# Trends in higher education and growth in India: A case study

# Trends in higher education and growth in India: A case study

**Sartaj Singh Wariah[1] and K Karthikeyan[2]**
[1]School of Electronics Engineering, VIT Vellore, Tamil Nadu, Vellore.
[2]Associate Professor, School of Advanced School, VIT Vellore, Tamil Nadu, Vellore.
E.Mail: k.karthikeyan@vit.ac.in

**Abstract.** This paper uses polynomial regression to analyze the relationship between the higher education and growth in India using data from 2001 to 2016. In this paper, we concentrate on higher education as it is usually neglected while examining such relationships. Thus we use regression analysis to predict future trends. Upon inspecting the data it indicated that a linear regression model will not be a good fit in all cases, thus a polynomial regression model has also been used. In examining this relationship, we included variables such as the gross enrollment ratio (GER), GDP per capita, population growth rate and average wage per household. The results show evidence of a high correlation between higher education and growth and predicts their trends in India.

## 1. Introduction

Traditionally, human capital is emphasized as one of the sturdiest sources of economic growth of a country. There have also been many cross-country papers examining the relationship between the contributions of education and economic benefits. The general consensus from these papers points to a positive correlation and causality between education and growth but controversially some recent studies such as Griliches Z., "R&D, education, and productivity. A retrospective," 2000 and Benhabib J, Spiegel MM, 'The role of human capital in economic development. Evidence from aggregate cross-country data," 1994 have shown that these effects are weak. A substantial part of papers on this topic consider primary education to have the most significant effects on economic growth and poverty reduction. While primary education and literacy result in the highest yield, it does not offer any meaningful levels of education for employment and the children could just as easily relapse back to illiteracy. Thus in this paper, we concentrate on India and the trends in higher education and growth as it directly relates to the employability and ability to contribute to society.

In this paper, the Gross Enrollment Ratio (GER) is taken as a proxy for the level of higher education in India. Gross Enrollment Ratio is a statistical measure used in the education sector to determine the number of students enrolled in Higher Education between the ages of 18-23 out of the total population. GER was also formerly used by the UN in its Education Index. GER is very important for a country as it shows the number of youth of our country which is undergoing higher education. For a country to develop it needs a well-educated youth, thus a high GER is indicative of a better-developed country. In this paper, the effect of the higher education is examined on the GDP per capita, average wage per household and the population growth rates of India as indicative of the growth of a country. The future trends of the GDP per capita, population growth rate and average wage per household are also predicted based on the higher education in India. In the final section of this paper, we assess the growth in enrollments in the different fields of education to have a complete knowledge of the trends in higher

education. Although, there are limitations to this study as it been found previously that secondary education has little effect to the growth of a country but ultimately, the objective is to demonstrate a clear and positive relationship between the higher education of a country and its growth. It important to do so because most time higher education is overlooked when it comes to such matter and the focus is mainly on primary education. The hope is to encourage greater government involvement and higher enrollment into secondary education, which would consequently stimulate the growth of India.

## 2. Review of Literature

Numerous studies focused on the relationship between education and economic growth. Most of them have found a positive correlation between education and economic growth. Edward F. Denison (1962) in his paper on "Education, Economic Growth, and Gaps in Information" found that increase in the amount of education the average worker raised the average quality of labour and contributed to the growth rate of real national income. Gerhard Glomm and B.Ravikumar (1998) found changes in taxes and spending on education have modest effects on growth. These and countless others have concured on the assumption. Whereas some such as Alan B. Krueger, Mikael Lindahl (2001) and J.R.W. Temple (2001) have found that evidence on education and growth is weak and clouded with uncertainty at best.

Sharmistha Selfx, Richard Grabowski (2003) in their paper on “Does education at all levels cause growth? India, a case study” use Granger causality to examine the impact of education on income growth in India and indicate that primary education has a strong causal impact on growth, with more limited evidence of such an impact for secondary education but find female education at all levels has a strong potential for initiating growth. Jandhyala B.G. Tilak (2007) in his paper attempts to break down the general misconception against higher education by showing that it has an important role in the reduction of poverty, in improving infant mortality and life expectancy, and for economic growth in India by using recent statistics. Tariq Saiful Islam, Md Abdul Wadud and Qamarullah Bin Tariq Islam (2007), in their paper on “Relationship between education and GDP growth: a multivariate causality analysis for Bangladesh”, use multivariate causality analysis to examine relationship between education and growth in Bangladesh using annual time series data from 1976 to 2003. The empirical results show evidence of bidirectional causality between education and growth in Bangladesh. And in the paper by H.-U. Habermeier from the Max-Planck-Institut für Festkörperforschung, Heisenbergstr, Germany the correlation between education, research and macroeconomic strength of countries at a global scale is analyzed on the basis of statistical data published by the UNIDO and OECD. The study by Yingying Van (2011) on “The impact of education on economic growth in China” indicates that education not only has a significant effect on economic growth in the short term but also playing a very important role in the long run.

## 3. Data Sources and Graphical Representation

The data and statistics used in this paper have been assimilated from trusted and official government sources such as the MHRD (Ministry of Human Resource Development), AISHE (All India Survey on Higher Education) and Ministry of Statistics and Programmed Implementation. The sample period for this paper is from 2001 to 2016. The GER is almost linearly increasing with time but the difference between male and female GERs has been decreasing. GER data was also collected from all the states. Since female education has been found to have more potential to initiate growth, it refreshing to find Chandigarh has consistently had the highest female GER almost every year and Delhi, Chandigarh, Goa, Kerala, Daman and Diu, Jammu and Kashmir are few states in which the female GER is greater than male GER throughout the 10 years. The minimum was observed to be a 3.5 GER of Daman and Diu in 2010 whereas the maximum was a 57.6 GER of Chandigarh in 2015.

The GDP per capita, average wage per household and the population growth were taken from the World Bank archives. The discipline wise enrollment numbers were taken from the All India Survey on

Higher Education (AISHE). These numbers were used to calculate ratios for the purpose of this study. The data is graphically represented below. Figure 1 shows the growth in the GER over the years from 2010 to 2016. Figure 2 shows the variation in GDP per capita of India in US Dollars from 2006 to 2016. Figure 3 shows the population growth rate slowly decreasing over the years from 2006 to 2016. Figure 4 shows the GERs for different disciplines: Science and Engineering, Arts and Commerce, Medicine and Others. Others include fields like law, education, etc.

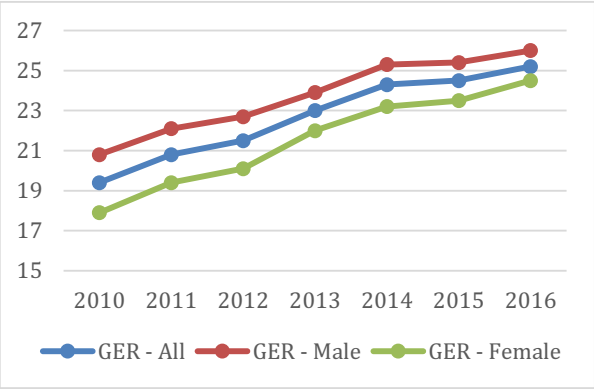


**Figure 1.** Gross Enrollment Ratio

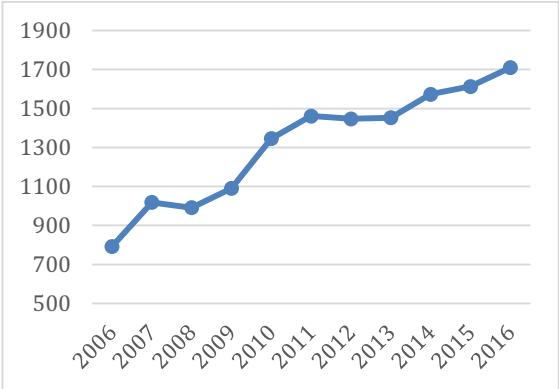


**Figure 2.** GDP

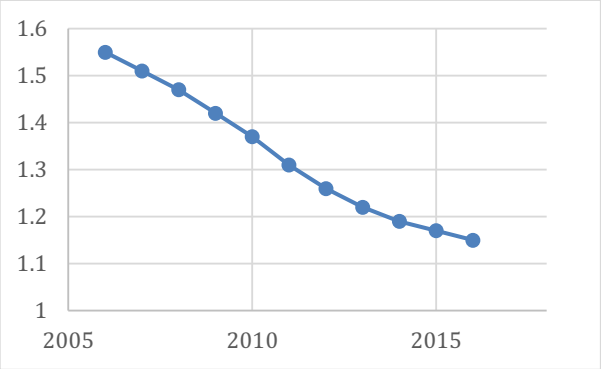


**Figure 3**. Population Growth Rate

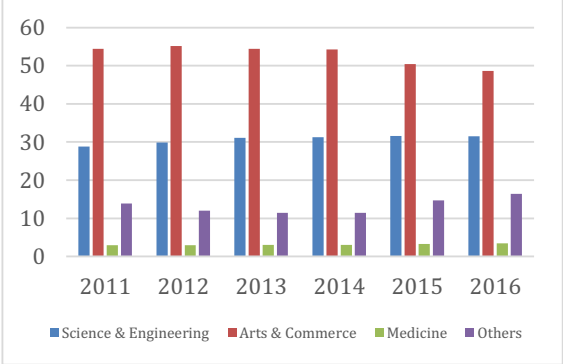


**Figure 4**. Discipline Wise Enrollment Ratio

## 4. Methodology

Regression analysis is used to model the relationship between a response variable and one or more predictor variables. Regression analysis helps one understand how the value of the dependent variable (or 'criterion variable' or Y) changes when any one of the independent variables (X) is varied, while the other independent variables are held fixed. Regression analysis is widely used for prediction and forecasting, which is our goal here but upon examining the scatterplot of the residuals versus our predictor (GER), it suggests non-linear relationships in some situations. Thus, to account for them we have used a polynomial regression model. The best fit regression line is one which has the highest $R^2$ value, where $R^2$ is the correlation coefficient squared (also known as the coefficient of determination, $R^2$) is a measure of the amount of variability in one variable that is shared by the other.

$$y = \beta_0 + \beta_1 x + \beta_2 x^2 + \cdots + \beta_n x^n$$

In this paper, the GER is the main independent variable and the GDP per capita, population growth and average wage are taken as the dependent variables. Although, there is only an indirect connection of GER to some of the dependent variables, the intention of this study to highlight those contributions of GER. First, we affirm that GER and GDP per capita, population growth rate and average wage per household are highly correlated. Also,a linear regression model to predict the future trends of the GER. With these predicted, the GDP per capita, population growth rate and average wage per household can be forecasted using a linear or polynomial regression model depending on the scatter plots of the data and the best fit line. The growth in the enrollment rate of each discipline is also found as it is not only important that there is a high ratio of the youth of a country enrolled in higher education, but also the disciplines they are in. Thus we also find trends in the fields of science and engineering, arts and commerce, medicine and other fields.

## 5. Result analysis

We forecast the GER using a linear regression model as this gives us accurate values and the best fit line is found as follows, with a coefficient of determination ($R^2$) as 0.9911. Where GER is the dependent variable (y) and time is the independent variable (x) as stipulated by Figure 5 and Table 1.

$$y = 1.0264x - 2043.4 \quad \textbf{(1)}$$

From here onwards, in this study used GER as the independent variable to predict the trends of the other dependent variables.

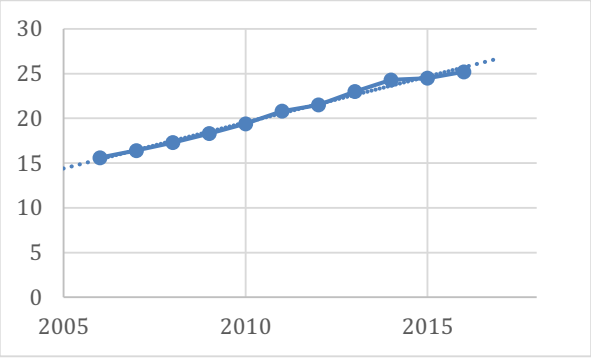


**Figure 5.** GER over time

**Table 1.** Predicted Values of GER

| Year | GER |
|---|---|
| 2017-2018 | 26.84 |
| 2018-2019 | 27.87 |
| 2019-2020 | 28.9 |
| 2020-2021 | 29.93 |

The education rate of a country plays a great role in the GDP growth of a country, thus we can forecast the future GDP according to the values of the GER. Using a third degree polynomial equation as the best fit regression line, we get the regression model as follows, with a coefficient of determination ($R^2$) as 0.9581. Where GDP is the dependent variable (y) and GER is the independent variable (x) as stipulated by Figure 6 and Table 2.

$$y = 0.8766x^3 - 59.007x^2 + 1383.2x - 9744.1 \quad \textbf{(2)}$$

A polynomial regression model was used here because from the scatter plot it could be interpreted that a linear regression model will not fit and we didn't use a higher degree polynomial because although they gave the better coefficient of determination values but their forecasted values did not align with the real world possibilities.

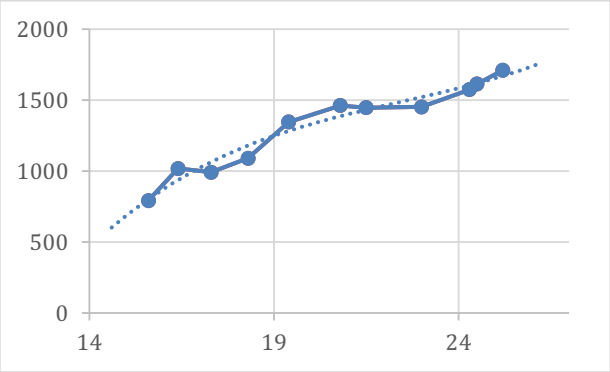


**Figure 6.** GDP vs. GER

| **Table 2.** Predicted Values of GDP | | |
|---|---|---|
| Year | GER | GDP |
| 2017-2018 | 26.84 | 1822.39 |
| 2018-2019 | 27.87 | 1949.10 |
| 2019-2020 | 28.9 | 2106.14 |
| 2020-2021 | 29.93 | 2299.23 |

The quality of life in a country and hence the average wages could be assumed to be directly related to the education level, thus we can forecast the future average wages according to the values of the GER. Using a linear regression line as the best fit regression line, the regression model is as follows, with a coefficient of determination ($R^2$) as 0.9954. Where average wage per household is the dependent variable and GER is the independent variable (x) as shown by Figure 7 and Table 3.

$$y = 11.604x - 10.15 \quad \textbf{(3)}$$

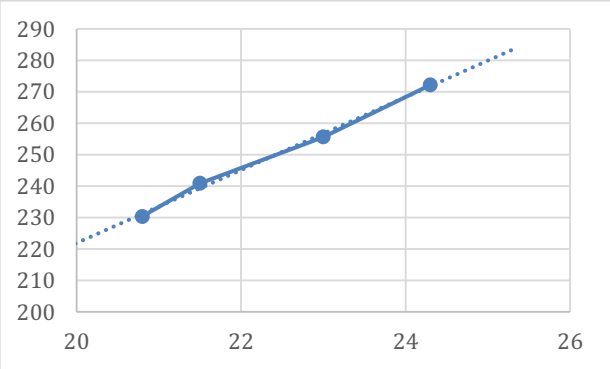


**Figure 7.** Average Wage vs. GER

| **Table 3.** Predicted Values of Average Wage | | |
|---|---|---|
| Year | GER | Average Wage |
| 2017-2018 | 26.84 | 1822.39 |
| 2018-2019 | 27.87 | 1949.10 |
| 2019-2020 | 28.9 | 2106.14 |
| 2020-2021 | 29.93 | 2299.23 |

As people get more educated and learn about sex education, family planning and other methods the population growth rate of a country is bound to decrease, thus the future population growth rate is forecasted according to the values of the GER. Using a linear regression line as the best fit regression line, we get the regression model as follows, with a coefficient of determination ($R^2$) as 0.9908. Where population growth rate is the dependent variable (y) and the GER is the independent variable (x) as stipulated by Figure 8 and Table 4.

$$y = -0.0417x + 2.1867 \quad \textbf{(4)}$$

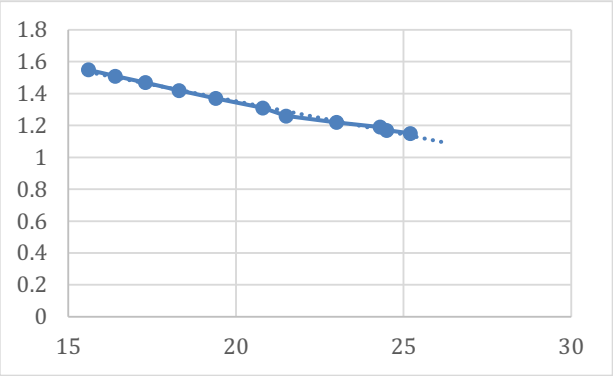


**Figure 8**. Population Growth Rate vs. GER

| **Table 4.** Predicted Values of Average Wage | | |
|---|---|---|
| Year | GER | Average Wage |
| 2017-2018 | 26.84 | 1822.39 |
| 2018-2019 | 27.87 | 1949.10 |
| 2019-2020 | 28.9 | 2106.14 |
| 2020-2021 | 29.93 | 2299.23 |

In the present study we have predicted the trends in the overall GER and its correlation to the growth of a country, thus we should also know what fields of study have seen the highest increase in enrollment. We noticed an increase in the enrollment in science and engineering and a decrease in the enrollment of arts and commerce. Analyzing the data, we observe that enrollment in Science & Technology has been increasing at a slow but steadily rate, Arts & Commerce, surprisingly, shows a significant decrease, Medicine, like Science & Technology, also increases at a slow and steady rate and finally the other fields show a very significant rate of increase. The predicted values are shown in the tables below, Figure 9 and Table 5 depicts the enrollment ratio for Science & Engineering, Figure 10 and Table 6 depicts the enrollment ratio for Arts & Commerce, Figure 11 and Table 7 depicts the enrollment ratio for Medicine and Figure 12 and Table 8 depicts the enrollment ratio for other disciplines.

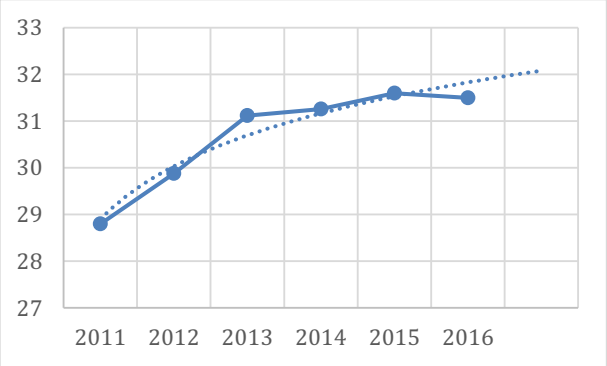


**Figure 9.** Science and Engineering

| **Table 5.** Trends in Science and Engineering | |
|---|---|
| Year | Science and Engineering |
| 2017-2018 | 32.8 |
| 2018-2019 | 32.3 |
| 2019-2020 | 32.5 |
| 2020-2021 | 32.66 |

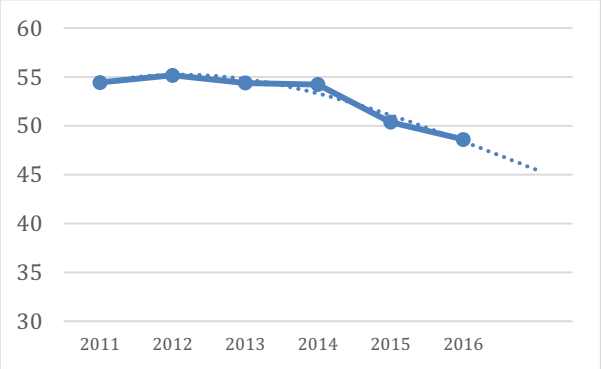


**Figure 10.** Arts and Commerce

| **Table 6.** Trends in Arts and Commerce | |
|---|---|
| Year | Arts and Commerce |
| 2017-2018 | 45.5 |
| 2018-2019 | 42.7 |
| 2019-2020 | 40.23 |
| 2020-2021 | 38.4 |

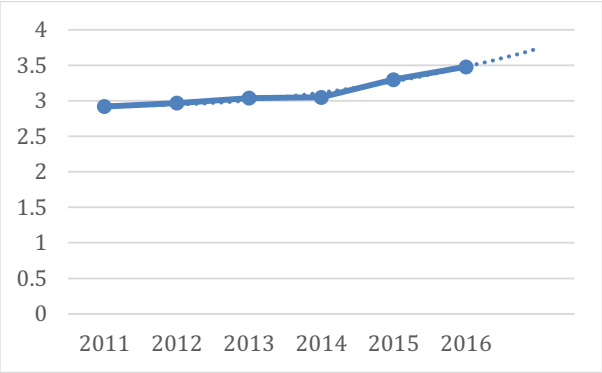


**Figure 11.** Medicine

| **Table 7.** Trends in Medicine | |
|---|---|
| Year | Medicine |
| 2017-2018 | 45.5 |
| 2018-2019 | 42.7 |
| 2019-2020 | 40.23 |
| 2020-2021 | 38.4 |

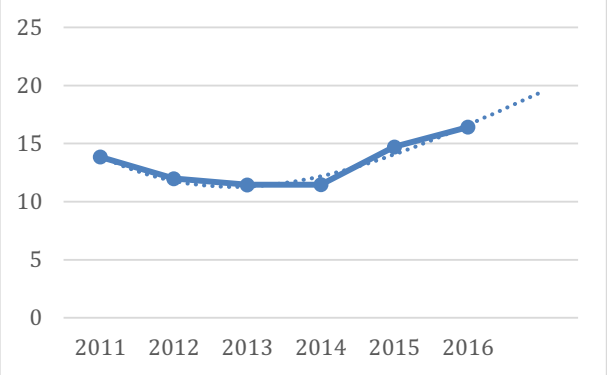


**Figure 12.** Others

| **Table 8.** Trends in Others | |
|---|---|
| Year | Others |
| 2017-2018 | 19.35 |
| 2018-2019 | 22.11 |
| 2019-2020 | 24.42 |
| 2020-2021 | 26.28 |

## 6. Conclusion

In this paper, we analyzed and forecasted the GER of India using regression analysis. The relationships between GER and GDP per capita, average wage and population growth rate of India were examined. The GER of India showed a steady increasing rate where the gap between male and female GER seemed to remain almost constant with it decreases slightly. The GDP per capita, average wages and population growth rate showed a high correlation with GER and we forecasted their values till 2020. We analyzed the trends in the discipline wise enrollment in higher education and observed the enrollment in arts and commerce decreasing and the enrollment in science and engineering, medicine and others increased. Thus, from our analysis, we demonstrated the importance of education in the growth of a country.

## References

[1] Edward F Denison 1962 Education,economic growth, and gaps in information *Journal of Political Economy,***70(5)** pp 124-128

[2] Self S, Grabowski R 2004 Does education at all levels cause growth? India, a case study Economics *of Education Review* **23(1)** pp 47-55

[3] Tapas R Dash, Professor 2011 Growth of higher education and its relationship with per capita gross domestic product in Cambodia *International Journal of Business and Social Science* **2 (12)** pp 53-62

[4] H U Habermeier 2007 Education and economy – an analysis of statistical data *Journal of Materials Education* **29(1-2)** pp 55-70

[5] Glomm G and Ravikumar B 1998 Flat-rate taxes, government spending on education, and growth *Review of Economic Dynamics* **1(1)** pp 306-325

[6] Temple J R W 2001 Generalization that aren't? evidence on education and growth *European Economic Review* **45(4-6)** pp 905-918
[7] Tariq Saiful Islam, Md Abdul Wadud and Qamarullah Bin Tariq Islam 2007 Relationship between education and GDP growth: a multivariate causality analysis for Bangladesh *Economics Bulletin* **3(35)** pp 1-7
[8] Krueger, Alan B and Mikael Lindahl 2001 Education for growth: why and for whom? *Journal of Economic Literature* **39(4)** pp 1101-1136
[9] Tilak J B G 2007 Post-elementary education, poverty and development in India *International Journal of Educational Development* **27(4)** pp 435-445
[10] Yingying Yan 2011 The impact of education on economic growth in China *Proc. Int. Conf. on e-Education Entertainment and e-Management* pp 202-204