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Child Mortality in India and Its Determinants

Ms. Sanya Sachdeva

Assistant Professor, Department of Economics, Manav Rachna International University, M.A. Development Economics, South Asian University

Abstract: *Children are the potential future of a nation; therefore the concern about their health status is unavoidable. One of the Millennium Development Goals (MDG's) is to reduce child mortality by two thirds, from its level in 1990, by the year 2015. The focus of this paper is to identify the various determinants of child mortality in India using empirical econometric analysis and then give policy suggestions on how these determinants can be altered in a desired way, leading to further reductions in child mortality and consequently the achievement of the MDG.*

Keywords: *Mortality*

1. INTRODUCTION

From the day of birth, a child is valued as an asset promising future economic prosperity to its family. On similar ideology, children stand important not just for their respective families, but for the nation as a whole. Children can be viewed as the future potential drivers of the economy. Thus improving their health status is an obvious matter of concern.

Since children form the most sensitive and vulnerable section of the society, any deterioration in economic, social, environmental or general health levels impacts them adversely.

Child mortality is thus a chief indicator of a nation's overall well being. It not just informs one about the health status of children, but also highlights the socio-economic conditions as well as the general health level of a country. Recognizing health of children as a vital factor, reducing child mortality has been incorporated as one of the eight Millennium Development Goals. This calls for reducing child mortality by two thirds, from its level in 1990, by the year 2015.

Meeting the millennium development goal requires India's child mortality rate to fall to at least 38 per thousand live births (one third of the 1990 level of 114 per thousand live births).

Although there has been a sharp reduction in child mortality rates in India from a high mortality rate of 238.9 per 1000 live births in 1960 to 62.7 in 2010, this rate of reduction does not guarantee meeting the MDG. Presently, India needs to reduce by half its 2010 child mortality rate within a span of just 5 years in order to meet the MDG. Secondly, a lot still needs to be done since a mortality rate of 62.7 per 1000 live births cannot be characterized as a low mortality rate. Also, the main reasons for relatively high child mortality in India has been exposure of fatal diseases, poor child care etc. This is in sharp contrast to the developed world, where the causes of child mortality are mostly accidents.

An improvement in the health status of children is not only a matter of pride for a nation, but also promises certain implicit fruits. Better child health would imply relatively less expenditure on treatment, hospital fee etc. These savings can be mobilized at the macro level and can be used for productive investment. Thus a fall in fertility rate can also contribute to growth by making available a pool of savings for investment purposes, which were earlier lost on hospital fee or treatment.

2. DETERMINANTS OF CHILD MORTALITY: SETTING UP THEORETICAL BACKGROUND

In this section we look at the various factors that determine child mortality and justify them on the basis of theory.

1. **Child mortality and maternal health**: It is an obvious notion that the health status of a child directly depends upon the health status of the mother. A child with a healthy mother stands a higher survival chance as compared

to a child with an unhealthy mother or no mother in some cases. Children born to healthy mothers are expected to be in good health at birth and to be well fed while nursing. Therefore one must expect a positive relationship between maternal health and child mortality.

2. **Child mortality and mother's education**: Similar to the above idea, children of educated mothers stand a higher survival chance compared to the children of uneducated mothers. Educated mothers are well aware of the importance of early years child care and thus stand a better chance in promising their children a healthy childhood. Thus, a negative relationship between mother's education and child mortality is expected to be inversely related to mother's education.

3. **Child mortality and Life expectancy at birth**: A higher life expectancy would imply a good socio-economic environment and consequently implying a lower mortality rate. Next, a higher life expectancy at birth would also imply a fall in the fertility rate (if parents expect their children to live longer they will decide to have a fewer number of children) and a consequent fall in child mortality. Thus a negative relationship between life expectancy at birth and child mortality rate is expected.

4. **Child mortality and Total Fertility rate**: Total fertility rate refers to the number of children per female. High fertility rate would mean higher number of births per woman. This would mean absence of individual attention per child leading poor child health and a greater risk exposure to disease. Thus a higher fertility rate would imply a higher rate of child mortality.

5. **Access to health facilities**: a high access to good quality medical facilities in a nation should mean a high survival rate, i.e. fall in the child mortality rate for that nation. Access to medical facilities can be represented by the reported coverage of immunization of diseases, number of hospital beds, number per doctors available etc.

6. **Public health expenditure**: health expenditure by the government includes expenditure on building new hospitals, expenditure on providing medical facilities in small villages and remote areas, expenditure on making medicines available to the poor at affordable prices etc. In general, a high public expenditure would guarantee lower child mortality.

3. ECONOMETRIC MODEL & EMPIRICAL TESTING

On the basis of theoretical ideas, major determinants of child mortality have been listed above. We next test which of the above determinants are empirically valid.

We formulate a regression function using Child Mortality as the dependent variable. Independent variables include:

i. Life expectancy at birth

ii. Female labour force participation rate (proxy for female literacy rate)

iii. Fertility rate (also acts as an indicator of maternal health)

iv. Immunization coverage of DPT (an indicator of availability of medical facilities)

v. Immunization of measles (an indicator of availability of medical facilities)

Regressions have been run for 2 data sets, both time series.

First from 1980 to 2010 (including immunization of DPT, excluding immunization of measles)

Second from 1985 to 2010 (including immunization of measles, excluding immunization of DPT).

Regression 1: Time series data from 1980 to 2010

Regression Function:

$$\textit{child mortality}_i = \beta_0 + \beta_1 \text{ (life expectancy at birth)}_i + \beta_2 \text{ (female labour force participation)}_i + \beta_3 \text{ (fertility rate)}_i + \beta_4 \text{ (immunization of DPT)}_i + u_i$$

On performing the above regression on STATA, the following output table was generated:

```
. reg childmortality lifeexpectancyatbirth femalelaborforceparticipationoff fertilityrate immunizationcoverageofdpt

      Source |       SS       df       MS              Number of obs =      30
-------------+------------------------------           F(  4,    25) =95229.41
       Model |  18488.7346     4  4622.18364           Prob > F      =  0.0000
    Residual |  1.21343388    25  .048537355           R-squared     =  0.9999
-------------+------------------------------           Adj R-squared =  0.9999
       Total |   18489.948    29  637.584414           Root MSE      =  .22031

------------------------------------------------------------------------------
childmorta~y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lifeexpect~h |  -2.108171   .1525854   -13.82   0.000    -2.422426   -1.793915
femalelabo~f |  -1.115877   .1179659    -9.46   0.000    -1.358833    -.872922
fertilityr~e |   30.35919    .814079    37.29   0.000     28.68257    32.03582
immunizati~t |  -.0065547   .0079601    -0.82   0.418    -.0229488    .0098394
       _cons |   157.6188   12.00182    13.13   0.000     132.9006     182.337
------------------------------------------------------------------------------
```

Interpretation of <u>R square</u>:

The value of R square is 0.99. This value is very high and represents a good fit of the model; almost a perfect fit of the model.

Interpretation of <u>F statistic</u>:

The value of the F statistic is 95229. This is an extremely high value, indicating that all the explanatory variables are jointly significant.

Interpretation of <u>constant</u> (β_0):

When then values of all explanatory variables is zero, then child mortality rate is 157.61 per thousand live births. This has no meaningful economic interpretation since it keeps life expectance at 0, fertility rate at 0 and labour force participation at 0.

Interpretation of the <u>coefficients</u> of the <u>explanatory variables</u>:

1. The **coefficient of life expectancy at birth (β_1)** has a negative sign, as expected on the basis of theory. Value of the coefficient is -2.108 implying that a rise in life expectancy by one year would reduce child mortality by 2.108 per 1000 live births.

   This tells us that even empirically it is justified to say that a higher life expectancy would lead to a fall in child mortality.

   Secondly, the p-value of its coefficient is 0, implying that the coefficient is highly significant. The "t" value of –13.82 is also high and lies to the left confidence interval. Thus we can conclude that the **coefficient of life expectancy at birth is statistically significant.**

2. The **coefficient of female labour force participation (β_2)** also has a negative sign, as expected. Value of the coefficient is -1.11, implying that a 1% rise in female labour force participation (as a percentage of total females) would reduce child mortality by 1.11 per 1000 births.

3. Secondly, a p-value of 0 means that the co-efficient of female labour force participation is statistically significant. The t- value of |9.46| is higher than the critical t value of |2.58| (at 5% level of significance) . There is thus ample evidence against a null of statistically insignificant co-efficient.

   Since this variable was taken as a proxy for female literacy rate, we can confidently expect a negative relationship between child mortality and female literacy rate.

4. The **co-efficient of fertility rate (β_3) has a positive sign** as expected on theoretical grounds. The value of the co-efficient of 30.35 is very high, implying that fertility rate has a strong effect on child mortality. It can be interpreted that a fall in fertility rate by 1 child would reduce child mortality by 30.35 per thousand live births.

   Secondly, again the p-value of the coefficient is 0, giving us stronger evidence against the null of **a statistically insignificant coefficient**. The t-value of 37 is also extremely high, reporting a good econometric result since the **null can now be safely rejected**.

Thus it is theoretically, empirically and statistically justified to conclude a positive impact of fertility rate on child mortality.

5. The **co-efficient of immunization of DPT (β_4)** has a negative sign, as expected, implying that a greater coverage of immunization of DPT leads to lower child mortality. However the value of the coefficient is very small, equal to 0.0065 almost negligible. However we do not need to worry about this because on further analysis is it found that the t value of this co-efficient is also small and is also **statistically insignificant**. The t value lies within the confidence interval (as seen from the table above). Thus the null of a statistically significant co-efficient is not rejected.

Regression 2: Time series data from 1985 to 2010

From the first model it was empirically found that immunization of DPT is not a significant determinant of child mortality in India. In this model, we replace immunization coverage of DPT by immunization coverage of measles and look at the results.

Regression function:

$$\boldsymbol{child\ mortality_i = \alpha_0 + \alpha_1(\text{life expectancy at birth})_i + \alpha_2(\text{female labour force participation})_i + \alpha_3(\text{fertility rate})_i + \alpha_4(\text{immunization of measles})_i + v_i}$$

```
. reg  childmortality lifeexpectancyatbirth femalelaborforceparticipationoff fertilityrate immunizationcoverageofmeasles

      Source |       SS       df       MS              Number of obs =      25
-------------+------------------------------           F(  4,    20) =       .
       Model |  9966.71621     4  2491.67905           Prob > F      =  0.0000
    Residual |  .287408952    20  .014370448           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =  1.0000
       Total |  9967.00362    24  415.291817           Root MSE      =  .11988

------------------------------------------------------------------------------
childmorta~y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lifeexpect~h |  -2.178279   .0789914   -27.58   0.000    -2.343052   -2.013506
femalelabo~f |  -.7129977   .0949152    -7.51   0.000    -.9109873    -.515008
fertilityr~e |   29.16545   .4570832    63.81   0.000     28.21199    30.11891
immunizati~s |  -.0154787   .0046546    -3.33   0.003    -.0251881   -.0057693
       _cons |   152.8756    6.39501    23.91   0.000     139.5358    166.2153
------------------------------------------------------------------------------
```

Interpretation of R square:

The value of R square is 1, representing a **PERFECT fit** of the model.

Interpretation of constant (α_0):

When then values of all explanatory variables is zero, then child mortality rate is 152.87 per thousand live births. This has no meaningful economic interpretation since it keeps life expectance at 0, fertility rate at 0 and labour force participation at 0.

Interpretation of coefficients of explanatory variables:

1. **Co-efficient of life expectancy (α_1)** has a **negative sign** as expected. However the value of the co-efficient has fallen by a very small amount to -2.178. The p value is still zero and the t statistic has a high value of 27. We can safely conclude that the co-efficient of life expectancy **is statistically significant.**

2. **Co-efficient of female labour force participation (α_2)** has a **negative sign** as expected. However the value of the co-efficient has fallen from |1.11| to |0.71|. Yet the p value is still zero, and the t of |7.51| value is also high implying that the co-efficient still remains **statistically significant**.

3. **Coefficient of fertility rate (α_3)** has a **positive sign** as expected. Here also the value of the coefficient has fallen from 30.35 in the first case to 29.16. Yet, the p value remains small at zero and t value is also high at 63. High enough to **reject the null**. Thus fertility rate remains an important determinant of child mortality.

4. Interesting result is of the fourth explanatory variable: **immunization coverage of measles.** Firstly, its coefficient **(α_4)** has a negative sign as expected. The value of coefficient is small at 0.01, but is larger than the coefficient of coverage of immunization of DPT. Secondly, this co-efficient is also statistically significant. The p value is low at 0.003 and also the t value of |3.33| is greater than the critical t value of 2.58 (at 5% level of significance). Also the t value lies outside the 95% confidence interval. Thus we have enough evidence against the null of an insignificant coefficient. We can conclude that the co-efficient of immunization coverage of measles **is statistically significant** (in the Indian case).

Undoubtedly, the result of regression two are better than results of regression one. One possible reason for immunization coverage of measles to be significant and immunization coverage of DPT to be insignificant can perhaps be that in India measles was relatively more responsible for deaths of children under the age of 5 than DPT. Thus spread of vaccinations and prevention methods against measles had a stronger impact on child mortality than spread of DPT vaccinations.

4. CHILD MORTALITY AND SAVINGS RATE OF INDIA

As stated above, a lower child morality is not just a vital indicator of social and economic status of a country. It can effectively contribute to economic growth by boosting the savings rate.

We have used time series data from 1980 – 2010 and regressed gross savings (%) of India on child mortality in India to see if empirically the hypothesis stated above holds or not.

The following regression output table was obtained using STATA:

```
. reg  grosssavingsrateofgni childmortality

      Source |       SS       df       MS              Number of obs =      30
-------------+------------------------------           F(  1,    28) =  108.75
       Model |  615.316195     1  615.316195           Prob > F      =  0.0000
    Residual |  158.431229    28  5.65825817           R-squared     =  0.7952
-------------+------------------------------           Adj R-squared =  0.7879
       Total |  773.747424    29  26.6809456           Root MSE      =  2.3787

------------------------------------------------------------------------------
grosssavin~i |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
childmorta~y |  -.1824237   .0174934   -10.43   0.000    -.2182573   -.1465902
       _cons |   44.05173   1.847182    23.85   0.000     40.26795    47.83551
------------------------------------------------------------------------------
```

Interpretation: Firstly, the **R square** value of the model is 0.79, which tells us that 79% of the variations in savings rate are explained by a change in child mortality, representing a good fit of the model. Secondly, though the **coefficient of child mortality rate** is small, yet it is **highly significant**. The p value is 0 and t value of |10.43| > |2.56| at 5% level of significance. The t value lies to the left of the 95% confidence interval. We can thus conclude that child mortality has a small yet statistically significant impact on gross savings rate of India.

Thus, reduced child mortality is capable of generating a pool of funds that if channelized towards productive investment can lead to higher growth.

5. POLICY RECOMMENDATION

Since child mortality in India is largely due to controllable factors and not uncontrollable factors like accidents etc. there is an obvious room for policy.

In our analysis we have established that health of a child is closely related to the health of the mother and education of his/her mother. Directly from this flow the following policy options:

1. Policies promoting education among females.
2. For the presently uneducated females workshops and awareness camps can be conducted, imparting to them the knowhow of proper child care, sanitation, proper nutrition intake etc.

Apart from these, it was also concluded that child mortality falls with the spread of medical care. Thus we must ensure:

1. Adequate public investment in hospitals, provision of medicines, treatment facilities not just in urban cities but also rural and remote areas.
2. In addition to investment, proper administration of these hospitals and medicine distribution systems is needed. In many parts of rural India, there are small nursing homes but no doctors. Absenteeism is a problem that needs to be dealt with effectively. Focus needs to be on "delivering" the service and not just on mere "provision" of the service.

6. CONCLUSION

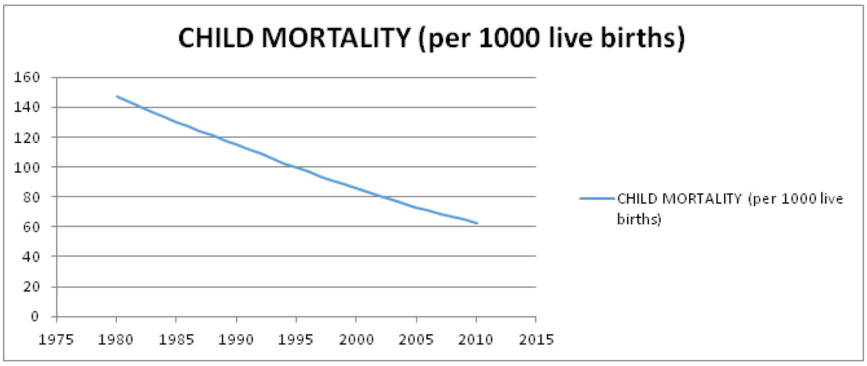
The focus of this research was to first identify the determinants of child mortality in India and then suggest policies directly dealing with those determinants in order to achieve lower rates of child mortality in future, motivation behind this being the target of MDG of reducing the child mortality rate of India to 38 per thousand live births.

According to the empirical testing performed above, we can conclude that life expectancy at birth, female education levels, total fertility rate and spread of immunization coverage of measles were the main determinants of child mortality in India for the period under study (1980 – 2010), satisfying the theoretical background of the research.

Child mortality in India has fallen with rising life expectancy at birth, higher female education levels (represented here by higher labour force participation), falling rates of total fertility and larger coverage of immunization facilities (at least during the period under study)

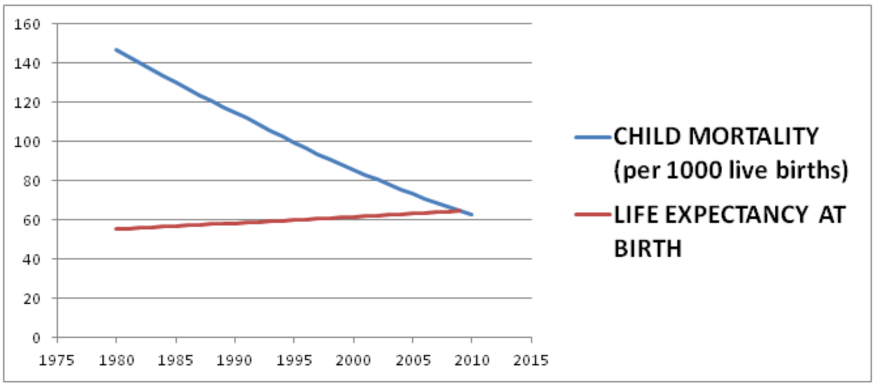
Policies targeted at reducing future rates of child mortality using these variables have been suggested.

7. TRENDS AND DESCRIPTIVE STATISTICS



Trend in child mortality: 1980 – 2010: Declining trend

Child mortality has been following a declining trend. Although the child mortality level of 62.7 in 2010 was far lower than its 1960 level of 238.12 per thousand live births, a lot still remains to be done to reduce the current figures.



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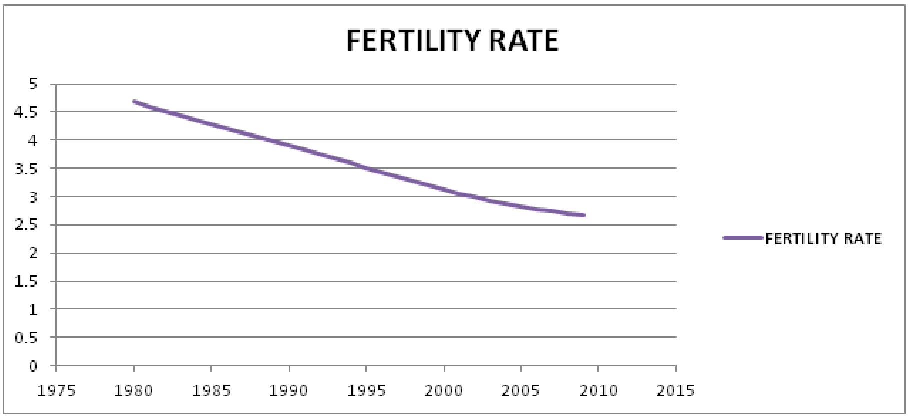
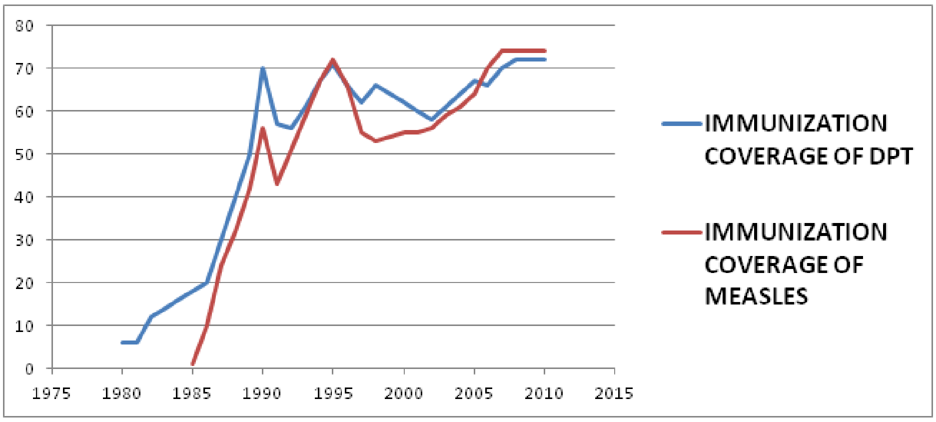
Trend: Child Mortality and Life Expectancy at birth

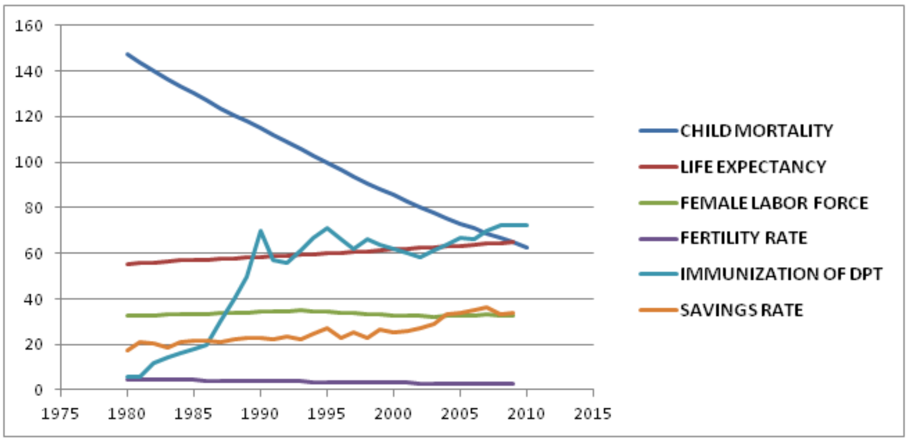
Along 1980 – 2010 Life expectancy has been following an upward trend, i.e. life expectancy has been rising and correspondingly child mortality has been following a downward trend. However one must notice that the fall in child mortality is sharper than the rise in life expectancy during the same period.



Trend of Total Fertility Rate: No. Of live birth per woman: Declining trend.



Trends of: coverage of immunization of DPT and Measles: Rising Trends.



Trend: All variables

APPENDIX

Here we have **checked for stationarity of series** of the variables that have been studied above.

In order to check stationarity, first the time variable "t" was created in stata as follows:


```
. generate t = 1985 + _n-1

. tsset t , yearly
        time variable:  t, 1985 to 2010
                delta:  1 year

. varsoc  lifeexpectancyatbirth femalelaborforceparticipationoff fertilityrate immunizationcoverageofmeasles

   Selection-order criteria
   Sample:  1989 - 2009                         Number of obs      =        21
  +---------------------------------------------------------------------------+
  |lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
  |----+----------------------------------------------------------------------|
  |  0 | -87.4667                      .071354   8.71112   8.7543   8.91008  |
  |  1 |  133.833   442.6   16  0.000  2.4e-10  -10.8412  -10.6253  -9.84644  |
  |  2 |  233.312  198.96   16  0.000  1.0e-13  -18.7916   -18.403   -17.001  |
  |  3 |  261.777   56.93   16  0.000  5.7e-14  -19.9787  -19.4174  -17.3923  |
  |  4 |  416.438  309.32*  16  0.000  5.7e-19* -33.1846* -32.4506* -29.8023* |
  +---------------------------------------------------------------------------+
   Endogenous:  lifeexpectancyatbirth femalelaborforceparticipationoff
                fertilityrate immunizationcoverageofmeasles
    Exogenous:  _cons
```

Once the "t" variable was successfully generated, we checked for stationarity.

Also since the maximum number of stars (*) appeared against the lag of 4 periods, we have used that to check and solve for the problem of non stationarity.

Stationarity of Child Mortality series: The following results were found using STATA:

Null Hypothesis: series has a unit root / presence of non stationarity.

```
. dfuller childmortality , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        21

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.401            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1415
```

The series was found to have been infected with non stationarity problem, since the 't' statistic = |2.401| was less than the critical t values at 1%, 5% and 10% levels of significance respectively.

Therefore we created a new variable CMD (difference variable) and then checked for stationarity again, using dickyfuller test. However, the problem of non stationarity was not eliminated. We repeated the same process by creating another difference variable CMDD but the problem of non stationarity still persisted, as shown in the results below. For both the difference variables the't' test statistic was lower than the critical values.

Therefore we generated another difference variable CMDDD, as shown on the next page:

```
. generate CMD = D1.childmortality
(1 missing value generated)

. dfuller  CMD , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        20

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              0.821            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9920

. generate CMDD = D1.CMD
(2 missing values generated)

. dfuller  CMDD , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.777            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.3921

. generate CMDDD = D1.CMDD
(3 missing values generated)
```

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When we checked dickyfuller test for the variable CMDDD, it was concluded that the problem of stationarity has been eliminated.

```
. dfuller CMDDD , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        18

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.825            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0027
```

Here, the p value has reduced sharply, compared to the previous results and the 't' statistic |3.825| is greater than the critical values at 1% 5% and 10% level of significance respectively.

Thus, the null can be rejected, and it can be concluded that the problem of non stationarity has been eliminated from the series.

<u>Stationarity of Life Expectancy at Birth Series:</u>

Null hypothesis: series had a unit root / presence of non stationarity.

The following result on STATA was generated when we used dickyfuller test:

```
. dfuller  lifeexpectancyatbirth , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        20

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              0.283            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9765
```

The p value was very high and also the't' statistic of |0.283| was smaller than the critical 't' values at 1%, 5% and 10% level of significance.

Thus we generated difference variable 'variableD' and then checked for stationarity.

```
. generate variableD = D1.lifeexpectancyatbirth
(2 missing values generated)

. dfuller  variableD , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.867            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0493
```

The p value fell sharply. Also, the problem of non stationarity was eliminated at 10% level of significance because: |2.867| > |2.630|. However the problem still persisted at 1% and 5% level of significance.

<u>Stationarity of Total Fertility Rate series:</u>

Null hypothesis: series had a unit root / presence of non stationarity.

The following STATA result was generated:

```
. dfuller  fertilityrate , lag(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        20

                              ---------- Interpolated Dickey-Fuller ----------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.601            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0001

.
```

The p value is extremely small (higher evidence against the null).

The't' value generated of |4.601| was high and is larger than the critical 't' values at 1%, 5% and 10% level of significance.

Thus the null can be rejected and it can be concluded that this series is stationary.

<u>Stationarity of Female Labor force participation:</u>

Null hypothesis: series has a unit root / presence of non stationarity.

On performing dickyfuller test, the following output table was generated:

```
. dfuller femalelaborforceparticipationoff , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        20

                              ---------- Interpolated Dickey-Fuller ----------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -0.943            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7733
```

The p value was found to be high (low evidence against the null). Secondly, the 't' value is less than the critical value at all three levels of significance. Thus the series suffers from the problem of non stationarity.

Thus, we generate the difference variable:

```
. generate FLFPD = D1.femalelaborforceparticipationoff
(2 missing values generated)

. dfuller  FLFPD , lags(4)

Augmented Dickey-Fuller test for unit root         Number of obs   =        19

                              ---------- Interpolated Dickey-Fuller ----------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.620            -3.750            -3.000            -2.630
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4727
```

Again, the p value is large and't' statistic is insignificant.

This process was repeated a number of times, but we could not solve the problem of non stationarity.

<u>Note</u>: the series of variables suffers from the problem of non stationary. However in the empirical model this has been ignored, because of time constraint and also because of complications.

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Data source: World Bank Data Set on World Development Indicator (WDI), year: 2011

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