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Justifying the Impact of Economic Deprivation, Maternal Status and Health infrastructure on Under-Five Child Mortality in Pakistan: An Empirical Analysis

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Abstract
During the 1980's child survival first time attached with biological and social factors for its determination (Mosley and Chen, 1984). Socioeconomic factors need some proximate factor to impact child survival, at that time, policymakers believe that socioeconomic factors indirect impact on child survival. But maternal factors, environmental contamination, nutrient deficiency and injury have direct impact on child survival. This study has tried to justify the fact that economic deprivation, health, infrastructure and maternal status impact under-five child mortality in Pakistan over the period of 1980 to 2017. For checking the stationarity of the data, Augmented Dickey-Fuller (ADF) unit root test is applied. Autoregressive Distributed Lag (ARDL) model has been used for examining the co-integration among the variables of the model. Granger causality test has been applied to explore the causal relationship among the variables. The estimated results show that there is a long run relationship among the variables of the model. The results of Granger causality test highlight that there is unidirectional causality is running from independent variables to the dependent variable. The findings suggest that for reducing under-five child mortality, the government of Pakistan should improve the maternal status and health infrastructure whereas economic deprivation should be minimized.

Keywords: economic deprivation, health, infrastructure, maternal status, under-five child mortality
JEL Codes: E24, E31, H75, I15

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I. Introduction

Death is the mandatory end of all living beings, but instead of developing countries the developed countries have postponed death for a longer time period. Although overall life expectancy of developing nations has increased, but under-five mortality rate is still very high (Cleland and Farooqui, 1998; Ali, 2015). Under-Five child mortality is considered one of the important and sensitive measure to know the socioeconomic development of a nation. Under-Five child mortality is defined as risks for a child before reaching its age 5 or above (Masuy-Stroobant and Gourbin, 1995). The main reason behind child survival sensitivity is that as compared to an adult, the child is more vulnerable to socioeconomic status of a nation (Madise et al 2003). Guillaumont (2009) mentions that low under-five child mortality is the best indicator to overview the social development of a country. Historical, economic deprivation and infant survival is studied by Lesaege-Dugied (1972). Now a vast body of literature is available which considered that high infant and under-five mortality rate is a sign of low social development and this problem is mainly faced by developing countries of the world. Although this accomplishment is medically oriented, but the conclusions of many studies show that there is a strong relationship between economic deprivation and under-five mortality (Shkolnikov et. al, 1998; Cornia and Paniccia, 2000).

Child survival is an important part of Human Development Index (HDI) of UNDP and it presents strategic evaluation and public health cares planning of a nation. Consequently, United Nations give special importance towards the reduction of child mortality in its Millennium Development Goals (UNICEF, 2006). There are four main channels through which socioeconomic factors influence the venerable part of the society. At first per capita income has direct relationship with under-five child mortality. Developed nations have more resources in the shape of per capita income for increasing the efficiency of the health sector and that efficient health sector is able to reduce under-five child mortality. Second, provisions of better social services have a direct negative impact on under-five mortality. Upward trends in economic growth, increase the provision of better social services. Economic growth work as driving force behind the provision of better social services as the economy grows urbanization and industrialization improves the living standard through easy access to medical cares and nutritional food which in turn decrease under-five child mortality. Mosley and Chen (1984) explain that economic growth, enhance the provision of some basic social services such as health cares, sanitation, clean drinking water and epidemiological protection which further lower the mortality and higher the life expectancy. Third, rising poverty has a positive relationship with under-five child mortality. Low poverty means easier access to basic necessities of life, such as food, health cares and education. Thus, low poverty reduces under-five child mortality with the help of proper and improved provision of social services. Baird et al., (2011) conclude that level of income has a direct impact on consumption pattern of households, as less income means households have the least amount of money for private consumption, then they spent less on nutritious foods, infant health inputs and health cares about the child when it got ill. Fourth, maternal education also reduces under-five child mortality. Hojman (1994) argues that on one side, maternal education puts a direct negative impact on mortality as educated mothers have more concern about the health cares and nutritional foods for children. On the other side, educated female can easily understand the time value between labor force participation and child rearing and caring. Mother education reduces child mortality as an educated mother prefers changing feed and improved health cares (Caldwell (1979). Hobcraft (1993) explains that education can contribute to child survival by making women more likely to marry and enter motherhood later and have fewer children, utilize prenatal care and immunize their children. So, they decide to make the gap between children and reduce fertility which enables a couple to pay more attention on child cares and mortality comes down.

Socioeconomic factors like health, education, environment etc, are closely interlinked with Human Development Indicator. Living standard and life showed improvement, but this is not uniform across the regional countries. The comparative position of regional countries' health development is given in table 1. The objective of this study is to find the impact of economic deprivation, maternal status and health infrastructure on under-five child mortality in case of Pakistan over the period of 1980 to 2017. The situation of economic deprivation in Pakistan is very miserable. Pakistan has been facing 10 to 24 percent inflation rate since throughout its whole economic history (Ali, 2015). The existing population of Pakistan is 200.71 million with 32.83 percent labor force participation rate and total labor force is 57.24 million. The unemployment rate in 2016-17 is recorded 6 percent, which is showing the failure of government policies regarding poverty alleviation. Health conditions in Pakistan reveal that the masses gained better health status from last few years. But under-five child mortality is 86.5 per 1000 which is highest in the region (Economic Survey of Pakistan, 2016). This study highlights that maternal status, economic deprivation and health infrastructure are impacting under-five child mortality in Case of Pakistan. This may be an interesting case study as this type of exercise is hardly done in case of Pakistan.

Table 1: Regional Health Indicators

Country	Life expectancy at birth, total (years)			Infant Mortality Rate (per 1,000 live births)			Maternal Mortality Rate (Per 100,000)			Under 5 Mortality Rate (Per 1,000)			Population growth (annual %)		
Country Name	2015	2016	2017	2015	2016	2017	2013	2014	2015	2015	2016	2017	2015	2016	2017
Pakistan	66.3	66.5	66.6	64.6	62.9	61.2	190.0	184.0	178.0	79.5	77.1	74.1	2.0	2.0	2.0
India	68.3	68.6	68.8	35.3	33.6	32.0	189.0	181.0	174.0	44.1	41.6	39.4	1.2	1.1	1.1
Bangladesh	72.2	72.5	72.8	29.8	28.3	26.9	201.0	188.0	176.0	36.4	34.3	32.4	1.1	1.1	1.0
Sri Lanka	75.1	75.3	75.5	8.2	7.8	7.5	32.0	31.0	30.0	9.5	9.1	8.8	0.9	1.1	1.1
Nepal	69.9	70.3	70.6	29.9	28.8	27.8	291.0	275.0	258.0	36.6	35.0	33.7	1.2	1.1	1.1
Bhutan	69.8	70.2	70.6	27.6	26.5	25.6	166.0	156.0	148.0	33.4	32.0	30.8	1.4	1.3	1.2
China	76.1	76.3	76.4	9.2	8.6	8.0	29.0	28.0	27.0	10.8	10.0	9.3	0.5	0.5	0.6
Indonesia	69.0	69.2	69.4	22.9	22.2	21.4	140.0	133.0	126.0	27.2	26.3	25.4	1.2	1.1	1.1
Malaysia	75.1	75.3	75.5	6.5	6.6	6.7	43.0	41.0	40.0	7.6	7.7	7.9	1.6	1.5	1.4
Philippines	69.0	69.1	69.2	23.0	22.7	22.2	121.0	117.0	114.0	29.1	28.6	28.1	1.6	1.6	1.5
Thailand	75.1	75.3	75.5	9.0	8.5	8.2	21.0	21.0	20.0	10.4	10.0	9.5	0.4	0.3	0.3

Source: World Bank

II. Literature Review

In previous literature, many theoretical and empirical studies are available which examined the determinants of child mortality. Some of very important and most relevant studies are presented here: Schultz (1984) and Mosley and Chen (1984) make distinction among socioeconomic, biomedical and demographic factors for child mortality. These studies identify the bio-medical factors as intermediate or proximate determinants of child mortality (Palloni, 1990; UN, 2008). Subbarao and Raney (1995) study the relationship of female education, family planning program on fertility and mortality for a panel of countries. The results of this study show that health programs and family planning programs reduce the rate of mortality and fertility in selected countries. They mention that the results should be more strengthened by using female education as an independent variable, because educated female preferred low fertility and high health care. Naturally, for investigating the impact of economic deprivation on under-five mortality rate, it depends upon the way economic deprivation's behavior for social progress. On one hand, economic deprivation increases child mortality by decreasing economic growth of the country. On the other hand, inflation and unemployment have a direct positive relationship with child mortality (Cleland, 2001). Bengtsson (1999) examines the hypothesis that macroeconomic fluctuations have significant impact on child mortality and different occupational groups have different infant mortality rate. For this purpose, he uses the long run macroeconomic time series data as well as micro data on an individual level. The results of the study show that there is no strong relationship with macroeconomic fluctuations, different occupational groups and child mortality. The results of the study confirm that infants are less vulnerable to insecurity and economic fluctuations. But on the other side, infant mortality is strongly influenced by maternal age at birth, breastfeed, sex and their birth order.

Senauer and Kassouf (2000) analyze the relationship between breast feeding and child health and further the health status and demand for medical care. For this purpose, the children having age 2 year and breastfeeding infants of 6 months are taken as samples. For empirical analysis, binomial probit model is used. The results of the study show that the breastfeeding plays a significant role in reducing child illness. The breastfeeding decreases child illness by 15% among infants and 10% among 2 year. Mutinga (2004) investigates the socioeconomic determinants of mortality in

the case of Kenya by using data of Demographic and Health survey. The results of this study show that education of mother, sanitation facilities, safe drinking water, better nutrition, housing condition and better education have a negative impact on child mortality. But the households with less amount of such facilities have a low child survival rate in the case of Kenya. Van den Berg et al., (2006) examine the historical trends in marriages, births and deaths in the case of the Netherlands for the period of 1815 to 2000. The results of the study indicate that birth in a recession most likely to increase the mortality in the coming years. The results of the study highlight that in Dutch society different occupational groups have different child mortality rates and society is showing inequality between rich and poor for attaining economic needs. Woldemicael (2008) investigates the impact of socioeconomic and environmental factors on child diarrhea in case of Eritrea. Eritrea Demographic and Health Survey (EDHS) is used for data collection from 1995 to 2007. The results of the study show that household economic status, floor material and residential place have a significant role in positive diarrhea cases. The results of the study also explain that the number of children and age of children has a positive relationship with diarrheal morbidity.

Baird et al., (2011) examine the relationship of infant survival and macroeconomic shocks in case of middle and low-income nations by using Demographic Household Survey data. The results show that there is a positive and significant relationship between infant mortality and negative shocks in per capita GDP. In case of developing nations when negative shocks of per capita GDP are occurring, infant mortality is increased, but infant girls are most likely to die. Ali (2015) investigates the impact of macroeconomic instability on social progress in case of Pakistan over the period of 1980 to 2012. Under-five survival rate is considered as a measure of social progress in case of Pakistan. ARDL bound testing approach is used for examining the cointegration among the variables of the model. The results of the study show that macroeconomic instability has a negative impact on under-five survival rate in Pakistan. Family planning, health cares and mother education plays a positive and significant role in deciding under-five survival rate. The study concludes that the government should take serious steps in reducing macroeconomic instability for enhancing under-five survival rate in Pakistan.

III. The Model

Previous literature mainly brought about this general conclusion that a reduction in child mortality is achieved by efficient preventive and medication. The historical empirics are also consistent with this viewpoint that medical innovations bring miraculous changes in the reduction of child mortality at world level after 1930 (Palloni, 1990). There are a number of empirical studies available which focused on the determinants of child mortality. Among them many studies have approved significant impact of demographic and socioeconomic factors on child mortality (Caldwell, 1979; Debpuur et al., 2005; Hosseinpoor et al., 2005; Madise and Diamond, 1995). Mosley and Chen (1984) present a basic theoretical framework for understanding the relationship between socioeconomic factors and child morality. Following the methodology of Mosley and Chen (1984), Ali (2015), Ali (2011), Ali (2018), Ali and Bibi (2017), Ali and Ahmad (2014), Ali and Audi (2016), Ali and Audi (2018), Ali and Rehman (2015), Ali and Zulfiqar (2018), Haider and Ali (2015) and Ali et al., (2016) the functional form of the model becomes as:

$$UFCM_t = f\left(MS_t, \mathrm{ED}_t, HI_t\right) \qquad (1)$$

$UFCM =$ Under-five Child Mortality
$MS =$ Maternal Status
$ED =$ Economic Deprivation
$HI =$ Health Infrastructure index
$t =$ time period

For finding the responsiveness of the dependent variable to the independent variable, the equation can be written in the following form:

$$UFCM_t = \alpha_1 MS_t^{\beta_1} ED_t^{\beta_2} HI_t^{\beta_3} e^{t+u_{1t}} \qquad (2)$$

Where
e is the base of natural logarithms and u is the white noise error term. By taking the natural log of both sides of the equation (2)

$$\ln UFCM_t = \alpha_1 + \beta_1 \ln MS_t + \beta_2 \ln ED_t + \beta_3 HI_t + u_t \qquad (3)$$

By following principle component method, Health infrastructure index is constructed. Total number of hospitals, total number of doctors, total number of dispensaries, basic health units, maternity and child health centers, rural health centers, registered midwives and registered lady health visitors are the main variables of this index. By incorporating inflation rate and unemployment, an index of Economic Deprivation (ED) is constructed. Maternal status is measured with the help of female higher secondary school enrollment rate. The data for all the variables is taken from various issues of economic survey of Pakistan and World Development Indicators maintained by World Bank online databases.

IV. Econometric Methodology

The application of econometric tools on macroeconomic models is one of the most important aspects within the quantitative economic analysis. In most of macroeconomic data, the involvement of time trend makes the time series data non-stationary and the regression results of this data become spurious. This study uses Augmented Dickey-Fuller unit root for examining the stationarity of the variables and Autoregressive Distributed Lag (ARDL) approach is used for cointegration. Granger causality test is used for exploring the causal relationship among variables.

IV.I. Augmented Dickey-Fuller (ADF) Test

Dickey and Fuller (1981) proposed the Augmented Dickey-Fuller (ADF). The general forms of the ADF can be written as:

$$\Delta X_t = \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{1t} \quad (4)$$

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{2t} \quad (5)$$

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \sum_{j=1}^{q} \phi_j \Delta X_{t-j} + e_{3t} \quad (6)$$

X_t is a time series for testing unit roots, t is the time trend and e_t is error term having white noise properties. If $j = 0$, it represents the simple DF test. The lagged dependent variables in the ADF regression equation are included until the error term becomes white noise. For checking the serial correlation of error terms, LM test is used. The null and alternative hypotheses of ADF unit roots are;

$H_0 : \delta = 0$ non-stationary time series; so, it has unit root problem.

$H_a : \delta < 0$ stationary time series

Apply OLS and compute τ statistic of the estimated co-efficient of X_{t-1} and compare with the Dickey Fuller (1979) critical τ values. If the calculated value of τ statistic is greater than the critical value then we reject the H_0. In this case the time series data is stationary. On the other hand, if we do not reject the H_0. In this case the time series is non-stationary. In this way of applying this procedure on all variables, we can easily find their respective orders of integration.

IV.II. Autoregressive Distributive Lag (ARDL) Approach to Co-Integration

In applied econometrics, a large number of co-integration tests are available. Most famous and traditional co-integration tests are the residual based Engle-Granger (1987) test, Maximum Likelihood based on Johansen (1991/1992) and Johansen-Juselius (1990) tests. One thing is common in these tests, they require same order of integration for their analysis. These co-integration tests become invalid and inefficient when the variables of the model have different level of integration. Pesaran and Pesaran (1997), Pesaran and Shin (1999), Pesaran et al., (2001) has

introduced, the most advance and recent method of co-integration known as the Autoregressive Distributive Lag (ARDL) bound testing approach. The ARDL bound testing approach has numerous advantages over traditional methods of co-integration. First, ARDL can be applied regardless by following the order of integration. It can be applied I(0), purely I(1) or mix order of integration (Pesaran and Shin, 1999). Second, the ARDL bound testing approach to co-integration can be used for smaller sample sizes (Mah, 2000) rather than traditional methods. Third, this approach allows to use sufficient number of lags for capturing the data generating process in a general to the specific modelling framework (Laurenceson et al., 2003). This technique is based on Unrestricted Vector Error Correction Model (UVECM) which have better properties for short and long run equilibrium as compared to traditional techniques (Pattichis, 1999). For applying the bounds testing procedure, it is necessary to represent equation in a conditional autoregressive distributed lag model as follows:

$$\Delta \ln Y_t = \beta_1 + \beta_2 t + \beta_3 \ln Y_{t-1} + \beta_4 \ln X_{t-1} + \beta_5 \ln Z_{t-1} + ... + \sum_{h=1}^{p} \beta_h \Delta \ln Y_{t-h} + \sum_{j=0}^{p} \gamma_j \Delta \ln X_{t-j} + \sum_{k=0}^{p} \phi_k \Delta \ln Z_{t-k} + ... + u_{it} \quad (7)$$

Here $\ln Y_t$ is used for different dependent t is for time of $\ln Y_{t-1}$ representing the lag of the dependent variable and $\ln X_t$ is first independent variable and $\ln Z_t$ is second independent variable and so on. Δ represents the rate of change in variables. The calculated F-Statistic is compared with the critical value tabulated by Pesaran and Pesaran (1997) or Pesaran et al., (2001) that is extended by Narayan (2005). If the F-test statistic exceeds the upper critical value, the null hypothesis of no co-integration is rejected regardless the order of integration I(0) or I(1). If the calculated F-test statistic is less than the lower critical value the null hypothesis is accepted and there is no co-integration among the variables of the model. On the base of the above equation our null and alternative hypothesis for co-integration test is as given below:

$H_0 : \beta_3 = \beta_4 = \beta_5 = 0$ (no co-integration among the variables)
$H_A : \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$ (co-integration among variables)

If there is long run co-integration relationship among the variables, then for finding short run relationship we use the Vector Error Correction Model (VECM). The VECM is explained as under:

$$\Delta \ln Y_{it} = \beta_1 + \beta_2 t + \sum_{h=1}^{p} \beta_h \Delta \ln Y_{it-h} + \sum_{j=0}^{p} \gamma_j \Delta \ln X_{t-j} + \sum_{k=0}^{p} \phi_k \Delta \ln Z_{it-k} + \omega ECT_{t-1} + u_t \quad (8)$$

All the variables above except ECT_{t-1} which is one time period lagged error correction term. The error correction model results indicate the speed of adjustment back towards long run equilibrium after a short run shock.

IV.III. Granger Causality with VECM

The Granger Causality Test (1987) has been conducted in order to examine the causal linkages between selected variables. In order to capture the impact of variables observed in the past time period in explaining the future performance, the optimal lag length *p* (which is 4 in the present study) is chosen and the criteria used in selecting the VAR model and optimal lag length require the combination of information criterion (AIC and SIC etc.).

V. Empirical Findings and Discussions

The aim of this study is to empirically investigate the impact of economic deprivation, health, infrastructure and maternal status on under-five child mortality in Pakistan. Table 1 presents the descriptive statistics of the model. The

results of table 1 reveal that economic deprivation, health, infrastructure, maternal status and under-five child mortality are negatively skewed. The results show that all variables of the model have positive Kurtosis. The values of Skewness and Kurtosis reveal that all the variables of the model are normally distributed. The estimated values of the Jarque-Bera indicate that all the variables have zero mean and finite covariance, this also confirms that selected variables are normally distributed.

Table 1

	LUFCM	LMS	LED	HI
Mean	4.541618	2.861546	2.596929	1.400398
Median	4.554929	2.924016	2.647669	1.590683
Maximum	4.798267	3.388083	3.248284	2.285176
Minimum	4.238445	2.168444	1.965210	0.028571
Std. Dev.	0.174881	0.438408	0.288245	0.677047
Skewness	-0.158571	-0.380991	-0.155212	-0.656928
Kurtosis	1.735780	1.628361	2.634181	2.254281
Jarque-Bera	2.335893	3.385266	0.316506	3.138182
Probability	0.311005	0.184034	0.853634	0.208234
Sum	149.8734	94.43100	85.69865	46.21313
Sum Sq. Dev.	0.978665	6.150437	2.658728	14.66855
Observations	35	35	35	35

This study is using time series data from 1980 to 2017 and non-stationarity of the error terms are the main problems with time series data. Non-stationary data makes the regression results spurious and policy implications for such type of data is not reliable. So, for removing the problem of non-stationary this study is using Augmented Dickey-Fuller (ADF) unit root test. The results of the unit root are presented in table 2. The results show that under-five child mortality, female status and economic deprivation are not stationary at level. Whereas health infrastructure is stationary at level. But after taking the first difference all the variables of the model become stationary. So, the overall results of ADF unit root, indicate that selected model has a mixed order of integration which is a suitable condition for applying ARDL co-integration approach.

Table 2

Augmented Dickey-Fuller unit root test		
At level		
Variables	T-statistic	Prob.
LUFCM	0.066805	0.9576
LMS	-1.121775	0.6949
LED	-2.469323	0.1321
HI	-3.321408	0.0221
At first difference		
DLUFCM	-2.660577	0.0927
DLMS	-4.461828	0.0013
DLED	-6.726629	0.0000
DHI	-3.588860	0.0119

Keeping the number of observations and number of variables in mind and maximum lags required for co-integration approach, 1 maximum lags are allowed for Vector Auto-Regressive process. But maximum 4 lags are allowed for Granger causality test. The results by lag selection criteria are presented in table 3. SC allows optimal lag length 1 is selected for ARDL bound testing approach, but for Granger causality test LR, FPE, AIC and HQ allow 4 maximum lag length.

Table 3

VAR Lag Order Selection Criteria						
Endogenous variables: LUFCM, LMS LED, HI						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	60.68280	NA	2.36e-07	-3.909159	-3.720566	-3.850094
1	272.8127	351.1116	3.19e-13	-17.43536	-16.49240*	-17.14003
2	282.9478	13.97937	5.13e-13	-17.03088	-15.33355	-16.49930
3	299.6069	18.38255	5.93e-13	-17.07634	-14.62464	-16.30850
4	341.1251	34.35983*	1.54e-13*	-18.83621*	-15.63014	-17.83211*
LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Table 4 presents ARDL bound testing approach results of the model when under-five child mortality is dependent variable and maternal status, economic deprivation and health infrastructure are independent variables. F-statistic and W-statistic are used for testing the null hypothesis of no co-integration among the variables of the model. The calculated F-statistic (62.3525) is greater than the upper bound (4.9212) value of Pesaran et al., (2001) at 5 percent and the calculated W-statistic (249.4099) is also greater than the upper bound (19.6848) value of Pesaran et al., (2001) at 5 percent. So, the null hypothesis of no co-integration is rejected and the alternative hypothesis is accepted which supports co-integration among the variables of the model. This confirms that under-five child mortality, maternal status, economic deprivation and health infrastructure have a long run relationship in case of Pakistan.

Table 4

ARDL Bounds Testing Approach				
Dependent Variable UFCM ARDL(1,1,1,1)				
Critical Value	F-Statistics 62.3525		W-statistic 249.4099	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
95%	3.6087	4.9212	14.4348	19.6848
90%	2.9564	4.0613	11.8255	16.2450

Table 4 confirms the existence of co-integration among the variables of the model. Now the long run relationship among the variables can be examined. The long run results of the study are presented in the Table 5. The estimated results reveal that maternal status has negative and significant impact on under-five child mortality in Pakistan. Maternal and Child Health (MCH) Program was initiated to improve women's and children's health conditions through better service delivery and supported health systems. Mother and Child health care is one of the most important concerns of the public health sector. The program aspires to provide better access to Mother and Child health and Family Planning services with the provision of comprehensive Emergency Obstetric and Neonatal Care (EmONC) services in 275 hospitals/health facilities, provision of basic EmONC services in 550 health facilities and family planning services in all health outlets. Pakistan has shown improvement in the Infant Mortality Rate (IMR) of 62 per thousand from 66 per thousand in 2015, but the maternal mortality rate 170/100000 is still very high as compared to the other countries in the region. More efficient implementation of this scheme can bring these indicators in a range with better health status of mothers and children. The estimates indicate that 1 percent increase in maternal status in Pakistan decreases under-five child mortality by (-0.34221) percent and this relationship is significant at 5 percent. The estimated results reveal that economic deprivation has a positive and significant relationship with under-five child mortality. Cumulative health expenditures by federal and provincial governments during 2018-19 (Jul-Mar) increased to Rs 203.74 billion, which is 3.29 percent higher than the corresponding period of the previous year, which was recorded at Rs 197.25 billion. The current expenditure increased by 19.84 percent from Rs 149.97 billion to Rs. 179.72 billion, while of development expenditure decreased by 49.19 percent from Rs 47.28 billion to Rs 24.03 billion. However, the break-up of expenditures among federal and provinces demonstrates that during July-March FY2019, Federal and Punjab health expenditures decreased by 10.0 and 8.2 percent, respectively, over the same period last

year. On the other hand, Sindh, Balochistan and Khyber Pakhtunkhwa health expenditures increased by 22.2, 18.4 and 10.5 percent, respectively. As a percentage of GDP health expenditure has improved from 0.91 percent in 2016-17 to 0.97 percent in 2017-18 and during FY 2018-19 (Jul-Mar) it increased by 0.53 percent compared to 0.49 percent during the corresponding period last year. The results show a 1 percent increase in economic deprivation in Pakistan increases under-five child mortality by (0.10852) percent. The results of this study are supported by the studies of Subbarao and Raney (1995), Visaria (1988) and Ali (2015) as they conclude that female education and stable economic situation are the main sources of decreasing under-five child mortality. The results show that health infrastructure has negative and significant relationship with under-five child mortality. Expanded Program for Immunization (EPI) Program provides immunization to children against the seven vaccine-preventable diseases under one year of age, i.e. Childhood tuberculosis, poliomyelitis, diphtheria, pertussis, neonatal tetanus, measles and hepatitis B. New vaccines like Penta-valent vaccine have been introduced with the help of United Nations Children Fund's (UNICEF). EPI Program envisaged protecting 07 million children of 0-23 months against 10 deadly vaccine preventable diseases and about 07 million pregnant and childbearing aged women, their neonates will be immunized against tetanus toxoid vaccine respectively. Although after devolution, this has become largely the responsibility of the provincial/area governments, Federal EPI cell currently took the responsibility of the procurements, coordination and technical guidance, whereas, provincial EPI cells are largely responsible for the implementation of the program. The recent achievements of the program are formulation of National Immunization Policy and National Communication Strategy for routine immunization endorsed and approved by provinces and stakeholders, Development of Effective Vaccine Management Improvement Plan and its implementation, Improvement in Vaccine Logistic Management Information System (VLMIS) and formulation of Multi-Donor Trust Fund (MTDF) with the support of World Bank along with other financial partners such as World Health Organization (WHO) and Japanese International Cooperation Agency (JICA). Still the issues of routine immunization in the out reached areas of erstwhile Federally Administered Tribal Areas (FATA) and Balochistan needs consideration. The recently conducted National Measles campaign has shown remarkable coverage of Measles Supplemental Immunization Activities (SIAs) recorded through Management Information System (MIS) which was 98 percent. The maximum coverage reported in GB (103 percent) while the minimum was reported from erstwhile FATA (96 percent). The estimates show that 1 percent increase in health infrastructure decreases under-five child mortality by (-0.30347) percent in Pakistan and this relationship is significant at 1 percent. These results support the findings of Ali (2015), when he claims that family planning and health cares have a positive and significant impact on under-five survival rate in Pakistan.

Table 5

Estimated Long Run Coefficients using the ARDL Approach ARDL(1,1,1,1,) Dependent variable is LUFCM Time Period 1980-2017			
Regressor	Co-efficients	Standard-Error	T-Ratio (Prob)
LMS	-.34221	.12374	-2.7655[.011]
LED	.10852	.053080	2.0444[.052]
HI	-.30347	.10016	-3.0297[.006]
C	4.6751	.36094	12.9527[.000]

After estimating the long run relationship among the variables of the model now by using Vector Error-Correction Model (VECM), short run dynamic among the variables can be examined. The results of short run dynamic are presented in Table 6. The results reveal that maternal status has a negative and insignificant relationship with under-five mortality, which is opposite as compared to long run. The coefficient of economic deprivation reveals that there is a positive and significant relationship between economic deprivation and under-five child mortality in Pakistan. The results indicate that 1 percent increase in economic deprivation in Pakistan increases under-five child mortality by (. 0023401) percent in the short run and this relationship is significant at 5 percent. Health infrastructure has a negative and insignificant relationship with under-five child mortality in the short run, which is opposite to long run estimates. The overall short run dynamic shows that economic deprivation impacts under-five child mortality in the short run, whereas maternal status and health infrastructure has no short run impact on under-five child mortality in Pakistan. ECM has significant and negative value (-0.017555) which is correct theoretically. The significant negative value of ECM shows the speed of adjustment from short run to long run equilibrium. The estimates of ECM reveal that short run needs 56 years and three months to converge in the long run equilibrium. This shows that for achieving a lowest level of under-five mortality in the region the government of Pakistan must have sound planning because this aim needs a long time to fulfill.

Table 6

Vector Error-Correction Model (VECM) ARDL(1,1,1,1) Dependent variable is dLUFCM Time Period 1980-2017			
Regressor	Co-efficients	Standard-Error	T-Ratio (Prob)
dLMS	-.0016558	.0036697	-.45121[.655]
Dled	.0023401	.8407E-3	2.7836[.010]
dHi	-.0020029	.0037867	-.52892[.601]
ECM(-1)	-.017555	.0039305	-4.4665[.000]

Diagnostic tests are conducted to overview the problem of serial correlation, functional form, normality and Heteroscedasticity among the variables of the model. The estimated results of diagnostic tests are presented in Table 7. The results of the Lagrange multiplier test of residual serial correlation show that there is no serial correlation between the variables of the model. Ramsey's RESET test using the square of the fitted values reveal that the model has correct functional form. Normality based on Skewness and Kurtosis explains that the time series data of all variables are normally distributed. The results also confirm that there is no heteroscedasticity in data.

Table 7

Diagnostic Tests		
Test Statistics	LM-Version	F-Version
A-Serial Correlation CHSQ(1)	3.6802[.095]*F(1,23)	2.9889[.097]
B-Functional Form CHSQ(1)	.0043463[.947]*F(1,23)	.0031244[.956]
C-Normality CHSQ(2)	.083085[.959]	Not-applicable
D-Heteroscedasticity CHSQ(1)	1.6859[.194]*F(1,30)	1.6685[.206]
A: Lagrange multiplier test of residual serial correlation B: Ramsey's RESET test using the square of the fitted values C: Based on a test of skewness and kurtosis of residuals D: Based on the regression of squared residuals on squared fitted values		

The stability of model is very important because the stability tests enable us to see whether the estimated model shifts or not over the selected time period. The Cumulative Sum (CUSUM) and the Cumulative Sum of the Squares (CUSUM sq) tests are used for this purpose. The results of Cumulative Sum (CUSUM) and the Cumulative Sum of the Squares (CUSUM sq) tests are reported in Figure 1 and Figure 2. The figures show that Cumulative Sum (CUSUM) and the Cumulative Sum of the Squares (CUSUM sq) are between the two critical boundaries and do not go outside the critical boundaries. The figures of Cumulative Sum (CUSUM) and the Cumulative Sum of the Squares (CUSUM sq) confirm that selected model is correctly specified.

Table 8 presents the results of the Granger causality test based on Block Endogeneity Wald Tests**.** The simple null hypothesis is that maternal status, economic deprivation and health infrastructure do not Granger cause under-five child mortality in Pakistan. The null hypothesis is accepted or rejected based on "chi-squared test based on Wald criterion" to determine the joint significance of the restrictions under the null hypothesis. The lag length is justified by a minimum Final Prediction error (FPE), Schwarz Information Criterion (SIC) and likelihood ratio test statistics. The estimated results suggest lag order 4 as optimal lag length. There are four models in the table, first under-five mortality is dependent, second when maternal status is dependent, third when economic deprivation is dependent and fourth when health infrastructure is dependent. The *p* value (0.0844) indicates that the coefficient of maternal status is not jointly zero in the equation when under-five child mortality is dependent. In this case the null hypothesis that maternal status does not Granger cause under-five child mortality can be rejected and unidirectional causality is observed from maternal status to under-five child mortality in Pakistan. The *p* value (0.0754) reveals that the coefficient of economic deprivation is not jointly zero in the equation when under-five child mortality is dependent. In this case the null hypothesis that economic deprivation does not Granger cause under-five child mortality can be rejected and unidirectional causality is observed from economic deprivation to under-five child mortality in Pakistan.

The *p* value (0.0799) shows that the coefficient of health infrastructure is not jointly zero in the equation when under-five child mortality is dependent. In this case the null hypothesis that health infrastructure does not Granger cause under-five child mortality can be rejected and unidirectional causality is observed from health infrastructure to under-five child mortality in Pakistan. When maternal status is dependent variable, the *p* value (0.0278) shows that the coefficient of health infrastructure is not jointly zero in this equation. In this case the null hypothesis that health infrastructure does not Granger cause maternal status can be rejected and unidirectional causality is observed from health infrastructure to maternal status in Pakistan. The results show that when maternal status, economic deprivation and health infrastructure are dependent they have no causal relationship with under-five child mortality. Hence it is concluded that a unidirectional causality is running from all explanatory variables (maternal status, economic deprivation and health infrastructure) to the dependent variable (under-five child mortality) in case of Pakistan. These findings are proposing that for reducing under-five child mortality, the government of Pakistan should improve the maternal status and health infrastructure whereas economic deprivation should be minimized.

Figure 1

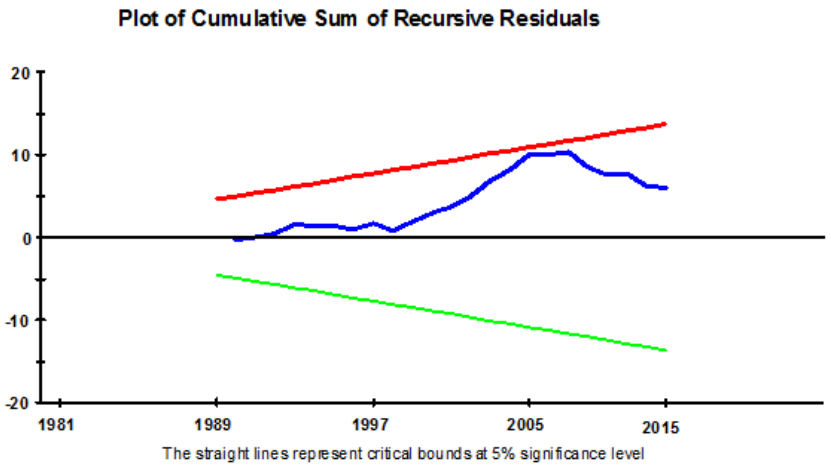

Figure 2

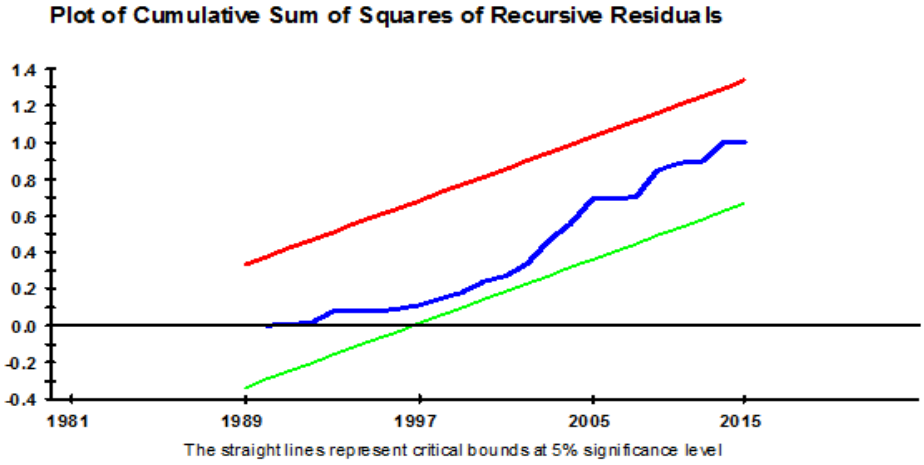

Table-8

VEC Granger Causality/Block Exogeneity Wald Tests			
Sample: 1980-2017			
Dependent variable: D(LUFCM)			
Excluded	Chi-sq	df	Prob.
D(LMS)	7.440671	4	0.0844
D(LED)	8.483056	4	0.0754
D(HI)	8.339873	4	0.0799
All	14.58572	12	0.2649
Dependent variable: D(LMS)			
D(LUFCM)	4.097608	4	0.3930
D(LED)	1.543776	4	0.8189
D(HI)	10.88965	4	0.0278
All	26.87648	12	0.0080
Dependent variable: D(LED)			
D(LUFCM)	6.888437	4	0.1419
D(LMS)	2.164077	4	0.7056
D(HI)	4.025435	4	0.4026
All	12.72737	12	0.3892
Dependent variable: D(HI)			
D(LUFCM)	3.560345	4	0.4688
D(LMS)	7.364089	4	0.1179
D(LED)	2.029435	4	0.7303
All	10.76741	12	0.5489

VI. Conclusions and Policy Implications

This study has tried to justify the fact that economic deprivation, health, infrastructure and maternal status impact under-five child mortality in Pakistan over the period of 1980 to 2017? By incorporating inflation rate and unemployment rate an index of economic deprivation is constructed. The health infrastructure index is constructed with the help of total number of hospitals, total number of doctors, total number of dispensaries, basic health units, maternity and child health centers, rural health centers, registered midwives and registered lady health visitors etc. Female higher secondary is taken as a proxy for maternal status. For checking the stationarity of data Augmented Dickey-Fuller (ADF) unit root test is used. Autoregressive Distributed Lag (ARDL) model has been used for examining the co-integration among the variables of the models and Vector Error-Correction model is used for short run dynamics of the model. Granger causality test has been applied to explore the causal relationship among the variables. The estimated results show that maternal status and health infrastructure have a negative and significant impact on under-five child mortality, whereas economic deprivation has a positive and significant relationship with under-five mortality in case of Pakistan. The results of the Granger causality test show that there is unidirectional causality is running from independent variables to the dependent variable. On the basis of estimated results, it is concluded that economic deprivation, maternal status and health infrastructure have a deep-rooted impact on under-five child mortality in case of Pakistan. Following these findings, it is suggested that for reducing under-five child mortality, the government of Pakistan should improve the maternal status and health infrastructure whereas economic deprivation should be minimized. Health sector of the country faces tough challenges and there is a dire need to enhance the budget allocation for health aggressively by federal and all provincial governments, especially development expenditure so that increased and better-quality health facilities may be available across the country. The present government is committed to increase the health coverage for the growing demand of an increasing population. A number of efforts are underway to provide health facilities, increasing health expenditure and to meet goals under SDGs like Sehat-Sahulat Program, Civil Registration & Vital Statistics, Deworm Islamabad Insensitive etc. And taking expenses at health as an investment rather considering its cost. The Pakistan Atomic Energy Commission (PAEC) has given high priority to the application of nuclear technology in the health sector especially utilizing radiotherapy in the treatment of cancer. Noncommunicable diseases are responsible for the majority of global deaths

and cancer is ranked second leading cause of death and single most important barrier to increasing life expectancy worldwide. Since the establishment of a first nuclear medical center of PAEC in 1960 at Karachi, currently there are 18 Atomic Energy Cancer Hospital (AECHs) dedicated to serving poor cancer patients not only in major cities but also in remote areas like D. I Khan, Bannu, Swat, Nawabshah etc. They are diligently working to provide latest and comprehensive diagnostic and treatment facilities for cancer patients irrespective of the stage of disease. AECHs are operated by skilled teams of more than 2,500 professionals, including doctors, scientists, engineers, paramedical, technical and other supportive staff. Construction of another AECH is underway at Gilgit which will be opened in the next fiscal year, while the proposal for establishment of other two such centers are under consideration.

References

Ali, A. (2011). Disaggregated import demand functions of Pakistan; An empirical Analysis. M-Phil Thesis, NCBA&E, Lahore, Pakistan, 1-70.

Ali, A. (2015). *The impact of macroeconomic instability on social progress: an empirical analysis of Pakistan*. (Doctoral dissertation, National College of Business Administration & Economics Lahore).

Ali, A. (2018). Issue of Income Inequality Under the Perceptive of Macroeconomic Instability: An Empirical Analysis of Pakistan. *Pakistan Economic and Social Review*, 56(1), 121-155.

Ali, A. and Bibi, C. (2017). Determinants of Social Progress and its Scenarios under the role of Macroeconomic Instability: Empirics from Pakistan. *Pakistan Economic and Social Review* 55 (2), 505-540.

Ali, A., & Ahmad, K. (2014). The Impact of Socio-Economic Factors on Life Expectancy in Sultanate of Oman: An Empirical Analysis. *Middle-East Journal of Scientific Research*, 22(2), 218-224.

Ali, A., & Audi, M. (2016). The Impact of Income Inequality, Environmental Degradation and Globalization on Life Expectancy in Pakistan: An Empirical Analysis. *International Journal of Economics and Empirical Research*, 4 (4), 182-193.

Ali, A., & Audi, M. (2018). Macroeconomic Environment and Taxes Revenues in Pakistan: An Application of ARDL Approach. *Bulletin of Business and Economics* (BBE), 7(1), 30-39.

Ali, A., & Rehman, H. U. (2015). Macroeconomic Instability and Its Impact on Gross Domestic Product: An Empirical Analysis of Pakistan. *Pakistan Economic and Social Review*, 53(2), 285.

Ali, A., & Zulfiqar, K. (2018). An Assessment of Association between Natural Resources Agglomeration and Unemployment in Pakistan. *Pakistan Vision*, 19(1), 110-126.

Ali, A., Ahmed, F., & Rahman, F. U. (2016). Impact of Government Borrowing on Financial Development (A case study of Pakistan). *Bulletin of Business and Economics* (BBE), 5(3), 135-143.

Arshad, S., & Ali, A. (2016). Trade-off between Inflation, Interest and Unemployment Rate of Pakistan: Revisited. *Bulletin of Business and Economics (BBE)*, *5*(4), 193-209.

Baird, S., Friedman, J. and Schady, N. (2011). Aggregate Income Shocks and Infant Mortality in the Developing World. *The Review of Economics and Statistics*, 93, 847-856.

Bengtsson, T. (1999). The Vulnerable Child. Economic Insecurity and Child Mortality in Pre- Industrial Sweden: A Case Study of Västanfors, 1757–1850. *European Journal of Population*, 15, 117-151.

Caldwell, J. C. (1979). Education as a factor in mortality decline an examination of Nigerian data. *Population studies*, 395-413.

Cleland, J. (2001). The effects of improved survival on fertility: A reassessment. *Population and Development Review*, 27, 60-92.

Cleland, J. A. H., and Farooqui, M. N. I. (1998). *Health and Survival*. Chapter, *8*, 1996-97, Pakistan Institute of Development Economics, Islamabad.

Cornia, G. A., & Paniccià, R. (2000). *The mortality crisis in transitional economies*. Oxford University Press.

Debpuur, C., Wontuo, P., Akazili, J., & Nyarko, P. (2005). Measuring Health Equity in Small Areas; Findings from Demographic Surveillance Systems. *Population Research Review, Ghana*, *20*, 45-65.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 1057-1072.

Engle, R. F. and Granger, C. W. J. (1987). Co-integration and Error Representation: Estimation and Testing. *Econometrica*, 55(2), 251-276.

Government of Pakistan (2012). Pakistan Economic Survey. Islamabad, Pakistan: Finance Division, Government of Pakistan.

Granger, C. W. (1987). Some recent development in a concept of causality. *Journal of econometrics*, 39(1), 199-211.

Guillaumont, P. (2009). An economic vulnerability index: its design and use for international development policy. *Oxford Development Studies*, 37(3), 193-228.

Hobcraft, J. (1993). Women's education, child welfare and child survival: a review of the evidence. *Health Transition Review*, 159-175.

Hojman, D.E. (1994), Economic and Other Determinants of Infant and Child Mortality in Small Developing Countries: The Case of Central America and the Caribbean, *Institute of Latin American Studies, University of Liverpool Research Paper* 16.

Hosseinpoor, A. R., Mohammad, K., Majdzadeh, R., Naghavi, M., Abolhassani, F., Sousa, A., & Vega, J. (2005). Socioeconomic inequality in infant mortality in Iran and across its provinces. *Bulletin of the World Health Organization*, 83(11), 837-844.

Johansen, S. (1991). Estimation and Hypothesis Testing of Co-integration Vectors in Gaussian Vector Autoregressive models. *Econometrica*, 59(6), 1551-1580.

Johansen, S. (1992). Co-integration in Partial Systems and the Efficiency of Single-Equation Analysis. *Journal of Econometric*, 52(3), 389-402.

Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Co-integration with Applications to the Demand for money. *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Laurenceson, J. Joseph, C. and Chai, H. (2003). Financial Reform and Economic Development in china. Cheltenham, UK, Edward Elgar.

Lesaëge-Dugied, A. (1972). La mortalité infantile dans le département du Nord de 1815 à 1914. *L'homme, la vie et la mort dans le Nord au 19e siècle (Université de Lille III-Editions Universitaires, Lille)*, 81-137.

Madise, N. J., & Diamond, I. (1995). Determinants of infant mortality in Malawi: an analysis to control for death clustering within families. *Journal of Biosocial Science*, 27(01), 95-106.

Madise, N. J., Banda, E. M., & Benaya, K. W. (2003). Infant mortality in Zambia: socioeconomic and demographic correlates. *Social Biology*, 50(1-2), 148-166.

Mah, J. S. (2000). An Empirical Examination of the Disaggregated Import Demand of Korea: The Case of Information Technology Products. *Journal of Asian Economics*, 11(2), 237-244.

Masuy-Stroobant, G., & Gourbin, C. (1995). Infant health and mortality indicators. *European Journal of Population/Revue européenne de démographie*, 11(1), 63-84.

Mosley, W. H., & Chen, L. C. (1984). An analytical framework for the study of child survival in developing countries. *Population and development review*, *10*(0), 25-45.

Mutunga, C. J. (2004, April). Environmental determinants of child mortality in urban Kenya. In *Discussed in an informal workshop held at the Abdus Salam ICTP: Trieste, Italy*.

Narayan, P. K. (2005). The Saving and Investment Nexus for China: Evidence from Co-integration Tests. *Applied Economic*, 37(17), 1979-1990.

Palloni, A. (1990). Fertility and mortality decline in Latin America. *The ANNALS of the American Academy of Political and Social Science*, 510(1), 126-144.

Pattichis, C. A. (1999). Price and Income Elasticities of Disaggregated Import Demand; Results from UECMs and an Application. *Applied Economics*, 31(9), 1061-1071.

Pesaran, M. H. and Pesaran, B. (1997). Working with Microfit 4.0: Interactive Econometric Analysis. Oxford: Oxford University Press.

Pesaran, M. H. and Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Co-integration Analysis. In Strom, S. (ED), Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium, Cambridge: Cambridge University Press.

Pesaran, M. H. Shin, Y. and Smith, R. J. (2001). Bound Testing Approaches to the Analysis of level Relationships. *Journal of Applied Econometric*, 16(3), 289-326.

Schultz, T. P. (1984). Studying the impact of household economic and community variables on child mortality. *population and Development Review*, 215-235.

Senauer, B., & Kassouf, A. L. (2000). The effects of breastfeeding on health and the demand for medical assistance among children in Brazil. *Economic Development and Cultural Change*, 48(4), 719-736.

Shkolnikov, V. M., Cornia, G. A., Leon, D. A., & Meslé, F. (1998). Causes of the Russian mortality crisis: evidence and interpretations. *World development*, *26*(11), 1995-2011.

Subbarao, K., and Raney, L. (1995). Social gains from female education: a cross-national study. *Economic development and cultural change*, 44(1), 105-128.

UNICEF. (2006). *The state of the world's children 2007: Women and children: The double dividend of gender equality* (Vol. 7). Unicef.

United Nations (2008): The Millennium Development Goals Indicators: The Official United Nations site for the MDG Indicators. Retrieved on July 23, 2008 at 14:18pm from http://mdgs.un.org/unsd/mdg/Data.aspx

Van den Berg, G., Lindeboom, M. and Lopez, M. (2006), Inequality in Individual Mortality and Economic Conditions in Earlier Life, *IZA Discussion Paper No.* 2425.

Visaria, L. (1985). Infant mortality in India: Level, trends and determinants. *Economic and Political Weekly*, 1352-1359.

Woldemicael, G. (2008). Recent fertility decline in Eritrea: Is it a conflict-led transition. *Demographic Research*, 18(2), 27-58.