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Can performance-based financing help reaching the poor with maternal and child health services? The experience of rural Rwanda

Laurence Lannes[1]*, Bruno Meessen[2], Agnes Soucat[3] and Paulin Basinga[4]
[1]*The London School of Economics and Political Science, Department of Social Policy, London, UK*
[2]*Institute for Tropical Medicine, Antwerp, Belgium*
[3]*World Bank, Washington DC*
[4]*Global Health Program, Bill & Melinda Gates Foundation, Seattle, WA, USA*

SUMMARY

More than 20 countries in Africa are scaling up performance-based financing (PBF), but its impact on equity in access to health services remains to be documented. This paper draws on evidence from Rwanda to examine the capacity of PBF to ensure equal access to key health interventions especially in rural areas where most of the poor live. Specifically, it focuses on maternal and child health services, distinguishing two wealth groups, and uses data from a rigorous impact evaluation.

Difference-in-difference technique is used, and different model specifications are tested: control for unobserved heterogeneity and common random error using linear probability model, seemingly unrelated regression equations, and clustering and fixed effects.

Results suggest that in Rwanda, PBF improved efficiency rather than equity for most health services. We find that PBF achieved efficiency gains by improving access to health services for those easier to reach, generally the relatively more affluent. It turns out to be less effective in reaching the poorest. Our results illustrate the advantages of rigorous randomized impact evaluation data as results published earlier using a nationally representative survey (Demographic and Health Survey) were not able to capture the pro-rich nature of the PBF scheme in Rwanda.

Our paper advocates for building mechanisms targeting the vulnerable groups in PBF strategies. It also highlights the need to understand the impact of PBF together with the specific development of health insurance coverage and the organization of the health system.

KEY WORDS: equity; incentives; maternal and child health; Rwanda

INTRODUCTION

One year before the deadline of the Millennium Development Goals (MDG), most countries were not running to schedule. Goal 4 aiming to cut mortality among

*Correspondence to: L. Lannes, The London School of Economics and Political Science, Department of Social Policy, Houghton Street, London WC2A2AE, UK. E-mail: l.e.lannes@lse.ac.uk

children under 5 years of age by two-thirds between 1990 and 2015 is unlikely to be met in Africa, despite substantial progress. Africa still has the world's highest under 5 years of age mortality rates and accounts for one in nine child deaths (United Nations Economic Commission for Africa *et al*., 2014). Over the last decade, an unprecedented search for strategies capable to accelerate progress toward these ambitious targets has taken place.

There is a growing recognition that as aggregate targets, MDGs may hide inequalities within countries. In an analysis conducted over 54 countries, Barros *et al*. (2012) found inequalities for most services. Skilled birth attendant coverage was found to be the least equitable intervention, followed by the indicator 'four or more antenatal care visits'. The poorest children are also two to three times more likely to die or to be malnourished than better off children (UN System Task Team on the Post-2015 UN Development Agenda, 2012).

This recognition invites researchers to assess the performance in terms of equity of strategies promoted in low income countries. Performance-Based Financing (PBF) is one of these strategies. As other results-based payment strategies, PBF organizes the 'transfer of money or material goods conditional on taking a measurable action or achieving a predetermined performance target' (Eichler, 2006). As a reform proposition (Meessen *et al.*, 2011), it tries to address systemic shortcomings of health systems in low-income countries. It focuses on the supply side and aims at improving the performance of the service delivery system by encouraging effort and compliance with recommended clinical practice leading to improved access to health services (Soeters *et al*., 2006, Meessen *et al.*, 2007, Eichler, 2006, Palmer *et al.*, 2006).

While there is growing evidence of the effectiveness of PBF, there is less evidence on the distribution of its effects. Most evidence is focused on the impact of the strategy in terms of the use of services and quality of care, but less is known on its cost-effectiveness, equity impact and potential adverse effects (Witter *et al.*, 2012, Witter *et al.*, 2013). It is however likely that the strategy can have a negative impact on equity in access to services as it can encourage health workers to cherry-pick patients that make it easier to reach targets (Ireland *et al.*, 2011).

Rwanda is one of the few countries in the world that is on track to reach the health-related MDGs (Binagwaho *et al.*, 2014), and the poor have not been left aside from progress achieved. Strategies aimed to improve financial access for the poor have resulted in increased utilization of health services and lower out-of-pocket payments. The country has experienced a rapid scale up of health insurance schemes from 7% of the target population in 2003 to 85% in 2008 (Rwanda Ministry of Health, 2009) thus improving equity in access to basic health services (Saksena *et al.*, 2010). As a result, health spending and catastrophic expenditures have declined (Sekabaraga *et al.*, 2011). Rwanda is also one of the few countries in the world that has implemented PBF on a large scale. The prevailing performance culture in Rwanda has facilitated the implementation of PBF that was piloted in three different areas of the country since 2001 (Rusa *et al.*, 2009). Given the positive results from the pilots (Meessen *et al.*, 2006, Soeters *et al.*, 2006, Meessen *et al.*, 2007), the Ministry of Health decided to scale up PBF nationally in 2006. The scale-up plan was accompanied by a rigorous impact evaluation that allows measuring the effect of PBF over a period of 2 years in 19 rural districts of Rwanda (Basinga *et al.*, 2011).

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In the PBF national scheme, payments for performance were made to primary healthcare facilities based on the quantity of outputs achieved conditional on the quality of services delivered. PBF was applied to 14 maternal and child health output indicators (Basinga *et al.*, 2011). The scheme did not target any socioeconomic group in particular, but poorest were somehow indirectly targeted as PBF subsidized services that benefited mainly the poor.

Evidence from developed countries on the impact of PBF (or pay-for-performance – P4P) on access to care for disadvantaged groups is mixed. The design of the schemes and context in which they are implemented also varies. Some studies show that P4P may exacerbate disparities in health care (Greene and Nash, 2009) while others find no impact on equity in access to care (Crawley *et al.*, 2009). Setting up a targeted mechanism for vulnerable groups is a critical element to improve access to care for these groups (Peterson *et al.*, 2006).

Evidence from developing countries is more limited (Lagarde and Palmer, 2006), and the diversity of schemes and contexts even more flagrant. In a review of 14 PBF experiences, the impact on equity was measured in only three cases (Loevinsohn, 2008). Still, available evidence insists on the importance of targeting the poor as the better-off could be the main beneficiaries of an increase in utilization (Gwatkin *et al.*, 2004). Equity in access can improve only when the poor are explicitly targeted by a PBF scheme such as in urban Bangladesh and Cambodia (Loevinsohn, 2008). In Rwanda, using Demographic and Health Survey (DHS) data, Priedeman *et al.* (2013) show that PBF was neither a pro-poor nor a pro-rich strategy. In neighboring Burundi, PBF was found to be pro-rich in the case of institutional deliveries, but pro-poor in the case of immunization (Bonfrer *et al.*, 2014).

In the absence of clear and robust evidence, this paper first seeks to examine the distributional impact of PBF on access to basic health services using data from a randomized control trial evaluating the impact of PBF in Rwanda. The analysis covers a large range of maternal and child health interventions. The hypothesis is that the population uniformly benefits from an increase in the volume of care because the implementation of PBF followed a situation where no mechanism existed to target the poor.

BACKGROUND

Overall access to basic health services in Rwanda

In Rwanda, increases in the health workforce and their skills, PBF, health insurance and better leadership and governance led to impressive results in service use. Births attended by skilled personal rose by 77% between 2006 and 2010 compared with 26% between 2000 and 2005. Similarly, contraceptive prevalence rose by 351% against 150% (Bucagu *et al.*, 2012).

Rapid increases in the use of essential maternal and child health services resulted in significant progress in health outcomes. The infant and under 5 years of age mortality rates fell drastically from 121 per 1000 to 50 per 1000 and from 217 per 1000 to 76 per 1000, respectively, between 2000 and 2010. The maternal mortality ratio also decreased, although not significantly from 1071 maternal deaths per 100 000

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live births in 2000 to 750 in 2005. The use of modern contraceptive rose from 10.3% in 2005 to 45.1% in 2010, and the percentage of children taken to health care provider in the event of diarrhea rose from 14.1% to 37.2% over the same period (National Institute of Statistics of Rwanda, 2006, National Institute of Statistics of Rwanda, 2009 and National Institute of Statistics of Rwanda, 2001; Table 1).

Equity in access to basic health services in Rwanda

It is significant to note that the poor experienced significant improvements in access to basic services. Although the rich still used more services than the poorest in 2010, the gap between the rich and the poor narrowed in many of the health services (Table 1). Using the 2005 and 2010 DHS data, Pierce *et al.* (2014) show that the greatest increases in health center deliveries occurred among less educated, less wealthy and rural Rwandan women. Strategies aimed at improving financial access for the poor, resulted in an increased utilization of health services and lower out-of-pocket payments. Health spending and catastrophic expenditures have declined (Sekabaraga *et al.*, 2011). The poorest also benefited from significant improvements in health outcomes. In 2005, the under-five mortality rate (U5MR) for the poorest quintile (211 per 1000) was almost twice as high as the level for the richest quintile (122 per 1000), but the gap between the two groups was cut by half between 2005 and 2010. The same pattern is true for U5MR. Finally, the poorest experienced significant improvements in fertility, but the gap between the poorest and the richest widened. The gap remained the same for stunting but little improvement was achieved (Table 1).

METHODS

Study design

The impact evaluation of the national PBF model in Rwanda is the first randomized experiment used to assess the impact of the strategy. The design of the study has already been described extensively elsewhere (Basinga *et al.*, 2011). The impact evaluation took advantage of the phased implementation of PBF over a 23-month period. The 19 rural districts (out of the 30 Rwandan districts) that did not implement a PBF pilot before 2006 were paired and randomly assigned to treatment (12 districts) or control groups (seven districts).

This impact evaluation is particularly valuable as budgets of control facilities were increased by the average PBF payment to treatment facilities to control for additional resources in treatment facilities. However, because of the decentralization reform that occurred during the impact evaluation, some health centers from the control group had to be reassigned to the treatment group and the evaluation shifted to a quasi-experimental status. Nevertheless, the descriptive analysis of baseline surveys shows that there is balance between treatment and control groups. One can remain confident that differences observed between the two groups at the end of the treatment period can be attributed to PBF alone (Basinga *et al.*, 2011).

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Table 1. Use of basic health services and health outcomes for richest and poorest quintile (2005–2010)

	2005				2010			
	Q1	Q5	Rwanda	Gap poorest–richest	Q1	Q5	Rwanda	Gap poorest–richest
Fertility (children per woman)	6.1	5	6.1	1.1	5.4	3.4	4.6	2
IMR (/1000)	114	73	86	41	70	50	50	20
U5MR (/1000)	211	122	152	89	119	75	76	44
Use of modern FP (%)	6	22.4	10.3	16.4	38.5	49.6	45.1	11.1
ANC by trained personnel (%)	91.6	95.3	94.4	3.7	96.6	98.9	98	2.3
Assisted delivery (%)	27.2	66.4	38.6	39.2	61.2	85.9	69	24.7
Children <5 taken to health provider for diarrhea (%)	13.3	18.3	14.1	5	26.5	50.4	37.2	23.9
Children under 5 years of age stunted (%)	55.1	29.7	45.3	25.4	54	25.8	44.2	28.2

Source: Author using DHS 2005 and 2010 data.
FP, family planning; U5MR, under-five mortality rate; IMR, infant mortality rate; Q1, poorest quintile; Q5, richest quintile.

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Data

Household surveys. The database contains baseline and follow-up rounds of household data collected in 2006 and 2008 for a total of 166 primary healthcare facilities and 2145 households in the catchment areas of these facilities. Thirteen zones, of about 15 to 20 households, were initially sampled for each health facility. Households with at least one child below the age of 6 years were selected until the fulfillment of the sample (Basinga *et al.*, 2011). The same households were interviewed at baseline and follow-up thus allowing panel data analysis. Household surveys provide basic socio-demographic characteristics of a population, data and health status and utilization rates of health services.

The analyses are performed using three different groups of population: a group of married women aged 15–49 years for the analyses on family planning, a group of women who were pregnant in the 2 years preceding the survey for the analyses of maternal health services and a group of children up to 5 years of age for analyses on child health services. Dependent variables are services that were incentivized as part of the PBF strategy: institutional deliveries, use of modern family planning, 'four or more antenatal care visits', 'prenatal care during the first quarter' and 'preventive and curative child care in the past 4 weeks' and for which baseline data showed lower utilization by the poorest.

Individual, household and health facility characteristics were added in the specification as explanatory variables: family members, children under 6 years of age in each household, the distance between the household and the facility, whether the individual had health insurance and the status of the health facility (public or faith-based). Specific controls for the analyses on women include years of schooling, marital status, partner living in the household, prior pregnancies and age. Specific controls for the children's analyses included whether the parents lived in the household, whether the mother had primary education and health insurance, the children's age and sex.

Constitution of wealth groups

Because data on income or consumption were not available, a wealth index was estimated to proxy living standards using a principal component analysis. As the same households were interviewed at baseline and follow-up, wealth groups were created according to the baseline wealth index and households' wealth status was categorized according to the baseline in both rounds. The two groups called the upper and lower groups thus represent households below and above the median wealth at baseline.

The asset score includes the following items: complete sofa set, refrigerator, deep freezer, radio, music system, television, satellite dish, video deck, DVD player, computer and accessories, landline phone, mobile phone, washing machine, mosquito net, ventilator, air conditioner, sawing machine, bed, wardrobe, metallic library, table, chair, car, lorry/trailer, motorcycle, boat and bicycle. Table 2 reports the assets possessed by households in the lower and upper wealth groups in both waves. It reveals three important findings: First, as discussed later in the paper, households in the upper group are not rich households. The sample was drawn from rural Rwanda where the population is mostly poor. Thus, the upper group households do not possess assets

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Table 2. Households assets according to wealth group and wave

	Baseline (2006)			Follow-up (2008)		
	Lower group (%)	Upper group (%)	Mean (%)	Lower group (%)	Upper group (%)	Mean (%)
Complete sofa set	0.0	7.9	2.5	0.0	15.3	9.8
Refrigerator	0.0	0.4	0.1	0.0	1.3	0.8
Deep freezer	0.0	1.6	0.5	0.0	1.7	1.1
Radio	36.0	80.4	50.0	26.5	88.7	66.2
Music system	0.0	15.3	4.8	0.0	8.1	5.2
Television	0.0	0.7	0.2	0.0	2.6	1.7
Satellite dish	0.0	0.4	0.1	0.0	1.6	1.0
Video deck, DVD	0.0	0.3	0.1	0.0	2.2	1.4
Computer	0.0	0.1	0.0	0.0	1.6	1.0
Landline phone	0.0	0.3	0.1	0.0	1.7	1.1
Mobile phone	0.0	7.3	2.3	0.0	28.9	18.5
Satellite dish	0.0	0.3	0.1	0.0	1.5	0.9
Washing machine	0.0	0.1	0.0	0.0	1.5	1.0
Mosquito nets	9.7	61.1	25.9	63.6	94.5	83.3
Ventilator	0.0	0.3	0.1	0.0	1.2	0.8
Air conditioner	0.0	0.4	0.1	0.0	1.2	0.8
Sawing machine	0.0	3.3	1.0	0.0	4.4	2.8
Bed	50.5	82.0	60.4	44.3	86.3	71.2
Wardrobe	0.0	15.6	4.9	0.0	11.5	7.3
Metallic library	0.0	3.3	1.0	0.0	4.0	2.6
Table	53.5	83.2	62.9	40.1	83.0	67.5
Chair	84.4%	84.9	84.5	81.6	91.1	87.7
Car	0.0%	1.9	0.6	0.0	2.1	1.4
Lorry/trailer	0.0%	0.1	0.0	0.0	1.5	0.9
Motorcycle	0.0%	1.5	0.5	0.0	2.4	1.5
Boat	0.0%	0.9	0.3	0.0	2.8	1.8
Bicycle	1.2%	51.6	17.2	0.4	34.1	22.0

Source: Author.

that characterize wealth such as a car, a refrigerator, or air conditioner. Second, the categorization of the population in the two wealth groups succeeded in constituting groups that differ in the assets they possess. Households from the upper group are more likely to possess a complete sofa set, a radio, music system, mobile phone, mosquito net, bed, wardrobe, table and bicycle. Indeed, assets of the lowest group

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households are limited to radio (26% in 2008), mosquito net (63%), bed (43%), table (40%) and chair (81%). Third, overall wealth status of households improved over the 2-year period as the number of assets possessed by households increased overtime as well as the proportion of households possessing a given asset. For instance, 18% of households possessed a mobile phone in 2008 against 2% in 2006.

Statistical methods

Clustered t-tests. Descriptive analyses including *t*-tests were performed for all dependent and independent variables in the models to compare the means in the treatment and control groups at baseline. Clustered *t*-tests for the variables of interest at baseline and follow-up by wealth groups were also run to assess the difference in access to basic services according to wealth status in both years. This enables us to check the validity of the data used in this paper by comparing results with those of the DHSs.

Regression analyses

A difference-in-difference model was used as it is appropriate for impact evaluation data (Bertrand *et al.*, 2004). This model first calculates the mean difference between the baseline and follow-up values of the variable of interest for the treatment and control groups; second, it calculates the difference between these two mean differences. This second difference isolates the impact of PBF. Although the dependent variables are dichotomous, a linear probability model was preferred to logistic regression as interactions in non-linear models are not consistently interpretable (Ai and Norton, 2003).

As there are reasons to believe that the probability of using one health service is linked to the probability of using another, Seemingly unrelated regression equations (SURE) were completed. SURE provide the advantage of gaining efficiency in estimation by combining information on different equations and by imposing or testing restrictions that involve parameters in different equations (Moon and Perron, 2006, Zellner, 1962).

A second set of robustness checks were run using fixed-effects and clustering. Fixed effects control the effect of unobservable characteristics that can influence the dependent variable (Bertrand *et al.*, 2004, Khandker *et al.*, 2010). They mitigate the risk of omitted variable bias related to unobservable variable that does not change over time or across facilities. As performed in a previous analysis using the same data, facilities and time-fixed effects were used to control for time and time-invariant location (Basinga *et al.*, 2011). Further, clustered standard errors were computed. Clustering allows the error terms to be correlated in the same cluster.

Empirical strategy

All multivariate statistical analyses were performed on three groups: total group, lower group and upper group to see whether there is a difference in the impact of PBF according to wealth status. Four different specifications were used successively. Specification 1 specifies a linear relationship between the dependent variable and the interaction between the treatment variable and the year variable without any control.

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Specification 2 adds a selection of explanatory variables to Specification 1. Specification 3 adds an interaction between PBF and insurance to describe the simultaneous influence of the two variables rather than the additive influence. Finally, Specification 4 adds an interaction between PBF and the asset index to provide a different measurement of the relationship between wealth and PBF. Only results of Specification 3, which provide the best estimates, are presented in this paper while other results are reported in the appendixes.

Limitations

This study has limitations, although it is the first to provide rigorous evidence on the impact of PBF on equity for family planning, maternal health and child health services. First, the sample was not balanced at baseline for modern family planning method for the richer group. However, as use was greater in the control group, results presented here are indeed underestimating the impact of PBF. Second, the sample is not representative of the total population of Rwanda. The sample was designed to test the impact of PBF in a randomized evaluation and included only the districts that had not piloted PBF in the past. These districts excluded the capital city Kigali (17% of the population) and the second main city of Butare (9%). The sample studied here represents a more rural and less wealthy population than the overall population of Rwanda. Consequently, our differentiation between lower and upper groups in this paper could be better characterized as a difference between 'poor' and 'near poor'. Third, as the observation period of the treatment was over 23 months only, one cannot observe the long-term effect of PBF on the use of services in general and on equity in access in particular, although this effect may be different from the one observed in the short term.

RESULTS

Balance check

The evaluation design achieved balance at baseline between the treatment and the control groups in the lower group, in the upper group and in the total sample (Annex). There are only significant differences for poor women who completed four or more prenatal care visits (with a larger utilization rate in the treatment group) and current use of family planning in the richest group (with a larger utilization rate in the control group).

Descriptive analysis

The descriptive analysis of the impact evaluation data on utilization of basic health services confirms the trends highlighted in DHS (National Institute of Statistics of Rwanda, 2006, National Institute of Statistics of Rwanda, 2009): between 2006 and 2008, utilization for women and children rose. Family planning intake rose by 23 percentage points to reach 34% in 2008, and assisted deliveries rose by 25 percentage points to reach 52% in 2008. The use of antenatal care services during the first trimester of pregnancy improved from 10% to 25% while the coverage of four or more

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antenatal care visits rose from 15% to 28%. Among the services under study, only preventive care at health centers did not experience any change (Table 3).

A further descriptive analysis on utilization of healthcare services shows a mixed picture on equity. Undisputable progress was achieved as the use of services rose significantly among the lower group between 2006 and 2008: Family planning intake rose from 9% to 28% and assisted deliveries from 25% to 48% for the poorest in the sample. Prenatal care services are equally used by lower and upper group women in both years showing that recent improvements in access to care are equitable. However, significant levels of inequity remain for family planning and use of Insecticide-treated net (ITN) with inequalities observed in both years, although the gap between the two wealth groups is narrowing. Access to care for children in the event of illness also improved overtime for the poor but inequalities remain in both years and access is low as fewer than one third of children visited a health center in the event of an illness (Table 4).

REGRESSION ANALYSES

Difference in difference estimates

Maternal health. Estimates from OLS regression analysis, which are assuming a linear probability for three groups (upper, lower and total population), are first reported (Table 5; see Annexes for results of the four specifications).

Consistently with the previous work (Basinga *et al.*, 2011), results suggest that PBF has an impact on increasing institutional deliveries, but not on prenatal care services. However, we find a positive impact on institutional deliveries for the upper group only. The probability of an upper group woman delivering in a health facility increases by 21% (99% confidence level) in the treatment group compared with the control group. However, PBF alone has no impact on the probability of a lower

Table 3. Trend in utilization of basic health services (2006–2008)

	2006			2008			Absolute change
	N	%	SD	*N*	%	SD	
Family planning and maternal health services							
Family planning	1592	0.11	0.01	1680	0.34	0.01	0.23***
Birth at facility	1089	0.36	0.02	1019	0.53	0.02	0.17***
Assisted deliveries	1271	0.27	0.02	1003	0.52	0.02	0.25***
4+ prenatal visits	1223	0.15	0.02	1000	0.28	0.03	0.13**
Prenatal care during first quarter	1227	0.10	0.02	996	0.25	0.03	0.15***
Child health services							
Curative care	1388	0.23	0.02	1039	0.32	0.02	0.09**
Preventive care	3150	0.12	0.02	2428	0.13	0.01	0.01
Use of bed nets	3129	0.18	0.03	2372	0.75	0.02	0.57***

Source: Author using the impact evaluation database.
SD, standard deviation.
Note: Cluster-adjusted *t*-tests for differences between 2006 and 2008.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

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Table 4. Equity in maternal and child health services in 2006 and 2008

		Total sample		Lower group		Upper group		Absolute change
	Year	Observations	Mean (%)	Observe	Mean (%)	Observe	Mean	Lower–upper (%)
Family planning and maternal health services								
Family	2006	1592	11	1049	9	543	15%	6**
planning	2008	1680	34	657	28	1023	37%	9***
Assisted	2006	1271	27	833	25	438	31%	6
deliveries	2008	1003	52	398	48	605	54%	6
4+ prenatal	2006	1223	15	791	14	432	16%	2
visits	2008	1000	28	392	27	608	28%	1
Prenatal	2006	1227	10	794	11	433	10%	1
care during	2008	996	25	390	25	606	25%	0
1st quarter								
Child health services								
Curative	2006	1388	23	934	21	454	28%	7*
care	2008	1039	32	338	28	701	35%	7*
Preventive	2006	3150	12	2048	12	1102	11%	1
care								
	2008	2428	13	767	13	1661	13%	0
Use of ITN	2006	3129	18	2033	7	1096	39%	32***
	2008	2372	75	748	59	1624	82%	23***

Source: Author using the impact evaluation database.
Note: *t*-tests for differences between lower and upper groups.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

group woman delivering in a facility. Interestingly though, the coefficient on the interaction between PBF and health insurance suggests that when a poor woman has health insurance and lives in the catchment area of a PBF facility, she has a 15% higher chance of delivering in a health facility (99% confidence level). In sum, for institutional deliveries, PBF has favored those who did not have a financial barrier to access the service, that is, the upper group women and those from the lower group who have health insurance. Hence, in Rwanda, the impact of PBF needs to be understood together with the specific development of health insurance coverage.

Other significant controls include health insurance for deliveries (upper group only with women having 18% more chance in delivering at a health facility if they have health insurance), female educational attainment, number of pregnancies (exhibiting a negative experience effect), distance to health facility (negatively correlated to the use of services) and status of the facility (with public facilities decreasing by 7% to 11% the chances of a woman delivering in a health facility). Finally, the coefficients on the wave dummy indicate a statistically significant increase in all maternal health services between 2006 and 2008 for all groups, as already highlighted in the bivariate analyses.

Family planning

The estimated impact of PBF on the probability of a woman using a modern contraceptive method is not significant if one considers the total sample. However,

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Table 5. Difference-in-difference estimates for maternal health services using LPM

	Institutional deliveries			4+ antenatal care visits			Antenatal care first trimester		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Treatment*post	−0.043	0.208***	0.063	−0.007	−0.004	−0.006	−0.014	0.038	0.007
	(−0.065)	(−0.065)	(−0.045)	(0.054)	(0.053)	(0.037)	(0.050)	(0.047)	(0.034)
Wave (2006 = 0, 2008 = 1)	0.175***	0.027	0.119***	0.115***	0.113***	0.117***	0.140***	0.145***	0.145***
	(−0.045)	(−0.046)	(−0.032)	(0.036)	(0.036)	(0.025)	(0.034)	(0.033)	(0.023)
PBF*insurance	0.135**	−0.082	0.027	0.032	−0.042	0.002	0.048	−0.078	−0.005
	(−0.061)	(−0.077)	(−0.047)	(0.047)	(0.061)	(0.036)	(0.042)	(0.058)	(0.033)
Age <20 years (=1)	0.153*	−0.301*	0.052	−0.006	−0.135	−0.044	0.022	0.001	0.014
	(−0.091)	(−0.173)	(−0.086)	(0.066)	(0.118)	(0.058)	(0.066)	(0.142)	(0.061)
Age >35 years (=1)	−0.044	−0.001	−0.029	−0.071**	−0.018	−0.047**	−0.024	−0.031	−0.025
	(−0.04)	(−0.043)	(−0.029)	(0.030)	(0.036)	(0.023)	(0.029)	(0.033)	(0.022)
Primary or more education (=1)	−0.054*	−0.019	−0.038*	0.000	0.012	0.005	0.014	0.073**	0.039**
	(−0.03)	(−0.036)	(−0.023)	(0.024)	(0.030)	(0.018)	(0.023)	(0.029)	(0.018)
Married/union (=1)	0	−0.037	−0.007	0.004	0.022	0.008	−0.068	−0.040	−0.063*
	(−0.056)	(−0.076)	(−0.045)	(0.040)	(0.069)	(0.035)	(0.045)	(0.071)	(0.038)
Partner present (=1)	0.066	0.095	0.076	0.098**	0.036	0.066	−0.051	0.046	−0.008
	(−0.085)	(−0.089)	(−0.062)	(0.049)	(0.076)	(0.043)	(0.065)	(0.070)	(0.048)
Number of pregnancies	−0.018**	−0.024**	−0.022***	0.014**	−0.000	0.008	0.003	−0.009	−0.001
	(−0.009)	(−0.01)	(−0.007)	(0.007)	(0.009)	(0.005)	(0.006)	(0.008)	(0.005)
Health insurance (=1)	−0.025	0.183***	0.075**	0.010	0.083**	0.040*	−0.019	0.045	0.009
	(−0.042)	(−0.054)	(−0.033)	(0.030)	(0.037)	(0.023)	(0.027)	(0.037)	(0.022)
Public facility (=1)	−0.072**	−0.111***	−0.089***	−0.008	−0.031	−0.020	0.022	0.008	0.016
	(−0.03)	(−0.033)	(−0.022)	(0.024)	(0.029)	(0.018)	(0.022)	(0.026)	(0.017)
Number of household members	−0.004	−0.005	−0.002	−0.009	−0.007	−0.008	0.008	0.001	0.003
	(−0.01)	(−0.011)	(−0.008)	(0.008)	(0.009)	(0.006)	(0.008)	(0.008)	(0.006)
Distance household–facility (km)	−0.027***	−0.023***	−0.024***	−0.011*	−0.010	−0.010**	2−0.005	−0.011**	−0.008*
	(−0.008)	(−0.009)	(−0.006)	(0.007)	(0.006)	(0.004)	(0.006)	(0.005)	(0.004)
Observations	1092	987	2079	1164	1031	2195	1165	1030	2195

LPM, linear probability model; PBF, performance-based financing; Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: Robust standard errors in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

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regressions run by wealth groups provide interesting results: The coefficient associated with PBF reports a large and positive impact for the upper group (probability of 17% with a 99% confidence level) and a negative impact on the lower group (probability of −10% with a 90% confidence level) suggesting that the richest are the main beneficiaries of PBF at the expense of the poorest. However, the latter benefited from a large improvement in access to family planning between 2006 and 2008 (an increase of 19 percentage points). The interaction between PBF and health insurance is significant for the lower group women only, but it affects utilization negatively (probability of −10% with a 95% confidence level) showing a possible crowding out effect for the poorest because of different strategies influencing family planning utilization. Another potential explanation is that lower group women enrolling in the insurance scheme do it while pregnant (as they expect more health expenditures), which is when they do not need family planning services. The increase in the use of family planning for the lower group is probably caused by other policies put into effect in Rwanda to increase contraception use (Table 6; see Annex for full results).

Child health services

Results from regression analyses on curative care received by a child at health center in the event of an illness show no impact of PBF for none of the groups under study. This may be related to the fact that the price paid by the PBF scheme for curative care was purposely low and most of the incentives came from health insurance that provided free access to those services. Indeed, the regression analysis shows a positive impact of health insurance for getting healthcare among all groups (12% and 25% increase, respectively, for the lower and upper groups). Besides, for the lower group, the coefficient on the interaction between insurance and PBF shows that if the child benefits from health insurance and lives in a treatment district, the child will be 8% more likely to get care at the health center in the event of an illness (90% confidence interval). Results for preventive care show a positive impact of PBF (probability of 0.09 for the total group with a 99% confidence interval) for all groups (Table 7). Age is negatively correlated showing that the older a child is, the less likely he or she will visit a health facility. Distance to the facility also influences the decision to visit (see Annex for all results).

Robustness checks

Maternal health. Results from ordinary least square for maternal health suggested that PBF has a positive impact, but only on institutional deliveries and for the richer group. As there are reasons to assume that the utilization of all maternal health services is linked and that error terms across the equations can be correlated, SURE were run simultaneously for institutional deliveries, four or more antenatal care visits, antenatal care visit during the first trimester and assisted deliveries (the latter not being incentivized by PBF) to see whether the use of any of these services was reinforcing that of other services.

Results confirm previous estimates: PBF benefited upper group women as well as lower group women with health insurance in the case of institutional deliveries. Further, SURE enables us to find the positive impact of PBF on the total group,

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Table 6. Difference-in-difference estimates for use of modern family planning method using LPM

	Use of modern family planning		
	Lower	Upper	Total
Treatment*post	−0.101*	0.174***	0.054
	(0.055)	(0.057)	(0.039)
Wave = 0 if 2006, Wave = 1 if 2008	0.191***	0.064	0.126***
	(0.042)	(0.042)	(0.029)
Interaction between PBF and insurance	−0.100**	−0.012	−0.068*
	(0.045)	(0.070)	(0.038)
Age	−0.000	−0.001	−0.001
	(0.002)	(0.004)	(0.002)
Has primary or more education (=1)	−0.007	0.013	−0.003
	(0.023)	(0.033)	(0.019)
Married/union (=1)	−0.016	0.383***	0.192**
	(0.150)	(0.032)	(0.089)
Partner present (=1)	−0.092	0.055	−0.035
	(0.069)	(0.092)	(0.056)
Number of pregnancies	−0.016**	−0.014	−0.015**
	(0.007)	(0.010)	(0.006)
Health insurance (=1)	0.079**	0.016	0.067**
	(0.033)	(0.051)	(0.027)
Public facility (=1)	0.031	0.039	0.028
	(0.022)	(0.030)	(0.019)
Total number alive child	0.011	0.017	0.011
	(0.011)	(0.018)	(0.010)
Number of household members	0.010	0.011	0.015*
	(0.010)	(0.015)	(0.009)
Household–facility distance (in km)	0.006	0.008	0.007
	(0.007)	(0.007)	(0.005)
Delivery assisted by a skilled attendant	0.026	0.042	0.040**
	(0.025)	(0.030)	(0.020)
Observations	1059	966	2025

LPM, linear probability model; PBF, performance-based financing; Treatment*post, indicates the interaction between treatment and time.
Note: Robust standard errors in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

as shown by Basinga *et al.* (2011). The coefficient associated with antenatal care remains non-significant with SURE estimates. Finally, clustering at the district and year level as well as individual and facility fixed effects also confirms results with slight modification in the size of coefficients: The effect of PBF on the upper group is lower, but the coefficient of the interaction between PBF and insurance for the lower group is greater. Significance disappears for the impact of PBF on the total group, which is caused by the interaction term with insurance. Indeed, the same analysis ran on Specification 2 shows a statistically significant coefficient associated with PBF (probability of 0.073% with a 95% confidence interval; Table 8).

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Table 7. Difference in difference estimates for use of child care using LPM

	Curative care			Preventive care		
	Lower	Upper	Total	Lower	Upper	Total
Treatment*post	0.035	0.024	0.027	0.081***	0.098***	0.092***
	(−0.053)	(−0.06)	(−0.039)	(−0.028)	(−0.026)	(−0.019)
Wave = 0 if 2006, Wave = 1 if 2008	0.027	0.013	0.024	−0.013	−0.015	−0.018
	(−0.034)	(−0.04)	(−0.026)	(−0.019)	(−0.019)	(−0.013)
PBF*insurance	0.078*	−0.093	0.006	0.033	−0.038	0.008
	(−0.046)	(−0.062)	(−0.037)	(−0.025)	(−0.031)	(−0.019)
Age	−0.023***	−0.009	−0.016***	−0.037***	−0.045***	−0.040***
	(−0.007)	(−0.009)	(−0.006)	(−0.004)	(−0.004)	(−0.003)
Sex	0.031	−0.065**	−0.013	0.015	0.008	0.012
	(−0.023)	(−0.028)	(−0.018)	(−0.012)	(−0.013)	(−0.009)
Mother has primary or more education (=1)	−0.019	0.039	0.007	−0.007	0.012	0.003
	(−0.023)	(−0.029)	(−0.018)	(−0.012)	(−0.013)	(−0.009)
Household–facility distance (in km)	−0.015**	−0.013*	−0.014***	−0.005	−0.007**	−0.006***
	(−0.006)	(−0.007)	(−0.005)	(−0.003)	(−0.003)	(−0.002)
Health insurance (=1)	0.117***	0.245***	0.179***	0.003	0.046**	0.015
	(−0.031)	(−0.039)	(−0.024)	(−0.018)	(−0.021)	(−0.014)
Number of household members	−0.019***	0.004	−0.008	−0.002	0.003	0
	(−0.007)	(−0.008)	(−0.005)	(−0.003)	(−0.004)	(−0.003)
Observations	1370	1074	2444	2964	2595	5559

LPM, linear probability model; PBF, performance-based financing; Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: Robust standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

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Table 8. Robustness checks for maternal health

	Institutional deliveries			4+ antenatal care visits			Antenatal care first trimester		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
LPM without specification									
Effect of PBF	−0.043	0.208***	0.063	−0.007	−0.004	−0.006	−0.014	0.038	0.007
	(−0.065)	(−0.065)	(−0.045)	(−0.054)	(−0.053)	(−0.037)	(−0.05)	(−0.047)	(−0.034)
Interaction PBF* insurance	0.135**	−0.082	0.027	0.032	−0.042	0.002	0.048	−0.078	−0.005
	(−0.061)	(−0.077)	(−0.047)	(−0.047)	(−0.061)	(−0.036)	(−0.042)	(−0.058)	(−0.033)
SURE estimates									
Effect of PBF	−0.033	0.241***	0.086*	−0.013	0.010	−0.001	−0.013	0.058	0.016
	(0.067)	(0.066)	(0.046)	(0.054)	(0.058)	(0.039)	(0.050)	(0.053)	(0.036)
Interaction PBF* insurance	0.115*	−0.090	0.009	0.033	−0.033	0.002	0.063	−0.057	0.008
	(0.065)	(0.082)	(0.050)	(0.052)	(0.072)	(0.042)	(0.049)	(0.066)	(0.039)
Clustering and fixed effects									
Effect of PBF	−0.005	0.185***	0.054	−0.009	0.003	0.011	0.004	0.060	0.024
	(0.066)	(0.043)	(0.041)	(0.049)	(0.049)	(0.035)	(0.050)	(0.055)	(0.036)
Interaction PBF* insurance	0.164**	−0.021	0.064	0.045	−0.033	−0.001	0.036	−0.107*	−0.011
	(0.064)	(0.070)	(0.055)	(0.054)	(0.088)	(0.039)	(0.040)	(0.063)	(0.033)
Observations	1092	987	2079	1164	1031	2195	1165	1030	2195

LPM, linear probability model; PBF, performance-based financing; SURE, seemingly unrelated regression equations; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: Robust standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

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Family planning

Results for the use of modern contraceptive suggest that PBF had a positive impact on family planning for the upper group but a negative impact on the lower group. This was reinforced by a negative and significant coefficient on the interaction between insurance and PBF for the lower group.

As family planning intake may be linked to a woman's knowledge of services provided at a health facility and may be proposed to a woman who recently gave birth, SURE were run to capture potential correlation between assisted deliveries, institutional deliveries, four or more antenatal care visits and family planning. Results show that it only slightly affects the size of the coefficient but not the interpretation of results. Similarly, running the model with clustering and fixed effect only slightly increases the size of coefficients. The impact of PBF on the upper group thus increases from 0.174 to 0.204, and the negative coefficient of the interaction between PBF and insurance changes from −0.100 to −0.119 (Table 9).

Child health services

The first estimates of the impact of PBF on the probability of a child getting curative care showed no impact. However, a positive impact was found for both wealth groups for preventive care.

Seemingly unrelated regression equations were conducted to account for other services that may influence a child's visit to a health center: curative care, preventive care but also the use of ITN as it can affect morbidity. SURE confirm the impact of

Table 9. Robustness checks for use of modern contraceptive

	Family planning		
	Lower	Upper	Total
LPM without specification			
Effect of PBF	−0.101*	0.174***	0.054
	(−0.055)	(−0.057)	(−0.039)
Interaction PBF* insurance	−0.100**	−0.012	−0.068*
	(−0.045)	(−0.07)	(−0.038)
SURE estimates			
Effect of PBF	−0.113**	0.188***	0.047
	(0.052)	(0.063)	(0.040)
Interaction PBF* insurance	−0.105**	0.024	−0.061
	(0.052)	(0.078)	(0.044)
Clustering and Fixed-Effects			
Effect of PBF	−0.087	0.204***	0.060
	(0.058)	(0.039)	(0.036)
Interaction PBF* insurance	−0.119**	0.015	−0.064
	(0.050)	(0.078)	(0.043)
Observations	1056	965	2021

LPM, linear probability model; PBF, performance-based financing; SURE, seemingly unrelated regression equations; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: Robust standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

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PBF on preventive care with a larger effect. The probability of a child receiving preventive care rises from 0.08 to 0.1 in the lower group, from 0.1 to 0.16 in the upper group and from 0.09 to 0.13 in the total sample. SURE do not find any significance in the interaction between insurance and PBF. Clustering and fixed effects on the contrary provide a lower, but still significant, coefficient associated with the impact of PBF in particular for the upper group (Table 10).

DISCUSSION

This paper measures and compares the impact of PBF on equity in access to healthcare in rural Rwanda and specifically examines the effect of PBF on income sub-groups defined according to their wealth status (upper and lower groups). Factors associated with inequality in access to basic services are quantified to show the dynamic and fairness of PBF in Rwanda and draw policy recommendations. Notably, findings confirm the positive trend in access to care in Rwanda, in particular for the poor. Still, they show remaining differences in access to child health services, family planning and maternal health services.

This paper adds to current knowledge in at least two independent ways: First, it speaks to existing evidence on the impact of PBF on the overall use of health services in Rwanda (Basinga *et al.*, 2011) by evaluating the effect of PBF on subgroups of the population. Second, this paper highlights the advantages of the impact evaluation panel data over nationally representative cross-sectional data by comparing results published earlier on PBF's impact on equity in Rwanda using DHS data (Priedeman *et al.*, 2013).

It is important to note that Rwanda is an outlier in many respects, and some of its specificities, such as the low corruption, well-grounded performance culture, large coverage of health insurance, rapid and successful implementation of fiscal decentralization and major improvements in the availability of healthcare providers at primary healthcare facilities, even in remote areas, may also have positively influenced the supply side.

Impact of performance-based financing on the use of health services

Results are consistent with previous studies conducted on Rwanda using nationally representative data or impact evaluation data (Basinga *et al.*, 2011, Sekabaraga *et al.*, 2011). Findings show a positive impact of PBF on the probability of a woman delivering in a health facility and no impact on antenatal care, consistent with results published elsewhere for the population as a whole (Priedeman *et al.*, 2013, Basinga *et al.*, 2011). Our results suggest that the probability of a woman delivering in a health facility increases by 8.6 percentage points (SURE) compared with 8.1 (Basinga *et al.*, 2011) and 10 (Priedeman *et al.*, 2013). As in previous studies, no impact of financial incentives was found on antenatal care. As shown by Basinga *et al.* (2011), results highlight a positive impact on the probability of a child benefiting from preventive care.

Distributional impact of performance-based financing

Other findings contradict previously published results as regard to the impact of PBF on equity in access to services. Priedeman *et al.* (2013) using DHS data found that PBF in Rwanda was neither a pro-rich nor pro-poor strategy for increasing use of

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Table 10. Robustness checks for child health services

	Curative Care			Preventive care		
	Lower	Upper	Total	Lower	Upper	Total
LPM without specification						
Effect of PBF	0.035	0.024	0.027	0.081***	0.098***	0.092***
	(−0.053)	(−0.06)	(−0.039)	(−0.028)	(−0.026)	(−0.019)
Interaction PBF* insurance	0.078*	−0.093	0.006	0.033	−0.038	0.008
	(−0.046)	(−0.062)	(−0.037)	(−0.025)	(−0.031)	(−0.019)
SURE estimates						
Effect of PBF	0.037	0.029	0.031	0.102**	0.160***	0.126***
	(0.051)	(0.060)	(0.038)	(0.047)	(0.050)	(0.033)
Interaction PBF* insurance	0.075	−0.099	0.001	0.067	−0.071	0.013
	(0.048)	(0.071)	(0.040)	(0.044)	(0.060)	(0.035)
Clustering and fixed effects						
Effect of PBF	0.012	−0.048	0.010	0.096***	0.089***	0.103***
	(0.055)	(0.057)	(0.036)	(0.031)	(0.029)	(0.024)
Interaction PBF* insurance	0.152***	−0.088	0.037	0.037	−0.011	−0.002
	(0.056)	(0.086)	(0.059)	(0.032)	(0.039)	(0.023)
Observations	1370	1074	2444	2964	2595	5559

LPM, linear probability model; PBF, performance-based financing; SURE, seemingly unrelated regression equations; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: Robust standard errors in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

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services. In contrast, results reported here using panel data from the PBF impact evaluation suggest that PBF has a positive impact on the upper group. That is, the already known positive impact of PBF on the probability of a woman delivering in a health facility is driven by the richest. This is consistent with findings from Burundi, although the magnitude of change is greater in the case of Rwanda (Bonfrer *et al.*, 2014). More specifically, we find that women from the upper group are 18% to 24% more likely to deliver in a health facility in the treatment group compared with those of the control group. In other words, the proportion of assisted deliveries in treatment facilities could reach up to 74% in 2008 for women of the upper group compared with 50% in control facilities. Women from the lower group with health insurance also experience a positive increase in use because of PBF.

Contrary to Priedeman *et al.* (2013), we find a significant impact of PBF on the use of modern contraceptive in the treatment group, women from the lower group are 10% to 11% less likely to use family planning (i.e., 21% use compared with 32% among the poorest women in the control group). On the contrary, women from the upper group are 17% to 20% more likely to use modern contraceptive in the treatment group (i.e., 55% intake of modern contraceptive for the richest women of the treatment group compared with 35% of those in the control group; Table 11).

Results thus support the hypothesis that, for most services, PBF favors efficiency at the expense of equity as the effect of PBF did not play equally on different income groups. PBF achieved efficiency gains by inciting healthcare providers to focus on the easier to reach, that is, the less poor. Further, PBF was not effective in helping reach the poorest. This confirms evidence from the literature, using less rigorous techniques, which shows that PBF can be equitable only if it is targeting the poor (Loevinsohn, 2008). This pattern in which health programs primarily benefit richer groups is typical and has been widely studied as an 'inverse care law' (Gwatkin, 2002, Hart, 1971).

This paper also brings new evidence on the impact of PBF on equity in access to basic health services for children. PBF alone has no impact on curative care for children but has a positive impact on the probability of getting preventive care for the upper and lower groups. One can thus assert that, of all services under study, PBF has the most equitable effect on preventive care at health center. Children from the lower and upper groups are, respectively, 10% and 16% more likely to benefit from preventive services in the treatment group compared with the control group. Further research is needed to better understand the synergies or competitions between different incentivized services as the impact found variations from one service to another.

Interaction with health insurance

This paper contributes in reducing the knowledge gap by providing evidence on the interaction of several strategies aiming at improving access to care (health insurance and PBF). As pointed out, different strategies were put into effect in Rwanda at the same time with the same purpose of raising the use of basic health services. The impact evaluation aimed to disentangle the impact of PBF. However, assessing synergies between the different initiatives is important to see whether they are mutually reinforcing or not.

Results suggest a mixed effect of the interaction of PBF and health insurance according to the services and the wealth group concerned. As health insurance removes

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Table 11. Estimated differential effects of PBF by wealth on service use (Specification 3)

	Lower group Coefficient (SE)	Upper group Coefficient (SE)
Family planning and maternal health services		
Family planning	−0113** (0.052) to −0.087 (0.058)	0.174*** (−0.058) to 0.204*** (0.039)
Birth at facility	−0.005 (0.066) to −0.043 (−0.065)	0.185*** (0.043) to 0.241*** (0.066)
4+ prenatal visits	−0.007 (−0.054) to −0.013 (0.054)	−0.004 (−0.053) to 0.010 (0.058)
Prenatal care during first quarter	−0.013 (0.050) to 0.004 (0.050)	0.038 (−0.047) to 0.060 (0.055)
Child health services		
Curative care	0.012 (0.55) to 0.037 (0.051)	−0.048 (0.057) to 0.029 (0.060)
Preventive care	0.081*** (−0.028) to 0.102** (0.047)	0.089*** (0.029) to 0.160*** (0.050)

PBF, performance-based financing; SE, standard error.
Note: Robust standard errors in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

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the financial barrier to health services (demand side) and PBF improves the supply of health services, one can expect that the interaction of interventions is positive. Results confirm the hypothesis for institutional deliveries and curative care for children among the lower group (for which the cost of services is a major barrier to care). The negative coefficient for the interaction of PBF and health insurance in the case of family planning for the poorest group probably reveals the existence of competing interventions aimed at increasing the intake of family planning service (free contraceptives, Imihigo) and the fact that insured women are primarily those that are not in need of family planning. Further research, using qualitative methods, is necessary to better understand this pattern in the particular context of Rwanda.

Strengths of the impact evaluation data over a cross-sectional nationally representative survey. Using data from the impact evaluation of PBF in Rwanda, we were able to isolate the distributional impact of PBF. We came to different results than those found by Priedeman *et al.* (2013) with DHS data. The strengths of the impact evaluation data reside in the fact that it allows for better identification as the same individuals were interviewed before and after; hence, unobserved heterogeneity was captured. Further, the selection of households was guided by the purpose of the evaluation (e.g., focus on households with young children).

Our results show the impact of the limitations highlighted by Priedeman *et al.* (2013) on their estimates. They recognized that relying on DHS data, which is a nationally representative dataset, involved some constraints to the analysis: The exposure window was limited to 18 months (instead of 23); the survey designed resampled the 2005 clusters in 2007, and individuals were not re-interviewed; finally, no rural-specific assets data were available to create an asset score, although the impact evaluation was conducted in rural areas.

Policy implications

The empirical results suggest that PBF can improve utilization of healthcare services but that its impact varies according to the population and services concerned. When utilization rates are low, such as for institutional deliveries and family planning, PBF can increase the demand for services. The results advocate a PBF model further tailored to target the most in need. One approach could be to introduce differential payment for PBF with higher levels of payments for poor and remote districts or identified poor groups. This would be feasible in Rwanda as poverty maps are developed in each sub-district in a participatory way (Niringiye and Ayebale, 2012). Neighboring Burundi and the Democratic Republic of Congo have already put into effect such a differential approach (Witter *et al.*, 2013).

Further, when utilization of basic services is greater among the richest, demand side mechanisms should complement PBF to ensure that the poorest benefit from the strategy. It is therefore important to better understand demand-side barriers to set up adequate incentives for the target population. In Cambodia for instance, PBF schemes were supported by health equity funds that target the most in need to ensure that they are not excluded from the health system. These health equity funds have been successful in ensuring greater access to care for the poorest and

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greater community participation (Jacobs and Price, 2006, Noirhomme *et al.*, 2007, Bigdeli and Leslie Annear, 2009, Hardeman *et al.*, 2004). Conditional cash transfers as seen in Mexico and Brazil can also be introduced and are tested in Rwanda. The evidence on conditional cash transfers indeed shows that they are effective ways to cut inequalities in access and ensure greater use of health services for the poor (Victora *et al.*, 2003, Lagarde *et al.*, 2009).

This paper contributes to a call for more rigorous research. Using the same independent and control variables, with similar econometric technique, results from the panel impact evaluation data differ from those produced using DHS data. Estimates from the DHS data were not able to capture unobserved heterogeneity as the pro-rich nature of PBF was not found.

This paper also provided some insights on the importance of specifications. The comparison of a simple linear model, SURE and further specifications using clustering and fixed effects enabled to highlight the importance of specification on coefficients. Specification tests showed that the significance of coefficients did not change according to the models but that the magnitude of coefficients is sensitive to specification. One other important conclusion is that results in this paper are robust as three different econometric approaches produced comparable results.

CONCLUSION

Over the last decade, the population of Rwanda has experienced improvement in health outcomes and access to care. Poor people have better access and use more services. Yet improvements benefitted the richest initially and more over time. Two of the innovative health financing strategies designed by Rwanda, health insurance and PBF, have seen a positive impact on the demand and supply of healthcare services. Nevertheless, results support the hypothesis that, for most services, PBF favors efficiency at the expense of equity. Rwanda is an outlier in many respects. Twenty years after the genocide of 1994 that killed one fifth of its population, it is one of the few countries on track to reach the MDGs and beyond. Yet Rwanda is no exception in the way benefits of health programs reach the poor last. As inequalities in access to care persist, policy changes are needed to tailor PBF payments to better reach the poor. As a 2005 benefit-incidence analysis showed a large share of public subsidies to the health sector benefited the richest, thus, some reorientation of public spending toward pro-poor programs is always required (World Bank, 2010).

This study highlights potential pitfalls of PBF (at least as originally designed and implemented in Rwanda), as this mechanism is increasingly adopted in Africa and elsewhere. PBF is not inherently pro-poor. Its effect on improving the welfare of the poor depends on its design, and the equity concern needs to be built early in the design of the program. Also PBF is unlikely to be the sole mechanism and is likely to be more effective if used in synergy with other programs such as health insurance or selected free healthcare. A number of African countries are indeed moving in that direction. Further research is necessary to test various designs and models of interactions in different contexts.

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APPENDIX A
Maternal health sample baseline (2006) characteristics

	Lower group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	415	0.70	0.09	432	0.60	0.10	0.10	0.500
Household characteristics								
distance (km)	415	3.22	0.25	432	3.39	0.29	−0.17	0.657
Number of household members	415	5.10	0.14	432	5.26	0.15	−0.16	0.442
Women's characteristics								
Married or live with a partner (=1)	415	0.93	0.02	432	0.89	0.02	0.05	0.117
Partner lives in the household (=1)	415	0.98	0.01	432	0.97	0.01	0.02	0.110
Total number children alive	415	3.37	0.16	432	3.55	0.16	−0.19	0.426
Total number of pregnancies	415	4.34	0.24	432	4.41	0.27	−0.07	0.855
Has primary education (=1)	415	0.35	0.04	432	0.37	0.04	−0.02	0.762
Age <20 years (=1)	415	0.04	0.01	432	0.27	0.01	−0.23	0.382
Age >35 years (=1)	415	0.21	0.03	432	0.34	0.04	−0.13	0.537
Health insurance (=1)	406	0.45	0.04	430	0.44	0.04	0.02	0.386
Dependent variable (utilization)								
Institutional deliveries	349	0.35	0.04	362	0.31	0.03	0.03	0.506
4+ prenatal visits	387	0.17	0.03	404	0.11	0.01	0.07	0.025**
Prenatal care first quarter	389	0.12	0.02	405	0.09	0.02	0.03	0.268

Obs, Observations; SD, standard deviation; Diff., difference.
Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

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Appendix A (Continued)

	Upper group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	205	0.63	0.10	238	0.70	0.11	−0.06	0.679
Household characteristics								
distance (km)	205	3.29	0.29	238	3.42	0.30	−0.13	0.762
Number of household members	205	5.26	0.17	238	5.66	0.17	−0.39	0.124
Women's characteristics								
Married or live with a partner (=1)	205	0.97	0.03	238	0.95	0.03	0.02	0.566
Partner lives in the household (=1)	205	0.98	0.01	238	0.98	0.01	0.00	0.837
Total number children alive	205	3.45	0.15	238	3.44	0.15	0.00	0.988
Total number of pregnancies	205	4.26	0.20	238	4.17	0.19	0.09	0.759
Has primary education (=1)	205	0.34	0.05	238	0.33	0.05	0.01	0.902
Age <20 years (=1)	205	0.01	0.01	238	0.00	0.01	0.01	0.649
Age >35 years (=1)	205	0.25	0.03	238	0.26	0.03	−0.01	0.876
Health insurance (=1)	203	0.73	0.05	237	0.66	0.06	0.07	0.367
Dependent variable (utilization)								
Institutional deliveries	173	0.35	0.06	205	0.45	0.04	−0.10	0.189
4+ prenatal visits	200	0.20	0.03	232	0.13	0.03	0.08	0.094*
Prenatal care first quarter	199	0.10	0.03	234	0.10	0.03	−0.01	0.872

Appendix A (Continued)

	Total							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	620	0.67	0.09	670	0.63	0.10	0.04	0.387
Household characteristics								
distance (km)	620	3.24	0.24	670	3.40	0.27	−0.16	0.666
Number of household members	620	5.2	0.11	670	5.40	0.12	−0.25	0.927
Women's characteristics								
Married or live with a partner (=1)	620	0.95	0.02	670	0.91	0.02	0.04	0.107
Partner lives in the household (=1)	620	0.98	0.01	670	0.97	0.01	0.01	0.162
Total number children alive	620	3.39	0.12	670	3.51	0.12	−0.12	0.755
Total number of pregnancies	620	4.32	0.18	670	4.33	0.20	−0.01	0.515
Has primary education (=1)	620	0.35	0.03	670	0.36	0.04	−0.01	0.555
Age <20 years (=1)	620	0.03	0.01	670	0.62	0.01	−0.59	0.161
Age >35 years (=1)	620	0.29	0.03	670	0.31	0.03	−0.02	0.713
Health insurance (=1)	609	0.55	0.05	667	0.52	0.05	0.03	0.334
Dependent variable (utilization)								
Institutional deliveries	522	0.35	0.04	567	0.36	0.04	−0.02	0.800
4+ prenatal visits	587	0.18	0.02	636	0.11	0.02	0.07	0.028***
Prenatal care first quarter	588	0.11	0.02	639	0.09	0.02	0.02	0.547

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APPENDIX B
Family planning sample baseline (2006) characteristics

	Lower group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	503	0.67	0.09	546	0.64	0.10	0.04	0.779
Household characteristics								
Distance (km)	503	3.36	0.23	546	3.34	0.25	0.02	0.946
Number of household members	503	5.03	0.18	546	5.10	0.19	−0.07	0.781
Women's characteristics								
Married or live with a partner (=1)	503	1.00	0.00	546	0.99	0.00	0.00	0.561
Partner lives in the household (=1)	503	0.99	0.01	546	0.97	0.01	0.02	0.026**
Total number children alive	503	3.34	0.19	546	3.33	0.20	0.01	0.481
Delivered at health center/last pregnancy (=1)	363	0.28	0.03	356	0.24	0.03	0.05	0.335
Has primary education (=1)	503	0.36	0.02	546	0.36	0.02	0.00	0.969
Age in years	503	31.20	0.49	546	31.20	0.51	0.00	0.988
Health insurance (=1)	495	0.45	0.04	543	0.43	0.04	0.02	0.738
Dependent variable (utilization)								
Family Planning	503	0.08	0.01	546	0.09	0.02	0.00	0.833

Obs, Observations; SD, standard deviation; Diff., difference.
Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

Appendix B (Continued)

	Upper group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	246	0.65	0.10	297	0.71	0.11	−0.06	0.709
Household characteristics								
Distance (km)	246	3.36	0.27	297	3.39	0.28	−0.03	0.943
Number of household members	246	5.22	0.18	297	5.46	0.17	−0.24	0.350
Women's characteristics								
Married or live with a partner (=1)	246	1.00	0.01	297	0.99	0.01	0.00	0.788
Partner lives in the household (=1)	246	0.98	0.01	297	0.97	0.01	0.01	0.640
Total number children alive	246	3.32	0.12	297	3.38	0.11	−0.06	0.634
Delivered at health center/last pregnancy (=1)	197	0.26	0.05	225	0.35	0.05	−0.09	0.335
Has primary education (=1)	246	0.30	0.05	297	0.32	0.05	−0.02	0.765
Age in years	246	30.51	0.36	297	30.51	0.31	0.00	0.993
Health insurance (=1)	242	0.71	0.05	296	0.68	0.05	0.03	0.591
Dependent variable (utilization)								
Family Planning	246	0.11	0.01	297	0.19	0.03	−0.09	0.009***

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Appendix B (Continued)

	Total							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	*p*-value
Health facility characteristics								
Public (=1)	749	0.67	0.09	843	0.66	0.10	0.01	0.968
Household characteristics								
Distance (km)	749	3.36	0.23	843	3.35	0.25	0.01	0.987
Number of household members	749	5.09	0.14	843	5.23	0.15	−0.14	0.512
Women's characteristics								
Married or live with a partner (=1)	749	1.00	0.00	843	0.99	0.00	0.00	0.573
Partner lives in the household (=1)	749	0.98	0.01	843	0.97	0.01	0.02	0.108
Total number children alive	749	3.34	0.14	843	3.35	0.15	−0.01	0.957
Delivered at health center/last pregnancy (=1)	560	0.27	0.03	581	0.28	0.03	−0.01	0.870
Has primary education (=1)	749	0.34	0.03	843	0.34	0.03	−0.01	0.865
Age in years	749	30.98	0.35	843	30.95	0.36	0.02	0.961
Health insurance (=1)	737	0.54	0.05	839	0.52	0.05	0.02	0.388
Dependent variable (utilization)								
Family Planning	749	0.09	0.02	843	0.12	0.02	−0.03	0.154

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APPENDIX C
Child sample baseline (2006) characteristics

	Lower group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	p-value
Health facility characteristics								
Public (=1)	1035	0.67	0.09	1042	0.61	0.10	0.05	0.698
Household characteristics								
Distance (km)	1035	3.30	0.22	1042	3.29	0.25	0.01	0.986
Number of household members	1035	5.34	0.12	1042	5.42	0.13	−0.08	0.648
Mother has primary education (=1)	1035	0.99	0.00	1042	1.00	0.00	−0.01	0.357
Child characteristics								
Age (years)	1035	2.35	0.05	1042	2.35	0.05	0.00	0.973
Female (=1)	1035	0.51	0.01	1042	0.49	0.01	0.02	0.429
Health insurance (=1)	991	0.44	0.03	1012	0.42	0.03	0.02	0.708
Dependent variable (utilization)								
Received care at health center in the event of illness	476	0.20	0.03	478	0.22	0.03	−0.01	0.737

$^{**}p<0.05$ $^{*}p<0.1$

APPENDIX C (Continued)

	Upper group							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	p-value
Health facility characteristics								
Public (=1)	500	0.65	0.10	581	0.70	0.11	−0.05	0.759
Household characteristics								
Distance (km)	500	3.27	0.28	581	3.26	0.30	0.01	0.979
Number of household members	500	5.54	0.13	581	5.74	0.13	−0.20	0.296
Mother has primary education (=1)	500	1.00	0.00	581	1.00	0.00	0.00	0.945
Child characteristics								
Age (years)	500	2.21	0.07	581	2.34	0.06	−0.13	0.235
Female (=1)	500	0.52	0.02	581	0.51	0.01	0.00	0.920
Health insurance (=1)	487	0.69	0.04	563	0.65	0.05	0.04	0.591
Dependent variable (utilization)								
Received care at health center in the event of illness	183	0.27	0.05	255	0.27	0.05	−0.00	0.987

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APPENDIX C (Continued)

	Total							
	Treatment			Control				
	Obs	Mean	SD	Obs	Mean	SD	Diff.	p-value
Health facility characteristics								
Public (=1)	1535	0.66	0.09	1623	0.64	0.10	0.02	0.899
Household characteristics								
Distance (km)	1535	3.29	0.22	1623	3.28	0.24	0.01	0.979
Number of household members	1535	5.40	0.09	1623	5.53	0.09	−0.13	0.304
Mother has primary education (=1)	1535	1.00	0.00	1623	1.00	0.00	0.00	0.333
Child characteristics								
Age (years)	1535	2.30	0.04	1623	2.35	0.04	−0.04	0.487
Female (=1)	1535	0.51	0.01	1623	0.50	0.01	0.01	0.501
Health insurance (=1)	1478	0.52	0.04	1575	0.51	0.04	0.01	0.770
Dependent variable (utilization)								
Received care at health center in the event of illness	659	0.22	0.03	733	0.24	0.03	−0.01	0.749

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APPENDIX D
Regression results for institutional deliveries

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Interaction between PBF and time	−0.019	0.186	0.074	0.002	0.194	0.071	−0.043	0.208	0.063	−0.051	0.197	0.069
	(0.061)	(0.064)	(0.043)	(0.061)	(0.063)	(0.042)	(0.065)	(0.065)	(0.045)	(0.071)	(0.064)	(0.044)
Wave = 0 if 2006, Wave = 1 if 2008	0.170	0.056	0.134	0.157	0.036	0.115	0.175	0.027	0.119	0.142	0.036	0.108
	(0.043)	(0.045)	(0.030)	(0.044)	(0.045)	(0.031)	(0.045)	(0.046)	(0.032)	(0.049)	(0.045)	(0.032)
Interaction between PBF and insurance							0.135	−0.082	0.027			
							(0.061)	(0.077)	(0.047)			
Age <20 years (=1)				0.149	−0.304	0.052	0.153	−0.301	0.052	0.149	−0.304	0.051
				(0.093)	(0.172)	(0.087)	(0.091)	(0.173)	(0.086)	(0.092)	(0.173)	(0.087)
Age >35 years (=1)				−0.042	−0.000	−0.029	−0.044	−0.001	−0.029	−0.046	−0.002	−0.029
				(0.040)	(0.043)	(0.029)	(0.040)	(0.043)	(0.029)	(0.041)	(0.044)	(0.030)
Has primary or more education (=1)				−0.056	−0.018	−0.039	−0.054	−0.019	−0.038	−0.054	−0.019	−0.039
				(0.030)	(0.036)	(0.023)	(0.030)	(0.036)	(0.023)	(0.032)	(0.036)	(0.024)
Currently married/union (=1)				−0.004	−0.037	−0.008	−0.000	−0.037	−0.007	0.004	−0.036	−0.002
				(0.056)	(0.077)	(0.045)	(0.056)	(0.076)	(0.045)	(0.058)	(0.077)	(0.045)
Partner present (=1)				0.057	0.089	0.076	0.066	0.095	0.076	0.019	0.089	0.053
				(0.087)	(0.088)	(0.062)	(0.085)	(0.089)	(0.062)	(0.095)	(0.088)	(0.065)
Number of pregnancies				−0.018	−0.024	−0.022	−0.018	−0.024	−0.022	−0.021	−0.023	−0.024
				(0.009)	(0.010)	(0.007)	(0.009)	(0.010)	(0.007)	(0.009)	(0.010)	(0.007)
Health insurance (=1)				0.039	0.142	0.088	−0.025	0.183	0.075	−0.022	0.143	0.086
				(0.031)	(0.039)	(0.024)	(0.042)	(0.054)	(0.033)	(0.042)	(0.039)	(0.024)
Public facility (=1)				−0.071	−0.111	−0.089	−0.072	−0.111	−0.089	−0.085	−0.112	−0.096
				(0.030)	(0.033)	(0.022)	(0.030)	(0.033)	(0.022)	(0.032)	(0.033)	(0.023)
Number of household members				−0.004	−0.006	−0.002	−0.004	−0.005	−0.002	−0.002	−0.006	−0.000
				(0.010)	(0.011)	(0.008)	(0.010)	(0.011)	(0.008)	(0.011)	(0.011)	(0.008)
Household–facility distance (in km)				−0.027	−0.023	−0.024	−0.027	−0.023	−0.024	−0.025	−0.023	−0.022

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	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
				(0.008)	(0.009)	(0.006)	(0.008)	(0.009)	(0.006)	(0.009)	(0.009)	(0.006)
Interaction between PBF and asset score										−0.634	−0.010	−0.005
										(0.360)	(0.018)	(0.018)
Observations	1112	996	2108	1092	987	2079	1092	987	2079	972	987	1959

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Appendix E
Regression results for antenatal care during the first trimester

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Iteraction between PBF and time	0.009	0.022	0.006	0.003	0.026	0.005	−0.014	0.038	0.007	0.024	0.027	0.016
	(0.049)	(0.046)	(0.033)	(0.050)	(0.046)	(0.033)	(0.050)	(0.047)	(0.034)	(0.058)	(0.046)	(0.035)
Wave = 0 if 2006, Wave = 1 if 2008	0.140***	0.142***	0.145***	0.133***	0.153***	0.145***	0.140***	0.145***	0.145***	0.122***	0.153***	0.141***
	(0.034)	(0.032)	(0.022)	(0.034)	(0.033)	(0.023)	(0.034)	(0.033)	(0.023)	(0.038)	(0.033)	(0.024)
Interaction between PBF and insurance							0.048	−0.078	−0.005			
							(0.042)	(0.058)	(0.033)			
Age <20 years (=1)				0.022	0.002	0.014	0.022	0.001	0.014	0.017	0.002	0.010
				(0.066)	(0.140)	(0.061)	(0.066)	(0.142)	(0.061)	(0.066)	(0.140)	(0.061)
Age >35 years (=1)				−0.023	−0.030	−0.025	−0.024	−0.031	−0.025	−0.020	−0.031	−0.024
				(0.028)	(0.033)	(0.022)	(0.029)	(0.033)	(0.022)	(0.029)	(0.033)	(0.022)
Has primary or more education (=1)				0.013	0.074**	0.039**	0.014	0.073**	0.039**	0.004	0.073**	0.035*
				(0.022)	(0.029)	(0.018)	(0.023)	(0.029)	(0.018)	(0.023)	(0.029)	(0.018)
Currently married/union (=1)				−0.070	−0.042	−0.063*	−0.068	−0.040	−0.063*	−0.061	−0.042	−0.059
				(0.044)	(0.071)	(0.038)	(0.045)	(0.071)	(0.038)	(0.044)	(0.071)	(0.038)
Partner present (=1)				−0.054	0.041	−0.008	−0.051	0.046	−0.008	−0.089	0.041	−0.025
				(0.065)	(0.070)	(0.048)	(0.065)	(0.070)	(0.048)	(0.070)	(0.070)	(0.050)
Number of pregnancies				0.003	−0.008	−0.001	0.003	−0.009	−0.001	0.000	−0.008	−0.003
				(0.006)	(0.008)	(0.005)	(0.006)	(0.008)	(0.005)	(0.006)	(0.008)	(0.005)
Health insurance (=1)				0.004	0.008	0.007	−0.019	0.045	0.009	−0.031	0.009	0.004
				(0.021)	(0.029)	(0.017)	(0.027)	(0.037)	(0.022)	(0.027)	(0.029)	(0.017)
Public facility (=1)				0.022	0.008	0.016	0.022	0.008	0.016	0.022	0.008	0.015

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Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: ***p < 0.01; **p < 0.05; *p < 0.1.

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
				(0.022)	(0.026)	(0.017)	(0.022)	(0.026)	(0.017)	(0.023)	(0.026)	(0.017)
Number of household members				0.008	0.000	0.003	0.008	0.001	0.003	0.012	0.000	0.005
				(0.008)	(0.008)	(0.006)	(0.008)	(0.008)	(0.006)	(0.008)	(0.008)	(0.006)
Household–facility distance (in km)				−0.005	−0.011**	−0.008*	−0.005	−0.011**	−0.008*	−0.004	−0.011**	−0.007*
				(0.006)	(0.005)	(0.004)	(0.006)	(0.005)	(0.004)	(0.007)	(0.005)	(0.004)
Interaction between PBF and asset score										−0.352	−0.004	−0.006
										(0.250)	(0.013)	(0.012)
Observations	1184	1039	2223	1165	1030	2195	1165	1030	2195	1047	1030	2077

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APPENDIX F
Regression results for 4+antenatal care visits

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Interaction between PBF and time	−0.002	−0.018	−0.009	0.005	−0.010	−0.005	−0.007	−0.004	−0.006	−0.032	−0.008	−0.016
	(0.051)	(0.051)	(0.035)	(0.052)	(0.052)	(0.035)	(0.054)	(0.053)	(0.037)	(0.062)	(0.052)	(0.037)
Wave = 0 if 2006, Wave = 1 if 2008	0.130***	0.126***	0.132***	0.110***	0.118***	0.117***	0.115***	0.113***	0.117***	0.141***	0.117***	0.128***
	(0.035)	(0.033)	(0.023)	(0.036)	(0.035)	(0.024)	(0.036)	(0.036)	(0.025)	(0.041)	(0.035)	(0.025)
Interaction between PBF and insurance							0.032	−0.042	0.002			
							(0.047)	(0.061)	(0.036)			
Age <20 years (=1)				−0.006	−0.134	−0.044	−0.006	−0.135	−0.044	−0.016	−0.135	−0.049
				(0.066)	(0.118)	(0.058)	(0.066)	(0.118)	(0.058)	(0.066)	(0.117)	(0.058)
Age >35 years (=1)				−0.070**	−0.018	−0.047**	−0.071**	−0.018	−0.047**	−0.068**	−0.019	−0.045*
				(0.030)	(0.036)	(0.023)	(0.030)	(0.036)	(0.023)	(0.031)	(0.036)	(0.023)
Has primary or more education (=1)				−0.000	0.012	0.005	0.000	0.012	0.005	−0.014	0.011	−0.002
				(0.024)	(0.030)	(0.018)	(0.024)	(0.030)	(0.018)	(0.025)	(0.030)	(0.019)
Currently married/union (=1)				0.003	0.021	0.008	0.004	0.022	0.008	0.014	0.021	0.015
				(0.040)	(0.068)	(0.034)	(0.040)	(0.069)	(0.035)	(0.040)	(0.068)	(0.034)
Partner present (=1)				0.096**	0.033	0.066	0.098**	0.036	0.066	0.075	0.033	0.054
				(0.048)	(0.077)	(0.043)	(0.049)	(0.076)	(0.043)	(0.053)	(0.077)	(0.046)
Number of pregnancies				0.014**	−0.000	0.008	0.014**	−0.000	0.008	0.011	−0.000	0.005
				(0.007)	(0.009)	(0.005)	(0.007)	(0.009)	(0.005)	(0.007)	(0.009)	(0.005)
Health insurance (=1)				0.025	0.063**	0.041**	0.010	0.083**	0.040**	0.016	0.063**	0.042**
				(0.023)	(0.030)	(0.018)	(0.030)	(0.037)	(0.023)	(0.030)	(0.030)	(0.018)

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	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Public facility (=1)				−0.008	−0.030	−0.020	−0.008	−0.031	−0.020	−0.017	−0.032	−0.026
				(0.024)	(0.029)	(0.018)	(0.024)	(0.029)	(0.018)	(0.025)	(0.029)	(0.019)
Number of household members				−0.009	−0.007	−0.008	−0.009	−0.007	−0.008	−0.006	−0.007	−0.006
				(0.008)	(0.009)	(0.006)	(0.008)	(0.009)	(0.006)	(0.008)	(0.009)	(0.006)
Household–facility distance (in km)				−0.011*	−0.010*	−0.010**	−0.011*	−0.010	−0.010**	−0.014**	−0.010*	−0.011**
				(0.007)	(0.006)	(0.004)	(0.007)	(0.006)	(0.004)	(0.007)	(0.006)	(0.005)
Interaction between PBF and asset score										−0.115	−0.009	−0.008
										(0.271)	(0.014)	(0.013)
Observations	1183	1040	2223	1164	1031	2195	1164	1031	2195	1046	1031	2077

Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: $^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$.

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APPENDIX G
Regression results for use of modern contraceptives

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Interaction between PBF and time	−0.076*	0.116***	0.018	−0.134***	0.172***	0.034	−0.101*	0.174***	0.054	−0.082	0.175***	0.069*
	(0.039)	(0.043)	(0.028)	(0.052)	(0.055)	(0.037)	(0.055)	(0.057)	(0.039)	(0.061)	(0.055)	(0.039)
Wave = 0 if 2006, Wave = 1 if 2008	0.235***	0.163***	0.218***	0.206***	0.065	0.136***	0.191***	0.064	0.126***	0.154***	0.065	0.118***
	(0.029)	(0.031)	(0.020)	(0.041)	(0.042)	(0.028)	(0.042)	(0.042)	(0.029)	(0.046)	(0.042)	(0.029)
Interaction between PBF and insurance							−0.100****	−0.012	−0.068*			
							(0.045)	(0.070)	(0.038)			
Age				−0.000	−0.001	−0.001	−0.000	−0.001	−0.001	0.000	−0.001	−0.001
				(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)
Has primary or more education (=1)				−0.006	0.014	−0.003	−0.007	0.013	−0.003	−0.013	0.013	−0.006
				(0.023)	(0.033)	(0.019)	(0.023)	(0.033)	(0.019)	(0.023)	(0.033)	(0.020)
Currently married/union (=1)				−0.024	0.382***	0.188****	−0.016	0.383***	0.192****	0.141***	0.384***	0.284***
				(0.151)	(0.032)	(0.089)	(0.150)	(0.032)	(0.089)	(0.029)	(0.032)	(0.030)
Partner present (=1)				−0.085	0.053	−0.035	−0.092	0.055	−0.035	−0.088	0.054	−0.026
				(0.069)	(0.091)	(0.056)	(0.069)	(0.092)	(0.056)	(0.075)	(0.091)	(0.058)
Number of pregnancies				−0.016**	−0.014	−0.015**	−0.016**	−0.014	−0.015**	−0.015**	−0.014	−0.015**
				(0.007)	(0.010)	(0.006)	(0.007)	(0.010)	(0.006)	(0.007)	(0.010)	(0.006)
Health insurance (=1)				0.031	0.011	0.034*	0.079**	0.016	0.067**	0.048	0.011	0.030
				(0.023)	(0.035)	(0.019)	(0.033)	(0.051)	(0.027)	(0.033)	(0.035)	(0.019)
Public facility (=1)				0.029	0.039	0.028	0.031	0.039	0.028	0.025	0.037	0.035*
				(0.022)	(0.030)	(0.019)	(0.022)	(0.030)	(0.019)	(0.022)	(0.030)	(0.019)
Total number alive child				0.011	0.017	0.011	0.011	0.017	0.011	0.009	0.017	0.009

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	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
				(0.010)	(0.018)	(0.010)	(0.011)	(0.018)	(0.010)	(0.009)	(0.018)	(0.009)
Number of household members				0.010	0.011	0.015*	0.010	0.011	0.015*	0.011	0.011	0.016****
				(0.010)	(0.015)	(0.009)	(0.010)	(0.015)	(0.009)	(0.009)	(0.015)	(0.008)
Household–facility distance (in km)				0.005	0.008	0.006	0.006	0.008	0.007	0.009	0.008	0.009*
				(0.007)	(0.007)	(0.005)	(0.007)	(0.007)	(0.005)	(0.007)	(0.007)	(0.005)
Delivery assisted by a skilled attendant				0.020	0.042	0.039****	0.026	0.042	0.040**	0.024	0.042	0.042****
				(0.025)	(0.030)	(0.020)	(0.025)	(0.030)	(0.020)	(0.026)	(0.030)	(0.020)
Interaction between PBF and asset score										0.345	−0.010	−0.001
										(0.264)	(0.014)	(0.015)
Observations	1706	1566	3272	1059	966	2025	1059	966	2025	942	966	1908

Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: ***$p < 0.01$; **$p < 0.05$; *$p < 0.1$.

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APPENDIX H
Regression results for curative care for children

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Interaction between PBF and time	0.048	0.02	0.039	0.063	0.004	0.027	0.035	0.024	0.027	0.016	0.006	0.017
	(0.048)	(0.056)	(0.035)	(0.05)	(0.057)	(0.039)	(0.053)	(0.06)	(0.039)	(0.06)	(0.057)	(0.038)
Wave = 0 if 2006, Wave = 1 if 2008	0.055*	0.061*	0.072***	0.014	0.024	0.024	0.027	0.013	0.024	0.044	0.024	0.036
	(0.032)	(0.037)	(0.024)	(0.034)	(0.039)	(0.026)	(0.034)	(0.04)	(0.026)	(0.039)	(0.039)	(0.026)
Interaction between PBF and insurance						0.006	0.078*	−0.093	0.006			
						(0.037)	(0.046)	(0.062)	(0.037)			
Age				−0.022***	−0.009	−0.016***	−0.023***	−0.009	−0.016***	−0.021***	−0.008	−0.015***
				(0.007)	(0.009)	(0.006)	(0.007)	(0.009)	(0.006)	(0.007)	(0.009)	(0.006)
Sex				0.029	−0.064**	−0.013	0.031	−0.065***	−0.013	0.024	−0.064***	−0.021
				(0.023)	(0.028)	(0.018)	(0.023)	(0.028)	(0.018)	(0.024)	(0.028)	(0.018)
Mother has primary or more education (=1)				−0.02	0.04	0.007	−0.019	0.039	0.007	−0.024	0.042	0.007
				(0.023)	(0.029)	(0.018)	(−0.023)	(0.029)	(0.018)	(0.024)	(0.029)	(0.019)
Household–facility distance (in km)				−0.015***	−0.013*	−0.014***	−0.015***	−0.013*	−0.014***	−0.016***	−0.013*	−0.015***
				(0.006)	(0.007)	(0.005)	(0.006)	(0.007)	(0.005)	(0.006)	(0.007)	(0.005)
Health insurance (=1)				0.154***	0.204***	0.179***	0.117***	0.245***	0.179***	0.112***	0.205***	0.180***
				(0.023)	(0.031)	(0.024)	(0.031)	(0.039)	(0.024)	(0.033)	(0.031)	(0.019)
Number of household members				−0.018***	0.004	−0.008	−0.019***	0.004	−0.008	−0.016***	0.004	−0.006
				(0.007)	(0.008)	(0.005)	(0.007)	(0.008)	(0.005)	(0.007)	(0.008)	(0.005)
Interaction between PBF and asset score										−0.505*	−0.018*	−0.014
										(0.292)	(0.01)	(0.011)
Observations	1469	1150	2619	1370	1074	2444	1370	1074	2444	1215	1074	2289

Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: ***$p < 0.01$; **$p < 0.05$. *$p < 0.1$.

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APPENDIX I
Regression results for preventive care for children

	Specification 1			Specification 2			Specification 3			Specification 4		
	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total	Lower	Upper	Total
Interaction between PBF and time	0.077***	0.098***	0.093***	0.092***	0.092***	0.092***	0.081***	0.098***	0.092***	0.064**	0.093***	0.092***
	(0.025)	(0.025)	(0.017)	(0.026)	(0.025)	(0.019)	(0.028)	(0.026)	(0.019)	(0.031)	(0.025)	(0.018)
Wave = 0 if 2006, Wave = 1 if 2008	−0.023	−0.029*	−0.030**	−0.018	−0.011	−0.018	−0.013	−0.015	−0.018	−0.006	−0.011	−0.019
	(0.017)	(0.017)	(0.012)	(0.018)	(0.018)	(0.013)	(0.019)	(0.019)	(0.013)	(0.021)	(0.018)	(0.013)
Interaction between PBF and insurance						0.008	0.033	−0.038	0.008			
						(0.019)	(0.025)	(0.031)	(0.019)			
Age				−0.037***	−0.045***	−0.040***	−0.037***	−0.045***	−0.040***	−0.034***	−0.045***	−0.039***
				(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)
Sex				0.015	0.008	0.012	0.015	0.008	0.012	0.014	0.008	0.011
				(0.012)	(0.013)	(0.009)	(0.012)	(0.013)	(0.009)	(0.013)	(0.013)	(0.009)
Mother has primary or more education (=1)				−0.007	0.014	0.003	−0.007	0.012	0.003	−0.012	0.014	0.002
				(0.012)	(0.013)	(0.009)	(0.012)	(0.013)	(0.009)	(0.013)	(0.013)	(0.009)
Household–facility distance (in km)				−0.005	−0.007**	−0.006***	−0.005	−0.007**	−0.006***	−0.006*	−0.006**	−0.006***
				(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Health insurance (=1)				0.019	0.027*	0.015	0.003	0.046**	0.015	0.005	0.028*	0.020**
				(0.013)	(0.016)	(0.014)	(0.018)	(0.021)	(0.014)	(0.019)	(0.016)	(0.01)
Number of household members				−0.002	0.003	0	−0.002	0.003	0	−0.002	0.003	0
				(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)
Interaction between PBF and asset score										−0.211	−0.008**	−0.009**
										(0.15)	(0.004)	(0.003)
Observations	3200	2762	5962	2964	2595	5559	2964	2595	5559	2660	2595	5255

Treatment*post, indicates the interaction between treatment and time; PBF*insurance, indicates the interaction between treatment and health insurance.
Note: ***$p < 0.01$; **$p < 0.05$. *$p < 0.1$.

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