0437) |
| HPF#Mid conflict | -0.386*** | -0.465*** | 0.0449* | 0.0183 |
| | (0.0572) | (0.0569) | (0.0261) | (0.0243) |
| HPF#High conflict | 0.782*** | 0.763*** | 0.528*** | 0.346*** |
| | (0.118) | (0.122) | (0.0653) | (0.0518) |
| Constant | 8.235*** | 7.906*** | 9.211*** | 8.773*** |
| | (0.0165) | (0.0177) | (0.00701) | (0.00653) |
| R-squared | 0.960 | 0.964 | 0.987 | 0.987 |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 |
| Number of facility | 1,508 | 1,508 | 1,508 | 1,508 |

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

Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses

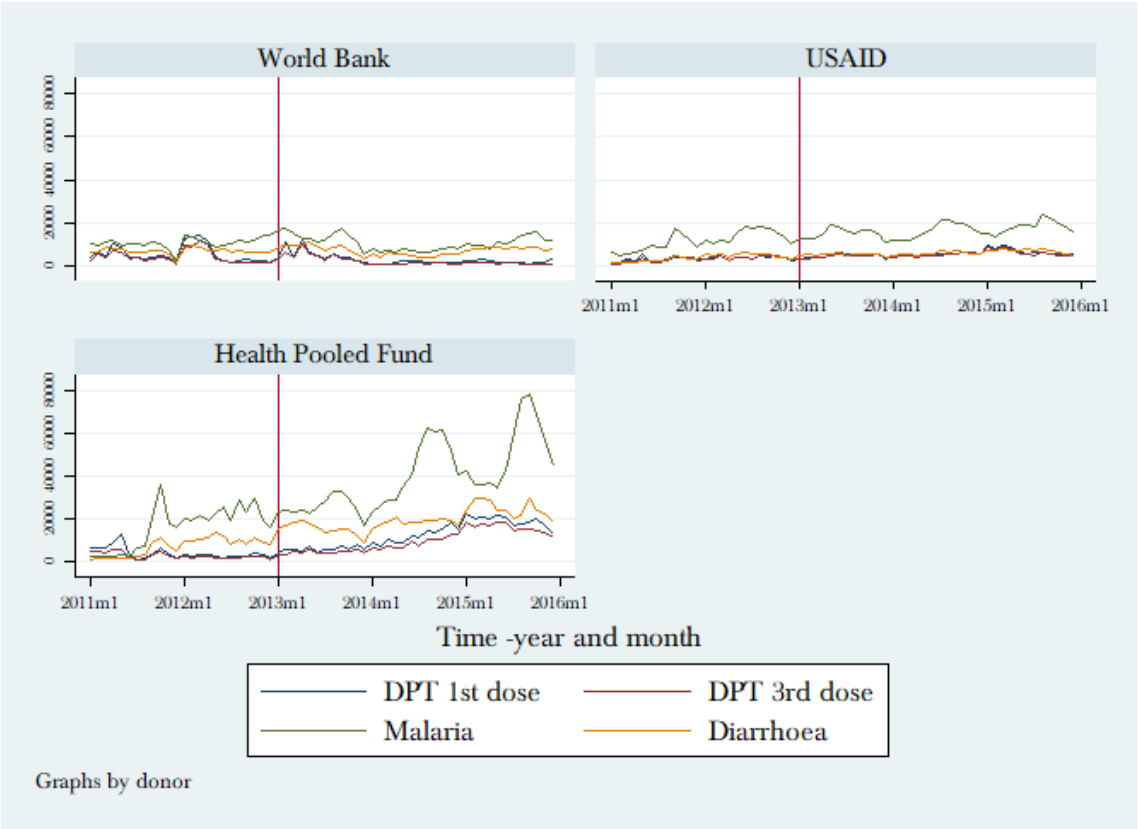


*Figure 1.8:* ***Child health indicators, by donor***

## 1.8 Conclusions

South Sudan became a signatory of the UN Millennium summit and committed to meeting MDG goals during the period 2010-2015. However, due to lack of nationally representative survey data, there has been limited information on the country's progress to date. The analysis sought to illuminate trends in maternal and child health indicators, using select global indicators for child and maternal health and the Ministry of Health's priority indicators.

Between 2011-2015, mean monthly ANC 1st visits increased by 3,357 visits and ANC 4th visits by 1,080 ($p<0.01$), whereas monthly deliveries at health facilities increased by a mere 481.2 on average from their already low 2011 baseline. There is noticeable drop-off in the number of women who complete ANC 4th visits compared to the number who have their first ANC visit. Thus, while ANC 1st visits were increasing, the proportion of pregnant women completing the recommended 4 ANC visits does not increase in a similar

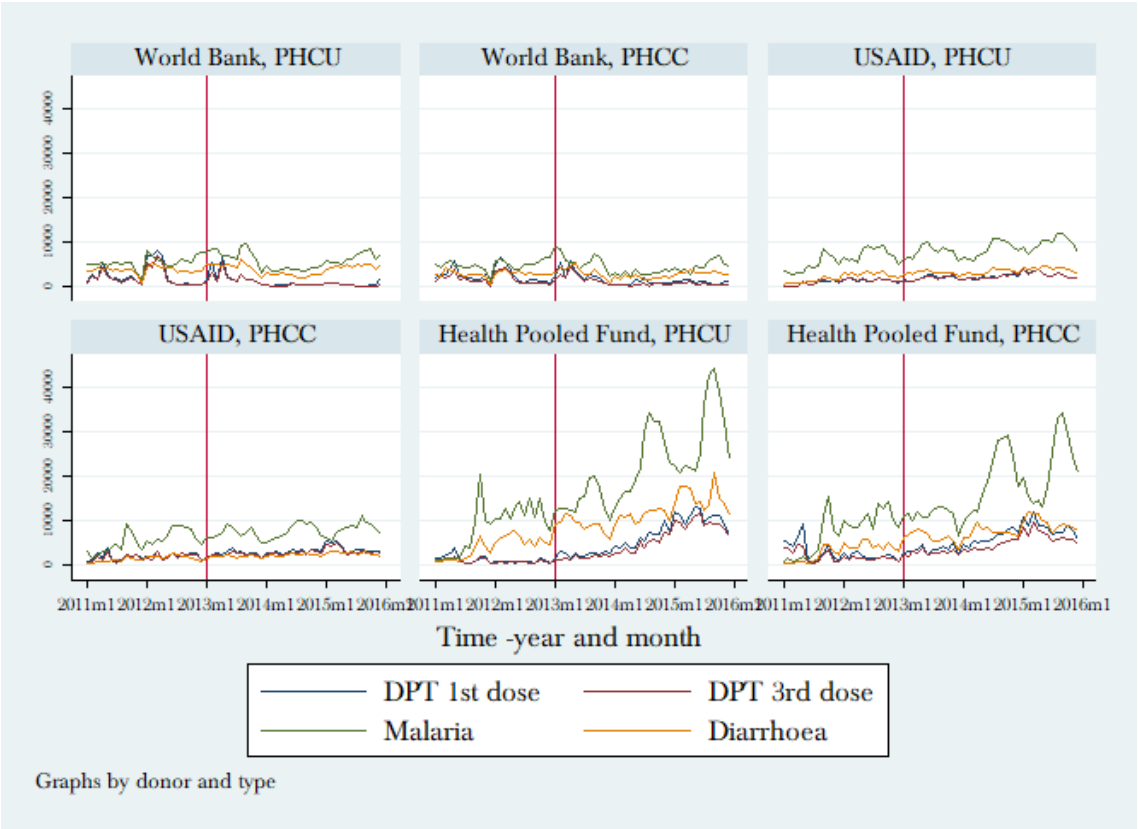


*Figure 1.9:* ***Child health indicators, by donor and facility type.***

rate and thus ANC 1st and ANC 4th visits are in fact diverging during that period. This may mean that while health facilities successfully attract women for their first visit, they are less successful in retaining women for care or encouraging facility delivery. This has negative implications for efforts to reduce maternal mortality.

Nationally, women appear to prefer to have their 1st antenatal care visit at the PHCCs, compared to PHCUs, with mean monthly visits at PHCCs increasing by 2,177 compared to 1,214 at the PHCUs between 2011-2015. However, PHCUs tend to have a relatively higher proportion of women completing their 4th ANC visit and receiving IPT-Sp second dose compared to PHCCs both increasing monthly by 541 and 673 compared to 551 and 854 at PHCCs, respectively. This suggests that while PHCCs attract a larger share of women for their 1st antenatal care visit, they have a harder time retaining women for health services compared to PHCUs despite serving a larger catchment population and having skilled health workers compared to the PHCUs.

Overall, there is need to exert additional efforts to increase health facility contacts

among pregnant women. This could be achieved by introducing incentives e.g. voucher schemes for individual women and by improving the quality of ANC 1st visits to encourage further health facility visits. Given that PHCUs are better at encouraging additional contacts with the health facility, this also suggests that provision of skilled birth attendants and increasing the capacity of PHCUs to provide delivery services may be a successful strategy in increasing health facility deliveries and thus reducing the overall maternal mortality ratio.

Child health pattern of utilization differs from that of pregnant women with PHCUs seeing more children with malaria and diarrhoea compared to PHCCs. Results suggest that mothers have a stronger preference for PHCUs compared to PHCCs when it comes to malaria and diarrhoea treatment for their children, but prefer PHCCs for antenatal care and facility deliveries. While this might be due to convenience; PHCUs tend to be closer to the village than PHCCs which are primarily in more urban areas, it also indicates that there is room for improving health facility utilization among mothers, despite barriers to access to care. They are accessing the health facility to receive treatment for their children.

DPT 1st and 3rd dose are higher at the PHCCs, albeit being significantly lower than the number of children receiving treatment for malaria and diarrhoea compared to the PHCUs. The higher DPT immunization at the PHCCs might be due to the fact that vaccines are more readily available at the PHCCs due to availability of cold chain (refrigerators and cold boxes), whereas PHCUs mainly receive their supply of vaccines in cold boxes from the nearest PHCCs. Therefore, there is a missed opportunity to improve immunization rates in the country given the larger number of children already receiving treatment at the facilities. Strengthening the capacity of PHCUs to provide immunization services may result in comparable levels of increase to that of the treatment indicators. In addition, using innovative methods of vaccine delivery e.g mobile vaccination clinics, or immunization campaigns as in the World Bank sites may expand coverage overall.

The mean monthly increases in children seen for malaria is considerably higher than for diarrhoea indicative of the high burden of malaria incidence in South Sudan, however the high number of diarrhoea cases may also reflect poor accessibility to clean water and

sanitation. The gap between number of children receiving treatment, compared to the number receiving preventive services (immunization) also suggest that health facility contacts remain reactive rather than preventive, suggesting need for behavioral interventions. This is also observed in pregnant women, while women attend their first antenatal care visit, they are less likely to return to the facility for additional preventive care.

At the donor level, the World Bank sites are the most affected by conflict; both USAID and HPF have higher health facility utilization during the observation period. However, while the HPF sites have markedly higher performance relative to World Bank, USAID sites have moderately higher performance, despite having a much higher per capita funding and being in areas with less conflict relative to the World Bank sites. In fact, in presence of low level conflict, performance at World Bank sites remains comparably higher than at USAID sites. The higher gap in utilization in 2014 and 2015 for HPF provides further evidence that the effect of the policy intervention was markedly higher in the HPF sites, relative to both USAID and World Bank, but also implies that the drop in World Bank performance may be primarily due to conflict.

This difference in relative levels of improvement in health facility utilization across the three donors also suggests that contract design, and not necessarily per capita investment, matters. It may suggest that contracts require a greater degree of flexibility to accommodate for contextual factors that might have alleviated the drop in health facility utilization in presence of conflict. For example, World Bank sites seem capable of continued service delivery in presence of low level conflict relative to USAID sites which are the more peaceful and have higher per capita funding. World Bank sites also have higher performance in presence of mid-level conflict relative to the HPF sites. Health Pooled Fund sites are however, the best managed of the three, judging by health facility utilization, but it is worth noting that they also start at the lowest levels.

Of the 3 programs, the World Bank sites had the lowest per capita spending on health, and were the most conflict affected. To identify innovative ways of providing health services in presence of conflict, it may be necessary to understand the contractual modalities in the World Bank sites. Additional information on how providers operate in situations of

hardship and whether contracts take into considering the challenges of meeting performance targets is also necessary in order to further contextualize these results.

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## 1.9 Appendix

Appendix table A1 provides the 13 core indicators that the MoH uses to compare performance across the three health donor programs in South Sudan. These indicators were negotiated with the three donor partners and are selected from a comprehensive list of 56 MoH performance indicators that cover child health, maternal health and expanded program of immunization.

*Table A1:* ***MoH Core performance monitoring indicators across the 3 health programs.***

| No. | Indicator |
|---|---|
| 1. | Number and proportion of children who received DPT3 before 12 months of age. |
| 2. | Number and proportion of children who received measles vaccination before 12 months of age. |
| 3. | Number and proportion of children 6-59 months who received vitamin A supplementation. |
| 4. | Number and proportion of pregnant women receiving ANC first visit. |
| 5. | Number and proportion of pregnant women delivering in a health facility. |
| 6. | Number and proportion of outpatient visits for children under 5 years. |
| 7. | Number of Insecticide treated nets (ITNs) purchased and/or distributed. |
| 8. | Number and proportion of functional health facilities submitting standardized HMIS monthly reports within one month of the reporting month. |
| 9. | Number and proportion of health facilities with structured supervision visit using a quantified supervisory checklist (QSC) within a month before the verification visit. |
| 10. | Number and proportion of health centers with at least two skilled health workers. |
| 11. | Number and proportion of PHCCs with ten essential tracer drugs at the time of supervisory visit. |
| 12. | Average score of quality of care from QSC. |

Appendix Table A2 provides national level health facility utilization for maternal and child health indicators respectively in natural logarithm (instead of raw levels). This allows for a comparison of these results with extant findings and with the theoretical and practical advantage that the coefficients are semi-elasticities of utilization across time. The following model is estimated for each variable;

$$LogUtilization = \beta_0 + \beta_1(Policy)\beta_2(Year) + \beta_3(Population) + \beta_4(Policy * Conflict) + \epsilon$$

hence for example, for ANC 1st visit this estimates;

$$LogANC1 = \beta_0 + \beta_1(Policy)\beta_2(Year) + \beta_3(Population) + \beta_4(Policy * Conflict) + \epsilon$$

Tables A3 and A4 provide maternal and child health utilization monthly averages in the raw levels. These are provided for primary health care centers and primary health care units and allow for comparison of utilization by health facility.

*Table A2:* ***Maternal and Child Health Indicators***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|---|---|---|---|
| Year | 0.297*** | 0.175*** | 0.238*** | 0.164*** | 0.257*** | 0.256*** | 0.222*** | 0.264*** |
| | (0.00146) | (0.00127) | (0.00156) | (0.00137) | (0.00116) | (0.00106) | (0.00146) | (0.00118) |
| Conflict = Low | -0.00795 | -0.00798* | -0.0120*** | -0.00595*** | -0.0267*** | -0.0304*** | 0.0200*** | -0.0191*** |
| | (0.00601) | (0.00433) | (0.00424) | (0.00226) | (0.00693) | (0.00733) | (0.00557) | (0.00411) |
| Conflict = Mid | 0.0282*** | 0.0104** | 0.000214 | -0.00530* | -0.0702*** | -0.0786*** | 0.0394*** | -0.0208*** |
| | (0.00426) | (0.00453) | (0.00590) | (0.00272) | (0.00611) | (0.00755) | (0.00371) | (0.00588) |
| Conflict = High | 0.00804 | -0.0246*** | -0.0519*** | -0.0275*** | -0.102*** | -0.122*** | 0.00527 | -0.0520*** |
| | (0.0115) | (0.00942) | (0.00905) | (0.00820) | (0.0104) | (0.0123) | (0.0180) | (0.00986) |
| Constant | 8.895*** | 8.521*** | 8.383*** | 7.799*** | 9.148*** | 8.947*** | 10.39*** | 9.578*** |
| | (0.00465) | (0.00422) | (0.00523) | (0.00455) | (0.00405) | (0.00366) | (0.00499) | (0.00381) |
| R-squared | 0.989 | 0.987 | 0.981 | 0.985 | 0.956 | 0.967 | 0.987 | 0.988 |
| Year = 2012 | 0.603*** | 0.416*** | 0.498*** | 0.356*** | 0.176*** | 0.248*** | 0.508*** | 0.583*** |
| | (0.00386) | (0.00403) | (0.00558) | (0.00560) | (0.00847) | (0.00805) | (0.00403) | (0.00371) |
| Year = 2013 | 0.898*** | 0.636*** | 0.778*** | 0.467*** | 0.455*** | 0.496*** | 0.687*** | 0.810*** |
| | (0.00452) | (0.00468) | (0.00638) | (0.00652) | (0.00662) | (0.00633) | (0.00502) | (0.00392) |
| Year = 2014 | 1.053*** | 0.676*** | 0.842*** | 0.589*** | 0.617*** | 0.629*** | 0.894*** | 0.895*** |
| | (0.00445) | (0.00476) | (0.00650) | (0.00660) | (0.00646) | (0.00606) | (0.00534) | (0.00382) |
| Year = 2015 | 1.231*** | 0.791*** | 1.064*** | 0.739*** | 1.012*** | 1.042*** | 0.992*** | 1.158*** |
| | (0.00424) | (0.00460) | (0.00634) | (0.00647) | (0.00638) | (0.00596) | (0.00526) | (0.00361) |
| 2012#Low conflict | -0.0264*** | -0.0113 | -0.0217*** | -0.0390*** | -0.139*** | -0.167*** | 0.00692 | -0.0611*** |
| | (0.00888) | (0.00712) | (0.00788) | (0.00780) | (0.0215) | (0.0207) | (0.00865) | (0.00839) |
| 2012#Mid conflict | -0.0123 | -0.00757 | 0.0150* | 0.00667 | -0.0811*** | -0.0731*** | 0.0101 | -0.0174** |
| | (0.00847) | (0.0107) | (0.00907) | (0.0101) | (0.0177) | (0.0203) | (0.0142) | (0.00819) |
| 2013#Low conflict | 0.0120 | 0.00241 | 0.00178 | 0.00636 | -0.00820 | -0.0131 | 0.00963 | 0.0104 |
| | (0.0123) | (0.00893) | (0.00975) | (0.00933) | (0.0132) | (0.0144) | (0.00795) | (0.0133) |
| 2013#Mid conflict | -0.0104** | -0.00656 | 0.00270 | 0.0144** | 0.00723 | 0.00640 | 0.0100 | -0.0145** |
| | (0.00504) | (0.00925) | (0.00638) | (0.00617) | (0.00970) | (0.0122) | (0.00663) | (0.00565) |
| 2014#Low conflict | 0.00534 | 0.00678* | 0.00698** | 0.0123*** | -0.000418 | -0.00544 | 0.0230*** | 0.00427 |
| | (0.00341) | (0.00394) | (0.00355) | (0.00394) | (0.00520) | (0.00597) | (0.00608) | (0.00348) |
| 2014#Mid conflict | -0.0166*** | -0.0154 | -0.00745 | 0.00612 | -0.0262*** | -0.0278** | -0.00856 | -0.0164*** |
| | (0.00425) | (0.0102) | (0.00684) | (0.00563) | (0.00920) | (0.0120) | (0.00787) | (0.00557) |
| Constant | 8.737*** | 8.367*** | 8.221*** | 7.695*** | 9.208*** | 8.971*** | 10.22*** | 9.414*** |
| | (0.00422) | (0.00460) | (0.00631) | (0.00649) | (0.00650) | (0.00605) | (0.00525) | (0.00361) |
| R-squared | 0.989 | 0.988 | 0.981 | 0.986 | 0.954 | 0.966 | 0.988 | 0.987 |
| Policy | 0.661*** | 0.420*** | 0.555*** | 0.335*** | 0.583*** | 0.551*** | 0.419*** | 0.575*** |
| | (0.00378) | (0.00313) | (0.00404) | (0.00349) | (0.00315) | (0.00293) | (0.00360) | (0.00333) |
| Policy#Low conflict | -0.146*** | -0.127*** | -0.132*** | -0.0703*** | 0.0881*** | 0.0682*** | -0.127*** | -0.128*** |
| | (0.0130) | (0.00836) | (0.0109) | (0.00919) | (0.0260) | (0.0248) | (0.00898) | (0.0135) |
| Policy#Mid conflict | -0.210*** | -0.154*** | -0.200*** | -0.140*** | -0.105*** | -0.142*** | -0.150*** | -0.245*** |
| | (0.0241) | (0.0143) | (0.0165) | (0.0106) | (0.0197) | (0.0192) | (0.0254) | (0.0178) |
| Constant | 9.080*** | 8.611*** | 8.512*** | 7.914*** | 9.307*** | 9.116*** | 10.55*** | 9.747*** |
| | (0.00545) | (0.00438) | (0.00581) | (0.00495) | (0.00422) | (0.00424) | (0.00578) | (0.00485) |
| R-squared | 0.984 | 0.986 | 0.978 | 0.983 | 0.955 | 0.964 | 0.984 | 0.983 |
| Observations | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 | 53,356 |

Std errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
Prais-Winsten and Cochrane-Orcutt AR(1) regression

Tables A5 to A7 provide maternal and child health utilization for each of the three donors; the World Bank, USAID and Health Pooled Fund, standardized for the population of women of reproductive age and children under-5 years respectively.

*Table A3:* ***Maternal Health Indicators by Facility Type***

| VARIABLES | PHCU ANC1 | PHCC ANC1 | PHCU ANC4 | PHCC ANC4 | PHCU IPT2 | PHCC IPT2 | PHCU Delivery | PHCC Delivery |
|---|---|---|---|---|---|---|---|---|
| **Panel A** | | | | | | | | |
| Year | 1,214*** | 2,177*** | 540.7*** | 550.6*** | 673.4*** | 854.0*** | 136.8*** | 348.4*** |
| | (4.164) | (10.46) | (2.956) | (6.995) | (3.079) | (8.714) | (1.898) | (2.850) |
| conflict = low | -107.3*** | -111.4* | -96.19*** | -19.32 | -123.5*** | 11.47 | -67.47*** | 21.25 |
| | (26.24) | (62.43) | (18.36) | (38.37) | (18.50) | (52.85) | (10.72) | (15.79) |
| conflict = mid | -159.5*** | -105.0 | -114.2*** | -109.5** | -294.6*** | -316.7*** | -112.2*** | -22.72 |
| | (31.02) | (72.02) | (21.31) | (47.90) | (20.94) | (60.95) | (13.63) | (19.73) |
| conflict = high | -297.5*** | -365.2** | -227.5*** | -245.2** | -440.6*** | -585.9*** | -167.9*** | -78.96* |
| | (90.48) | (154.4) | (60.11) | (105.2) | (59.51) | (121.2) | (38.74) | (41.97) |
| Constant | 2,875*** | 4,960*** | 2,051*** | 3,299*** | 1,687*** | 2,993*** | 1,204*** | 1,379*** |
| | (13.67) | (32.72) | (9.709) | (22.11) | (10.24) | (26.81) | (6.084) | (8.606) |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.740 | 0.826 | 0.624 | 0.677 | 0.716 | 0.582 | 0.538 | 0.740 |
| Number of facility | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 |
| **Panel B** | | | | | | | | |
| Year = 2012 | 1,538*** | 3,448*** | 800.3*** | 1,152*** | 835.6*** | 1,107*** | 179.0*** | 441.3*** |
| | (17.72) | (43.85) | (11.56) | (30.53) | (11.29) | (34.55) | (8.154) | (11.65) |
| Year = 2013 | 3,198*** | 5,659*** | 1,844*** | 1,678*** | 1,817*** | 1,931*** | 260.8*** | 629.3*** |
| | (17.58) | (43.32) | (11.43) | (30.70) | (11.30) | (33.84) | (7.987) | (11.80) |
| Year = 2014 | 3,724*** | 7,055*** | 1,716*** | 1,839*** | 1,738*** | 2,103*** | 221.8*** | 998.9*** |
| | (17.83) | (43.82) | (11.61) | (31.00) | (11.38) | (34.08) | (8.069) | (12.08) |
| Year = 2015 | 5,129*** | 9,403*** | 2,404*** | 2,540*** | 2,940*** | 3,749*** | 615.8*** | 1,454*** |
| | (17.64) | (43.32) | (11.56) | (30.47) | (11.18) | (33.77) | (8.043) | (12.08) |
| Population | 4.08e-05 | 0.000166* | 4.97e-05 | 0.000219*** | 4.95e-05* | 0.000168** | 4.74e-05** | 7.75e-05*** |
| | (4.76e-05) | (9.86e-05) | (3.12e-05) | (6.51e-05) | (2.92e-05) | (7.01e-05) | (1.97e-05) | (2.56e-05) |
| conflict = low | -6.664 | -1.675 | 2.211 | 22.73 | 10.24 | 7.478 | -21.91** | 9.605 |
| | (24.20) | (58.30) | (15.87) | (36.82) | (14.33) | (40.47) | (9.130) | (14.67) |
| conflict = mid | -30.10 | -14.75 | -7.465 | -23.36 | -19.48 | -11.72 | 3.267 | 3.787 |
| | (29.47) | (69.18) | (19.08) | (48.25) | (17.70) | (53.45) | (12.58) | (18.97) |
| conflict = high | -35.09 | -73.25 | -3.767 | -77.46 | -12.26 | -47.97 | -2.931 | -33.45 |
| | (91.37) | (140.2) | (59.27) | (100.9) | (57.18) | (115.2) | (37.19) | (40.82) |
| Constant | 2,557*** | 4,158*** | 1,762*** | 2,942*** | 1,539*** | 2,885*** | 1,215*** | 1,372*** |
| | (16.20) | (37.86) | (10.57) | (26.97) | (10.45) | (30.04) | (7.575) | (10.52) |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.766 | 0.837 | 0.671 | 0.680 | 0.783 | 0.611 | 0.541 | 0.761 |
| Number of facility | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 |
| **Panel C** | | | | | | | | |
| Policy | 2,943*** | 5,193*** | 1,495*** | 1,310*** | 1,564*** | 1,924*** | 270.5*** | 670.1*** |
| | (18.32) | (53.21) | (9.714) | (22.87) | (11.76) | (32.87) | (5.833) | (11.16) |
| conflict - Low | 409.2*** | 1,619*** | 170.7*** | 750.5*** | 301.5*** | 524.9** | -116.5*** | 310.4*** |
| | (87.82) | (544.5) | (47.10) | (226.0) | (53.77) | (264.0) | (23.64) | (102.0) |
| conflict - Mid | 451.8** | 1,336*** | 306.0*** | 421.2*** | 291.7** | 457.7*** | 47.86 | 171.1*** |
| | (187.2) | (271.2) | (105.2) | (139.5) | (123.0) | (175.5) | (69.64) | (59.27) |
| conflict - High | -199.4 | -233.3 | -240.2*** | -230.6* | -322.1*** | -434.1*** | -131.3*** | 10.47 |
| | (135.6) | (261.2) | (74.24) | (119.3) | (80.68) | (160.5) | (43.00) | (55.53) |
| policy#low conflict | -169.7* | -481.4 | -131.9** | -455.9** | -202.9*** | 139.6 | 122.2*** | -52.03 |
| | (96.95) | (554.1) | (52.49) | (230.2) | (59.71) | (272.2) | (27.04) | (104.2) |
| policy#mid conflict | -797.1*** | -1,848*** | -520.5*** | -616.9*** | -624.8*** | -867.1*** | -161.0** | -247.3*** |
| | (191.3) | (300.9) | (107.6) | (149.9) | (125.3) | (193.1) | (70.97) | (64.78) |
| Constant | 3,566*** | 6,247*** | 2,259*** | 3,690*** | 2,101*** | 3,550*** | 1,328*** | 1,680*** |
| | (15.28) | (43.78) | (8.128) | (19.04) | (9.788) | (26.68) | (4.910) | (9.283) |
| Observations | 39,595 | 14,049 | 39,595 | 14,049 | 39,595 | 14,049 | 39,595 | 14,049 |
| R-squared | 0.635 | 0.592 | 0.628 | 0.591 | 0.621 | 0.505 | 0.515 | 0.623 |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.743 | 0.827 | 0.636 | 0.677 | 0.716 | 0.584 | 0.524 | 0.750 |
| Number of facility | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 |

Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table A4:* ***Child Health Indicators by Facility Type***

| VARIABLES | PHCU DPT1 | PHCC DPT1 | PHCU DPT3 | PHCC DPT3 | PHCU malaria | PHCC malaria | PHCU diarrhoea | PHCC diarrhoea |
|---|---|---|---|---|---|---|---|---|
| Year | 2,536*** | 1,588*** | 2,152*** | 1,294*** | 6,324*** | 4,672*** | 3,746*** | 2,258*** |
| | (14.68) | (25.35) | (13.49) | (19.12) | (49.97) | (72.58) | (14.31) | (18.78) |
| conflict = low | -348.6*** | 231.0* | -177.2** | 121.4 | 661.2** | 189.1 | -560.1*** | -198.4* |
| | (90.09) | (139.1) | (82.10) | (110.8) | (282.9) | (400.8) | (93.77) | (112.3) |
| conflict = mid | -1,517*** | -988.9*** | -1,357*** | -841.1*** | 462.7 | 417.9 | -1,664*** | -642.6*** |
| | (108.7) | (176.2) | (96.04) | (129.3) | (328.0) | (440.6) | (100.5) | (130.1) |
| conflict = high | -2,072*** | -1,076*** | -1,911*** | -1,095*** | -169.4 | -969.5 | -2,115*** | -1,211*** |
| | (316.7) | (376.1) | (268.8) | (252.5) | (1,003) | (986.3) | (281.0) | (238.4) |
| Constant | 2,856*** | 6,358*** | 2,529*** | 4,805*** | 17,804*** | 15,327*** | 8,275*** | 6,353*** |
| | (49.23) | (76.91) | (45.15) | (57.93) | (151.9) | (212.1) | (47.49) | (58.39) |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.519 | 0.352 | 0.491 | 0.389 | 0.536 | 0.465 | 0.748 | 0.611 |
| Year = 2012 | 1,716*** | -409.3*** | 1,604*** | 207.5*** | 8,618*** | 8,224*** | 5,296*** | 3,766*** |
| | (56.03) | (101.4) | (46.91) | (72.64) | (180.4) | (251.3) | (53.02) | (71.01) |
| Year = 2013 | 2,889*** | 1,296*** | 2,290*** | 1,634*** | 14,145*** | 11,569*** | 9,296*** | 5,923*** |
| | (53.81) | (100.3) | (45.88) | (72.95) | (190.5) | (264.8) | (52.29) | (72.43) |
| Year = 2014 | 4,471*** | 2,332*** | 3,674*** | 1,983*** | 20,956*** | 16,014*** | 9,970*** | 6,370*** |
| | (54.78) | (103.3) | (46.84) | (75.69) | (202.7) | (293.3) | (52.57) | (73.97) |
| Year = 2015 | 10,209*** | 6,000*** | 8,866*** | 5,163*** | 26,212*** | 19,758*** | 16,261*** | 9,896*** |
| | (53.56) | (102.8) | (45.92) | (75.41) | (210.9) | (299.5) | (51.67) | (73.17) |
| conflict = low | -32.42 | 8.249 | 21.41 | 9.159 | 498.8* | 499.6 | -20.08 | -52.59 |
| | (74.16) | (129.2) | (66.42) | (102.0) | (283.8) | (400.5) | (74.10) | (101.4) |
| conflict = mid | -63.44 | -133.3 | -8.517 | -65.57 | -15.05 | -74.02 | -130.5 | -16.49 |
| | (92.13) | (163.0) | (79.98) | (119.2) | (330.2) | (439.7) | (85.49) | (120.6) |
| conflict = high | -209.0 | -22.05 | -216.3 | -26.94 | -851.3 | -1,113 | -94.58 | -115.6 |
| | (286.9) | (346.4) | (242.2) | (240.3) | (997.2) | (973.5) | (274.0) | (227.1) |
| Constant | 4,048*** | 7,631*** | 3,478*** | 5,496*** | 16,496*** | 13,585*** | 7,505*** | 5,592*** |
| | (49.89) | (88.13) | (42.28) | (63.84) | (180.6) | (242.7) | (47.61) | (62.70) |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.631 | 0.385 | 0.616 | 0.422 | 0.539 | 0.476 | 0.804 | 0.635 |
| Facilities | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 |
| Policy | 4,239*** | 3,198*** | 3,292*** | 2,633*** | 12,567*** | 9,010*** | 8,358*** | 4,924*** |
| | (59.03) | (81.59) | (52.27) | (60.65) | (158.1) | (214.6) | (63.45) | (68.82) |
| conflict = low | 731.2*** | -417.4 | 870.5*** | -380.2 | 4,725*** | 4,277** | 1,526*** | 1,203* |
| | (283.3) | (819.0) | (241.2) | (633.0) | (725.3) | (2,107) | (316.5) | (702.7) |
| conflict = mid | 311.0 | -363.7 | 219.3 | 3.794 | 3,010** | 3,623*** | 1,561*** | 1,586*** |
| | (608.2) | (458.6) | (482.2) | (312.2) | (1,499) | (1,004) | (575.0) | (354.1) |
| conflict = high | -1,823*** | -822.0** | -1,680*** | -887.2*** | 618.6 | -300.9 | -1,375*** | -915.6*** |
| | (401.1) | (376.3) | (331.0) | (247.4) | (1,113) | (1,179) | (465.7) | (292.2) |
| Policy#low | -231.1 | 1,631* | -332.8 | 1,261* | -2,409*** | -1,848 | -884.6** | -224.6 |
| | (314.6) | (835.3) | (268.9) | (645.8) | (802.0) | (2,152) | (350.6) | (716.4) |
| Policy#mid | -2,239*** | -926.9* | -1,871*** | -1,092*** | -3,516** | -4,184*** | -3,337*** | -2,555*** |
| | (619.0) | (499.5) | (491.7) | (343.3) | (1,526) | (1,099) | (590.3) | (388.7) |
| Constant | 5,252*** | 7,488*** | 4,691*** | 5,677*** | 22,575*** | 18,456*** | 10,646*** | 7,721*** |
| | (66.57) | (83.82) | (60.34) | (63.03) | (180.5) | (233.9) | (71.34) | (72.00) |
| Observations | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 | 39,436 | 13,920 |
| R-squared | 0.258 | 0.280 | 0.269 | 0.323 | 0.471 | 0.396 | 0.540 | 0.489 |
| Number of facility | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 | 1,154 | 354 |

Prais-Winsten regression, heteroskedastic panels corrected standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table A5:* ***Maternal and Child Health Indicators - World Bank***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|---|---|---|---|
| Year = 2012 | 135.8*** | 33.00 | 116.2*** | 7.257 | 65.07 | 105.8 | 176.3 | 52.68 |
| | (49.70) | (31.69) | (29.41) | (17.71) | (238.9) | (186.5) | (180.7) | (121.8) |
| Year = 2013 | 359.8*** | 99.96*** | 191.7*** | 27.20 | 128.5 | 186.4 | 640.6*** | 163.8 |
| | (55.43) | (35.40) | (32.61) | (17.86) | (250.9) | (199.9) | (191.9) | (129.7) |
| Year = 2014 | -85.43 | -154.0*** | -46.36 | -98.08** | -607.1 | -438.4 | -617.0* | -495.9** |
| | (78.62) | (50.95) | (46.48) | (40.26) | (434.7) | (323.1) | (325.0) | (215.8) |
| Year = 2015 | 31.95 | -131.1** | -29.42 | 25.57 | 31.47 | -15.54 | 111.7 | 367.7* |
| | (86.75) | (56.39) | (50.41) | (62.34) | (434.2) | (321.1) | (507.5) | (216.8) |
| conflict = low | 36.42 | 57.23 | 100.00*** | 104.9*** | 150.9 | 159.6 | -52.13 | -33.24 |
| | (62.57) | (41.17) | (35.69) | (28.93) | (288.1) | (204.4) | (236.1) | (145.8) |
| conflict = mid | -48.48 | 12.30 | -135.4** | -85.63 | 244.3 | -403.2 | -236.4 | -294.3 |
| | (108.2) | (70.92) | (61.99) | (55.31) | (552.1) | (357.9) | (428.6) | (253.1) |
| conflict = high | -35.27 | 13.69 | 2.218 | -5.163 | -497.5* | -414.6** | -715.4*** | -492.7*** |
| | (64.18) | (42.09) | (36.64) | (29.18) | (293.8) | (208.4) | (242.5) | (148.6) |
| 2012#low conflict | -112.5 | -85.61* | -154.6*** | -119.4*** | 280.9 | 41.42 | 130.8 | 52.49 |
| | (78.13) | (51.28) | (44.59) | (34.91) | (356.2) | (253.2) | (293.2) | (180.2) |
| 2012#high conflict | -48.07 | -51.35 | -43.69 | 21.61 | 1,452*** | 1,188*** | 1,603*** | 748.3*** |
| | (92.58) | (61.29) | (53.28) | (47.51) | (460.7) | (330.7) | (358.2) | (233.4) |
| 2013#low conflict | -246.7*** | -152.4*** | -202.0*** | -160.8*** | 0.420 | -120.5 | -336.0 | -68.84 |
| | (82.79) | (54.19) | (46.86) | (34.58) | (346.8) | (245.0) | (299.6) | (177.8) |
| 2013#mid conflict | -161.2 | -123.6 | | | | 573.9 | | 84.58 |
| | (152.0) | (99.67) | | | | (534.5) | | (375.6) |
| 2013#high conflict | -313.0*** | -154.2*** | -159.2*** | -72.26* | 189.2 | 17.26 | 25.07 | 160.0 |
| | (88.78) | (57.94) | (50.70) | (38.13) | (392.4) | (279.9) | (329.1) | (200.0) |
| 2014#low conflict | -50.22 | -36.88 | -73.56 | -101.3** | -108.9 | -189.4 | 169.0 | 167.2 |
| | (97.28) | (64.22) | (56.02) | (49.42) | (486.6) | (348.7) | (380.3) | (245.3) |
| 2014#mid conflict | -16.04 | -6.595 | 142.6* | 99.15 | -248.6 | 361.0 | 172.6 | 358.5 |
| | (135.8) | (88.99) | (78.24) | (69.74) | (700.2) | (473.4) | (542.5) | (332.4) |
| 2014#high conflict | 34.35 | 0.754 | 18.20 | 15.92 | 599.9 | 455.4 | 804.2** | 568.6** |
| | (98.28) | (64.75) | (56.65) | (49.79) | (491.2) | (351.7) | (384.9) | (247.6) |
| 2015#low conflict | -61.74 | -23.88 | -67.48 | -199.0*** | -680.5 | -573.1* | -172.8 | -404.0* |
| | (94.52) | (62.76) | (53.98) | (68.18) | (453.1) | (322.8) | (545.9) | (229.4) |
| 2015#mid conflict | | | 131.9 | | -788.7 | | | |
| | | | (87.65) | | (744.3) | | | |
| 2015#high conflict | | | | -97.86 | | | 374.5 | |
| | | | | (73.10) | | | (588.7) | |
| Constant | 429.6*** | 271.2*** | 197.2*** | 162.6*** | 811.6*** | 615.6*** | 1,924*** | 1,307*** |
| | (33.00) | (20.77) | (19.85) | (12.22) | (174.5) | (139.9) | (126.6) | (87.30) |
| R-squared | 0.581 | 0.505 | 0.537 | 0.415 | 0.241 | 0.280 | 0.533 | 0.307 |
| policy | 40.77 | -64.88** | -0.158 | -49.75** | -468.6** | -359.9** | -187.7 | -118.0 |
| | (42.10) | (27.86) | (27.18) | (21.36) | (202.0) | (163.3) | (198.7) | (116.6) |
| conflict = low | -37.33 | -8.129 | 0.292 | -7.407 | 170.8 | 72.75 | -62.89 | -27.41 |
| | (28.21) | (18.24) | (16.22) | (10.33) | (129.8) | (95.23) | (109.3) | (63.53) |
| conflict = mid | -95.82** | -30.93 | -32.27 | -6.419 | 55.20 | 8.907 | -208.6 | -81.92 |
| | (45.00) | (29.11) | (26.03) | (17.81) | (219.2) | (162.5) | (185.0) | (107.7) |
| conflict = high | -75.72** | -21.25 | -22.30 | -17.26 | 4.796 | -60.49 | -210.1 | -163.7** |
| | (32.79) | (21.24) | (19.00) | (13.49) | (166.0) | (123.1) | (139.2) | (81.05) |
| Constant | 438.2*** | 275.7*** | 226.6*** | 166.1*** | 897.1*** | 714.2*** | 2,104*** | 1,362*** |
| | (35.14) | (22.74) | (22.40) | (17.85) | (158.6) | (131.3) | (161.3) | (95.27) |
| R-squared | | 0.121 | 0.059 | 0.105 | 0.065 | 0.071 | 0.105 | 0.167 |
| Number of State | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Observations | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table A6:* ***Maternal and Child Health Indicators - USAID***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|---|---|---|---|
| Year = 2012 | 262.8*** | 263.5*** | 222.1*** | 84.33*** | 146.7 | 203.8 | 962.4** | 927.3*** |
| | (63.19) | (68.95) | (42.10) | (26.19) | (175.1) | (178.3) | (465.8) | (231.6) |
| Year = 2013 | 456.2*** | 320.1*** | 273.4*** | 109.4*** | 356.1* | 376.1** | 1,415*** | 1,160*** |
| | (66.82) | (71.74) | (44.32) | (28.15) | (182.8) | (188.0) | (516.4) | (258.6) |
| Year = 2014 | 485.0*** | 289.4*** | 290.4*** | 126.9*** | 571.3*** | 559.2*** | 1,563*** | 1,193*** |
| | (73.44) | (80.71) | (49.00) | (30.56) | (203.8) | (206.3) | (562.5) | (282.0) |
| Year = 2015 | 539.7*** | 183.9* | 399.9*** | 176.1*** | 924.0*** | 832.2*** | 1,508** | 1,314*** |
| | (90.20) | (110.0) | (57.97) | (36.81) | (278.9) | (260.4) | (639.9) | (325.3) |
| conflict = low | 124.2 | 58.72 | 117.4 | 40.24 | -19.16 | 43.70 | -161.8 | 392.3 |
| | (107.1) | (121.3) | (78.67) | (34.92) | (269.0) | (267.3) | (607.0) | (251.1) |
| conflict = mid | 61.37 | 254.3** | 66.10 | 2.751 | -419.7 | 149.8 | -160.5 | -122.9 |
| | (94.10) | (128.0) | (63.10) | (33.51) | (311.6) | (261.1) | (575.1) | (230.6) |
| conflict = high | -232.9** | -174.5 | -53.44 | -11.48 | -288.5 | -236.1 | -485.5 | -221.7 |
| | (107.2) | (121.7) | (78.70) | (34.83) | (270.1) | (267.3) | (604.3) | (249.3) |
| 2012#low conflict | -142.6 | -93.32 | -195.0** | -59.71 | 221.7 | 140.3 | 339.8 | -425.0 |
| | (124.9) | (141.7) | (91.33) | (40.83) | (316.4) | (312.4) | (704.5) | (291.4) |
| 2013#low conflict | -137.7 | -97.76 | -124.3 | -52.81 | 152.9 | 63.90 | 180.9 | -434.5 |
| | (117.1) | (133.8) | (85.59) | (38.34) | (299.4) | (293.8) | (660.7) | (274.9) |
| 2014#low conflict | -101.0 | -98.07 | -104.5 | -56.50 | -169.8 | -203.4 | 55.23 | -502.4* |
| | (116.3) | (134.8) | (84.54) | (38.42) | (304.3) | (295.1) | (656.0) | (276.5) |
| 2014#mid conflict | 26.41 | -278.0 | -77.33 | | 417.7 | | | |
| | (141.4) | (176.3) | (100.0) | | (410.8) | | | |
| 2015#low conflict | -29.82 | 61.09 | -67.48 | -51.44 | -48.37 | -60.34 | 181.5 | -356.6 |
| | (126.6) | (154.3) | (90.04) | (43.09) | (357.7) | (335.0) | (713.7) | (314.8) |
| 2015#mid conflict | | | | 60.41 | | -452.5 | 89.94 | 257.4 |
| | | | | (47.74) | | (376.1) | (773.9) | (340.6) |
| Constant | 363.8*** | 274.8*** | 210.5*** | 136.4*** | 704.2*** | 588.7*** | 2,554*** | 517.5*** |
| | (47.17) | (49.65) | (31.56) | (20.39) | (126.4) | (133.5) | (388.8) | (197.9) |
| R-squared | 0.491 | 0.177 | 0.420 | 0.163 | 0.189 | 0.129 | 0.066 | 0.180 |
| policy | 352.9*** | 176.7*** | 188.7*** | 84.03*** | 414.5*** | 370.8*** | 690.8* | 520.6** |
| | (51.84) | (60.71) | (41.73) | (24.51) | (129.0) | (135.0) | (396.5) | (210.2) |
| conflict = low | 33.06 | -23.04 | 7.270 | -7.376 | 45.77 | 42.51 | -5.282 | -10.34 |
| | (25.61) | (29.39) | (17.81) | (8.017) | (76.11) | (68.06) | (132.7) | (53.83) |
| conflict = mid | 39.36 | 56.86 | 20.53 | 48.65** | -157.3 | -69.09 | -84.89 | 54.84 |
| | (66.73) | (75.68) | (46.75) | (20.35) | (195.5) | (175.7) | (341.3) | (132.6) |
| conflict = high | -249.1** | -142.7 | -67.14 | -9.100 | -328.1 | -252.4 | -473.1 | -149.9 |
| | (108.8) | (108.2) | (81.79) | (28.30) | (267.2) | (256.8) | (536.5) | (139.2) |
| Constant | 512.4*** | 391.5*** | 354.0*** | 172.7*** | 825.4*** | 743.9*** | 3,154*** | 998.1*** |
| | (41.50) | (48.61) | (34.50) | (21.93) | (99.92) | (107.4) | (354.3) | (226.1) |
| R-squared | 0.385 | 0.028 | 0.167 | 0.050 | 0.093 | 0.031 | 0.002 | |
| Number of State | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Observations | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Table A7:* ***Maternal and Child Health Indicators - HPF***

| VARIABLES | ANC1 | ANC4 | IPT2 | Delivery | DPT1 | DPT3 | Malaria | Diarrhoea |
|---|---|---|---|---|---|---|---|---|
| Year = 2012 | 332.2*** | 118.9*** | 80.68 | 36.44** | -174.9 | -61.32 | 764.7** | 504.0*** |
| | (67.03) | (43.82) | (56.84) | (16.83) | (114.9) | (82.11) | (368.6) | (128.4) |
| Year = 2013 | 544.5*** | 203.4*** | 197.9*** | 78.86*** | 29.36 | 85.50 | 1,056** | 953.3*** |
| | (79.17) | (50.50) | (67.65) | (18.02) | (130.5) | (94.93) | (427.5) | (147.8) |
| Year = 2014 | 804.2*** | 248.3*** | 242.5*** | 115.5*** | 522.8*** | 421.5*** | 2,026*** | 1,277*** |
| | (88.83) | (60.16) | (72.14) | (19.99) | (142.7) | (103.9) | (481.7) | (164.9) |
| Year = 2015 | 893.3*** | 309.5*** | 340.2*** | 139.2*** | 972.2*** | 830.4*** | 2,616*** | 1,786*** |
| | (93.79) | (60.91) | (76.63) | (20.17) | (148.8) | (107.7) | (511.4) | (168.6) |
| conflict = low | -255.5** | -199.7* | -61.08 | 44.24 | -119.3 | -64.50 | -310.7 | -298.4 |
| | (126.9) | (118.5) | (100.1) | (35.45) | (189.0) | (137.8) | (605.5) | (290.6) |
| conflict = mid | -107.0 | -95.22 | -60.46 | 10.80 | 549.3** | 355.5** | 357.6 | 56.49 |
| | (153.4) | (113.8) | (111.9) | (46.54) | (263.7) | (180.1) | (523.7) | (393.4) |
| conflict = high | 161.2 | 22.05 | -19.24 | 9.699 | 289.1 | -49.61 | -80.96 | -51.56 |
| | (153.4) | (70.55) | (111.9) | (27.74) | (201.9) | (140.8) | (475.7) | (271.7) |
| 2012#low conflict | 153.9 | 131.1 | -8.198 | -35.57 | 86.08 | 19.91 | -5.783 | 345.6 |
| | (136.4) | (122.5) | (107.2) | (38.32) | (214.0) | (153.7) | (658.6) | (307.3) |
| 2012#mid conflict | 127.1 | 179.6 | -45.48 | -63.98 | -481.3 | -276.4 | -359.9 | -358.1 |
| | (197.0) | (156.0) | (198.2) | (56.35) | (334.8) | (235.2) | (826.9) | (485.4) |
| 2012#high conflict | | -20.22 | | 2.595 | -351.7 | -48.44 | 50.47 | -116.2 |
| | | (133.7) | | (54.17) | (332.1) | (228.6) | (706.2) | (477.8) |
| 2013#low conflict | 279.2** | 214.3* | 75.68 | -45.94 | 124.0 | 73.95 | 172.5 | 358.4 |
| | (133.8) | (122.9) | (106.6) | (37.49) | (206.0) | (150.6) | (641.2) | (304.1) |
| 2013#mid conflict | -114.4 | 152.5 | -54.86 | 10.02 | -830.3** | -520.4** | -347.4 | 67.20 |
| | (199.0) | (133.2) | (130.6) | (58.56) | (375.2) | (244.5) | (921.9) | (438.6) |
| 2013#high conflict | -242.6 | | -3.076 | | | | | |
| | (186.8) | | (188.6) | | | | | |
| 2014#low conflict | 191.3 | 251.9** | 93.65 | -37.48 | 69.48 | 17.28 | 116.6 | 245.5 |
| | (136.3) | (124.9) | (110.4) | (37.97) | (211.1) | (154.3) | (656.4) | (308.6) |
| 2014#mid conflict | -49.35 | 101.8 | 65.36 | -16.06 | -723.5** | -456.0** | -846.6 | -243.3 |
| | (167.5) | (123.1) | (131.8) | (51.06) | (295.8) | (201.0) | (669.4) | (418.2) |
| 2014#high conflict | -274.8 | -21.69 | -23.06 | -9.527 | -466.9** | -89.27 | -405.3 | 66.46 |
| | (168.9) | (87.78) | (128.5) | (33.02) | (226.6) | (158.4) | (565.7) | (302.8) |
| 2015#low conflict | 191.4 | 213.3* | 38.32 | -50.31 | 72.01 | -7.413 | -210.7 | 143.7 |
| | (137.0) | (125.3) | (110.2) | (37.84) | (211.4) | (154.5) | (659.9) | (307.6) |
| 2015#mid conflict | -72.26 | -18.49 | 21.77 | -25.19 | -553.1* | -378.8* | -1,169 | -492.2 |
| | (183.4) | (131.3) | (134.2) | (58.14) | (333.5) | (221.3) | (859.7) | (442.4) |
| 2015#high conflict | -194.2 | -40.30 | -11.96 | -7.907 | -247.5 | -10.10 | -654.1 | -509.4 |
| | (174.6) | (89.59) | (142.1) | (36.50) | (257.4) | (178.4) | (639.6) | (331.3) |
| Constant | 235.7*** | 131.6*** | 195.1*** | 59.08*** | 471.3*** | 304.2*** | 1,386*** | 414.9*** |
| | (59.48) | (36.42) | (47.49) | (13.21) | (91.47) | (66.51) | (328.5) | (108.9) |
| R-squared | 0.395 | 0.166 | 0.242 | 0.133 | 0.254 | 0.262 | 0.105 | 0.337 |
| policy | 440.4*** | 180.9*** | 230.5*** | 79.85*** | 376.9*** | 274.4*** | 892.6** | 893.7*** |
| | (59.28) | (40.67) | (51.28) | (14.31) | (110.4) | (79.62) | (351.8) | (119.2) |
| conflict = low | -24.80 | 2.962 | -2.239 | 7.085 | 13.57 | -10.52 | -169.8 | 12.28 |
| | (24.27) | (17.92) | (20.24) | (6.277) | (42.90) | (30.92) | (114.3) | (50.89) |
| conflict = mid | -108.9** | -10.87 | -35.48 | -4.254 | -21.27 | -16.50 | -174.1 | -158.7* |
| | (43.02) | (28.27) | (37.98) | (13.11) | (83.18) | (53.37) | (251.6) | (90.04) |
| conflict = high | -15.74 | -2.698 | -27.87 | 8.444 | 22.36 | -57.19 | -222.0 | -94.57 |
| | (44.20) | (31.46) | (41.85) | (12.48) | (76.96) | (51.66) | (212.6) | (106.1) |
| Constant | 513.7*** | 205.5*** | 250.2*** | 81.43*** | 499.6*** | 387.6*** | 2,046*** | 751.8*** |
| | (51.41) | (35.09) | (43.69) | (12.08) | (96.57) | (71.00) | (332.6) | (103.2) |
| R-squared | 0.402 | 0.084 | 0.247 | 0.053 | 0.045 | 0.070 | 0.023 | 0.169 |
| Number of State | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Observations | 353 | 353 | 353 | 353 | 353 | 353 | 353 | 353 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

# Paper 2: Does contracting-out of primary health care services to Non-State Providers reduce child mortality in South Sudan? A synthetic control analysis

**Abstract**

Contracting-out is increasingly utilized as a health system strengthening strategy to expand access health interventions known to reduce child mortality in lower- and middle-income countries (LMICs). Existing scholarship suggest its effect has been mixed, limiting a definitive conclusion on its magnitude and direction. Few evaluations of the large-scale interventions in Sub-Saharan Africa have been done to date. . I test the hypothesis that the contracting-out approach led to reductions in U5MR, using a novel approach to construct a synthetic South Sudan from a panel of LMICs, and using data from the World Bank Developmental Indicators (WDI) database. The analysis shows that on average, contracting out had a negative effect on the rate of decline of U5MR; between 2000 and 2010, U5MR declined by 5.22% annually, prior to declining by 4.67% in 2011 and by 2.58% annually between 2012 and 2016. These findings suggest limitations in the contracting approach implemented in South Sudan and I discuss the possible policy implications of these findings.

**Keywords**— Synthetic Control; Under-five mortality; Conflict-affected settings; Lower-and-middle-income countries; South Sudan

## 2.1 Introduction

The under-five mortality rate (U5MR), is a core indicator of the social, economic and environmental conditions of children, and the quality of a country's healthcare overall (UNIGME, 2011). The U5MR was a key indicator of progress in the 2000 United Nations (UN) Millennium Declaration where 189 heads of state committed to reducing child mortality by two-thirds from their 1990 baseline by 2015. It remains a key objective of the 2030 UN Sustainable Development Goals (SDGs) developed in 2015, which commit to reducing U5MR to as low as 25 per 1,000 live births by 2030 (UNGA, 2015, 2000). Contracting-out has been proposed as a health system strengthening approach to speed up the reduction in child mortality by expanding access to evidence-based interventions and particularly in countries with severe public resource constraints.

Globally, there has been substantial progress in reducing the U5MR, with rates declining from 90 to 43 deaths per 1,000 live births between 1990 and 2015, a reduction of approximately 6.7 million deaths (UN, 2015). There are however wide regional disparities; while 55 countries achieved U5MR of less than 10 per 1,000 live births in 2013, only 9 were in developing economies. Sub-Saharan Africa (SSA), despite experiencing some of the largest declines, remains the region with the highest U5MR; the U5MR declined from 179 to 86 deaths per 1,000 live births by 2015, further declining to 76 deaths per 1,000 live

births in 2017. Of the 26 countries accounting for 80 per cent of all child deaths worldwide in 2013, the ten countries with the highest U5MR were all in Sub-Saharan Africa (Wang et al., 2014; UNIGME, 2011). Sub-Saharan Africa is also the only region in the world where U5MR is expected to rise in the coming decades due to its relatively higher fertility rate and despite the impressive gains (UN, 2015). For Sub-Saharan Africa to achieve the SDGs, there is a need for health systems approaches that accelerate access to health interventions known to reduce child mortality.

Contracting out is increasingly utilized as one such approach to rapidly scale-up primary health care in lower- and middle-income countries. It involves the public sector paying private organizations, typically non-governmental organizations (NGOs), for the delivery of a defined package of evidence-based health interventions to defined populations. Contracting is regarded as having the potential to expand access to health services, reduce production costs, improve quality, and to facilitate the provision of a package of standardized health interventions known to reduce child mortality where existing capacity is limited. It can increase allocative efficiency by increasing competition between providers, improve quality, and overall health system performance by linking incentives to payments on achievement of predefined targets and improvements in quality of care provided (Barbara and Ngalande, 1994; Bennett and Mills, 1998; Palmer, 2000).

Thus far, there have been a limited number of studies that have directly assessed the impact of contracting out on U5MR, with a relatively larger number of studies assessing the effect on health facility utilization. The underlying assumption is that increasing access to services results in improved health outcomes and thus reductions in child mortality. These studies have however, also shown an unclear relationship between contracting-out and increasing the utilization of specific health interventions that impact childhood morbidity and mortality and there less evidence showing a relationship between contracting out and production cost. In addition, the quality and rigor of the research design of existing studies have been shown to be inadequate (Lagarde and Palmer, 2009; Bloom et al., 2006; Liu et al., 2007).

This paper addresses some of these limitations; assuming that the contracting inter-

vention increased health facility utilization among children under-five, I use the synthetic control method- a rigorous study design - to test the hypothesis that the contracting-out policy implemented nationally to expand coverage of primary healthcare services in South Sudan in 2012 led to reductions in the U5MR. I thus add to the existing evidence-space on the impact of contracting-out on under-five mortality.

## 2.2 Background

### 2.2.1 Theoretical Framework

The major causes of child mortality are well-known and have been documented in various studies (Rutstein, 2000; Bryce et al., 2005; Black et al., 2010). Between 68-75 percent of under-five deaths are attributable to six causes; pneumonia, diarrhoea, malaria, neonatal sepsis, preterm birth complications, and birth asphyxia, with malnutrition being an underlying cause of over half of these deaths. Evidence-based interventions that reduce childhood mortality are also well-known.

Progress in reducing U5MR requires broad-based interventions that address not only the distal determinants, but also the more proximal determinants primarily delivered within the health sector. Within the health sector, these include preventive interventions such as antenatal care that encourages birth spacing using modern contraceptive methods, tetanus toxoid vaccination for pregnant women, delivery by skilled birth attendants, and exclusive breastfeeding in the first six months of life, distribution of insecticide treated nets, childhood immunization, zinc and vitamin A supplementation. Treatment interventions include integrated case management of childhood infections (diarrhoea and dysentery, pneumonia, malaria), and neonatal sepsis. Outside the health sector, improving levels of education for women, women's empowerment through increasing political and socioeconomic participation, reducing fertility rate and poverty and environmental management for example improving access to clean water and sanitation also play a role in reducing child mortality (Jones et al., 2003; Rutstein, 2005; Kuruvilla et al., 2014).

Recent studies have assessed the proportion of U5MR reductions attributable to health interventions to those outside of the health sector. The 2013 Global Burden of Disease

Study estimated that income growth and maternal education reduced child mortality by 16% and 38% respectively, while higher fertility rates which result in increased numbers of births, were associated with increases in the number of the children dying. Overall however, 72% of childhood deaths were averted through investments in new drugs, vaccines, diagnostic procedures and public health campaigns, thus providing strong evidence for prioritizing investment in health-related interventions (Wang et al., 2014). A more recent analysis of 146 low-and-middle income countries (Bishai et al., 2016) evaluated health and social determinants of maternal and child mortality across eight policy areas; wealth (gross domestic product (GDP) per capita), environment (clean water and improved sanitation access), infrastructure (rural electricity access, urbanization and road density), education (gross female primary and secondary school enrolment), gender equality (female labour force participation and number of women parliamentarians in national legislatures), health service coverage (skilled birth attendance, physicians per 1,000 population and prenatal care), immunization (measles and diphtheria, pertussis, and tetanus (DPT) immunization) and fertility (total fertility and adolescent fertility rate). Results show that 89% of the reduction in child mortality between 1990 and 2010 were attributable to improvements in the health determinants, while per capita GDP growth was associated with a mere 20% of improvements in child health, suggesting that even low-income economies can significantly improve U5MR (Bishai et al., 2016).

In-depth analysis of 10 countries that were on track to achieve the Millennium Development Goals (MDGs) 4&5 in 2012 suggested that GDP growth per capita accounted for only 12% of the reduction in child mortality between 1990 and 2010, however health system investments (immunization coverage (DPT, measles and polio), reduction in total fertility rate, skilled birth attendance and maternal and newborn care) accounted for over half the reductions (Kuruvilla et al., 2014). Another study of 241 sub-national regions in Sub-Saharan Africa found that improvements in child mortality in the region between 2000 and 2010 occurred despite moderate growth in GDP during that period. These improvements were largely a result of increased antenatal care coverage, expansion of intermittent preventive treatment of malaria in pregnancy (IPTp), vaccination coverage, and maternal education (Akachi et al., 2017). Taken together, these studies suggest that health sector

investments that expand quality of and access to health care services are key factors to successfully reducing child mortality, even in countries with low GDP per capita.

### 2.2.2 Contracting-out

Contracting-out the provision of health services is increasingly utilized as an approach to scale-up access to and quality of primary healthcare services in lower- and middle-income countries. It involves governments entering into contracts with the private sector to deliver a defined package of health services due to capacity constraints inherent within the public sector. This allows the government to concentrate on providing stewardship and oversight to the health sector while the private sector retains responsibility for rapidly expanding access to care.

Contracting-out is believed to increase allocative efficiency by increasing competition among providers and to improve health system performance by linking incentives to payments on achievement of predefined targets (Barbara and Ngalande, 1994; Bennett and Mills, 1998; Palmer, 2000). Contract payments have thus been predicated on achievement of pre-specified targets based on increases in health facility utilization to increase access to care and to improvements in quality of care. To date, most contracting interventions have had the overall objectives of reducing maternal and child mortality by expanding access to health services, improving quality of care, and reducing inequity. In Afghanistan, the Democratic Republic of Congo, Liberia and South Sudan for example, the contract has been based on the provision of a basic package of health services comprising of high-impact interventions known to improve reproductive health and child health.

The underlying assumption is that contracting-out can aid in reducing child mortality by expanding access to a package of health interventions known to reduce child mortality on a larger scale. For example, contracting has been found to increase coverage by 3.4-26.0 percentage points compared to non-contracted services (Loevinsohn and Harding, 2005) and a study of 12 contracting-out projects found that 10 out of the 12 studies reported significant gains in increasing access to contracted health services (Liu et al., 2007). Contracting out may also be a cost-effective means of delivering public health interventions; the cost of implementing the basic package of health services per head per year ranged from

US$ 2.82 in Cambodia, US$4.50 in Afghanistan and US$ 6.25 in Guatemala. Contracting-out may also lead to an increase government spending for health; Bloom (2006) found that it increased government health expenditure by $2.94 in contracted districts compared with a $1.59 in non-contracted districts, suggesting higher public sector investment in health. This was offset by reductions in individual health expenditures of USD$ 19.25 dollars (Bloom et al., 2006; Liu et al., 2007; Odendaal et al., 2018). Reductions in health care costs at the household level may reduce poverty, leading to increased spending in other goods and services that improve overall health for example food, education, and clean water.

Contracting-out can also improve equity in health services provision resulting in the poor accessing health services. Studies in Cambodia and Bangladesh showed that contracting that targeted poor and marginalized populations increased access to health services (Loevinsohn and Harding, 2005). Contracting out has also been effective in reducing the inequity-gap of health services utilization when comparing the poor and non-poor in Afghanistan (Alonge et al., 2014). Interestingly, this study found that this was also dependent on the contracting model with variation in access depending on whether the contract budget is negotiable but deliverables or outputs are not (OR 2.82, p=0.001) or non-negotiable with a degree of flexibility on deliverables (OR 2.00, p=0.001). Inputs based contracts did not have a significant effect on equity. Given that child mortality is often highest in poorer and marginalized communities, contracting may thus reduce within country variations in child mortality with careful design of the contract itself. This implies that while contracting-out may overall improve access to care, the design and implementation of the approach is critical and may explain variations in observed outcomes.

### 2.2.3 Effect heterogeneity

Successful contracting depends on the ability of the public sector to design and manage contracts particularly where financial management, human resources and technical capacity is limited, as well as the broader socio-economic and political environment (Mills, 1998; Bennett and Mills, 1998). This influences the competitiveness of the contract bidding process (where there are few providers) and the capacity of providers to implement health

interventions and meet predefined targets. This suggests that while contracting is presumed to increase allocative efficiency, it may be dependent on the availability of providers. Thus, while contracting may be implemented as a strategy to increase access to health services and improve health outcomes, it may have a limited effect due to contextual circumstances and the specifics of the contract itself.

The design of the contract may itself influence the achievement of outputs, targets and therefore U5MR. Contract design has been shown to influence the effectiveness of interventions aimed at improving equity where there is limited flexibility in negotiating the cost of the contract or the contract deliverables (Alonge et al., 2014). The case of health is particularly relevant as the principal (government) may not be able to observe the efforts the providers undertake to meet targets. Contracts that focus solely on outcomes may therefore create distortions in the allocation of resources as these may reward those providers that exert less effort. For instance, providers may only be willing to work in easy areas where the cost of achieving specific goals may be lower than other geographic areas with higher mortality rate. There have been limited studies that have assessed the specifics of the contract design on health system performance, thus this relationship remains unclear.

Changes in health facility utilization, and ultimately reductions in child mortality may also take a long time to accrue resulting in reductions in U5MR only becoming apparent years after a contracting-out policy is implemented. In addition, the success of contracting is likely to vary at the sub-national level due to e.g. limited capacity of governments to provide overall stewardship to the health system, inadequate financial and management systems, differences in implementation modalities across providers, resource constraints and incompleteness of contracts (Batley and Mcloughlin, 2010; Witter, 2012; Rao et al., 2018). Studies have also shown that sub-national variations in for example poverty and health care utilization at the individual and population level influences the overall magnitude and direction of U5MR (Burke et al., 2016) suggesting that the observed U5MR may mask improvements in sub-national U5MR.

Reductions in U5MR may also depend on the quality of health services provided. However, there is limited evidence on the effect of contracting-out on the quality of health

services provided primarily due to inconsistencies in the definition of quality of care, and lack of control groups with which to assess improvements in quality accrued to contracting (Liu et al., 2007). Thus, while contracting-out may increase access to care, poor quality of health services may limit impact on the overall U5MR despite increases in health facility utilization.

### 2.2.4 Previous Literature

To date, there have been a limited number of studies that directly assessed the impact of contracting out on U5MR. In Cambodia, two studies found that contracting had little to no effect on infant and child mortality; one study found reduced mortality in children younger than one year of age by a non-significant 4.3% (p=0.36) (Odendaal et al., 2018) while another study found a non-significant increase of 0.0023% (Bonfrer et al., 2014). In Sao Paulo, Brazil, the effect of contracting on child mortality was a non-significant reduction of 0.093 percentage points (Greve and Schattan Ruas Pereira Coelho, 2017). The limitations in the number of studies may be related to lack of adequate measures of child mortality at the national level, as these estimates require relatively large populations and are thus primarily ascertained through national household surveys, and observable reductions in U5MR may take a long time to accrue. There is need for additional evidence to clarify the effect of contracting on under-five mortality. Synthetic control analysis provides an additional toolkit for researchers seeking to understand the impact of contracting on mortality outcomes.

Lack of progress on reducing U5MR may also be due to an overall assumption that improvements in access to evidence-based health interventions are correlated with reductions in under-five mortality. Alternatively, increases in health facility utilization may not necessarily be accompanied by advances in the quality of care, limiting overall impact. There have been relatively more studies assessing the effect of contracting on utilization of health services. Two systematic reviews published in 2009 and 2018 assessed the effect of contracting on access in Cambodia, Bolivia, Pakistan, and Guatemala, and found mixed results (Lagarde and Palmer, 2009; Odendaal et al., 2018). In Bolivia contracting-out of the primary care facilities at the district level led to an increase of 8.8% in skilled birth

attendance, and in Pakistan the average number of monthly consultations increased by 144%, though this steadily declined to 73% over an 18-month period, indicative of regression to the mean. In Cambodia, contracting-out significantly increased the use of public health facilities by 21% ($p = 0.02$) and uptake of vitamin A by 19% ($p = 0.02$), but had little to no effect on the number of pregnant women with more than two antenatal care visits, skilled birth attendance, contraceptives use, childhood immunization, incidence of childhood diarrhoea and mortality of children younger than one year in the 12 months of the study period. Results from Guatemala also showed limited effect on children receiving 3 doses of DPT immunization, more than 3 antenatal care visits to a health professional and use of contraceptives. In Afghanistan, contracting-out was found to increase the average number of new patient visits per health facility per month by 5.08, representing an increase of a factor of 21.88, total deliveries at health facilities by a factor of 41.75, and DPT3 by a factor of 13.46 by 2011, compared to the baseline in 2004 (Newbrander et al., 2014).

There have been limited assessments of contracting-out in Sub-Saharan Africa, despite its increasing popularity. In Burundi and Rwanda, the contracting-out model included performance-based financing in select health facilities, with payments tied to increased utilization of pre-selected interventions. In Rwanda there was a 23% increase in health facility deliveries, 56% and 135% increase in curative consultations among children younger than 23 months and aged 24 - 59 months respectively in intervention facilities. However, there were no improvements in antenatal care 4th visits or children fully immunized (Basinga et al., 2011). In Burundi, there was no effect on skilled birth attendance, and quantity or timeliness of antenatal care visits. There may have been improvements in quality of ANC services as measured by an increase in the proportion of mothers with blood pressure measurements and receiving one or more tetanus toxoid vaccination (Bonfrer et al., 2014).

Overall, these results suggest that while contracting does increase utilization of public health facilities potentially by reducing barriers to access, its effect on specific health interventions is mixed. Maternal health interventions and expansion of immunization coverage appear less influenced by the contracting-out intervention and may require more

demand-driven approaches at the individual level, for example the use of vouchers or more expansive health education for behavioural change at the community level.

Previous studies therefore show an unclear relationship between contracting-out and actual or perceived reductions in child mortality. Firstly, there are a limited number of studies that have directly assessed impact on child mortality, with these few studies suggesting a limited effect overall albeit this may be due to the short duration of the study periods and limitations in sample size. There is need for additional assessments of the effect of contracting on U5MR that take into consideration these limitations. Secondly, studies assessing the utilization of specific health interventions known to reduce child mortality have also shown mixed results. Of note are lack of improvements in antenatal care visits, skilled birth attendance and immunization coverage which may suggest that the specifics of the contracting interventions may require further research in implementation modalities and to identify innovations in improving coverage.

Lastly, the quality and rigor of the research design of a number of these studies have been shown to be inadequate (Lagarde and Palmer, 2009; Bloom et al., 2006; Liu et al., 2007). For example (Bloom et al., 2006) was a cluster randomized study with too few randomized districts and control districts with significantly lower funding, in Bolivia the selected control was a maternity unit whereas intervention sites were health facilities, and in Pakistan there was regression to the mean over the 18-month study period. In addition, very few studies utilized population-based household data; most were descriptive studies and thus did not control for potential confounders and only a few included a control group to allow a counterfactual assessment.

I address a number of these limitations by evaluating the impact of contracting on U5MR in South Sudan with data from 2000-2016 using the synthetic control method. Synthetic control is a rigorous study design that utilizes a data-driven approach to construct a counterfactual, allowing for an assessment of the direction and magnitude of U5MR. The evaluation contains U5MR data from 2000-2016, with 5 years of data after the contracting intervention is implemented, allowing us to observe the overall trend of U5MR and to assess for any regression to the mean. The evaluation is at the national level, and thus

does not assess the effect of contracting on specific health interventions. Note that U5MR is influenced by a wide range of interventions. I make the assumption that the effect of health interventions on U5MR should be observable given the studies that have shown these to have greater weight on U5MR reduction (Kuruvilla et al., 2014; Bishai et al., 2016; Akachi et al., 2017). Previous literature therefore suggest that the limitation in reducing childhood mortality may be due to the specifics of the contracting-out intervention itself and not the effectiveness of the specific interventions. However this study does not assess this and instead adds to the evidence-base on the effect of contracting on U5MR.

I evaluate whether the contracting policy led to reductions in child mortality, compared to a synthetic South Sudan comprised of a weighted average of similar countries which acts as the counterfactual. I hypothesize that the contracting policy led to improved access to evidence-based health interventions known to reduce childhood mortality and thus reduced U5MR.

## 2.3 Empirical Strategy

In 2012, South Sudan implemented a nation-wide contracting-out approach in a geographically focused financing architecture aimed at ensuring adequate financial, technical support and oversight to all health facilities nationwide. The basis of the contracts was a basic package of health services known to have a high impact on reducing child and maternal mortality. Three mechanisms were established and financed primarily by bilateral and multilateral donors with implementation by local and international NGOs; the World Bank provided US$28 million for a population of approximately 2.7 million, an annual per capita spending for health estimated at US$4.93, USAID provided US$ 85 million to cover a population of 2 million, an estimated annual per capita spending of US$8.5 per annum, and a Health Pooled Fund consisting of 6 donors contributed GB120 million for a population of 5.1 million resulting in per-capital health expenditure of US$ 10.4[1].

Due to the nationwide implementation, there are no valid comparison units within South Sudan with which to assess impact on U5MR. South Sudan also has a unique history

[1]using 2012 exchange rates of 1 GB = 1.55 US$. The program was for 3.5 yrs

among the countries in East Africa; it emerged from over 30 years of conflict in 2005, had very low health indicators as per the 2006 and 2010 Sudan Health and Household Survey, and had high GDP per capita due to its reliance on oil exports. None of the other Eastern Africa countries had a similar trajectory, making it difficult to compare the trends in South Sudan to that of other countries in the region.

### 2.3.1 Synthetic Control Method

The synthetic control method resolves the previously mentioned limitation of a comparative unit by using a data-driven approach to construct a 'synthetic' South Sudan as a weighted average of similar countries, chosen to reflect the characteristics of South Sudan prior to the implementation of the health system policy. Synthetic control is a comparative case study methodology developed by Abadie and colleagues (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2015). It has primarily been used in the fields of political science and economics with limited studies focusing on lower- and middle-income economies and on health specifically. For LMICs, it has been used to assess the effect of trade liberalization on child mortality (Barlow, 2018), effect of democracy on child mortality (Pieters et al., 2016), to evaluate a tobacco control policy in South Africa (Chelwa et al., 2017), and the effect of the elimination of user fees in health facilities in Zambia (Lépine et al., 2018).

The synthetic control method estimates the effect of a policy, for example contracting, by approximating a counterfactual constructed from a weighted combination of similar countries, referred to as the donor pool. The underlying assumption is that the characteristics of South Sudan are more accurately matched by a weighted combination of countries i.e. the synthetic control, than by a single country or by the average of several countries.

I therefore select pre-intervention characteristics, W such that the characteristics of South Sudan best resemble those of the synthetic control. Thus, if we let $x_1$ be the pre-intervention characteristics for South Sudan, and $x_0$ the pre-intervention characteristics of countries in the donor pool, we aim to closely match $x_1$ to $x_0$ such that the difference between the pre-intervention characteristics between the South Sudan and synthetic South Sudan is $x_1 - x_0$, with a weight W* selected to minimize this difference. Thus, the difference

between pre-intervention characteristics is the vector $X_1 - X_oW$. If we denote the specific variable as m, where m=1,...k, we are thus choosing the value of W that minimizes;

$$\sum_{m=1}^{k} v_m(x_{1m} - x_{0jW)^2} \tag{2.1}$$

where $v_m$ is a weight reflecting the relative importance of the specific variable; $x_{1m}$ is the value of the m-th variable for the treated unit, while $X_{0m}$ is the value for the corresponding donor units.

Note that the pre-intervention characteristics are variables with large predictive power on U5MR, and following (Abadie et al., 2015), we also include the outcome of interest among the pre-intervention variables in the subsequent analysis. Given a large number of pre-intervention periods, matching on pre-intervention characteristics controls for the effect of observed and unobserved confounders on the outcome of interest and thus the observed difference following the intervention can be attributed to the policy. The effect of the contracting policy is therefore the difference between South Sudan and the synthetic South Sudan, given by;

$$\alpha_1 t = Y_{1t}^1 - \sum_{j=2}^{j+1} w *_j Y_{jt} \tag{2.2}$$

Where$Y_{1t}$ is the observed U5MR for South Sudan after contracting and $w *_j Y_{jt}$ is the U5MR for synthetic South Sudan.

### 2.3.2 P-values and inference

A key limitation of the synthetic control method is the inability to use standard methods of statistical inference due to the small-sample size, the lack of randomization and that probabilistic sampling is not used. However, falsification tests, referred to as placebo studies can be conducted as an alternative model for inference (Abadie et al., 2015).

To assess the validity of the observed effect, a series of falsification tests are conducted. This involves replicating the synthetic control procedure but iteratively reassigning the

treatment unit to each of the donor countries and comparing the effect estimate to that obtained initially, referred to as " in-space" placebos. Additionally, we also reassign the treatment time to a period when the intervention did not occur, in an "in-time" placebo test. As we have adequate data prior to 2012 when contracting was implemented, we test whether the method produces large effects when applied to that earlier period.

Another limitation is that a few countries in the donor pool have also implemented a similar nationwide contracting intervention, for example Liberia and Sierra Leone, while other countries have implemented contracting at a smaller scale (for example Rwanda and Burundi). This may result in a smaller effect size comparing South Sudan to synthetic South Sudan, should those countries also have experienced reductions in U5MR. An analysis comparing South Sudan to a synthetic South Sudan that does not include Liberia and Sierra Leone is thus also done. However, note that the synthetic control is selected based on comparability of the U5MR to South Sudan prior to the contracting intervention introduced in 2012, while contracting in donor unit countries occurred prior to that of South Sudan.

### 2.3.3 Data sources and measurement

Data is obtained from annual country-level panel data covering the period 2000 to 2016 obtained from the World Bank Developmental Indicators (WDI) database. The WDI represents the most accurate global development data for 217 countries. Data for South Sudan is dis-aggregated from Sudan for the period 2000-2016, representing 12 year prior and 5 years after the 2012 health system policy implemented in South Sudan. This gives us adequate pre-implementation data points to construct a counterfactual to South Sudan, henceforth referred to as synthetic South Sudan, as described in the methodology section. The donor pool for synthetic South Sudan consists of 81 countries identified as low income and lower middle-income economies from Africa, Latin America and Asia, according to the World Bank's classification of countries by per capita gross national income (Fantom and Serajuddin, 2016). The full list of countries is available in the Supplemental Appendix. The outcome variable, $Y_{jt}$, is mortality rate for children under-5 years of age, per 1,000 live births for each of the countries consisting of the donor pool. The World Bank estimates

are obtained from the median estimates of under-five mortality from the United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) database (Alkema et al., 2016). The UN IGME estimates are based on household surveys and are thus the most robust estimates available.

Following the variables described in (Bishai et al., 2016), the following predictor variables for U5MR are selected; Wealth ( domestic health expenditure, nutrition status), education (female literacy rate amongst 15-24 year olds), gender equality (female labor force participation rate), health service coverage (cause of death, by communicable diseases and maternal, prenatal and nutrition conditions), immunization (DPT immunization), fertility (Crude birth-rate and Fertility rate, total), and also include mortality indicators (U5MR, Probability of dying, Lifetime risk of maternal death, Crude death-rate). Note that due to limited data for South Sudan, indicators for environment and infrastructure are not included in the model. A comprehensive definition of these variables is found in Table 2.1.

### 2.3.4 Sample specification

As noted previously, synthetic South Sudan is constructed as a weighted average of countries in the donor pool, with higher weights applied to countries more similar to South Sudan in the pre-intervention period.

The model is fitted with the outcome variable for the pre-intervention period, assuming that the intervention had no effect on U5MR prior to 2012. To best approximate the U5MR prior to the intervention year 2012, vm weights are chosen so that the resulting synthetic South Sudan and South Sudan have similar pre-intervention trends in U5MR as shown in Table 2.2.

Where year is specified, predictors are averaged for the year indicated and not the entire pre-intervention period as these are the years for which data for South Sudan is available.

Using the assigned vm weights, we find that the most important predictors for U5MR during the pre-intervention period were; U5MR in 2011 (0.55), cause of death, by communicable diseases and maternal, prenatal and nutrition conditions (0.12), survival to age 65,

*Table 2.1:* ***Data sources and definition of measures.***

| Variable | Source | Measure |
|---|---|---|
| U5MR | UN IGME | Probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year |
| Communicable disease deaths | WDI database | Cause of death, by communicable diseases and maternal, prenatal and nutrition conditions (% of total) |
| Survival to age 65, female | WDI database | Percentage of a cohort of newborn infants that would survive to age 65, if subject to age specific mortality rates of the specified year. |
| Domestic health expenditure | WDI database | Domestic general government health expenditure (% of current health expenditure. |
| Probability of dying | WDI database | Probability of dying between age 5-14 years of age expressed per 1,000 children aged 5, if subject to age-specific mortality rates of the specified year. |
| Population ages 0-14 | WDI database | Population ages 0-14, total |
| Lifetime risk of maternal death | WDI database | Probability that a 15-year-old female will die eventually from a maternal cause assuming that current levels of fertility and mortality (including maternal mortality) do not change |
| Fertility rate, total | WDI database | Number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates of the specified year. |
| Labor-force participation rate (female) | WDI database | Labor force participation rate for ages 15-24, female (%) (modeled ILO estimate) |
| Life expectancy, female | WDI database | Number of years a newborn female infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. |
| Crude birth-rate | WDI database | Number of live births per 1,000 midyear population. |
| Crude death-rate | WDI database | Number of deaths per 1,000 midyear population. |
| Prevalence of stunting | WDI database | Prevalence of stunting, height for age (% of children under 5) |
| Literacy Rate, 15-24 females | WDI database | Literacy rate, youth female (% of females ages 15-24) |
| DPT immunization | WDI database | Percentage of children ages 12-23 months who received DPT vaccinations before 12 months |

*Table 2.2:* ***Under-Five Mortality Predictor Weights.***

| | |
|---|---|
| Under-5 mortality rate | 0.5534 |
| Communicable disease deaths(2010) | 0.1203 |
| Survival to age 65, female | 0.1135 |
| Domestic health expenditure(2012) | 0.0413 |
| Probability of dying (2010) | 0.0403 |
| Population ages 0-14 | 0.0402 |
| Lifetime risk of maternal death (%) | 0.0378 |
| Fertility rate, total | 0.0189 |
| Female labor force participation rate | 0.0169 |
| Life expectancy, female | 0.0067 |
| Crude birth-rate | 0.0039 |
| Crude death-rate | 0.0028 |
| Prevalence of stunting (2006&2010) | 0.0028 |
| Literacy Rate, 15-24 females(2008) | 0.0010 |
| DPT immunization coverage(2011&2012) | 0.0002 |

Notes: Definitions from World Bank Indicator Database.

among females as percentage of cohort (0.11), domestic general government health expenditure as percentage of current health expenditure (0.04), probability of dying at age 5-14 years per 1,000 children age 5 (0.04), lifetime risk of maternal death (0.04), total fertility rate (0.2), female labour force participation rate (0.02), and female life expectancy (0.01).

In accordance with previous studies (Bishai et al., 2016; Kuruvilla et al., 2014), our model assigns highest weights ( 70%) to health sector determinants, specifically U5MR (although this may be due to the fact that it is our outcome variable), probability of dying before 15 years of age among children under five, and communicable disease deaths. The importance of mothers to the survival of the child is also predicated with predictor variables for maternal health, education, fertility and mortality assigned an importance of approximately 20 percent. Domestic health expenditure for health contributes a mere 4 percent, likely as a result of data being available only for the year 2012 for South Sudan, but also consistent with previous studies (Akachi et al., 2017). The low contribution of nutrition as ascertained by the prevalence of stunting may be due to its correlation with the determinants of childhood morbidity and mortality (Charmarbagwala et al., 2004).

By construction, the weights of countries making up synthetic South Sudan sum up to 1. Synthetic South Sudan is a weighted average of Liberia, Malawi, Sierra Leone, Burundi, Central African Republic, Angola, Eswatini, Gambia and Kenya in order of decreasing weight as illustrated in Table 2.3.

*Table 2.3:* ***Synthetic South Sudan Countries***

| Country | Synthetic Weight |
|---|---|
| Angola | 0.047 |
| Burundi | 0.095 |
| Central African Republic | 0.048 |
| Eswatini | 0.03 |
| Gambia | 0.026 |
| Kenya | 0.024 |
| Liberia | 0.306 |
| Malawi | 0.25 |
| Sierra Leone | 0.174 |

Among the countries selected, Liberia and Sierra Leone have both implemented a similar health system strengthening contracting policy as that implemented in South Sudan in 2012, thus further analysis excluding the two countries is done as a check on their relative importance to the model. These results are discussed in a subsequent section on robustness tests as the results do not vary significantly, whether we include or exclude them.

Comparison of the pre-intervention characteristics of South Sudan, Synthetic South Sudan, and remaining 80 lower and middle income economies is provided in Table 2.4. As observed, Synthetic South Sudan more closely resembles South Sudan prior to the 2012 intervention, when compared to all other LMICs. For example, the difference in U5MR between synthetic South Sudan and South Sudan is less than 0.2, while the remaining LMIC countries have close to half the U5MR of South Sudan. Across all other indicators, except female literacy rate, prevalence of stunting, and DPT immunization coverage, there is a less than 5% variation between South Sudan and synthetic South Sudan.

Comparing South Sudan with the other LMIC countries, South Sudan has lower domestic spending on health care, a higher crude birth rate, a much younger population that also has a higher probability of dying between the ages of 5-14 years, almost double the risk of dying of communicable diseases, and lower DPT immunization coverage. All indicators except prevalence of stunting among children under 5 years have a greater than 20% variation and of note, South Sudan has poorer indicators on average compared to the other LMICs.

*Table 2.4:* ***Comparison of U5MR pre-intervention predictor***

| Predictor Balance | South Sudan | Synthetic South Sudan | LMIC countries |
|---|---|---|---|
| Under-5 mortality rate | 138.59 | 138.78 | 65.67 |
| Domestic health expenditure (2012) | 22.86 | 22.12 | 32.25 |
| Population ages 0-14 | 44.18 | 44.79 | 39.00 |
| Crude death-rate | 14.21 | 13.91 | 9.89 |
| Probability of dying (2010) | 28.05 | 28.23 | 16.95 |
| Crude Birth-rate | 40.32 | 41.40 | 32.78 |
| Life expectancy, female | 52.62 | 52.99 | 62.84 |
| Female labor force participation rate | 48.38 | 48.63 | 39.39 |
| Fertility rate, total | 5.76 | 5.67 | 4.37 |
| Literacy Rate, 15-24 females (2008) | 29.58 | 5.45 | 80.62 |
| Communicable disease deaths (2010) | 71.30 | 70.36 | 45.73 |
| Lifetime risk of maternal death (%) | 5.91 | 5.77 | 2.30 |
| Survival to age 65, female | 46.79 | 46.66 | 61.62 |
| Prevalence of stunting (2006&2010) | 33.65 | 29.29 | 36.14 |
| DPT immunization coverage (2011&2012) | 60.00 | 85.24 | 80.75 |

## 2.4 Results

### 2.4.1 Synthetic control analysis

Figure 2.1 plots trends in U5MR comparing South Sudan to all other LMICs, to neighbouring countries and to countries within Eastern Africa only. These countries are Burundi, Somalia Djibouti, Ethiopia, Eritrea, Kenya, Tanzania, Rwanda, South Sudan, Sudan, Uganda, Democratic Republic of Congo, Central African Republic.

As illustrated in the figure, countries close to or neighbouring South Sudan may not provide a valid comparison to estimate the impact of contracting on U5MR. U5MR falls throughout the observation period, however South Sudan has higher U5MR compared to its neighbours throughout. U5MR is similar in a pool of countries consisting of a select number of Eastern African countries and South Sudan's neighbours and Eastern African countries only, although U5MR does begin to diverge with the Eastern African countries achieving higher reductions. However, the U5MR of these countries is higher than that of all LMICs combined, but the accelerated rate of decline of the U5MR suggest that these countries may close this gap in future.

As explained above, we construct a synthetic South Sudan from a pool of LMICs in order to ensure that the pre-intervention trends provide a valid counterfactual. A graphical illustration of the trend in U5MR for South Sudan and synthetic South Sudan for the period 2000 – 2016 is depicted in Figure 2.2. Synthetic South Sudan closely replicates the U5MR

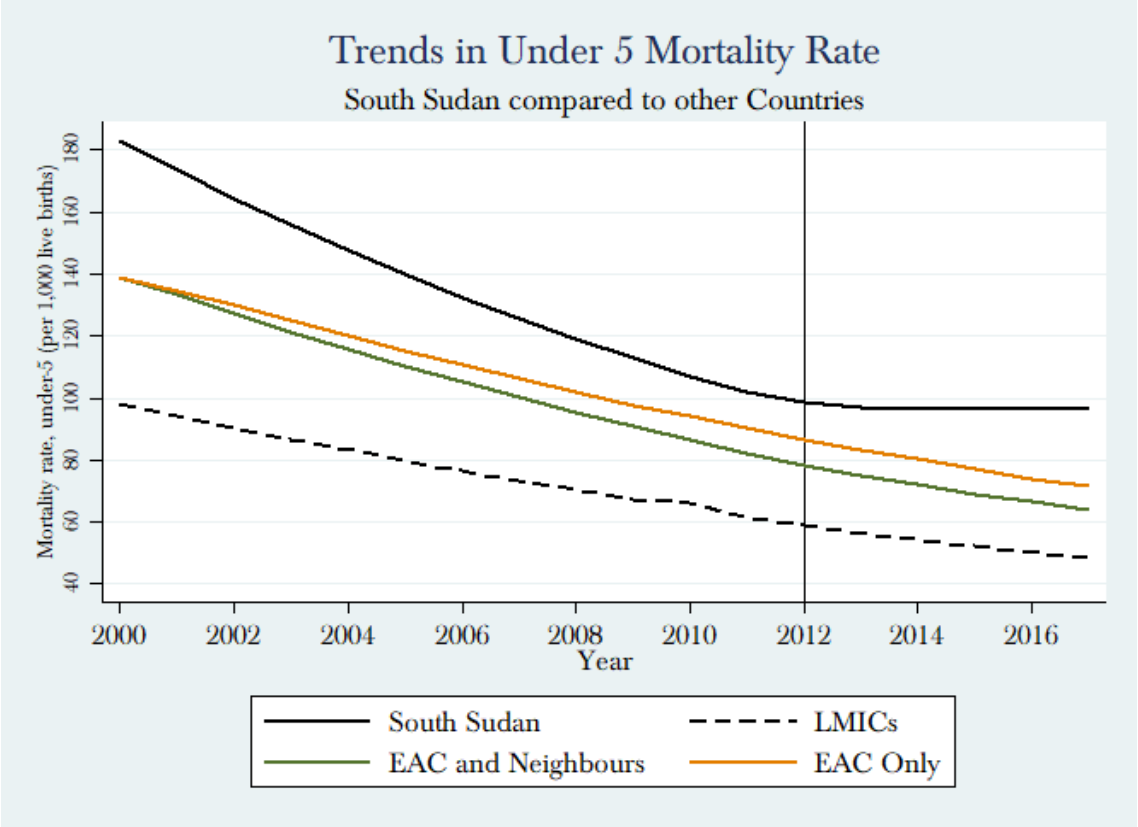


*Figure 2.1:* ***Trend in U5MR rate, South Sudan compared to other LMICs.***

for South Sudan during the period prior to the 2012 health system policy, indicating that it provides an acceptable counter-factual, relative to the other lower- and middle-income economies or countries within Sub-Saharan Africa.

During the pre-intervention period, U5MR for South Sudan and synthetic Southern Sudan falls from a high of approximately 180 under-five deaths per 1,000 live births to a low of 102 under-five deaths per 1,000 live births. This largely follows the overall drop in U5MR observed in Sub-Saharan Africa during the MDG period. The drop in U5MR prior to the signing of a Comprehensive Peace Agreement (CPA) between Sudan and southern Sudan in 2005, is surprising as this was during the period when southern Sudan was in conflict with northern Sudan and may be suggestive of the effect of humanitarian aid during that time period.

The U5MR for synthetic South Sudan begins to diverge from that of South Sudan mid- 2011, corresponding with the independence of South Sudan on July 2011. In 2012 and 2013, U5MR in South Sudan is estimated at 98.6 and 96.9 per 1000 live births, before

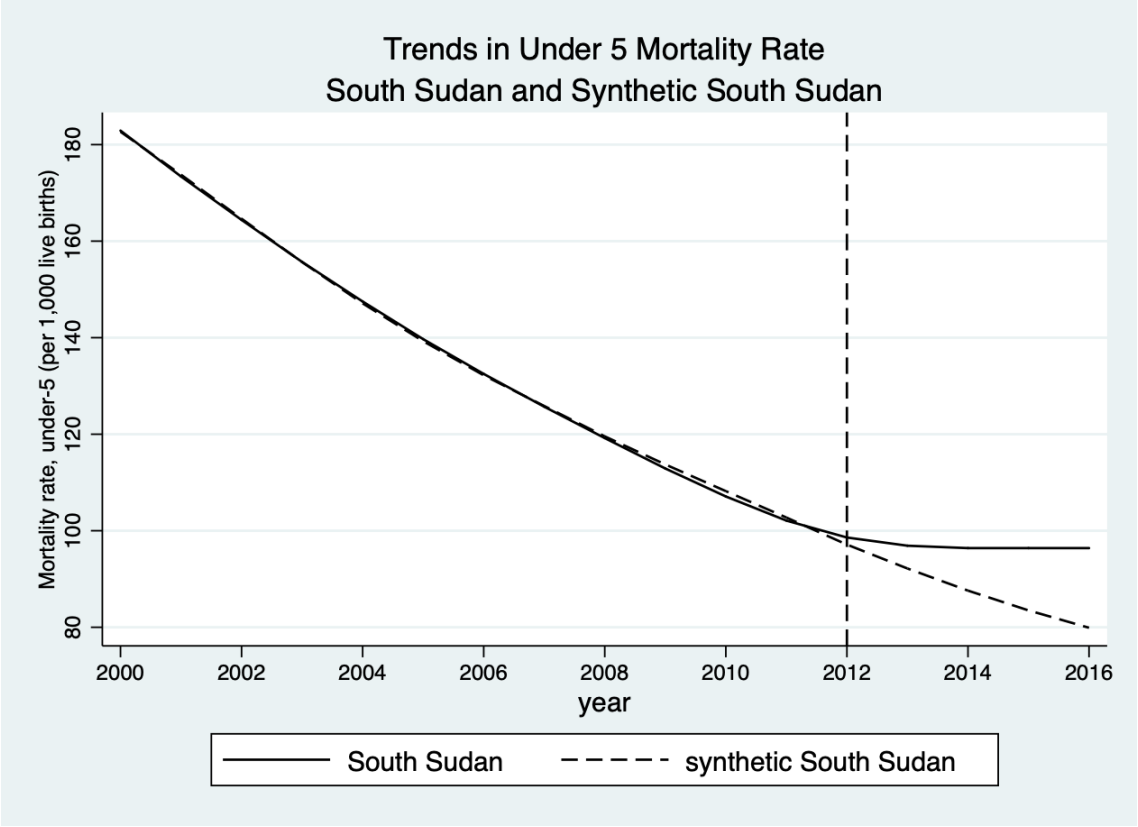


*Figure 2.2:* ***Trend in U5MR rate, South Sudan and Synthetic South Sudan.***

stagnating at 96.4 during the remaining observation period, while that of synthetic South Sudan drops to 96.5, 91.5, 86.8, 82.7 and 79 per 1,000 live births between 2012 and 2016. Thus the percentage difference between South Sudan diverges from synthetic South Sudan by 2%, 6%, 10%, 14% and 18% between 2012-2016 as shown in table 2.5

*Table 2.5:* ***Impact of Contracting on U5MR.***

| Year | South Sudan | Synthetic South Sudan | Percentage Change |
|---|---|---|---|
| 2012 | 98.6 | 96.55 | 2% |
| 2013 | 96.9 | 91.50 | 6% |
| 2014 | 96.4 | 86.84 | 10% |
| 2015 | 96.4 | 82.67 | 14% |
| 2016 | 96.4 | 79.03 | 18% |

Another way of depicting the effect of the contracting policy on U5MR is by depicting the yearly gaps in U5MR rate between South Sudan and synthetic South Sudan as illustrated in figure 2.3. These results suggest that the contracting-out policy had a negative effect on the rate of decline of U5MR during the observation period. Reduction in the U5MR would have therefore been larger, had the contracting-out intervention not

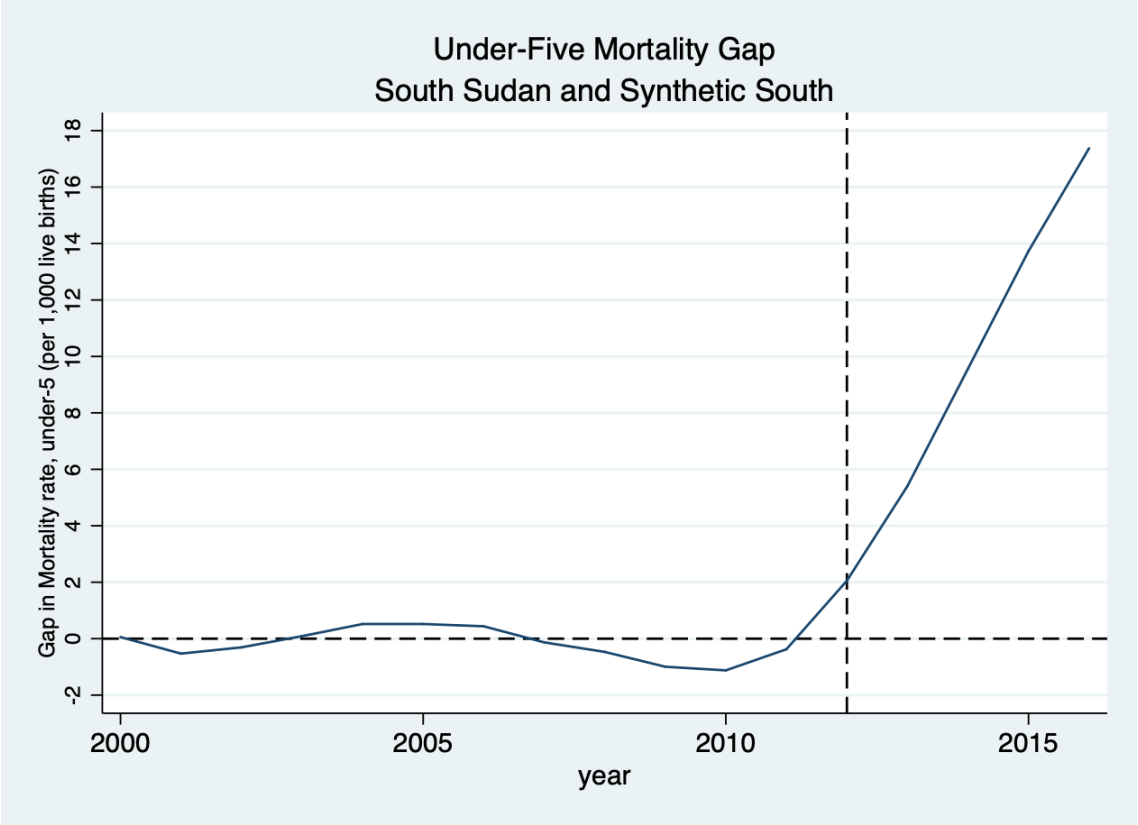


*Figure 2.3:* ***Gap in U5MR rate, South Sudan and Synthetic South Sudan.***

been implemented, or in other words had the existing interventions continued during the intervention period.

In order to assess the robustness of the results, I exclude the two countries that have implemented similar large-scale contracting intervention in Sub-Saharan Africa that were included in construction of synthetic South Sudan and rerun the synthetic control analysis. The synthetic South Sudan pre-intervention trend in U5MR is similar to that of South Sudan even when I exclude these two countries, and the overall trend remains the same, as illustrated in figure 2.4.

I also assess U5MR using a pool of countries neighbouring South Sudan selecting the countries depicted in figure 2.1. While the pre intervention trend of U5MR comparing South Sudan to synthetic South Sudan is less similar, the overall trend of U5MR after the contracting intervention remains the same, with U5MR remaining higher, compared to that of the synthetic South Sudan (Fig. 2.5). I also further compare South Sudan to a synthetic South Sudan consisting of oil-producing countries, and while the pre-intervention

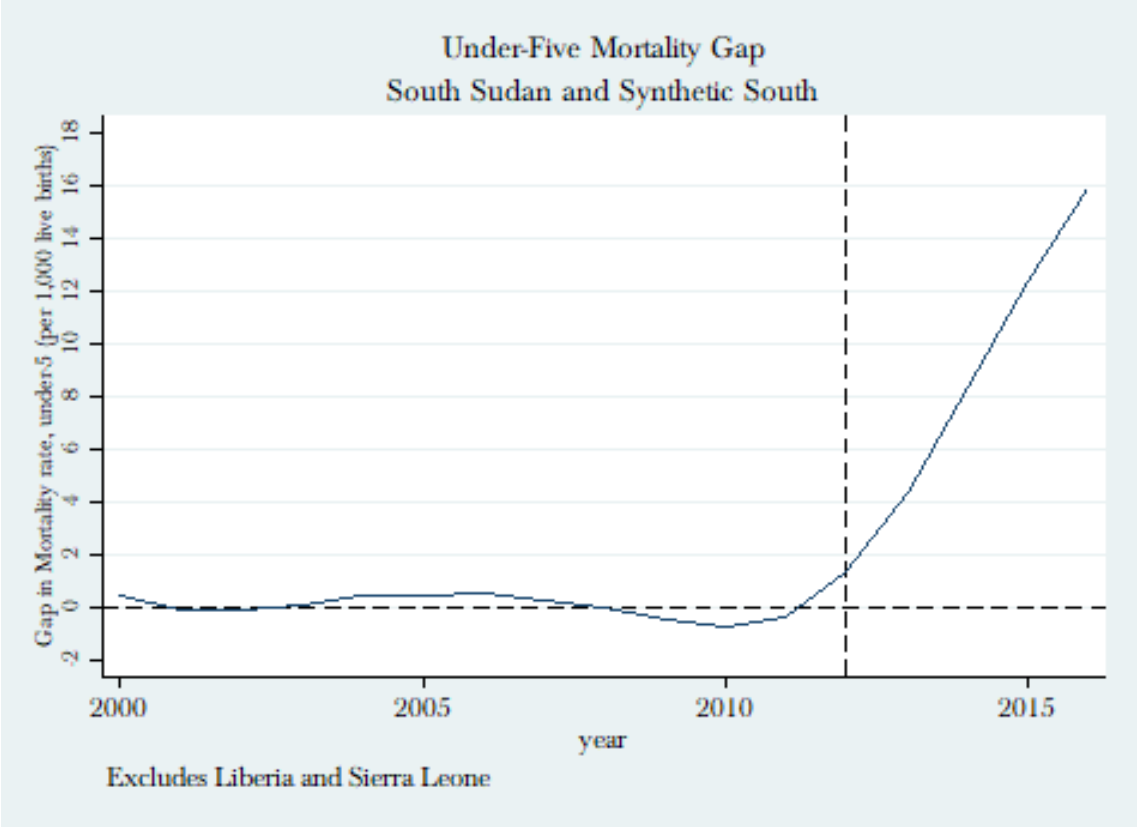


*Figure 2.4:* ***Trend U5MR excluding Liberia and Sierra Leone.***

trend is similar, find a similar post-intervention effect (Fig. 2.6).

Due to the limited number of existing studies that have directly estimated the impact of contracting on U5MR at a national level, it is difficult to compare these results to other findings. However, note that in Cambodia two studies found that contracting had little to no effect on infant and child mortality in children younger than one year of age (Odendaal et al., 2018; Bonfrer et al., 2014) while in Sao Paulo, Brazil, there was a non-significant reduction of 0.093 percentage points (Greve and Schattan Ruas Pereira Coelho, 2017).

The results however, may also be reflective of broader socio-economic and political environment in South Sudan. They may be as a result of transferring greater management and stewardship of the health system to the state with limited capacity, whereas prior to independence the health system was primarily managed by private sector, with little to no oversight from the public sector. However, due to the donor-driven design of the contracts in South Sudan, and the fact that these were primarily managed by agencies selected by the donors, I infer that this management role of the government was limited, especially

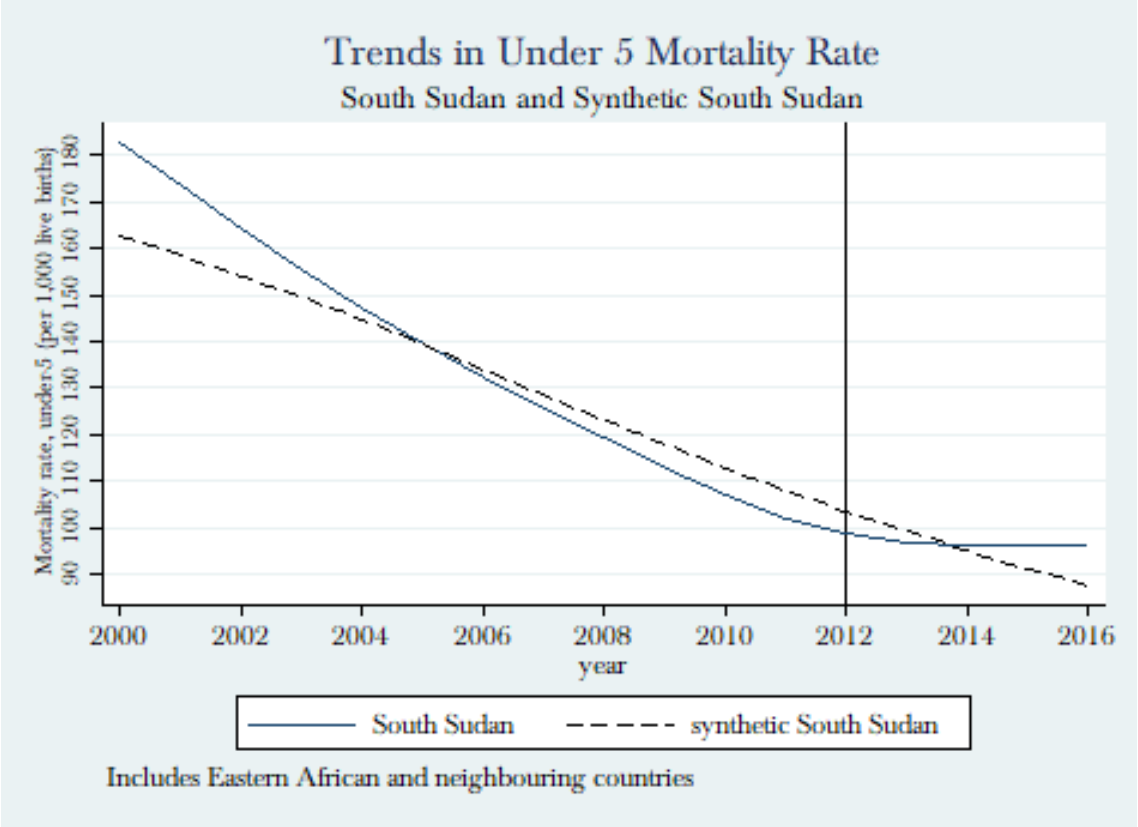


*Figure 2.5:* ***Trend U5MR restricting to neighbouring countries.***

during the initial implementation of the policy. South Sudan gained its independence in 2011 and in 2013 conflict broke out in a few regions in the country, with further expansion of the geographical scope of the conflict in 2016. While this may explain the slowing down of rate of decline of U5MR, it does not explain the results immediately prior to 2013, but may explain the U5MR observed after 2013 where it remains relatively stable.

Also, note that the U5MR is constructed based on existing household surveys as well as by modelling and there have been a limited number of representative surveys conducted in South Sudan since its independence. Thus the U5MR for South Sudan may not be as valid, and it is also possible that the U5MR may have actually increased during the contracting period due to the contract design, and given the existence of conflict in South Sudan. This strongly indicates that this is an area worthy of further research to assess whether these results are unique to South Sudan, by conducting similar SCM analysis of countries that have implemented contracting.

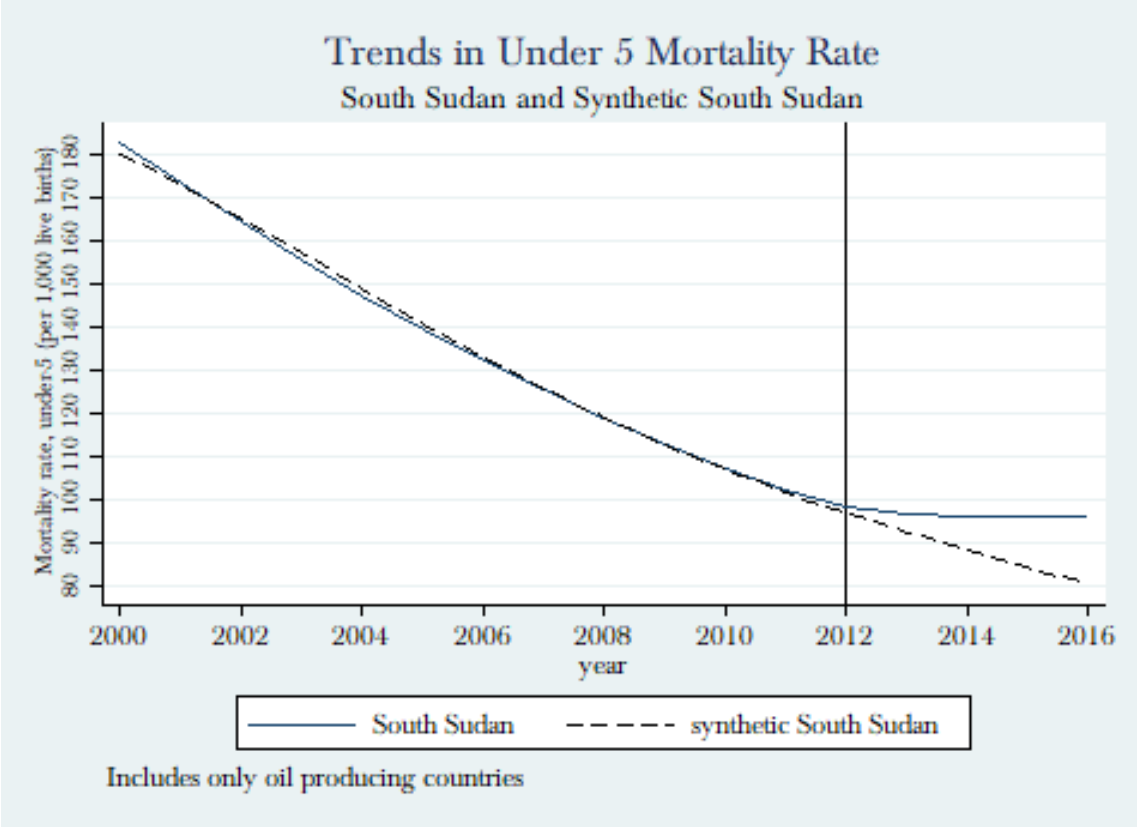


*Figure 2.6:* ***Trend U5MR restricting to oil producing countries.***

### 2.4.2 Robustness checks

#### In-Space Placebo Study

To assess the robustness of the results, I further conduct a series of placebo studies. I iteratively reassign the treatment to each country in the donor pool that did not experience the health policy intervention, in what is referred to as 'in-space' placebo studies. This then allows us to compare South Sudan's estimated effect to the distribution of placebo effects for the remaining 80 countries. The South Sudan effect is then considered significant if it is different in comparison to the distribution of the placebo effects. This is illustrated in Figure 2.7. The robustness test once again affirms that South Sudan appears to be one of the few countries with stagnating U5MR relative to progress made in other countries.

To evaluate the gap obtained from the 'in-space' placebo, the distribution of the ratios of post/pre the 2012 health system intervention RMSPE (root mean square prediction error) is compared for South Sudan and the remaining 80 countries. This is depicted in

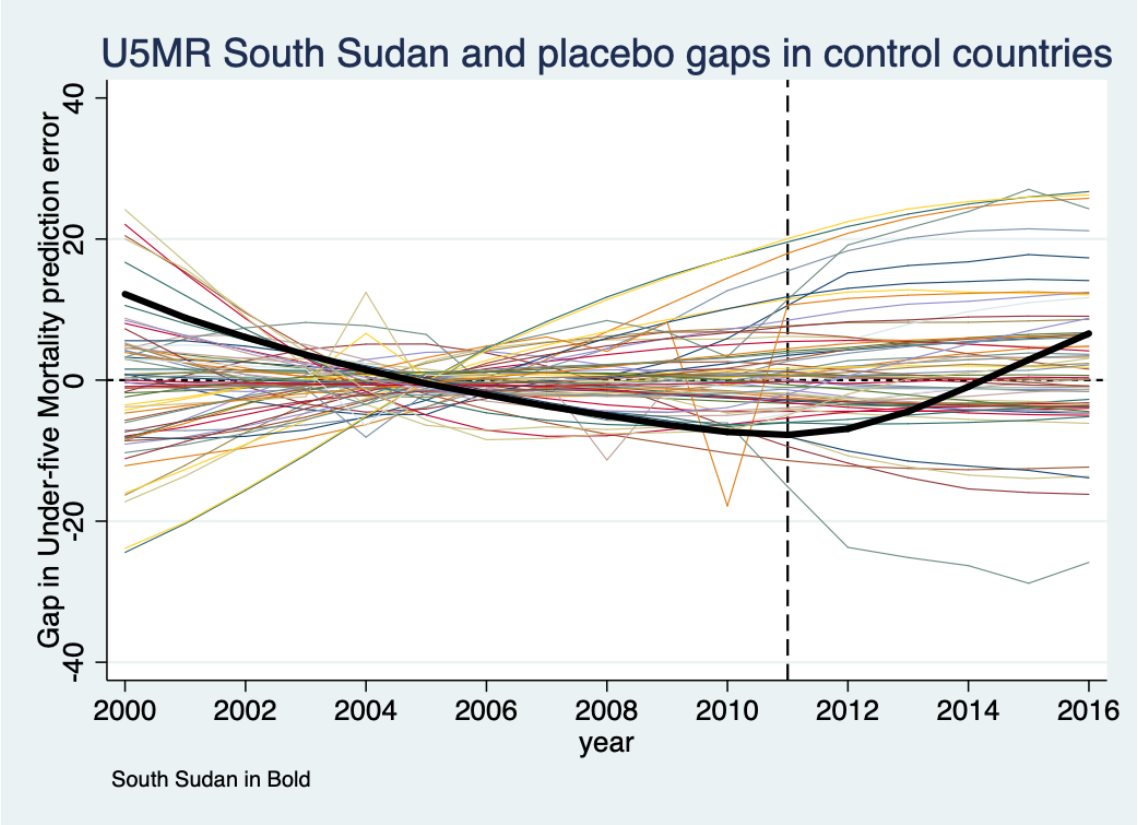


*Figure 2.7:* ***Gap in U5MR Placebo Controls.***

Figure 2.8. RMSPE measures the magnitude of the gap in U5MR between each country and its counterfactual. This ratio is 0.67 for South Sudan, which is not significantly different from that of other countries. South Sudan ranks 58, resulting in a non-significant p-value of 0.725 [2]. This further supports the result that contracting had limited effect on U5MR.. This further supports the result that contracting had limited effect on U5MR. The countries with the largest ratios are Cote D'Ivoire, Senegal, Sudan, Pakistan and Uzbekistan with ratios of 4.7, 3.87, 3.57, 3.27 and 3.16 respectively. It is also worth noting that of these countries, only Pakistan implemented a contracting-out health intervention.

### In-time Placebo Study

I also conduct an in-time placebo study where the synthetic control method is estimated assuming the contracting policy occurs in 2005 and 2011, corresponding to the signing of the comprehensive peace agreement and the independence of the Republic of South Sudan. That is, the same model is rerun, but intervention period is reassigned to 2005 and 2011

[2]Null hypothesis of no effect. p≈ 58/80

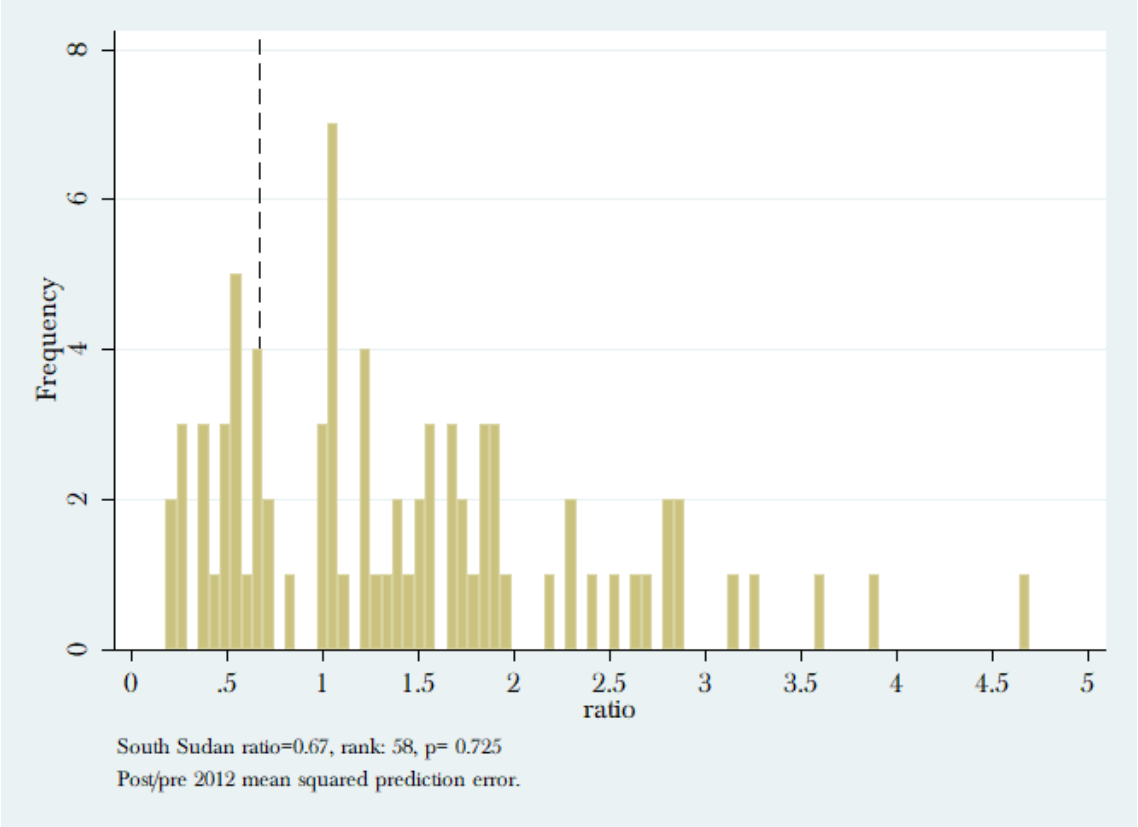


*Figure 2.8:* ***Ratio of pre and post U5MR.***

respectively.

For treatment year 2011, all previous variables are included in the model. Countries used in the construction of synthetic South Sudan now include Bolivia (0.012), Burundi (0.162), Eswatini (0.019), Liberia (0.27), Malawi (0.232), Nigeria (0.159), and Sierra Leone (0.147). Once again observe in Figure 2.9 and Figure 2.10 that the synthetic South Sudan replicates under-five mortality rates for the real South Sudan, in the pre-intervention period. In addition, the same divergence in U5MR is observed between South Sudan and its counterfactual, although this divergence occurs closer to 2012 than in the previous result.

For treatment year 2005, DPT immunization rates and female literacy rate variables are dropped due to lack of availability of data for the southern Sudan region prior to 2008. Countries used in the construction of the 2005 synthetic South Sudan are Burundi (0.168), Central African Republic (0.023), Djibouti (0.064, Liberia (0.4), Malawi (0.1), Niger (0.033), Sierra Leone (0.19), and Timor-Leste (0.021). While there are fewer pre-intervention years with which to fit the pre-intervention variables for synthetic southern

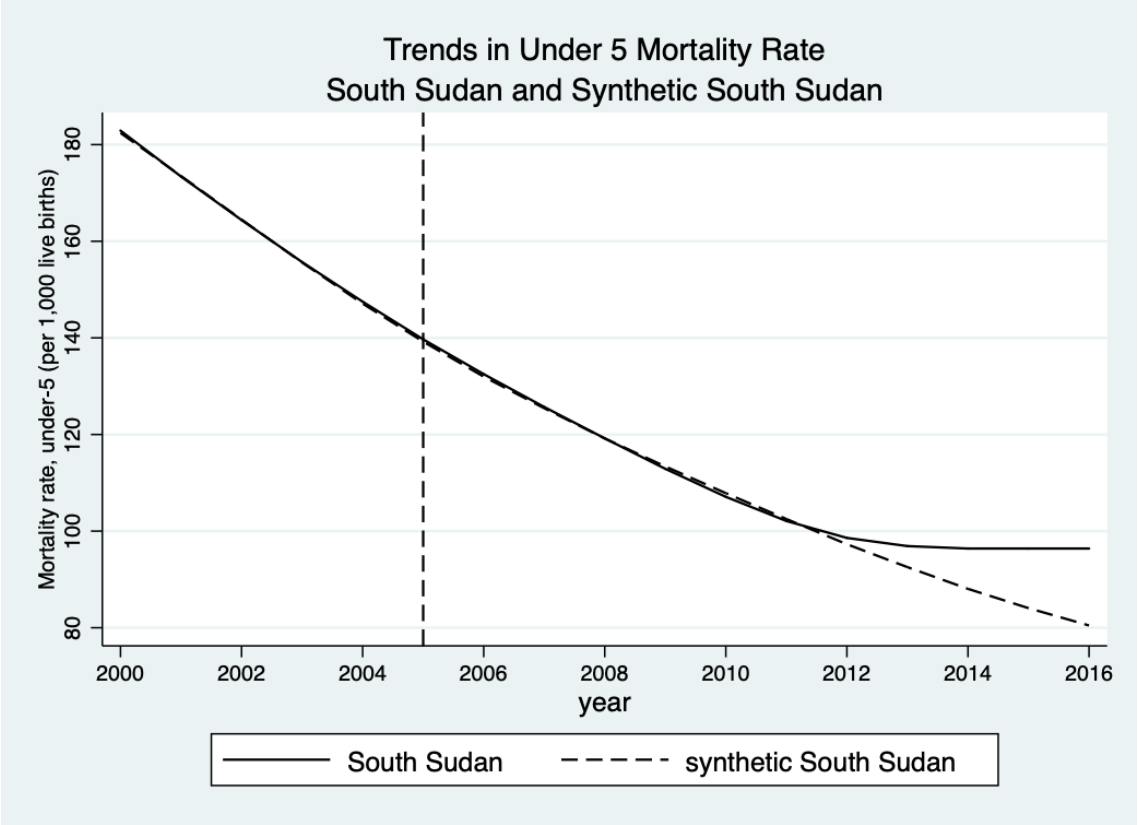


*Figure 2.9:* ***Trends in U5MR rate.***

Sudan, it once again replicates U5MR for the southern Sudan as observed in Figure 2.9. More importantly, we observe the same effect on U5MR as previously. Critically, these results support the utility of the synthetic control method for comparative case analysis.

## 2.5 Conclusions

This analysis has produced two important results. Firstly, it has extended the synthetic control method to the analysis of the impact of contracting out of primary healthcare services on U5MR in lower and middle-income. Given the popularity of contracting-out primarily in Sub-Saharan Africa, it is also the first evaluation of impact on U5MR and provides replicable methodology for future analysis.

Second, results suggest that the contracting out intervention in South Sudan had a negative impact on the U5MR. This is a surprising result, worthy of further research to identify the specific reasons why the policy was not effective. However, the results complement earlier discussion on the limitations of contracting to increase utilization of

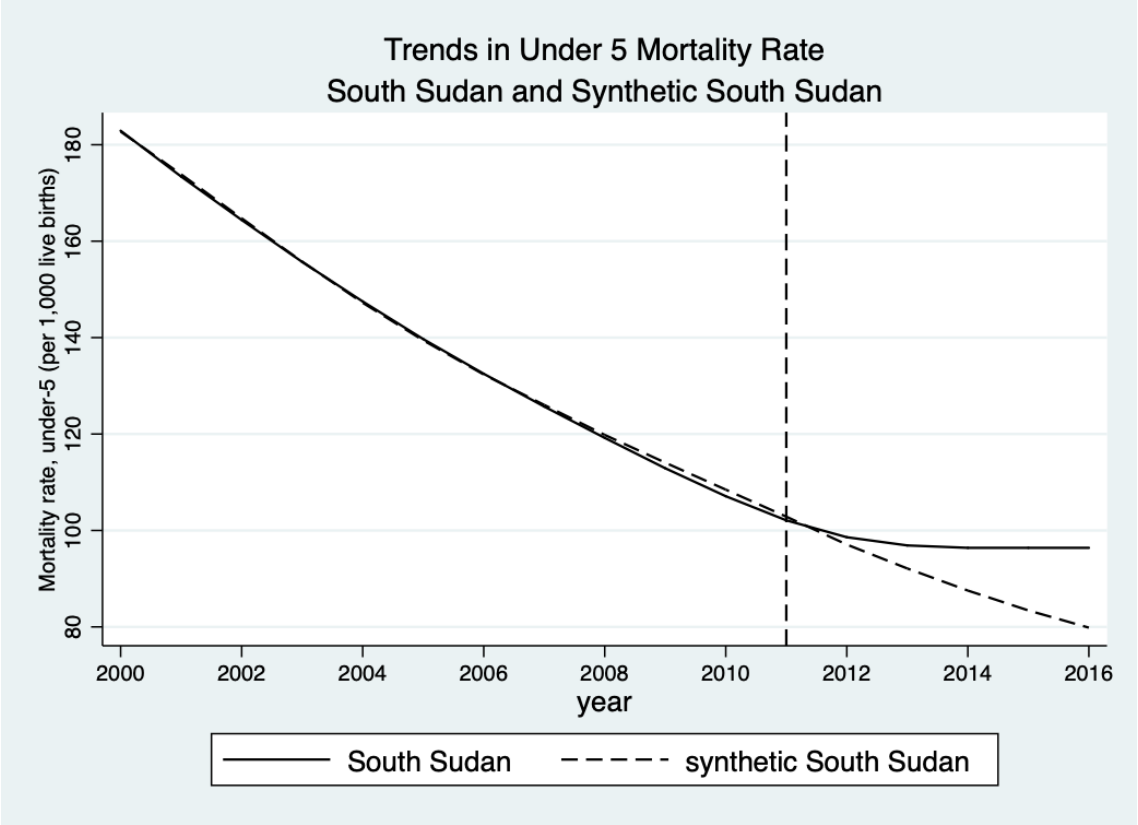


*Figure 2.10:* ***Trends in U5MR rate.***

specifically antenatal care services, uptake of delivery with skilled birth attendants and expansion of coverage of the immunization services. It also highlights the possibility that private entities may not be willing to work in remote and costly geographic areas.

It is worth noting that South Sudan has a high fertility rate, and low uptake of modern contraceptive methods and this may explain the lack of progress in reducing child mortality. Also, worth noting is the large influx of returnees to the country after the signing of the peace agreement in 2005, most of whom were recorded as arriving in 2009 and 2010 during the census.

This might therefore also be a result of an increase in fecundity due to a return of younger men and women to the country, resulting in a slow-down of reduction of U5MR. While one may argue that South Sudan experienced conflict starting primarily in 2013, these results show that the rate of decline of U5MR did not change even prior to 2013. This also implies that there was no observed 'peace dividend' from the country experiencing relative peace after the signing of the CPA, as there is no steep decline in U5MR observed

even prior to 2005.

These findings have important implications for the broader discussion on the effectiveness of contracting given its increasing popularity as a health system strengthening mechanism. As one of the few evaluations of a national contracting policy, the results broadly support other studies that found a limited effect of contracting as an approach to increase utilization of health services, and thus to impact health outcomes. There is therefore a need for further research to determine if these results are also observed in other contracting countries.

One critical question that also needs to be addressed in further research is whether the failure to accelerate reduction of the U5MR was due to the specific contracting design and implicit incentive of the contracts implemented in South Sudan, unobserved contextual factors or if it is reflective of inadequate health systems financing. Furthermore, the complexity of observing effort may create distortions that slowdown the reduction in desired outcomes. The study has a few limitations. First, the U5MR for South Sudan, while based on household surveys, is also primarily modelled, thus the estimates may not be the most up-to-date or valid as South Sudan has had a limited number of national household surveys. This is especially true for the period after 2013. In addition, the contracting intervention may have a delayed effect on U5MR and lack of additional data points may reflect additional reductions.

Second, given the sub-national variations in health status in South Sudan, and the differential per capita spending on health, national level U5MR may mask gains in reducing U5MR at the regional or state level in South Sudan. Identifying sub-national variation in U5MR may illuminate differences but will require large sample sizes. Given wide-spread conflict in South Sudan, this may not be possible.

Third, the study did not explore contextual factor that may have an impact on U5MR. It is possible that events or policy changes that occurred in South Sudan during the study period may have affected the rate of decline of U5MR. Future evaluations of other national contracting interventions may therefore show that the South Sudan case is unique.

In summary, the analysis has shown that contracting in South Sudan did not increase

the rate of decline of the U5MR as expected. For the country to achieve the UN SDGs, there is need for additional health system strengthening approaches, perhaps targeting the capacity of the government to provide stewardship of the health system, strengthening the health-care workforce or provision of additional financial resources. Further research should devote more effort to understand the incentives embedded in different forms of contracting out.

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# 2.6 Appendix

## 2.6.1 Synthetic Control Analysis

*Table B1:* ***Synthetic South Sudan Countries***

| Country | Synthetic Weight | Country | Synthetic Weight |
|---|---|---|---|
| Afghanistan | 0 | Angola | 0.047 |
| Bangladesh | 0 | Benin | 0 |
| Bhutan | 0 | Bolivia | 0 |
| Burkina Faso | 0 | Burundi | 0.095 |
| Cabo Verde | 0 | Cambodia | 0 |
| Cameroon | 0 | Central African Republic | 0.04 |
| Chad | 0 | Comoros | 0 |
| Congo | 0 | Democratic Republic of Congo | 0 |
| Cote d'Ivoire | 0 | Djibouti | 0 |
| Egypt | 0 | El Salvador | 0 |
| Eritrea | 0 | Eswatini | 0.03 |
| Ethiopia | 0 | Gambia | 0.026 |
| Georgia | 0 | Ghana | 0 |
| Guinea | 0 | Guinea-Bissau | 0 |
| Haiti | 0 | Honduras | 0 |
| India | 0 | Indonesia | 0 |
| Kenya | 0.024 | Kiribati | 0 |
| Korea | 0 | Kosovo | 0 |
| Kyrgyz Republic | 0 | Lao PDR | 0 |
| Lesotho | 0 | Liberia | 0.306 |
| Madagascar | 0 | Malawi | 0.25 |
| Mali | 0 | Mauritania | 0 |
| Micronesia | 0 | Moldova | 0 |
| Mongolia | 0 | Morocco | 0 |
| Mozambique | 0 | Myanmar | 0 |
| Nepal | 0 | Nicaragua | 0 |
| Niger | 0 | Nigeria | 0 |
| Pakistan | 0 | Papua New Guinea | 0 |
| Philippines | 0 | Rwanda | 0 |
| Sao Tome and Principe | 0 | Senegal | 0 |
| Sierra Leone | 0.174 | Solomon Islands | 0 |
| Somalia | 0 | Sri Lanka | 0 |
| Sudan | 0 | Syrian Arab Republic | 0 |
| Tajikistan | 0 | Tanzania | 0 |
| Timor-Leste | 0 | Togo | 0 |
| Tunisia | 0 | Uganda | 0 |
| Ukraine | 0 | Uzbekistan | 0 |
| Vanuatu | 0 | Vietnam | 0 |
| West Bank and Gaza | 0 | Yemen | 0 |
| Zambia | 0 | Zimbabwe | 0 |

*Table B2:* ***South Sudan and Synthetic South Sudan U5MR***

| Year | South Sudan U5MR | Synthetic South Sudan U5MR | % difference |
|---|---|---|---|
| 2000 | 182.9 | 182.8426 | 0.03% |
| 2001 | 173.4 | 173.9289 | -0.31% |
| 2002 | 164.4 | 164.7069 | -0.19% |
| 2003 | 155.7 | 155.6087 | 0.06% |
| 2004 | 147.5 | 146.9793 | 0.35% |
| 2005 | 139.7 | 139.1794 | 0.37% |
| 2006 | 132.5 | 132.06 | 0.33% |
| 2007 | 125.7 | 125.8299 | -0.10% |
| 2008 | 119.2 | 119.6679 | -0.39% |
| 2009 | 112.9 | 113.8931 | -0.88% |
| 2010 | 107.1 | 108.2225 | -1.05% |
| 2011 | 102.1 | 102.4761 | -0.37% |
| 2012 | 98.6 | 96.5463 | 2.08% |
| 2013 | 96.9 | 91.4954 | 5.58% |
| 2014 | 96.4 | 86.8374 | 9.92% |
| 2015 | 96.4 | 82.669 | 14.24% |
| 2016 | 96.4 | 79.0279 | 18.02% |

### 2.6.2 Robustness test results

Similar analysis was conducted excluding Liberia and Sierra Leone from the donor pool, as these are countries that have implemented a similar health policy as South Sudan. The pre-intervention trend in U5MR does not closely fit that of South Sudan when we exclude these two countries, however, the overall trend remains the same. Results are presented here.

*Table B3:* ***Predictor Variables***

| Predictor Variable | Weight |
|---|---|
| Under-5 mortality rate | 0.1327 |
| Domestic health expenditure (2012) | 0.0007 |
| Population ages 0-14 | 0.0548 |
| Crude death-rate | 1.60E-01 |
| Probability of dying (2010) | 0.1895 |
| Crude Birth-rate | 9.87E-03 |
| Life expectancy, female | 0.0023 |
| Female labor force participation rate | 8.89E-02 |
| Fertility rate, total | 0.0732 |
| Literacy Rate, 15-24 females (2008) | 0.0075 |
| communicable disease deaths (2010) | 0.15355 |
| Lifetime risk of maternal death (%) | 0.00015 |
| Survival to age 65, female | 0.1230 |
| Prevalence of stunting (2006&2010) | 0.0001 |
| DPT immunization coverage (2011&2012) | 0.0043 |

*Table B4:* ***Synthetic South Sudan Countries***

| Country | Synthetic Weight |
|---|---|
| Angola | 0.111 |
| Kenya | 0.125 |
| Korea | 0.002 |
| Mozambique | 0.27 |
| Nigeria | 0.46 |
| Rwanda | 0.032 |

*Table B5:* ***Predictor Variables***

| Predictor Variable | South Sudan | Synthetic South Sudan |
|---|---|---|
| Under-5 mortality rate | 138.5917 | 138.0507 |
| Domestic health expenditure (2012) | 22.86306 | 26.99581 |
| Population ages 0-14 | 44.18048 | 44.5997 |
| Crude death-rate | 14.21 | 14.24993 |
| Probability of dying (2010) | 28.05 | 28.0265 |
| Crude Birth-rate | 40.32167 | 42.30844 |
| Life expectancy, female | 52.61517 | 52.71315 |
| Female labor force participation rate | 48.37935 | 48.04113 |
| Fertility rate, total | 5.75925 | 5.755696 |
| Literacy Rate, 15-24 females (2008) | 29.57762 | 26.85879 |
| communicable disease deaths (2010) | 71.3 | 70.4794 |
| Lifetime risk of maternal death (%) | 5.909626 | 4.727339 |
| Survival to age 65, female | 46.78858 | 46.7125 |
| Prevalence of stunting (2006&2010) | 33.65 | 0.7088 |
| DPT immunization coverage (2011&2012) | 60 | 62.2325 |

*Table B6:* ***South Sudan and Synthetic South Sudan U5MR***

| Year | South Sudan U5MR | Synthetic South Sudan U5MR |
|---|---|---|
| Year | South Sudan | Synthetic South Sudan |
| 2000 | 182.9 | 173.5464 |
| 2001 | 173.4 | 166.9913 |
| 2002 | 164.4 | 160.4029 |
| 2003 | 155.7 | 153.7676 |
| 2004 | 147.5 | 147.1411 |
| 2005 | 139.7 | 140.548 |
| 2006 | 132.5 | 134.1189 |
| 2007 | 125.7 | 127.6838 |
| 2008 | 119.2 | 121.4343 |
| 2009 | 112.9 | 115.4249 |
| 2010 | 107.1 | 110.3371 |
| 2011 | 102.1 | 105.2119 |
| 2012 | 98.6 | 100.3136 |
| 2013 | 96.9 | 95.8525 |
| 2014 | 96.4 | 91.9773 |
| 2015 | 96.4 | 88.0134 |
| 2016 | 96.4 | 84.5357 |

# Paper 3: Contracting primary health care services in South Sudan: Does type of contract matter?


## Abstract

Contracting primary health care services to private providers is viewed as a means of expanding access to services and strengthening the government's stewardship role in post-conflict settings. This is despite that limited capacity of governments is often what necessitates contracting in the first place, and thus governments may be unable to appropriately monitor performance. There is need to assess different contracting modalities, to identify innovative ways of rebuilding health systems in post-conflict settings, taking into consideration public-sector capacity. This paper evaluates three contracting approaches in the two most populous states in South Sudan, Jonglei and Upper Nile; contracting-out (C-O) using non-governmental organizations (NGOs), contracting-in (C-I) using county health departments (CHD) and performance-based contracting (PBC) in select counties. Using difference-in difference (DD) and DD with propensity score matching, I hypothesized that contracting-out to NGOs leads to higher performance relative to contracting-in with CHDs, that performance-based contracting incentivizes health workers, hence PBC counties have higher utilization relative to non-PBC counties. However, results suggest that this is not as straightforward. Mean ANC 1st visits fall by almost 50% in CHD counties, whereas malaria treatment for pregnant women falls from 14 to 9 mean monthly treatments in NGO counties relative to CHD counties. There are no significant differences in ANC 4th visits and health facility deliveries. Similarly, there are no statistically significant differences in the double differences for DPT 1, DPT 3 and diarrhoea. PBC had no effect on utilization relative to counties where there was no PBC incentive. There is need to identify contextual factors, the specific implementation activities of providers such that compensation is tied to level of effort, appropriate incentives (reward) and penalty mechanisms and risk-sharing in order to accurately judge performance of health providers.



**Keywords**— Difference-in-Difference; Propensity-score matching; Under-five mortality; Contracting; Conflict-affected settings; Lower-and-middle-income countries; South Sudan

## 3.1 Introduction

Contracting-out of primary health services to the private sector has been advocated as a means of accelerating access to health services in lower and middle-income countries (LMICs) and particularly in fragile and conflict-affected states (Palmer, 2000; Batley and Mcloughlin, 2010; Kruk et al., 2010; Newbrander et al., 2011; Carpenter et al., 2012; Witter et al., 2015). Governments in these settings often have limited technical and managerial capacity to directly provide health services and therefore contracting is seen as a way of engaging the private sector, which is often perceived as having higher capacity and of being more efficient. Contracting-out started in developed countries, and has to-date been undertaken in Latin America (e.g. Bolivia and Guatemala) Asia (e.g. Bangladesh, Cambodia, Pakistan and India) and Africa (Rwanda, Southern Sudan and the Democratic Republic of Congo), largely influenced by bilateral and multilateral donor agencies, including the World Bank.

Contracting involves a formal contractual agreement between two parties with the relationship defined by a contract in which the principal, hereby referred to as the purchaser, engages an agent or provider to perform services on their behalf, and therefore delegates some decision-making authority to the agent (Jensen and Meckling, 1976; Smith et al., 1997). The purchaser is often the government, whose responsibility is providing financial support and oversight with the overall objective of improving the performance of the health system, while the providers or agents are typically non-governmental organizations (NGOs) (Liu et al., 2007). The contract therefore provides a link between public finance and defined results.

Contracting-out and contracting-in, in the context of fragile and conflict affected countries was first implemented in Cambodia starting in 1999. Contracting-out (CO) involves the implementation of the contract by a party outside of the government, typically international or local NGOs, whereas contracting-in (C-I) involves the national or central level of government utilizing local government institutions in the implementation of the contract, where the health-sector is decentralized (Abramson, 2009; Bhushan et al., 2002; Soeters and Griffiths, 2003). In both cases, the NGO and the local government is considered the

provider or agent. Performance-based contracting (PBC) was also implemented in Cambodia, and subsequently popularized in Afghanistan (Sondorp et al., 2009; Newbrander et al., 2014). PBC is often embedded in contracting, whereby fixed price contracts are based on pre-specified performance targets and includes a mechanism to reward or penalize performance against a pre-specified standard (often measures of quality). PBC therefore depends on careful monitoring of performance, and fidelity to the design of the approach, in order to be successful.

South Sudan, a fragile and conflict-affected country, provides a unique opportunity to assess the results of large-scale contracting for primary health care services. In the two most populous states, Jonglei and Upper Nile, three different contracting approaches were implemented by a World Bank project; contracting-in, contracting-out and performance-based contracting (PBC). Contracting-in involved utilizing county-health departments (CHD), which are formally part of the MoH as the provider, while contracting-out was done with local and international NGOs. I hereby refer to these as C-I (CHD) contracts and C-O (NGO) contracts respectively, for simplicity. Performance-based contracting was also utilized in counties where health-worker salaries were paid by the government and not by the project, as a way of incentivising performance among public-sector employees. PBC was implemented in all C-I (CHD) counties and select C-O (NGO) counties where health worker salaries were paid by the state. Therefore, success of the PBC approach will also depend on whether the incentives were adequate to motivate performance of health-workers, in addition to whether the penalty and reward mechanism was adhered to.

Utilizing the CHD as a provider may increase the sustainability of the contracting model due to the lower costs associated, as well as the level of ownership the CHD has over the health facilities and health workers. CHDs may also have a larger sense of responsibility to improve health services being part of the MoH, and this may provide additional incentive to ensure performance targets are met. However, CHDs may also have limited human resources capacity to manage large-scale contracts, and this limited technical and managerial capacity may deter performance and necessitate additional capacity-building efforts on the part of the purchaser. This can be adduced by the fact that the contracting

intervention was introduced due to existing capacity constraints within the public sector, which would also affect the local government institution.

In South Sudan, NGOs have had a longer experience providing basic health services as there were no formal government structures during the period of protracted conflict. NGOs therefore tend to have existing technical, financial and managerial capacity, and may therefore be able to negotiate and receive larger contracts than CHDs as a result. NGOs may also have stricter contractual obligations as they may be easier to replace whereas it may be difficult to replace a non-performing government agency as this may carry political risk. These differences in contract modalities may matter and hence it is worthwhile to make comparative assessments of health services utilization of the two contracting types.

I hypothesize that as C-O (NGO) contracts have greater accountability mechanisms and verifiable performance measures compared to C-I (CHD) contracts, are often more enforceable and may attract higher bids, NGOs have greater incentive to meet contract deliverables, compared to CHDs. Therefore, counties managed by local or international NGOs will have higher performance, as measured by number of children receiving diphtheria, pertussis and tetanus (DPT) vaccines, receiving treatment for malaria and diarrhoea, number of women with antenatal-care visits, with two or more doses of intermittent presumptive treatment of malaria during pregnancy with sulphadoxine with pyrimidine (IPT-Sp) and delivering in the health facilities. These outcome measures are selected as they are priority indicators for the Ministry of Health and also due to the fact that they are key priority interventions for reduction of child and maternal mortality. The primary data source is the district health information database which captures routine health facility utilization nationwide. I focus on the post-independence period (2011-2015) to assess the effect of the contracting approaches; comparing C-O (NGO) counties to C-I (CHD) counties to assess contracting in relative to contracting out, using difference-in difference (DD) and DD with propensity score matching.

Contract-theory suggests that the provider or agent, in this case the CHDs and NGOs may not always act in the best interest of the purchaser, unless adequately incentivized

and there are appropriate monitoring controls. Indeed, the 2016 Nobel Prize in economics was awarded to Hart and Holmström, for their work on the design of incentives in contracts, underscoring the importance of understanding payment or incentive mechanisms (Committee et al., 2016). In addition, the purchaser does not directly observe the actions undertaken by providers which produce the outcome, as is often the case when contracting in fragile and conflict-affected settings, where monitoring and evaluation mechanisms are often non-existent. This may lead to a problem of moral hazard: the provider may undertake actions that increase his/her compensation, for example focusing on deliverables that are carefully monitored at the expense of providing a full complement of health services, contrary to the expectations of the provider. To alleviate the moral hazard problem, the payment structure must therefore be tied to an observable and verifiable performance measure (Smith et al., 1997; Committee et al., 2016). This is referred to as paying for performance or results-based financing.

Paying for performance requires contracts that detail the services to be provided, and performance measures to be used for verification *ex ante*, as well as the ability to verify and measure performance, *ex post*. This is often difficult to achieve, as the performance measures are typically in the control of the provider, and not the purchaser. In the case of South Sudan, the DHIS collects monthly routine health facility utilization data from health facilities nationwide and is relatively independent of provider control, as reporting is through government channels.

An additional problem with contracts arises when performance depends on factors largely beyond the provider's control, and hence well-drawn contracts must balance compensation against risk-sharing. This often results in what Hart refers to as incomplete contracts, whereby "the contract will specify some actions the parties must take but not others; it will mention what should happen in some states of the world, but not in others(Hart and Moore, 1988)." The result of this may be that parties to the contract act in ways beneficial to them, but different from the agreement, hence contracts must also specify penalties when parties fail to meet their obligations. Recognizing the incompleteness of contracts necessitates understanding the relationship between the parties to the con-

tract, and the specifics of the contracts as this may determine how the overall contracting agreement operates(Palmer, 2000).

Performance-based contracting (PBC), is increasingly seen as a way of aligning provider incentives with health outcomes to address the inherent weakness of incomplete contracts. PBC is defined as the mechanism by which performance is expressed in a formal agreement between parties, often by setting a fixed price for the desired output, and that includes penalties for poor performance or rewards for performance that exceeds the standard defined in the contract (Musgrove, 2011). Thus, PBC rewards providers for achieving pre-specified performance targets, awards effort toward improving quality of services, while penalizing poor performance (Miller and Babiarz, 2013; Fritsche et al., 2014). PBC has been a key feature of contracting-out in a number of LMICs[1].

In South Sudan, all C-I (CHD) counties were under PBC, however, this was not true for all NGO counties, where some implemented PBC while others did not. In order to assess whether PBC had an effect on increasing utilization, I compare PBC and non-PBC counties under the hypothesis that PBC counties have higher utilization. Lack of adequate sample size makes its difficult to compare PBC within NGO counties. The analysis also uses difference-in difference (DD) and DD with propensity score matching.

This analysis is important for extending elements of contract theory to the health system research and specifically in conflict affected settings. In an optimal setting, provider compensation is based solely on the observed and verified performance of the provider. This performance however, relies on the provider's effort, as well as factors that may be beyond their control (referred to as noise). For example, some providers may consistently achieve good results due to working in easy to operate environments, whereas others may achieve poor results regardless of effort, if they are working in hostile environments. This is often the case in fragile and conflict-affected settings, where providers may avoid working in areas that have high insecurity or are inaccessible.

[1]While PBC and PBF (performance-based financing) are often used interchangeably, PBF refers to situations where individual health-workers are paid directly, on achievement of performance targets of a pre-specified quality. The payments are often per-capita improvements in health facility utilization. PBC payments are however paid to the providers (who may be NGOs, government agencies or the health facility)

Rewarding the provider based on 'output', may thus result in a model which rewards the noise factors and not actual effort. Hart and Holmström recommend that contracts be based not only on measurable outcomes *ex post*, but also on the providers' effort. This is the informativeness principle, whereby compensation is tied to level of effort and this is increasingly observed in existing contracting-out models where providers receive an equity bonus if they work in difficult environments. Holmström argues that "additional information is of value because it allows a more accurate judgment of the performance of the agent; or viewed differently, it provides the same incentives for effort with less loss of risk-sharing benefits (Holmström, 1979). For South Sudan specifically, the analysis considers the context in which these contracts are drawn, by accounting for variation in counties and health facility infrastructure.

Well-designed contracts provide adequate incentives for both parties to gain from the contractual agreement; are explicit in expectations of both parties, transfer a degree of management autonomy to the providers and have well defined monitoring mechanisms. This suggests that the way in which contracts are designed and their specificity as well as performance monitoring mechanisms are critical determinants for their success (Liu et al., 2007). In fragile and conflict-affected countries, the services defined in the contract are often based on a basic package of health services developed by the government/ Ministry of Health (MoH). This analysis presents an extensive description of the NGO and CHD contracts, based on a qualitative assessment of contracts received from the implementing agency. In numerous similar studies, the specifics of the contract are not well explained, and this has been previously noted as a limitation (Palmer, 2000; Liu et al., 2007).

The degree of management autonomy allows providers to make context-specific decisions to meet their contractual obligations while performance monitoring ensures that the purchaser's expectations are indeed met. Often though, contracts in post-conflict settings do not carry adequate penalties, as the regulatory environment is often weak making it difficult to enforce contractual obligations ( OECD Partnership for Democratic Governance (PDG), 2010). Furthermore, there is often lack of competitive bidders making it difficult to drop non-performing providers. Contract monitoring also depends on the capacity of

the purchaser- both financial and technical capacity – to adequately manage contracts (Liu et al., 2007; Arur et al., 2009).

There is limited information on how contracts are managed and monitored especially in fragile and conflict-affected settings where the capacity of the provider may be limited, and it is this limited capacity that often informs the need for contracting-out the health sector in the first place (Witter et al., 2015). This is also a limitation of this analysis; there is inadequate information on the capacity of the implementing providers and the lead agency managing the contracts. In addition, there is inadequate information on whether the penalty and reward mechanism in the contracts is adhered to during the implementation of the contracts. Despite this, the paper provides useful information in understanding the contracting modalities in South Sudan with aim of improving how contracts are designed and managed in fragile and conflict affected settings.

The paper is organized as follows; I first provide a brief history of contracting globally and in South Sudan, and then extensively describe the contracting intervention in Jonglei and Upper Nile states, describing the specifics of the contract mechanism, and the contracting environment. I then outline the empirical strategy, difference-in-difference (DD) and difference in difference with propensity score matching and discuss the results. Finally, I discuss the policy implications.

### 3.1.1 A brief history of contracting

Contracting-out as a health-sector reform began in the 1980s primarily in countries within the Organization for Economic Cooperation and Development (OECD), in response to the increasing rate of publicly financed health-care. Increased spending was primarily due to expansion in public insurance but was also associated with increase in the number of health facilities, medical personnel and healthcare technologies (Oxley and MacFarlan, 1994; Docteur and Oxley, 2003; Maarse, 2006). Due to the expansion of the social insurance net, health insurance was transformed from a market commodity to a public good, which resulted in reductions in private spending on healthcare, with concurrent increases in public spending prior to the initiation of the reforms (Maarse, 2006). Health-sector reforms thus consisted of efforts to shift healthcare spending back to individuals by increasing private

expenditures and reducing costs by reintroducing market principles in efforts to reduce public expenditure.

In the OECD countries, health services delivery largely consisted of a *public-integrated* model whereby health-providers were public sector employees managing publicly owned health facilities and a *public-contract* model (also referred to as a public-private model) whereby the state contracted private healthcare providers and payment for services primarily occurred *ex post*. Reforms entailed separating the role of purchasers/ funders of healthcare from that of providers of health services, in effect moving to the public-contract model, with ownership of provider organizations shifting to the private sector (Docteur and Oxley, 2003; Vining and Globerman, 1999; Maarse, 2006). The underlying assumption was that competition within the private sector would result in better performance and efficiency gains, with the government better suited to play a stewardship/regulatory role within the health sector. Thus contracting happened in a context where government financing for healthcare was adequate, but rising as a proportion of GDP. For example, among all OECD countries, total expenditure on health care increased by 1.9 percentage points in the 1970s before decreasing to 0.2 percentage points between 1980 and 1992 (Oxley and MacFarlan, 1994). In some countries, reforms consisted of efforts to re-introduce elements of the market into the health care sector and to shift some healthcare costs from public financing to private insurance. underlying all these reforms, governments largely had the capacity to provide stewardship to the health sector.

Whereas health reforms in the OECD countries were driven by cost-containment efforts, in the developing world reforms were primarily due to concerns about government capacity to efficiently manage the health sector (Broomberg, 1994; Mills, 1998; Palmer, 2000) in settings with inadequate government spending on health. The private sector was largely perceived to be a more efficient provider of basic services. Lack of adequate information on the rational allocation of resources had also led to an over reliance on historical costs rather than on population needs, resulting in poor quality care, inequitable health systems and an over-extended state health system that did not deliver as expected (Broomberg, 1994). The health delivery model in developing countries is similar to the

*public-integrated* model in most OECD countries whereby health workers are public sector employees and health facilities are primarily government owned. The health reform therefore was a shift to a *public-contract* model, however unlike the OECD countries, health facilities remained under ownership of the public sector but managed by local and international non-governmental organizations (NGOs).

Similar to OECD countries, the underlying assumption of health reforms was that expanding the role of the private-sector in health-care provision would increase competition, improve efficiency, reduce costs and extend consumer choice (Mills, 1998; McPake and Banda, 1994; Broomberg, 1994). The contract was a way to link financial allocations to health sector outputs and outcomes, and to clarify the roles and responsibilities of parties to the contract, presumably leading to greater transparency and accountability (Palmer, 2000; England, 2000; Liu et al., 2007). In contrast to the developed world however, these health reforms were initiated by bilateral and multi-lateral donors with the government presumed to have the capacity to perform its stewardship role of the health sector.

In fragile and post-conflict settings, contracting-out has been promoted as a health-system strengthening model where it is viewed as a means of rebuilding the health system, transitioning from humanitarian aid to developmental aid, and more importantly establishing the legitimacy of the state through strengthening its capacity to provide basic services (Palmer, 2000; Batley and Mcloughlin, 2010; Kruk et al., 2010; Newbrander et al., 2011; Carpenter et al., 2012; Witter et al., 2015). The use of contracting-out in a post-conflict setting was first carried out in Cambodia, and has since been utilized in Afghanistan, the Democratic Republic of Congo (DRC), Liberia and South Sudan (Newbrander et al., 2011). In these settings, the physical health infrastructure is either significantly impaired or non-existent, there is a critical shortage of the health workforce, and basic services are typically delivered by NGOs and financed by international donors. In addition, the government often lacks the resources, capacity or legitimacy to ensure security, provide services and guarantee political or economic stability, resulting in contracting-out often being the only viable strategy for service delivery. However, due to weak government capacity, there also often lacks a legal regulatory framework within which to enforce contracts, and it

is questionable whether the government can adequately monitor the performance of contracted NGOs. ( OECD Partnership for Democratic Governance (PDG), 2010; Witter et al., 2015).

The purchasers in these settings are typically bilateral and multilateral donors (primarily the World Bank, the United States Agency for International Development (USAID), the European Union or United Kingdom's Department for International Development (DFID)) (Mills, 1998; Palmer, 2000; Sondorp et al., 2009; Newbrander et al., 2011), although funding might also be channelled through government procurement systems, thus retaining the classical definition of contracting. The providers or agents are typically NGOs who may or may not have already been providing services during the conflict period or public providers (for example government agencies or health departments) responsible for implementing the contract.

In the cases where the government is also party to the contract as a provider, this is referred to as "contracting-in" or internal contracting, and often accompanies management support to the government by an external agency (Bhushan et al., 2002; Grundy et al., 2009). Liu 2007 argues that the provider's status, i.e. whether public or private may impact the effectiveness of the contracting-out initiative. For example, in Cambodia, the contracting-out model was found to perform better than the contracting-in model in expanding access to health services overall by 1.7 contacts per capita compared to 1.2, for reproductive and child health services specifically (Bhushan et al., 2002). This, however, may have been due to the contracted-out districts receiving more funding and hence this may have been due to greater availability of resources due to the higher incentive to achieve targets and ability to pay higher health worker salaries. It is therefore necessary to understand the contract details to effectively compare contracting approaches as the contracts directly affect how they are implemented.

Performance-based contracting is increasingly seen as a way of aligning provider incentives with health outcomes to address the inherent weakness of incomplete contracts. The approach rewards providers for achieving pre-specified performance targets that are tied to minimum quality standards (Miller and Babiarz, 2013; Fritsche et al., 2014). PBC thus

incorporates a mechanism that rewards provider's efforts when they supersede minimum quality standards or penalties where standards are not met. Performance-based contracting in lower and middle-income countries can be traced to the introduction of contracting of non-governmental organizations. For example, in Cambodia, contracts between NGOs and the Ministry of Health were fixed price contracts with payment linked to achievement of performance targets, primarily for the provision of maternal and child health services (Van de Poel et al., 2016). In some districts, a performance-based incentive structure was introduced in contracts signed with individual health workers whereby health-worker salaries were based on a monthly incentive payment of 55% over 3-month contract periods, punctuality incentive of 15% based on attendance history and a performance bonus of 30% for meeting health facility monthly financing targets (Soeters and Griffiths, 2003). In both cases, incentives were provided at the health facility level with individual staff[2] or in contracts with NGOs and were funded by introduction of user-fees in addition to government subsidies. During the same time period, USAID implemented a performance-based model in which NGOs received 95% of their budget based on reported expenditures, but were eligible to earn a 10% bonus on meeting pre-defined targets. Thus NGOs risked 5% of their budgets for a potential 10% gain (Eichler et al., 2006).

### 3.1.2 History of contracting in South Sudan

The Comprehensive Peace Agreement (CPA) between Sudan's National Congress Party and the Southern region's Sudan People's Liberation Movement and Army (SPLM/A) in 2005 led to the formation of the Government of Southern Sudan (GoSS) based in the semi-autonomous southern region and a Government of National Unity (GoNU) in the North. Over 30 years of conflict had left the southern region with limited developmental and economic activities. Infrastructure was virtually non-existent, livelihoods were limited to subsistence agriculture and the civil service and service delivery structures had to be developed from scratch (WB and UN, 2005; AFR/OPCS, 2010).

During the conflict period, the health-sector was primarily supported by at least 76

[2]Where health-workers are compensated directly, this is technically referred to as performance-based financing (PBF), although PBF and PBC are often used interchangeably (Musgrove, 2011).

NGOs with humanitarian aid funding from multilateral and bilateral donors and United Nations agencies. Majority of NGOs were under a consortium established by the United Nations Children Fund (UNICEF) and the World Food Programme (WFP) known as Operation Lifeline Sudan (OLS). This resulted in fragmented health services delivery with most NGOs focussing on specific diseases and specific geographical regions, resulting in a highly inefficient health sector (Cometto et al., 2010). It is therefore not surprising that in 2006, a national Sudan Health and Household Survey (SHHS-I) confirmed that the southern region had some of the worst health indicators in the world; maternal mortality was 2,054 per 100,000 live births, infant and child mortality of 102.4 and 135.3 per 1,000 live births. Only 2.7% of children were fully immunized by 12 months of age, with 43% of children in this same age-group had not received any of the recommended vaccinations whatsoever (South Sudan National Bureau of Statistics(SSNBS), 2006a).

The CPA mandated the formation of the Multi-Donor Trust Fund for Southern Sudan (MDTF-SS) to support the implementation of the CPA by international partners, and as means to identify key priority areas for national focus and international support ( AFR/OPCS, 2010; FAFO, 2013). A key component of state-building was the provision of basic services, thus the Southern Sudan Umbrella Program for Health Systems Development (UPHSD) was designed as a three-year, US$225 million project to be operative in all 10 states [3] and implemented between 2006 – 2010. The UPHSDP aimed to develop health sector systems and capacities and to rapidly increase access to basic health services and high-impact interventions at the primary health care level (World Bank, 2013). These interventions were outlined in a basic package of health services (BPHS) which prioritized preventable childhood illnesses, reproductive health, nutrition services and communicable diseases (Ministry of Health Republic of South Sudan, 2010). The UPHSD adopted a "contracting-out" approach involving technical lead agencies to oversee the contracts and non-governmental organizations to support the delivery of services and to build the capacity of local partners. Note that given the limited capacity of the government, contracting out was also the only feasible mechanism for rapid expansion of health services delivery in

[3] the ten states are: Western Equatoria, Central Equatoria, Eastern Equatoria, Northern Bahr el Ghazal, Western Bahr el Ghazal, Lakes, Warrap, Jonglei, Unity and Upper Nile

the country.

Donors were to finance US$75 million and the GOSS US$150 million, however GoSS did not meet its obligations, and the project was redesigned as a US$63 million project covering only 6 counties in the 4 states of Upper Nile, Jonglei, Central Equatoria, and Eastern Equatoria. Due to delays in MDTF disbursements and in obtaining competitive bids from NGOs, the first contract signed by the UPHSD was with IMA World Health in 2008, to support health programs in Upper Nile and Jonglei States of Southern Sudan. Subsequent contracts were signed with Norwegian People's Aid in Central Equatoria and Health and Life Sciences Partnership in Eastern Equatoria. Phase II of the UPHSD had similar objectives and design and an explicitly limited geographical scope; the objectives were; to improve delivery of the BPHS in the four states (Upper Nile, Jonglei, Central Equatoria, and Eastern Equatoria) with existing contracts; and to strengthen key stewardship functions of the Ministry of Health including in monitoring and evaluation and pharmaceuticals management. IMA continued as the lead agency in the two states through UPHSD-II and subsequently after the independence of South Sudan in 2011, thus the two states may have benefitted from having continuous support by one lead agency. Note that the remaining six states had other donors, for example USAID and DFID-UK, but were largely outside the remit of the MoH as the government did not pool funds into these health programs.

### Geographically-focused donor-funding approach

In 2010, a second Sudan Health and Household Survey (SHHS-II) was conducted to update information on the health status of children and women of South Sudan and to generate data to monitor progress towards achieving the Millenium Development Goals (MDGs) (South Sudan National Bureau of Statistics(SSNBS), 2006b). SHHS-II indicated that there had been limited improvements in the health status of southerners, despite the large amounts of external assistance in the transition period. The survey did not assess maternal mortality and infant and under-five mortality rates were calculated based on indirect estimation to estimate probability of dying before the first and fifth birthday respectively. The probability of dying before 1 year of age and 5 years of age was estimated

at 75 and 105 respectively. There were limited improvements in immunization coverage; DPT coverage was 25% and 13% for the first and third doses with measles vaccination coverage of 26.3% lower than the 28% estimate in 2006. Reproductive health indicators also showed slight improvements; 13% of pregnant women had had antenatal care, with 17% of them receiving care from a skilled provider while 40.3% of women had given birth under the attendance of at least one skilled personnel, an increase from 2006.

*Table 3.1:* ***Select Health Indicators, SHHS***

| **Indicators** | **Value 2010** | **Value 2006** |
|---|---|---|
| Under-five mortality rate | 106/1000 | 135/1000 |
| Infant mortality rate | 84/1000 | 102/1000 |
| Maternal mortality ratio | | 2054/100,000 |
| **Water and sanitation** | | |
| Improved drinking water sources | 68.00% | 48.30% |
| Water treatment | 9.90% | 13.10% |
| Use of improved sanitation facilities | 15.40% | 6.40% |
| **Child health** | | |
| DPT immunization coverage (children 12-23 months) | 13.80% | 20.20% |
| Measles immunization coverage (children aged 12-23) | 20.60% | 27.70% |
| Fully immunized children (children aged 12-23) | 1.80% | 2.70% |
| Anti-malarial treatment | 9.00% | 47.00% |
| Proportion children U5 who had diarrhoea | 34.40% | 42.90% |
| Proportion children U5 who had fever- malaria | 32.00% | 45.50% |
| **Reproductive Health** | | |
| Antenatal care coverage at least once | 46.7% | 26.20% |
| Skilled attendant at delivery | 14.70% | 10.02% |
| Institutional deliveries | 12.30% | 13.60% |

Progress was however slower than that observed in other post-conflict states and especially those that had implemented contracting-out. This may have been due to the nature of the NGO service delivery contracts during the MDTF period, which were short-term contracts as well as the delays in signing the first contracts suggesting a limited number of competitive bids(World Bank, 2013). Thus the nature of the contracts may have been a limitation. In addition, there was a lack of equitable geographical coverage of services with some areas receiving little to no adequate funding, and others supported by more than one donor. Therefore in 2011, the Ministry of Health established a geographically focused financing approach to support the primary health care system across all 10 states in the country, in order to address the gaps in geographical coverage of services, and to rapidly improve the health status of primarily women and children in South Sudan, after the limited progress observed in SHHS-II ((MoH) Government of Southern Sudan (GoSS),

2010). This also allowed the MoH to play a greater role in stewarding the health-sector, as donors signed agreements with the government.

The financing architecture primarily relied on three key donor mechanisms; USAID, World Bank and a Health Pooled Fund led by DFID-UK and consisting of funds from 5 countries. Three health programs were established; USAID-funded Integrated Service Delivery Program (ISDP), World Bank-funded Rapid Results for Health Program (RRHP) and the Health Pooled Fund (HPF). The three donors recruited lead agencies, to manage and coordinate state-level health service delivery and to strengthen the capacity of State Ministries of Health (SMoH) and County Health Departments (CHD) to oversee the health system. The lead agencies subsequently established county-wide contracts with one implementing partner in each county, typically a local or international NGOs to cover all the health facilities in a county.

The overall goal of the MoH was to ensure that all primary health care facilities in the country received technical and financial support. USAID and HPF health programs had similar implementation modalities, with NGOs as implementing partners, however, the World Bank RHHP instituted two unique mechanisms; contracting-in with county-health departments in select counties in addition to contracting-out and performance-based contracting (PBC), allowing for a comparison of the different contracting modalities. The focus of this analysis is thus on the RHHP project. In addition, the RHHP project shared contract documents, allowing for a deeper insight into the design of the contracts, which as previously argued, is necessary to understand the strengths and limitations of the contract design, based on contract-theory.

## 3.2 Contracting in Jonglei and Upper Nile States

After 2011, the IMA health program was redesigned as the South Sudan Rapid Results Health Project (RRHP) with funding from the World Bank and drawing from the implementation lessons of the pre-independence period. The RRHP was established in December 2011, with a grant of US$28 million to the government of South Sudan, to improve health service delivery in Upper Nile and Jonglei States. The grant was directly administered

by a Project Financial Management Unit (PFMU) within the Ministry of Finance and Economic Planning (MOFEP) which provided direct oversight of funds disbursed to the Ministry of Health. This was another unique element of the RRHP; unlike the other two donor mechanisms, USAID and HPF which provided funds to lead agencies, the RHHP used government procurement mechanisms to channel funds to the lead agency (World Bank, 2012).

The project enabled the MoH to establish a performance-based contract directly with IMA, which was selected due to its long history supporting primary health care services in the two states, under the Multi-Donor Trust Fund (MDTF). As the lead agency, IMA was obligated to submit quarterly reports which were verified by the MoH and a third-party M&E team, prior to receipt of lump payments from the Ministry of Finance, thus these contracts were based on a pay-for-performance model. The project developed and piloted the MoH's district health information system (DHIS), and as reporting was based on the results obtained from the DHIS, prioritized strengthening the reporting system.

In Jonglei State, IMA contracted non-governmental agencies (NGOs) to manage all 11 counties[4], a contracting-out model, while in Upper Nile State [5] 5 counties had contracts with County Health Departments while the remaining 8 counties were managed in a similar model as in Jonglei. The CHD is the lowest level of the decentralized MoH system, reporting to the State MoH and finally the centralized MoH, and thus represent a contracting-in model. CHD-managed counties were Renk, Manyo, Melut, Malakal and Akoka. IMA established two types of contracts; fixed-price contracts with NGOs, hereby referred to as C-O (NGOs), and flexible contracts based on a memorandum of understanding (MOU) with the CHDs, referred to as C-I (CHDs) for simplicity. The contracts specified the catchment population targeted for health services and the health facilities under the contract. The smallest health facilities are the primary health care units (PHCUs) serving a catchment population of approximately 5,000 followed by primary health care centers (PHCCs), which serve a catchment population of approximately 10,000. The populations are not distinct,

[4]Counties in Jonglei: Akobo, Ayod, Bor, Duk, Fangak, Nyirol, Pibor, Pigi, Pochalla, Twic East, and Uror

[5]Counties in Upper Nile: Akoka, Baliet, Fashoda, Longechuk, Luakpiny/Nasir, Maban, Maiwut, Malakal, Manyo, Melut, Panyikang, Pibor, Renk, and Ulang

as they often serve the same populations and provide similar services, however PHCCs also serve as referral sites for PHCUs. Some contracts also included support for county hospitals where these existed, as these are referral centers for both PHCCs and PHCU's.

Health facility ownership remained with the MoH and all health facility staff are government staff, although the contracts allowed for payment of staff salaries and incentives, and recruitment of additional staff where needed to ensure the right mix of staff as per MoH guidelines. IMA and the SMOH also established a salary range to mitigate the differences in salaries between former NGO and MOH supported facilities that existed prior to the RRHP, and to prevent movement of staff to higher paying areas[6]. In addition, there was a performance bonus for county health departments and health facilities which met or exceeded targets; CHDs received a bonus of up to 4,000 SSP per month (approximately 1,400US$), PHCCs up to 1,600 SSP (500US$) and PHCUs up to 600 SSP per month (200US$)[7]. These bonuses were based on timely submission of health facility monthly reports, number of structured supportive supervisory visits to health facilities and achievement of diphtheria, pertussis and tetanus vaccination coverage rates and antenatal care 1st visit targets. Supervisory visits were based on MoH quantified supervisory checklists (QSC), and were meant to assess the quality of services provided, thus implementing partners also provided minimum QSC scores.

### 3.2.1 Contracting-out with NGOs: C-O (NGO) Contracts

I received four NGO contracts from IMA in March 2019; two with local NGOs and two with international NGOs, which I have carefully reviewed. The contracts are standardized across both local and international NGOs. C-O (NGO) contracts are fixed-price annual contracts based on a pre-specified scope of work and paid through periodic instalments. Summary cost details are presented in table 3.2 below for illustration. The scope of work included supporting the CHDs and strengthening the health system through ensuring availability of the right mix of health facility staff according to MoH guidelines, ensuring drugs

[6]For example, the per monthly range for a clinical officer/ medical assistant was 2,119 South Sudanese Pounds (SSP) – 2,590 SSP (US$ 700-850), for a certified midwife was 1,949 – 2,382SSP (US$660-800), and community midwife was 1,082SSP – 1322SSP (US$ 360-450), as per IMA internal documents

[7]1US$ = SSP 2.95 using 2012 exchange rates

and medical supplies were available at functional health facilities, supporting monitoring and reporting through monthly review meetings, payment of the monthly operational costs for CHDs (fuel, repairs and communications) and providing monthly performance incentives to CHD personnel directly engaged in the RRHP. One of the key objectives of the RHHP was to strengthen the capacity of the local and central MoHs in providing oversight and management of the health sector, hence this was to strengthen the role of the CHDs as stewards of the health system.

Implementing partners were also expected to facilitate monthly review meetings between the CHDs and health facilities staff. In addition, they were expected to conduct quarterly supervision visits to health facilities using the MoH quantified supervisory checklist (QSC) in addition to weekly supervision visits to the health facilities. To increase health facility utilization, the contract outlines several activities; community mobilization and health education to increase demand and service uptake, regular discussions with community leaders to encourage health services utilization and to promote feedback mechanisms and active surveillance of vaccine-preventable and other reportable diseases.

*Table 3.2:* ***C-O (NGO) Contracts***

| **Type of NGO** | **I-NGO (1)** | **I-NGO (2)** | **local-NGO (1)** | **local-NGO (2)*** |
|---|---|---|---|---|
| County | Ulang | Fashoda | Bor | Duk |
| Target Population | 25,342 | 52,650 | 304,400 | 65,588 |
| Total Contract Cost | $156,863 | $191,813 | $384,000 | $148,500 |
| Cost per capita (Estimated) | 6.19 | 3.64 | 1.26 | 2.26 |
| Type of Contract | Fixed Price | Fixed Price | Fixed Price | Fixed Price |
| Payment | installments | installments | installments | installments |
| | | | | |
| Monthly Cost Summary | | | | |
| Total CHD support | 900.00 | 9,166.00 | 5,234.00 | |
| Total PHCC support | 9,709.00 | 5,061.00 | 28,070.00 | |
| Total PHCU support | 6,158.00 | 9,817.00 | 10,771.00 | |
| Program Management | 21,204.00 | 16,119.00 | 18,793.00 | |
| Indirect cost (%) | 7% | 5% | 0% | |
| Indirect Amount | 1,484 | 2,007.13 | 0 | |
| | | | | |
| Primary healthcare costs (calculated) | | | | |
| Number of PHCCs | 2 | 2 | 6 | |
| Number of PHCUs | 3 | 7 | 18 | |
| Cost per PHCC | 4,854.50 | 2,530.50 | 4,678.33 | |
| Cost per PHCU | 2,052.67 | 1,402.43 | 598.39 | |

*I-NGO= International NGO. Duk county contract did not include monthly operational costs

While providers were to implement the complete basic package of health services, targets were based on five verifiable performance measures; number of children who received DPT3 before 12 months of age, number and proportion of pregnant women receiving

ANC first visit, number and proportion of health facilities submitting standardized HMIS monthly reports, number and proportion of health facilities with monthly structured supervision visits (using QSC) and number and proportion of health facilities having essential drugs. These performance measures were selected after discussion with the Ministry of Health (MoH) and are based on MoH priorities. Providers may have had motivation to focus on these five measures, at the expense of providing the entire basic package of health services due to compensation being directly tied to these performance measures.

Payment of contracts was after the submission of the following key deliverables; a two-part monthly report consisting of a technical report and data, payment of monthly operational costs to the CHD, joint monthly supervision visits with the CHD and conducting community mobilization activities. The contracts do not outline how weekly supervision visits, performance against targets or community mobilization efforts are verified by the lead agency. It is also unclear how the results are assessed against the above-mentioned performance measures; the external M&E agency may have played a verification role, but this is not clearly specified in the contracts. There were, however, quarterly joint verification meetings between the lead agency, MoH and implementing partners. Critically, the contracts do not stipulate the reward and compensation mechanism (these are outlined in external project documents, as in the PBC section below). These limitations have implications on whether the contracts are adequately implemented, given that performance relies on provider effort (the informativeness principle).

In conclusion, while the contracts outline performance measures, they do not also indicate the means of verifying providers' effort and may thus be subject to the problem of moral hazard. Neither do the contracts stipulate associated rewards for exceeding targets, nor the penalties for poor performance, albeit they may be terminated at will. This may be a limitation of the contracting approach as implemented in these two states. I argue that the contracts do not take adequate consideration of the contextual environment; it is possible that some counties were operationally challenging compared to others and an 'equity bonus' might have provided additional incentives for providers in difficult environments. The analysis relies on propensity score matching to account for these differences.

As illustrated in table 3.2, while international NGOs were able to charge indirect costs, this was not available for local NGOs. It also appears that local NGOs may have received less compensation despite having to meet the same contractual obligations as international NGOs. Due to lack of adequate sample size, resulting from the relatively few local NGOs, it is not possible to determine whether there were performance differences as a result. Lastly, I was unable to ascertain the number of bids received per county or the overall bidding process as this information was not available, thus it is difficult to determine the competitiveness of the contracting environment, and thus allocative efficiency. Should there have been a lack of bids for contracts, this would have limited the ability of the purchaser to select the most competent provider for each county, or to replace non-performing providers. Most NGOs were retained during the entirety of the evaluation period with changes made in only four counties where contracts were transferred to local NGOs, suggesting that there may have been a lack of competitive bids. Two of these changes were due to the withdrawal of international NGOs from the states.

### 3.2.2 Contracting-in with CHDs: C-O (CHD) Contracts

IMA also contracted County Health Departments (CHD) in Akoka, Manyo, Makal, Melut and Renk counties in a similar manner to NGOs; to provide health services to select catchment populations and health facilities. I reviewed C-O (CHD) contracts from Manyo, Melut, and Renk counties. These contracts are referred to as memoranda of understanding (MoU) and document the roles and responsibilities of either party, with IMA also playing an active role in meeting project deliverables and building the capacity of the CHDs to manage the contracts.

IMA's obligations were to provide supplies and equipment, jointly supervise and assess the health facilities with the CHDs, and to pay facility staff salaries and CHD operation costs. CHD responsibilities included the deployment and recruitment of health workers, submission of monthly health facility reports, supervision of health facilities, and submission of reports on operation subsidies allocated to the CHD by IMA. Amendments to the MOU was by mutual consent and the MOU could be terminated at any time also by mutual consent, but only after meeting remaining contractual obligations. However, as the

CHD was the acting representative of the government, and the IMA contract was with the MoH, it is unclear whether IMA had the flexibility to terminate the MOUs, even where there was non-performance. Indeed, none of the CHD contracts were terminated during the observation period, and at the end of 2016, Twic East County in Jonglei State also transitioned from an NGO to CHD contract. Table 3.3 summarizes monthly costs for 3 CHDs.

*Table 3.3:* ***C-I (CHD) Contracts***

| **County** | **Manyo** | **Melut** | **Renk** |
|---|---|---|---|
| Target Population | 46,170 | 60,377 | 169,291 |
| Total Contract Cost | $ 90,468.72 | $ 101,566.56 | $ 92,129.96 |
| Cost per capita (Estimated) | 1.96 | 1.68 | 0.54 |
| Type of Contract | MoU | MoU | MoU |
| | | | |
| Monthly Cost Summary | | | |
| CHD costs | 90,847.46 | 77,122.03 | 82,483.39 |
| County hospital | | 32,993.56 | 51,140.00 |
| Health facility incentives | 147,137.29 | 168,885.08 | 125,787.80 |
| Health facility operations | 21,204.00 | 16,119.00 | 18,793.00 |
| | | | |
| Primary healthcare costs (calculated) | | | |
| Number of facilities | 5 | 6 | 5 |
| Cost per facility | 5,779.59 | 3,436.78 | 2,474.44 |

*Costs originally in South Sudanese Pounds (SSP). Exchange rate: 1US$ = 2.95SSP

There were several differences in the C-I (CHD) contracts compared to the C-O (NGO) contracts. Unlike NGO contracts, CHD contracts did not outline performance measures and stipulate that the MOUs were an agreement to undertake general responsibilities agreed by both parties. Amendments to the MOU was by mutual consent and the MOU could be terminated at any time also by mutual consent. In contrast, NGO contracts were fixed-price contracts with payments tied to performance.

The CHDs did not directly receive funds from IMA; these were handled by the IMA according to a monthly budget shared with the CHD. The CHD did receive monthly operations costs, which had to be accounted for prior to receipt of subsequent funds. Thus, CHD's did not have the same incentive as the NGOs to reduce costs in order to retain any budgetary surplus, neither did they receive a percentage of project funds for indirect costs.

CHDs also seem to have received less compensation than both local and international

NGOs and hence has less funding to support primary health facility operations[8] (see tables 3.2 and 3.3). Also, while NGO contracts were paid in USD, the CHD contracts were paid in local currency and hence were subject to exchange rate fluctuations, and once again CHDs did not benefit from any fluctuations in the value of the local currency.

Lastly, the CHD MOUs were not directly tied to performance targets, instead the CHD and IMA agreed to work collaboratively to ensure annual work plan activities were carried out. Nevertheless, as CHD staff were directly accountable to the local population in a way that NGOs may not have been, they may have had an intrinsic motivation to ensure health facilities were high performing. However, as health-workers were directly accountable to the CHD/MoH, the CHDs may have had more flexibility in firing staff for non-performance and/or adding staff to the government payroll, these contract differences may not have had an observable impact on performance.

### 3.2.3 Performance-Based Contracting (PBC)

In counties where health facility staff salaries were paid by the government, RHHP instituted performance-based contracting to incentivize health facility staff. In counties where staff salaries were paid by the RHHP, health facility staff received no incentives. Hence it is unclear if the PBF model was instituted to harmonize state salaries with project-based salaries of it truly functioned as an incentive. Counties where staff salaries were paid by the RHHP were Akobo, Twic East, Uror and Maiwut. In two counties (Melut and Nasir) a few facilities received state-paid salaries however the majority received full salaries from the project hence these counties are considered non-PBC counties for the purpose of this analysis. In the remaining counties, health facility staff received state-paid salaries and were thus eligible for PBC incentives. PBC model is presented in tables 4 and 5.

### 3.2.4 Monitoring and evaluation (M&E)

IMA used a variety of mechanisms to monitor the sub-contractor's performance and progress toward attainment of key deliverables. These included business meetings with

[8]The lower cost of contracting-in is also noted as a strength of using CHDs as a provider in several IMA reports

*Table 3.4:* ***County Health Department PBC Payments (SSP)***

| Target | % Paid | Amount (SSP) |
|---|---|---|
| **HMIS report sent to the SMOH** | | |
| No DHIS report is submitted | 0% | 0 |
| Report submitted late, 50% of HF reports received | 33% | 200 |
| Report submitted on time; 50- 74% HF reports received | 66% | 400 |
| Report submitted on time; >=75% HF reports received | 100% | 600 |
| **IDSR sent to SMOH weekly** | | |
| No IDSR report submitted during the month | 0% | 0 |
| Only one report submitted (1 week) | 33% | 200 |
| Two reports are submitted (2 weeks) | 66% | 400 |
| Three or more reports are submitted | 100% | 600 |
| **Quarterly QSC** | | |
| No HFs have been supervised using QSC | 0% | 0 |
| Less than 1/3 of planned QSC visits are done. | 33% | 200 |
| Less than 2/3 of planned QSC visits are done | 66% | 400 |
| Greater than 2/3 of planned QSC visits are done | 100% | 600 |
| **Monthly meetings with minutes held** | | |
| No meetings are held | 0% | 0 |
| Only CHD meeting is held | 33% | 200 |
| CHD plus at least 1 VHC meeting held | 66% | 400 |
| CHC plus VHC plus coordination meeting held | 100% | 600 |
| **DPT vaccination** | | |
| No Immunization activity undertaken | 0% | 0 |
| DPT 3 coverage less than baseline or 250 children for Akobo | 33% | 200 |
| DPT 3 coverage equal to or more than baseline | 66% | 400 |
| DPT 3 coverage reaches or above target | 100% | 600 |

*Table 3.5:* ***Health Facility PBC Payments (SSP)***

| Target | % Paid | Amount (SSP) | |
|---|---|---|---|
| **HMIS report delivered to CHD** | | | |
| No DHIS report or poor-quality data | 0% | 0 | 0 |
| Report late but with good quality data | 50% | 200 | 75 |
| Report on time with good quality data | 100% | 400 | 150 |
| **IDSR sent to CHD weekly** | | | |
| No IDSR report submitted | 0% | 0 | 0 |
| 1-2 IDSR reports submitted | 50% | 150 | 75 |
| 3-4 IDSR reports submitted | 100% | 300 | 150 |
| **DPT vaccination** | | | |
| No Immunization activity undertaken | 0% | 0 | 0 |
| DPT 3 achievement is less than baseline | 33% | 100 | 50 |
| DPT 3 achievement > baseline but less than target | 66% | 200 | 100 |
| DPT 3 target is achieved | 100% | 300 | 150 |
| **Facilities are clean and sanitary** | | | |
| Infrastructure clean in appearance | 33% | 100 | 50 |
| Infrastructure Water for hand washing | 33% | 100 | 50 |
| Infrastructure Waste disposal system in use | 33% | 100 | 50 |
| **Facilities provide ANC** | | | |
| ANC not integrated | 0% | 0 | 0 |
| ANC achievement less than baseline | 33% | 100 | 50 |
| ANC 1 achievement > baseline but less than target | 66% | 200 | 100 |
| Target is achieved | 100% | 300 | 150 |

the sub-contract team with feedback from key partners primarily the CHD, site visits, and review and assessment of periodic work plans, progress reports and quarterly program reports. The progress reports and quarterly program reports reviews were based on quantitative analysis of progress toward attainment of pre-specified targets.

In addition, there was an annual evaluation of performance with results used to determine future renewal of contracts. The annual evaluation assessed the quality and timeliness of deliverables, technical capacity of the NGOs, quality of financial management, and administration of the subcontract. Unlike the contract between IMA and the MoH, the subsequent contracts with implementing partners do not specify an external agency to oversee M&E. However, the annual review would have covered implementing partners' activities. Overall however, It is difficult to assess the quality of these monitoring mechanisms due to lack of data on their relative effect on performance or reward and incentives mechanism.

### 3.2.5 Contract duration and early termination

Contract duration was 12 months, renewable on an annual basis based on performance. Early termination of the contract was by a 30-day written notification by either IMA or the provider. In addition, the contract could be terminated by IMA due to non-performance, but the provider had the right to claim costs incurred up to the date of notification for any unpaid or incomplete deliverables. However, the contracts did not designate compensations to either party due to early termination.

The annual renewal process and the quarterly payment schedule may encourage performance due to the threat of non-renewal or cancellation. Despite this, lack of competitive bids may also result in an unwillingness to terminate contracts due to non-performance and the relatively few changes of county-partners between 2013-2015 suggest that this may have been the case. The contracts also allowed for delays in meeting project deliverables due to situations beyond the providers' control, but with prior notification and approval. Additional costs incurred in meeting project deliverables were to be borne by the provider and delays of more than thirty days or those that delayed IMA's obligation to deliver its commitments under its government contract would result in termination of the contract.

In conclusion, given that C-O (NGO) contracts have greater accountability mechanism and verifiable performance measures compared to C-I (CHD) contracts, NGOs may have had greater incentive to meet contract deliverables, compared to the CHDs. Also, given that most NGOs were already managing contracts in the counties under the previous

health program, they may have had more experience in program implementation. Lastly, CHDs were not directly responsible for managing funds for program implementation and thus may have had lower incentive to reduce costs, and also had lower technical capacity compared to the NGOs, which necessitated substantial managerial support from the lead agency. Thus, I assume that counties supported by local or international NGOs would have higher performance relative to those contracted-in with the CHDs.

## 3.3 Methods

### 3.3.1 Data Sources

Data for the analysis were obtained from several sources. County characteristics, specifically population in 2013, population density, percentage of females enrolled in primary school (2010), percentage of farming households (2010 baseline) and poverty headcount (2010) are obtained from the National Bureau of Statistics Statistical Yearbook for South Sudan with estimates based on the 2008 Sudan Population and Housing Census and the 2009 National Baseline Household Survey (NBHS). Due to limitations in availability of county-level data, these are the only control variables used in the analysis. There is some variation across the countries, for example population density in Malakal is 172 per square kilometre compared to Nasir County (41 per sq. km.), Ulang County (18 per sq. km) and Renk County (14 per sq.km.) as observed in table 3.6. School enrollment is higher in Pochalla country (48%) relative to Nyirol (30%), while poverty headcount is 64% in Ayod relative to Uror (40%). This may have implications in contract performance had NGOs or CHDs selected better performing counties resulting in selection bias. However, this does not seem to be the case for example if we compare counties managed by international NGOs relative to those managed by CHDs.

The primary data-source for health facility data is the District Health Information Database (DHIS) which aggregates monthly health facility utilization data for all health facilities across South Sudan. These data are extracted from standardized registers available at all health facilities and submitted monthly to the county health departments. The DHIS was first piloted in Jonglei and Upper Nile States and through funding from the

*Table 3.6:* ***County Baseline Data***

| County | Partners | Population(2013) | Pop Density | School enrollment | Farming% | Poverty |
|---|---|---|---|---|---|---|
| **Jonglei** | | | | | | |
| Akobo | local NGO | 164,231 | 15 | 0.35 | 0.8 | 0.52 |
| Duk | local NGO | 78,831 | 9.5 | 0.39 | 0.9 | 0.54 |
| Pibor* | I-NGO | 179,011 | 4.5 | 0.33 | 0.5 | 0.44 |
| Pigi* | I-NGO | 119,888 | 22.5 | 0.39 | 0.9 | 0.44 |
| Ayod | I-NGO | 169,158 | 10.3 | 0.38 | 0.9 | 0.62 |
| Bor | I-NGO | 267,696 | 15.7 | 0.42 | 0.8 | 0.50 |
| Fangak | I-NGO | 133,027 | 14.5 | 0.41 | 0.9 | 0.55 |
| Nyirol | I-NGO | 131,384 | 15.2 | 0.30 | 0.9 | 0.43 |
| Pochalla | I-NGO | 80,473 | 7.9 | 0.48 | 0.8 | 0.56 |
| Twic East | I-NGO | 103,465 | 14 | 0.42 | 0.9 | 0.50 |
| Uror | I-NGO | 215,142 | 14.7 | 0.38 | 0.9 | 0.40 |
| Total | | 1,642,306 | | | | |
| **Upper Nile** | | | | | | |
| Akoka | CHD | 9,842 | 4.1 | 0.29 | 0.8 | 0.32 |
| Makal | CHD | 155,085 | 171.5 | 0.48 | 0.5 | 0.12 |
| Manyo | CHD | 46,170 | 5.7 | 0.45 | 0.9 | 0.19 |
| Melut | CHD | 60,377 | 7.1 | 0.42 | 0.38 | 0.21 |
| Renk | CHD | 169,291 | 13.7 | 0.46 | 0.38 | 0.22 |
| Baliet | I-NGO | 59,193 | 4.1 | 0.45 | 0.8 | 0.32 |
| Fashoda | I-NGO | 44,986 | 10.3 | 0.40 | 0.9 | 0.21 |
| Longechuk | I-NGO | 78,134 | 9.1 | 0.37 | 0.9 | 0.31 |
| Luakpiny/Nasir | I-NGO | 258,080 | 40.8 | 0.37 | 0.8 | 0.32 |
| Maban | I-NGO | 55,641 | 3.8 | 0.43 | 0.8 | 0.26 |
| Maiwut | I-NGO | 97,076 | 21 | 0.40 | 0.8 | 0.27 |
| Panyikang | I-NGO | 55,641 | 8.9 | 0.46 | 0.5 | 0.21 |
| Ulang | I-NGO | 104,179 | 17.8 | 0.41 | 0.8 | 0.38 |
| Total | | 1,193,695 | | | | |

I-NGO = International NGO
Pibor and Pigi County changed ownership from I-NGOs to local NGOs in 2014

UPHSD, all county health departments transmit data electronically to the national DHIS, as they were equipped with VSAT (Very Small Aperture Terminal) satellite communications. Regular reporting to the DHIS is part of the contractual requirement for all county health departments and NGOs in the two states, and for health facilities participating in PBC hence they have additional motivation to ensure completeness and quality of reporting. Note that the DHIS is the best available data on utilization in South Sudan.

The DHIS collects data from 2009, however for the purpose of the analysis, I restrict the analysis to 2011-2015, allowing for adequate data points both pre and post implementation of the contracting approach. The analysis begins with 2011 as prior to that, there were relatively fewer health facilities reporting to the DHIS (as this was during the pilot phase of the DHIS). The data are aggregated at the state, county and payam [9] levels and health facilities are distinguished based on whether they are primary health care centers, which serve a catchment population of approximately 30,000 or primary health care units serving

[9]payams have a catchment population of approximately 30,000 people

a catchment population of approximately 10,000. The total number of health facilities in the two states was three hundred and sixty nine, with 53 health facilities in CHD counties and 316 in NGO counties. In 2013, this translated to 440,765 people covered in CHD counties compared to 2,395,236 by NGO partners.

Outcome variables extracted from the DHIS are; number of women with first antenatal care visit, number with third antenatal care visit, and number with IPT-Sp second dose. Although these are provided at different stages of a woman's pregnancy, as the DHIS does not collect personal longitudinal data it is not possible to assess completeness and thus quality of antenatal care at the individual level. Additional indicators are number of deliveries at the health facility, both skilled and unskilled, number of children receiving their 3rd diphtheria, pertussis and tetanus vaccination, number of children with malaria, and number with diarrhoea diagnosis captured monthly. As with ANC data, it is not possible to assess completeness of DPT vaccination by individual child.

Health facility infrastructure data are obtained from a health mapping exercise which physically surveyed 1,145 health facilities between 2016-2018 with data available on the MoH website [10] and included as covariates (EU-CGA, 2019). The data-source is selected due to the limited existence of data covering the observation period. I incorporate data on physical infrastructure (permanent infrastructure, access to a pit latrine (or flushing toilet), access to utilities (improved water source and power-source), and diagnosis (room with auditory and visual privacy for patient consultations) with dummy variables constructed to indicate availability. Although indicators for equipment (e.g. delivery table, examination table, delivery kit, blood pressure machines etc.) and health facility staffing are available, these are not utilized as it is presumed that these are more likely to have changed since 2013, whereas health facility construction is less likely to have occurred since 2013, to account for the disparity in observation periods.

Comparing CHD and non-CHD health facilities, 25% of CHD facilities had permanent infrastructure compared to 26% non-CHD facilities, 13% had an improved water source compared to 25%, 6% had a power-source compared to 3%, 28% compared to 21% had

[10] www.southsudanhealth.info

an improved toilet or flushing toilet and 15% compared to 16% had a room with auditory and visual privacy for patient consultations. Analysis matching health facilities using a propensity score technique is combined with difference-in-difference analysis using the above variables. Additional covariates include dummy variables for the policy effect (1>=2013, 0 otherwise), implementing partner (1=county health department, 0 otherwise) and performance-based contracting (1=PBF, 0 otherwise). This comparison is presented in table 3.7.

CHD-supported counties (Akoka, Malakal, Manyo, Melut and Renk) are all in Upper Nile state, however Twic East county in Jonglei state was transferred to CHD at the end of 2016, beyond the period of analysis. In addition, the RHHP also instituted performance-based contracting (PBC) providing incentives to health facility staff in counties where staff salaries were primarily paid by the state; counties where staff salaries were paid by the RRHP received no incentives. PBC covered all counties except Akobo, Twic East, Uror, Maiwut, Melut and Nasir hence additional analysis will compare PBC health facilities to non-PBC facilities. Thus health facility staff in 275 facilities were eligible for incentives while 94 facilities received no incentives.

*Table 3.7:* ***Comparison of CHD and non-CHD counties***

| | **CHD** | **Non-CHD** | **Total** |
|---|---|---|---|
| Population (2013) | 440, 765 | 2,395,236 | 2,836,001 |
| Population Density | 18.06 | 13.65 | 14.18 |
| Total # of facilities | 53 | 316 | 369 |
| PHCCs | 22 | 71 | 93 |
| PHCUs | 31 | 245 | 276 |
| **Health Facility Characteristics** | | | |
| Permanent infrastructure | 13 (25%) | 81 (26%) | 94 (25%) |
| Improved water source | 7 (13%) | 80 (25%) | 87 (24%) |
| Power Source | 3 (6%) | 10 (3%) | 13 (12%) |
| Improved toilet | 15 (28%) | 67 (21%) | 82 (22%) |
| Private consultation room | 8 (15%) | 51 (16%) | 59 (16%) |

## 3.4 Empirical Strategy

Contracted out counties and performance-based health facilities were not randomized. Instead, the lead agency, IMA selected these counties and I assume that CHD counties were selected based on capacity to manage the health facilities in the county by the CHDs.

Note that NGOs are already selected based on existing capacity to manage counties during the contract bidding process. To address the lack of randomization, the analysis utilizes a non-experimental approach, difference-in-difference (DD), to assess changes over time in health facility utilization in CHD-contracted facilities relative to NGO-contracted facilities, attributing the difference-in-difference to the effect of the policy instituted in 2013.

DD provides an unbiased estimate if the trend over time would have been the same between the treatment (CHD counties) and the comparison group (NGO counties) in the absence of the introduction of the policy (Stuart et al., 2014). However, The DD method used is modified; I assume that prior to the policy, some health facilities were primarily managed by NGOs, however after the policy change, all health facilities are managed either by CHDs or NGOs.

I hypothesize that CHDs may have relatively lower capacity and experience in managing the health facilities compared to NGOs and also due to their relatively more flexible contracts and lower contracting costs, their performance would also be lower post 2013. Should their performance be similar to that of NGOs, this has policy implications that may suggest either that the contracting approach has limitations in improving performance at the health facility level, or that the assumption of higher capacity of NGOs relative to CHDs does not necessarily stand. As the comparison groups may differ in ways related to their trends, propensity score weighting using health facility infrastructure covariates are used to ensure comparability of the groups. This results in estimation of essentially four groups; CHD pre, CHD post, NGO pre and NGO post as shown below. The DD estimate is the change in the difference between the groups across time. I define the group variable (CHD) as follows;

$$Groups = \begin{cases} 1 & if CHD = 1, and P = 0 \\ 2 & if CHD = 1, and P = 1 \\ 3 & if CHD = 0, and P = 0 \\ 4 & if CHD = 0, and P = 1 \end{cases}$$

PBF and non-PBF groups are constructed similarly. The DD estimator can also be

illustrated as a simple 2x2 table as illustrated in table C1 in the appendix. To obtain standard errors and significance levels for the DD estimate, a linear regression model is fit with the general form;

$$f(Y_{it}) = \alpha + \beta E_j + \gamma P_t + \delta E_i P_t + \epsilon_{it} \tag{3.1}$$

Where;

$Y_{it}$ is the outcome (e.g antenatal care first visits) at health facility i at time t;

$E_j$ is the CHD group vs the NGO group and P reflects the time-period (pre (0) vs post (1) and;

$\delta$ is the DD estimator, i.e. the difference in the changes over time between the two groups. This assumes that in the absence of the policy change in 2013, both groups would have continued with the same trends across time, and that changes after 2013 are due to the differences in the contracts between the two groups. Health facility indicators are added as covariates in the model, which is estimated using the *diff* program in Stata *version 13* (Villa, 2012).

### 3.4.1 Difference-in-Difference Estimator with propensity-score matching

As noted in Stuart (2014), there may be changes in group composition across time and we observe that the number of health facilities varies across time for both the CHD and NGO contracted counties potentially introducing selection bias.

Propensity scores are used to balance the comparison groups on a set of health facility infrastructure variables, similar to the approach taken in (Rajkotia et al., 2017). The PSM approach weights the 4 groups on these health facility infrastructure variables, with the propensity score defined as the probability of being in group 1 (versus groups 2,3, or 4) with groups weighted to be similar to group 1 (CHD health facilities prior to 2013). This

is accomplished using the following weight for health facility i:

$$W_i = e_i(X_i)/e_g(X_1) \tag{3.2}$$

where g refers to the group that health facility i was in. Thus, health facilities in Group 1 receive a weight of 1, while facilities in other groups receiving a weight proportional to the probability being in group 1 relative to the probability of their being in the group they are actually in. Fitting a weighted regression model using propensity score weights allows us to obtain consistent estimates of the outcome even in the presence of selection bias due to the observed covariates across the four groups (Stuart et al., 2014).

I also estimate DD with Kernel-based Propensity Score Matching for repeated cross sections, using *psmatch2* in Stata (Leuven and Sianesi, 2018). However, it is worth noting that the number of health facility variables included in the estimation may be inadequate and additional covariates may result in more robust comparisons in future analysis. The DD and DD with PSM approach is done for comparison of both C-I (CHD) and C-O (NGO) counties and PBF and non-PBF counties, with bootstrap estimation of coefficients and standard errors. Thus, for both contracting and PBF, I compare two methods of estimating the treatment effect following Stuart (2014);

1. A DD model that includes covariates X: $Y = \alpha + \beta E_E + \beta P_P + \beta_{EP} EP + \beta_X X + \mu, \mu \approx N(0,1), where \beta_{EP} EP$ is the DD estimate and;

2. A weighted version of the regression model in (1), with the four group propensity score-based weights.

# 3.5 Results

## 3.5.1 Unadjusted means

Maternal health and child health unadjusted mean values comparing NGO and CHD counties during the period 2011-2012 (henceforth referred to as the baseline) and the period 2013-2015 (the policy period) are presented in table 3.8 and illustrated in figures 3.1 and 3.2. Mean monthly annual utilization is presented in the appendix tables C3 and C4 for

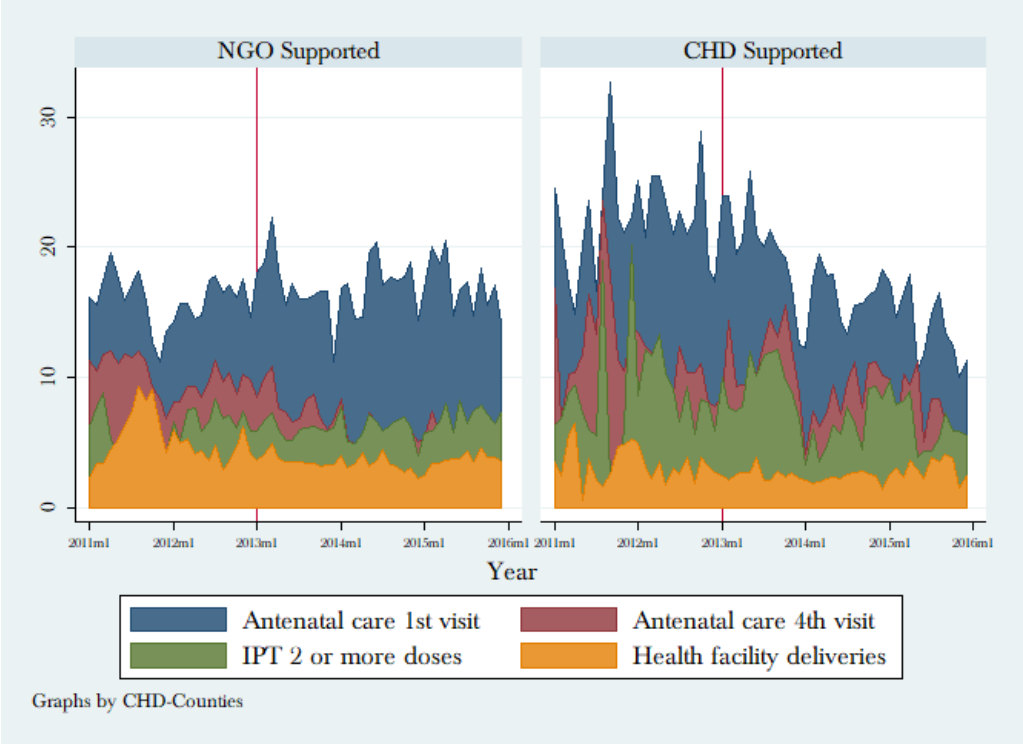


*Figure 3.1:* ***Maternal health by contract group***

reference

*Table 3.8:* ***Unadjusted Means by Contracting group and year***

| | NGO | CHD | Diff | NGO | CHD | Diff | NGO | CHD | Diff | NGO | CHD | Diff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ANC 1 | | | ANC 4 | | | IPT2 | | | Deliv | |
| 2011-12 | 16.46 | 21.47 | -5.01** | 9.30 | 11.91 | -2.61** | 6.17 | 8.97 | 2.81*** | 4.68 | 3.00 | 1.68*** |
| 2013-15 | 17.05 | 16.68 | 0.38 | 5.84 | 9.39 | -3.55*** | 6.57 | 6.37 | 0.20 | 3.54 | 2.63 | 0.92*** |
| Avg. | 16.67 | 19.97 | -3.30*** | 8.06 | 11.13 | -3.07*** | 6.30 | 8.16 | -1.86*** | 4.30 | 2.89 | 1.42*** |
| | | DPT1 | | | DPT3 | | | Mal | | | Diarr | |
| 2011-12 | 25.03 | 16.95 | 8.08*** | 18.95 | 14.55 | 4.40** | 55.61 | 38.82 | 16.79*** | 36.44 | 27.66 | 8.78*** |
| 2013-15 | 10.43 | 8.43 | 2.0 | 6.54 | 5.63 | 0.91 | 61.75 | 39.58 | 22.17*** | 42.99 | 31.57 | 11.43*** |
| Avg. | 20.15 | 14.29 | 5.87*** | 14.80 | 11.76 | 3.04*** | 57.66 | 39.06 | 18.60*** | 38.66 | 28.89 | 9.76*** |

*** p<0.01, ** p<0.05, * p<0.1

Diff= Difference, Deliv=Delivery, Mal=Malaria, Diarr = Diarrhoea

Maternal health utilization for antenatal care 1st and 4th visits, and deliveries is higher in CHD counties compared to NGO counties during the baseline period by approximately 5, 2.6 and 2.8 mean monthly visits while deliveries are higher in NGO counties by 1.7 mean deliveries. However, after the policy is implemented, all maternal health utilization indicators fall across both contract types, except for IPT-Sp which increases slightly for NGO counties.

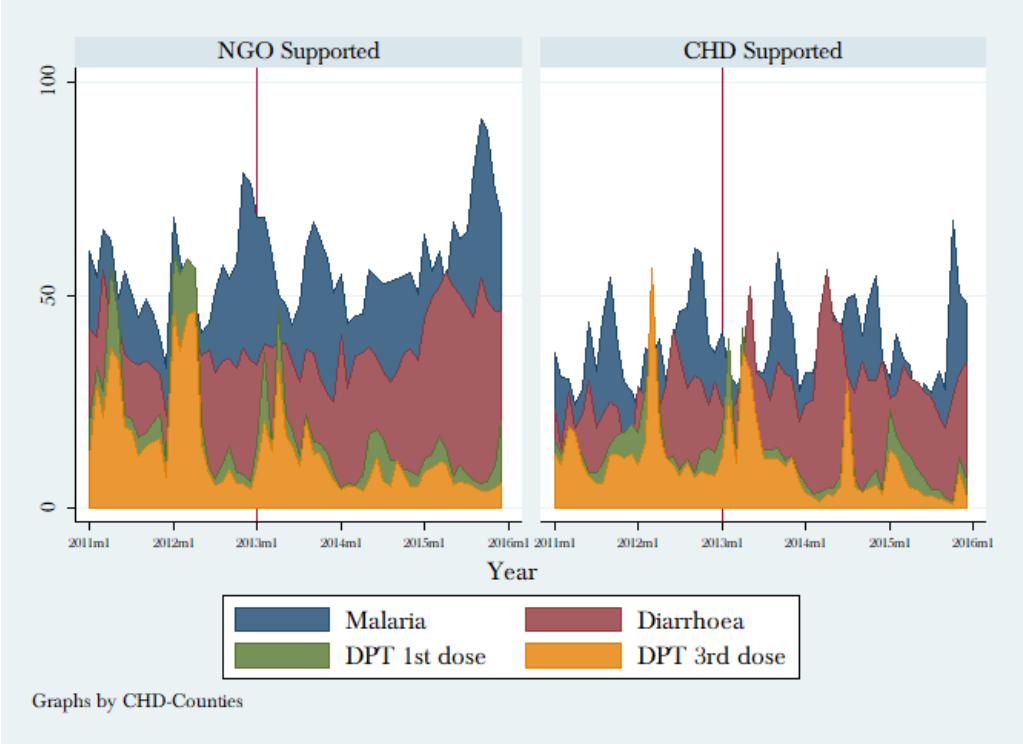


*Figure 3.2:* ***Child health by contract group***

During the policy period, there is no difference in ANC 1st visits and IPT-Sp between NGO and CHD counties, but statistically significantly lower ANC 4th visits in NGO counties, as ANC 4th visits fall faster in NGO counties compared to CHD counties. Health facility deliveries also decrease further in NGO counties relative to CHD counties, with the difference between the two decreasing to less than 1 mean delivery per month.

Child health baseline means shows a different pattern compared to unadjusted maternal health means; whereas CHD counties had higher baseline means compared to NGO counties for maternal health variables, NGO counties have higher mean child health values relative to CHD counties. In CHD counties, DPT 1st and DPT 3rd dose, malaria and diarrhoea cases are lower by 8, 4, 17 and 9 mean monthly utilization relative to NGO counties during the baseline.

DPT 1st and 3rd doses fall substantially during the policy period in both types of contracts, resulting in statistically similar results, implying that DPT coverage falls further in NGO counties relative to CHD counties. Malaria and diarrhoea cases, however, increase during the policy period for both contract types, with utilization in NGO counties

remaining much higher than at CHD counties.

It is unclear why the pattern of utilization would be different for mothers and children and this may be worthy of further research. These results do suggest that the policy had a negative effect on maternal health and child health utilization- except for malaria and diarrhoea treatment - which is contrary to expectation. For CHD counties, it has a more negative effect across all maternal health utilization indicators, whereas for NGO counties, it has a more negative effect for DPT coverage.

A similar comparison is done comparing counties that implemented performance-based financing and those that did not with results presented in table 3.8 and illustrated in figures 3.3 and 3.4. Mean monthly annual utilization is presented in the appendix table C4 for reference.

*Table 3.9:* ***Unadjusted Means by PBF group and year***

| | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ANC 1 | | | ANC 4 | | | IPT2 | | | Deliv | | |
| 2011-12 | 16.27 | 17.87 | -1.60** | 8.99 | 10.14 | -1.16*** | 6.63 | 6.66 | -0.03 | 4.48 | 4.36 | 0.12 |
| 2013-15 | 15.09 | 17.80 | -2.71*** | 6.65 | 6.26 | 0.40 | 6.50 | 6.56 | -0.06 | 3.92 | 3.19 | 0.72*** |
| Avg. | 15.88 | 17.85 | -1.97*** | 8.21 | 8.74 | -0.53 | 6.59 | 6.63 | -0.04 | 4.30 | 3.96 | .34** |
| | DPT1 | | | DPT3 | | | Mal | | | Diarr | | |
| 2011-12 | 20.83 | 24.89 | -4.05** | 15.09 | 19.57 | -4.47** | 47.76 | 54.93 | -7.17*** | 33.35 | 35.70 | -2.35*** |
| 2013-15 | 8.67 | 10.68 | -2.02 | 6.30 | 6.43 | -0.13 | 51.37 | 60.96 | -9.59*** | 38.79 | 42.20 | -3.41*** |
| Avg | 17.04 | 20.08 | -3.04*** | 12.35 | 15.13 | -2.77*** | 48.88 | 56.97 | -8.08*** | 35.07 | 37.93 | -2.86*** |

*** p<0.01, ** p<0.05, * p<0.1

Diff= Difference, nPbf=No Pbf, Deliv=Delivery, Mal=Malaria, Diarr = Diarrhoea

For maternal health utilization, ANC 1st visits are statistically significantly higher in PBF counties at baseline and during the policy period by 2 and 3 mean visits respectively, while ANC 4th visits are higher only during the baseline, by 2 mean visits. IPT-Sp provision is similar across both sites both during and after the policy, whereas deliveries are lower in PBF counties, being significantly higher during the policy period by 1 mean delivery per month.

Child health utilization is also higher in PBF counties for DPT 1st and DPT 3rd dose but only statistically significantly higher during the baseline period. Similar to contracting types, DPT 1st and 3rd doses falls during the policy period for both PBF and non-PBF sites. This suggests that the policy had a negative effect on immunization coverage, regard-

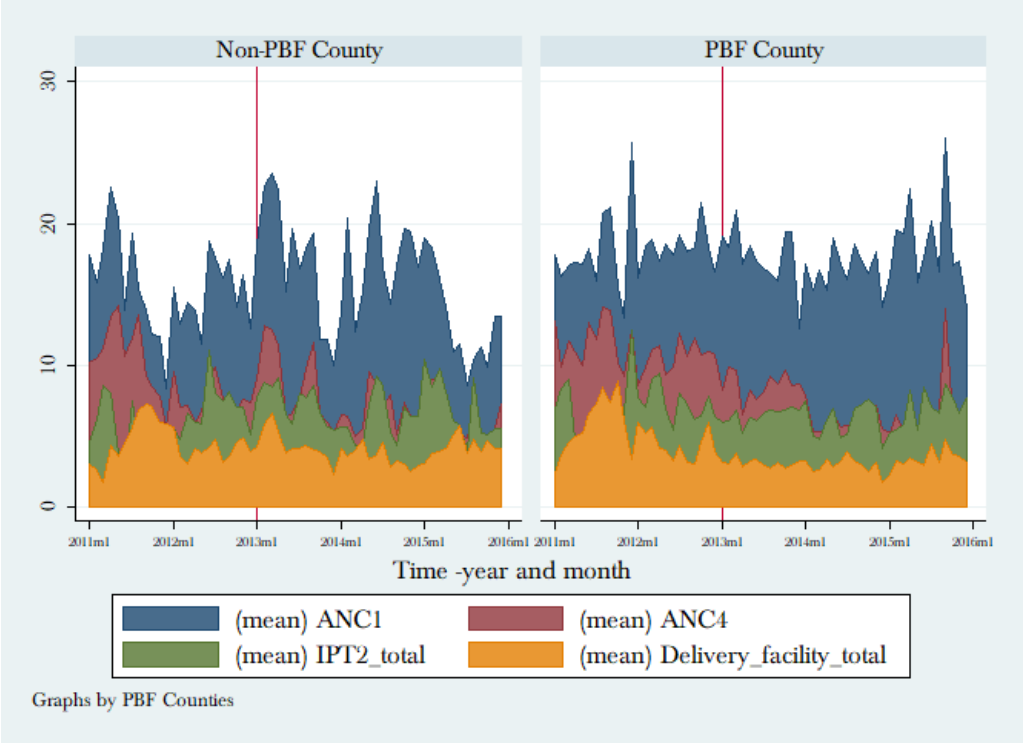


*Figure 3.3:* ***Maternal health by PBF group***

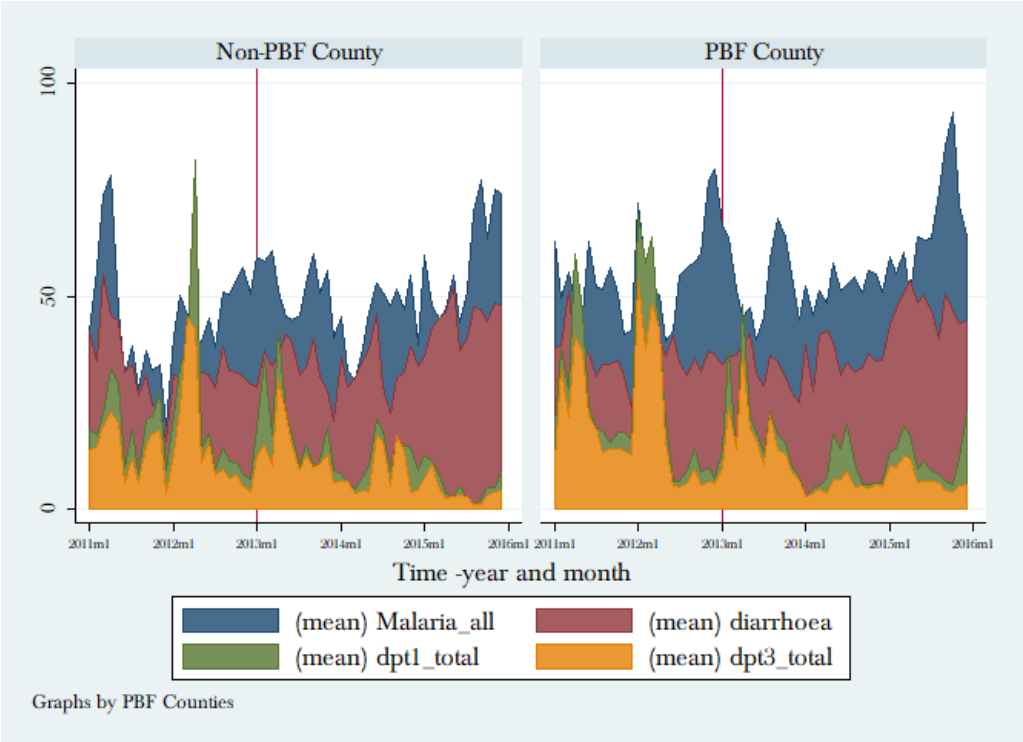


*Figure 3.4:* ***Maternal health by PBF group***

less of contract type and the performance-based financing. Malaria and diarrhoea cases, however, increase during the policy period, relative to baseline, with PBF counties having higher utilization overall.

### 3.5.2 Propensity score matching analysis

Propensity score matching analysis largely confirms the DD results as observed in Table 3.10; only ANC 1st and IPT-Sp are significantly higher at NGO counties relative to CHD counties by 9.3 and 5.6 on average, respectively. There is a similar pattern of decline after 2013 as noted above. However, it is difficult to conclude that NGO counties consistently achieve higher results relative to CHD counties. Note that while ANC 1st visits decline dramatically in CHD counties, there is a higher drop in IPT-Sp in NGO counties relative to CHD counties. The lack of statistically significant differences in ANC 4th visits and health facilities deliveries also suggests that both regions experience challenges in increasing health facility utilization, that may be related to context-specific issues. Without a thorough review of the activities providers undertook to expand access to health services (e.g through community mobilization), it is difficult to make a conclusive determination.

Panel B compares PBF versus non-PBF counties, utilizing the same analytical approach. For all maternal health indicators, the double difference is statistically significantly lower for PBF counties, relative to non-PBF counties, however when we match using PSM, ANC 1st visits and IPT-2 Sp are similar across both types of counties. Once again, the pre-2013 means are higher for both groups compared to the post 2013 means, except for facility deliveries which increase from 1.5 to 1.9 mean deliveries at non-PBF counties compared to the decline of 3.3 to 1.6 at PBF counties in the DD analysis.

These results are surprising as they suggest that PBF may not have had much impact on performance, contrary to other settings (Rajkotia et al., 2017; Basinga et al., 2011). This may be due to the design of the PBF approach in the two states; as noted earlier, PBF health facilities where in locations where health workers received salaries from the state, and hence might have begun with lower salaries compared to facilities where NGOs paid health-workers salaries. Thus the PBF incentive may have merely harmonized salaries across the counties, without necessarily providing additional motivation to improve health

facility utilization.

*Table 3.10:* ***Maternal Health Indicators***

| | Difference in Difference with covariates | | | | Kernel Propensity Score Matching | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | ANC1 | ANC4 | IPT2-Sp | Deliveries | ANC1 | ANC4 | IPT2-Sp | Deliveries |
| CHD Contracts relative to NGO Contracts | | | | | | | | |
| Diff-in-diff | -10.72*** | -3.633 | -4.617** | -0.366 | -9.927*** | -4.310 | -5.648** | -0.224 |
| | (2.760) | (2.777) | (2.183) | (0.595) | (3.503) | (2.833 ) | (2.269) | (0.767) |
| Observations | 4,103 | 4,103 | 5,080 | 5,080 | 3,926 | 3,926 | 4,718 | 4,718 |
| R-squared | 0.141 | 0.089 | 0.059 | 0.046 | | | | |
| Mean control t(0) | 9.177 | 7.269 | 4.329 | 2.803 | 17.53 | 11.36 | 6.572 | 4.693 |
| Mean treated t(0) | 30.32 | 18.16 | 14.11 | 2.129 | 37.39 | 21.57 | 16.26 | 4.281 |
| Diff t(0) | 21.14 | 10.89 | 9.781 | -0.673 | 19.86 | 10.21 | 9.692 | -0.412 |
| Mean control t(1) | 5.855 | 2.602 | 3.853 | 1.876 | 12.86 | 6.820 | 6.617 | 3.434 |
| Mean treated t(1) | 16.28 | 9.860 | 9.017 | 0.837 | 22.79 | 12.72 | 10.66 | 2.798 |
| Diff t(1) | 10.42 | 7.258 | 5.164 | -1.039 | 9.935 | 5.900 | 4.044 | -0.636 |
| PBC relative to non PBC | | | | | | | | |
| Diff-in-diff | -2.616** | -2.897*** | -1.280** | -2.205*** | -1.678 | -2.409** | -1.073 | -1.845*** |
| | (1.241) | (1.062) | (0.587) | (0.384) | (1.331) | (1.110) | (0.766) | (0.418) |
| Observations | 4,103 | 4,103 | 5,080 | 5,080 | 4,103 | 4,103 | 5,080 | 5,080 |
| R-squared | 0.109 | 0.076 | 0.042 | 0.051 | | | | |
| Mean control t(0) | 5.369 | 3.797 | 2.187 | 1.501 | 15.51 | 9.673 | 5.724 | 3.085 |
| Mean treated t(0) | 13.09 | 9.774 | 5.893 | 3.305 | 21.44 | 14.28 | 8.318 | 4.996 |
| Diff t(0) | 7.724 | 5.978 | 3.706 | 1.805 | 5.937 | 4.611 | 2.594 | 1.911 |
| Mean control t(1) | 2.002 | 0.332 | 1.857 | 1.957 | 10.83 | 5.538 | 5.452 | 3.257 |
| Mean treated t(1) | 7.110 | 3.412 | 4.283 | 1.558 | 15.09 | 7.741 | 6.972 | 3.324 |
| Diff t(1) | 5.108 | 3.080 | 2.426 | -0.400 | 4.259 | 2.203 | 1.520 | 0.0661 |

Standard errors in parentheses
Means and Standard Errors are estimated by linear regression
*** p<0.01, ** p<0.05, * p<0.1

Child health results adjusted for health facility infrastructure variables are presented in table 3.11 and also show a marked difference from the maternal health indicators. Comparing CHD and NGO counties, there are no statistically significant differences in the double differences across DPT 1, DPT 3 and diarrhoea, however for children seen for malaria treatment, NGO counties have a statistically significantly higher mean of 10 mean monthly visits per child, relative to CHD counties. Once again, we observe the decline in health facility utilization after 2013 across all child health indicators, similar to that of maternal health indicators.

Of note, comparing means prior to 2013, NGO and CHD counties have relatively similar averages across all indicators, except for diarrhoea. For example, mean DPT1 and DPT3 for NGO counties prior to 2013 is 19.43 and 17.34 while that of CHD counties is 22.34 and 19.59. This is also true for malaria and diarrhoea; mean values for CHD counties are 42.39 and 21.33, while for NGO counties 42.10 and 29.30. Child health results may therefore

provide a more robust comparison of performance, as they are not biased by baseline levels, compared to the maternal health results.

Matching by propensity scores provides similar results to the DD analysis, except there are no differences comparing NGO and CHD counties across all indicators except diarrhoea cases which are higher in CHD counties relative to NGO counties. However, NGO counties start at higher means in 2013, relative to CHD counties (38.79 compared to 29.93), but experience a sharper decline in health facility utilization after 2013 (28.51 compared to 27.91). Baseline mean values across other indicators are similar.

Comparing PBF and non-PBF counties, there are no differences in health facility utilization for children under five years. This is despite that DPT-3 is an incentivized indicator for all counties. These results suggest that there may be remaining contextual challenges in improving health facility utilization for children under-five years and additional research on innovative ways to improve utilization is needed. Lastly, it may be that incentives directly provided to the clients (e.g. voucher schemes to mothers who bring children to the health facility) may be a more effective way of improving access to health services in this context.

## 3.6 Discussion

The study findings are surprising in a number of ways. They contrast other studies where a geographically focused financing approach, contracting-out through NGOs, contracting-in with government agencies and performance-based financing showed increases in health facility utilization. In Rwanda and Mozambique, PBF was associated with increases in maternal and child health service utilization (Basinga et al., 2011; Rajkotia et al., 2017) and specifically for post-conflict settings, results from Afghanistan show that contracting-out was associated with overall increase in health facility utilization for both women and children (Arur et al., 2009; Newbrander et al., 2011). However, these studies primarily compared contracted regions with non-contracted regions whereas I compare across contracting approaches. As contracting typically involves an increase in financial and technical support to health facilities, I argue that this should naturally follow increases

*Table 3.11:* ***Child Health Indicators***

| | Difference in Difference with covariates | | | | Kernel Propensity Score Matching | | | |
|---|---|---|---|---|---|---|---|---|
| VARIABLES | DPT1 | DPT3 | Malaria | Diarrhoea | DPT1 | DPT3 | Malaria | Diarrhoea |
| CHD Contracts relative to NGO Contracts | | | | | | | | |
| Diff-in-diff | 2.440 | 4.559 | -9.564** | 2.311 | 0.925 | 2.950 | -6.898 | 8.253*** |
| | (2.950) | (3.454) | (4.246) | (2.745) | (3.081) | (3.277) | (5.675) | (2.168) |
| Observations | 5,080 | 5,080 | 5,080 | 4,881 | 4,718 | 4,718 | 4,718 | 4,533 |
| R-squared | 0.022 | 0.020 | 0.044 | 0.056 | | | | |
| Mean control t(0) | 19.43 | 17.34 | 42.10 | 29.30 | 22.38 | 19.29 | 54.05 | 38.79 |
| Mean treated t(0) | 22.32 | 19.59 | 42.39 | 21.33 | 25.49 | 21.17 | 54.86 | 29.93 |
| Diff t(0) | 2.893 | 2.251 | 0.283 | -7.972 | 3.108 | 1.883 | 0.811 | -8.853 |
| Mean control t(1) | 9.072 | 8.137 | 37.44 | 26.09 | 12.34 | 10.58 | 45.71 | 28.51 |
| Mean treated t(1) | 14.41 | 14.95 | 28.16 | 20.43 | 16.37 | 15.41 | 39.62 | 27.91 |
| Diff t(1) | 5.333 | 6.810 | -9.281 | -5.661 | 4.033 | 4.833 | -6.087 | -0.600 |
| PBC relative to non PBC | | | | | | | | |
| Diff-in-diff | 0.459 | -0.0480 | 3.537 | 0.501 | 0.102 | 0.425 | 4.169 | 0.838 |
| | (2.458) | (1.815) | (3.160) | (1.964) | (2.456) | (2.138) | (3.324) | ( 2.250 ) |
| Observations | 5,080 | 5,080 | 5,080 | 4,881 | 5,080 | 5,080 | 5,080 | 4,881 |
| R-squared | 0.026 | 0.025 | 0.060 | 0.054 | | | | |
| Mean control t(0) | 13.94 | 11.89 | 30.11 | 26.84 | 18.64 | 16.23 | 41.16 | 31.51 |
| Mean treated t(0) | 20.64 | 18.48 | 44.59 | 29.08 | 25.14 | 21.59 | 55.57 | 35.72 |
| Diff t(0) | 6.705 | 6.590 | 14.48 | 2.244 | 6.495 | 5.356 | 14.42 | 4.212 |
| Mean control t(1) | 3.421 | 3.120 | 21.63 | 23.56 | 8.543 | 7.010 | 33.26 | 27.88 |
| Mean treated t(1) | 10.58 | 9.662 | 39.64 | 26.30 | 15.14 | 12.79 | 51.85 | 32.93 |
| Diff t(1) | 7.164 | 6.542 | 18.01 | 2.745 | 6.596 | 5.781 | 18.59 | 5.050 |

Standard errors in parentheses
Means and Standard Errors are estimated by linear regression
*** p<0.01, ** p<0.05, * p<0.1

in health facility utilization compared to regions which lack similar investments hence it may be more informative to compare across regions that receive similar investments in order to assess the utility of different contracting approaches to determine which works best.

The underlying assumption to date has been that building the capacity of NGOs rapidly accelerates access to health facility utilization, but increasingly several studies have noted lack of adequate information on the alternative; contracting using government agencies e.g. (Palmer, 2000). In addition, the assumption that the government, which is deemed to lack capacity to provide health services, can provide oversight to NGOs despite the lack of capacity that necessitated the contracting in the first place, may be excessive and this analysis sought to assess this assumption.

In Upper Nile, South Sudan, the contracting-in approach involved establishment of an external management unit that supported the government agency (CHD) in its implementation and management of the health facilities. This may have contributed to the second

surprising finding; comparing CHD-contracted and NGO-contracted counties, there were no statistically significant differences in health facility utilization by children-under five years, except for malaria (DD analysis) and diarrhoea (DD with PSM analysis).

For maternal health indicators, the statistically significantly higher double differences were observed in antenatal care and IPT-SP largely due to the large drop in health facility utilization in CHD counties relative to NGO counties, despite that CHD counties started at a higher baseline values; whereas child health indicators were relatively similar pre-2013 across all counties. While one can argue that drop in utilization may have been due to conflict, as it occurs in both NGO and CHD contracted sites, I argue that it does not explain the large drop in antenatal care in the CHD counties. It may suggest that NGOs were better able to mitigate against the effect of conflict than the CHDs, or may be due to lack of capacity on the side of the CHDs to support maternal health services. However, note also that while C-O (NGO) contracts directly stipulated performance measures, which included indicators for antenatal care, C-I (CHD) contracts did not. Therefore this may also be due to NGOs prioritizing achieving antenatal care targets (moral hazard). I argue that this does not fully explain it as diptheria, tetanus and pertussis vaccination was also a verifiable performance measure and there were no differences in performance.

There is a need to understand the contextual factors that may have led to this variation as it is not observed in results child health results where CHDs and NGOs have similar performance, as this may have policy implications in future. For example, it may be that CHDs require additional support to address maternal health service delivery constraints. Without additional research in the "efforts" of both NGOs and CHDs to attain performance targets, it is difficult to provide meaningful explanations of these results. This is worthy of further analysis. Also worth noting is that NGOs received higher compensation for managing the health facilities relative to the CHDs, and the expectation is that higher compensation results in higher performance. This does not appear to be the case as overall, the performance of both contracting models is remarkably similar, or stated otherwise, the differences are not remarkable. This makes it difficult to argue for either contracting approach; as CHDs achieve similar performance to NGOs despite receiving lower compen-

sation, it may be more cost-effective to utilize CHDs instead of NGOs. This would also aid in meeting the objective of strengthening the capacity of the MoH especially where an external management unit is established.

The third surprising finding is that PBC may not have affected the motivation of health-workers to increase health facility utilization as there were no differences compared counties that implemented PBC, relative to those that did not. However, careful reading of the PBC model highlights several weaknesses. PBC was implemented in counties where health-workers were primarily paid by the government and not by the RHHP thus, the PBC incentive may have merely harmonized salaries across all counties to deter health-workers from relocating to higher-paying facilities (as noted in IMA quarterly reports). As previously noted, this underscores the importance of understanding payment or incentive mechanisms; the incentive should be adequate to ensure that health-workers place additional effort in meeting performance targets, and this may have not been the case in this PBF model. In addition, it is unclear what the penalty was for missing performance-based targets, or the reward for meeting these in difficult settings. Thus, the contracts may not necessarily have rewarded providers' efforts as they were not tied to level of effort, as argued by Hart and Holmström. Perhaps a model that rewarded health-workers based on number of clients seen per month at the health facility (as in the case in Rwanda) may have been more successful. Therefore perhaps a different PBC model may have replicated the results obtained in other settings.

Lastly, it is also worth noting that the RRHP program had the lowest per capita spending on health in South Sudan, approximately 5 US$ compared to for example US$8 in some regions. This was despite Jonglei and Upper Nile states being the most conflict-affected and thus the most difficult to work this and the most logistically expensive due to geographical inaccessibility. As an example, the program implemented dry season immunization campaigns due to large areas of both states being inaccessible in the rainy season which lasts for six months in some areas[11]. Thus the contracts themselves may have limited the number of competitive bids from implementing partners, which may then have

[11]This is noted in several IMA quarterly reports

restricted the purchaser's ability to penalize non-performance and lastly may have been inadequate in meeting the costs for the expansion of service delivery. I would argue that future contracts in Jonglei and Upper Nile states would need to be much higher than that provided by the project. Understanding the historical costs of the RHHP would provide data for the design of a future, adequately funded project.

### 3.6.1 Study Limitations

The study has several limitations, primarily, the inability to compare cost-effectiveness of CHD versus NGO counties. This was due to lack of adequate information on PBF payments schedules as well as contracts penalty and rewards mechanisms for NGOs and CHDs. This information would have provided additional data for a more robust comparison.

Limited health facility variables was another limitation. The health facility service availability and readiness survey was conducted after the analysis period, between 2017-2018. As a result, health facility variables were limited to infrastructure as this is less likely to have varied from the period of the analysis, to 2018 considering that the contracting approach had limited funding for reconstruction. However, data on availability of equipment and supplies, staffing levels at each facility, and service availability would have allowed a more vigorous matching of health facilities, but were excluded as these may have changed in the 2 years after the analytical period. There was also limited data on county-specific socio-demographic variables that may have further strengthened PSM.

The analysis relies primarily on data from the District Health Information System (DHIS) database. Thus, analysis is dependent on whether health facilities report into the DHIS, and not necessarily on whether people do access health facilities. Results may be subject to poor reporting by health-workers, despite increases in health facility utilization. Annual health facility reporting per county is presented table 2 in the appendix. These results indicate that 5 counties experienced reduced reporting by health facilities in 2014. It is unclear whether this may have affected payments to implementing partners, or subsequently, reimbursements to the purchaser, which may have incentivized implementing partners to identify innovative ways to continue service delivery. The drop in utilization post 2013, which indicates relative elasticity to conflict, suggests that data was not in-

flated in order to obtain contract payments and may also indicate that DHIS data is fairly accurate.

This analysis does not control for conflict. However, I have assumed that conflict affected both NGO and CHD counties and therefore mitigating for the effect of conflict is related to effort made in achieving performance targets. Further analysis may show that conflict may have affected some regions more than others. Exploratory analysis of number of health facilities reporting in each county between 2011-2015 indicate that the counties with highest reduced reporting were Luakpiny/Nasir and Panyikang counties; other counties also saw a drop in reporting in 2013, with some recoveries in 2014.

### 3.6.2 Conclusions

This is the first study to assess the implication of different contracting modalities in South Sudan. The study finds a limited effect on both contracting-in and contracting-out approaches in South Sudan, and no effect of performance-based financing on expanding access to health services in Jonglei and Upper Nile States. This may be due to several factors; the design of the PBF mechanism which may have been inadequate in incentivizing performance, and mainly acted as a means of harmonizing salaries for public sector employees relative to private sector health workers, as well as the fact that PBF was not directly tied to health facility utilization. Contracting-in with NGos has higher results, however in the post-period, the CHDs had greater success in mitigating for the effect of conflict, as observed by the relatively lower reduction in health services utilization compared to the NGOs. Given that CHD contracts were also lower in costs, and CHDs did not have the ability to directly manage funds, this suggests that prioritizing implementation by CHDs may be just as effective as utilizing NGOs, with changes in the contracting modalities. This would necessitate establishing management contracts with external agencies to continuously build the capacity of CHDs to manage and oversee the health system. Future research should focus on establishing the cost-benefits of contracting-in and contracting-out in South Sudan and to assess approaches in ensuring continuous health services delivery where regions are affected by conflict.

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## 3.7 Appendix

Table C1 below is an illustration of difference in difference estimation.

*Table C1:* ***Illustrative DD design***

| | Treatment (CHD) | Comparison(NGO) | Difference |
|---|---|---|---|
| Pre | $\bar{y}1, pre$ | $\bar{y}0, pre$ | $\bar{y}0, post$ -$\bar{y}0, pre$ |
| Post | $\bar{y}1, post$ | $\bar{y}0, post$ | $\bar{y}1, post$ - $\bar{y}0, post$ |
| Change | $\bar{y}1, post$ - $\bar{y}1, pre$ | $\bar{y}0, post$ - $\bar{y}0, pre$ | $\Delta = (\bar{y}1post$ - $\bar{y}1pre)$ - $(\bar{y}0post$ - $\bar{y}0pre) = (\bar{y}0pre$ -$\bar{y}0pre)$ - $(\bar{y}1post$ - $\bar{y}0post)$ |

Table C2 shows reports received from health facilities annually. This is presented to show how reporting rates differ across the years. For Jonglei State, the highest number of facilities reporting was in 2013, with 161 sites submitting reports, while for Upper Nile State, reporting rates vary from 138, 132 and 135 in 2011, 2012 and 2013 before dropping to 100 sites in 2014, possibly as a result of conflict that started in December 2013.

*Table C2:* ***Health Facility Reporting***

| Partner | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| **Jonglei** | | | | | | |
| Akobo County | 16 | 15 | 15 | 14 | 13 | 14 |
| Ayod County | 15 | 18 | 15 | 11 | 9 | 7 |
| Bor County | 24 | 29 | 27 | 21 | 22 | 22 |
| Duk County | 13 | 13 | 15 | 10 | 3 | 7 |
| Fangak County | 13 | 14 | 19 | 19 | 19 | 19 |
| Nyirol County | 14 | 15 | 15 | 11 | 11 | 11 |
| Pibor County | 6 | 8 | 7 | 2 | 11 | 4 |
| Pigi County | 6 | 7 | 11 | 0 | 6 | 6 |
| Pochalla County | 9 | 9 | 8 | 8 | 8 | 8 |
| Twic East County | 20 | 18 | 16 | 16 | 8 | 8 |
| Uror County | 13 | 13 | 13 | 12 | 8 | 8 |
| Total | 149 | 159 | 161 | 124 | 118 | 114 |
| | | | | | | |
| **Upper Nile** | | | | | | |
| Akoka County | 4 | 4 | 3 | 3 | 3 | 3 |
| Baliet County | 8 | 7 | 7 | 4 | 4 | 0 |
| Fashoda County | 10 | 9 | 9 | 12 | 11 | 11 |
| Longechuk County | 12 | 12 | 13 | 12 | 12 | 11 |
| Luakpiny/Nasir County | 17 | 18 | 18 | 0 | 9 | 2 |
| Maban County | 13 | 9 | 14 | 14 | 13 | 13 |
| Maiwut County | 11 | 11 | 10 | 10 | 12 | 11 |
| Malakal County | 9 | 10 | 10 | 4 | 6 | 2 |
| Manyo County | 10 | 10 | 10 | 10 | 4 | 5 |
| Melut County | 9 | 9 | 9 | 9 | 9 | 7 |
| Panyikang County | 12 | 11 | 11 | 1 | 4 | 4 |
| Pibor County | 1 | 0 | 1 | 1 | 1 | 0 |
| Renk County | 14 | 15 | 13 | 13 | 9 | 9 |
| Ulang County | 8 | 7 | 7 | 7 | 12 | 10 |
| Total | 138 | 132 | 135 | 100 | 109 | 88 |

Figure 3.5 illustrates ANC 1st visits and deliveries across the counties and by supporting partner (NGO or CHD) in Upper Nile State. These graphs largely show that the difference

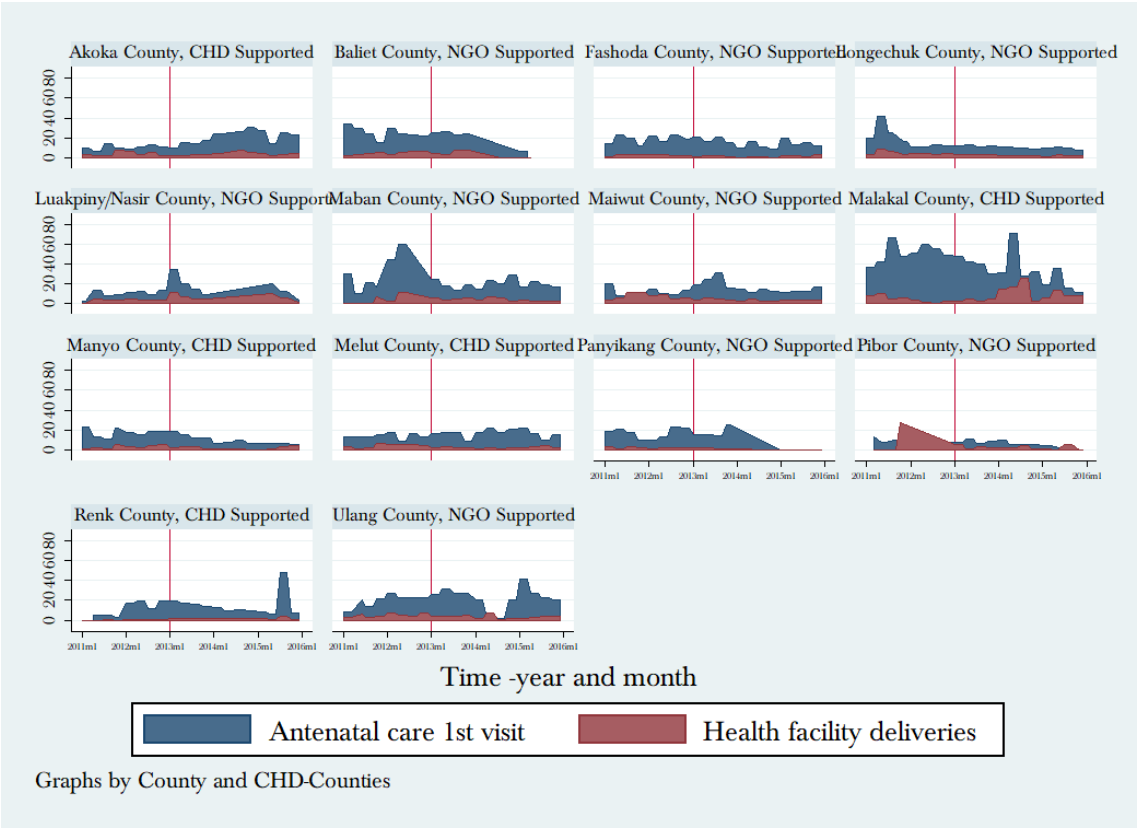


*Figure 3.5:* ***Maternal health by contract group***

between NGO supported and CHD supported counties is not distinct, suggesting that performance may not be related to type of contract, but more dependent on county-context. ANC 1st visits are chosen as these have been highest in utilization across all maternal health utilization indicators, while deliveries have been lowest.

Figure 3.6 illustrates ANC 1st visits and deliveries comparing across the counties and by performance-based financing in Upper Nile State, for similar reasons as above.

Mean monthly annual utilization is presented in tables C3 and C4 for contracting group and by PBF group.

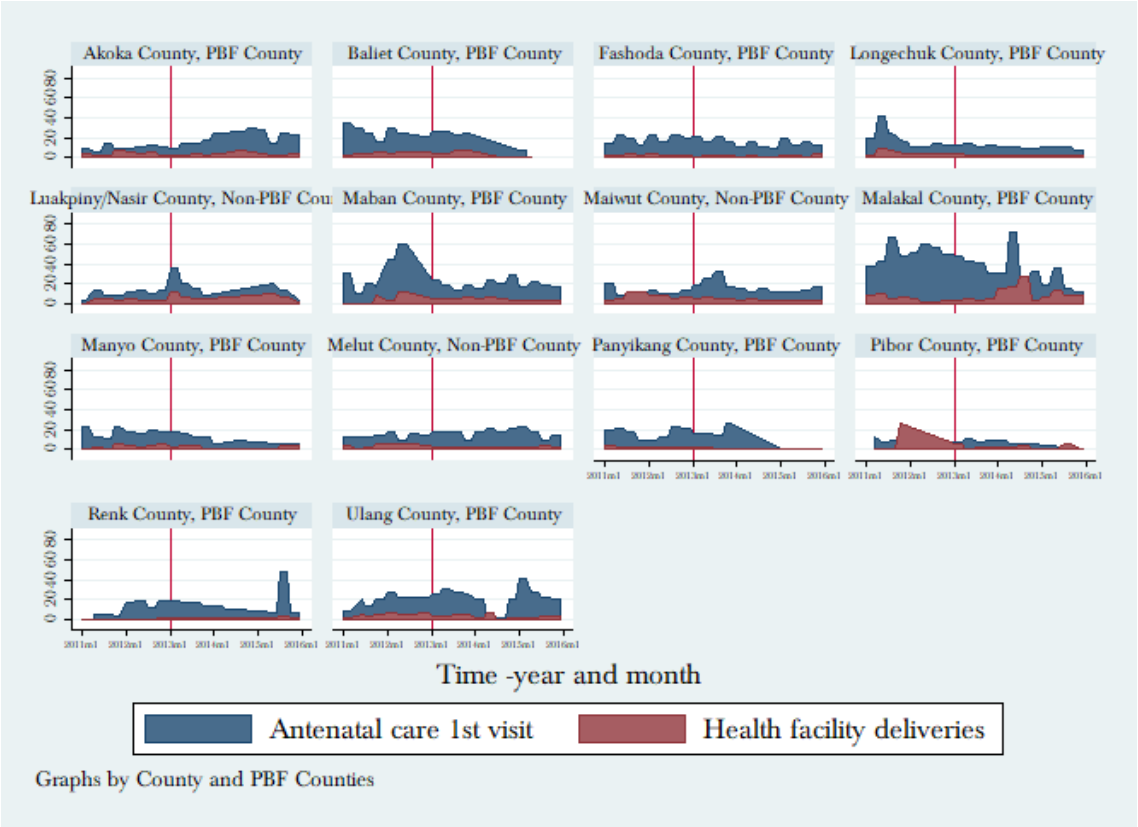


*Figure 3.6:* ***Maternal health by PBF group***

*Table C3:* ***Unadjusted Means by Contracting group***

| | NGO | CHD | Diff | NGO | CHD | Diff | NGO | CHD | Diff | NGO | CHD | Diff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ANC 1 | | | ANC 4 | | | IPT2 | | | Deliv | | |
| Annual | | | | | | | | | | | | |
| 2011 | 16.01 | 21.98 | -5.96*** | 10.82 | 14 | -3.18*** | 5.63 | 7.79 | -2.16*** | 6.03 | 3.53 | 2.50*** |
| 2012 | 15.98 | 22.64 | -6.66*** | 9.40 | 10.61 | -1.21 | 6.76 | 9.03 | -2.28*** | 4.60 | 3.10 | 1.51*** |
| 2013 | 17.23 | 20.23 | -3.00*** | 8.02 | 11.62 | -3.60 | 6.07 | 9.70 | -3.63*** | 3.68 | 2.57 | 1.10*** |
| 2014 | 17.18 | 16.09 | 1.09 | 5.87 | 8.46 | -2.59*** | 6.10 | 6.20 | -0.10 | 3.33 | 2.28 | 1.06*** |
| 2015 | 16.97 | 17.31 | -0.33 | 5.82 | 10.40 | -4.58*** | 6.94 | 6.56 | 0.36 | 3.71 | 3.06 | 0.65 |
| | DPT1 | | | DPT3 | | | Mal | | | Diarr | | |
| Annual | | | | | | | | | | | | |
| 2011 | 26.99 | 14.19 | 12.80*** | 20.65 | 11.29 | 9.35*** | 51.73 | 36.07 | 15.66*** | 38.13 | 21.48 | 16.65*** |
| 2012 | 27.95 | 17.35 | 10.60*** | 20.90 | 14.28 | 6.62*** | 56.96 | 41.87 | 15.09*** | 36.88 | 29.40 | 7.48*** |
| 2013 | 20.89 | 18.42 | 2.47 | 15.87 | 16.92 | -1.05 | 57.50 | 37.98 | 19.51*** | 34.76 | 30.29 | 4.46*** |
| 2014 | 10.03 | 7.34 | 2.69 | 6.40 | 5.69 | 0.71 | 51.46 | 42.14 | 9.32*** | 34.94 | 35.01 | -0.08 |
| 2015 | 10.74 | 9.77 | 0.97 | 6.64 | 5.56 | 1.08 | 69.67 | 36.44 | 33.23*** | 49.21 | 27.63 | 21.57*** |

*** p<0.01, ** p<0.05, * p<0.1

Diff= Difference, Deliv=Delivery, Mal=Malaria, Diarr = Diarrhoea

*Table C4:* ***Unadjusted Means by PBF group***

| | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** | **nPbf** | **Pbf** | **Diff** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ANC 1 | | | ANC 4 | | | IPT2 | | | Deliv | | |
| Annual | | | | | | | | | | | | |
| 2011 | 15.78 | 17.55 | -1.78 | 10.60 | 11.68 | -1.08 | 5.47 | 6.21 | -0.73 | 4.96 | 5.98 | -1.02*** |
| 2012 | 15.04 | 18.20 | -3.17*** | 7.67 | 10.59 | -2.92*** | 6.77 | 7.34 | -0.56 | 4.09 | 4.45 | -0.36 |
| 2013 | 17.79 | 17.82 | -0.03 | 8.97 | 8.60 | 0 .37 | 7.50 | 6.41 | 1.09*** | 4.44 | 3.09 | 1.35*** |
| 2014 | 17.39 | 16.74 | 0.65 | 6.83 | 6.11 | 0.72 | 6.19 | 6.09 | 0.10 | 3.60 | 2.90 | 0.69*** |
| 2015 | 12.84 | 18.45 | -5.61*** | 6.49 | 6.351 | 0.13 | 6.83 | 6.91 | -0.08 | 4.27 | 3.41 | 0.86*** |
| | DPT1 | | | DPT3 | | | Mal | | | Diarr | | |
| Annual | | | | | | | | | | | | |
| 2011 | 20.44 | 27.23 | -6.78** | 14.73 | 21.37 | -6.64*** | 43.46 | 52.15 | -8.69*** | 34.17 | 36.23 | -2.06 |
| 2012 | 22.56 | 27.66 | -5.10 | 16.387 | 21.25 | -4.86** | 46.68 | 57.73 | -11.05*** | 31.94 | 37.36 | -5.42*** |
| 2013 | 19.54 | 20.81 | -1.27 | 14.20 | 16.82 | -2.63* | 52.49 | 54.60 | -2.11 | 33.96 | 33.96 | 0.001 |
| 2014 | 11.50 | 8.54 | 2.96 | 8.45 | 5.20 | 3.25*** | 44.18 | 52.33 | -8.15*** | 33.53 | 35.66 | -2.13 |
| 2015 | 5.56 | 12.27 | -6.71*** | 3.94 | 7.344 | -3.41*** | 59.26 | 67.34 | -8.09*** | 44.56 | 46.96 | -2.40 |

*** p<0.01, ** p<0.05, * p<0.1

Diff= Difference, nPbf=No Pbf, Deliv=Delivery, Mal=Malaria, Diarr = Diarrhoea

# Curriculum Vitae

**Juliana Bol**
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Baltimore, MD 21201
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jbol@outlook.com

## Education and Training

**Johns Hopkins Bloomberg School of Public Health. Baltimore, MD**
Department of International Health, Health Systems.
Doctor of Philosophy (Ph.D.), October 2019
Overall GPA: 3.5

**Thesis Title:** Contracting-out of Primary Health Care Services in Conflict-affected Settings: The Case of South Sudan
**Advisor:** Prof. Antonio J. Trujillo, Ph.D.

**Columbia Univ. Mailman School of Public Health. New York, NY**
Department of Population and Family Health,
Forced Migration and Health.
Master of Public Health (MPH), May 2009

**University of North Carolina at Chapel Hill. Chapel Hill, NC**
Department of Chemistry
Bachelor of Arts, Chemistry, Dec 2004
Minor, Biology

## Teaching Assistantships

Digital Health in Lower-and-Middle-Income Countries *Jan-March 2019*
Program Evaluation for Public Policy (4 years) *Sept- Dec 2015/16/17/18*
Econometrics Methods (including Stata lab session) *March-May 2016/17*
Behavioral Economics in Health Decisions *March-May 2016*
Systems Science in Public Health: Basic Modeling & Simulation Methods *March-May 2016*
Health Systems Strengthening in LMICs *Oct-Dec 2015*

## Research Experience

**Research Assistant** *Oct March 2017*
Maternal and Child Epidemiology Estimation (MCEE) Project
Johns Hopkins Bloomberg School of Public Health.

**Graduate Research Assistant, M&E Unit** *Sept 2007- June 2009*
Reproductive Health Access Information and Services in Emergencies (RAISE) Initiative
Columbia University, Mailman School of Public Health.

**Consultancies**

**Stanford University WomenLift Health.** *Aug 2019 – to date*
Clear Outcomes
Team Leader, M&E.

**Population-based HIV/AIDS Impact Assessments (PHIA) Project.** *March - Aug 2019*
ICAP Columbia University
Project final evaluation with primary data collection in Tanzania, Rwanda and Zambia.

**Population Services International (PSI).** *May- Nov 2018*
Data-analysis of South Sudan Malaria Indicator Survey (MIS) 2017.

**Population-based HIV/AIDS Impact Assessments (PHIA) Project.** *Aug- Dec 2017*
ICAP Columbia University
Project mid-term evaluation with primary data collection in Cote d'Ivoire, Lesotho and Ethiopia.

**CBM East Africa Regional Office.** *Nov- Dec 2015*
Situational Analysis of Neglected Tropical Diseases (NTDs), epidemiological profile, and desk review of current programs in the Republic of South Sudan.

**Professional Experience**

**USAID-MCHIP South Sudan Integrated Service Delivery Program (ISDP)** 2012 – -2014
Quality Advisor, JhpiegoJuba, South Sudan
Provided leadership in quality improvement for USAID funded, US$83million primary health-care program covering 2 (out of 10) states in South Sudan.

**USAID Sudan Health Transformation Project II (SHTP-II)** 2011-2012
M&E/Quality Assurance Specialist, Gender Focal PersonJuba, South Sudan
Overall quality assurance of SHTP-II, supporting 9 national and international NGOs to implement quality improvement processess in 165 health facilities in 10 states.

**Population Services International (PSI)** 2009-2010
Monitoring & Evaluation (M&E) Technical AdvisorJuba, South Sudan
M&E lead for the Global Fund to Fight AIDS, Tuberculosis and Malaria Program Management Unit (GFATM-PMU), USAID Safe Water and Sanitation, HIV and Social Marketing programs.

**Novozymes North America Inc.** 2005-2007
Research Associate, Research and Development Unit, Fuel Ethanol Application-Raleigh, NC
Laboratory experimental work on fuel ethanol using corn substrate and enzymes under different conditions to optimize yield.

**Professional Memberships**
**Association Memberships**
American Public Health Association (APHA)
American Evaluation Association (AEA)

**Student Group Memberships**
African Public Health Network (APHN)
Black Graduate Students Association (BGSA) [President: 2017]

**Publications Submitted**

**Juliana Bol** and Antonio J. Trujillo. Does contracting-out of primary health care services to Non-State Providers reduce child mortality in South Sudan? A synthetic control analysis.
(Submitted to Social Sciences and Medicine 7/2019)

**Technical Strengths**

Computer Languages: Stata, R, Python (beginner)
Skills: Econometric methods in program impact evaluation, microeconometrics, macroeconometrics, economic evaluation and cost-effectiveness analysis, demographic estimation methods, spatial data analysis, LaTex
Databases: Microsoft Access

**ADDITIONAL INFORMATION**

**Personal statement of research**

My research interests involve the following five categories:

1. Studying health system strengthening approaches in conflict and fragile-affected settings. I am interested in innovative program implementation and contracting modalities that impact maternal and child health outcomes.
   Currently preparing a manuscript for submission.

2. Extending the application of contract theory from the field of economics on the contracting interventions implemented in fragile and conflict-affected settings to improve the efficiency and delivery of primary health care services. Currently preparing a manuscript for submission.

3. The development of new approaches to estimate the impact of health programs using routine health facility data (e.g. district health information system datasets). These include econometrics methods, synthetic control for estimating program impact at the aggregate level, propensity score matching etc.

4. Strengthening monitoring and evaluation of existing programs to better integrate M&E with program implementation and embedding evaluations in program planning and design.

5. Quality improvement approaches for strengthening the health workforce in lower-and-middle-income settings.