

# **A Study on Under Five Mortality Rates in Selected ASEAN Countries (1999-2013)**

**Myint Myint Thein\***

## **Abstract**

Mortality levels in most of the Asian countries were relatively low during the second half of the 21<sup>st</sup> century. Mortality statistics are not only important indicators of demographic situation but also social and health conditions of a country. Moreover, the low levels of mortality are associated with spread of diseases and standard of living. Therefore, the determinants of mortality rates are also investigated in this paper for some ASEAN countries. This paper examines the statistical analysis on under five mortality rates in Myanmar, Lao PDR, Philippines and Indonesia. These rates depend on time have significant or not by using trend analysis. Measures of accuracy (MAPE, MAD and MSD) were used as the model selection criteria that could best describe the trend of Under Five Mortality Rates of selected ASEAN countries during 1999 to 2013. Under Five Mortality Rates are described to estimate for 2014 to 2016 individual year.

**Key words:** U5MR, Linear regression, Trend analysis

## **Introduction**

Mortality is not important indicators of demographic situation but also social and health conditions of a country. Mortality refers to the occurrence of the deaths which provide indications of the health status of the population, depends on the quality of life and access to the health care services. It also varies by community and physical environment. Such as the climate, the attitude, the quality of health facilities, environmental conditions, sanitation, the type of water supply, degree of the levels of mortality are needed for making demographic analysis, and for determining the level of development. Mortality of infants, children, mothers, and life expectancy at birth are being major factors of population change. Moreover, the speed and magnitude of declines in U5MR rates have varied from one country to country in Asia. Therefore, this study intended to compare the trend of under five mortality rates in selected ASEAN countries.

## **Objective of the Study**

The objective of study is to estimate trend of under five mortality rate in selected ASEAN countries which are Myanmar, Lao PDR, Philippines and Indonesia.

## **Method of Study**

The secondary data were obtained from World Bank Indicators (2014). Descriptive analysis and regression analysis were used to study the trend of U5MR in selected four countries.

## Scope and Limitations of the Study

Under five mortality rate of Myanmar, Lao PDR, Philippines and Indonesia for the year 1999 to 2013 were used in this study.

## Results and Findings

For the purpose of satisfaction (acceptance) of the estimated regression models, the diagnostic standard error of estimate (S.E) were used to examine whether the estimated regression models are statistically significant and acceptable. In addition to these statistics, measures of accuracy, Mean Absolute Percent Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD) were used as the model selection criteria. On the basis of these statistics and criteria, the estimated trend for under five mortality rates in selected ASEAN countries were examined and presented in this section.

### Under Five Mortality Rates (U5MR) for Selected ASEAN Countries

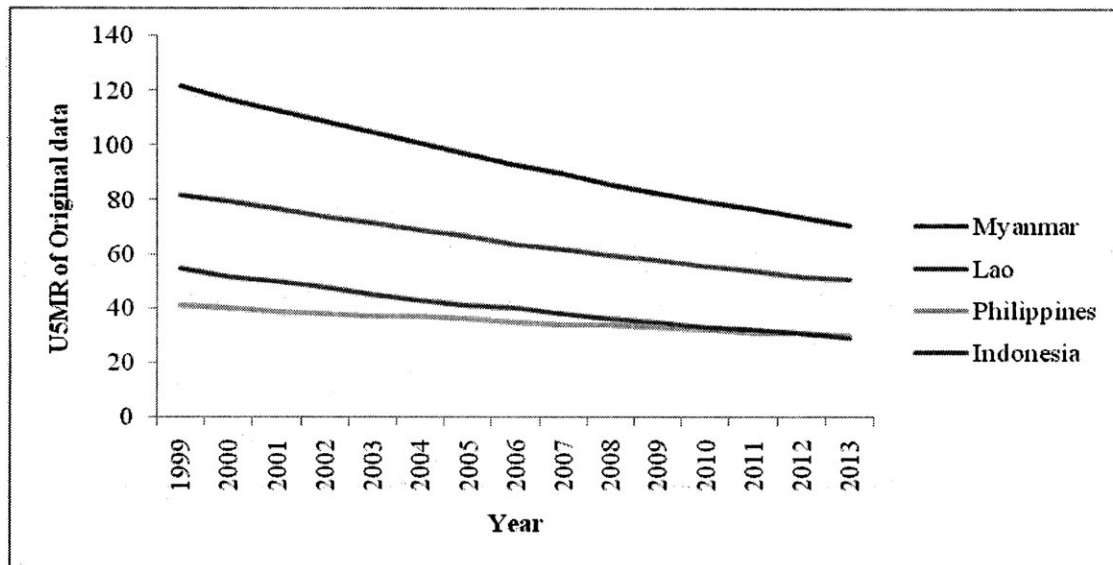
The Under Five Mortality Rates of selected ASEAN countries for the year 1999 to 2013 were shown in Table (1). According to this table the trend of U5MR varied widely from country to country. Beginning of the year 1999, the highest U5MR can be seen in Lao PDR and the lowest U5MR can be seen in Philippines. But at the end of the year 2013, the highest U5MR can be seen in Lao PDR and the lowest U5MR can be seen in Indonesia. During the studying period, the U5MR significantly decline in all studying countries due to Figure (1). It might be due to the effect of the government has made progress in providing effective health care services to all sectors of population.

**Table (1)**  
**U5MR for Selected ASEAN Countries**

Year	U5MR per 1000 live-births			
	Myanmar	Lao	Philippines	Indonesia
1999	82	122	41	55
2000	80	117	40	52
2001	77	113	39	50
2002	74	109	38	48
2003	72	105	37	45
2004	69	101	37	43
2005	67	97	36	41
2006	64	93	35	40
2007	62	90	34	38
2008	60	86	34	36
2009	58	83	33	35
2010	56	80	32	33
2011	54	77	31	32
2012	52	74	31	31
2013	51	71	30	29

Source : World Bank Indicators (2014)

**Figure (1) U5MR for Selected ASEAN Countries**



Source: World Bank Indicators (2014)

#### **Estimated Trend Model for U5MR in Myanmar**

According to the Appendix Table (1), the estimated model for U5MR in Myanmar was linear trend model, because of the value of F statistics was 2042.198 and the model was significant at 1 % level and the  $R^2$  value is 0.994 and this model can explain 99.4% for U5MR. The standard error of estimate was 0.842. Since, the linear trend model is fitted trend for U5MR in Myanmar. The coefficients were significant at 1% level. The estimated values of coefficient for the U5MR in Myanmar were described in the following table.

**Table (2)**  
**Estimated Values of Coefficient for U5MR in Myanmar**

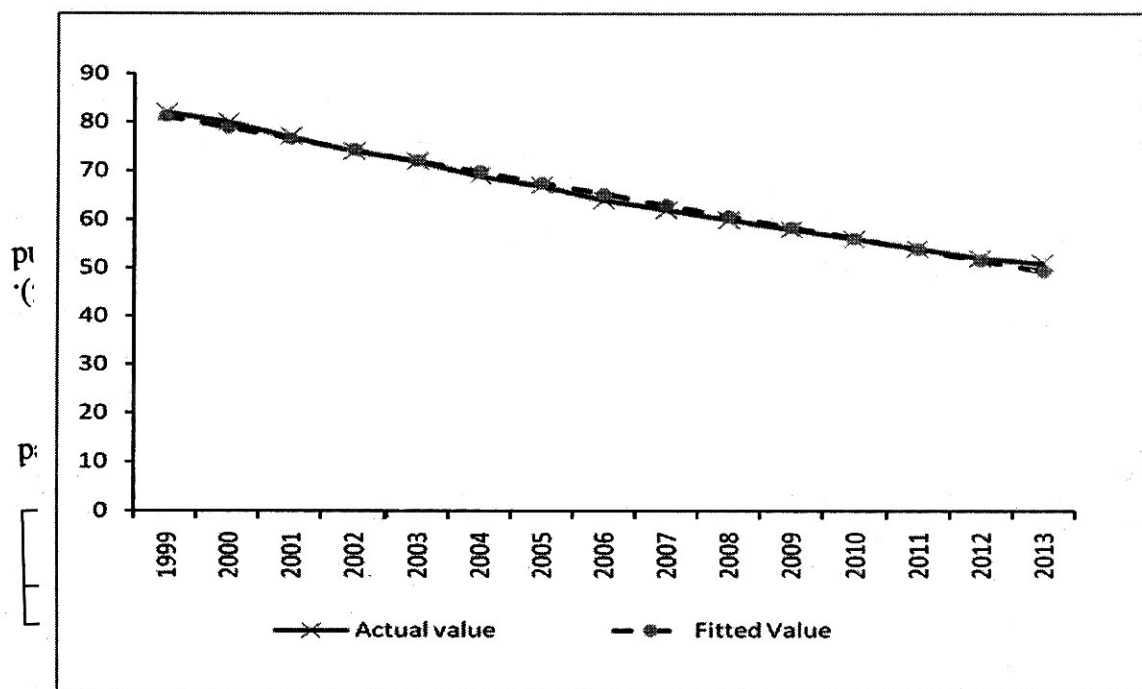
Variable	Coefficient	Standard Error	t- statistic	Sig-t
Constant	83.400	0.458	182.208	0.000
T	-2.275	0.05	-45.191	0.000

According to the Table (2), the estimated linear trend model can be described as follows:

$$\hat{y}_t = 83.4 - 2.275 t$$

The plot of the trend analysis for U5MR in Myanmar was shown in Figure (2). The accuracy measures (MAPE, MAD, MSD) of this model were 1.009, 0.64 and 0.615.

**Figure (2) Plot of Actual and Estimated values for U5MR in Myanmar**



#### **Estimated Trend Model for U5MR in Lao PDR**

According to the Appendix Table (2), the estimated model for U5MR in Lao PDR was linear trend model, because of the value of F statistics was 2711.634 and the model was significant at 1 % level and the  $R^2$  value is 0.995 and this model can explain 99.5% for U5MR. The standard error of estimate was 1.164. Since, the linear trend model is fitted trend for U5MR in Lao PDR. The coefficients were significant at 1% level. The estimated values of coefficient for the U5MR in Lao PDR were described in the following table.

**Table (3)**  
**Estimated Values of Coefficient for U5MR in Lao PDR**

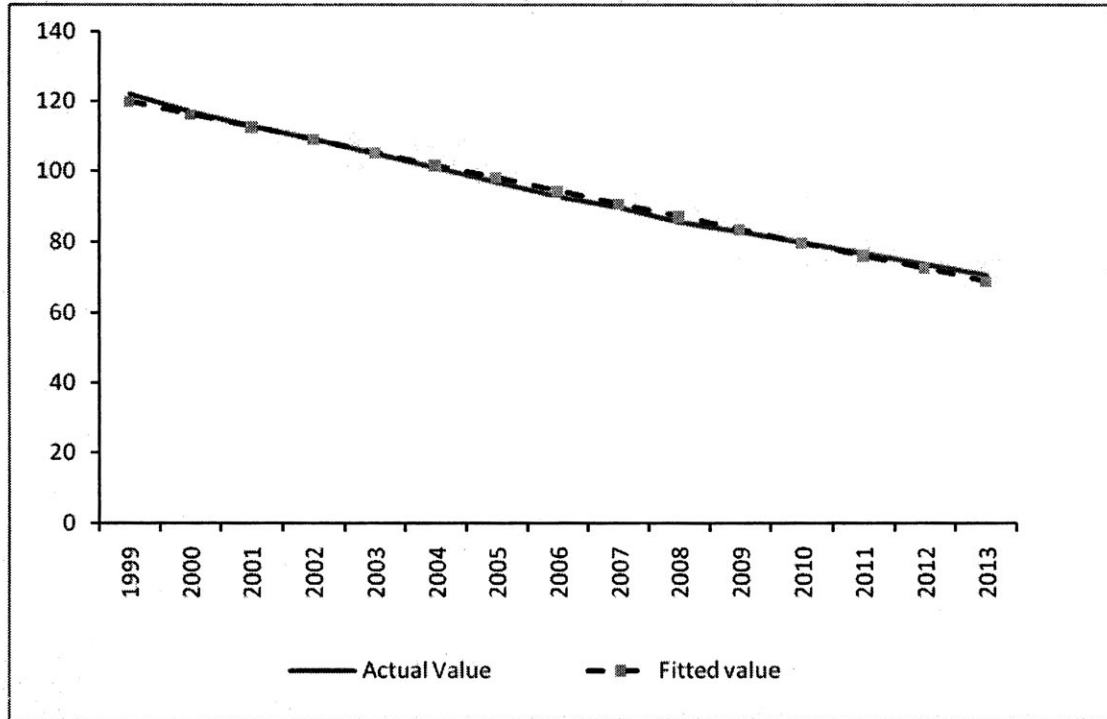
Variable	Coefficient	Standard Error	t- statistic	Sig-t
Constant	123.505	0.632	195.323	0.000
T	-3.621	0.07	-52.073	0.000

According to the Table (3), the estimated linear trend model can be described as follows:

$$\hat{y}_t = 123.505 - 3.621 t$$

The plot of the trend analysis for U5MR in Lao PDR was shown in Figure (3). The accuracy measures (MAPE, MAD, MSD) of this model were 0.999, 0.9067 and 1.1737.

**Figure (3) Plot of Actual and Estimated values for U5MR in Lao PDR**



#### **Estimated Trend Model for U5MR in Philippines**

According to the Appendix Table (3), the estimated model for U5MR in Philippines was exponential trend model, because of the value of F statistics was 1976.523 and the model was significant at 1 % level and the  $R^2$  value is 0.993 and this model can explain 99.3% for U5MR. The standard error of estimate was 0.008. Since, the exponential trend model was selected for the fitted model of U5MR in Philippines. The coefficients were significant at 1% level. The estimated values of coefficient for the U5MR in Philippines were described in the following table.

**Table (4)**  
**Estimated Values of Coefficient for U5MR Philippines**

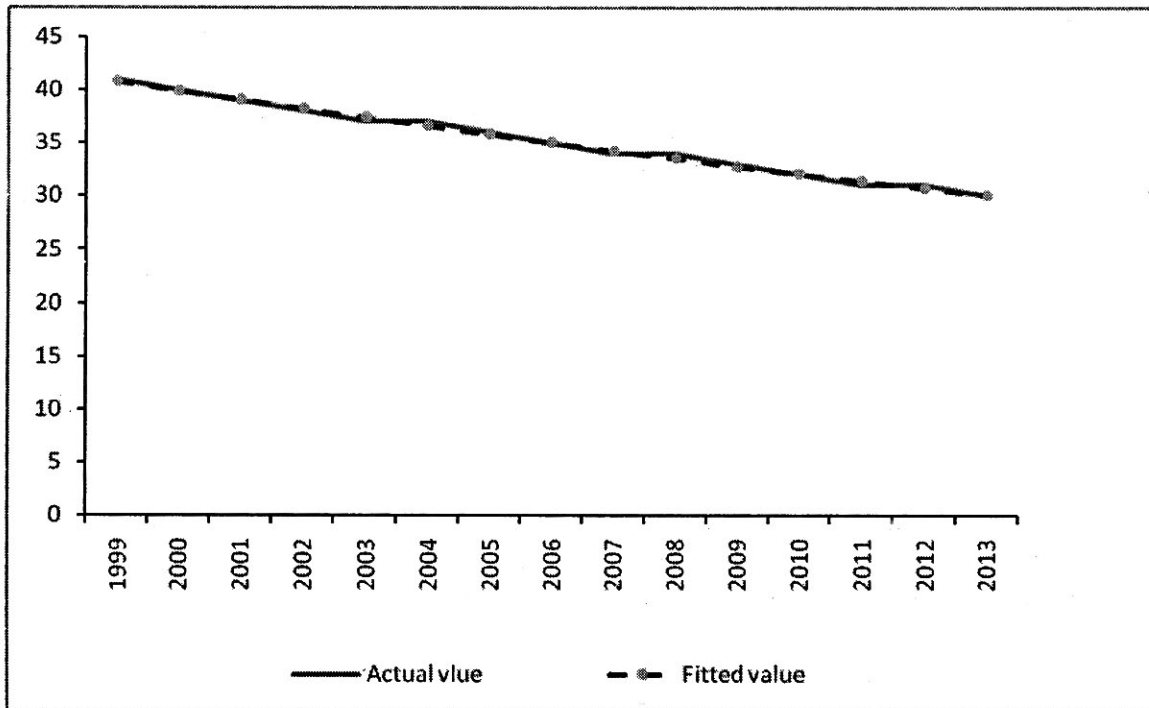
Variable	Coefficient	Standard Error	t- statistic	Sig-t
Constant	44.739	0.187	223.686	0.000
T	-0.022	0.000	-44.458	0.000

According to the Table (4), the estimated exponential trend model can be described as follows:

$$\hat{y}_t = 44.739 \exp (-0.022 t)$$

The plot of the trend analysis for U5MR in Philippines was shown in Figure (4). The accuracy measures (MAPE, MAD, MSD) of this model were 0.6467, 0.224 and 0.069.

**Figure (4) Plot of Actual and Estimated values for U5MR in Philippines**



#### **Estimated Trend Model for U5MR in Indonesia**

According to the Appendix Table (4), the estimated model for U5MR in Indonesia was quadratic trend model, because of the value of F statistics was 3342.863 and the model was significant at 1 % level and the  $R^2$  value is 0.998 and this model can explain 99.8% for U5MR. The standard error of estimate was 0.371. Since, the quadratic trend model was selected for the fitted model of U5MR in Indonesia. The coefficients were significant at 1% level. The estimated values of coefficient for the U5MR in Indonesia were described in the following table.

**Table (5)**  
**Estimated Values of Coefficient for U5MR in Indonesia**

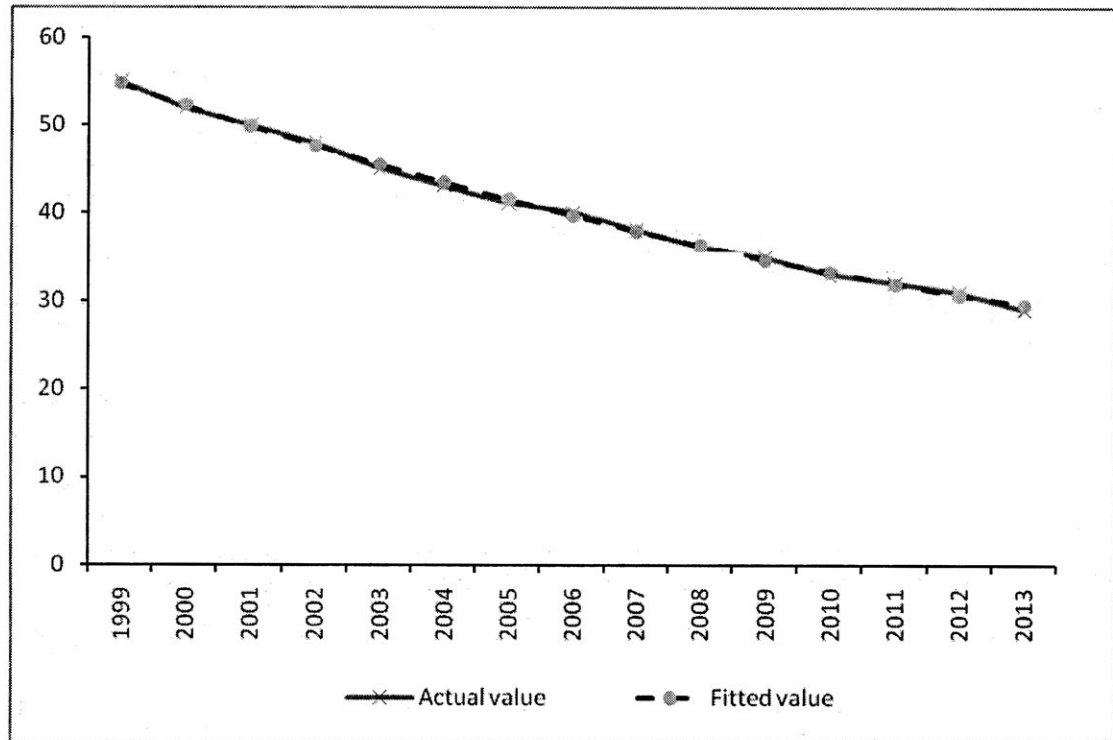
Variable	Coefficient	Standard Error	t- statistic	Sig-t
Constant	57.332	0.332	173.316	0.000
t	-2.640	0.950	-27.750	0.000
t <sup>2</sup>	0.052	0.006	9.042	0.000

According to the Table (4), the estimated quadratic trend model can be described as follows:

$$\hat{y}_t = 57.332 - 2.640 t + 0.052 t^2$$

The plot of the trend analysis for U5MR in Indonesia was shown in Figure (5). The accuracy measures (MAPE, MAD, MSD) of this model were 0.799, 0.309 and 0.1103.

**Figure (5) Plot of Actual and Estimated values for U5MR in Indonesia**



**Forecast Values for U5MR for Selected ASEAN Countries**

The following table shows the predicted U5MR for the period of coming three years from 2014 to 2016 are presented for selected ASEAN countries.

**Table (6)**  
**Predicted U5MR for Selected ASEAN Countries**

Year	Estimated U5MR			
	Myanmar	Lao PDR	Philippines	Indonesia
2014	47.00	65.57	29.34	28.40
2015	44.73	61.95	28.70	27.48
2016	42.45	58.32	28.08	26.66

As a result, the average rate of U5MR is change year by year in selected ASEAN countries. The forecast values for the year 2014 to 2016 were decreased for all the years. It is found that, the U5MR of Myanmar is expected to be decreasing little by little from 47 in 2014 to 42.45 in 2016. Similarly, the predict value of U5MR for Lao PDR, Philippines and Indonesia are also expected to be decreasing. Therefore, the estimated U5MR of survival year at death will be decreased in future.

## **Conclusion**

During the past two decades, there have been changes in Asia, not only in the socio-economic and political situation, but also in the demographic situation. In selected ASEAN countries, population growth has declined to moderate or low levels of decline in U5MR.

Generally, the changes of U5MR is also influenced by socio-economic factors, such as parents education, family income, urban or rural residence, housing conditions, cultural and environment factors, order of birth, mother's age and nutritional conditions, especially breast-feeding. Furthermore, U5MR depends upon the characteristics of family's living condition, other sanitation facilities and employment attainment.

This paper assesses to study the conditions of under five Mortality rates in Myanmar, Lao PDR, Philippines and Indonesia for the period 1999-2013. From the estimated trend model, the most appropriate models are found to be linear trend for Myanmar and Lao PDE, exponential trend model for Philippines and quadratic trend model for Indonesia. According to the predicted values, U5MR for forecasting period 2014 to 2017 is expected to be looking forward to decrease from year to year.

Based upon these findings the study suggests that the U5MR of selected ASEAN countries still needs to decrease and needs to support more health service for public. The policy makers must decide suitable health program and other related health services for the public due to the impact of U5MR.



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Appendix Table (1)  
Results of Trend Analysis for U5MR in Myanmar

Model	R	R <sup>2</sup>	Adj R <sup>2</sup>	S.E	F	t - test			
						Constant	Year (t)	t <sup>2</sup>	t <sup>3</sup>
Linear	0.997	0.994	0.993	0.842	2042.198 (0.000)	182.208 (0.000)	-45.191 (0.000)		
Logarithmic	0.957	0.916	0.910	3.062	142.577 (0.000)	42.100 (0.000)	-11.191 (0.000)		
Inverse	0.779	0.608	0.577	6.635	20.128 (0.001)	24.794 (0.000)	-4.486 (0.001)		
Quadratic	1	0.999	0.999	0.304	7897.818 (0.000)	315.690 (0.000)	-38.359 (0.000)	9.380 (0.000)	
Cubic	1	0.999	0.999	0.284	6038.745 (0.000)	220.763 (0.000)	-13.262 (0.000)	-0.101 (0.922)	1.612 (0.125)
Compound	1	0.999	0.999	0.005	13584.949 (0.000)	366.128 (0.000)	3328.883 (0.000)		
Power	0.940	0.883	0.874	0.056	97.90 (0.000)	26.184 (0.000)	-9.894 (0.000)		
S	0.748	0.559	0.525	0.108	16.481 (0.001)	106.609 (0.000)	4.06 (0.001)		
Growth	1	0.999	0.999	0.005	13584.944 (0.000)	1627.852 (0.000)	-116.554 (0.000)		
Exponential	1	0.999	0.999	0.005	13584.944 (0.000)	366.128 (0.000)	-116.554 (0.000)		
Logistic	1	0.999	0.999	0.025	13584.944 (0.000)	366.128 (0.000)	3328.883 (0.000)		

Appendix Table (2)  
Results of Trend Analysis for USMR in Lao PDR

Model	R	R <sup>2</sup>	Adj R <sup>2</sup>	S.E	F	t - test			
						Constant	Year (t)	t <sup>2</sup>	t <sup>3</sup>
Linear	0.998	0.995	0.995	1.164	2711.634 (0.000)	195.323 (0.000)	-52.073 (0.000)		
Logarithmic	0.958	0.918	0.912	4.816	146.081 (0.000)	39.806 (0.000)	-12.086 (0.000)		
Inverse	0.784	0.614	0.585	10.462	20.712 (0.000)	22.509 (0.000)	-4.551 (0.001)		
Quadratic	1	1	1	0.228	3543.85 (0.000)	622.016 (0.000)	-79.52 (0.000)	1806 (0.000)	
Cubic	1	1	1	0.238	21709.329 (0.000)	391.487 (0.000)	-27.331 (0.000)	2.490 (0.03)	0.169 (0.869)
Compound	1	1	1	0.003	64616.384 (0.000)	23.396 (0.000)	-9.709 (0.000)		
Power	0.937	0.879	0.869	0.062	94.265 (0.000)	26.184 (0.000)	-9.894 (0.000)		
S	0.747	0.558	0.524	0.119	16.393 (0.001)	105.25 (0.000)	4.049 (0.001)		
Growth	1	1	1	0.003	64616.384 (0.000)	3512.481 (0.000)	-254.195 (0.000)		
Exponential	1	1	1	0.003	64616.384 (0.000)	725.17 (0.000)	-254.198 (0.000)		
Logistic	1	1	1	0.003	64616.384 (0.000)	725.27 (0.000)	6593.331 (0.000)		

Appendix Table (3)  
Results of Trend Analysis for USMR in Philippines

Model	R	R <sup>2</sup>	Adj R <sup>2</sup>	S.E	F	t - test			
						Constant	Year (t)	t <sup>2</sup>	t <sup>3</sup>
Linear	0.996	0.992	0.992	0.318	1637.398 (0.000)	239.625 (0.000)	-40.415 (0.000)		
Logarithmic	0.952	0.906	0.898	1.099	124.862 (0.000)	57.049 (0.000)	-11.174 (0.000)		
Inverse	0.777	0.604	0.574	2.25	19.861 (0.001)	41.298 (0.000)	-4.457 (0.001)		
Quadratic	0.997	0.994	0.993	0.295	947.823 (0.000)	158.532 (0.000)	-11.84 (0.000)	1.74 (0.107)	
Cubic	0.997	0.994	0.992	0.301	609.021 (0.000)	102.763 (0.000)	-4.890 (0.000)	1.003 (0.337)	-0.750 (0.469)
Compound	0.997	0.993	0.993	0.008	1976.523 (0.000)	223.686 (0.000)	2033.78 (0.000)		
Power	0.939	0.881	0.872	0.035	96.228 (0.000)	41.506 (0.000)	-9.810 (0.000)		
S	0.755	0.569	0.536	0.067	17.192 (0.001)	148.103 (0.000)	4.146 (0.001)		
Growth	0.997	0.993	0.993	0.008	1976.523 (0.000)	834.671 (0.000)	-44.458 (0.000)		
Exponential	0.997	0.993	0.993	0.008	1976.523 (0.000)	223.686 (0.000)	-44.458 (0.000)		
Logistic	0.997	0.993	0.993	0.008	1976.523 (0.000)	223.686 (0.000)	2033.78 (0.000)		

**Appendix Table (4)**  
**Results of Trend Analysis for U5MR in Indonesia**

Model	R	R <sup>2</sup>	Adj R <sup>2</sup>	S.E	F	t - test			
						Constant	Year (t)	t <sup>2</sup>	t <sup>3</sup>
Linear	0.993	0.986	0.985	0.997	915.751 (0.000)	101.427 (0.000)	-30.261 (0.000)		
Logarithmic	0.969	0.939	0.934	2.084	199.669 (0.000)	41.437 (0.000)	-14.130 (0.000)		
Inverse	0.807	0.651	0.624	4.982	24.213 (0.001)	19.705 (0.000)	-4.921 (0.001)		
Quadratic	0.999	0.998	0.998	0.371	3342.863 (0.000)	173.316 (0.000)	-27.750 (0.000)	9.042 (0.000)	
Cubic	0.999	0.999	0.998	0.354	2454.609 (0.000)	110.557 (0.000)	-11.887 (0.000)	2.925 (0.014)	-1.487 (0.165)
Compound	0.999	0.998	0.997	0.010	5447.39 (0.000)	181.845 (0.000)	1653.357 (0.000)		
Power	0.947	0.896	0.886	0.067	112.387 (0.000)	21.822 (0.000)	-10.601 (0.000)		
S	0.764	0.583	0.551	0.134	18.194 (0.001)	75.06 (0.000)	4.265 (0.001)		
Growth	0.999	0.998	0.997	0.010	5447.39 (0.000)	734.762 (0.000)	-73.806 (0.000)		
Exponential	0.999	0.998	0.997	0.010	5447.39 (0.000)	181.845 (0.000)	-73.806 (0.000)		
Logistic	0.999	0.998	0.997	0.010	5447.39 (0.000)	181.845 (0.000)	1653.357 (0.000)		