

Comparing the Expanded Effect of Higher Education Systems on Their GPI in China and India

Tien-Li Chen

Abstract—China and India are with the most populous and second populous countries in the world. This study selected China and India as research targets to compare their trends of gender parity in expanding higher education. The data on the gross enrollment ratio of male and female in both countries were collected from the World Bank from 1973 to 2018. The study applies the Gender Parity Index (GPI), which according to Trow's definition, interpret the trends of gender parity in three stage within expanding higher education system. Furthermore, the study uses ARIMA model to predict the trends of GPI in higher education systems in both China and India toward 2030. This study suggests the trends of gender equality have made significant progress in expanding higher education systems. As our prediction, the higher education system is going to be more favorable to female in the future.

Index Terms—ARIMA, gender parity Index, higher education, higher education expansion.

I. INTRODUCTION

The United Nations General Assembly has set 17 Sustainable Development Goals (SDGs) in 2015 to achieve by 2030 [1]. One of the SDGs is gender equality. Gender equality is not only a fundamental human right, but also an essential foundation for a peaceful, prosperous and sustainable world. Providing women and girls with equal access to education will promote a sustainable economy that benefits society as a whole. China and India are the most populous and second populous countries in the world. According to the United Nations 2019 World Population Prospects Report shown that China and India combined currently account for 28 percent of the worlds' population, with 1.43 billion and 1.37 billion people respectively. India is forecast to takeover China as the most populous country in the world within a decade [2]. For a long time, women in China and India have been influenced by social culture, which leads to gender inequality. Chinese Confucianism and Dowry in India two key cultural factors lead to educational inequality between men and women [3]. Confucianism is an ideology in ancient China, which creates the practice of patriarchy. Despite the improvement of education equality under the rule of Mao Zedong but did not change the view of female education directly. Dowry is a deeply rooted sexism in Indian society. Dowry is the money the bride's family transfers to the groom in return for her marriage. Highly educated female can lead to high-cost dowry, causing families to have to choose between expansive dowry or female education [4].

Today, China and India have the most complex and revolutionary legislation to protect female and promote equality of rights. In 1992, the *Law of the People's Republic of China on the Protection of Rights and Interests of Women* was promulgated to guarantee equal rights for men and women. The Chinese women's liberation movement is regarded as a part of the social revolution. It has improved women's social status, enable women to exercise social rights and realize and social values. Women's organizations and women's movements began to shift their focus from welfare to equality, striving to realize equal rights with men. India has enacted an *India Constitution* guaranteeing equal rights and equal treatment between men and women. China and India have taken accelerating economic and social development as their goals. Both countries have set up a vision of poverty eradication, fill employment and improvement of living standards. China and India recognized the importance of higher education in promoting national development [5]. In China's higher education system, public universities have been dominant in the mass stage. Although private institutions also surged during this period, public institutions still accounted for more than 80 percent of enrollment in 2008. From 2001 to 2012, the number of universities in India increased from 12,806 to 35,539. Two-third of them are public institutions and one-third of them are private institutions. With the expansion of higher education, the number of students entering higher education system has gradually increased. We selected China and India as the research target for their higher education development and amazing populous. This study converted the gross enrollment ratio of male and female in higher education to gender parity index (GPI), and conducting autoregressive integrated moving average (ARIMA) to predict the trends of gender parity index (GPI) in China and India within expanding higher education to determine whether gender inequality can be transformed by expanding higher education participation. The projection of the GPI series to 2030 is to fit the SDGs. Given these purposes, the following research questions will be answered in the study:

- (a) What are the trends of gender parity in higher education systems in china and India?
- (b) Has gender inequality ameliorated in the expanding higher education systems?
- (c) Toward 2030, what are the trends of gender parity can be expected in both higher education systems?

The rest parts of the paper are as follows: First, the research method will address the transformation of GPI and ARIMA model building; Second, the proposed trends of GPI within expanding higher education will be interpreted; Finally, the conclusion of this study will be drawn.

II. METHODS

This section describes how to collect and transform series

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Tien-Li Chen is with Technology Management of Tamkang University, No. 151, Yingzhuang Road, Tamsui District, New Taipei City 25137, Taiwan (e-mail: tienlin@ymail.com).

of data. The time series analysis was used in this study. The data on gross entrance ratio (GER) of male and female in higher education in China and India from 1973 to 2018 were collected from the World bank. The study employed GPI to explain gender parity in higher education systems in China and India. Building ARIMA model with Minitab, we predict the trends of gender parity in higher education systems in both China and India. To fit the SDGs progress, we proceed the time period to 2030.

A. The GPI in Higher Education System

The GPI is the ratio of male and female enrollment rates at the level of higher education. It is calculated by dividing female value for the indicator by the male value for the indicator. A GPI equal to 1 indicates parity between females and males. The index is less than 1 means more male than female. GPI greater than 1 means more female than male, and the current higher education system is favor to female [6,7]. The following is the definition of GPI in this study:

$$GPI = EF / EM$$

EF: the enrollment rate of higher education for female;

EM: the enrollment rate of higher education for male.

B. Higher Education Expansion

This study considered the higher education expansion as Trow's definition. Trow mentioned the expansion of higher education from the elite stage (stage 1) to the mass stage (stage 2), with a gross enrollment rate of at least 15% and then 50% in the universal stage (stage 3) [8].

C. Using ARIMA to Predict GPI

The study conducted ARIMA to predict the GPI trends of the higher education systems in both China and India by 2030. Before using the model to predict, this study follows the ARIMA model building process to check whether the sequence data is stationary or non-stationary. Typically, non-seasonal ARIMA models are classified as ARIMA (p, d, q) models, where:

p is the auto regressive terms;

d is the non-seasonal differences needs for stationarity;

q is the logged forecast error in the predication equation.

Then, we based on the assumption of the ARIMA model to review the residual left behind by fitted the model is only white noise. This is done by checking the ACF and the PACF for the residuals and their modified Box-Pierce Chi-square statistics [9,10]. The Box-Pierce Chi-square statistics is used to test the independence of residual, and the significance of p -value of each chi-square statistic is compared. A significant level of .05 is the best. Basically, the p -value of the Ljung-Box chi-square statistics are greater than .05 [11]. In the study, Minitab® statistical package software was used for analysis.

III. RESULTS

A. The GPI within Expanding Higher Education in China and India (1973-2018)

In order to promote the development of the country, China and India regard the development of higher education as one of the important policies. In recent years, higher education reform in China and India, such as the increase of higher

education funds and higher education enrollment. After the adoption of the *Law for Promoting Minban Education* in 2003, the number of private higher education institutions offering formal courses increasing rapidly 278 in 2008 [4]. In China, the proportion of college-age population has increased from 1.2 percent in 1978 to nearly 30 percent; by 2020, it will reach 40 percent. In India, the target is to increase the population of college-age from 14 percent to 30 percent by 2020. In China, higher education system entered the mass stage in 2003, entering universal stage in 2018. India's higher education system entered the mass stage in 2008 and has not entered the universal stage. With expansion of higher education and the promotion of gender equality laws in China and India, the education opportunities for male and female in higher education system have an impact. Figure 1 and Figure 2 shows the GPI of higher education system in the two countries from 1973 to 2018. China's GPI in higher education system reached 1 in 2008 and India's GPI also reached 1 in 2015. After expanding in mass stage, China and India are significantly improving their gender equality in higher education system. The females have become critical mass in the higher education systems.

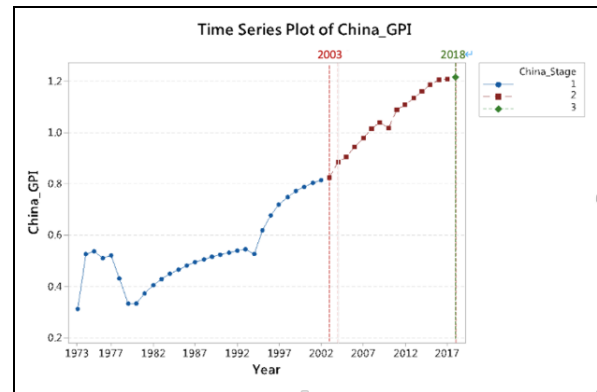


Fig. 1. The trend of GPI in higher education system in China (1973-2018).

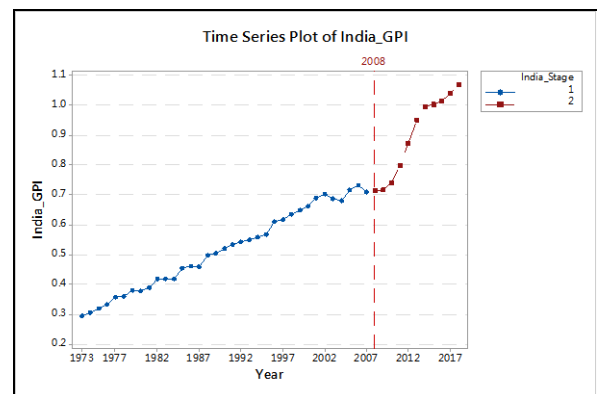


Fig. 2. The trend of GPI in higher education system in India (1973-2018).

B. Interpretation of the GPI by ARIMA

According to ACF and PACF, ARIMA (1,1,1) can be used to predict the series of GPI in China, and ARIMA (0,1,1) can be used to predict the series of GPI in India. The residual follows the white noise process. The final estimated parameter for the percentage of GPI are shown in Table I. The ACF and PACF diagrams of residual values are shown in Fig. 3. Due to the fact that their autocorrelation and partial autocorrelation meet 5% limited requirement, no recognizable patterns are displayed.

TABLE I: THE FINAL ESTIMATES OF THE GPI IN CHINA AND INDIA

JAPAN				
ARIMA (1,1,1)				
	COEF.	SE COEF.	T-VALUE	P-VALUE
AR (1)	-0.4976	0.1867	-2.66	0.011
AR (1)	-0.8985	0.1038	-0.865	0.000
MA (1)	0.03108	0.01102	2.82	0.007
KOREA				
ARIMA(0,1,1)				
	COEF.	SE COEF.	T-VALUE	P-VALUE
MA (1)	-0.5079	0.1314	-3.87	0.000
CONSTANT	0.017229	0.04130	4.17	0.000

Note. Differencing: 1 regular difference; Original series 46, after one differencing

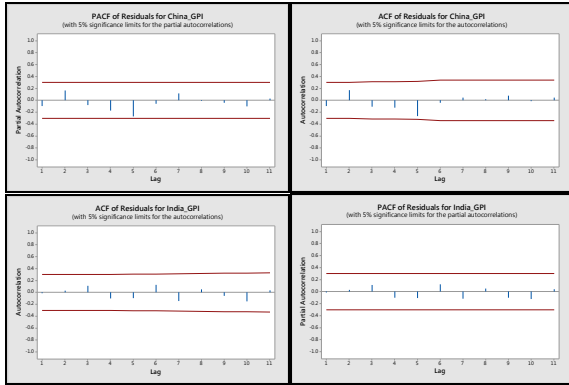


Fig. 3. Checking the GPI with ACF and PACF.

In addition, Ljung-Box test is used to provide indication that the model is correctly specified. In this study, Ljung-Box square statistics demonstrate that the model meet the assumptions that residuals are independent. Basically, a significant level of .05 works well. In the study, the p-value of the Ljung-Box square statistics was greater than .05.

TABLE II. MODIFIED BOX-PIERCE CHI-SQUARE STATISTICS FOR ARIMA MODEL

CHINA LAG	12	24	36	48
CHI-SQUARE	7.6	16.9	24.8	*
DF	9	21	33	*
P-VALUE	0.573	0.717	0.846	*
INDIA LAG	12	24	36	48
CHI-SQUARE	5.6	12.3	16.7	*
DF	10	22	34	*
P-VALUE	0.849	0.951	0.994	*

Note: * represents the value is not available.

TABLE III. FORECASTING THE GPI IN HIGHER EDUCATION IN CHINA AND INDIA FROM 2019 TO 2030

YEAR	C-GER		I-GER		I-GER	
	Forecase	Up	Low	Forecase	Up	Low
2019	1.22617	1.22617	1.30277	1.09008	1.05398	1.12617
2020	1.25254	1.12071	1.38438	1.10731	1.04199	1.17262
2021	1.27050	1.10973	1.43127	1.12453	1.03951	1.20956
2022	1.29264	1.10351	1.48178	1.14176	1.04081	1.24272
2023	1.31270	1.10067	1.52474	1.15899	1.04430	1.27369
2024	1.33380	1.10033	1.56727	1.17622	1.04927	1.30318
2025	1.35438	1.10165	1.60712	1.19345	1.05532	1.33158
2026	1.37522	1.10442	1.64602	1.21068	1.06221	1.35915
2027	1.39593	1.10827	1.68359	1.22791	1.06978	1.38604
2028	1.41670	1.11309	1.72032	1.24514	1.07790	1.41238
2029	1.43745	1.11869	1.75620	1.26237	1.08650	1.43824
2030	1.45820	1.12499	1.79142	1.27960	1.09549	1.43824

Fig. 4, Fig. 5 and Table III show the predicted the result of GPI in higher education in China and India by 2030. Based on the result of the ARIMA (1,1,1), it is predicted that the GPI in China from 2019 to 2030 will be in the range of 1.22617 to 1.45820. The ARIMA (0,1,1) predicts that the GPI in India from 2019 to 2030 may be in 1.09008 to 1.27960. This means that the higher education system is more and

more favorable for female in the future.

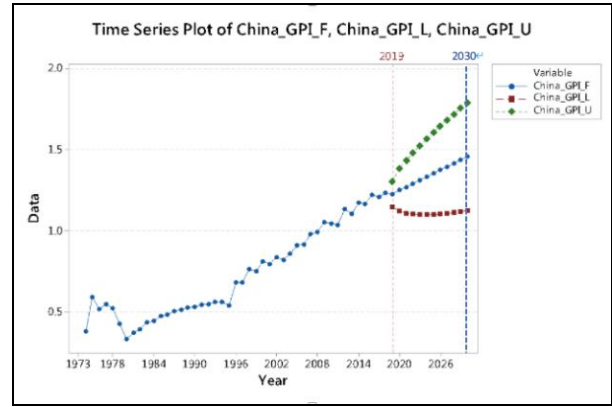


Fig. 4. Predicting the GPI in higher education in China 2030.

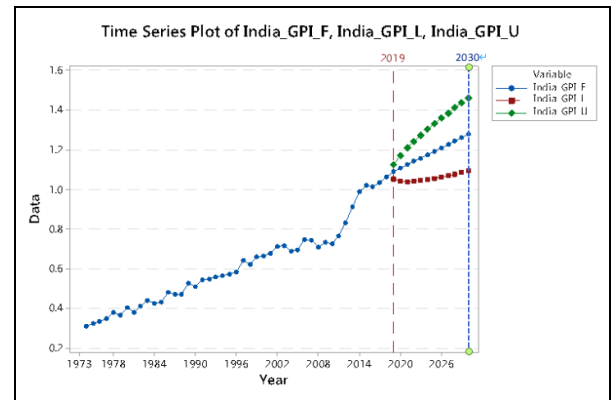


Fig. 5. Predicting the GPI in higher education in India by 2030.

IV. CONCLUSION

This study applies GPI to interpret the gender parity in higher education systems in both China and India. ARIMA model is a useful method to predict the trend of GPI in higher education systems. According to the results of the study as a basic to explain the three research questions of the study. The results show that China’s GPI in higher education system reached 1 in 2008 and India’s GPI also reached 1 in 2015, meaning there are more opportunities for females to enter their higher education systems. ARIMA models suggest predicting China’s GPI in higher education system will reach 1.4582, while it is 1.27960 in India by 2030. Both China and India have shown that gender parity pattern in higher education expansion systems is approaching another inequality phenomenon which is more favorable to female’s participation while it might be unfavorable for males.

Although the data is limited, the trend analysis methods is used to transform the data into a vertical perspective, which shows the process of gender parity within expanding higher education systems. The study analyzed the trends of GPI in higher education system in China and India from 2019 to 2030, which will provide useful information for the related policy makers. In the future, gender parity will persist to be an important issue in higher education systems, GPI can be an effective indicator of the results of the expansion of the review system. For further studies, we suggest try alternative indices to detect the gender issue in the development of the higher education systems.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The author conducted the research, analyzed the data, and wrote the paper; the author had approved the final version.

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Tien-Li Chen is a PhD student from Doctoral Program of Educational Leadership and Technology Management of Tamang University, Taiwan.

She researches interests are higher education development and higher education policy. Publication articles: "Predicting the concurrent relationships between GDP and GER expansion in Japan and Korea by Using ARIMAX," *Advances in Computer Science Research*, vol. 93, pp. 157-160.

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