The Determinants of Child Mortality: Empirical Findings from Developing Countries

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Objective of the study

The main purpose of this study is to:

- Increase the level of knowledge pertaining to child mortality in the age of under five years.
- To identifying the relative importance of various socioeconomic and environmental factors.

IMPORTANCE OF EARLY CHILDHOOD HEALTH

Good health raises:

- Child learning and improved levels of education by increasing levels of schooling and learning performance.
- Individual productivity
- Levels of human capital
- Opportunities for obtaining better paid work.
- Workforce productivity
- Economic growth
- Overall well-being

(World Bank; Barro and Sala-i-Martin 2004)

Motivations

- High child mortality is exclusive problem in the world's poorest countries.
- Understanding the causes of death of children provides insight to help reduce it (WHO)
- It is a composite index reflecting country's level of socio-economic development, environmental health care services and quality of life (*Alderman and Behrman, 2004)*

Worrying Trends in Child Mortality

Child deaths have been halved over the last few decades due to better nutrition, health care, and standards of living (World Bank; MDG; UNICEF, 2010). But:

- 13 million children in developing countries in 1990 died before the age of 5 from preventable causes
- The number had dropped to 10 million in 2006.
- 8 million children under five died in 2010.

High Child mortality as a problem to society

Child mortality poses problems to the society, which may be due to

- Malnutrition
- Insufficient basic health infrastructure
- Lack of access to water
- Poor sanitation
- Lack of access to health care facilities.
- Lack of immunization programs
- Environmental degradation
- Poor living condition

DATA SOURCE

- The data on child mortality and other socioeconomic variables used in this study are taken from World Bank data.

- The study employed the data from 1985 to 2009 on a five-year basis for 96 low middle income countries.

- Panel Data – so estimate appropriate models

- Concerned about model misspecification
  - ✓ Hetroscedasticity
  - ✓ Hetrogeneity
  - ✓ Endogeneity

Empirical model and methodology

This study considered four different estimation methods.

- Pooled OLS
- Error Component Model
  - Fixed Effects
  - Random Effects
- 2SLS
- Dynamic-GMM

Diagnostic Tests

- ✓ Test of Hetroscedasticity
- ✓ Test of poolability
- ✓ Hausman Test for FE and RE
- ✓ Hansen J test for over-identification Restrictions
- ✓ Test for autocorrelation

Empirical model and methodology

Pooled Cross-Sectional Specification

The dependent variable, child mortality (CMR_{it}), is hypothesized to be determined by *K* explanatory variables, denoted *X* and indexed by *k* = 1, . . …. *K*. It is assumed that the basic model relating these variables takes the form:

$$CMR_{it} = \sum_{k=1}^{k} \beta_k X_{k,it} + \tau_t + \mu_{it}, \quad \mu_{it} \sim \mathrm{N}(0, \sigma 2) \qquad (1)$$

Where

i denotes countries

t denotes time

β is a vector of parameters

τ_t is a vector of period dummies capturing time trends and

u_{it} is an error term.

Error Component Model

It composed error term into two components.

$$\mu_{it} = \mu_i + v_{it}$$

Where

μ_i Country specific time constant invariant factors does not change over time.

V_{it} Idiosyncratic or stochastic error term varies over countries and time

Empirical model and methodology

Fixed Effects Panel Data Specification

The country FE model is as follows:

$$CMR_{it} = \sum_{k=1}^{k} \beta_k X_{k,it} + \tau_t + \mu_i + v_{it}, \qquad v_{it} \sim \mathrm{N}(0, \ \sigma 2) \qquad (2)$$

The actual estimating equation is obtained by transforming the observations on each variable into deviations from the country- specific averages:

$$CMR_{it} - \overline{CMR_{\iota}} = \sum_{k=1}^{k} \beta_k \left(X_{k,it} - \overline{X_{k,\iota}}\right) + (\mu_i - \bar{\mu}_{\iota}) + (v_{it} - \overline{v_{\iota}}) \qquad (3)$$

Empirical model and methodology

Dynamic GMM Specification

Equation (1) is modifies as follows for GMM (Arellano and Bond 1991)

$$CMR_{it} = \beta_0 CMR_{i,t-1} + \sum_{k=1}^{k} \beta_k \; X_{k,it} + \tau_t + \mu_i + v_{it} \quad \mu_{it} \sim N(0, \; \sigma 2) \qquad (4)$$

$$\Delta CMR_{it} = \beta_0 (\Delta CMR_{i,t-1}) + \sum_{k=1}^{k} \beta_k \, (\Delta X_{k,i,t-1}) + \Delta \tau_t + \Delta v_{it} \qquad (5)$$

Where $CMR_{i\,,\,t-1}$ is the lagged value and $\Delta CMR_{i,t-1}$ is a differenced lagged of child mortality.

TABLE 1
Description of Variables

Dependent Variable	Description
Child mortality	Mortality rate, under-5 (per 1,000 live births)
Independent Variables	
Female labor force participation	Labor force, female (% of total labor force)
Female education	Average years of primary schooling, 15+, female
Immunization coverage	Immunization (% of children ages 12-23 months)
Fertility rate	Fertility rate, total (births per woman)
Access to water	Improved water source (% of population with access)
Access to sanitation	Improved sanitation facilities (% of population with access)
N_2O	Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)
Population Density	people per sq. km of land area)
Real GDP per capita	(US$)
Child malnutrition	Percentage of underweight children
Age dependency ratio	% of working-age population
Physician	Physicians (per 1,000 people)
Prenatal care	Pregnant women receiving prenatal care (%)
Contraceptive prevalence	Contraceptive prevalence (% of women ages 15-49)

TABLE 2
Descriptive Statistics of the variables

Number of countries: 96 Time period: 06 Total observations : 576			
Variable	**Mean**	**SD**	**N**
Child mortality	103.67	65.74	576
Female labor force	39.73	9.44	576
Female education	3.18	1.66	576
Immunization coverage	69.08	23.52	576
Fertility rate	4.87	1.60	471
Access to water	70.04	19.76	575
Access to sanitation	47.20	28.46	575
N_2O	30084.41	83534.14	569
Population Density	97.54	140.25	576
Real GDP per capita	1755.03	4923.14	573
Child malnutrition	37.35	20.91	573
Age dependency ratio	80.53	16.51	576
Physician	.749	1.26	575
Prenatal care	103.67	65.74	576

TABLE 3

Dependent Variable: Child Mortality (Under-5)	Pooled OLS	FE	RE
Independent Variables	**Coefficients**	**Coefficients**	**Coefficients**
Age dependency ratio	.001	0.01**	0.01***
Female labor force participation	0.02***	-0.02**	0.01***
Immunization coverage	-0.002*	-0.003***	-0.004***
Fertility rate	0.18***	0.004	0.06**
Female Schooling	-0.09***	0.03	-0.05**
Access water	-0.004**	0.001	-0.001
Access sanitation	-0.003***	-0.001	-0.002**
Population density	3.51e-06	-0.0003	-0.002
Log Real GDP per capita	-0.06***	0.004	-0.01
Physician	-0.01	0.01	-0.03**
Log N_2O	0.02*	0.02***	0.03*
Child malnutrition	0.09**	-0.08**	0.05
Year dummies			
1985	0.15***	-	0.20***
1990	0.16**	-0.04***	0.22***
1995	0.13**	-0.12***	0.16***
2000	0.06	-0.23***	0.08***
2005	-	-0.35***	
Constant		4.98***	3.32***
Pooled OLS Prob > F = 0.0000	F(16, 447) = 126.88	N= 464	R2 = 0.84
FE Corr(u_i,xb) = -0.29	Rho = .975	Prob>F = 0.0000	Number of groups= 94 N= 464 R^2 = 0.68
RE Prob>chi2 = 0.0000	Corr(u_i,x) = 0(assumed)	Rho = 0.803	Number of groups= 94 N= 464 R^2 = 0.61

TABLE 4
Results of Dynamic GMM estimation

Dependent Variable: Child Mortality (Under-5)	Two-Step Difference GMM	Two-Step System GMM
Independent Variables	**Coefficients**	**Coefficients**
Lagged CMR	0.74**	0.91***
Age dependency ratio	0.004	0.002
Female labor force participation	-0.0001	0.004*
Immunization coverage	-0.0002	-0.001*
Fertility rate	-0.06***	0.01
Female Schooling	-0.01	-0.01
Access water	-0.0001	0.002
Access sanitation	0.001	-0.001*
Population density	-0.001	-0.0003**
Log Real GDP per capita	-0.004	-0.02**
Physician	0.05	-0.01
Log N_2O	-0.05	0.02**
Log Child malnutrition	-0.01	0.02
Year dummies		
1985	-	
1990	0.12**	0.04*
1995	0.09**	0.05**
2000	0.04**	0.01
2005	-	
Constant		-0.29
Difference-GMM Prob> F = 0.0000	F(16, 94) = 116.12 Groups = 94 Number of Instruments = 81 N= 279	
System-GMM Prob> F = 0.0000	F(16, 93) = 555.05 Groups = 94 Number of Instruments = 134 N= 373	

Summary of Diagnostic Tests

- We reject the null hypothesis such that pooling the data is not appropriate.

- The null hypothesis is rejected for Hausman test for FE versus RE.

- Hansen J statistics for over identification restrictions, confirming that the instrument set can be considered valid.

- The Arellano-Bond tests AR(1) and AR(2) under the hypothesis of no autocorrelation fails to reject the null hypotheses which provide evidence that lags of the dependent variable and other variables used as instruments are strictly exogenous.

Results of Interest (i)

- The empirical results from pooled OLS and system GMM demonstrate that immunization coverage has negative and significant effects on child mortality.

- These findings are supported by Kamiya (2010) when employed OLS and insignificant in system-GMM .

- Real GDP per capita is significantly contributing to reducing child mortality

- Alves and Belluzzo (2005) and Issa and Quattara (2005) also found the same results using panel data.

- The striking results from GMM show that environmental degradation has positive and significant effect on child mortality

- This variable was also statistically significant in Issa and Quattara (2005) study for low income countries and statistically weak for high income countries when employing GMM model.

Results of Interest (ii)

- Female labor force is positive and significant in OLS and GMM model and it was also positive in Ware(1984) - OLS model.

- The variables of female schooling and fertility rate become insignificant in GMM which were significant in OLS. It implies that residuals in the equations contain unobserved time varying specific factors
- The variable of child malnutrition is positively related with child mortality in Pooled, RE models and it has become insignificant in sys-GMM.

- The variable of access sanitation is negative in FE and GMM models which also found by Shandra et al., (2011) in FE model. While access to water is positive in FE and sys-GMM.

- System GMM is preferred because exploiting the additional moment conditions in the levels provides a dramatic improvement in the accuracy of the estimates when the dependent variable is persistent (Blundell and Bond, 2000).

Policy Suggestion/Recommendations

- Increases of immunization programs will significantly reduce child mortality and therefore investments in this activity will yield welfare benefits.

- Improvements in sanitation services, meaning greater availability of treated running water and sewerage services, also lead to a fall in child mortality.

- The environmental degradation positively effects child mortality which suggests that more attention should be given to the economic costs of poor health and morbidity associated with environmental damage such as air pollution.

- From a policy perspective education, enhancement in the coverage of immunization programs and higher per capita income brought about by economic growth are all important for improving child health in developing countries.

Thank You

List of sample Countries

Afghanistan	Mauritania	Djibouti	Paraguay
Bangladesh	Mozambique	Ecuador	Philippines
Benin	Myanmar	Egypt, Arab Rep.	Samoa
Burkina Faso	Nepal	El Salvador	Sao Tome and Principe
Burundi	Niger	Georgia	Senegal
Cambodia	Rwanda	Guatemala	Sri Lanka
Central African Republic	Sierra Leone	Guyana	Sudan
Chad	Solomon Islands	Honduras	Swaziland
Comoros	Somalia	India	Syrian Arab Republic
Congo, Dem. Rep.	Tajikistan	Indonesia	Thailand
Eritrea	Tanzania	Iraq	Timor-Leste
Ethiopia	Togo	Jordan	Tonga
Gambia, The	Uganda	Kiribati	Tunisia
Ghana	Zambia	Kosovo	Turkmenistan
Guinea	Zimbabwe	Lesotho	Tuvalu
Guinea-Bissau	Angola	Maldives	Ukraine
Haiti	Armenia	Marshall Islands	Uzbekistan
Kenya	Belize	Micronesia, Fed. Sts.	Vanuatu
Korea, Dem. Rep.	Bhutan	Moldova	Vietnam
Kyrgyz Republic	Bolivia	Mongolia	West Bank and Gaza
Lao PDR	Cameroon	Morocco	Yemen, Rep.
Liberia	Cape Verde	Nicaragua	
Madagascar	China	Nigeria	
Malawi	Congo, Rep.	Pakistan	
Mali	Cote d'Ivoire	Papua New Guinea	