

# Forecasting Gender Parity in Higher Education System and Labor Market in Japan and Korea

Tien-Li Chen

**Abstract**—Education can promote social mobility and gender equality. This study selects Japan and Korea as the research targets to explore how gender parity in higher education system and labor market has been changing with expanding higher education. The data are from the World Bank, including gross enrollment ratio in higher education and unemployment rate for male and female from 1971 to 2016. Using Becker's coefficient of discrimination (D) to analysis the trends of D in higher education system and labor market in Japan and Korea. And predicting D index in higher education system and labor market for the next decade (2017-2026) by using ARIMA. The results show that gender parity in higher education system in Japan and Korea is approaching gender equality, it is more favorable to female in higher education system. Under the impact of aging society, lower birth rate and wage gap, Japanese female's participation in labor market has been increasing. In the future, the high unemployment rate of male will be more serious. In Korea, the employment rate of female due to marriage, childbirth, child-rearing and other reasons is relatively low. The unemployment rate for female in labor market is going to be much higher than male in the next decade. In Japan and Korea, the traditional allocation of family roles has subsided into an established social norm. For the Japanese and Korean governments, gender equality is still an important issue.

**Index Terms**—ARIMA, gender parity, expanding higher education, unemployment rate, labor market.

## I. INTRODUCTION

Equality of opportunity optimize the economics of education by ensuring all available productive talent would become educated. Higher education is a major to take off economic growth in a knowledge-driven global economy. Education equity and quality can improve economic growth and social development in a country [1]-[3]. Countries are working to boost higher education expansion to promote national economic development. In 1974 Scholar Martin Trow published *Problems in the Transition from Elite to Mass Higher*. He mentions that higher education expands from an elite stage to a mass stage gross enrollment ratio at least 15 percent, and then a universal stage at 50 percent [4]. With expanding higher education, it could occur quantitative growth leads to qualitative change [5]. Despite the expansion of higher education might lead to an increase in graduate unemployment or oversupply, it becomes a symbol of rising social status. As more people enter higher education, Japanese and Korean are no exception. Japan and Korea share similar socio-culture background. Traditionally, the roles of men are considered as breadwinners, and women are

seen as housekeepers. The government of Japan and Korea have enacted a series of gender equality policies and relative laws in order to dispel the gender stereotypes in the social structure.

Japan's and Korea's private higher education institutions was increasing in last two decade, their higher education system has been entering into universal stage (GER upper 50%). Tracing back higher education expansion in Japan and Korea. Japan has a breakthrough to get better on economic growth in the early 1990s after the bubble collapse. Reforming higher education system was one of the public policies. During the period, the private higher education institutions were growing rapidly, nearly 78% of universities were private institutions. In Korea, expanding higher education has occurred over the last 20 years [6]. The private institutions and enrollment rate were growth rapidly, the number of students has been more than double. Along with the government sponsored expansion of higher education, the enrollment rate of women in Japan and Korea were low compared with all the OECD countries [7], [8]. The cause of the gender inequality was rooted in traditional view of the roles of women. The roles of women were limited on family housework [9]. Men participate in wage generating labor, and women participate in wage-less production in the form of domestic labor. In labor market does not recognize the labors of female to have the same value as male labor. It is an important worldwide issue on gender equality in labor market. In Japan. Due to the democratization and gender equality mainstreaming in global countries, Japanese government enacted gender-related laws such as the *Equal Employment Opportunity Law* in 1986, *Child Care Leave Law* in 1992 and *Basic Law a Gender-equal Society*, including the education and labor market spheres in society in 1999. In Korea, the gender inequality problem has been improving since the takeoff the economy in the 1970s [10]. In the last 1990s, gender equality in education was absorbed into the discussion about human resources policy to encourage national economic growth. Training and utilizing female workers became a focal interest in national policy. Understanding the major issues to improve gender equality in entering higher education and labor market in the global economic competitiveness [11].

The study is going to explore that how gender parity in higher education system and labor market has been changing with expanding higher education. The study selected Japan and Korea as the targets, and explores the following research questions:

- 1) Does it provide more education opportunities for female in higher education system within expanding of higher education?
- 2) Does it provide more employment opportunities for female in labor market within expanding higher education?

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3) What are the trends of D in higher education system and labor market in the next decade?

The study collected the series data with gross enrollment ratio and unemployment rate in Japan and Korea to explore the study topic. The structures of the study as follow: Section 1 is introduction. Section II is describing what the methods will be used in the study. Section III is the results which explore the trends of D in higher education system and labor market in Japan and Korea and predicts D in the next decade. Section IV is conclusion of the study.

## II. METHODS

### A. Becker's Coefficient of Discrimination (D)

The data of GER and unemployment rate were collected from the World Bank from 1971 to 2016 [12]. The study calculated D by using Becker's formula to measure the equality of opportunity in higher education system and labor market [13]. Becker's coefficient discrimination (1971) is defined as follow:

$$D = (EM/EF)-1 / D = (UM/UF)-1$$

EM: the education opportunity for male in higher education system;

EF: the education opportunity for female in higher education system;

UM: the unemployment rate for male in labor market;

UF: the unemployment rate of female in labor market.

In higher education system, if D is positive, implying education opportunity for female is less than male, and the negative D means female students are more than male students. In labor market, positive D implying unemployment rate of male is higher than female, denoting employment opportunity for female is more than male. Whereas, the negative D in labor market signifies the unemployment rate of female is higher than male. When D is nearly zero or zero, expressing the participation rate for males and females in higher education system and labor market are equal. In this study, using Becker's D index to explore gender parity in higher education system and labor market in Japan and Korea.

### B. Forecasting D in the Next Decade by ARIMA

Using Auto-regressive Integrated Moving Average (ARIMA) to forecast the trends of D in higher education system and labor market in the next decade (2017-2026). ARIMA model is being building process the series data whether it is stationary or non-stationary series. Typically, a non-seasonal ARIMA model is classified as an ARIMA (p, d, q) model, 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.

The study also checked the residual are independent by using Box-Pierce Chi-square statistics and compared the signification of the p-value for each chi-square statistic. A significant level of .05 works well [14], [15]. Basically, the p-values for Ljung-Box chi-square statistics are all greater than .05. In the study, the analyses are carried out using Minitab® statistical package.

## III. RESULTS

### A. The Trends of D in Higher Education System and Labor Market in Japan (1971-2016)

Scholar Trow (1973) defined the gross enrollment ratio is classified into three stages, elite stage (GER below 15%), mass stage (GER 15%-50%), and universal stage (GER above 50%). This study redefined the three stages of higher education system, that GER below 25% is stage 1, GER 25%-50% is stage 2, and GER above 50% is universal stage. In Japan the gross enrollment ratio in higher education entered into mass stage in 1976. During the mass stage (1976-2002), D in higher education system was declining obviously in Fig. 1. Japanese government enacted gender-related laws since 1986. In 1999 Japanese government drew up the *Basic Law for a Gender-equal Society* that was basis for gender equity policy. Gender equity policies have begun to make some impact in Japanese social structure. Along with expanding higher education and enacting the gender equity laws, there are more and more opportunities in higher education system and labor market for female. In Fig. 1 and Fig. 2, in mass stage (stage 2), the average D in higher education was 0.583, and the D in labor market was 0.013. Then, the gross enrollment ratio was over 50%, entering into universal stage (stage 3) in 2002. In universal stage, the average of D in higher education and labor market were 0.111 and 0.103. Both of Ds in higher education system and labor market are closer zero, approaching gender equality. There are more education opportunities for female in higher education system. At the same time, under the impact of aging society, lower birth rate and wage gap, female's labor market participation is higher than males.

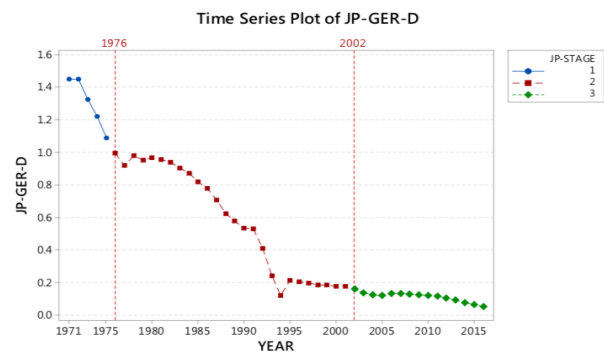


Fig. 1. The trend of D in higher education system in Japan.

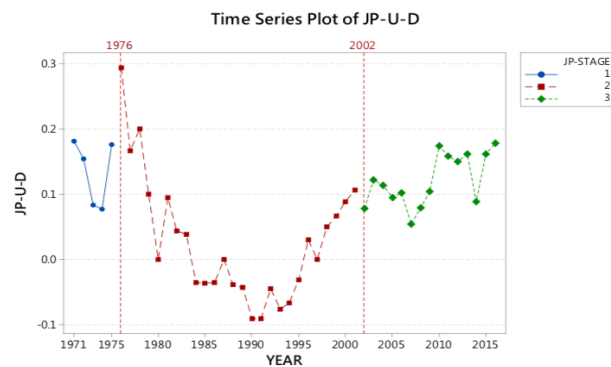


Fig. 2. The trend of D in labor market in Japan.

**B. The Trends of D in Higher Education System and Labor Market in Korea (1971-2016)**

Since 1980s, Korean government carried out policy revisions to counter discriminatory aspects of female participation in higher education and labor market. Private higher education institutions were expanding in the last two decades. As the higher education institutions expansion, providing more education opportunities for female. In Figure 3, higher education system had been entering into mass stage (stage 2) from 1982 to 1995. The trend of D in higher education has dropping down obviously since 1980s. In mass stage, the average of D in higher education system was 1.172, the average of D in labor market was 0.82. Implying it was not favorable to female in higher education system and labor market. Since 1996, higher education system entered into universal stage (stage 3). In universal stage, the average of D in higher education system was 0.506, and the average of D in labor market was 0.238. The participation rates of male in higher education system still higher than female. In universal stage, the trend of D in higher education system is below 1. Implying the female's participation rate has been increasing, and the higher education system is becoming more favorable to female within higher education expansion. In labor market, the male's unemployment rate was high, instead, the female's employment rate in labor market was much higher than male (Figure 4). The data of Korea labor institute survey (2013) shown 42.5% of female who has full-time job and 57.5% of female who has part-time job. Lots of females are participation in lower level jobs, the differences in the treatment of males and females in Korean labor market. The high unemployment rate of male has been declining in the last decade.

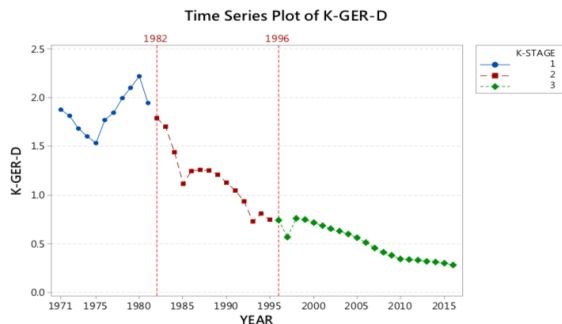


Fig. 3. The trend of D in higher education system in Korea.

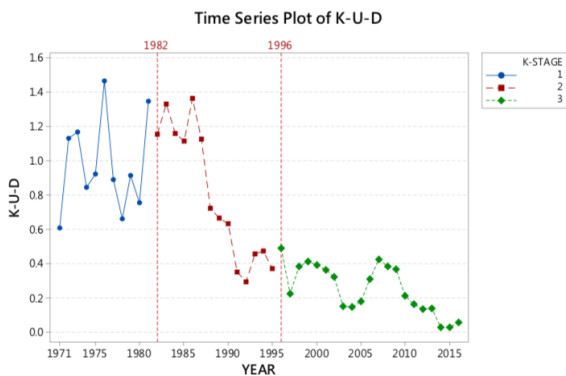


Fig. 4. The trend of D in labor market in Korea.

**C. Interpretation of the D by ARIMA**

D index in higher education system in Japan and Korea

The ACF and PACF indicated that ARIMA (1,1,0) could be used to predict the series of Japan's D index in higher education system, and ARIMA (3,3,0) could be predict the series of Korea's D index. The residuals follow a white noise process. Table I shows both of Japan's and Korea's the final estimates parameters for percent of D are less than 0.001.

TABLE I: FINAL ESTIMATES D OF GER IN HIGHER EDUCATION SYSTEM

JAPAN				
ARIMA(1,1,0)	COEF.	SE COEF.	T-VALUE	P-VALUE
AR (1)	0.4256	0.1382	3.08	0.004
CONSTANT	-0.017435	0.006886	-2.53	0.015
KOREA				
ARIMA(3,3,0)	COEF.	SE COEF.	T-VALUE	P-VALUE
AR (1)	-1.2403	0.1214	-10.22	0.000
AR (2)	-0.0477	0.1586	-6.11	0.000
AR (3)	-0.6510	0.1194	-5.45	0.000

Ljung-Box test was used to provide an indication of whether the model was correctly specified. Basically, the p-values for Ljung-Box Chi-square statistics greater than .05 works well. Table II shows the the p-values for the Ljung-Box Chi-square statistics are all greater than .05. And the ACF and PACF diagrams of the residual values are returned in Fig. 5.

TABLE II: MODIFIED BOX-PIERCE CHI-SQUARE STATISTICS FOR ARIMA MODELS

JAPAN LAG				
	12	24	36	48
CHI-SQUARE	8.5	24.9	26.0	*
DF	10	22	34	*
P-VALUE	0.578	0.302	0.834	*
KOREA LAG				
	12	24	36	48
CHI-SQUARE	15.8	23.5	24.4	*
DF	9	21	33	*
P-VALUE	0.071	0.315	0.862	*

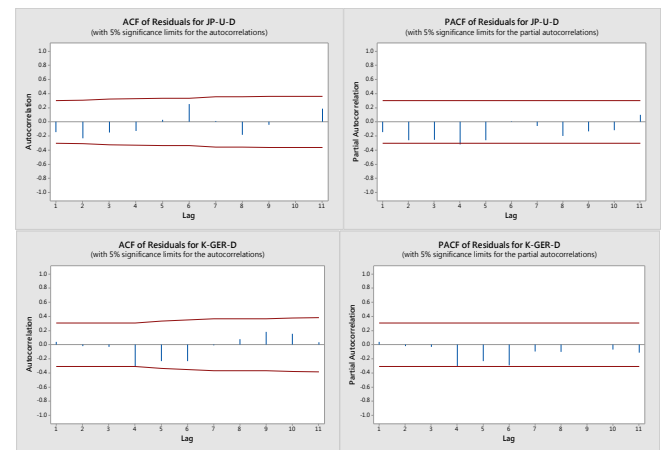


Fig. 5. Checking D index with ACF and PACF.

**D. Index in Labor Market in Japan and Korea**

TABLE III: FINAL ESTIMATES D INDEX IN LABOR MARKET

JAPAN				
ARIMA(2,2,1)	COEF.	SE COEF.	T-VALUE	P-VALUE
AR (2)	-1.4412	0.1203	-11.99	0.000
AR (2)	-0.6403	0.1180	-5.43	0.000
MA (1)	-0.9425	0.685	-13.75	0.000
KOREA				
ARIMA(2,2,1)	COEF.	SE COEF.	T-VALUE	P-VALUE
AR (2)	-0.3663	0.1454	-2.52	0.016
AR (2)	-0.3384	0.1445	-2.34	0.024
AR (1)	-1.0422	0.0835	12.46	0.000
CONSTANT	-0.0037848	0.0003813	-9.93	0.000

The ACF and PACF indicated that ARIMA (2,2,1) could be used to predict the series of Japan's D index in labor market, and ARIMA (2,2,1) could be predict the series of Korea's D index. The residuals follow a white noise process. Table III shows both of Japan's and Korea's the final estimates parameters for percent of D are less than 0.001.

In this study, the *p*-values for Ljung-Box Chi-square statistics are greater than .05 in Table IV. The ACF and PACF diagrams of the residual values are returned in Fig. 6.

TABLE IV: MODIFIED BOX-PIERCE CHI-SQUARE STATISTICS FOR ARIMA MODELS

JAPAN LAG	12	24	36	48
CHI-SQUARE	13.6	19.9	42.1	*
DF	9	21	32	*
P-VALUE	0.136	0.527	0.133	*
KOREA LAG	12	24	36	48
CHI-SQUARE	5.5	13.7	18.7	*
DF	8	20	32	*
P-VALUE	0.704	0.847	0.970	*

Most of female are participation in lower level jobs. According to Catalyst Report (2014), a few females are managerial, only 7.5 percent of cesareans are female, and 8.5 percent of mangers in businesses with more than 100 employees are female. In addition, under the impact of aging society, lower birth rate and wage gap, high unemployment rate of male is becoming a social issue in Japan in the future.

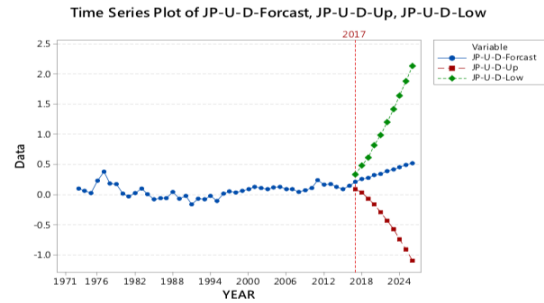


Fig. 8. The trend of D in labor market in Japan (2017-2026).

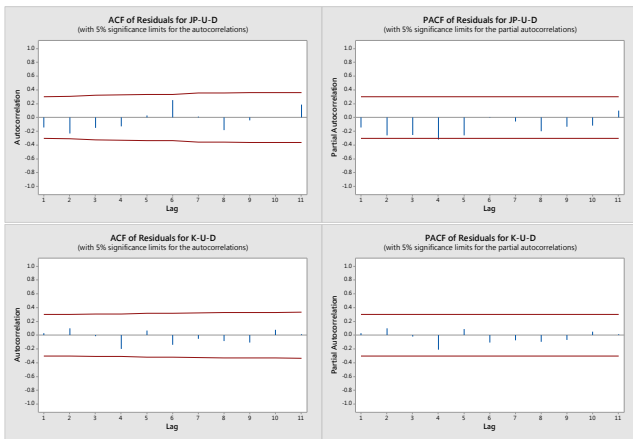


Fig. 6. Checking the D index with ACF and PACF.

TABLE V: THE PREDICTION OF JAPAN'S D IN HIGHER EDUCATION SYSTEM AND LABOR MARKET (2017-2026)

YEAR	JP-GER-D Forecast	JP-GER-D Up	JP-GER-D Low	JP-U-D Forecast	JP-U-D Up	JP-U-D Low
2017	0.028608	-0.061935	0.119152	0.211	0.0874	0.33459
2018	0.001667	-0.155998	0.159332	0.2573	0.03436	0.48024
2019	-0.027233	-0.241756	0.187289	0.27391	-0.06647	0.61429
2020	-0.056967	-0.320141	0.206207	0.32443	-0.1669	0.81577
2021	-0.087055	-0.392694	0.218584	0.34509	-0.29391	0.98409
2022	-0.117294	-0.460754	0.226165	0.38708	-0.42944	1.20359
2023	-0.147598	-0.525331	0.230135	0.41744	-0.57829	1.41318
2024	-0.177928	-0.587162	0.231305	0.4509	-0.74224	1.64404
2025	-0.208271	-0.646782	0.230241	0.48734	-0.91243	1.88711
2026	-0.238618	-0.704586	0.22735	0.5175	-1.09899	2.13399

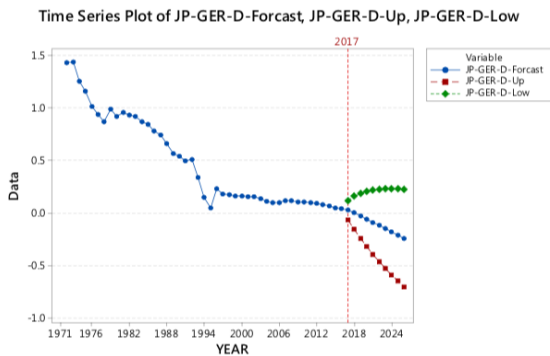


Fig. 7. The trend of D in higher education system in Japan (2017-2026).

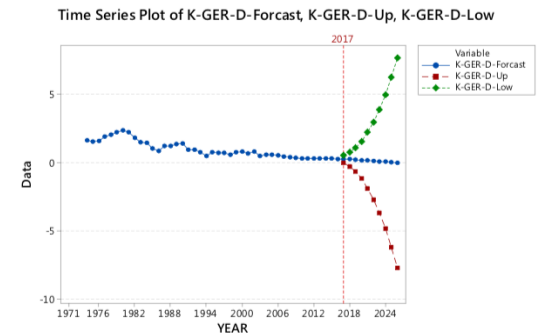


Fig. 9. The trend of D in higher education system in Korea (2017-2026).

### E. The Trends of D in Higher Education System and Labor Market in Japan (2017-2026)

Forecasting the trends of D in higher education system and Labor market in Japan are displayed in Figure 7 and Figure 8. According to the ARIMA model (1,1,0), the range of D in higher education system are from 0.028608 to -0.238618 (Table V). The ARIMA model (2,2,1) predicts D in labor market will locate in the range from 0.211 to 0.5175 (2017-2026). According to the result, in 2026 the D in higher education system is -0.238618, the participation rate of female in higher education system is rising. At the same time, the D in labor market is 0.5175. Obviously, the unemployment rate of male is much higher than female, because most of female who works part-time or temporarily.

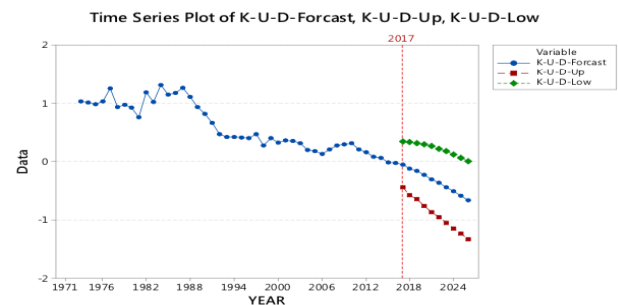


Fig. 10. The trend of D in labor market in Korea (2017-2026).

### F. The Trends of D in Higher Education System and Labor Market in Korea (2017-2026)

The result of predicting Korea's D in labor market is showed in Figure 9 and 10. In Korea, the range of D in higher



education system is from 0.26473 to -0.01157. Showing the female students will be more than the male students in higher education system in the future. The ARIMA model (2,2,1) predicts D in labor market will locate in the range from -0.04993 to -0.66313 (2017-2026). According to the predicting result, the D in 2026 in higher education system is -0.01157 (Table VI), the participation rate of female will be higher than male, meaning it is becoming favorable to female in higher education. At the same time, the D in labor market in 2026 is -0.66313, obviously, the unemployment rate of female is much higher than male. In Korea, the traditional allocation of family roles has subsided into an established social norm: once a woman is married, she will give up career and play a role of housewife. The reluctant resignation or choice of temporary workers because of marriage, childbirth, child-rearing, etc. that is also one of reasons for the low employment rate of female. Does the gender inequality still in the Korean social structure within expanding higher education? More and more female are participating in higher education system, but less and less female are involved in labor market. It is an important issue for Korea.

TABLE VI: THE PREDICTION OF KOREA'S D IN HIGHER EDUCATION SYSTEM AND LABOR MARKET (2017-2026)

YEAR	K-GER-D	K-GER-D	K-GER-D	K-U-D	K-U-D	KU-D
	Forecast	Up	Low	Forecast	Up	Low
2017	0.26473	0.0073	0.52215	-0.04993	-0.44416	0.3443
2018	0.24517	-0.27586	0.76619	-0.12006	-0.5785	0.33838
2019	0.22151	-0.66158	1.1046	-0.16183	-0.64218	0.31852
2020	0.19581	-1.17444	1.56605	-0.22974	-0.75599	0.29651
2021	0.16811	-1.87832	2.21454	-0.30145	-0.86569	0.26278
2022	0.13748	-2.69535	2.97031	-0.36672	-0.95533	0.2219
2023	0.1037	-3.67704	3.88443	-0.43684	-1.04918	0.1755
2024	0.06798	-4.83392	4.96988	-0.51115	-1.14524	0.12294
2025	0.02966	-6.18239	6.24171	-0.58606	-1.23764	0.06551
2026	-0.01157	-7.69794	7.67481	-0.66313	-1.32975	0.0035

#### IV. CONCLUSION

To explore the higher education system under the expansion of higher education and gender parity in labor market according to the research purpose. Understanding gender parity in higher education and labor market by using Becker's coefficient of discrimination (D) and predicting D in higher education system and labor market in the next decade (2017-2026) with ARIMA. For the first research question, as expanding higher education, in both of countries the education opportunity for female has been increasing indeed. Higher education system in Japan and Korea are more favorable for female, and it is expected that the higher education system in Japan and Korea will approach gender equality in 2025 and 2026. Japanese and Korean government have enacted the policies and laws on gender equality, we will see the result in higher education system.

For the second and third research questions, according to the result that the unemployment rate of male in Japan is higher than that of female, and unemployment rate of male is going to be more serious in the next decade. Although the employment rate of Japanese female will be higher than male, most of them are part-time or temporarily workers. In Korea's labor market, the high unemployment rate for female is going to rise rapidly in the next decade. Expanding higher education enables female to get more education opportunities, but the employment participation rate of female is getting lower and lower.

In Japan and Korea, gender parity in higher education system is approaching gender equality, it is more favorable to female in higher education system. Is there gender inequality in labor market of Japan and Korea? In the next decade, the labor market of Japan and Korea will face more serious problem. The study analyzed the trends of D in higher education system and labor market to provide the information for the related policy makers. In the future, gender equality will remain an important issue for Japan and Korea, even for each country.

#### 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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