In low- and middle-income countries (LMICs), many women of reproductive age experience morbidity and mortality attributable to inadequate access to and use of health services. Access to personal savings has been identified as a potential instrument for empowering women and improving access to and use of health services. Few studies, however, have examined the relation between savings ownership and use of maternal health services. In this study, we used data from the Indonesian Family Life Survey to examine the relation between women's savings ownership and use of maternal health services. To estimate the effect of obtaining savings ownership on our primary outcomes, specifically receipt of antenatal care, delivery in a health facility, and delivery assisted by a skilled attendant, we used a propensity score weighted difference-in-differences approach. Our findings showed that acquiring savings ownership increased the proportion of women who reported delivering in a health facility by 22 percentage-points [risk difference (RD)=0.22, 95%CI=0.08, 0.37)] and skilled birth attendance by 14 percentage-points (RD=0.14, 95%CI=0.03, 0.25). Conclusions were qualitatively similar across a range of model specifications used to assess the robustness of our main findings. Results, however, did not suggest that savings ownership increased the receipt of antenatal care, which was nearly universal in the sample. Our findings suggest that under certain conditions, savings ownership may facilitate the use of maternal health services, although further quasi-experimental and experimental research is needed to address threats to internal validity and strengthen causal inference, and to examine the impact of savings ownership across different contexts.

BACKGROUND

Despite initiatives such as the Millennium Development Goals (MDGs) and Sustainable Development Goals, large health inequalities exist for women across low- and middle-income countries (LMICs). Women of reproductive age (15 to 49 years) in LMICs suffer disproportionately poorer maternal and reproductive health than their counterparts on wealthier nations (Requejo *et al.*, 2015; Victora *et al.*, 2016). According to the World Health Organization (WHO), the maternal mortality ratio (the ratio of the number of maternal deaths in a given time period per 100,000 live births during the same time period) in 2015 was 237 per 100,000 live births in LMICs, compared to 12 per 100,000 in high-income countries (WHO *et al.*, 2015). In 2015, around 303,000 women died during or following pregnancy; 99% of all maternal deaths occurred in LMICs (WHO, 2016).

Maternal death is divided into direct obstetric death (i.e., resulting from obstetric complications of pregnancy or incorrect treatment) and indirect obstetric death (i.e., resulting from pre-existing disorders, such as HIV infection, anemia, and malaria, when aggravated by pregnancy) (Mas'ud *et al.*, 2016). Evidence suggests most maternal deaths in LMICs were the direct consequences of pregnancy and childbirth (Nour, 2008; Ronsmans and Graham, 2006). In particular, maternal death has been mainly attributed to delays in recognition and treatment of life-threatening complications, and relatedly, to poor health services (Nour, 2008; Carine Ronsmans and Graham, 2006; Thaddeus and Maine, 1994). For example, complications are less likely to be diagnosed and treated while giving birth at home with unskilled attendants.

To receive timely quality maternal health services, previous research has shown that health service expansion is, by itself, not sufficient for women in LMICs with or without universal healthcare coverage (Ahmed *et al.*, 2010; Thaddeus and Maine, 1994). Instead, some

argue that women's empowerment – defined by women's share of household assets, education, decision-making power, or family background – helps determine maternal health service use (Ahmed *et al.*, 2010; Beegle *et al.*, 2001; Mainuddin *et al.*, 2015; Mistry *et al.*, 2009). For example, poor education of women and their partners can limit awareness of pre-existing conditions and acute complications, as well as appropriate resources within health systems, which together reduces efforts to seek risk-appropriate health care. Additionally, among cultures with strong patriarchy where care-seeking decisions often belong to a husband or to senior family members, women's limited bargaining power within households can inhibit their access to medical care (Ahmed *et al.*, 2010). In such situations, efforts to increase women's relative bargaining power may facilitate early recognition of complications and a quicker decision to seek care (Fotso *et al.*, 2009; Thaddeus and Maine, 1994).

To explore women's empowerment as an instrument to reduce maternal mortality, this longitudinal study investigates the extent to which acquiring savings ownership is associated with use of maternal health services, using Indonesia as a case study. Findings provide insight into how to reduce women's socioeconomic barriers that potentially restrict use of maternal health services in LMICs.

Women's Savings Ownership and the Use of Maternal Health Services

To understand the relation between women's socioeconomic status (SES) and health, we turn to Sen's capability theory. According to Sen, poverty is a deprivation of capabilities rather than a lack of income, per se (Sen, 1999). Capabilities enable people to lead the lives that they have reason to value. All individuals, even those at the bottom of the socioeconomic ladder, can actively shape their own destinies with adequate opportunities (in the forms of education and health facilities, for example) that help to advance the capability of a person. Within this

framework, one of the reasons for the high rates of maternal mortality observed in LMICs is a deprivation of women's basic capabilities to pursue high quality health services that are needed to address preventable causes of morbidity and mortality (Ruger, 2004; Sen, 2002). Under the same logic, expanding capabilities – by increasing women's earning power, expanding economic roles outside the home, attaining literacy and education, and securing property rights – has the potential to positively influence well-being (Sen, 1992, 1999).

The process of asset accumulation is one mechanism by which people gain a sense of empowerment and expanded capabilities. Assets can be financial and non-financial. The asset-based theory of social welfare asserts that asset accumulation, independent from income, provides important psychological and socioeconomic benefits for individuals and families. For example, assets orient the individual or family toward the future, stimulate development of human capital, increase personal efficacy, and strengthen social and political power (Sherraden, 1990). Research reveals that savings owned by vulnerable populations, including women and youth, positively affects their decision-making power within the household (Ashraf *et al.*, 2006; Chowa *et al.*, 2012; Dupas and Robinson, 2013a, 2013b; Ssewamala *et al.*, 2009). If savings are sequestered in a bank account and less easily accessed, women might have more power to reject requests for withdrawals by family members, including their husband (Ashraf *et al.*, 2003; Vonderlack and Schreiner, 2002).

Context: Maternal Health in Indonesia

The Indonesian economy has been one of Southeast Asia's highest performing in recent decades. At the same time, the Indonesian government has invested in its community-based health care system (Statistics Indonesia *et al.*, 2013). Investments have included expanded maternal and newborn health care via increased community health centers, village health posts,

village midwives, and birth facilities. Additionally, the government has increased services offered by skilled health attendants and simultaneously discouraged the use of traditional birth attendants *(dunkun;* Joint Committee on Reducing Maternal and Neonatal Mortality in Indonesia *et al.*, 2013). With these policy efforts, 88% of mothers in Indonesia reported four or more antenatal care visits during pregnancy, and skilled providers assisted with 83% of births (Statistics Indonesia *et al.*, 2013).

Despite these efforts, the maternal mortality ratio in Indonesia remains high. At an estimated 359 per 100,000 live births for the period 2008-2012 (Statistics Indonesia *et al.*, 2013), the maternal mortality ratio in Indonesia is higher than other South Asian countries with lower GDP per capita, such as India and Bangladesh. In Indonesia, maternal mortality is unequally distributed across economic and demographic groups. With data from West Java, Ronsmans (2009) found that maternal mortality was three times greater among the poorest women compared to the wealthiest. Furthermore, around 40% of all births took place in women's homes, and the percentage is higher in rural areas, at 52% (Statistics Indonesia *et al.*, 2013). Claims that 60% of births take place in medical facilities need to be interpreted cautiously because medical facilities often include the homes of nurses or qualified midwives, in addition to certified hospitals or clinics (Joint Committee on Reducing Maternal and Neonatal Mortality in Indonesia *et al.*, 2013). In sum, despite policy efforts to enhance access to health services, women remain at high risk of maternal mortality, and these risks are unequally distributed across economic and social strata.

The extent of women's empowerment and decision-making power within households may influence maternal health services utilization. Further, having savings may be a mechanism for building empowerment. Only 37% of Indonesian women over age 15 own bank accounts and

only 27% save at a financial institution (World Bank, 2014). These rates are much lower than the average in East Asian and Pacific countries, where 67% of women have bank accounts and 36% have savings. An important gap in research on the association between woman's empowerment and the use of maternal health conditions is the potential role of women's savings ownership. In this context, we have formulated the following research question: Does obtaining savings ownership increase women's use of maternal health services in LMICs?

METHODS

Sources of Data

Data came from two waves of the Indonesian Family Life Survey (IFLS), an ongoing longitudinal socioeconomic and health survey begun in 1993. The 13 most populated provinces in Indonesia were sampled, accounting for about 83% of the country's population in 1991 (Strauss *et al.*, 2009). The first wave (IFLS-1) was administered in 1993 to 22,000 individuals living in 7,224 households. We used data from the 2000 IFLS-3 and 2007/2008 IFLS-4, which contacted 95.3% and 90.6% of IFLS-1 households, respectively. Between the IFLS-3 and IFLS-4, there was the tsunami in 2004, and the tsunami struck the west and north costs of northern Sumatra, particularly in Aceh province. Since Aceh was excluded from the IFLS due to the area's political violence and the potential risk to interviewers (Strauss *et al.*, 2009), there may not be a significant impact of the tsunami on the outcomes of this study. In order to maintain the representativeness of the IFLS, members of original households were followed if they formed or joined new households; these split-off households form a new sample group. The IFLS-3 was a collaborative effort of RAND and the center for Population and Policy Studies (CPPS) of the University of Gadjah Mada, and the IFLS-4 was a collaborative effort of RAND, CPPS, and Survey METRE (Strauss *et al.*, 2009).

Births (live) in the five years preceding the 3rd and 4th waves of the IFLS were used to form our analytic sample. In the original sample, there were 5,959 births reported at the third and 9,574 reported at the fourth wave. The increase in the number of births between the two waves may reflect the increase in the number of families that joined the IFLS due to household splits. As a result, the number of women who have ever given birth increased from the third (3,393) to the fourth wave (6,160). To form our analytic sample, we first restricted to the 4,736 births among mothers without a savings account in the third wave, since our objective was to measure the impact of obtaining savings ownership. Next, we restricted to the 4,172 births (2,086 at the third and 2,086 at the fourth wave) delivered by 1,148 mothers who were surveyed and had ever given birth at both waves. Lastly, we dropped observations with missing covariate information, resulting in a sample of 1,832 births in the third wave and 1,833 births in the fourth wave.

Measurement

Women's savings ownership.

In the IFLS survey, each household member over 15 years old answered questions about whether they or any members of their household own savings/certificates, the total value of these, and which household member owns them. We only used answers provided by female heads or female household members. Based on these questions we created a dichotomous indicator for women's savings ownership (sole or jointly) in the fourth wave, regardless of the value of the savings. A value of 1 was assigned to births reported by the mother in the five years prior to the survey if she owned savings at the time of survey; if not, a value of 0 was assigned.

Maternal health service utilization.

We defined and measured the use of maternal health services based on Wang *et al.* (2011): antenatal care (current use of antenatal care, trends in four or more antenatal care visits, providers and content), delivery care (place and attendance of delivery), and postnatal care

(current use of postnatal care, timing of the first postnatal checkup, and provider). Based on previous literature and data availability in the IFLS, we created three binary indicators of maternal health service use in the past five years: (a) receiving four or more antenatal care visits, (b) delivery assisted by a skilled attendant, and (c) delivery in a health facility. "Health facilities" included public and private hospitals, delivery hospitals, community health centers, village delivery posts, physician's clinics and offices, and midwives' clinics and offices; this excludes clinics or offices of traditional birth attendants. "Skilled attendants" include physicians, private and village midwives, and nurses. This excludes traditional birth attendants *(dunkun)* in accordance with Indonesian government policy discouraging use of *dunkun*.

Analysis

To estimate the effect of obtaining savings ownership on the use of maternal health services, we used a difference-in-differences (DID) design. The DID approach estimates the causal effect of an intervention by comparing changes over time in a group unaffected by the intervention (a control group) with changes over time in a group exposed to the intervention (a treatment group) (Meyer, 1995). By accounting for fixed characteristics of treatment groups and shared temporal trends in outcomes, the DID method provides the unbiased estimate of mother's savings ownership (the treatment) on the use of maternal health services (the outcome) under certain assumptions. In particular, the DID design assumes that, in the absence of the treatment, the comparison group emulates the trend in the use of health services that the treated group would have experienced had they not obtained a savings account (Stuart *et al.*, 2014). Selection bias across time can occur if there are changes in group composition that are likely to affect the outcome. For example, if the treated group was overrepresented by rural women in the 3rd wave, but overrepresented by urban women in the 4th wave due to household's moving or split-off

between waves, this change in group composition may lead to an increase in the use of maternal health services and an overestimate of the treatment effect. Selection bias across groups can occur if treatment and comparison groups differ with respect to women's socioeconomic characteristics, aside from savings ownership, that are also related to trends in outcomes across time. To mitigate the potential for selection bias, we incorporated propensity score weighting with the traditional DID model as described by Stuart *et al.* (2014). The propensity score is defined as the probability of receiving the treatment of interest as a function of observed covariates (also known as conditioning variables) (Guo *et al.*, 2006; Stuart *et al.*, 2014). We chose conditioning variables based on a review of the determinants of women's empowerment and the use of maternal health services. Fifteen socio-demographic, economic, and birth-related factors were chosen (Table 1), including: mother's age; relationship with the head of household; marital status; rural/urban residence; province; knowledge of the location of a hospital, public health center, and private clinic or physician; religion; employment status; education; husband's education; asset ownership (housing, vehicle, jewelry, appliance, and furniture and utensil); birth order within each survey and the gender of the birth. Including measures of knowledge about the location of health facilities and providers was intended to control for geographic differences in access to health services; these questions were asked to a wife of the head of the household or female head of the household.

Table 1.

Description of covariates included in the propensity score model

Variables	Description
Age	Continuous age and age squared
Relationship with a head of household	Relationship with a head of household (head of household / spouse / other members)
Marital status	Marital status (married / not married)
Residence	Residence area (rural / urban)
Religion	Religion (Islam / Protestant / Catholic / Hindu)
Employment status	Employment status (work, try to work, help to earn income during the past week / other activities such as job searching, attending school, housekeeping)
Education	Education (elementary / junior high / senior high / college or university / others)
Husband's education	Husband's education (elementary / junior high / senior high / college or university / others)
Province	Province (Sumatra / Java / Others)
Knowledge of hospital	Knowledge of the location of a public or private hospital (yes / no)
Knowledge of public health center	Knowledge of the location of a public health center (yes / no)
Knowledge of private clinic/physician	Knowledge of the location of a private clinic or private physician (yes / no)
Asset ownership	Sole or jointly housing, vehicle, appliance, jewelry, and furniture and utensil ownership (yes / no)
Birth order	Continuous birth order within each survey (1 to 12)
Gender of birth	Gender of birth (female / male)

As illustrated in Table 2, the propensity score weighted DID approach compares four groups [i.e., (1) treatment pre-intervention, (2) treatment post-intervention, (3) comparison pre-intervention, and (4) comparison post-intervention] that, when weighted by the propensity score, are conditionally exchangeable across time and across groups.

Table 2.

Group assignment and illustration of the DD design (Stuart et al., 2014)

	Treatment group (Savings)	Comparison group (non-Savings)	Difference
Pre	$\overline{y}_{1,pre}$ (Group 1)	$\overline{y}_{0,pre}$ (Group 3)	$\overline{y}_{1,pre} - \overline{y}_{0,pre}$
Post	$\overline{y}_{1,post}$ (Group 2)	$\overline{y}_{0,post}$ (Group 4)	$\overline{y}_{1,post} - \overline{y}_{0,post}$
Change	$\overline{y}_{1,post} - \overline{y}_{1,pre}$	$\overline{y}_{0,post} - \overline{y}_{0,pre}$	$\hat{\Delta}^{a} = \left(\overline{y}_{1,post} - \overline{y}_{1,pre}\right)$ $-\left(\overline{y}_{0,post} - \overline{y}_{0,pre}\right)$ $= (\overline{y}_{1,pre} - \overline{y}_{0,pre}) - (\overline{y}_{1,post} - \overline{y}_{0,post})$

Note. [a] Estimated treatment effect

Therefore, each observation *i* (each birth) has four resulting propensity scores, $e_g(X_i)$: the probability of being in group g, for g = 1 - 4. To estimate the propensity score, we used a multinomial logistic regression model predicting group as a function of a set of observed covariates X. The weights are then applied so that, when scaled, each of the groups is similar to

group 1 (i.e., the treatment group in the pre-intervention period). This process is accomplished using the following weight for birth i:

$$w_i \; = \; e_1(X_i)/e_g(X_i) \quad (1)$$

where g refers observation i's actual group membership. Accordingly, an observation in group 1 receives a weight of 1, while observations in other groups receive a weight that is proportional to their probability of being in group 1 relative to their probability of being in the group they were actually in. Therefore, observations which look very similar to those in the treated group in the pre-intervention period, and very different from the observations in their own group, will receive higher weights. Conversely, those which look dissimilar from those in Group 1, but more similar to observations in their own group, will receive lower weights (Stuart *et al.*, 2014). While Stuart *et al.* (2014)'s approach is often implemented with data from repeated cross-sections, it has been applied to longitudinal data (McConnell *et al.*, 2017), as was the case in this study.

We compared the sensitivity of our main results across a range of model specifications. In particular, we compared results from DID models: (1) without weighting by the propensity score, (2) weighted by propensity scores with predictors from the baseline (3rd) wave only, (3) weighted by propensity scores that included demographics at both (3rd and 4th) waves, (4) weighted by propensity scores that included demographics and knowledge on health facilities at both waves, and (5) weighted by propensity scores that included demographics, knowledge on health facilities, and economic indicators at both waves.

Since our outcome measures were binary variables, we used logistic models, weighted by w_i, with post-estimation to estimate effects of savings ownership on the risk difference (RD) scale:

$$log[P(Y_{ip})] = \alpha + \beta_1 E + \beta_2 P + \beta_3 EP + \upsilon, \upsilon \sim N(0,1) \quad (2)$$

where Y_{ip} is an indicator of the receipt of maternal health services (four or more antenatal care

visits, delivery in a health facility, and delivery with a skilled attendant) for birth i at time p (pre

vs post status). E represents the treatment and indicates whether the birth occurred while the

mother had her own savings (sole or jointly). The coefficient of interest is β_3, which represents

the change in the probability of receiving maternal health services associated with acquiring

savings ownership. To examine whether the association between women's savings ownership

and the use of maternal health services varied by maternal SES, we calculated DID estimates for

each SES group based on wave 3 values (employment status, housing ownership, and education

level as less than senior high school or higher). Results from the stratified analysis are described

in Appendix A. Standard errors accounted for clustering by mother and all analyses were

performed using Stata version 14.

RESULTS

Descriptive Statistics

Table 3 presents maternal characteristics for births reported in the 3rd and 4th waves.

Maternal age increased over time, as would be expected in a cohort study. In all groups, most

mothers were the spouse of the head of household. The treatment group was overrepresented by

births to urban mothers, whereas in the comparison group the share of residents in rural areas

was higher than those living in urban areas.

In terms of women's empowerment, the proportion of mothers who worked to earn

income increased over time in both groups. Changes in education were modest; however, in the

post-treatment group, 50% of mothers received more than a senior high school education,

whereas in the post-comparison group, more than 50% of mothers had less than an elementary

school education. The ownership of assets differed between the treatment and comparison groups over time. For example, vehicle ownership increased from 26% to 58% in the treatment group, compared to 19% to 37% in the comparison group. For housing, the increase was slightly greater in the comparison group (41% to 57%) than that in the treatment group (38% to 51%).

Mothers in the treatment group were, on average, more aware of the location of health facilities than mothers in the comparison group. In both groups, the proportion of mothers who knew the location of a hospital increased over time (from 81% to 84% in the treatment group compared to 70% to 79% in the comparison group). Differences in the socioeconomic profile of mothers and births across the four groups justified the application of propensity score weighting to account for selection by observed covariates.

Table 3.

Sample characteristics before propensity score weighting

Variable	Group1: Treated Pre	Group2: Treated Post	Group3: Comparison Pre	Group4: Comparison post
N	257	253	1,575	1,580
Mother's characteristics				
Age	27.07	34.30	28.72	35.86
Household status - head	0.03	0.11	0.04	0.10
Spouse	0.70	0.83	0.73	0.85
Other members	0.26	0.06	0.24	0.05
Marital status – Married	0.98	0.96	0.98	0.95
Residence - Urban	0.55	0.58	0.43	0.45
Employment status - Earning income	0.35	0.62	0.32	0.58
Education - Less than elementary	0.33	0.31	0.54	0.53
Junior high school	0.19	0.17	0.21	0.21
Senior high school	0.36	0.39	0.23	0.22
College/University	0.11	0.13	0.02	0.03
Others	0.00	0.00	0.00	0.01
Housing ownership	0.38	0.51	0.41	0.57
Vehicle ownership	0.26	0.58	0.19	0.37
Appliance ownership	0.59	0.93	0.50	0.75
Jewelry ownership	0.72	0.72	0.55	0.41
Furniture and utensil ownership	0.76	0.96	0.75	0.91
Religion - Islam	0.93	0.92	0.88	0.87
Protestant	0.02	0.02	0.05	0.06
Catholic	0.01	0.01	0.01	0.02
Hindu	0.04	0.04	0.05	0.04
Husband Edu - Less than elementary	0.26	0.28	0.49	0.47
Junior high school	0.20	0.17	0.20	0.22
Senior high school	0.37	0.36	0.26	0.25
College/University	0.16	0.18	0.05	0.05
Others	0.00	0.01	0.00	0.01
Province – Sumatra	0.23	0.23	0.32	0.33
Java	0.54	0.55	0.47	0.46
Others	0.24	0.22	0.21	0.21
Knowledge of hospital	0.81	0.84	0.70	0.79
Knowledge of public health center	0.95	0.96	0.94	0.95
Knowledge of private health clinic	0.26	0.26	0.15	0.16
Birth's characteristics				
Birth order	1.32	1.36	1.59	1.62
Gender - Male	0.53	0.53	0.52	0.53

Changes in the Use of Maternal Health Services

  Table 4 shows that the frequency of antenatal care visits, delivery with a skilled attendance, and health facility delivery increased over time in the treatment and comparison groups. In the full sample prior to propensity score weighting, the proportion of mothers in the treatment group who delivered in a health facility increased from 57% to 72%, compared to 41% to 49% in the comparison group. The proportion who reported having a skilled attendant during delivery increased from 80% to 93% in the treatment group versus 61% to 69% in the comparison group. The proportion of mothers who reported four or more antenatal care visits increased slightly in the treatment group from 98% to 99%, compared to 93% at both waves in the comparison group.

Table 4.

Prevalence of maternal health services use before and after propensity score weighting

	Group 1	Group 2	Group 3	Group 4
Unweighted				
Health facility delivery	0.57	0.72	0.41	0.49
Skilled attendant during delivery	0.80	0.93	0.61	0.69
More than 4 antenatal care visits	0.98	0.99	0.93	0.93
Weighted				
Health facility delivery	0.57	0.80	0.55	0.55
Skilled attendant during delivery	0.80	0.93	0.75	0.73
More than 4 antenatal care visits	0.98	1.00	0.96	0.97

Balance Check

Table 5 presents the unweighted and weighted standardized differences in means for each covariate when comparing the groups to the treated group in the pre-intervention period. Estimation of the difference in means of each covariate divided by the standard deviation is a common method of balance checking which is referred to as the "standardized bias" or "standardized difference in means" (Stuart, 2010). Lower values are preferred, with guidelines suggesting that acceptable thresholds for standardized biases are 0.1 or 0.25 (Stuart *et al.*, 2013). Many of the unweighted standardized differences in means exceeded this level. However, the weighted standardized differences in means were closer to zero, suggesting that the weighting was successful in creating conditionally exchangeable groups in terms of measured covariates.

Table 5.

Standardized difference in means of sample characteristics showing balance of covariates by group

Variable	Unweighted standardized difference in means[a]			Weighted standardized difference in means		
	2 vs 1	3 vs 1	4 vs 1	2 vs 1	3 vs 1	4 vs 1
Mother's characteristics						
Age	0.81	0.19	0.99	0.36	-0.05	0.36
Household status - Head	0.33	0.02	0.30	0.02	-0.01	0.04
Spouse	0.20	0.04	0.22	0.12	-0.01	0.14
Other members	-0.33	-0.05	-0.34	-0.13	0.02	-0.16
Married	-0.11	-0.01	-0.18	0.01	-0.03	-0.01
Residence – Urban	0.05	-0.17	-0.14	-0.08	-0.03	-0.06
Employment status -Earning income	0.39	-0.05	0.34	0.24	-0.03	0.20
Education – Less than elementary	-0.03	0.32	0.29	0.12	-0.02	0.15
Junior high school	-0.05	0.03	0.04	-0.17	0.00	-0.03
Senior high school	0.04	-0.20	-0.21	0.09	0.00	-0.10
College/University	0.04	-0.20	-0.19	-0.10	0.03	-0.04
Others	0.00	-0.04	0.14	0.00	0.07	-0.04
Housing ownership	0.18	0.03	0.27	0.13	-0.02	0.10
Vehicle ownership	0.54	-0.12	0.18	0.24	-0.02	0.17
Appliance ownership	0.49	-0.13	0.22	-0.09	0.00	0.13
Jewelry ownership	0.00	-0.27	-0.49	-0.12	0.00	-0.02
Furniture and utensil ownership	0.34	-0.01	0.26	-0.07	0.01	0.08
Religion – Islam	0.00	-0.14	-0.17	0.01	-0.01	0.03
Protestant	0.00	0.18	0.23	-0.07	0.01	-0.02
Catholic	0.00	0.00	0.05	0.12	-0.02	0.00
Hindu	0.00	0.03	0.01	-0.04	0.01	-0.03
Husband Edu - Less than elementary	0.03	0.36	0.34	0.00	-0.01	0.08
Junior high school	-0.05	-0.01	0.03	0.02	0.00	-0.01
Senior high school	-0.01	-0.17	-0.18	0.05	0.01	-0.05
College/University	0.04	-0.22	-0.22	-0.08	0.00	-0.02
Others	0.00	0.00	0.00	0.00	0.00	0.00
Province – Sumatra	0.00	0.16	0.18	0.00	-0.01	0.03
Java	0.02	-0.09	-0.11	0.10	0.01	0.00
Others	-0.03	-0.05	-0.05	-0.11	0.00	-0.03
Knowledge of hospital	0.06	-0.19	-0.04	0.04	0.02	-0.04
Knowledge of public health center	0.01	-0.04	0.00	0.14	-0.01	0.07
Knowledge of private health clinic	-0.01	-0.18	-0.17	0.03	0.02	-0.07
Birth characteristics						
Birth order	0.04	0.30	0.00	0.09	-0.04	0.21
Gender of birth	-0.01	-0.03	0.00	-0.18	0.01	-0.03

Note. [a]Standardized difference in means defined as the difference in means divided by the standard deviation; For standardized difference in means, lower values are preferred, with guidelines suggesting that acceptable threshold are 0.1 or 0.25 (Stuart et al., 2013)

Mother's Savings Ownership and The Use of Maternal Health Services

Figure 1 presents the impacts of savings ownership on the use of maternal health services from both unweighted and propensity score weighted models. As seen in the figure, mother's savings ownership increased the probability of delivery in a health facility by 22 percentage-points (RD=0.22, 95%CI=0.08, 0.37) and the probability of delivery with a skilled birth attendant by 14 percentage-points (RD=0.14, 95%CI=0.03, 0.25). On the other hand, there was no evidence to suggest that savings ownership increased the probability of receiving four or more antenatal care visits, although there was a ceiling effect since coverage was nearly universal in our sample.
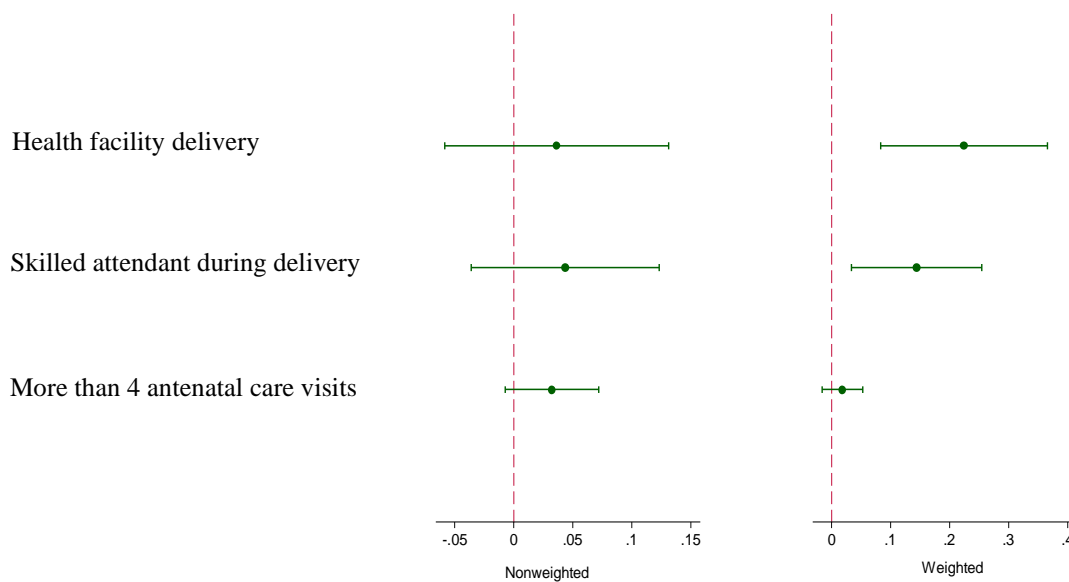

Figure 1. Impacts of savings ownership on the use of maternal health services from propensity score weighted difference-in-differences analyses; risk differences (RD) with 95% confidence intervals (CI)

When dividing the sample based on respondent's SES, savings ownership was associated with the use of maternal health services among lower SES mothers. For example, savings ownership increased the probability of delivery with a skilled attendant by 21 percentage-points (95%CI=0.10, 0.33) among mothers without housing ownership and 20 percentage-points (95%CI=0.05, 0.35) among less-educated mothers. On the other hand, savings ownership did not increase the use of maternal health services among higher SES mothers (Table A1 and A2 in the appendix).

Sensitivity Analysis

Table 6 shows the results of analyses examining the sensitivity of various model specifications. Results were in the same direction and of a similar magnitude for a range of propensity score models, although in some cases estimates were attenuated compared to our primary propensity score weighted DID estimates. For example, when predicting the propensity score based only on covariates from the 3rd (baseline) wave, acquiring savings ownership increased the proportion of women who reported delivering in a health facility by 12 percentage-points (RD=0.12, 95% CI=0.02 0.23) and skilled birth attendance by 12 percentage-points (RD=0.12, 95% CI=0.00 0.25). In a crude model that did not account for measured confounding through propensity score weighting, acquiring savings did not increase the use of maternal health services. This is, however, consistent with what we would expect given the lack of exchangeability and lower socioeconomic profile of the control group vis-à-vis the treated group. As seen in Table 4, the largest impact of the weights was to increase the prevalence of maternal health service use in the control group in the pre-intervention period.

Table 6.

Sensitivity analyses assessing potential confounding bias; Models 1-5 show results for different propensity score model specifications

Outcome variables		Main specification	1	2	3	4	5
Health facility delivery	RD (CI)	0.22 [0.08 0.37]	0.07 [-0.02 0.15]	0.12 [0.02 0.23]	0.17 [0.03 0.30]	0.18 [0.05 0.32]	0.24 [0.10 0.38]
Skilled attendant during delivery	RD (CI)	0.14 [0.03 0.25]	0.05 [-0.03 0.13]	0.12 [0.00 0.24]	0.09 [-0.04 0.22]	0.11 [-0.03 0.24]	0.14 [0.04 0.25]
Four or more antenatal care visits	RD (CI)	0.02 [-0.02 0.05]	0.01 [-0.02 0.05]	0.02 [-0.02 0.07]	0.02 [-0.02 0.06]	0.02 [-0.02 0.06]	0.02 [-0.02 0.05]
Propensity score model predictors		Includes demographics, knowledge on health facilities, economic indicators, and birth characteristics at both waves	None	Includes demographics, knowledge on health facilities, economic indicators, and birth characteristics at the baseline	Includes demographics at both waves	Includes demographics and knowledge on health facilities at both waves	Includes demographics, knowledge on health facilities, and economic indicators at both waves

DISCUSSION

We used longitudinal data from Indonesia between 2000 and 2008 to examine the association between mother's savings ownership and the use of maternal health services. Women who were urban residents, employed, and better educated were more likely to have their own savings.

In propensity score weighted DID models, acquiring savings ownership was positively associated with the probability of delivering in a health facility and having a skilled birth attendant present during delivery. Savings ownership, however, did not increase the probability of women making four or more antenatal care visits. In addition, our results were generally consistent across a series of sensitivity analyses varying the specification of our propensity score model. These findings are broadly consistent with previous research showing that women's ownership of assets such as a house, vehicles, and appliances was associated with a greater probability of obtaining prenatal care, delivering in a hospital or private doctor's office, and having a midwife when giving birth at home in Indonesia (Beegle *et al.*, 2001). Concerted policy efforts to enhance the use of formal (i.e. non-*dunkun* providers) maternal health services in Indonesia have increased the proportion of women receiving antenatal care over the past decade, which was nearly universal in our sample and limited the potential impact of savings ownership on this outcome. In contrast, larger gaps still exist in access to health facilities between rich and poor, and urban and rural population groups.

When splitting the cohort into subsamples based on woman's employment status, education level, and housing ownership, the impacts of savings ownership were larger in magnitude among more socially disadvantaged women. This suggests that the positive effects of savings ownership on the use of maternal health services were concentrated among women of

lower SES, and moreover that savings ownership has the potential to reduce socioeconomic inequalities in the use of maternal health services. However, with large and overlapping confidence intervals, stratified estimates were not statistically different, and a larger sample would be needed to provide more precise estimates for the impact of savings ownership by social class.

While we mainly focused on the quantity of maternal care services, recent research shows that poor *quality* care is a major concern in Indonesia (Mahmood *et al.*, 2018). A majority of maternal deaths occurred in hospitals in Indonesia (57.5%) due to the poor organizational capacity and health-care provider knowledge and capacity (Mahmood *et al.*, 2018; Mas'ud *et al.*, 2016). In particular, women's SES, indicated by their education level and asset ownership, might play an important role in receiving better quality of care (Mas'ud *et al.*, 2016). Considering these previous studies, savings ownership may contribute to receipt of better quality health services.

Limitations and Research Implications

Our study has several limitations common to observational research. First, although we reduced bias from most observed covariates by combining propensity score weighting with DID analysis, there may be residual confounding in some covariates such as mother's age. For mother's age, the weighted standardized difference in means was greater than 0.25 (0.05 to 0.36) due to large differences in the unweighted distributions of age for the treated and control groups (0.19 to 0.99). In addition, there may be unobserved covariates which affected women's decisions to use maternal health services. For example, we could not measure preference for a traditional birth attendant (*dunkun*) and home delivery because of trust and confidence based on familiarity, given that they may live in the same community and share the same culture (Titaley *et al.*, 2010). Changes in these factors would have had to coincide with changes in savings

ownership to bias our estimates. In addition, because of data limitations, we could not control for the impact of other initiatives by the Indonesian government, or other programs seeking to address maternal and reproductive health. As savings ownership was not randomly assigned, we cannot be certain about the causal impact of savings ownership on the use of maternal health services.

Second, savings ownership at the time of each birth and the time of survey may have differed, which introduces potential measurement error. Ideally, we would have assigned the treatment (savings ownership) to subsequent births after the survey. However, this is not possible as respondents only reported their savings ownership status at the time of survey, although births were reported in the five years prior to the survey. For baseline (pre-period) the potential misclassification was likely negligible given the sample was restricted to mothers who reported not having savings, and it is unlikely that they would have previously had savings and subsequently closed their account before the 3rd wave interview. For the treatment group in the post period, however, it is likely some births categorized as a '1' (i.e. mother had savings) were in fact a '0' (i.e., no savings) at the time of birth; this may have biased our effect estimates toward the null.

Third, due to low item response rates on the total value of savings, savings ownership was included as a binary variable. However, previous research has shown that the association of assets with health outcomes varies depending on how assets are measured (Pollack *et al.*, 2007). Therefore, future research should consider the quantity of savings necessary to translate into health-promoting decisions and behaviors. This would be more feasible if the IFLS used follow-up interviews to address this missing covariate information.

Fourth, our sample represents a selection of IFLS cohort members. Specifically, in order to estimate the effect of obtaining savings ownership on the use of maternal health services we restricted our analytic sample to women who did not report savings ownership at baseline and who reported a birth in the past five years at both survey waves. Additionally, we did not incorporate sampling weights into the propensity score weighted DID approach. Estimates should therefore be generalized with caution.

Lastly, due to an increase in health service provision and changes in macroeconomic and social context during the last two decades, minor savings might not be a significant factor now in Indonesia. However, our findings may have relevance to other contexts, including low-income countries that have a similar social and economic profile to Indonesia's in 2000. **Policy Implications**

Our study suggests that savings ownership may positively influence maternal health service utilization, especially delivery in a health facility and skilled birth attendance. Further, the observations that effects were larger in magnitude among socially disadvantaged groups indicates that asset-based interventions may play a role in reducing inequality by improving maternal health service use among the least advantaged. Our results provide a basis for evaluating the impact of interventions which introduce savings programs for women on the use of maternal health services. For example, commitment savings programs could positively impact women's use of maternal and child health services and prevent them from suffering from poor-quality care. Commitment savings programs are designed for individuals who elect to pre commit to restricting withdrawals until a certain period of time or for a pre-defined goal or purpose (Ashraf *et al.*, 2006). Empirical evidence has shown that commitment savings programs can help women commit to saving (Ashraf *et al.*, 2003; Dupas and Robinson, 2013a), which in

turn help empower them to have a greater say in achieving their capabilities and improving (or even saving) their lives. In light of this, the Indonesian government has encouraged commercial banks to provide microfinance programs for the poor and low-income earning individuals who cannot easily access to the formal banks. In particular, some banks have introduced micro-savings product (i.e., very small deposits) without charging for monthly administration, account opening or closing, and payment of cash transactions or transfers in, to encourage the poor to have their own savings (KPMG Indonesia, 2015).

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Appendix A1.

The use of maternal health services by SES before and after propensity score weighting

(a) Employment status

	Working to earn income				Non-working			
	Group1	Group2	Group3	Group4	Group1	Group2	Group3	Group4
Unweighted								
Health facility delivery	0.58	0.74	0.38	0.47	0.57	0.71	0.42	0.51
Skilled attendant during delivery	0.74	0.94	0.60	0.72	0.82	0.93	0.61	0.68
More than 4 antenatal care visits	0.98	0.98	0.91	0.91	0.97	1.00	0.94	0.94
Weighted								
Health facility delivery	0.58	0.81	0.48	0.55	0.57	0.69	0.55	0.56
Skilled attendant during delivery	0.74	0.91	0.76	0.80	0.82	0.85	0.74	0.71
More than 4 antenatal care visits	0.98	0.98	0.97	0.96	0.97	1.00	0.97	0.97

(b) Housing ownership

	With housing ownership				Without housing ownership			
	Group1	Group2	Group3	Group4	Group1	Group2	Group3	Group4
Unweighted								
Health facility delivery	0.55	0.79	0.30	0.39	0.58	0.68	0.48	0.56
Skilled attendant during delivery	0.81	0.91	0.49	0.59	0.79	0.94	0.67	0.75
More than 4 antenatal care visits	1.00	1.00	0.93	0.91	0.96	0.99	0.93	0.95
Weighted								
Health facility delivery	0.55	0.79	0.45	0.49	0.58	0.91	0.64	0.61
Skilled attendant during delivery	0.81	0.88	0.63	0.62	0.79	0.99	0.82	0.80
More than 4 antenatal care visits	1.00	1.00	0.96	0.98	0.96	0.99	0.97	0.98

(c) Education level

	Senior high school of higher				Less than senior high			
	Group1	Group2	Group3	Group4	Group1	Group2	Group3	Group4
Unweighted								
Health facility delivery	0.71	0.70	0.56	0.62	0.38	0.63	0.28	0.38
Skilled attendant during delivery	0.93	0.99	0.70	0.78	0.63	0.86	0.47	0.57
More than 4 antenatal care visits	0.97	0.99	0.95	0.91	0.96	1.00	0.91	0.89
Weighted								
Health facility delivery	0.71	0.92	0.69	0.73	0.38	0.76	0.33	0.39
Skilled attendant during delivery	0.93	0.99	0.85	0.87	0.63	0.91	0.55	0.62
More than 4 antenatal care visits	0.97	0.99	0.98	0.94	0.96	1.00	0.94	0.94

Appendix A2.

Impacts of savings ownership on the use of maternal health services by SES

(a) Employment status		Working to earn income (n= 1,201)			Non-working (n= 2,464)		
Weighted							
Health facility delivery	RD[a]	0.17	[-0.06	0.40]	0.11	[-0.11	0.33]
Skilled attendant during delivery	RD	0.12	[-0.09	0.34]	0.06	[-0.16	0.28]
Four or more antenatal care visits	RD	0.00	[-0.05	0.06]		-	
(b) Housing ownership		With housing ownership (n= 1,461)			Without housing ownership (n= 2,204)		
Weighted							
Health facility delivery	RD	0.19	[-0.02	0.40]	0.36	[0.19	0.52]
Skilled attendant during delivery	RD	0.08	[-0.14	0.31]	0.22	[0.10	0.33]
Four or more antenatal care visits	RD		-		0.02	[-0.02	0.06]
(c) Education level		Senior high school of higher (n= 1,511)			Less than senior high (n= 3,129)		
Weighted							
Health facility delivery	RD	0.16	[-0.01	0.34]	0.31	[0.14	0.48]
Skilled attendant during delivery	RD	0.04	[-0.10	0.18]	0.20	[0.05	0.35]
Four or more antenatal care visits	RD	0.06	[-0.05	0.18]		-	

Note. [a]Risk Difference