2021
Research Paper-17

Development of Strategies by Sector for Reducing the Gender Gap in the Labor Market (III): Focusing on Gender Segregation across Fields of Study

Seon-Mee SHIN, Jongsoog Kim, Sunhaeng Lee,
Hyokyung Kim, Kyungju Kang, Hea Jun Yoon

Korean Women's Development Institute

Development of Strategies by Sector for Reducing the Gender Gap in the Labor Market (III): Focusing on Gender Segregation across Fields of Study

Korean Women's Development Institute
225 Jinheung-ro Eunpyeong-gu
Seoul, 03367, Republic of Korea
www.kwdi.re.kr

Contents

Tables

Figures

Development of Strategies by Sector for Reducing the Gender Gap in the Labor Market (III): Focusing on Gender Segregation across Fields of Study

Seon-Mee SHIN
Jongsoog Kim
Sunhaeng Lee
Hyokyung Kim
Kyungju Kang
Hea Jun Yoon

Abstract

This study analyzes whether gender segregation across fields of study in advanced education influences the gender gap in the labor market. Although the gender gap in education level has largely been bridged, the gender gap in college majors remains substantial. For those who landed jobs for the first time after college graduation, gender segregation across fields of study is a main reason for occupational segregation. In turn, occupational segregation by gender has a significant impact on wage. Those females who studied male-dominant majors largely entered jobs in female-dominant occupations, and those females who studies female-dominant majors mostly found jobs in female-dominant occupations. In the meantime,

wages of those who found jobs in male-dominant and gender-mixed occupations were significantly greater than those of entrants in female-dominant occupations. Based on the findings, this study proposed policy suggestions regarding career, higher education, and vocational training for female students so as to resolve the gender gap in the youth labor market.

1. Introduction

Although Korea achieved great success in economic development, it has a large gender gap. Although the Korean government has implemented national-level women's policies for almost four decades, the gender gap largely remains unbridged in the labor market. According to the *Global Gender Gap Report 2020* of the WEF, Korea's Gender Gap Index ranks 108th out of 153 countries. In particular, it ranked 127th in Economic Partition and Opportunity (WEF, 2019:12-13). The Korea Women's Development Institute has carried out a three-year research project to address the gender gap in the labor market since 2018. The institute has addressed the following issues by year: in 2018, gender gap in recruitment; in 2019, gender gap in workplace culture; in 2021, gender gap in the labor market depending on gender segregation across fields of study.

With the improvement inwomen's education level, the gender gap is mostly considered to have been resolved at least in the realm of education, as opposed to the realm of the labor market. However, this is not the case in the labor market. In fact, the share of female students entering college is higher than that among males. Regarding gender

composition in graduate schools, women students account for 53% in master's and 40% in doctoral programs. However, just as there is occupational gender segregation in the labor market, there is gender segregation across fields of study in education. In other words, there are male-dominant majors and female-dominant ones. As the fourth industrial revolution progresses, the demand for those who studied natural sciences and engineering has been on the rise. Indeed, since there is a preference for such talent in the job market, this situation raises the possibility that gender segregation across fields of study might impact the gender gap in the labor market.

In the early 2000s, a reluctance to join STEM majors was observed across many countries around world, Korea being no exception. However, since 2013, this trend has been reversed, with large companies taking the lead in hiring STEM major graduates. Since female students have a tendency to choose humanities and social studies over STEM fields (engineering in particular) as their majors,, this preference change can intensify the gender gap in the youth labor market. In November 2014, the G20 Summit set a goal of reducing the gender gap in the rate of economic participation by 25% by 2025, and the OECD and the ILO decided to monitor statistical indicators relevant to achieving said goal. One exemplary indicator is the share of women in engineering majors in colleges. It is not rare for women to disproportionately take up more education, humanities, social sciences, and public health and welfare relative to men. The OECD's *Education at a Glance 2017* (2017:282) shows that with regard to the share of women entering advanced educational institutes by major, women made up more than 70% of education and public health-welfare and men took up over 70% of the ICT, architecture and other engineering fields in most countries.

In this study, we regarded the state where a certain major is dominated by students of some gender as gender segregation across fields of study, and investigated how this impacts females with college education in participating in economic activities and securing decent jobs. The rate of the males who graduated from college and found a job for the first time was 5% points higher than that of their female counterparts (Ministry of Education, 2020). This gap widens when it comes to full-time jobs or decent ones (Shin Seon-mee et al., 2013). Some previous studies on college majors and labor market performance showed that, amid the aversion to STEM majors, those who majored in natural sciences and engineering had not done well in the labor market performance (Heo Sik, Lim Jin-woo, 2003; Ryu Jae-woo, 2011). However, this has been reversed since the 2010s, and numerous studies have shown that those who studied humanities and social studies had lower performance in the labor market. (Shin Seon-mee et al, 2013; Yoon Soo-kyung and Han Yu-kyung, 2014; Oh Ho-young, 2015; Lee Jae-seong, 2016; Ahn Yung-eun, Min Yun-kyung and Moon In-yeong, 2017)

It is a challenge to identify whether gender segregation across fields of study effectively leads to the gender gap in the labor market, as it requires one to cover a wide range of research areas. For example, one needs to analyze how differently students choose their majors depending on gender and to see if those studies are related to occupational segregation. It also has to verify whether gender segregation across fields of study leads to a wage disparity through occupational segregation. If gender segregation across fields of study is shown to be related to occupational segregation, which is in turn seen to be associated with gender disparities in terms of employment rate and employment quality

(wage in particular), then there would be a need to put forth measures for addressing gender segregation across fields of study. To this end, it is necessary to adequately understand the detailed reasons behind college major choices. The topics of this study are listed in Table 1 below.

〈Table 1〉 Topics and research questions

Topic	Question
Gender segregation across fields of study	- How are male and female college graduates distributed among male-dominant, female-dominant, and gender-mixed majors? - Over the past 20 years, what changes have there been in gender segregation across fields of study?
Occupational segregation by gender	- How are male and female college graduates distributed among male-dominant, female-dominant, and gender-mixed occupations? - Over the past 20 years, has occupational segregation by gender been mitigated?
Relationship of major segregation, occupational segregation and labor market performance	- Is gender segregation across fields of study related to occupational segregation by gender? - Does gender segregation across fields of study impact occupational segregation by gender? Does the former eventually contribute to the gender gap in the labor market?
Factors determining college major, and career development in college and employment preparation	- What are the factors that influence female students' decision to choose male-dominant, female-dominant, or gender-mixed majors? - Compared to their male counterparts in the same field and to other female students in different fields, how did female students in engineering majors in terms of their college major choice in high school and preparations for career development and employment preparation while in college?

2. Data and analysis method

The state of gender segregation across fields of study and its evolution over the past 20 years were analyzed based on the "University-Department Data (1999-2019)" provided in the Education Statistics Service database of the Korea Educational Development Institute(KEDI). In this study,

gender segregation across fields of study refers to the concentration of male or female students in a particular major. Following Hakim (1993; Argouarc'h & Calavrezo, 2013:3 re-citation), a total of 35 college graduates' majors were categorized into male-dominant ones if men take up more than 70%; female-dominant ones if women account for over 70%, and gender-mixed ones for the remaining majors. We employed the Duncan index to analyze changes over the two decades in looking into how equally occupation were distributed among men and women. If this distribution is perfectly equal, the Duncan index will be zero. On the contrary, if it is completely segregated by gender, it will be 100. This study calculated changes in the Duncan index over the past 20 years based on the distribution of majors by male and female college graduates.

Next, the Regional Employment Survey (2008, 2018) published by Statistics Korea was used to analyze the state of occupational segregation by gender and the changes in it over the past decade. Male-dominant occupations and female-dominant occupations were classified as such if either comprised of more than 70% of men or women, respectively. The occupational category used two digits of the Korean Standard Occupation Category (52 occupations). Owing to the revision of the Korean Standard Classification of Occupations, it was difficult to conduct long-term time series analysis together with gender segregation across fields of study.

To investigate the relationship among segregation across fields of study, occupational segregation, and labor market performance, this study analyzed the data of 4-year college degree holders (14,216 in total, excluding associate degree holders and graduates of universities of education) in the 2018 Graduate Occupational Mobility Survey (2017GOMS). College graduates' majors were also categorized into male-dominant, female-dominant, and gender-mixed ones depending on

whether men or women account for more than 70% of each group. Using data from the "2018 Regional Employment Survey," college graduates were grouped into male-dominant, female-dominant, and gender-mixed occupations, depending on whether men or women account for more than 70% of each group. Regarding the relationship between segregation across fields of study and occupational segregation, cross-analysis was first conducted, followed by factor analysis of the Karmel & Maclachlan indices. The latter, used in Couppié & Epiphane (2004), decomposes the occupational segregation index by gender through labor market-related factors and major-related factors. Finally, an extended regression model (ERM) was used to link and analyze the impact of gender segregation across fields of study on occupational segregation and the influence of occupational segregation on wage levels. In such regression models, dependent variables represent labor market performance, including job opportunities, employment status, job satisfaction, major-job match, wage level, among others, while independent variables include gender, age, GPA, number of certificates held, college major, whether or not a major is male/female-dominant, location of college, and others. The performance of the labor market is greatly influenced by the nature of the job, not just by the characteristics of individuals shaped before entering the labor market (gender, age, education level, major, academic performance, qualifications, features of the universities they graduated from, etc.). However, as this study is concerned with the influence of college major on labor market performance, it employs individual characteristics formed prior to entering the labor market as independent variables.

Finally, data from waves 1 (2016) and 3 (2018) of the Korean Education & Employment Panel II , in addition to a survey conducted

directly by this study, was used to analyze career development and employment preparation for female college students. The Korea Education Employment Panel II data was used in the analysis of the factors that affected female students' choice of male-dominant, female-dominant, or gender-mixed majors. The Korea Education Employment Panel II includes 10,558 high school juniors as of 2016, who were then tracked every subsequent year (Yoon Hye-joon et al., 2019:10). We analyzed the data of 3,298 male and female students (excluding graduates of specialized high schools and meister diploma course high schools) who entered four-year university in the third wave (2018). A binomial logistic regression analysis model was run, with male-dominant, female-dominant, and gender-mixed majors as the dependent variables and individual characteristics, family background, and school characteristics variables at the high school level as the independent variables. Additionally, we examined 1,124 juniors and seniors at four-year universities in order to better understand the background of gender segregation across fields of study. Subjects of the study were categorized into five groups so that this study could shed light on how the factors behind female students' choice of engineering majors and college education experience differ from that of their male counterparts and other female students who chose non-engineering majors. The survey comprises 18.1% in male students in engineering, 21.7% in female students in engineering, 19.6% in female students in natural sciences, 18.3% in female students in medicine and pharmacology, and 22.3% in female students in the humanities and social sciences.

3. Gender segregation across fields of study

In 2019, the share of male graduates with male-dominant majors from four-year universities was 33.2%; with 59.3% in gender-mixed majors and 7.5% in female-dominant majors. The share of female graduates with male-dominant majors from four-year universities was 8.7%; with 65.5% in gender-mixed majors and 25.7% in female-dominant majors. These numbers have hardly changed compared to 20 years ago (Table 2). The list of majors in each category is as shown in Table 3. During the 1999 to 2019 period, four majors - chemistry, architecture, medicine, and law - shifted from male-dominant studies to gender-mixed ones, while two majors - secondary education and pharmacology - shifted from female-dominant studies to gender-mixed majors. On the other hand, computer/telecommunications and design shifted from gender-mixed studies to male-dominant ones and female-dominant studies, respectively. Other majors have not shifted since 1999.

〈Table 2〉 Shifts in majors by gender among four-year university graduates (2019 vs. 1999)

(Unit: %)

Year	Majors of male graduates				Majors of female graduates			
	Male-dominant	Gender-mixed	Female-dominant	Total	Male-dominant	Gender-mixed	Female-dominant	Total
1999	38.9	54.8	6.3	100.0	7.6	62.0	30.4	100.0
2019	33.2	59.3	7.5	100.0	8.7	65.5	25.7	100.0

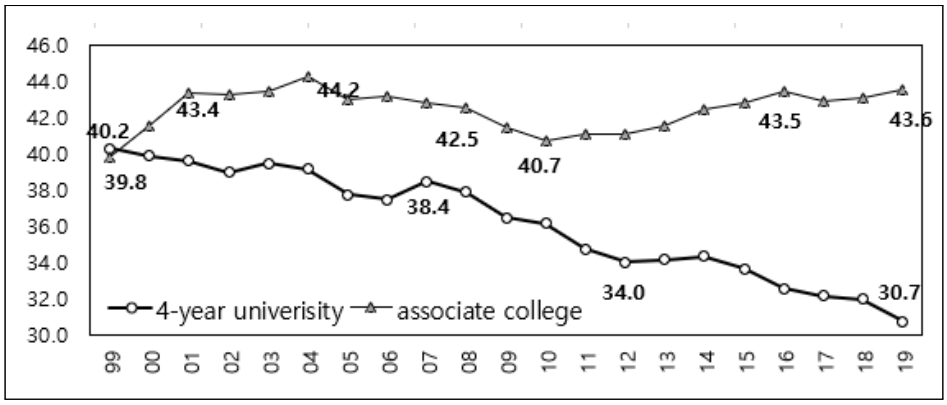
Source: Based on University-Department data sets(1999, 2019) available at the web site of Educational Statistics of the Korean Educational Development Institute

〈Table 3〉 Major classification of four-year university graduates by gender (2019)

Male-dominant (9 majors)	Gender-mixed (16 majors)	Female-dominant (10 majors)
① Transportation, transportation ② machinery, metals ③ Industry ④ Materials, materials ⑤ electricity, electronics ⑥ precision, energy ⑦ computers, telecommunications ⑧ civil engineering, urban studies ⑨ other(other engineering)	① Humanities ② Languages, Literature ③ Management and Economy ④ Law ⑤ Social Sciences ⑥ Secondary Education ⑦ Architecture ⑧ Chemical engineering ⑨ Biology, Chemistry, Environmental studies ⑩ Mathematics, Physics, Astronomy, Geography ⑪ Agriculture, Fisheries ⑫ Medicine ⑬ Pharmacology ⑭ Treatment, Health ⑮ Theater, Film ⑯ Dance and Sports	① Elementary education ② special education ③ general education ④ early childhood education ⑤ life science ⑥ nursing ⑦ design ⑧ art and sculpture ⑨ music ⑩ applied arts;

Note: 35 majors in total

Applying the Duncan Index, we analyzed the trends in gender segregation across fields of study among four-year university graduates over the past 20 years, observing a decrease in the Duncan Index value from 40.2 in 1999 to 30.7 in 2019(Figure 1). This means that in order to equalize the major distribution by gender, 40.2% of women (or men) had to change their majors to male-dominant majors (or female-dominant) in 1999, while 30.7% of women (or men) had to do so in 2019. According to these findings, gender segregation across fields of study has been resolved by a quarter over the past 20 years. For reference, the Duncan index among two or three-year college graduates had decreased from 44.2 to 40.7, before reverting again to an upward trend since 2011.



Source: Based on University-Department data sets(1999-2019) available at the web site of Educational Statistics of the Korean Educational Development Institute

[Figure 1] Changes in the Duncan Index in relation to gender segregation across fields of study(1999-2019)

4. Occupational segregation by gender

As of 2018, the share of male workers with college degrees in male-dominant occupations was 44.7%; with 48.7% in gender-mixed occupations and 6.6% in female-dominant occupations. Meanwhile, the share of female workers with college degrees in female-dominant occupations was 38.9%; with 52.2% in gender-mixed occupations and 8.9% in male-dominant occupations, (Table 4) Compared to 2008, female workers saw their share in female-dominated jobs decrease from 43.3% to 38.9%; while increasing from 39.4% to 52.2% in gender-mixed jobs and decreasing from 17.3% to 8.9% in male-dominant jobs . In the case of male workers, they witnessed their share in male-focused jobs decrease from 63.6% to 44.7%; while increasing from 28.7% to 48.7% in gender-mixed jobs.

〈Table 4〉 Changes in occupations of employees with bachelor's degree, by gender (2018 vs. 2008)

(Unit: %)

Year	Jobs of male workers			Jobs of female workers		
	Male-dominant	Gender-mixed	Female-dominant	Male-dominant	Gender-mixed	Female-dominant
2008	63.6	28.7	7.7	17.3	39.4	43.3
2018	44.7	48.7	6.6	8.9	52.2	38.9

Source: Statistics Korea. Regional Employment Survey (First half of 2008 and 2018).

The Duncan index was calculated to examine the occupational segregation by gender among employees with associate or higher degrees between 2008 and 2018 (Table 5). The index declined from 52.5 in 2008 to 48.9 in 2018. By education level, 4.9 points have decreased among those employed with bachelor's degrees or higher. Meanwhile, the index among associate degree holders remained unchanged. Thus, the decline in the Duncan index over this period can be attributed to changes in the distribution of jobs among holders of four-year (bachelor's) or higher degrees.

〈Table 5〉 Duncan Index of occupational segregation by gender among workers with associate or higher degrees (2008, 2018)

Education	Age	2008(A)	2018(B)	Difference(B-A)
Total		52.5	48.9	-3.6
Bachelor's degree and above	Total	50.7	45.8	-4.9
	25-29	48.7	41.0	-7.7
	30-34	52.1	42.5	-9.6
	35-39	55.8	46.5	-9.3
	40-44	58.0	52.5	-5.5
	45-49	56.1	52.2	-3.9
	50-54	57.3	54.5	-2.8
	55-59	60.4	51.3	-9.1

Education	Age	2008(A)	2018(B)	Difference(B-A)
Associate degree	Total	57.2	57.2	0.0
	25-29	52.8	54.9	2.2
	30-34	59.4	58.7	-0.7
	35-39	56.7	59.9	3.2
	40-44	60.7	60.4	-0.3
	45-49	63.7	62.0	-1.7
	50-54	67.0	64.6	-2.4
	55-59	77.3	67.7	-9.6

Source: Statistics Korea. Regional Employment Survey (First half of 2008 and 2018).

5. Relationship among segregation across fields of study, occupational segregation, and labor market performance

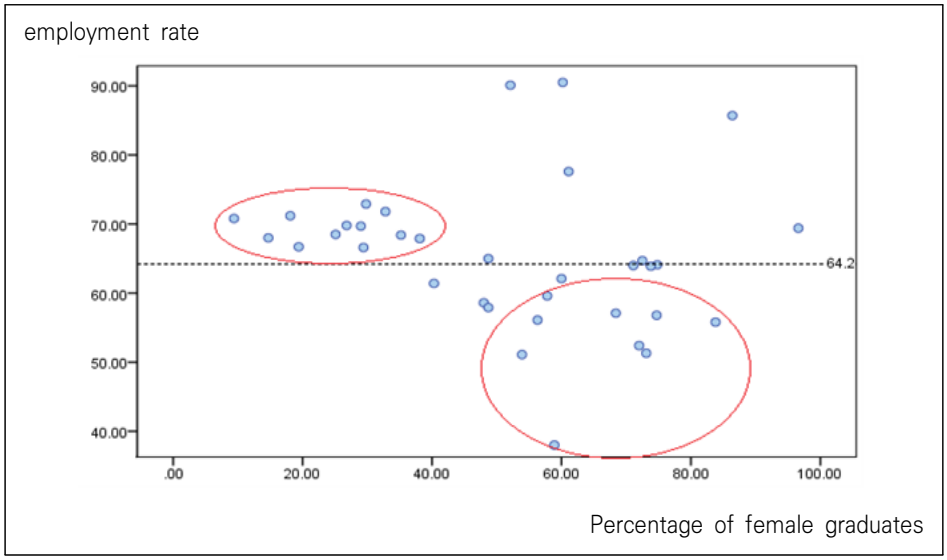
1) Scatterplot of the percentage of female graduates and employment rate by major

According to the employment statistics of graduates of higher education institutions published by the Korean Educational Development Institute, the employment rate of those who studied male-dominant majors is higher than the national average, 64.2%. More than half of those who studied gender-mixed or female-dominant majors are below the national average. (Figure 2)

2) Cross-Tabulation Analysis between types of major and occupation by gender ratio

Of the four-year college graduates in 2017, 70.1% of those who belonged to male-dominant majors secured jobs in male-dominant jobs; 61.1% of those who belonged to gender-mixed majors found jobs in

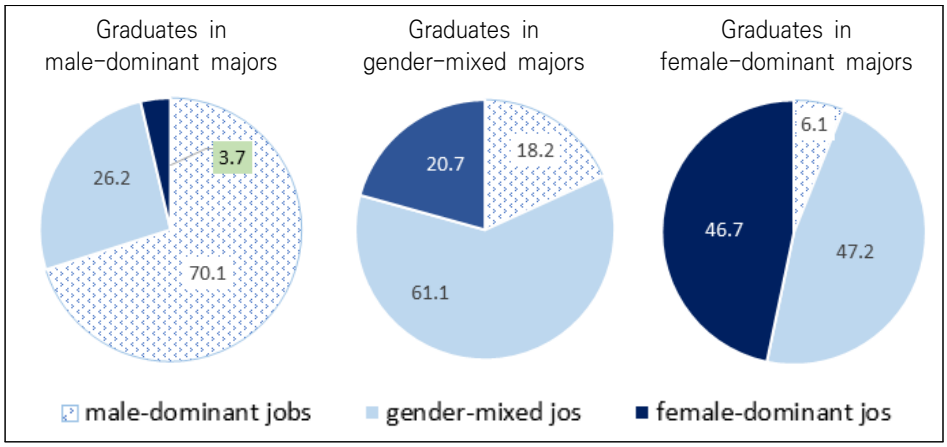
gender-mixed jobs; 46.7% of those who belonged to female-dominant majors landed jobs in female-dominant jobs; 47.2% of those who belonged to gender-mixed majors found jobs in gender-mixed jobs. (Figure 3) Looking only at female graduates, 51.5% of female graduates who studied female-dominant majors found jobs in female-dominant jobs; 43.3% in gender-mixed jobs; and 5.1% in male-dominant jobs. Meanwhile, 57.8% of female graduates who studied male-dominant majors found jobs in male-dominant jobs; 36.1% in gender-mixed jobs; 6.1% in female-dominant jobs.



Note: A total of 35 majors were classified.

Source: Based on University-Department data sets(1999-2019) available at the web site of Educational Statistics of the Korean Educational Development Institute; Ministry of Education and Korean Educational Development Institute(2018), Survey on the Employment Rate of Higher Education Graduates(2019).

[Figure 2] Scatterplot of the employment rates by major (4-year college) and the percentage of female graduates (Class of 2018)



Source: Korea Employment Information Service. 2018 Graduate Occupational Mobility Survey(2017GOMS)

[Figure 3] Difference in Occupation by major among four-year college graduates

3) Decomposition of the occupational gender segregation index by major and labor market factors

The Karmel & Maclachlan index, which represents the occupational gender segregation among workers with college degrees, was calculated and then decomposed into the major and labor market factors. The index stood at 0.2075, in which the factor attributable to the major, 0.1556, was greater than the labor market factor, 0.0950. The sum of the two factors, 0.2506, is greater than the Karmel & Maclachlan index, 0.2075, indicating the presence of an offset between the two factors. For young workers who just graduated from college, gender segregation across fields of study would be more closely related to occupational segregation compared to other age groups.

4) Relationship of gender segregation across fields of study, occupational segregation, and wages (Extended regression model)

Setting wage as a function of occupational segregation by gender, and occupational segregation by gender as a function of major segregation, we specified the following model:

$$Occupationsegregation = f(majorsegregation, X)$$

$$Wage = f(\widehat{Occupationsegregation}, major, X)$$

In order to control for endogeneity, this study estimated their relationship using ERM (Extended regression model) (Table 6). Independent variables include gender, age, major, whether or not graduates are from universities in Seoul, and others. According to the analysis, wages among gender-mixed and male-dominant occupations were significantly higher than among female-dominant occupations. Gender-mixed occupations paid 16.3% more than female-dominant ones did, while male-dominant occupations offered 24.3% more than female-dominant ones did. The influence of the major factor on occupational segregation is very evident. In other words, those who studied male-dominant majors had a significantly higher possibility of working in male-dominant occupations. In contrast, those who studied female-dominant majors had significantly lower chances of transitioning to male-dominant occupations.

〈Table 6〉 ERM on impact of occupational segregation and major segregation on wage

Independent variable	Coef.	Std. Err.	z
sex	-.0651***	0.0162	-4.01
age	.1276***	0.0097	13.14
agesqr	-.0014***	0.0001	-11.2
inseoul	.0966***	0.0119	8.11
major_humanities	.0763***	0.0228	3.35
major_social studies	.2215***	0.0211	10.5
major_engineering	.2156***	0.0292	7.38
major_natural sciences	.1330***	0.0222	5.97
major_medicine and pharmacology	.5782***	0.0293	19.68
major_education	.2696***	0.0286	9.4
Gender-mixed occupation	.1634***	0.0335	4.87
Male-dominant occupation	.2429***	0.0639	3.8
_cons	2.6541***	0.1837	14.44
Occupational segregation (1=female-dominant, 2=gender-mixed, 3=male-dominant)			
sex	-.5029***	0.0282	-17.8
age	-.0160	0.0211	-0.76
agesqr	.0001	0.0002	0.53
Female-dominant major	-.4167***	0.0356	-11.69
Male-dominant major	1.1647***	0.0315	36.87

Note 1 : *, **, *** indicate significance at 90%, 95% and 99% levels, respectively

Note 2 : The comparative category of the major variable is artss and physical education, and the comparative category of the occupational variable is female-dominant occupations.

Source: Korea Employment Information Service. Graduate Occupational Mobility Survey (2017GOMS)

5) Factors that have a significant impact on female students' choice of college majors (logistic regression).

Using waves 1 (2016) and 3 (2018) of KRIVET's Korean Education & Employment Panel II to examine how female students chose among male-dominant, female-dominant, and gender-mixed majors, we found the following:

① Preference for science subjects, rather than math, is pivotal when a female student decides on a male-dominant major.

② Career counseling and activity satisfaction had no significant impact on female students' choice for a male-dominant major.

③ High school juniors with top-level grades had a lower probability of choosing male-dominant majors compared to those with mid-level grades. This may be related to the tendency for high-performing female students to opt for the STEM track in order to apply for medicine and pharmacology majors.

④ Diligence was identified as a significant variable among character factors. In other words, this factor was positively related to girls' choice of gender-mixed majors while being negatively related to their selection of female-dominant or male-dominant majors . Similarly, rote memorization was related positively with gender-mixed majors and negatively with male-dominant majors.

6) Survey result from the questionnaires on college students' major choice, career development, and employment preparation

For this study, we conducted a survey on 1,124 college juniors and seniors. (excluding those who graduated from vocational high schools)

Gender-wise and major-wise, only 203 male engineering students were included, while in the case of female students, 244 in engineering, 220 in natural sciences, 206 in medicine and pharmacology, and 251 in humanities and social studies were surveyed. Surveys were only administered in universities located within the Seoul metropolitan area. However, the survey on medicine and pharmacology students included universities throughout Korea.

① The reasons for choosing liberal arts or natural sciences in high school were mainly related to aptitude and interest (35.1%) and desired future career (19.0%). However, 16.6% of the respondents also presented reasons such as preference for related subjects or academic performance. Some of the female students in engineering (19.5%) and natural sciences (22.2%) were found to have not taken Physics II while in high school or had lower grades in the subject, which limited their choice of major in college. 23.6% of female students in engineering and 20.7% of female students in natural sciences said they were unable to Physics II in high school, while this was the case for only 9.9% of male engineering students.

② Many female students said they did not receive career counseling or career education in high school. Even if they did, they did not find it helpful. (27.1% of male students on engineering courses; 40.5% of female students on engineering courses; 37.3% of female students in natural sciences; 33.5% of female students in medicine and pharmacy; 39.5% of female students in humanities and social sciences).

③ Most engineering major female students said they considered occupation/employment prospects (36.1%) when choosing their

major. But in the case of natural sciences and humanities and social studies, female students replied that they took into account interest and aptitude when determining their major (37.3% of female students in natural sciences and 47.8% of female students in humanities and social studies). Female students in medicine and pharmacology had a strong tendency to consider occupation/employment prospects in deciding their major (44.7%).

④ More female students in engineering responded having difficulty with their major courses from the junior year and thereafter compared to their male counterparts and other female students in different majors. Those female engineering students also had lower levels of confidence that they could successfully finish the study of their major (53.7% of male students in engineering majors; 44.3% of female students in the same major group; 55.4% of female students in natural sciences; 63.5% of female students in medicine and pharmacology; 59.3% of female students in humanities and social studies).

⑤ More students studying majors that are less- sought-after in the labor market were completing additional studies, including a minor, double major, or interdisciplinary studies (26.6% of male students and 33.2% of female students in engineering, 45.9% of female students in natural sciences, and 8.3% of female students in medicine and pharmacology). As it is more difficult to complete a double major than a minor or an interdisciplinary study, female students in natural sciences (28.2%) and in humanities and social studies (36.3%) pursued dual degrees.

⑥ Students in engineering and medicine / pharmacology had a higher percentage of finding a job and/or running their own business,

capitalizing on their major (75.9% of male students and 72.3% of female in engineering, and 81.8% of female in medicine and pharmacy). In the case of female students, 57.0% of those in natural sciences and 51.8% of those humanities and social studies planned to find a job or open a business in their major field. Regarding transfer or advancing into graduate school, 81.8% of male students in engineering wanted to stay on their main former major, but only 59.3% female students in the same field hoped to do so.

⑦ Many female engineering students replied that they had experienced discrimination during college life (9.4% of male students in engineering; 25.4% of female students in engineering; 16.4% of female students in natural sciences; 16.5% of female students in medicine and pharmacology; 17.1% of female students in humanities and social studies). 42.4% of female engineering students who wanted to get a job or start a business said that job opportunities were not fair and equal. This contrasts with the findings among male engineering students (6.0%) or female students in other majors (14% to 22%).

5. Policy recommendations

1) Strengthen science education for female students to adapt to the future society.

In the past, even if women studied majors which were dominated by men, they found it difficult to find jobs related to their degrees. However, this is expected to see some changes in the era of the fourth industrial revolution, where more jobs will become available for women on par with men. Indeed, female workers are more demanded in the ICT industries whose growth has outpaced that of traditional manufacturing

and male-dominant sectors such as automobiles, steelworking, and shipbuilding. Against this backdrop, it is necessary to strengthen science education among female students in order to promote women's entry into such jobs that the fourth industrial revolution would create. To this end, the following measures are suggested: actively take preventive measures to curb the occurrence of opportunity gaps in science education by gender; effectively address the gender gap in honor science courses for juniors and seniors in high school; compile statistics on gender segregation in relation to enrollment in math and science subjects and academic achievement; promote non face-to-face experiential activities by establishing relevant content platforms for female students.

2) Reinforce career education in science and technology for female students

The interest in science and technology majors and occupations shown among female students during primary and middle school do not lead to their choice of college major. This is in part due to the fact that a significantly fewer number of girls choose natural sciences courses than boys do. And among the high school students who opted for natural sciences, girls mostly choose to major in medicine and pharmacology as well as natural sciences, while boys select engineering majors. In order for more girls to enter engineering colleges that pose higher chances of better outcomes in the labor market, a greater share of female must choose natural sciences (or science subjects) in high school. To this end, the following ideas were put forth: develop career education standards for mathematics and science curricula in high school; provide decision-making guides and video materials of math and science curricula; promote female youth activities, including club and camp

activities in science-related disciplines. We also proposed specific gender impact assessments to be carried out with regards to the Science Career Support Center and the Korea Foundation for the Advancement of Science and Creativity.

3) Innovate engineering education for female students in engineering colleges

In order to expand the female talent pool in the engineering community, it is necessary to actively take the following facts into account: many females in engineering colleges chose their majors simply because their academic performance in high school could afford it, or said that they did not have interest and aptitude in them; more female students found it difficult to study their major particularly in junior and later years, and were also less confident that they could successfully complete their major studies; more female students, 25.4%, said that they encountered gender discrimination during college compared to their male counterparts (9.4%). Given these issues, the following proposals were put forth: craft a program for engineering colleges to attract more female students; conduct diagnostic studies on the education environment of engineering colleges regarding gender equality.

4) Provide innovative curricula in liberal arts and natural sciences to nurturing experts

Girls in humanities and social studies and natural sciences tend to have less interest in occupation and employment prospect from the time they choose their majors. Instead, they have a tendency to select their major in pursuit of their aptitudes, interests and preference for subjects. On top

of that, since humanities and social studies and natural sciences deal with fundamental studies, chances are that these majors are not likely to foster experts and professionals. In order to raise a specialized workforce, those majors have to ascertain such workforce demands and innovate their curricula in a way that can accommodate those needs. To this end, we proposed the following ideas: expand the scope of curriculum choice for university students; systematize career paths by major and notify them on websites of each department; produce statistics on gender gaps in secondary, university, and graduate education.

5) Address occupational gender segregation in youth vocational training

Although gender segregation in desired occupations is less serious among young job seekers compared to middle-aged ones, young female job searchers with relatively weaker competency in the labor market tend to find jobs in female-dominant trades. (Oh Eun-jin et al., 2020). With the recent progress of the fourth industrial revolution, the traditional service industries that female students used to enter have been transforming into digital technology-based service industries. Under such circumstances, it is necessary to support female students in humanities and social studies and natural sciences, majors that largely present lower chances of employment, so that they can effectively secure jobs through vocational training in fields outside their majors (including ICT) while attending college. To this end, we proposed the following suggestions: recommend vocational training institutions to tackle the gender gap among their trainees; conduct a diagnostic study on gender-equal training environments in polytechnic universities and public vocational training institutions; incentivize youth employment subsidies to address occupational / task segregation by gender.

References

An, Y. E., Min, Y. K. & Moon, I. Y.(2017). Analysis of Long-term Employment Stability by College Major. *The Journal of Vocational Educaion Research*, 36(5), 73-94.

Argouarc'h, J. & Calavrezo, O.(2013). La répartition des hommes et des femmes par métiers. *DARES Analyses*, décembre 2013, n°079.

Couppié T. & Epiphane D.(2004). Mesurer et décomposer la ségrégation professionnelle: un travail de composition démesuré?, in Degenne, Giret, Guegnard, Paul et Werquin (dir.) *Genre et données longitudinales*, Céreq, Relief n" 4, 2004, 163-177.

Hakim, C.(1993), Segregated and integrated occupations: a new approach to analysing social change. *European Sociological Review*, 9(3), 289-314.

Heo, S. & Yim, J. W.(2003). An Empirical Study on the Wage Differentials by Subject of Degree in Korean College Graduates, *Korea Review of Applied Economics*, 7(1), 21-36.

Korean Educational Statistics Service. *University-Department database(1999-2019)*, https://kess.kedi.re.kr/index. (2020, April 10). Korean Educational Development Institute(KEDI)

Lee, J. S.(2016). Disadvantage for Arts and Humanities?: Comparison Analysis on the Labor Market Performance with other Majors. *Symposium conducted at the 2016 Employment Panel Conference*, 532-551.

Ministry of Education(2020). *Press release on the findings of 2019 Survey on the Employment Rate of Higher Education Graduate* (reported by newspaper The Chosunilbo on December 29, 2020).

Ministry of Education & Korean Educational Development Institute(2019). 2018 *Survey on the Employment Rate of Higher Education Graduate*.

OECD(2017). *Education at a glance 2017*.

OECD·ILO(2015). *Monitoring progress in reducing the gender gap in labour force participation*. Report prepared for the meeting of the G20 Employment Working Group Istanbul, Turkey. 7-8 May 2015(https://www.oecd.org/g20/topics/employment-education-and-social-policies/Monitoring-progress-in-reducing-the-gender-gap-in“labour-force-participation. pdf).

Oh, E. J., Shin, S. M., Jeong, S. M. & Kim, H. K.(2020). *Labor policy strategies for decreasing job and job training sector segregation by gender*. Ministry of Employment and Labor.

Oh, H. Y.(2015). Employment Issue among the Young College Graduates with Arts and Humanities Degree. *The HRD review*(2015, November). Korea Research Institute for Vocational Education & Training.

Ryoo, J. W. (2011). Ability and Labor Market Performance of Science and Engineering Graduates : Korea and the U.S. *Korea Review of Applied Economics*, 13(1), 27-53.

Shin, S. M., Min, M. S., Kwon, S. Y. & Ko, H. W.(2013). *Effects of Employment Preparation Activities and Support Measures for Female College and University Graduates*, Korean Women’s Development Institute.

WEF(2019). *Global gender gap report 2020*. http://www3.weforum.org/docs/WEF_GGGR_2020.pdf.

Yoon, H. J., Song, C. Y., Hwang, S. S.,... Kim, Y. S.(2019). *Korean*

Education & Employment Panel Ⅱ(2019). Korea Research Institute for Vocational Education & Training.

Yoon, S. K. & Han, Y. K.(2014). Analysis on Factors Influencing Career Outcomes. *The Journal of Economics and Finance of Education*, The Korean Society for the Economics and Finance of Education, 23(4), 131-160.

KWDI
Korean Women's Development Institute

225 Jinheung-ro, Eunpyeong-gu (1-363, Bulgwang-dong) Seoul, 03367, Republic of Korea
TEL 02.3156.7000 FAX 02.3156.7007
http://www.kwdi.re.kr