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## Maternal Mortality, Religion and the Enrolment of Girls and Boys: Is there a Link?

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## **Abstract**

We investigate empirically the impact of maternal mortality on the enrolment rate of girls and boys at the primary and secondary levels. We also examine whether the effect of maternal mortality on enrolment is strengthened or weakened by religion. Evidence shows that at both the primary and secondary levels, maternal mortality has a negative impact on the enrolment of girls and boys, with the negative greater for girls than for boys. For girls, the negative effect of maternal mortality is compounded by religion and increased fertility.

## **Keywords**

Maternal mortality, enrolment of girls, enrolment of boys, religion.

## **JEL Codes**

J16, I25, O15.

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## 1. Introduction

This study investigates the impact of maternal mortality on the educational attainment of boys and girls<sup>1</sup>. The literature shows that a mother's health has important implications not only for her children, but through her children on the future level of economic growth (e.g. King, Klasen, and Porter, 2009). In 2008, an estimated 358,000 maternal deaths took place worldwide. Developing countries accounted for 99% (335,000) of which Sub-Saharan Africa and South Asia accounted for 87% (313,000) of total deaths (WHO, UNICEF, UNICFPA, World Bank 2010). As a result, the fifth Millennium Development Goal (MDG) has been to improve maternal health with the target of reducing the maternal mortality rate (MMR) by 75% between 1990 and 2015.

The impacts of maternal mortality are severe. Many children are left motherless each year. Micro studies suggest that maternal deaths reduce educational outcomes. Educating girls has been shown to be an important foundation for creating the next generation of human capital as mothers are seen as crucial in determining the education and health of their children (Schultz 2002). Thus an increase in the MMR can have a number of detrimental effects such as increase in number of child deaths adversely affect the education and health levels of the next generation. The effect of a mother's death on enrolment has been investigated at the microeconomic level, and generally found substantial effects. Studies include those by Ainsworth et al. (2005) for Tanzania; Chen et al. (2009) for Taiwan; Gertler et al. (2004) for Indonesia; Jayachandran and Lleras-Muney (2009) for Sri Lanka; Case and Ardington (2006) South Africa; Lang and Zagorsky (2001) the US. Ainsworth et al (2005) show that the mortality of parents could reduce children's primary schooling by constraining a households' ability to pay fees, and leaving orphaned children with guardians who are less concerned with the education of a child than their parents. Jayachandran and Lleras-Muney (2009) investigating whether girls' education relative to boys' increase by more in areas with greater falls in maternal mortality, find that for every extra year of life expectancy, literacy increases by 2% and years of education increase by 3%. Chen et al. (2009) find evidence of a much stronger effect of maternal death on child education compared to paternal death. Similarly, Case and Ardington (2006) that the loss of a mother is a strong forecaster of poor schooling outcomes for a child, with a lower probability for maternal orphans to be enrolled in school and greater likelihood to have completed fewer years of schooling Lang and Zagorsky (2001) on the contrary, find little evidence that a parent's presence in childhood adversely affects economic well being in adulthood.

At the same time, there is a surprising lack of empirical work conducted at the *macroeconomic* level on the effect of maternal mortality on child education. Studies conducted at the microeconomic level do not directly address the issue of how maternal mortality explains differences in child education across countries which is a gap this study attempts to address; in addition, micro studies focus on the impact of maternal mortality on education within the same household; maternal mortality may have external effects, however, that affect the educational attainment of people outside of the individual households. Such external effects can be captured in macro studies. Identifying these factors at the macroeconomic level are important for the implementation of policy.

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<sup>1</sup> 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 the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" (WHO, UNICEF, UNICFPA, World Bank 2010).

At one level, a high maternal mortality is related to a poor overall health situation in a country; this can be seen in a rather close correlation between the child and the maternal mortality rates (Klasen and Vollmer, 2012). A number of factors can weaken or strengthen the effect of maternal mortality on the enrolment of boys and girls. Caldwell (2000) argues that cultural norms limiting women's autonomy when reinforced by religious beliefs can have adverse effects on female health. According to Caldwell (2000), cultural and religious beliefs can act to limit the health effectiveness of education in certain societies which could explain the relatively higher mortality rates in some societies compared to income. Levine et al. (2009) argue that poverty and religious and cultural norms, force girls into marrying at a young age leaving them susceptible to HIV, among other illnesses. Similarly, cultural factors can restrain women's mobility preventing them from receiving proper health care during pregnancy (Kabeer 2005). Bloom et al (2001), in a study of India show that increased women's autonomy can lead to greater use of maternal healthcare facilities. This in turn would lead to better health outcomes and therefore education levels of a population. Cooray and Potrafke (2011) in an investigation of the influence of political institutions on gender in/equality in education show that religion has a greater influence on gender in/equality in education than political institutions. Therefore religious factors can influence the effect of maternal mortality on enrolment.

Consequently the purpose of this study is to: (1) investigate the degree to which maternal mortality impacts upon the education levels of girls and boys as measured by enrolment ratios; (2) examine how religion increases or decreases the impact of maternal mortality on the enrolment rate of girls and boys. While a number of factors can increase or decrease the effects of maternal mortality on the enrolment rate of girls and boys, this study focuses specifically on religion. Identifying these factors can have important policy implications for promoting gender equality in education.

The estimation is carried out for girls and boys simultaneously within a SUR panel regression framework controlling for country fixed effects. Results are tested for robustness in a number of ways: additional control variables to capture a range of possible influences on maternal health, several interaction terms, testing the model exclusively for countries exhibiting a high maternal mortality rate, fixed effects estimation to account for country level time invariant unobservable influences on enrolment, and the use of instrumental variable (IV) estimation to correct for any potential endogeneity. Given the uncertainty and likely measurement error in maternal mortality rates, we also examine the robustness of our results to the use of two different data sets on maternal mortality, the World Development Indicators (WDI) data and the data set on maternal mortality recently compiled by Hogan et al. (2010).

The rest of this study is organised as follows. Section 2 states the hypothesis. Section 3 presents the data. Section 4 discusses the empirical results and Section 5 concludes.

## **2. The Hypotheses**

While a number of factors such as income, government expenditure on education and health related variables can influence the enrolment ratio of children, maternal mortality is hypothesised to have a significant negative impact upon the schooling outcomes of a child. This may be further compounded by cultural and religious beliefs in certain societies. According to WHO (2012), among the factors that prevent women from receiving care during pregnancy are poverty, distance, lack of information, lack of services and cultural practices. Studies so far, have generally focused on the effect of maternal

orphanhood on education. Colclough et al. (2000) show that in the absence of a mother, girls could be withdrawn from school to help with household chores or be given in marriage at an early age, and boys may have to help with work on family farms. Gertler et al. (2004) argue that the death of a parent is a traumatic experience, and hence can directly reduce enrolment ratios due to the lack of incentive to stay on in school. If maternal deaths take place due to greater poverty, then children faced with maternal deaths may face greater deprivation from birth which can lead to a fall in enrolment (Case et al. 2004). Similarly, the death of a mother at birth, can adversely affect the schooling outcomes of a child due to greater pressure placed upon a child to do household and other chores that might usually have been undertaken by a mother. Or alternatively, the transmission of illness from mother to child, for example HIV prevalence, can adversely affect a child's health and consequently education. Thus the channels through which maternal mortality can affect a child's schooling outcomes are likely to be similar to maternal orphanhood.

Maternal mortality can also have differential effects on girls and boys. Girls may have to disproportionately bear a larger share of the negative shock due in the absence of a mother if boys are expected to take care of parents in old age, or if sons have a higher return to education. Furthermore, parents may have a preference for the higher education of their sons rather than their daughters, due to cultural norms and traditional practices (Gertler et al. 2004). According to Gertler et al. a survey of village experts in traditional law in Indonesia found that approximately 50% of villagers had the custom of giving their sons preference in education over their daughters. Mothers may have a preference for educating daughters than do fathers (Alderman and King 1998). This could particularly be the case, if mothers are more interested in pursuing the education of their daughters than fathers (Thomas 1990). Maternal mortality could therefore, adversely affect the education of a girl to a greater extent than that of a boy. Lillard and Willis (1994) show that in Malaysia while both the education of a father and mother have a positive significant effect on the education of their children, the education of a mother has a much larger effect on a daughter than on a son. Similarly, Lang and Zagorsky (2001) find that living without a mother affects girls' cognitive performance. Thus maternal death can have a larger negative impact on the enrolment ratio of girls. While some studies show that the death of a mother/parent has a larger negative impact on daughters than sons (Ainsworth et al. 2005 for Tanzania), others show that there are no differential effects (Case et al. for Africa 2004).

While our study is closely related to the literature on maternal orphanhood, the point of departure of the present study lies in the investigation of the impact of maternal mortality on education outcomes. Studies further suggest that cultural factors play a role in influencing health and education outcomes. Schultz (2002) discusses a number of cultural reasons such as arrangements of marriage, intergenerational support systems and women being confined to working at home which can limit the enrolment of girls compared to boys. LeVine (1987) and LeVine et al. (1991) highlight the complexity of the relationship between education and health, and the numerous channels through which education influences health outcomes, including patterns of marriage, relationship between mother and child, and knowledge. Investigating reasons for differential maternal health care in Morocco and Tunisia, Obermeyer (1993) observes that cultural factors should be taken into account as they influence beliefs concerning reproduction, risk, and views on how to prevent adverse outcomes. Similarly, Caldwell (1979) highlights the importance of women's education for use of health services. Caldwell (2000) shows that cultural and religious beliefs can act to limit the health effectiveness of education in certain societies which could explain the relatively higher mortality rates in some societies compared to income. Norton and Tomal

(2009) show that religion influences gender equality in education with the proportion of Hindu and Muslim adherents in a country having a negative influence on female educational attainment. Accordingly, religion and other aspects of culture could act to weaken or strengthen the effect of maternal mortality on enrolment.

Thus with the objective of gaining a better understanding of the influence of maternal mortality on the enrolment ratio of girls and boys, this study tests the hypotheses that:

- 1) Maternal mortality influences the enrolment ratio of girls and boys.
- 2) Maternal mortality influences the enrolment of girls and boys through its interaction with religion.

### 3. Data

Panel data covering the 1990-2012 period with observations corresponding to five year intervals and 2008 and 2012, for 144 countries are used in the empirical analysis<sup>2</sup>. The high income OECD countries are excluded from the empirical analysis because in these countries compulsory education and welfare policies secure enrolment even if one's mother has died. The primary and secondary enrolment rates for girls and boys are the dependent variables and this data are sourced from the World Development Indicators (WDI). The choice of independent variables is severely restricted by the availability of data. For the main independent variable, maternal mortality, we use two alternative data sources, the WDI data, and data on maternal mortality compiled by Hogan et al. (2010)<sup>3</sup>. WDI data for maternal mortality are available for every fifth year, 1990, 1995, 2000, 2005, and 2008. The Hogan et al. (2010) data are available for the years 1980, 1990, 2000 and 2008. To ease comparability, we restrict the estimation using the Hogan et al data to the same sample of countries and years for which WDI data are available. Thus the estimation is repeated using the Hogan et al. data on maternal mortality for the years 1990, 2000 and 2008<sup>4</sup>. Given that there would be a time lag between maternal mortality and its influence on schooling outcomes, the current values of enrolment are regressed on maternal mortality rates lagged by four periods.

The other independent variable of interest is the interaction term between maternal mortality and religion. We measure religion in two ways: one, with dummy variables that take on the value one when a particular religion is dominant in a country. The effect of religion on enrolment is captured by four dummy variables for religion – Buddhist, Hindu, Islam and Indigenous, with Christianity as the base group. The data are drawn from the CIA World Factbook (2012). For robustness checks, we also employ data on the percentage of religion in each country by Alesina et al. (2003). In addition, we include several control variables. Higher income levels lead to better education and health outcomes, therefore the level of GDP per capita is used to capture the level of development of an economy. High enrolment ratios have been achieved in countries where governments are committed to the provision of education facilities, for example, Sri Lanka. Hence government expenditure on education is included as an explanatory variable.

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<sup>2</sup> Note that although the study covers 144 countries data for all variables for all countries are not available.

<sup>3</sup> Hogan et al. (2010) construct observations of maternal mortality for 181 countries for 1980, 1990, 2000 and 2008 using vital registration data, censuses, surveys, and verbal autopsy studies.

<sup>4</sup> See AbouZahr (2011) for a discussion of the limitations associated with measuring maternal mortality.  
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A low fertility rate affects female health and therefore education positively. High fertility rates have been shown to reduce enrolment (Klasen 2002). Therefore fertility is included as an additional control variable in the empirical analysis that follows<sup>5</sup>. Summary statistics for the data used in the model are presented in Table 1.

Table 1 Descriptive Statistics and Data Sources

| Variable  | Obs | Mean    | Standard Deviation | Minimum | Maximum   | Source                  |
|---|-----|---------|--------------------|---------|-----------|-------------------------|
| Per Capita Income (Constant 2000 \$US)            | 668 | 2607.07 | 4257.08            | 62.24   | 29,453.53 | WDI                     |
| Enrolment Rate Female Primary (Gross %)           | 528 | 93.52   | 24.25              | 19.42   | 152.02    | WDI                     |
| Enrolment Rate Male Primary (Gross %)             | 533 | 99.85   | 20.82              | 21.00   | 165.89    | WDI                     |
| Enrolment Rate Female Secondary (Gross %)         | 461 | 59.64   | 32.35              | 2.33    | 123.52    | WDI                     |
| Enrolment Rate Male Secondary (Gross %)           | 457 | 59.60   | 27.78              | 5.21    | 108.54    | WDI                     |
| Maternal Mortality Rate (per 100,000 live births) | 692 | 321.90  | 364.42             | 6       | 1800      | WDI                     |
| Maternal Mortality Rate (per 100,000 live births) | 414 | 322.51  | 363.02             | 6       | 1800      | Hogan et al.            |
| Government Expenditure on Education (% of GDP)    | 568 | 4.37    | 2.37               | 1.34    | 16.89     | WDI                     |
| Fertility Rate (births per woman)                 | 576 | 3.87    | 1.71               | 1.1     | 8.0       | WDI                     |
| Christian   | 432 | 0.61    | 0.49               | 0       | 1         | CIA World Factbook 2012 |
| Buddhist  | 432 | 0.07    | 0.25               | 0       | 1         | CIA World Factbook 2012 |
| Hindu   | 432 | 0.03    | 0.18               | 0       | 1         | CIA World Factbook 2012 |
| Islam   | 432 | 0.33    | 0.47               | 0       | 1         | CIA World Factbook 2012 |
| Indigenous  | 432 | 0.01    | 0.12               | 0       | 1         | CIA World Factbook 2012 |

Note: WDI = World Development Indicators

<sup>5</sup> There is a literature which shows that female adults with HIV can increase maternal mortality. Data are available only for the percentage of HIV positive population 15+ that are female and therefore cannot be used as a measure of HIV prevalence.

## Empirical Strategy

The majority of empirical studies have estimated the enrolment rate for girls and boys separately. This study employs a seemingly unrelated regression analysis with error components to simultaneously estimate the enrolment of girls and boys. This permits more efficient estimates compared to using OLS to estimate the equations separately. The panel SUR has the advantage of correcting for heteroscedasticity related to the period and also for correlation within cross sections.

The panel data model takes the following form:

$$E_{it} = \gamma M_{it-4} + \beta x_{it} + a\mu_i + \eta_t + \upsilon_{it} \quad (2)$$

where  $E_{it}$  is the enrolment ratio for girls and boys for country  $i$  in period  $t$ .  $M_{it-4}$  is the maternal mortality rate for country  $i$  in period  $t-4$ . All other control variables mentioned above including the interaction term between maternal mortality and religion are captured by the vector  $x_{it}$ .  $\mu_i$  represents a set of region dummy variables.  $\eta_t$  is a fixed time effect. The random error term  $\upsilon_{it}$  is the sum of a country error component shared by all in country  $i$ , and an error component which is unique to girls and boys in country  $i$ . The variables have been converted into logarithmic form for the empirical estimation.

We also use instrumental variable estimation to address potential endogeneity concerns. The validity of IV estimates, depends on having a variable correlated with maternal mortality but having no direct role on schooling. This eliminates the problem arising from the probability of simultaneous determination of enrolment and maternal mortality. We instrument maternal mortality with infant mortality. We believe that the choice of infant mortality is a good candidate from this perspective, as infant mortality is strongly correlated with maternal mortality, but has no strong correlation with schooling.

Fixed effects estimation is also carried out to account for country level time invariant unobservable influences on enrolment.

## 4. Empirical Results

A first set of estimations is carried out by regressing the maternal mortality rate on the primary and secondary enrolment rates columns (1)-(2) and (5)-(6) in Table 2.

The religion dummy variables interacted with the maternal mortality rate are added in columns (3)-(4) and (7)-(8). Panel A of Table 2 reports estimation results using the WDI maternal mortality rate and Panel B, the Hogan et al. maternal mortality rate. Note that the results in panels A and B are similar. The maternal mortality rate has a negative effect on the enrolment rate of both boys and girls. The magnitude of the coefficients on maternal mortality are higher for girls than for boys suggesting that girls are more affected compared to boys by the death of a mother at both the primary and secondary levels. Columns (1) and (2) in both Panels A and B show that a 1% increase the maternal mortality rates leads to a 0.01% and 0.008% fall in the enrolment ratio of girls and boys respectively at the primary level. At the secondary level, a 1% increase in the maternal mortality rate leads to a 0.006% fall in the enrolment rate of girls and a 0.004% fall in the enrolment of boys in columns (5) and (6) respectively in Panel A, and a fall in 0.01 % for boys and girls in Panel B. The equations incorporating the interaction terms between maternal



mortality and the religion dummy variables indicate that all religions increase the negative effect of maternal mortality on enrolment at the secondary level. At the secondary level, the interaction terms between the maternal mortality rate and dummy variables on Buddhism, Islam and Indigenous religion are statistically significant for girls and boys and at the interaction term between the maternal mortality rate and Hinduism for girls. At the primary level, the interaction terms between maternal mortality and the dummy variables on Islam and Indigenous religions are statistically significant, suggesting that the negative effect of maternal mortality on enrolment is increased due to these religions.

Table 2: SUR Estimation

| Panel A                    | (1)                      | (2)                      | (3)                      | (4)                      | (5)                       | (6)                      | (7)                        | (8)                      |
|----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|---------------------------|--------------------------|----------------------------|--------------------------|
|                            | Girls                    | Boys                     | Girls                    | Boys                     | Girls                     | Boys                     | Girls                      | Boys                     |
| Independent Variables      | Primary Enrolment Ratio  |                          |                          |                          | Secondary Enrolment Ratio |                          |                            |                          |
| MMR: WDI                   |                          |                          |                          |                          |                           |                          |                            |                          |
| $MMR_{t-4}$                | -0.010<br>(0.004)**<br>* | -0.008<br>(0.004)**<br>* | -0.008<br>(0.003)**<br>* | -0.006<br>(0.002)**<br>* | -0.006<br>(0.002)**<br>*  | -0.004<br>(0.004)**<br>* | -0.008<br>(0.003)**<br>*   | -0.006<br>(0.002)**<br>* |
| $MMR_{t-4}$<br>*Buddhist   | -                        | -                        | 0.007<br>(0.005)         | 0.005<br>(0.005)         | -                         | -                        | -0.009<br>(0.004)**        | -0.008<br>(0.003)**      |
| $MMR_{t-4}$<br>*Hindu      | -                        | -                        | 0.005<br>(0.003)         | 0.004<br>(0.005)         | -                         | -                        | -0.006<br>(0.007)          | -0.006<br>(0.009)        |
| $MMR_{t-4}$<br>*Islam      | -                        | -                        | -0.009<br>(0.002)**<br>* | -0.007<br>(0.003)**<br>* | -                         | -                        | -0.014<br>(0.007)**        | 0.015<br>(0.007)**<br>*  |
| $MMR_{t-4}$<br>*Indigenous | -                        | -                        | -0.009<br>(0.004)*       | -0.007<br>(0.002)**<br>* | -                         | -                        | -0.009<br>(0.003)**<br>*   | -0.008<br>(0.003)**<br>* |
| R <sup>2</sup>             | 0.34                     | 0.18                     | 0.42                     | 0.27                     | 0.59                      | 0.62                     | 0.59                       | 0.63                     |
| Observations               | 513                      | 513                      | 513                      | 513                      | 444                       | 444                      | 444                        | 444                      |
| <b>Panel B</b>             |                          |                          |                          |                          |                           |                          |                            |                          |
| MMR: Hogan et al.          | (1)                      | (2)                      | (3)                      | (4)                      | (5)                       | (6)                      | (7)                        | (8)                      |
|                            | Girls                    | Boys                     | Girls                    | Boys                     | Girls                     | Boys                     | Girls                      | Boys                     |
|                            | Primary Enrolment Ratio  |                          |                          |                          | Secondary Enrolment Ratio |                          |                            |                          |
| $MMR_{t-4}$                | -0.012<br>(0.006)**      | -0.010<br>(0.004)**<br>* | -0.009<br>(0.003)**<br>* | -0.010<br>(0.004)**<br>* | -0.008<br>(0.003)**<br>*  | -0.006<br>(0.003)**      | -0.008<br>(0.003)**<br>*   | -0.006<br>(0.003)**      |
| $MMR_{t-4}$<br>*Buddhist   | -                        | -                        | -0.008<br>(0.006)        | 0.002<br>(0.003)         | -                         | -                        | -0.008<br>(0.002)**<br>*** | -0.007<br>(0.002)**<br>* |
| $MMR_{t-4}$<br>*Hindu      | -                        | -                        | -0.008<br>(0.005)        | 0.004<br>(0.002)*        | -                         | -                        | -0.011<br>(0.005)**        | -0.008<br>(0.009)        |
| $MMR_{t-4}$<br>*Islam      | -                        | -                        | -0.010<br>(0.002)**<br>* | -0.012<br>(0.006)**      | -                         | -                        | -0.009<br>(0.002)**<br>*   | 0.007<br>(0.003)**<br>*  |
| $MMR_{t-4}$<br>*Indigenous | -                        | -                        | -0.010<br>(0.005)*       | -0.009<br>(0.004)**      | -                         | -                        | -0.008<br>(0.003)**<br>*   | -0.008<br>(0.003)**<br>* |
| R <sup>2</sup>             | 0.36                     | 0.20                     | 0.44                     | 0.29                     | 0.59                      | 0.62                     | 0.59                       | 0.63                     |
| Observations               | 308                      | 308                      | 308                      | 308                      | 266                       | 266                      | 266                        | 266                      |

Table 3 estimates the model incorporating GDP per capita, the fertility rate, and government expenditure on education. Government expenditure on education has been found to increase enrolment and is hence interacted with the maternal mortality rate to observe whether the impact of mortality on enrolment is reduced due to increased government expenditure on education. The dependent variable is the primary enrolment ratio. Columns (1) –(4) report results using the WDI maternal mortality rate and columns (5) –

(8) results using the Hogan et al. maternal mortality rate. The results presented in columns (1) and (2) indicate that a 1% increase in the maternal mortality rate leads to a 0.007% decrease in the female enrolment rate and 0.006% decrease in the male enrolment rate. Results employing the Hogan et al. data reveal a 0.009% and 0.008% fall respectively. Note that the maternal mortality rate has a significant negative impact on both the enrolment rate of boys and girls, but a higher impact on girls. The fertility rate has a significant negative impact on the enrolment rate of girls. Government expenditure on education is positive and significant in columns (3) and (7) suggesting that an increase in government expenditure on education leads to an increase in the primary enrolment rate for girls and boys. The interaction of maternal mortality with government expenditure on education reduces the negative impact of maternal mortality on enrolment. The interaction terms between the dummy variables on Islam and Indigenous and maternal mortality are negative and statistically significant in all columns and Buddhist x maternal mortality and Hindu x maternal mortality for girls. This suggests that the negative effects of maternal mortality on the enrolment of girls are increased due to religion.

Table 3: SUR Estimation: Dependent Variable Primary Enrolment Ratio with Additional Control Variables and Interaction Terms

| Independent Variables                   | (1)<br>Girls             | (1)<br>Boys               | (3)<br>Girls             | (4)<br>Boys              | (5)<br>Girls                    | (6)<br>Boys              | (7)<br>Girls             | (8)<br>Boys              |
|---|--------------------------|---------------------------|--------------------------|--------------------------|---------------------------------|--------------------------|--------------------------|--------------------------|
|   | WDI Maternal Mortality   |                           |                          |                          | Hogan et al. Maternal Mortality |                          |                          |                          |
| GDP per Capita                          | 0.001<br>(0.0002)*<br>** | 0.0008<br>(0.0002)*<br>** | 0.001<br>(0.0002)*<br>** | 0.001<br>(0.0002)*<br>** | 0.001<br>(0.0003)*<br>**        | 0.001<br>(0.0003)*<br>** | 0.001<br>(0.0003)*<br>*  | 0.001<br>(0.001)         |
| $MMR_{t-4}$                             | -0.007<br>(0.002)**<br>* | -0.006<br>(0.002)**<br>*  | -0.006<br>(0.002)**<br>* | -0.005<br>(0.001)**<br>* | -0.009<br>(0.004)**<br>*        | -0.008<br>(0.003)**<br>* | -0.005<br>(0.001)**<br>* | -0.004<br>(0.002)**      |
| Govt. Expenditure on Education          | -                        | -                         | 0.394<br>(0.121)**<br>*  | 0.310<br>(0.539)         | -                               | -                        | 0.321<br>(0.084)**<br>*  | 0.321<br>(0.117)         |
| Fertility Rate                          | -0.224<br>(0.077)**      | -                         | -0.258<br>(0.170)*       | -                        | -0.255<br>(0.103)**<br>*        | -                        | -0.287<br>(0.100)**<br>* | -                        |
| $MMR_{t-4}$<br>*Govt. Exp. on Education | -                        | -                         | -0.003<br>(0.001)**<br>* | -0.001<br>(0.001)        | -                               | -                        | -0.003<br>(0.001)**<br>* | -0.003<br>(0.001)**<br>* |
| $MMR_{t-4}$<br>*Fertility Rate          | -0.256<br>(0.086)**<br>* | -                         | -0.265<br>(0.097)**<br>* | -                        | -0.267<br>(0.099)**<br>*        | -                        | -0.290<br>(0.102)**<br>* | -                        |
| $MMR_{t-4}$<br>*Buddhist                | -                        | -                         | -0.008<br>(0.004)*       | -0.004<br>(0.005)        | -                               | -                        | -0.006<br>(0.003)*       | -0.006<br>(0.006)        |
| $MMR_{t-4}$<br>*Hindu                   | -                        | -                         | -0.054<br>(0.021)**      | -0.031<br>(0.029)        | -                               | -                        | -0.008<br>(0.003)**<br>* | -0.020<br>(0.028)        |
| $MMR_{t-4}$<br>*Islam                   | -                        | -                         | -0.016<br>(0.006)**<br>* | -0.006<br>(0.004)*       | -                               | -                        | -0.010<br>(0.006)*       | -0.006<br>(0.003)*       |
| $MMR_{t-4}$<br>*Indigenous              | -                        | -                         | -0.010<br>(0.005)*       | -0.008<br>(0.003)**<br>* | -                               | -                        | -0.012<br>(0.006)**      | -0.006<br>(0.003)*       |
| R <sup>2</sup>                          | 0.71                     | 0.65                      | 0.75                     | 0.66                     | 0.69                            | 0.70                     | 0.78                     | 0.62                     |
| Observations                            | 347                      | 347                       | 233                      | 233                      | 177                             | 177                      | 126                      | 126                      |

Note: Standard errors reported in parenthesis. \*, \*\*, \*\*\* Significant at the 10%, 5% and 1% levels respectively.

### *Robustness Tests*

In order to address potential endogeneity concerns, the estimation is modified in a number of ways to ensure that the results are robust to the estimation method, to various control variables and the exclusion of certain countries. First, the estimation for girls and boys was carried out using panel SUR which permits taking into account the cross correlation between the error terms for the enrolment equations of girls and boys simultaneously.

The findings of the study could also be the result of an omitted variable bias but the results reported in Table 3 showed that inclusion of further covariates do not affect the results significantly.

In order to further address any endogeneity concerns and to establish that the effect of maternal mortality on child enrolment is a causal relationship, the estimation in Table 2 is replicated by instrumenting maternal mortality with infant mortality. This is chosen on the basis of Shea's (1997) partial  $R^2$ . The results for IV estimation are reported in Table 4. The results are broadly consistent with those obtained above in that the negative effect of maternal mortality on the enrolment of girls is higher than that for boys at both the primary and secondary levels and that the effect of maternal mortality on enrolment is increased by religion. The p values for the Hausman test suggests the absence of any statistically significant difference between the OLS and IV estimates and the Sargan suggests that the model is correctly specified and that the instruments are valid.

Table 4: IV Estimation

| <b>Panel A</b>             | (1)                     | (2)                  | (3)                  | (4)                      | (5)                       | (6)                  | (7)                     | (8)                  |
|----------------------------|-------------------------|----------------------|----------------------|--------------------------|---------------------------|----------------------|-------------------------|----------------------|
|                            | Girls                   | Boys                 | Girls                | Boys                     | Girls                     | Boys                 | Girls                   | Boys                 |
| Independent Variables      | Primary Enrolment Ratio |                      |                      |                          | Secondary Enrolment Ratio |                      |                         |                      |
| <b>MMR: WDI</b>            |                         |                      |                      |                          |                           |                      |                         |                      |
| $MMR_{t-4}$                | -0.010<br>(0.004)***    | -0.009<br>(0.004)*** | -0.012<br>(0.005)*** | -0.011<br>(0.004)***     | -0.009<br>(0.004)***      | -0.007<br>(0.003)*** | -0.009<br>(0.003)***    | -0.006<br>(0.003)**  |
| $MMR_{t-4}$<br>*Buddhist   | -                       | -                    | -0.007<br>(0.004)*   | -0.001<br>(0.012)        | -                         | -                    | -0.009<br>(0.004)<br>** | -0.010<br>(0.010)    |
| $MMR_{t-4}$<br>*Hindu      | -                       | -                    | -0.010<br>(0.005)*   | -0.009<br>(0.008)        | -                         | -                    | -0.010<br>(0.005)*      | -0.005<br>(0.020)    |
| $MMR_{t-4}$<br>*Islam      | -                       | -                    | -0.013<br>(0.005)*** | -0.013<br>(0.006)**<br>* | -                         | -                    | -0.010<br>(0.005)***    | 0.008<br>(0.004)**   |
| $MMR_{t-4}$<br>*Indigenous | -                       | -                    | -0.012<br>(0.006)*   | -0.112<br>(0.006)**      | -                         | -                    | -0.010<br>(0.005)**     | -0.008<br>(0.004)**  |
| R <sup>2</sup>             | 0.42                    | 0.25                 | 0.45                 | 0.31                     | 0.58                      | 0.60                 | 0.63                    | 0.61                 |
| p value: Hausman Test      | 0.21                    | 0.21                 | 0.20                 | 0.22                     | 0.29                      | 0.18                 | 0.30                    | 0.17                 |
| p value: Sargan Statistic  | 0.42                    | 0.30                 | 0.21                 | 0.38                     | 0.22                      | 0.29                 | 0.28                    | 0.19                 |
| Observations               | 513                     | 513                  | 513                  | 513                      | 444                       | 444                  | 444                     | 444                  |
| <b>Panel B</b>             |                         |                      |                      |                          |                           |                      |                         |                      |
| MMR Hogan et al.           | (1)                     | (2)                  | (3)                  | (4)                      | (5)                       | (6)                  | (7)                     | (8)                  |
|                            | Girls                   | Boys                 | Girls                | Boys                     | Girls                     | Boys                 | Girls                   | Boys                 |
|                            | Primary Enrolment Ratio |                      |                      |                          | Secondary Enrolment Ratio |                      |                         |                      |
| $MMR_{t-4}$                | -0.009<br>(0.004)***    | -0.006<br>(0.002)*** | -0.008<br>(0.003)*** | -0.006<br>(0.002)***     | -0.007<br>(0.002)***      | -0.005<br>(0.002)*** | -0.008<br>(0.003)***    | -0.006<br>(0.002)*** |
| $MMR_{t-4}$<br>*Buddhist   | -                       | -                    | -0.008<br>(0.004)*   | 0.003<br>(0.003)         | -                         | -                    | -0.009<br>(0.004)***    | -0.007<br>(0.008)    |
| $MMR_{t-4}$<br>*Hindu      | -                       | -                    | -0.009<br>(0.004)*   | 0.005<br>(0.005)         | -                         | -                    | -0.008<br>(0.004)*      | -0.009<br>(0.033)    |
| $MMR_{t-4}$<br>*Islam      | -                       | -                    | -0.010<br>(0.004)*** | -0.007<br>(0.004)**<br>* | -                         | -                    | -0.009<br>(0.003)***    | 0.009<br>(0.004)**   |
| $MMR_{t-4}$<br>*Indigenous | -                       | -                    | -0.010<br>(0.005)*   | -0.008<br>(0.004)**      | -                         | -                    | -0.010<br>(0.005)***    | -0.009<br>(0.004)**  |
| R <sup>2</sup>             | 0.40                    | 0.25                 | 0.48                 | 0.32                     | 0.60                      | 0.61                 | 0.61                    | 0.62                 |
| p value: Hausman Test      | 0.30                    | 0.18                 | 0.37                 | 0.23                     | 0.30                      | 0.23                 | 0.34                    | 0.20                 |
| p value: Sargan Statistic  | 0.31                    | 0.21                 | 0.46                 | 0.21                     | 0.19                      | 0.29                 | 0.30                    | 0.39                 |
| Observations               | 308                     | 308                  | 308                  | 308                      | 266                       | 266                  | 266                     | 266                  |

Given however, that the religion variables are time invariant, the estimation is also carried out using fixed effects estimation and the percentage of population belonging Christianity, Buddhism, Islam, Hinduism and Indigenous Religion for each country (from Alesina et al. 2003). Only results using WDI maternal mortality rates are reported<sup>6</sup>. The results are reported in Table 5. The conclusions do not change.

<sup>6</sup> Results using Hogan et al. data on maternal mortality are similar.  
[www.bwpi.manchester.ac.uk](http://www.bwpi.manchester.ac.uk)

Table 5: Fixed Effects Estimation

|                            | Primary Enrolment Ratio |                     | Secondary Enrolment Ratio |                      |
|----------------------------|-------------------------|---------------------|---------------------------|----------------------|
|                            | (1)<br>Girls            | (2)<br>Boys         | (3)<br>Girls              | (4)<br>Boys          |
| $MMR_{t-4}$                | -0.053<br>(0.020)***    | -0.019<br>(0.009)** | -0.084<br>(0.015)***      | -0.010<br>(0.005)**  |
| $MMR_{t-4}$<br>*Buddhist   | -0.029<br>(0.011)***    | 0.111<br>(0.110)    | -0.021<br>(0.010)**       | 0.112<br>(0.120)     |
| $MMR_{t-4}$<br>*Hindu      | -0.025<br>(0.013)*      | -0.010<br>(0.016)   | -0.003<br>(0.001)*        | -0.110<br>(0.120)    |
| $MMR_{t-4}$<br>*Islam      | -0.020<br>(0.009)**     | -0.018<br>(0.009)** | -0.020<br>(0.013)*        | 0.021<br>(0.011)**   |
| $MMR_{t-4}$<br>*Indigenous | -0.021<br>(0.010)**     | -0.020<br>(0.010)** | -0.081<br>(0.024)***      | -0.074<br>(0.025)*** |
| $R^2$                      | 0.45                    | 0.35                | 0.65                      | 0.64                 |
| Observations               | 143                     | 143                 | 127                       | 127                  |

Note: Robust standard errors clustered by region reported in parenthesis. \*, \*\*, \*\*\* Significant at the 10%, 5% and 1% levels

Finally, the sample is restricted to countries with a high maternal mortality rate as defined by WHO, UNICEF, UNICFPA, World Bank (2010), that is, maternal mortality rates above or equal to 300. The results are reported in Table 6<sup>7</sup>. Note that maternal mortality has a larger negative impact on the enrolment rate compared to the results for the full sample. All the religion dummy variables have a negative impact on the enrolment ratio of girls and boys when interacted with maternal mortality suggesting that all religions act to increase the adverse effect of maternal mortality on enrolment. GDP per capita and government expenditure on education have a positive effect on enrolment. Note however, that the conclusion that the impact of the maternal mortality rate on the enrolment of girls is higher for girls than for boys and that religion has a negative effect on the enrolment of girls does not change.

<sup>7</sup> Only results using WDI data on maternal mortality are reported due to space constrains. Similar results are obtained using the Hogan et al. dataset.

Table 6: SUR Estimation: Dependent Variable Secondary Enrolment Ratio: Restricted to countries with Maternal Mortality => 300

| Independent Variables                             | (1)                  | (2)                  | (3)                  | (4)                 | (5)                      | (6)                  |
|---|----------------------|----------------------|----------------------|---------------------|--------------------------|----------------------|
|   | Girls                | Boys                 | Girls                | Boys                | Girls                    | Boys                 |
|   | Primary Enrolment    |                      | Secondary Enrolment  |                     | Secondary Enrolment      |                      |
| GDP per Capita                                    | 0.190<br>(0.064)***  | 0.120<br>(0.058)**   | 0.016<br>(0.002)***  | 0.012<br>(0.001)*** | 0.014<br>(0.002)**<br>*  | 0.011<br>(0.001)***  |
| MMR <sub>t-4</sub>                                | -0.010<br>(0.003)*** | -0.009<br>(0.003)*** | -0.012<br>(0.003)*** | 0.011<br>(0.002)*** | -0.011<br>(0.002)**<br>* | -0.009<br>(0.003)*** |
| Govt. Expenditure on Education                    | 0.240<br>(0.047)***  | 0.135<br>(0.021)***  | 0.124<br>(0.031)***  | 0.095<br>(0.037)*** | 0.186<br>(0.054)**<br>*  | 0.104<br>(0.045)***  |
| Fertility Rate                                    | -0.125<br>(0.021)*** | -                    | -0.101<br>(0.040)*** | -                   | -0.132<br>(0.031)**<br>* | -                    |
| MMR <sub>t-4</sub><br>*Buddhist                   | -                    | -                    | -                    | -                   | -0.009<br>(0.004)**      | -0.08<br>(0.004)**   |
| MMR <sub>t-4</sub><br>*Hindu                      | -                    | -                    | -                    | -                   | -0.008<br>(0.002)**<br>* | -0.008<br>(0.004)*   |
| MMR <sub>t-4</sub><br>*Islam                      | -                    | -                    | -                    | -                   | -0.010<br>(0.003)**<br>* | -0.009<br>(0.003)*** |
| MMR <sub>t-4</sub><br>*Indigenous                 | -                    | -                    | -                    | -                   | -0.012<br>(0.006)**<br>* | -0.011<br>(0.004)*** |
| Govt. Expenditure on Education*MMR <sub>t-4</sub> | -                    | -                    | -                    | -                   | 0.138<br>(0.045)**<br>*  | 0.178<br>(0.039)***  |
| R <sup>2</sup>                                    | 0.47                 | 0.48                 | 0.37                 | 0.58                | 0.57                     | 0.60                 |
| Observations                                      | 156                  | 156                  | 133                  | 133                 | 133                      | 133                  |

Note: Standard errors reported in parenthesis. \*, \*\*, \*\*\* Significant at the 10%, 5% and 1% levels respectively.

## 5. Conclusions

This study examines the impact of the maternal mortality rate on the enrolment ratio of girls and boys at the primary and secondary levels. The study also investigates the influence of the maternal mortality rate on enrolment with its interaction through religion. The study finds that maternal mortality has a negative impact on the enrolment of girls and boys at both the primary and secondary levels. However, this negative effect is more pronounced for girls than for boys. For girls, the effect of maternal mortality on enrolment appears to be magnified by religion, and increased fertility. Government expenditure on education reduces the negative impact of maternal mortality on enrolment. The results therefore suggest that increased health facilities to reduce maternal mortality will increase enrolment particularly that of girls. Policies implemented to reduce fertility and relaxation of cultural restrictions permitting greater female access to health care facilities and mobility, and channelling more government expenditure into health care will reduce the negative impacts of maternal mortality on enrolment.

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