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The impact of foreign aid on maternal mortality

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WIDER Working Paper 2019/11

The impact of foreign aid on maternal mortality

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Abstract: In 2010, the G8 placed renewed focus on maternal health via the Muskoka Initiative by committing to spend an additional US$5 billion on maternal, newborn, and child health before 2015. Following the end of the Millennium Development Goals and the advent of the Sustainable Development Goals, maternal health issues have continued to feature prominently on the global health agenda. Despite substantial investments of foreign aid over the past decade, however, there is limited evidence on the effectiveness of foreign aid in reducing maternal mortality in low- and middle-income countries. Using data from the Organisation for Economic Co-operation and Development, the World Development Indicators, and the Institute for Health Metrics and Evaluation, this study analyses the effects of aid on maternal health in a sample of 130 low- and middle-income countries from 1996 through 2015. Our results show that the effects of total foreign aid on maternal mortality are limited, but that aid allocated to the reproductive health sector and directly at maternal health is associated with significant reductions in maternal mortality. Given these targeted effects, it is important to channel more donor assistance to the promotion of reproductive health and contraceptive use among women, as it serves as a tool towards the reduction of maternal mortality.

Keywords: foreign aid, maternal mortality, Muskoka Initiative, reproductive health family planning

Tables and Figures: at the end of the paper.

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1. Introduction

Recent debates concerning the effectiveness of aid in improving development outcomes have been inconclusive (Tilburg, 2015). Aid critics (Easterly, 2006; Moyo, 2009; Winters, 2010) have voiced their concerns that aid is 'dead'. They maintain that billions of dollars have been transferred to poor economies with the aim of improving living conditions, but the results have always been catastrophic, leaving more than a billion people still living in abject poverty. Despite these concerted efforts, there has been limited academic research on the links between foreign aid and maternal mortality reduction in low- and middle-income countries (LMICs) (Taylor, Hayman, Crawford, Jeffery, & Smith, 2013).

In the case of aid committed to maternal health, the Muskoka Initiative on Maternal, Newborn and Child Health (MNCH) was one such commitment adopted at the G8 summit in 2010. This initiative saw a commitment of US$7.3 billion through 2015 to improve maternal and child health in the world's poorest countries and to contribute to the achievement of Goal 5 of the Millennium Development Goals (MDGs). The presumption that aid can combat maternal mortality, however, seemed to be based on limited evidence, and this relationship has rarely featured in the global health research agenda.

Given the Muskoka commitments, and support for the MDGs and Sustainable Development Goals (SDGs), over the past decade, the donor community has committed sizeable financial resources to the reduction of maternal deaths in developing countries. Between 1990 and 2017 an estimated US$11.6 billion has been invested in maternal health (Institute for Health Metrics and Evaluation [IHME], 2018). Yet, high levels of maternal mortality are still prevalent in many parts of the world. It is estimated that in 2015 99% (302,000) of maternal deaths were recorded in LMICs and just 1% in developed regions of the world (WHO, 2015). Given the seeming role for international development assistance in combatting this development challenge, it is important to assess the evidence of aid's efficacy in reducing maternal mortality. Thus, this study examines the effect of foreign aid on maternal mortality in LMICs using a two-way fixed effects panel regression over the period from 1996 through 2015.

2. Background

Evidence suggests that most LMICs were not able to meet the targets of the health-related MDGs of reducing the maternal mortality ratio (MMR) by 75% between 1990 and 2015 (WHO, 2015). Indeed, by 2015, the WHO reported an estimated decline in the global MMR of 45% in that period to 210 deaths per 100,0000 live births, far short of the 75% reduction goal. Following the MDGs, the SDGs set a target of lowering the MMR to 70 per 100,000 live births, as part of SDG 3's goal to 'Ensure healthy lives and promote wellbeing for all at all ages'. To this end, several donor countries have pledged to increase funding to the countries with the poorest health indicators with the aim of reducing maternal mortality levels in those countries (Proulx, Ruckert, & Labonté, 2017).

Previous foreign aid research has focused on economic development and poverty reduction, with mixed results. For example, Arndt, Jones, and Tarp (2015), Bornschier, Chase-Dunn, and Robinson (1978), and Hansen and Tarp (2001) all show that foreign aid has a positive impact on economic growth. In contrast, Annen and Kosempel (2009), Durbarry, Gemmel, and Greenaway (1998), and Easterly (2003) show that foreign aid has no impact on economic growth. Ekanayake,

Cookman, and Chatrna's (2010) study on the effect of foreign aid in developing countries also shows that there is no impact. Given the complex relationship between health and development, there is an interest in exploring how investments in people's overall health in a country contribute to its economic development. It is argued that if the productive workforce is healthy, they can work meaningfully towards higher productivity, which translates into higher economic growth and development.

While these studies provide important empirical evidence on the effect of foreign aid on development outcomes, few studies to date have examined the impact of foreign aid on health outcomes such as mortality (Kotsadam, Østby, Rustad, Tollefsen, & Urdal, 2018). Early studies point to a harmful effect of aid on mortality and health outcomes, specifically in the case where aid increases the indebtedness of recipient countries (Bradshaw, Noonan, Gash, & Sershen 1993; Sell and Kunitz 1986). Shen and Williamson (1999) find that greater indebtedness—in some cases aid-related—indirectly increases maternal mortality, but conclude their study with a rallying call to donors, arguing: 'It is likely that even a modest increase in aid could substantially improve maternal mortality rates if it were spent on improving the access of poor women to health services' (p. 211).

More recent studies on the impact of foreign aid on mortality have focused on infant or child mortality (Burguet & Soto, 2012; Kotsadam et al. 2018; Mishra & Newhouse, 2009; Pandolfelli, Shandra, & Tyagi, 2014; Winkleman & Adams, 2017). Like the economic literature, empirical evidence suggests that the effects of foreign aid on mortality are inconclusive. Many studies highlight the inefficacy or negative effects of aid. For example, Williamson (2008) finds that foreign aid is ineffective in improving overall health. Likewise, Pandolfelli et al. (2014) find that IMF loans and structural adjustment contribute to higher maternal mortality in Sub-Saharan Africa. These deleterious effects of structural adjustment on child and maternal mortality are echoed by Thomson, Kentikelenis, and Stubbs (2017). Powell-Johnson, Borghi, Mueller, Patouillard, and Mills (2006) also find a positive relationship between mortality and Official Development Assistance (ODA). Other research is mixed: Mishra and Newhouse (2009) showed that total overall aid had no impact on infant mortality, while health aid reduced mortality levels. Still other studies find beneficial effects of aid on mortality rates: Kotsadam et al. (2018) show that aid programming reduces infant mortality for marginalized communities, while Yogo and Mallaye (2015) demonstrate that increased health aid is linked to significant decreases in child mortality.

While few studies have touched on aid's effect on maternal mortality, there has been a concerted effort to track aid spending in this area. Greco, Powell-Jackson, Borghi, and Mills (2008) tracked the flow of health-related aid from 2003 through 2006 and found that aid to maternal health did not always go to the most affected countries. This tracking was part of a series of *Lancet* articles which mapped ODA spending on maternal health but did not analyze its effects on maternal mortality (Arregoces et al., 2015; Grollman et. al, 2017; Hsu, Pitt, Greco, Berman, & Mills, 2012; Powell-Johnson et al., 2006). These studies provide a strong basis upon which to examine the effects of the flow of aid to maternal health.

Considering the significant international attention paid to the maternal mortality issue by the international community and donor agencies in recent years, the relative absence of empirical evidence linking aid and reduced mortality is surprising. This study aims to provide some of this evidence and examine the impact of several categories of foreign aid spending on maternal mortality over time. This evidence is important, not only to better understand the health effects of aid, but also to expand the growing literatures linking aid to gender equality outcomes (Grown, Addison, & Tarp, 2016; Pickbourn & Ndikumana, 2016; Tiessen, 2015).

3. Data and Methods

3.1. Data

Data for this study are drawn from the OECD Creditor Reporting System (CRS) database, the World Development Indicators (WDI) from the World Bank, the IHME database, and Grollman et al.'s (2017) ODA+ data set on aid to maternal health.

Our main sample consists of 130 LMICs that were eligible to receive the various categories of aid between 1996 and 2015. In total, the sample consists of 2,093 country-year observations over that period for which all data was available. Descriptive statistics for our sample are shown in Table 1.

The dependent variable in this study is Maternal Mortality Rate (MMR): the number of maternal deaths in a given period per 100,000 women of reproductive age during the same time period (WHO, 2015). We test the relationship between aid and MMR using two different data sources for the dependent variable. The MMR measure in our main analysis consists of MMR data from the WHO and data housed in the World Bank's WDI dataset. As a robustness check, we also repeat our analysis using MMR data from the IHME's 'Maternal Mortality Estimates and MDG 5 Attainment by Country 1990–2011' dataset (IHME, 2011). The WHO defines maternal death as 'the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes' (WHO, 2010, p. 156). The causes of maternal death according to the WHO can be direct or indirect. Direct causes are those resulting from complications of the pregnant state, from interventions, omissions, or incorrect treatment, or from a chain of events resulting from any of the above. Indirect causes are those not due to direct obstetric causes.

Not surprisingly, there is a close association between economic development in a country and its rates of maternal mortality. Figure 1 highlights this relationship for our sample countries in 2015, showing that wealthier countries are likely to have lower rates of mortality. Mean MMR in our sample is approximately 289 deaths per 100,000 women, while median MMR is approximately 148. MMR varies significantly across different geographic regions within our sample and over time. Figure 2 shows this variability, revealing that overall MMR has declined significantly over time, but remains high in certain regions.

Our main independent variables are the annual ODA flows for six categories of aid, in millions of constant 2011 US$. The source from the OECD is the net bilateral ODA commitments by the Development Assistance Committee (DAC) donors reported from the CRS. This study considers all forms of aid commitments allocated by the DAC donor countries. We consider the effects of six categories of bilateral aid: total aid, total health-related aid, total aid to population/reproduction policy and programming, reproductive health aid, family planning aid, and total aid to maternal and newborn health.[1] To account for variation in population size between countries, we convert these ODA data into per capita measures. Our analysis uses the log (base 2) of these measures to

[1] The first five categories correspond to the following DAC Sector Codes in the Creditor Reporting System: Total Aid (1000); Health Total (120 I. 2); Total Population and Reproductive Programming and Policy (total of 13000s); Reproductive Health Care (13020); and Family Planning (13030). The final category, total aid to maternal and newborn health, is drawn from the ODA+ dataset presented in Grollman et al. (2017).

account for skewness, meaning that the coefficients for each measure can be interpreted as the marginal effect of a doubling of that type of aid.

Our analysis also accounts for other variables that have an impact on maternal mortality, including GDP per capita, births attended by a skilled birth attendant, adolescent fertility rate, population using any method of contraception, and the total population. Each of these variables is drawn from the World Bank's WDI databank. To address missing values in this data we replaced missing data with the most recent year's non-missing data. These independent variables are explained below.

GDP per capita: There is a strong negative correlation between a country's level of national income and MMR (Bishai et al., 2016). This relationship has been shown to be robust over time and is evident in Figure 1. Mean GDP per capita in our sample is US$5,415. In our models, GDP per capita is measured in constant 2010 US$ and is logged to account for skewness.

Skilled birth attendant: According to a joint statement by the WHO, International Confederation of Midwives, and International Federation of Gynecology and Obstetrics in 1999, the term 'skilled attendant' refers to

> an accredited health professional – such as midwife, doctor or nurse – who has been educated and trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management or referral of complications in women and newborns. (WHO, 2004).

Traditional birth attendants, either trained or not, are excluded from this category of skilled health workers (WHO, 2004, cited in Nanda, Switlick, and Lule, 2005, p. 9). This measure reflects the percentage of births attended by skilled health personnel, with a mean of 72% of births in countries in our sample over time.

Adolescent fertility rate: The association between maternal mortality and the age at childbirth of mothers is well established in the literature (Conde-Agudelo, Belizan, & Lammers 2005; Nove, Mathews, Neal, & Camacho, 2014; WHO, 2012). In our models, adolescent fertility is measured by the rate of births per 1,000 women aged 15–19 years, and averages 72 births per 1,000 women in our sample.

Modern contraceptive use: We account for contraceptive use in our analysis using a measure of the percentage of women aged 15–49 using at least one modern form of birth control. In our models we use this measure to serve as a proxy measure of reproductive health services and women's empowerment (WHO, 2011). The mean of modern birth control use in our sample is approximately 34%.

3.2. Analysis

We use a two-way fixed effects panel regression model with both year- and country-fixed effects to analyze the impact of foreign aid on maternal mortality. Including both fixed effects components in our models allows us to account for the influence of correlation within countries over time and the effect of global time trends on maternal mortality ratios and all other co-variates. As a result, our models help us predict the effect of aid on change in MMR within countries over time and control for all time-invariant characteristics of a given country. We lag all of our independent measures one year behind the dependent variable to allow for a temporal gap in which

the effects of aid might take hold.[2] For example, in our analysis we predict the effects of all independent measures in 2000 on MMR in 2001, or the effects of independent variables in 1996 on MMR in 1997. Finally, we run separate sets of nested models for each of the four aid measures because they are too highly correlated to provide meaningful results if included in a single model.

3.3. Robustness Checks

We also conducted a set of robustness checks (see Appendix, Table A1) using: (1) instrumental variable models; (2) five different lag periods for our independent variables; and (3) the alternative measure of MMR from the IHME. Our first robustness check was to reanalyze our data using an instrumental variable approach. Because foreign aid levels are likely to be correlated with measures of development and the other independent variables in our model, we control for endogeneity by using a two-stage approach in our robustness models. In the first-stage regression, the instrumented aid measure is regressed on the other independent variables and as well as a set of instruments: three different lagged aid flow measures, recipient country population, and whether a recipient country was colonized. The results of these checks broadly support our main analysis, with minor differences we discuss below.

Our second robustness check tested the effect of different lag periods between our dependent and independent variables (see Appendix, Table A2). These results are consistent with our main analysis, but with a longer lag period, the predicted effects of family planning aid no longer attain p-values below the commonly accepted 0.5 threshold.

Our final robustness check was to repeat our analysis using the alternative MMR measure discussed earlier (see Appendix, Table A3). These results closely echo our main analysis but, as in the case of Table A1, there are some minor differences of note.

4. Results

We ran a series of nested models for each aid measure, but in Table 2 we present only the full models for each for the sake of parsimony. Each model includes one of our aid measures, as well as the controls for country-level characteristics. Each of the aid measures is negatively associated with maternal mortality rates, but in the case of the Total Aid measure we fail to reject the null hypothesis. The results represent the effect of a doubling of a given type of aid. The strongest effects are seen in total maternal and newborn health aid (from the ODA+ source) and in ODA committed under the reproductive health category, where a doubling predicts a more than 33 death reduction and 26 death reduction in MMR, respectively. These marginal effects are shown in Figure 3, and indicate that, apart from total aid's non-significant relationship to MMR, the most modest effect on MMR is for total health aid. Increases in family planning aid and total population/reproductive policy aid also predict reduced MMR.

Our controls for country and society characteristics are all correlated with maternal mortality rates at the $p<0.001$ level. A doubling of GDP per capita predicts the sharpest reduction in MMR in all models, while more modest reductions in MMR are associated with increased rates of birth attendance by skilled health professionals and contraceptive prevalence. In contrast, adolescent fertility rates are associated with increases in MMR in all models. The results of these controls

[2] We also tested 2-, 3-, 4-, and 5-year lags and the results were comparable except in the case of one aid measure. Due to the nature of our dataset, the one-year lag maximizes our sample size.

show that countries with growing economies, improving health systems, more readily available contraception, and decreasing teen birth rates all stand to see reductions in their national MMR over time.

When comparing our main results with those in our robustness checks included in the Appendix, we note two differences worth discussing. First, with the change in sample introduced via the instruments in the instrumental variable analysis (Table A1), via the longer lag period (Table A2), or via the use of the IHME MMR data, which is restricted to the 1996–2011 period, the robustness of our estimate for the effect of family planning-related aid on MMR is challenged. In each of the robustness check models, we see that the family planning aid parameters no longer allow us to reject the null hypothesis. The second difference, seen in Tables A1 and A3, is that with the shorter timeframe and alternate specifications, the total effect of aid on MMR does meet the $p<0.05$ level in our robustness checks, suggesting that overall aid is correlated with reductions in MMR.

5. Discussion

Our findings show clearly that aid—depending on the sector in which it is spent—has the potential to help reduce maternal mortality. As Figure 3 highlights, the effects of reproductive health-focused aid or aid targeted specifically at maternal health are stronger than those of total aid or total health aid. Given the narrowed focus of reproductive health-focused aid, it is not unexpected that it might reduce maternal mortality more directly. If, for instance, reproductive health aid is specifically channeled to the promotion of prenatal and postnatal care including deliveries (which are crucial elements in the reduction of maternal mortality), an increase in reproductive health aid will have a greater likelihood of diminishing maternal mortality rates.

With an equally narrow focus as reproductive health-related aid, what might explain the counterintuitive finding we see in the mixed effects of family planning-focused aid between our main analysis and the robustness checks? Comparing the relationship between reproductive health aid and family planning aid in Figure 4 reveals relatively low correlation between the two types of aid (Pearson's R of 0.28 in our sample). This suggests that the countries receiving significant amounts of reproductive health aid are not necessarily also in receipt of family planning aid and vice versa. Likewise, the bivariate relationship of family planning aid to each of adolescent fertility, birth control, and MMR reveals very low levels of correlation: <0.1 in each case. This implies that, regardless of the intent of family planning-related aid to make contraceptives more widely available, these programs are not necessarily associated with reducing MMR either directly or indirectly through reduced fertility or contraceptive use. Cleland et al. (2006) suggest that uneven and at times inconsistent uptake of the most effective contraceptive methods, erosion of donor and government support for family planning, and the reallocation of funds towards HIV/AIDS programming are all factors in the reduced efficacy of family planning programs in recent years. Given these challenges, it is perhaps not surprising that our results reveal an association with family planning aid that is inconsistent. If family planning programs are increasingly limited, have less political support, and are being sidetracked by resources reallocated to other priorities, it is not unimaginable that they might not reduce maternal mortality.

In contrast to the narrower focus of reproductive health aid and aid to maternal health, our main analysis shows that total aid has no statistically significant effect on maternal mortality once other factors are controlled for. This may be due to the fact that the entirety of a country's ODA is expansive, and the amount allocated for maternal health is marginal. This is clear in our sample, where the mean level of total aid was US$68.66 per capita, while mean aid focused on reproductive health amounted to slightly less than half a percent of that amount at US$0.34 per capita. It is not

surprising, then, that total aid might not contribute directly to reductions in maternal mortality. Indeed, as has been indicated in much research, maternal mortality rates tend not to influence the amount of aid that is allocated to the health sector, whereas, in the case of HIV/AIDS, prevalence rates are closely linked to the amount of foreign funding for HIV/AIDS programs (Shiffman, 2006; Youde, 2010). To be sure, because the global HIV epidemic is perceived by donors as a threat to their own citizens, significantly more resources have been committed to reduce HIV prevalence rates (Shiffman, 2006). A report from the OECD indicates that between 2006 and 2007, 39% of health-related aid was allocated to HIV/AIDs programs, compared with 13% to the reproductive health sector (OECD, 2008). Maternal mortality may have seized the attention of the international aid community, but it is clear that, even with efforts like the Muskoka Initiative and the Sustainable Development Goals, funding perhaps does not yet match the development challenges posed by maternal mortality.

Our other results are in keeping with what is known about maternal mortality. Each factor shows the type of association with MMR that we would expect to see based on the research literature on maternal mortality. In our main analysis, higher rates of adolescent fertility are associated with higher rates of maternal death. Likewise, our findings show that increasing access to modern methods of contraception reduces maternal mortality. The results of this study are consistent with the Ahmed, Li, Liu, and Tsui (2012) study, which found that increased access to contraception in countries with low prevalence of contraceptive use averted 272,040 maternal deaths. This is because people can make choices regarding their reproductive health issues and will also avoid unintended pregnancies and be able to space the number of children they do have. Women with high parity are likely to have a higher MMR than women who have timed and spaced their children. In addition, contraceptives lower the risk of unwanted and unintended pregnancies, which often lead to abortion, considered to be the leading cause of maternal mortality in most developed countries (Haddad & Nour, 2009; Okonofua, 2006; Rosmans & Graham, 2006). Despite our potentially contradictory finding regarding the impact of family planning-related aid funds, the effects of birth control use suggest that it may well remain important to ensure that donor assistance is channeled towards the provision of contraceptives, as it is a substantial and effective strategy of reducing maternal mortality in developing countries. Cleland et al.'s (2006) argument that family planning should receive more international priority within the context of the SDG post-2015 might be worth heeding in this case.

6. Conclusion

Since total aid is overly broad, there is insufficient evidence to suggest that overall ODA levels lead to a reduction in maternal mortality. However, once aid is targeted at the health sector generally, and at reproductive health, population programming, and maternal health more specifically, there is likely to be accelerated progress towards the achievement of the SDG target for maternal mortality. Still, despite increased efforts under Muskoka, there is a need to increase resources not only to the health sector but in a more targeted way towards maternal health. Our results show that, despite the potential inefficacy of family planning-focused aid programs, access to contraceptives has a significant effect on the reduction of maternal mortality. It would, therefore, be important to channel more donor assistance to the promotion of contraceptive use among women, as it serves as a tool to empower them and to take decisions that influence their reproductive behavior.

One limitation of this study was that it only analyzed bilateral ODA from the DAC donors and did not capture multilateral aid or aid from other non-traditional donors such as the WHO, NGOs, private foundations, and businesses. By tracking the amount committed from these other donors,

a clearer picture of the effects of donor assistance on maternal mortality might emerge. Future research should track the amount of resources from the other donors not reported by the DAC so that the true effect of foreign assistance on maternal health could be established. Research is also needed to compare how aid from DAC donors and emerging donors has different impacts on maternal mortality.

A second limitation of this study is that its cross-country analysis of donor funding to a large sample of countries may not accurately reflect the local context in all countries. A possible extension of this study could focus on individual countries and the amount of donor assistance each receives, with attention paid to what services, expertise, and reforms aid money is actually funding. Likewise, multilevel models studying the maternal health outcomes of individuals nested in national contexts could deepen our understanding of the effects of aid. A detailed case study of an individual country is necessary in order to establish a more nuanced picture of the effect of foreign aid on maternal mortality. Donor decisions on the level of maternal health assistance provided, the nature of those programs, and how they are implemented in individual countries likely vary widely, and it would be important to treat each country as a unique case.

The results of this study should be interpreted with caution since the data on the DAC reporting system broken down at the sector level record commitments from the donor community rather than actual disbursements, and actual aid flows to each country might depart significantly from what donors committed. Still, given these data limitations, our study is one of the first to clarify the relationship between aid and maternal mortality over time, and makes a contribution to both the research literature on maternal mortality specifically, and to the literature on the effects of aid more generally.

The Muskoka Initiative in 2010 drew significant donor attention to the issue of maternal mortality and encouraged an intensification of efforts towards supporting recipient countries in achieving MDG 5 and reducing the burden of maternal mortality. These efforts now continue under the SDG framework. Our results suggest that this international agenda-setting exercise is not without merit. Foreign aid narrowly focused on issues of reproductive and maternal health is strongly associated with declining maternal mortality. As the implementation of the post-2015 agenda continues to unfold, these results suggest that the international community would do well to continue to invest its development assistance resources in ongoing efforts to counter maternal mortality wherever it remains a significant threat to women's lives.

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Table 1. Sample descriptive statistics, 130 countries, 1996–2015.

	Min	Mean	Median	Max.	SD	N	Source
Dependent variable							
Maternal mortality ratio (MMR)—primary analysis	4.00	289.32	148.00	2,650.00	321.69	2,093	WDI
Maternal mortality ratio (MMR)—robustness analysis	6.80	294.00	113.50	2592.50	335.29	1,709	IHME
Aid measures (per capita)							
Total aid (constant 2011 US$)	0.00	68.66	39.95	1,257.09	98.73	2,093	OECD CRS
Total aid to health (constant 2011 US$)	0.00	4.14	1.57	170.19	8.94	2,093	OECD CRS
Total population/reproductive policy and programming (constant 2011 US$)	0.00	2.87	0.80	133.76	7.56	2,093	OECD CRS
Aid to reproductive health (constant 2011 US$)	0.00	0.34	0.09	11.83	0.76	2,093	OECD CRS
Aid to family planning (constant 2011 US$)	0.00	0.16	0.00	5.75	0.41	2,093	OECD CRS
Total maternal and newborn health aid (constant 2013 US$)	0.00	0.57	0.09	12.36	1.10	2,093	Grollman et al. 2017
Controls							
GDP per capita (constant 2010 US$)	186.66	5,414.95	2,357.40	72,670.96	9,666.15	2,093	WDI
Births attended by skilled health personnel, percentage	5.60	72.28	81.00	100.00	27.06	2,093	WDI
Adolescent fertility rate (births per 1,000 women aged 15–19)	3.82	72.17	63.98	218.77	47.62	2,093	WDI
Contraceptive prevalence, modern methods (percent of women aged 15–49)	1.20	35.76	34.50	86.20	20.92	2,093	WDI

Source: Authors' construction.

Table 2. Two-way fixed effects panel regression of maternal mortality on total foreign aid, 1996–2015.

	(1)	(2)	(3)	(4)	(5)	(6)
Aid measures (logged)						
Total aid	-1.34					
Total aid to health		-7.12***				
Aid to reproductive health			-26.07***			
Aid to family planning				-13.10*		
Total aid to population/reproductive policy and programming					-16.41***	
Total maternal and newborn health aid (ODA plus dataset)						-33.46***
Controls						
Logged GDP per capita (constant 2010 US$)	-42.31***	-42.83***	-44.84***	-41.72***	-43.74***	-47.16***
Births attended by skilled health personnel, percentage	-1.06***	-1.08***	-0.93***	-1.04***	-1.10***	-1.03***
Adolescent fertility rate (births per 1,000 women aged 15–19)	3.66***	3.63***	3.53***	3.59***	3.44***	3.41***
Contraceptive prevalence, modern methods (percent of women aged 15–49)	-1.89***	-1.86***	-1.83***	-1.89***	-1.55***	-1.77***
Constant	649.76***	661.10***	679.78***	644.47***	683.94***	716.45***
Observations	2,093	2,093	2,093	2,093	2093	2,093
Countries	130	130	130	130	130	130
R-Squared	0.70	0.70	0.69	0.70	0.69	0.70
Country FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors' construction.

Figure 1. Relationship of sample country GDP per capita and maternal mortality, 2015.

Source: Authors' construction.

Figure 2. Mean maternal mortality ratio by region, 1995–2015.

Source: Authors' construction.

Figure 3. Marginal effect of logged aid on maternal mortality with 95% confidence intervals.

Source: Authors' construction.

Figure 4. Scatterplot of per capita family planning vs. reproductive health-related aid, sample countries 1996–2014.

Source: Authors' construction.

Appendix

Table A1. Instrumental variable two-stage fixed effects regression of maternal mortality on total foreign aid, 1996–2010.

	(1)	(2)	(3)	(4)	(5)	(6)
Aid measures (logged)						
Total aid	-12.16**					
Total aid to health		-97.24**				
Aid to reproductive health			-68.20**			
Aid to family planning				-3.28		
Total aid to population/reproductive policy and programming					-39.20***	
Total maternal and newborn health aid (ODA plus dataset)						-46.58***
Observations	1,476	1,476	1,476	1,476	1,476	1,476
Countries	126	126	126	126	126	126
R-Squared	0.42	0.81	0.39	0.44	0.38	0.46
Controls	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
Sargan-Hansen test	2.57	1.58	1.60	2.30	8.02	8.78
Sargan-Hansen p-value	0.46	0.66	0.66	0.51	0.05	0.03

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors' construction.

Table A2. Two-way fixed effects panel regression of maternal mortality on total foreign aid, different lags of independent variables.

	(1) 1-year lag	(2) 2-year lag	(3) 3-year lag	(4) 4-year lag	(5) 5-year lag
Aid measures (logged)					
Total aid	-1.34	-1.85	-1.85	-1.83	-1.57
Total aid to health	-7.12***	-5.37***	-5.52***	-5.59***	-4.65***
Aid to reproductive health	-26.07***	-23.78***	-21.58***	-17.42***	-17.10***
Aid to family planning	-13.10*	-9.76*	-2.82	-0.24	3.12
Total aid to population/reproductive policy and programming	-16.41***	-16.72***	-16.25***	-15.44***	-14.90***
Total maternal and newborn health aid (ODA plus dataset)	-33.46***	-38.67***	-35.04***	-30.73***	-26.81***
Observations	2,093	1,965	1,837	1,709	1,582
Countries	130	130	130	128	127
Controls	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors' construction.

Table A3. Two-way fixed effects panel regression of maternal mortality on total foreign aid, 1996–2011 (IHME MMR Measure).

	(1)	(2)	(3)	(4)	(5)	(6)
Aid measures (logged)						
Total aid	-13.79***					
Total aid to health		-13.64***				
Aid to reproductive health			-28.30***			
Aid to family planning				3.33		
Total aid to population/reproductive policy and programming					-45.16***	
Total maternal and newborn health aid (ODA plus dataset)						-23.18**
Controls						
Logged GDP per capita (constant 2010 US$)	41.74**	39.23**	39.05**	39.47**	40.01**	36.12**
Births attended by skilled health personnel, percentage	0.02	-0.09	0.17	0.05	-0.09	0.06
Adolescent fertility rate (births per 1,000 women aged 15–19)	0.79	0.75	0.52	0.69	-0.10	0.42
Contraceptive prevalence, modern methods (percent of women aged 15–49)	-4.88***	-5.02***	-4.96***	-5.15***	-3.91***	-5.01***
Constant	52.25	48.72	43.57	29.44	100.65	88.75
Observations	1,582	1,582	1,582	1,582	1,582	1,582
Countries	127	127	127	127	127	127
R-Squared	0.06	0.11	0.07	0.11	0.02	0.08
Country FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes

* p<0.05, ** p<0.01, *** p<0.001

Source: Authors' construction.