

# Determinants of Gender Parity Index in Higher Education in India: A Panel Data Approach

A dissertation Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Philosophy (Arts) in Economics of Jadavpur University, Kolkata, India.

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Certified that the thesis entitled, **Determinants of Gender Parity Index in Higher Education in India: A Panel Data Approach**, submitted by me towards the partial fulfilment of the Degree of Master of Philosophy (Arts) in **Economics** of Jadavpur University, is based upon my own original work and there is no plagiarism. This is also to certify that the work has not been submitted by me for the award of any other degree/diploma of the same Institution where the work is carried out, or to any other Institution. A paper out of this dissertation has also been presented by me at a seminar/conference at **Department of Economics, University of Kalyani**, thereby fulfilling the criteria for submission, as per the M.Phil Regulation (2017) of Jadavpur University.

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On the basis of academic merit and satisfying all the criteria as declared above, the dissertation work of **Sanghita Ghosh** entitled **Determinants of Gender Parity Index in Higher Education in India: A Panel Data Approach** is now ready for submission towards the partial fulfilment of the Degree of Master of Philosophy (Arts) in **Economics** of Jadavpur University.

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## SYNOPSIS

According to the Times Higher Education Emerging Economies University Rankings 2018, Indian Higher Education system is the second largest in the world after China. Higher Education system is the source of development and it is the key to increase the economic efficiency and social consistency. The higher education sector is a vast and varied area. Nowadays there is a rapid growth of this sector and becoming more diversified. The developed nations around the world pay equal importance on participation of females and males in higher education. But in the developing countries that is not happening always. In this context Gender Parity Index (GPI) is considered as an important socio-economic indicator to measure the enrolment of women in any particular type of education in relation to men. On this ground using GPI this study analyses the factors determine the relative enrolment of female and male students in higher education. To identify the factors affect GPI in higher education, we have collected information from All India Survey on Higher Education (AISHE) published by Ministry of Human Resource Development (MHRD) and RBI Bulletin from 2010-11 to 2015-16 for the major 17 states of India. Before starting the analysis it is assumed that the variable 'Number of colleges per lakh population' and 'Pupil Teacher Ratio' (PTR) are endogenous (correlation with the error term) variables in nature. But the Hausman Specification Test reports that the assumed explanatory variables are not an endogenous variable in our investigation. Then running both Fixed Effect and Random Effect regressions it is found that Hausman Test supports Fixed Effect Model. The Fixed Effect Panel data regression shows that percentage of female teachers, male literacy rate, female literacy rate, Per Capita State Domestic Product and PTR create an important role to improve GPI in higher education in India.

## Introduction

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The higher education system of a country is important in economics mainly because its ability to create and/or accumulate human capital and increase the aggregate productivity level of the economy (Mincer, 1981; Lucas, 1988; Bogetoft *et al.* 2007; Núñez and Livanos, 2010). Thus, the increase productivity level can produce goods more and more efficiently in an economy (Fischer, 1993; Gregorio, 2004). These effects of human capital have led countries to invest in higher education and the number of higher education institutions and thus the student population worldwide has risen dramatically. So much of our economic and social well-being is built on this source. In that way Higher Education System of a country helps to indicate that the country is competitive in world markets now characterized by changing technologies and production methods.

The Indian Higher Education system had its roots in the early time as well. **Taxila** was the earliest recorded higher education centre in India in the 5th century BC although there is a debate with its status – whether it was an university or not. But in the modern sense of the term “University” Nalanda University was the oldest University system of education in the World. Today India holds an important position in the global higher education system. Our country has one of the largest education systems in the world and has been witnessing a healthy growth in its number of institutions and enrollment. In India the regulatory framework of Higher Education system is multi layered.

1. Department of Higher Education, Ministry of Human Resource Development, Association of Indian Universities, Central Advisory Board of Education and State Council of Higher Education, are responsible for the overall development of Higher Education sector both in terms of Policy and Planning.
2. University Grants Commission (UGC), All India Council for Technical Education (AICTE), Medical Council of India (MCI), Bar Council of India (BCI) and State Regulators are different type of organizations which determine and maintain the standard of higher education institutions.



3. National Board of Accreditation and National Assessment of Accreditation are the two accrediting institutions which objective is to judge the higher education institutes.

According to All India Survey on Higher Education (AISHE) 2015-2016 report there is 799 Universities, 39071 colleges and 11923 Stand Alone Institutions in India.

## **1.1 The Objectives of Higher Education in India**

The main objectives of higher education system are:

*(1) Wisdom and knowledge:* Education is both a training of minds and training of souls. So it should provide both knowledge and wisdom. No amount of factual information would take ordinarily into educated men unless something is awakened in them. Therefore, there should be inculcation of wisdom and knowledge.

*(2) Aims of the social order:* Indian education system must find its guiding principle in the aims of the social order for which it prepares.

*(4) Training for leadership:* One of the important objectives of higher education is giving training for leadership in professional and public life. So it is the function of the higher education institutes to train the men and women for wise leadership.

Therefore, Government of India takes several policies for improving the Higher Education sector in India. In the following some of the policies are discussed.

- a) Several government initiatives have been adopted to boost the growth of distance education market, besides focussing on new education techniques, such as E-learning and M-learning.
- b) In recent years, education sector has seen a lot of reforms and improved financial outlays that could possibly transform the country into a knowledge heaven. Today human resource is increasingly gaining importance in the overall development of the country, so development of education infrastructure is expected to be the key focus in the current decade. In this scenario it is likely to see a considerable increase in infrastructure investment in the education sector.
- c) The Government of India has taken several steps for improving the higher education system in India such as opening of new IIT's and IIM's in new locations as well as allocating

educational grants for research scholars in most government institutions etc. Furthermore, with online modes of education being used by several educational organizations, the higher education sector in India is set for some major changes and developments in the years to come.

## **1.2 Definition of Higher Education**

The higher education sector is a vast and varied area. It comprises general subject disciplines (science, humanities, arts, social and cultural sciences), technical (engineering, medicine, agricultural and life sciences and other applied sciences), education and training, vocational and skill-based programmes, training for the service and hospitality sector, teacher education, management education and so on. There is a rapid growth of this sector and becoming more diversified and today covers all types of higher education, training and research institutions. Ministry of Human Resource Development defines Higher Education as “the education, which is obtained after completing 12 years of schooling or equivalent and is of the duration of at least nine months (full time) or after completing 10 years of schooling and is of the duration of at least 3 years. The education may be of the nature of General, Vocational, Professional or Technical education”.

Today there has been a remarkable growth of higher education system in India. However, the higher education system has many issues, like financing and management including access, equity and relevance, reorientation of programmes by laying emphasis on health consciousness, values and ethics and quality of higher education together with the assessment of institutions and their accreditation. These issues are important for the country, as it is now engaged in the use of higher education as a powerful tool to build a knowledge-based information society of the 21st Century.

In that scenario Gender Parity Index (GPI) is considered as an important index to measure the progress towards gender equity and the level of learning opportunities available for women in relation to those available to men. Various researchers (Knowles *et al.* 2000; Lagerlöf, 2003; Klasen and Lamanna, 2009) suggest that the gender inequality in education has a negative impact on economic growth. According to World Bank (2001), Knowles *et al.* (2002) gender equality in education increases the human capital stock, makes labour market most competitive (Seguino, 2000) and can increase the stock of physical capital. Therefore, narrow gender gaps in educational

attainment not only help to boost female participation in the workforce but also are strongly correlated with the status of girls and women in the family, linked with lower prevalence of child marriage, violent abuse by an intimate partner and improved maternal and reproductive health. Women who have parity in education are more likely to share unpaid work with men more equitably, to work in professional and technical occupations and to assume leadership roles. Therefore, Gender Parity Index serves also as a significant indicator of the empowerment of women in society.

### **1.3 Definition of GPI**

GPI is a socioeconomic index. It is used to measure the relative enrolment of females and males in a certain stage of education (primary, secondary, etc.). It is calculated as the quotient of the number of females by the number of males enrolled in a certain stage of education.

The main aim of GPI is to achieve equal participation of males and females in a certain stage of education. If the value of GPI is 1 then it indicates parity between females and males in that level of education. But if the GPI value is less than 1 then it can be said that there is a disparity in favour of males and if the value is greater than 1 then disparity in favour of females in that level of education.

In this study GPI is calculated for the Higher Education level and measured as

$$\text{GPI} = \frac{\text{Number of females enrolment in higher education}}{\text{Number of males enrolment in higher education}}$$

### **1.4 Importance of GPI in Higher Education**

The Report published by All India Survey on Higher Education (AISHE) has shown that India has now registered its best performance on the Gender Parity Index (GPI) in the last six years- from 0.86 in 2010-11 to 0.92 in 2015-16. Specially, in the states Goa, and Kerala; more women are educated than men. In fact, in 2015, India was predicted to be the only country in South and West Asia to have an equal ratio of girls to boys in both primary and secondary education. However, the proportion of students pursuing higher education is in the range of 23% to 25 % since 2013-14, with not much difference.

It is assumed that equal access to education makes possible social and economic mobility of the poor. According to Schultz (2002), both for developing and more economically advanced countries, economic gains from educating girls are higher than from educating boys. Mamen and Paxson (2000) conclude that female education, like male education promotes economic growth by expanding skilled working-age population and by improving the productivity of the female labour force. A balanced distribution of education among men and women is also likely to foster economic growth if male and female human capital are production factors with diminishing returns and are imperfectly substitutable (Knowles, Lorgelly, and P. Owen, 2002). Moreover, if women get a chance to opt for higher education then it will help to produce additional social gains by reducing fertility and infant mortality, increasing life-expectancy, and increasing the quantity and quality of investments in children education (Schultz, 1988). There are many empirical studies confirm that increase in females' education boost their wages and that returns to education for women are frequently larger than that of men. It is also found that increase in women's education improve human development outcomes such as child survival, health and schooling (World Bank, 2001; Schultz, 2002; Strauss and Thomas, 1993; King and Hill, 1993). Klasen (2002) finds that lower female education has a negative effect on economic growth. Knowles *et al.* (2002) report that if females are educated in developing countries then it will help to reduce fertility, infant mortality and increase children's education. Ahmad *et al.* (2005) study the relationship between inequality in the access to secondary education and poverty in Bangladesh. A study by Agénor *et al.* (2015) based on India and another study by Agénor and Canuto (2015) based on Brazil report that gender equality in higher education improves the next generation's human capacities. Thus various studies support the fact that gender parity in higher education is important for the overall development of a country.

### Literature Review

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The country's gender statistics, gives an overall indication of what has been happening in India since the Millennium Development Goals were set, and helps to understand how close they are to achieve the various gender specific goals set by the United Nations and the Government of India. Khalid (2008) has mentioned that women are crucial to a country's development and the economic survival of their own personal households. Therefore, education is the most important tool for enhancing women's socio economic situation and statistically has been associated with better health, lower fertility rate, higher economic growth and better standards of living (Khan, 1993; Khalid, 2008). It is observed that especially in India, there is several type of barriers like institutional, social, psychological and cultural boundaries limit a female's potential (Jain, 2003; Khalid, 2008). Little research has been done in India relating to the transition rates for females at further levels of education, i.e. secondary school onward. So this chapter will examine some of the existing research studies surrounding gender and higher education in India.

Parsons (2009) has shown that in the developed world, females are more likely to go into university than males but according to Marshall (2014) in the developing world the picture is different; many girls will not be able to reach secondary school. In the developing world there can be many different forms of gender inequality. In the Global South, girls access of education often get restricted as a result of deep-rooted social and cultural practices, such as preference for a son's education, violence against girls' inside the home and in educational institutions, and household duties and domestic obligations (Marshall, 2014). In India, all of the above mentioned obstructions exist, as well as a number of smaller scale issues that arise, like lack of girls' toilets or lack of female teachers. A report by the International Programs Centre for the U.S. Department of Commerce (Velkoff, 1998) also shows that the important barriers behind the women's higher education in India are inadequate sanitary facilities, shortage of female teachers and gender bias in curriculum. The variety of obstacles that females' face in accessing education are also present even in the lower levels of education also. Hence, inclusive approach is required to improve the situation in India. Khan (1993) shows that if men earn more from their careers for the same level of education then the human capital model would predict a lower investment in female's education .

Jain (2003) reports that the inclusion of girls in as many diverse fields as are available in society must be reinforced and the need for necessary investments in their education must be recognised. If this happened, it would change the overall situation in women's employment and consequently motivate parents and communities to support female education. Strauss and Thomas (1995), Khalid (2008) report that improving females' education will help to eliminate the gender gap in employment and earnings and this will have some important non-market benefits like improved child nutrition and lower fertility etc. Summers (1994) also concludes that females' education can impact the next generation of both sexes and probably even further. For example when girls have been educated, they have economic opportunities, their families have more of a stake in their survival and success, they marry later and are able to take part in household decisions, and they choose to have fewer children and thus can invest more in the health and development of each child.

Tilak and Biswal (2015) have pointed out that supply-side expansion and falling poverty rates have led to an increase in the demand for higher education across India. Unterhalter *et al.* (2014) have considered that improved female education can contribute to gender equality as a whole through the emergence of a new generation of educated females who are able to participate in political, social, cultural, economic and technological spheres, changed gender norms, attitudes and identities in both sexes, and changed gender relations in a variety of institutions at all levels. The GER, GPI, GAR and pass rates are all important as they influence transition rates (Tilak and Biswal, 2015, UNICEF, 2014). Chanana (2007) has said that the increased participation of girls in education would eliminate the gender gap and inequality if underachievement and under-representation were taken care of. However, this has proven to be false because it is observed that sometimes there are more girls than boys in lower levels of education and yet there is still a huge gap in secondary and further education.

- **Importance of Parental Education:**

Parental education plays a vital role behind females' higher education. Illiterate parents are not interested to educate their daughters' as they view that investment in girls' education is wastage of money and resources. There is a common view that after getting employment son of the house will earn and thus support the family financially whereas parents do not see their daughters working or bringing home any income once they leave home (Khan *et al.*, 2011; Desai *et al.* 2010).

Various studies have found different conclusions on whether mother's education has greater, smaller or no impact on their children's education than father's education (Farré, Klein, and Vella,

2009). Studies like Behrman and Rosenzweig (2002) report that father's education has larger impact on children's education. On the other hand in a study by Becker, Hubbard and Murphy (2010) find that maternal education is more beneficial to children.<sup>1</sup>

Gender differences in educational outcomes are also related to community and family attitudes regarding the education of girls. These attitudes are embedded in cultural norms and are influenced by marriage and kinship patterns which may lead parents to invest more emotional and financial resources in educating sons rather than daughters.

- **Early Marriage Practice:**

The Probe Team (1999) finds that the centrality of preparing girls for marriage is pronounced in the North India where parents have historically held lower aspirations for educating daughters rather than sons. In Pakistan there is also a common view that after marriage a woman's responsibility is to do domestic chorus, looking after her in-laws, children and husband. Parents' think that marriage of their daughters is their primary responsibility as compared to educate their daughters. Therefore, early marriage practice in Pakistan seriously stops girl's education and it needs to stop immediately with systematic approach from government and society (Maqsood *et al.*, 2012). There are several reasons behind the low enrolment in higher education; such as the high dropout rates at primary and secondary level, (Shah, 2005) conservative local culture and customs, poverty, sexual harassment, preference of boy's education over girls, lack of higher education institutions at local levels, and poor governance in universities etc. According to Sen (2001) the country has generally a male dominating society, and commonly holds a hostile attitude towards women.

- **Parents' Conservative Mind:**

Conservative and out dated local cultural norms and values are also standing as an obstacle in the way of females' higher education. A study by Maqsood *et al.* (2012) based on Pakistan have reported that parents of a female student consider that coeducation is a major threat to their family honour. South Asian countries especially India, Pakistan, Bangladesh are very conservative. As members of conservative society, families believe that after studying in coeducation system, no one will marry their daughters' which strongly influence to their opposition of education with boys.

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<sup>1</sup>Becker, Hubbard and Murphy (2010) said that "Maternal education may benefit children more, because mothers spend more time than fathers with children and higher education may increase the productivity of that time."

Similarly Channa (2000) has documented the same scenario is present also in India. Therefore, various research studies documented that coeducation system limits enrolment of females in higher education, because most of the higher educational institutions have this system. Mehmood *et al.* (2018) find that parents are more sensible for their daughter's physical security and threat of sexual harassment. This fear stops them to send their daughters in universities and colleges. Numerous studies indicate that the children of parents with a college education are much more likely to go to college, even when family income is held constant (Haveman and Wolfe, 1995).

- **Availability of Higher Education Institutions:**

Similarly female's entry into higher education institutes is also obstructed by lack of higher educational institutions on appropriate distance. This long distances hamper female's higher education which has increased cost of physical and economic expenses. Lina *et al.* (2006) has reported that the higher study of females is hampered due to weak transportation system, travel cost, accompany costs, opportunity cost, physical costs and the cultural restrictions on the mobility of adolescent girls.

According to UNESCO (2007) report there is now more number of women in undergraduate than men. In an empirical study Morley (2006) finds that participation rates of men in higher education system continue to outstrip women in East Asia and the Pacific, South and West Asia and Sub-Saharan Africa. The study was based on interviews<sup>23</sup> with students and staffs of higher education institutes from Nigeria, South Africa, Sri Lanka, Tanzania and Uganda. Women are globally under-represented in science and technology disciplines also. Parents may also discourage daughters from active participation in laboratory work and therefore to science subjects because they are generally scheduled beyond the teaching and classroom activities. Since it entails staying late in the afternoon and in the evening at college/university and travelling home later and may be alone, women students are discouraged from participation in these activities (Channa, 2000).

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<sup>2</sup>There was a situation when two students (a female and male) handed in the same piece of work, the lecturer awarded marks to the male student and cancelled the work of the female student on assumption that the female student had cheated. This in my view was not fair. (Ugandan student).

<sup>3</sup>[Men] hardly attend class. But get their notes from women. I know of several incidents where the boys have copied the tutorial and given it in and they've got higher marks for the same thing (Sri Lankan student).



- **Poverty:**

Economic factors are always playing an influential role in education sector. The low income and scarcity of financial resources hinder poor population to enrol their younger generation for proper education (Muhammad Zia Ullah Khan, 2015). Feudalism and its sub forms Jagirdaari and Zamindari systems create challenges for female's higher education. In the past the feudal system are exploiting peasants and paying lowest wages which even is not sufficient for survival. Thus poverty and deprivation is prevailing which leads to low enrolment of females in higher education. Kingdon (2005) reports that for rural households' inequality in educational expenditure within these households is primarily the result of enrolment differentials between boys and girls.

- **Public Expenditure:**

In the study by Kingdon (2005) it is also documented that within certain states gender disparities in educational expenditure are more prevalent in rural areas. Rani (2002) has pointed out the state and public supports are playing a vital role in the higher education system. Tilak (2009) has said that public subsidies in higher education are an important instrument to protect democratic rights, promote national values and furthering cooperation instead of competition. Despite the arguments put forth by the proponents of public spending in higher education several studies discard the same on the grounds that the benefits of public subsidy are skewed towards the higher income individuals, and higher private returns accrue to those who are enrolled in higher education (Dandekar, 1991; Rao, 1992; Shasrabuddhe and Srivastava, 1998; Verma, 1998; World Bank, 1995).

## Research Objective

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Gender Parity Index is a socioeconomic index. It is used to measure the relative enrolment of females and males in a certain stage of education (Primary, Secondary, Higher Secondary, Under Graduation, Post-Graduation etc.). This index is released by UNESCO. GPI is an important indicator of women empowerment in the society. Because narrow gender gaps not only help to increase female laborers in the labor force but also help to create strong position in the household decision making process, raise voice against child marriage and physical torture by their intimate partner and will improve maternal and reproductive health.

The objectives of this paper are:

- i. To observe the transition from higher secondary to higher education this study compares the GPI between Higher Secondary Education and Higher Education.
- ii. To examine the changing pattern of gender parity in different courses (Under Graduation, Post-Graduation and Technical Education) of higher education in different years.
- iii. The main objective is to investigate which factors are playing an important role to determine the value of GPI in Higher Education in different states.

So we have collected the GPI data from Ministry of Human Resource Development (MHRD) for the major 17 states of India from 2010-11 to 2015-16.<sup>4</sup>

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<sup>4</sup>All the variables considered in this study are available from 2010-11 to 2015-16.

# Comparisons between GPI in Different Levels of Education and in Different Courses of Study

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### 4.1 Comparison between GPI in Higher Secondary and GPI in Higher Education

Initially through Table-1, we want to show how GPI changes from higher secondary education to higher education (in age cohort between 18 to 23 years) in all the major 17 states of India. Here we consider two years gap between GPI in higher secondary education and GPI in higher education. Because when a student is enrolled in higher secondary education he/she will complete it after two years. So after completing the higher secondary education the student will be enrolled in higher education. Actually through this table, we want to see whether GPI has decreased in higher education if we compare that with higher secondary education in the male dominated Indian society. The GPI in Higher Secondary Education is calculated using the following method:

$$\text{GPI in Higher Secondary Education} = \frac{\text{Number of female students enrolled in higher secondary}}{\text{Number of male students enrolled in higher secondary}}$$

**Table 1A: Comparison between GPI in Higher Secondary and GPI in Higher Education**

State	2010-11 HIGHER SECONDARY GPI	2012-13 HIGHER EDUCATION GPI	2011-12 HIGHER SECONDARY GPI	2013-14 HIGHER EDUCATION GPI	2012-13 HIGHER SECONDARY GPI	2014-15 HIGHER EDUCATION GPI	2013-14 HIGHER SECONDARY GPI	2015-16 HIGHER EDUCATION GPI
Andhra Pradesh	0.9	0.777849	0.96	0.802363	0.99	0.809365	1.02	0.812273
Bihar	0.75	0.80343	0.9	0.808006	0.97	0.816464	1.04	0.799641
Chhatisgarh	0.81	0.8848	0.87	0.879907	0.915	0.912077	0.96	0.928927
Goa	1.04	1.568348	1.06	1.458701	1.06	1.217171	1.06	1.234438
Gujarat	0.84	0.802549	0.82	0.801747	0.82	0.789204	0.82	0.799513
Haryana	1	0.922369	1.03	0.901592	0.965	0.995104	0.9	1.017709
Jharkhand	0.89	0.976724	0.99	0.905089	0.995	0.927219	1	0.918647
Karnataka	1.04	0.93891	1.09	0.957508	1.14	0.972825	1.19	0.986082
Kerala	1.12	1.394709	1.18	1.359096	1.11	1.384341	1.04	1.315011
Madhya Pradesh	0.69	0.666986	0.76	0.800522	0.825	0.800431	0.89	0.848077
Maharashtra	0.83	0.825416	0.92	0.845151	0.96	0.855699	1	0.863452
Odisha	0.82	0.758529	0.67	0.823356	0.745	0.810416	0.7075	0.832001
Punjab	1	1.136812	1.07	1.16144	1.03	1.09207	0.99	1.104571
Rajasthan	0.63	0.691533	0.69	0.829376	0.715	0.815663	0.74	0.848117
Tamil Nadu	1.24	0.851833	1.28	0.885335	1.26	0.922094	1.24	0.915645
Uttar Pradesh	0.77	1.089726	0.84	1.131098	0.9	1.038262	0.96	1.028993
West Bengal	0.9	0.773307	0.99	0.790577	1.01	0.826269	1.03	0.846518

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

**Table 1B: Ranking between GPI in Higher Secondary and GPI in Higher Education**

	2010-11	2012-13	2011-12	2013-14	2012-13	2014-15	2013-14	2015-16
State	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION	HIGHER SECONDARY	HIGHER EDUCATION
	RANK	RANK	RANK	RANK	RANK	RANK	RANK	RANK
Andhra Pradesh	7	13	9	14	8	15	7	15
Bihar	15	11	11	13	9	12	4	16
Chhattisgarh	13	8	12	9	12	9	11	7
Goa	3	1	5	1	4	2	3	2
Gujarat	10	12	14	15	15	17	15	17
Haryana	5	7	6	7	10	5	13	5
Jharkhand	9	5	7	6	7	7	8	8
Karnataka	3	6	3	5	2	6	2	6
Kerala	2	2	2	2	3	1	4	1
Madhya Pradesh	16	17	15	16	14	16	14	12
Maharashtra	11	10	10	10	11	10	8	10
Odisha	12	15	17	12	16	14		14
Punjab	5	3	4	3	5	3	10	3
Rajasthan	17	16	16	11	17	13	16	11
Tamil Nadu	1	9	1	8	1	8	1	9
Uttar Pradesh	14	4	13	4	13	4	11	4
West Bengal	7	14	7	17	6	11	6	13

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

From Table 1A it is observed that for the states Goa, Kerala, Punjab and Uttar Pradesh, GPI values in Higher Education in 2012-13 are greater than the GPI values in Higher Secondary Education in 2010-11. The similar result is found in 2011-12 and 2013-14, 2012-13 and 2014-15, 2013-14 and 2015-16. The GPI value in Higher Education is higher than GPI value in Higher Secondary Education is may be due to the fact that GPI in Higher Education includes all the courses (Under Graduate, Post Graduate). For all the mentioned states GPI values for all the years in both Higher secondary and Higher education are greater than 1 which indicates that relative enrolment of females in higher education is higher than males in all the mentioned states. In the All India Survey on Higher Education (AISHE) 2015-16 report it is mentioned that states like Goa, Kerala more women are educated than men. On the other hand if we observe the state Andhra Pradesh, we can see each year GPI value in Higher Secondary Education is increasing specially in the financial year 2013-14 it is 1.02. On the other hand GPI in Higher Education is also increasing but the GPI value is less than the Higher Secondary education GPI value. It is already said that in 2013-14 GPI in Higher Secondary level is more than 1 but in 2015-16 GPI value in Higher Education is 0.81, which is less than 1. This implies that a section of female students who passed the Higher Secondary Examination are not enrolled in Higher education. From the above table, it is also observed that there is a significant improvement in GPI values for Madhya Pradesh in Higher Secondary Education. In the year 2010-11 GPI value in Higher Secondary for the state Madhya Pradesh is 0.69 and in Higher Education it is 0.66 but from 2011-12 it is improving and in 2013-14 GPI in Higher Secondary education is 0.89 and GPI in Higher Education in 2015-16 is 0.84. Therefore it can be said that there is still some inequality in enrollment between male and female students. The similar picture is found in West Bengal also, the GPI values in Higher Education are lower than GPI values in Higher Secondary Education. The GPI values in both the education sections are less than 0.90. Interestingly West Bengal's position in Higher Education is 13<sup>th</sup> in 2015-16 (shown in Table 1B). Gujarat position in Higher Education is 17<sup>th</sup> (shown in Table 1B) in 2015-16 and the GPI value in Higher Education is less than 0.80. Hence it can be concluded that there is a disparity in favor of males in higher education in both West Bengal and Gujarat.

## 4.2 Comparison between GPI in Different Courses of Higher Education

Table 2A-2C describe the relative enrolment of female and male students in different courses of studies (Post Graduation, Under Graduation, Technical) in higher education sector in all the major 17 states of India. In this study GPI in Post Graduate and Under Graduate and Technical Education are calculated in the flowing way:

$$\text{GPI in under Graduation} = \frac{\text{Number of female students enrolled in Under Graduation}}{\text{Number of male student enrolled in Under Graduation}}$$

$$\text{GPI in Post-Graduation} = \frac{\text{Number of female students enrolled in Post Graduation}}{\text{Number of male student enrolled in Post Graduation}}$$

GPI in Technical Education

$$\frac{\text{Total number of female students enrolled in PG Diploma, Diploma and Certificate Courses}}{\text{Total number of male students enrolled in PG Diploma, Diploma and Certificate Courses}}$$

### 4.2.1 Comparison of GPI in Under Graduation among the Major Seventeen States of India

Under Graduate Education is education conducted after Higher Secondary Education and prior to Post Graduate Education. According to the Ministry of Human Resource Development (MHRD) it is defined as “Programme after 10+2 and generally having the duration of 3/4/5 years, in General or Professional courses”.

Table 2A illustrates the changing pattern of GPI in Under Graduation (UG) for the major 17 states of India.

**Table 2A: Comparison between GPI in Under Graduation Course of Study**

State	Under Graduate GPI					
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh	0.718823	0.780412	0.767927	0.80189	0.828184	0.830802
Bihar	0.673757	0.680156	0.711809	0.720054	0.739011	0.731894
Chhattisgarh	0.697925	0.928141	0.922634	0.924013	0.953963	0.960946
Goa	1.313827	1.238873	1.417536	1.332035	1.259766	1.241573
Gujarat	0.788968	0.782396	0.767093	0.767766	0.736758	0.71858
Haryana	0.698095	0.892237	0.832265	0.782618	0.864641	0.861992
Jharkhand	0.777521	0.88701	0.939455	0.851329	0.890771	0.897761
Karnataka	0.893045	0.902009	0.950423	0.963605	0.982573	0.997839
Kerala	1.276355	1.411023	1.406406	1.336375	1.367974	1.277986
Madhya Pradesh	0.708784	0.65316	0.655676	0.684692	0.692476	0.731798
Maharashtra	0.718869	0.791387	0.762311	0.786617	0.792709	0.783022
Odisha	0.872012	0.935188	0.837156	0.92202	0.913323	0.92115
Punjab	0.582864	0.994551	1.078586	1.077023	0.945391	0.917071
Rajasthan	0.638063	0.681979	0.628816	0.770719	0.790308	0.812938
Tamil Nadu	0.943647	1.002927	0.992985	1.030232	1.049527	1.020533
Uttar Pradesh	1.008673	0.830909	0.934118	0.982543	0.91431	0.904543
West Bengal	0.747901	0.740831	0.771118	0.79451	0.84437	0.877279

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

From Table 2A it is observed that states like Goa and Kerala GPI in Under Graduation (UG) is above 1. So in both of these states there exist gender disparity in favour of females in UG. But the GPI values are decreasing over time in these two states. Though these values are greater than 1 but as these are decreasing so there are some alarming features in these states. On the other hand states like West Bengal, Andhra Pradesh, Karnataka GPI values are below 1 so there exist gender disparity in UG in favour of male students but as the values are increasing over time this implies that the states are moving towards gender parity. Chhattisgarh is a tribal state; a third of the state's populace is dominated by tribals'. But the state improves its position in higher education very rapidly. In 2010-11 GPI value in UG was 0.69, but from 2011-12 this state has crossed the GPI value in UG 0.90 and in 2015-16 the value is 0.96. This implies Chhattisgarh is now moving towards gender parity in Under Graduation.



## 4.2.2 Comparison of GPI in Post-Graduation among the Major Seventeen States of India

MHRD defines Post-Graduation course of study as “Programme after Graduation and generally having the duration of 2/3 years in General/Professional courses”.

Table 2B describes the changes in GPI in Post-Graduation (PG) course.

**Table 2B: Comparison between GPI in Post-Graduation Course of Study**

State	Post Graduate GPI					
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh	0.705219	0.733841	0.744775	0.771569	0.771569	0.815864
Bihar	0.517442	0.594781	0.66173	0.720709	0.720709	0.763163
Chhatisgarh	0.843296	1.130986	0.971943	0.9624	0.9624	1.080382
Goa	0.755257	0.617857	2.086538	1.564252	1.564252	1.580363
Gujarat	0.70349	0.852372	0.877244	0.943756	0.943756	1.168399
Haryana	1.114977	1.263145	1.317505	1.37036	1.37036	1.509963
Jharkhand	0.85226	0.879446	0.965825	1.264969	1.264969	1.347936
Karnataka	0.799028	0.868371	0.899811	0.904988	0.904988	1.057482
Kerala	1.497745	1.736936	1.89337	1.768825	1.768825	2.066359
Madhya Pradesh	0.810999	0.698867	0.740368	0.90092	0.90092	1.068847
Maharashtra	0.743377	0.746902	0.758627	0.827042	0.827042	0.967137
Odisha	0.618445	0.810156	0.838204	1.033357	1.033357	0.975653
Punjab	0.78599	1.78935	1.98724	1.903448	1.903448	1.97857
Rajasthan	0.837417	0.820075	0.749425	1.158841	1.158841	1.048761
Tamil Nadu	0.927339	1.065327	1.122431	1.225313	1.225313	1.435644
Uttar Pradesh	0.90487	0.901238	1.008626	1.143766	1.143766	1.306865
West Bengal	0.784083	0.747901	1.075902	1.166929	1.166929	1.224413

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

It is observed that like UG in PG also GPI values in Kerala are above 1 in all the mentioned years. Surprisingly, in 2012-13 and in 2015-16 the GPI values have crossed the value 2 in Goa and Kerala respectively. This is due to the reason that in both of these states male students are not interested to enrol in Post-Graduation rather they are more interested to go to job market. The Kerala Migration Survey (2014) conducted by Centre for Development Studies, Thiruvananthapuram report that several thousand educated youths have moved to the Gulf for searching jobs as government fail to create jobs for the educated youths. Haryana also has crossed the GPI value 1 in PG like Kerala. It is observed that in 2015-16 all the states except Andhra

Pradesh, Bihar, Maharashtra and Odisha have crossed the GPI value in PG “1” from below “1” in 2010-11. This implies that these states are moving towards gender disparity in favour of females from gender disparity in favour of males.

### 4.2.3 Comparison of GPI in Technical Education among the Major Seventeen States of India

In this study Technical education includes Diploma, Post Graduate Diploma and Certificate courses. According to MHRD this courses are defined as:

Diploma - Programme generally after 10+2 or after Graduation in General and Professional courses and having duration of 1/2/3 years.

Post Graduate Diploma - Programme generally after Diploma in General and Professional courses and having duration of 1/2/3 years.

Certificate – It is a Programme similar to Diploma, but is awarded a Certificate by the Institution.

Table 2C discusses about the changing pattern of GPI in Technical Education.

**Table 2C: Comparison between GPI in Technical Education Course of Study**

State	TECHNICAL GPI					
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Andhra Pradesh	0.79285	1.02418	0.984491	0.901518	0.674056	0.702133
Bihar	0.74954	0.38714	0.42318	0.489012	0.420969	0.441126
Chhattisgarh	0.385127	0.634167	0.593054	0.590394	0.649637	0.728621
Goa	0.416105	0.336155	0.391381	0.335005	0.152897	0.14703
Gujarat	0.379199	0.338408	0.363503	0.360625	0.411448	0.406375
Haryana	0.193171	0.230599	0.233501	0.274664	0.343599	0.390446
Jharkhand	0.976077	0.568035	0.395219	0.349777	0.269478	0.298922
Karnataka	0.750958	0.675373	0.604939	0.633948	0.598142	0.570343
Kerala	1.631505	1.471845	1.017423	1.127393	0.988586	0.901313
Madhya Pradesh	0.525029	0.151619	0.126829	0.664126	0.59786	0.668898
Maharashtra	0.614198	0.589889	0.567257	0.509675	0.555816	0.549971
Odisha	0.245153	0.276747	0.304841	0.311388	0.310248	0.378149
Punjab	0.194388	0.230268	0.272201	0.306183	0.447525	0.493503
Rajasthan	0.355646	0.326308	0.324267	0.182511	0.176343	0.215181
Tamil Nadu	0.224757	0.298709	0.264988	0.251926	0.281407	0.256947
Uttar Pradesh	0.544383	0.818103	0.813601	0.675579	0.488386	0.48356
West Bengal	0.280826	0.326099	0.297531	0.284149	0.392986	0.401231

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

From Table 2C it is observed that GPI values in Technical Education are very poor in all the major 17 states in India except Kerala. States like Goa, Rajasthan, Maharashtra, Andhra Pradesh this value is decreasing throughout the above mentioned years. Only in Kerala GPI is above 1 from 2010-11 to 2013-14. But from 2014-15 the GPI value starts falling and in 2015-16 it is 0.90. On the other hand states like Odisha, West Bengal, Haryana, Chhattisgarh this value is rising but still this is below 1. This implies that there exists gender disparity in favour of male students in Technical Education in all the major 17 states of India. It is already mentioned that Channa (2000) reports that parents discourage their daughters to opt science subjects/technical education considering their daughters physical security. As these subjects are associated with laboratory works and field survey and most of the time the laboratory works are scheduled after the regular classes, mostly in evening. So if the female students attain the laboratory classes then they will come back home in late evening may be alone. So there may be some physical safety issue for them. On the other hand if they go to the field survey then they will stay out of their house for some days. This hinders their parents to encourage their daughters to opt for science subjects/technical education.

## Factors Influence Overall GPI in Higher Education

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This section will try to identify the factors are actually playing an important role to determine the value of Gender Parity Index in Higher Education in different states of India. For that reason data on various variables are collected from different sources.

### 4.1 DATA

The data used in this empirical study has collected from All India Survey on Higher Education (AISHE) published by Ministry of Human Resource Development (MHRD), RBI Bulletin and Dice Statistics/Census Data for the 17 major states of India. Here we are not considered the special category states and the union territories as they get special funds for development of themselves from center. The list of major 17 states is below:

- Andhra Pradesh, Bihar, Chhattisgarh, Goa, Gujarat, Haryana, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal
- The study period is considered here from 2010-2011 to 2015-16<sup>5</sup>.

There are different factors which may influence GPI in Higher Education in India. On the basis of the availability of data we consider the following factors which may possibly influence GPI in Indian higher education. Therefore, considering some of these factors the following variables are used in our study:

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<sup>5</sup>All the variables considered in this study are available from 2010-11 to 2015-16.

**Table 3: Name and Definition of the variables Necessary here to Address the Research Problems:**

No.	Variable	Definition
1.	GPI	Gender Parity Index. It is measured as the ratio of number of female students enrolled in higher education to the number of male students enrolled in higher education in a particular state and in a particular time period.
2.	PSDP	Per capita State Domestic Product at current prices. It is measured as the ratio of Net State Domestic Product and population of a particular state.
3.	PTR	Pupil Teacher Ratio. It is the ratio between total number of students who attain the institution and the total number of teachers in the institutions of a particular state.
4.	No_College	Number of colleges per lakh population of a particular state.
5.	Female_Teacher	Percentage of Female Teachers out of total teachers working in higher education institutions in a particular state.
6.	Hostel_Intake	Total intake of women students in Girls' hostel in a particular state in a particular year.
7.	Expenditure_HE	Expenditure in Higher education as a percentage of Gross State Domestic Product (GSDP) of a state in a particular financial year.
8.	Lit_Male	Literacy rate of Male of a state in a particular year. It is used as proxy of father's education.
9.	Lit_Female	Literacy rate of Female of a state in a particular year. It is used as proxy of mother's education.

## 4.2 Theoretical Justification for Considering these Variables

*PSDP*: It is considered as a proxy of households' income. It is known to us that family income plays a very crucial role to decide whether the daughter/ son of the household will go for higher education or not. Many Indian families are low income earners. They think that it is beneficial for them to educate their son rather than their daughter. It is expected that higher family income may encourage the household of a particular state to take initiative to enroll their daughter in higher education. So PSDP is an important factor which can influence GPI.

*PTR (class size proxy):* It is an indicator of infrastructure of a college. If a college has huge number of students but less number of teachers to teach them then it is difficult for these students to complete their higher studies. So a higher value of PTR implies that each teacher has to be responsible for a large number of students. Therefore, it can be said that higher the PTR, lower relative access of students to teachers. This may discourage female students to enroll in higher education. Low PTR may improve the quality of higher education which may encourage the parents to send their daughters for higher education.

*No\_College:* It explains existing number of colleges in a particular state in any particular period. This is an important influencing factor on GPI. Because increased number of colleges help to increase the learning opportunities both for female and male students to complete their higher studies. There are 597264 numbers of villages in India. In many cases Higher education Institutes (college or university) are far away from a village. Therefore, due to the huge distance it is very difficult for a female student to go to college. On the other hand parents of the female student don't want to send their daughter to the far away college considering their daughter's safety issue. In that case distance between college and home, hinders the female student to enroll in higher education institutes. It is expected that larger number of colleges in a state encourage females to enroll in higher education relative to males.

*Female\_Teacher:* A country like India, this is a very important factor to influence the GPI. It is already mentioned that GPI is an index to measure the level of learning opportunities available for women in relation to those available to men. Indian families are conservative. In this 21<sup>st</sup> century most of the Indian families still prefer to send their daughters in a college under a female teacher than male teacher considering their daughters' safety. So it is assumed that greater percentage of female teachers will encourage parents to send their daughters to the higher education institutes.

*Hostel\_Intake:* Providing hostel accommodation is an important factor for enrollment of female students in higher education. It is observed in many cases there is only one college covering 5-6 numbers of villages. Therefore, to complete their higher studies this is also an important factor for those female students who stay far away from the college.

*Expenditure\_HE:* It is measured as Expenditure on higher education of a particular state in any financial year as a percentage of Gross State Domestic Product in that state in that particular year. It is also a very important variable in this study. Higher Education helps to grow a country. When a student moves from primary and secondary education to higher education this involves huge cost. To ensure greater participation in various types of economic activities from the economically

deprived socio-religious communities' expenditure on higher education is required by the government to reduce the direct cost of education.

*Lit\_Male and Lit\_Female*: It is already said that these two variables are considered as a proxy of parental education. If parents are more educated then they always want to send their daughters in higher education. So it is always observed that for a wealthy family with highly educated parents there is a greater probability that the daughter of this family will go for higher education than the family where parents are less literate.

Before going into the deep econometric analysis first we discuss the descriptive statistics.

### 4.3 Descriptive Statistics

**Table 4: Summary Statistics**

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
<b>Year: 2010-2011</b>					
GPI	0.853	0.791	0.185	0.616	1.335
PSDP	61934.43	62250.87	34974.12	19111.17	168024.1
PTR	24.352	25	7.713	13	39
No_College	25	26	12	5	48
Female_Teacher	36.677	35.570	9.274	15.6215	55.7379
Hostel_Intake	120037.1	48413	170641.1	654	631613
Expenditure_HE	3.040	2.88	0.700	2.02	4.85
Lit_Male	76.947	76.1	8.141	59.7	94.2
Lit_Female	55.829	55.7	13.483	33.1	87.7
<b>Year: 2015-2016</b>					
GPI	0.947	0.915	0.152	0.799	1.315
PSDP	115698.8	123979	60865.16	34168	291022
PTR	25.529	23	12.135	14	54
No_College	29	32	13	7	53
Female_Teacher	39.654	37.573	11.314	17.448	58.251
Hostel_Intake	156278	102367	156067.9	1642	523870
Expenditure_HE	3.084	2.62	1.749	1.81	9.43
Lit_Male	83.311	82.4	5.880	73.39	96.02
Lit_Female	66.855	66.77	10.448	52.66	91.98

Source: Calculated by the author on the basis of data provided by MHRD, Government of India

Table 4 describes the summary statistics for the years 2010-11 and 2015-16. It is observed that the average value of GPI in 2011 was 0.85 but in 2015-2016 it increases to 0.94. So it can be said that there is an improvement in GPI. On the other hand the minimum value of GPI was 0.616 in 2010-11 and in 2015-16 it is 0.79. But for the maximum value of GPI we get a different picture. Although the maximum GPI values in 2010-11 and 2015-16 are above 1 but in 2015-16 the maximum GPI is slightly lower than 2010-11 (from 1.335 to 1.315). It is found that in 2010-11 in India the average number of colleges were 25 but in 2015-16 it is increased to 29. In 2010-11 there were only 5 colleges in Bihar but in 2015-16 this number is increased to 7. Andhra Pradesh has highest number of colleges in both of these years. There is very little increase in average Pupil Teacher Ratio from 2010-11 to 2015-16. In 2010-11 there were 37% (approx.) female teachers in the colleges but in 2015-16 this increased to 40% (approx.). In 2010-11 the highest percentage of female teachers was found in the state Kerala but in 2015-16 Punjab has maximum percentage of female teachers. The average hostel intake is also increased from 2010-11 to 2015-16. Minimum hostel intake in 2010-11 was 654 students and in 2015-16 it is 1642. Both average male and female literacy rate are also increased from 200-11 to 2015-16. Surprisingly, the minimum value of male literacy in 2010-11 was 59.7 in 2015-16 it is 73.39. So it can be said that approximately 13% increase in male literacy rate. The same picture is also observed for female literacy rate and the maximum female literacy rate is observed in the state Kerala in 2015-16.

#### **4.4 Econometric Methodology**

In this study the relative enrollment of females to males in higher education is measured by the socioeconomic index **GPI**. To identify the possible factors affect GPI in higher education in India, panel data regression analysis is used in addition to the descriptive comparisons. For this investigation the overall GPI of a particular state in higher education is considered here. The data here used is Balanced Panel Data set.

First correlation matrix is used to check collinearity among the variables. This test reports that there is very high correlation between the variables 'No\_College' and 'PTR' and 'PTR' and 'Female\_Teacher'. To check the impact of these variables on GPI these are used in different regression models.

Before starting the analysis first it is assumed that the variable 'Number of colleges per lakh population' (No\_College) is an endogenous (correlation with the error term) variable in nature. It



is assumed that Expenditure on higher education as a Percentage of Gross State Domestic Product (Expenditure\_ HE) is used as an instrument of No\_College.

It is expected that there are some other factors which can affect GPI but due to unavailability of data these are accommodated in the disturbance term which may be correlated with this variable. Error term of a panel regression model constitutes two factors- time invariant factor and idiosyncratic error term i.e.

$$\mu_{it} = a_i + v_{it} \dots\dots\dots (i)$$

Where,  $\mu_{it}$  denotes the error term of a panel regression model

$a_i$  is the unobservable individual specific effect

$v_{it}$  is the idiosyncratic error term.

In the original model (Eq. 1), there is also a time invariant factor ( $a_i$ ) which can influence GPI of the  $i^{\text{th}}$  state and time variant factor. Here  $a_i$  accommodates socio-cultural and religious factors of the  $i^{\text{th}}$  state which can influence the parents to take decision whether they send their daughters for higher education or not? Taking decision on early marriage of their daughters reduces the possibility of women to enrol themselves in higher education. This can be accommodated in cultural factor. It is observed in the previous table (Table1A) that low value of GPI is observed in higher education in the states like Madhya Pradesh, Rajasthan Gujarat etc. Actually in these states we observe high presence of male dominance in the households (Chowdhury, 2005). This time invariant factor can accommodate scholarship facility for the women in higher education in that particular state. On the other hand the time variant factor includes number of Higher Secondary Schools in that particular area, percentage of female students passed in a particular year in a particular state. From Table 1A it is observed that many states like Andhra Pradesh, Tamil Nadu, West Bengal etc. GPI value in Higher Education is lower than GPI value in Higher Secondary Education. Higher percentage of female students passed in the Higher Secondary Examination in a particular state in a particular period may influence GPI in Higher Education mainly at UG level in that state in that particular period.

Therefore, number of colleges in any particular state in any particular time period may depend on percentage of expenditure on higher education in that state in that particular time period. It is assumed that expenditure of a particular state in Higher Education as a Percentage of Gross State Domestic Product is independent of the time variant factor. So it is assumed that

$$\text{No\_College}_{it} = f \text{ Expenditur\_HE}_{it} \dots \dots \dots (ii)$$

Hence, to investigate that whether the assumption about the endogeneity factor is correct or not this study considers two-equations Simultaneous Equation Model and it is a Balanced Panel Regression.

The regression equation is

$$\text{GPI}_{it} = \alpha_{11} + \beta_{11}\text{No\_College}_{it} + \beta_{12}\text{Female\_Teacher}_{it} + \beta_{13}\text{Hostel\_Intake}_{it} + \beta_{14}\text{PSDP}_{it} + \beta_{15}\text{Lit\_Male}_{it} + \beta_{16}\text{Lit\_Female}_{it} + \varepsilon_{11it} \dots \dots \dots (1)$$

The auxiliary equation, which is the reduced form equation of No\_College becomes

$$\text{No\_College}_{it} = \alpha_{21} + \beta_{21}\text{Expenditure\_HE}_{it} + \beta_{22}\text{Female\_Teacher}_{it} + \beta_{23}\text{Hostel\_Intake}_{it} + \beta_{24}\text{PSDP}_{it} + \beta_{25}\text{Lit\_Male}_{it} + \beta_{26}\text{Lit\_Female}_{it} + \varepsilon_{21it} \dots \dots \dots (2)$$

Where, i=1,2,...17 and t=1,2,...6.

To investigate that we have to go for the Hausman Specification Test.

First, we have to estimate this auxiliary regression equation i.e. Eq. (2) and estimate the residual of the auxiliary equation using the fixed effect model. Then incorporate the estimated residual value ( $\bar{\varepsilon}_{21it}$ ) in the Eq.(1) and the new regression equation is

$$\text{GPI}_{it} = \alpha_{11} + \beta_{11}\text{No\_College}_{it} + \beta_{12}\text{Female\_Teacher}_{it} + \beta_{13}\text{Hostel\_Intake}_{it} + \beta_{14}\text{PSDP}_{it} + \beta_{15}\text{Lit\_Male}_{it} + \beta_{16}\text{Lit\_Female}_{it} + \theta\varepsilon_{21it} + \varepsilon_{11it} \dots \dots \dots (3)$$

Now we estimate the equation (3) again using the fixed effect model. The same procedures are followed for the random effect model also. Then run the Hausman Specification Test. If the parameter estimate of the estimated residual that is  $\theta$  is statistically significant, then it can be concluded that there is endogeneity of our assumed variable in the Eq. (1). Otherwise we have to reject our assumption of endogeneity. The Hausman test support the fixed effect model and it is also checked that the assumed explanatory variable is an exogenous variable in our investigation because  $\theta$  is statistically insignificant. So we have to do simple fixed effect panel regression in Eq. (1).

Again we assume that the variable 'PTR' is an endogenous variable in nature. Higher PTR means each teacher is responsible to larger number of students and it is very difficult to give attention to

each and every student individually. So if the number of teachers increases that do not ensure good quality of teaching. Quality of teaching is an important factor that cannot be measured but it is accommodated in the disturbance term. Similarly here also the number of higher secondary schools, percentage of female students passed in the higher secondary exams in a particular state in a particular year is accommodated in the time variant error term. So expenditure on higher education at any point of time at any state may have impact on PTR in that state in that particular time period. It is expected that government can recruit more number of teachers or set-up more colleges if Government's expenditure on higher education will increase. Considering this issue we also run the two equation simultaneous regression model in the following.

The regression equation is

$$GPI_{it} = \alpha_{11}' + \beta_{13}'PTR_{it} + \beta_{14}'PSDP_{it} + \beta_{15}'Lit\_Male_{it} + \beta_{16}'Lit\_Female_{it} + \varepsilon_{11it}' \dots \dots (4)$$

It is also assumed that  $PTR_{it} = f(\text{Expenditure\_HE}_{it}) \dots \dots 4(A)$

The auxiliary regression equation which is the reduced form of equation of PTR becomes

$$PTR_{it} = \alpha_{21}' + \beta_{21}'\text{Expenditure\_HE}_{it} + \beta_{22}'PSDP_{it} + \beta_{23}'Lit\_Male_{it} + \beta_{24}'Lit\_Female_{it} + \varepsilon_{21it}' \dots \dots \dots (5)$$

Following the same procedures for the endogeneity test we run the Hausman Specification test. The test reports that the  $\chi^2$  value is significant but the parameter estimate of the estimated residual of the fixed effect model is insignificant which supports the fact that PTR is an exogenous variable in our study.

Hence, finally we run the following three regression equations. As from the correlation matrix it is found that the variables No\_College and PTR are highly correlated so to check the impact of these two variables, consider both of them in two different equations. Model 1 is for investigating the impact of No\_College and Model 2 is used to check the effect of PTR on GPI.

**Model 1:**

$$\begin{aligned}
GPI_{it} = & \alpha + \beta_1 No\_College_{it} + \beta_2 PSDP_{it} + \beta_3 Hostel\_Intake_{it} + \beta_4 Lit\_Male_{it} + \beta_5 Lit\_Female_{it} \\
& + \beta_6 Female\_Teacher_{it} + \beta_7 Expenditure\_HE_{it} + \epsilon_{it}
\end{aligned}
\tag{6}$$

**Model2:**

$$\begin{aligned}
GPI_{it} = & \delta + \gamma_1 PTR_{it} + \gamma_2 PSDP_{it} + \gamma_3 Hostel\_Intake_{it} + \gamma_4 Expenditure\_HE_{it} + \gamma_5 Lit\_Male_{it} \\
& + \gamma_6 Lit\_Female_{it} + \vartheta_{it}
\end{aligned}
\tag{7}$$

Similarly, as the variables Female\_Teacher and PTR are highly correlated so Model 3 is considered to check the impact of the variable Female\_Teacher.

**Model 3:**

$$\begin{aligned}
GPI_{it} = & \rho + \lambda_1 Female\_Teacher_{it} + \lambda_2 PSDP_{it} + \lambda_3 Lit\_Male_{it} + \lambda_4 Lit\_Female_{it} + \\
& \lambda_5 Hostel\_Intake_{it} + \mu_{it}
\end{aligned}
\tag{8}$$

Here also Hausman Test is used to decide between Fixed Effect Model and Random Effect Model. Because the null hypothesis of Hausman test is Random Effect Model is better against the alternative hypothesis, Fixed Effect model is better. So if the  $\chi^2$  value is significant then that implies Fixed Effect Model is best for this study. Because in the Fixed Effect Model the  $\alpha_i$  are assumed to be fixed parameters to be estimated and the remainder disturbances stochastic and independently and identically distributed. On the other hand the regressors are assumed to be independent of the idiosyncratic error term for each i and t.

### 4.5 Empirical Results and Discussions

Enrollment of females in higher education is influenced by many factors. In order to evaluate which factors are playing vital role to decide the enrollment of females in higher education we adopt Fixed Effect estimation for all of these three models as suggested through Hausman Test because the Hausman test yields

Model 1:  $\chi^2(5)= 13.70^{**}$  (Prob.>  $\chi^2(5)= 0.0176$ )

Model 2:  $\chi^2(4)= 8.70^*$  (Prob.>  $\chi^2(4)=0.0690$ )

Model 3:  $\chi^2(3)= 7.90^{**}$  (Prob.>  $\chi^2(3)= 0.0482$ )

All of these three models  $\chi^2$  values are statistically significant. Therefore, the results clearly lead us to accept that Fixed Effect Estimation is best for all of these three models. Beside this there may be some state specific unobserved factors which may influence GPI in different states. According to Wooldridge (2002) it is said that in some application of panel data models, samples collected from large populations cannot be treated as random samples especially when the unit of observation is large geographical locations (states/provinces). In that scenario it is best to think each of the unobserved effect ( $a_i$ ) as a separate intercept to estimate for each cross-sectional unit. In that case Fixed Effect Model is best to use. So in this study to capture the state specific unobserved effect on GPI Fixed Effect estimation is appropriate.

**Table 5: Determinants of GPI**

<b>Explanatory Variable</b>	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
PTR		-0.004* (0.002)	
No_College	-0.002 (0.005)		
Female_Teacher	0.016*** (0.003)		0.016*** (0.003)
Hostel_Intake	5.01e-08 (2.74e-07)	3.27e-07 (2.86e-07)	-2.08e-09 (2.55e-07)
Expenditure_HE	0.002 (0.010)	0.001 (0.012)	
PSDP	7.70e-07 (5.38e-07)	8.28e-07* (4.52e-07)	5.79e-07 (3.92e-07)
Lit_Male	0.031* (0.018)	0.057*** (0.021)	0.030* (0.017)
Lit_Female	-0.017 (0.010)	0.030** (0.012)	-0.017 (0.010)
Intercept	-1.164 (0.779)	-1.872** (0.923)	-1.214 (0.763)
R <sup>2</sup>	0.423	0.246	0.4210
F-statistics	8.19***	4.31***	11.64***

\*\*\*, \*\* and \* indicates level of significance at 1%, 5% and 10 %.

Table 5 shows that according to the Model 1 discussed in Eq.(6), percentage of female teachers have significant positive impact on GPI. This may be due to the fact that parents of a female student think it is safe for his/her daughter to go to a college where more number of female teachers are present than male teachers. Or they may prefer totally girl's college for higher education of their daughter considering their daughter's physical safety issue. On the other hand the coefficient of male literacy rate has also positive and significant effect on GPI. This is because our society is male dominated. So living in a male dominated society fathers' education is always playing a vital role than mothers' education to decide whether the daughter of the household will go to the higher education institution or not.

Model 2 discusses Eq.(7). This regression equation reports that the coefficient of PTR has significant negative impact on GPI. Lower PTR implies each teacher is responsible to smaller number of students and thus they can give attention each and every student individually. So lower pupil teacher ratio helps to improve the GPI because parents wish to send their daughters' to those institutions where they can learn properly and sincerely. But this model also shows that beside the male literacy rate female literacy rate has also positive significant impact on GPI. It is already said that Male\_Literacy is considered here as a proxy of father's education. So it is evident that as more and more fathers are highly educated then more number of female students will be enrolled in higher education institutions. Plug (2004) also documents that father's education play an important role on his daughter's/son's higher education. This is because parental especially father's education plays a vital role to decide whether the daughter of a family get enrolled in higher education or not. If a father of a female student is highly educated then there is a high chance to send his daughter in higher education institutions. On the other hand this model also provides evidence that mother's education is also important to improve GPI. Because women especially mother's education have multiplier effect on development of a country. Khalid (2008) documents that improving females' education will help to eliminate the gender gap in employment and earnings and this will have some important non-market benefits like improved child nutrition and lower fertility etc. This model also shows that the coefficient of PSDP has positive significant effect on GPI. This implies that as income of a household increases then parents will take initiative to enrol their daughter in higher education institutions.

Model 3 shows the regression result after dropping both of the variables PTR and No\_College. This reports that the coefficient of the variable Female\_Teacher and male literacy rate have positive significant effect on GPI. Velkoff (1998) reports that lack of female teachers in the higher education institutions is an important barrier behind the low enrolment of females in higher

education institutions. As parents are always in a fear of their daughters' physical safety so they prefer to send their daughters under a female teacher rather than a male teacher. So both of these factors help to improve the GPI in higher education. On the basis of parameter value male literacy rate is more important than the variable percentage of female teacher.

Among all the three models only Model 2 reports that the intercept term is negatively significant. Though Model 1 and Model 3 report moderately high R-square value than Model 2 but Model 2 shows both the male and female literacy rate and the variable PSDP help to improve the GPI value in higher education. The values of F-statistics (indicator of overall significance) are significant in all the three models.

## Conclusion

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In an economy either developed or developing, it is known to all that higher education has a significant influence in the quality of life, awareness among the individual as well as in social transformation of the society. Therefore, all the countries in the world are promoting higher education in one hand and also trying to achieve gender parity in higher education. In 2005-06 Indian government has started to bring a separate gender budget. It is not a separate budget for women. The aim of gender budgeting is to deal with budgetary gender inequality issues. In this budget, special funds are allocated for females' education.

In this study data on several variables are collected from different sources to identify the factors which are playing a vital role to determine the value of Gender Parity Index in Higher Education after considering seventeen major states of India as cross sectional unit where the considered time period is from the period 2010-11 to 2015-16. First compare the GPI between Higher Secondary and Higher Education level of studies in the major 17 states then again compare the GPI values in different course of Higher Education. These comparisons report today more number of female students are eager to enrol in higher education system. It is observed that states like Goa, Kerala, Punjab have crossed the GPI value 1 and some of the states (Haryana, Jharkhand, Tamil Nadu) are very close to achieve the GPI value 1 in higher education. On the other hand being a tribal state Chhattisgarh improves its position in higher education very rapidly. The GPI values both in Under Graduation and Post-Graduation courses indicate that the relative enrolment of female students in that states is high. But the GPI values in Technical Education are very low and are decreasing in many states of India over all the mentioned six years. In the statistical analysis the summary statistics shows that all the collected variables' average, minimum and maximum values are increased from 2010-11 to 2015-16.

The econometric analysis shows that increases in the percentage of female teachers in colleges and improvement in Male and Female Literacy rate help to improve the relative enrolment of female students in higher education. As parent of a female student is always in a panic of their daughter's physical security, this hinders them to send their daughters in colleges under a male



teacher. But if a college has more number of female teachers then that will mitigate their problem and this leads to increase female student enrolment in higher education institutions. On the other hand parental education especially father's education is also important to improve the GPI in higher education. This is because Indian society is a male dominated society. Here the head of the household is a male member. He will take every important decision of the household. So if the father of a female student is highly educated then there is always a high chance to send his daughter to higher education institutes. On the other hand maternal education is also important and it has multiplier effect on the development of the country. As mothers spend larger time with children than fathers so if mothers are highly educated then the productivity of that time will increase. This study also shows that beside the parental education and percentage of female teachers the variable PSDP also helps to improve the GPI in Higher education. Here PSDP is considered as a proxy of household's income. So as the income of a household in a particular state increases then that leads to encourage the household to send the female member of the household to the higher education institutions. In this study it is also found that lower value of Pupil Teacher Ratio also encourages female students to enrol in colleges/universities.

Today Government of India takes several measures to achieve gender parity in higher education. For example Central Board of Secondary Education (CBSE) has started a project "UDAAN" under guidance of MHRD to address the issue of low female enrolment in prestigious engineering institutions and the teaching gap between school education and engineering entrance examination.

Gender Parity Index in higher education is a socio-economic indicator and it is used to measure the relative enrolment of female and male students in higher education. But this index has some limitations. It never reflects the fact that whether the improve value of GPI is due to increase of females enrolment in higher education or decrease males enrolment in higher education.

Ignoring this issue this study reports that nowadays more girls are eager to enrol in higher education institutes and the GPI values in higher education show that the major seventeen Indian states are now moving towards gender parity in higher education.

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# Certificate of Presentation

This is to certify that

Sanghita Ghosh of Department of Economics, Jadavpur University has presented a paper titled "*Determinants of Gender Parity Index in Higher Education in India: A Panel Data Approach*" in One Day Research Scholar Workshop on Economics on 28th February, 2019 is organized by Department of Economics, University of Kalyani, Kalyani, Nadia, West Bengal.

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