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How Changes in Skills Affect the Gender Wage Gap

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I . Introduction

- One indicator that aptly reflects the vulnerability of the labor market for women in Korea is the gender wage gap. For many years, it has consistently placed at or near the top among OECD economies. Although the gap has shown signs of narrowing since 2012, and this narrowing has picked up pace since 2016, it still hovers in the relatively high 30% range.
- Meanwhile, amid rapidly shifting industry structures and the increasing prevalence of higher education in the workforce, it has become increasingly difficult to employ the conventional proxy variable for skill - i.e., years of schooling - for explaining the gender wage gap. The skills that were demanded by an industrial society built around male-dominated manufacturing differ from those demanded in a society based on services, a sector where female employment has been prominent. Furthermore, due to advances in technology, traditional notions of skill are already being substituted via machines or computers. Thus, it is only to be expected that

market demand for skills will also change. Under such circumstances, it is becoming increasingly difficult to rely on conventional modes of analyses to interpret labor markets for women and to study the gender wage gap.

- By directly measuring the skills associated with job characteristics and wages in the labor market, this study seeks to analyze how skill changes affect jobs, wages, as well as the gender wage gap. The skills measured in this study are identified as the common factors driving the content and level of skills needed for work-based tasks. We then empirically analyze how changes in such skills affect changes in jobs and the associated gender wage gaps, so as to draw policy implications with a view to bridging such gaps over the long run.

II . Measurement of Occupational Skills

- This study draws on the dataset known as the Korean Network for Occupations and Workers(KNOW) compiled by the Korea Employment Information Service. The level of requisite occupational skills were identified based on the dataset's 'work performance ability' entry. Using the most recent data available (from year 2015), the average ability level among the respondents for each job were interpreted as the average requisite skill level for those jobs.
- Instead of individually analyzing all of the items constituting 'work performance ability', this study categorized skills as the common

factors driving them, in following with the common factor analysis employed in Ingram & Neumann (2006). In this study, we derived 3 categorizations which we termed 'cognitive', 'functional', and 'physical' skills. Using the factor loading matrix, we calculated standardized skill factor scores, thereby allotting cognitive, functional, and physical skill factor scores for every job.

- To associate these skill factor scores to the Korean labor market as a whole, the above data was matched with the Regional Employment Survey (RES) data (covering 2008 to 2019, with 3-digit occupation codes). To reflect the skill levels involved in a more intuitive manner, the factor scores were normalized to values ranging between 0 to 1.

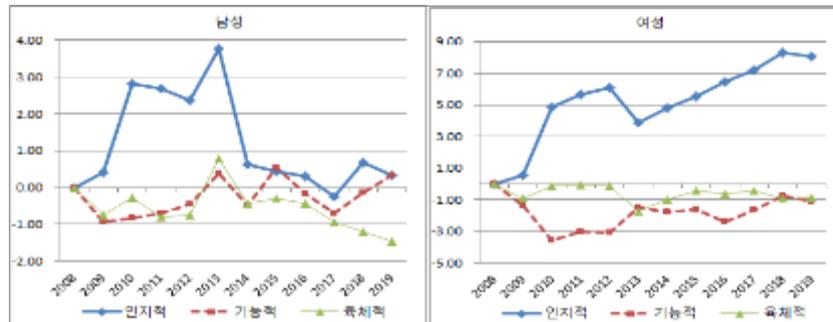
III. Changes in Jobs, across Skill Structure and Level by Gender

1. The Skill Structure of the Korean Labor Market

- As derived in this study, skills were distributed as follows in the Korean labor market. Cognitive skills, being influenced by years of schooling, were distributed bimodally. Functional skills were distributed normally, albeit skewed to lower skills, while physical skills were distributed with most of the mass in the mid-high ranges. Over the 2008-2019 period, cognitive skills saw an increase in level, particularly among women. Meanwhile, functional and physical skills exhibited no level changes over time. These changes may be interpreted variously. As per the 'skill-biased technological change'

hypothesis, was there job losses among the mid-level cognitive skills that could be substituted via technology, accompanied by job gains among the low and high-level cognitive skills? Or rather, were such changes attributable to structural factors, where highly-educated workers were concentrated in high-skill jobs and less-educated workers were concentrated in low-skill jobs? Further analyses will be needed to ascertain the cause.

- Looking at changes in the relative demand for each skill type (setting 2008 as the base year), women saw a sharp increase in labor market demand for cognitive skills while demand for functional / physical skills were either stagnant or slightly decreasing. While men also saw increased demand for cognitive skills, this has been stagnant since 2014. Demand for functional skills fluctuated repeatedly, ending with an uptick in 2019. Meanwhile, relative demand for physical skill has been steadily decreasing since 2014.
- The increased market demand for cognitive skills in women was concentrated on those with a high school diploma or lower, with relative demand for cognitive skills falling among women with technical college or higher diplomas. Thus, highly educated women saw no increased market demand for high-level cognitive skills. On the other hand, there has been marked growth in the market demand for functional skills among holders of university or higher diplomas. Thus, there have been substantial changes in the skills demanded in the labor market for university-educated women over the past 10 years.



Source: KNOW and RES, matched data (*Cognitive, Functional, Physical)

[Figure 1] Relative Level Changes in Labor Market Skill Indicators, by Gender

2. Employment Changes by Skill Level

- Classifying skill levels into the relative levels of 'low', 'mid', and 'high', we looked at how job numbers have changed among each skill level group. The results revealed striking changes in the market-demanded content and level of skills depending on gender. In the case of cognitive skill jobs, women were most highly represented in high-level jobs, with this share expanding between 2008 and 2019. In the case of functional skill jobs, on the other hand, women were most highly represented in mid-level jobs. Thus, depending on the type of skill, there has been a tendency for jobs to be concentrated in certain skill levels. This was in contrast to the case of men, where market demand for cognitive skills was focused on mid-level skills and demand for functional skills was focused on high-level skills.

〈Table 1〉 Relative Share and Change in Employment, by Cognitive Skill Level
(2008 and 2019)

(unit: %, 1,000 persons)

Skill Level	Men		Women		Change in Employment(2008~2019)	
	2008	2019	2008	2019	Men	Women
Low	16.1	16.1	10.5	7.4	261	-187
Mid	37.0	39.7	40.2	36.0	1,045	218
High	46.8	44.2	49.3	56.7	376	1,751
Total	100.0	100.0	100.0	100.0	1,682	1,782

〈Table 2〉 Relative Share and Change in Employment, by Functional Skill Level
(2008 and 2019)

(unit: %, 1,000 persons)

Skill Level	Men		Women		Change in Employment (2008~2019)	
	2008	2019	2008	2019	Men	Women
Low	16.1	15.8	35.1	35.5	223	667
Mid	53.2	53.1	53.1	54.0	889	1,045
High	30.7	31.0	11.7	10.6	571	70
Total	100.0	100.0	100.0	100.0	1,682	1,782

- We also noticed a tendency where certain levels of schooling were associated with certain skill levels. In the case of cognitive skills, there was a strong positive association between education and skill level, such that low skill + low education and high skill + high education level were strongly linked. On the other hand, in the case of functional skills, there was no appreciable association between the level of education and skill level. Using factor decomposition to look at the extent to which education explained skill levels, we found that in the case of cognitive skills, most of the variation in

skill level was explained by the distribution of education level. Meanwhile, in the case of functional skills, the distribution of education level explained very little of the variation in skill level, in line with the findings of this study.

IV. Analysis of Gender Wage Gaps by Skill

1. The Relationship between Skill Levels and Wages

- Looking at how skill levels (by skill type) were correlated to wages, we found that in the case of cognitive and functional skills, higher skill levels were strongly associated with higher wages in both men and women. On the contrary, the level of physical skill was found to be negatively correlated to wages in both men and women.

〈Table 3〉 Correlations between Wages and Various Skill Indicators

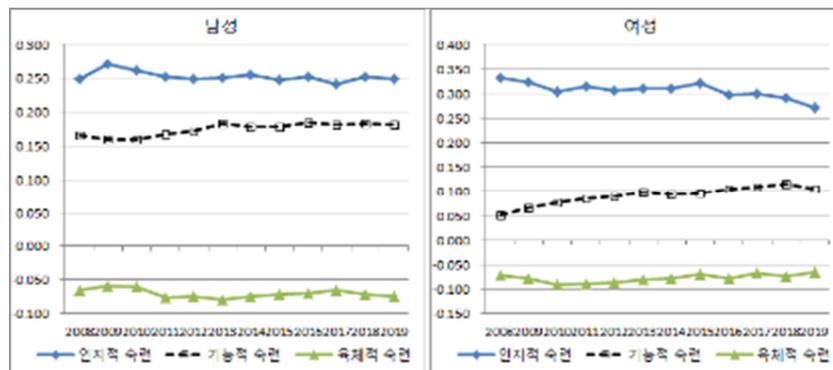
	Total		Men		Women	
	2008	2019	2008	2019	2008	2019
Cognitive	0.410 (0.000)	0.366 (0.000)	0.417 (0.000)	0.394 (0.000)	0.466 (0.000)	0.397 (0.000)
Functional	0.201 (0.000)	0.226 (0.000)	0.127 (0.000)	0.159 (0.000)	0.044 (0.000)	0.117 (0.000)
Physical	-0.166 (0.000)	-0.172 (0.000)	-0.224 (0.000)	-0.230 (0.000)	-0.095 (0.000)	-0.096 (0.000)

Note : 1) p-values are reported in ().

2) Job skill scores calculated through factor decomposition were normalized to values between 0 and 1.

Source: KNOW and RES, matched data

- Looking at how skill types affected wages, we found that for both sexes, wages were affected by cognitive > functional > physical skills(in descending order). Meanwhile, looking at trend changes in the wage effect of each skill type since 2008 showed that there were differences between gender. Unlike men, for whom there were no marked changes over time, the wage effect of cognitive skills for women has been on a downward trend since 2016, suggesting that it has had a diminishing degree of influence on wages over the long run. Also, the wage effect of functional skills for women has followed a continued upward trend since 2008.
- These results are also reflected in wage growth trends by skill level. In the case of cognitive skills, there was a marked jump in wage growth among low-skill workers since 2016. Meanwhile, in the case of functional skills, wage growth was faster among the mid and high skill groups.



Note : All coefficient estimates were statistically significant at the 1% level.

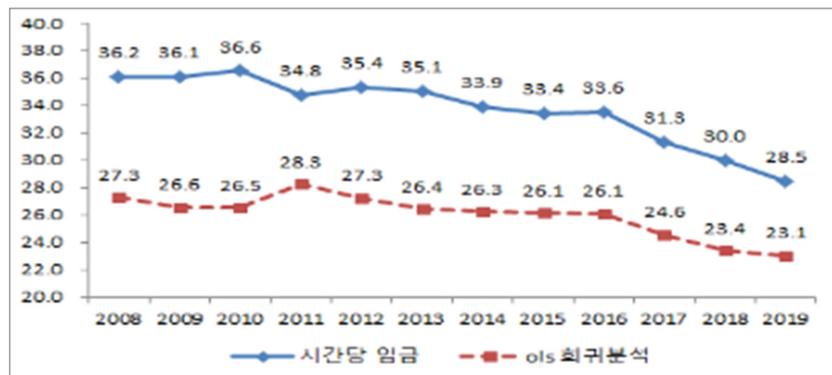
Source: KNOW and RES, matched data (*Cognitive Skills, Functional Skills, Physical Skills)

[Figure 2] Yearly Effect of Skill Levels on Wages, by Gender and Skill Type
(coefficient estimates, standardized beta)

2. Gender Wage Gaps Across Skill Levels

- Estimating the gender wage gap for the overall labor market after controlling for individual and workplace characteristics, including skill types, we found that the controlled gap (23.1% as of 2019) was smaller than the uncontrolled gap in terms of hourly wages. Nevertheless, the gender wage gap remained substantial at above 20%, even after controlling for demographic, industry, and skill-type related characteristics.

(unit : %)



Note : All coefficient estimates were statistically significant at the 1% level.

Source: KNOW and RES, matched data (* Hourly Wage , OLS Estimates)

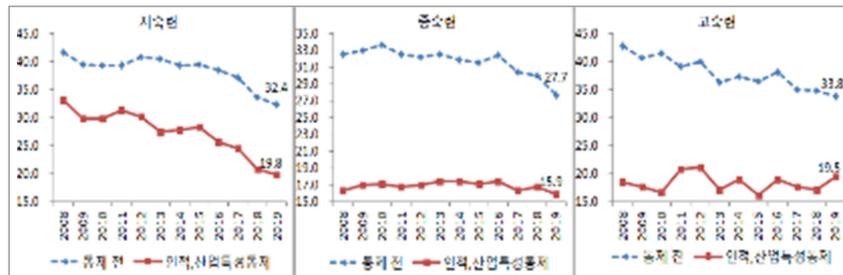
[Figure 3] Evolution of Overall Gender Wage Gap, before and after Controlling for Characteristics

- Looking at how the gender wage gaps have changed between 2008 and 2019 by each skill level, we found overall downward trend, albeit with some variation in degree and duration, across all skill levels. However, controlling for all individual and workplace characteristics reveals a different picture of the wage gap.
- In particular, the controlled gap for the high-level cognitive skill group followed a flat and fluctuating trend just under 20%. This may

be attributable to the fact that, compared to the past, some of the gaps in the characteristics of men and women have been bridged in the high-level cognitive skill sector.

- However, despite such bridging in characteristics between men and women, there remains a persistent gender wage gap of 15~19% in the high-level cognitive skill sector where the increase in female employment has been rapid.

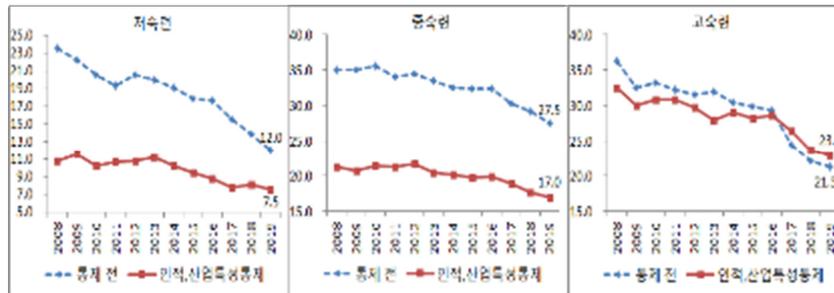
(unit : %)



Note : All coefficient estimates were statistically significant at the 1% level.
 Source: KNOW and RES, matched data (*Uncontrolled , Controlled for Demographic & Industrial Characteristics)

[Figure 4] Evolution of Gender Wage Gap by Skill Level, before and after Controlling for Characteristics (Cognitive Skills)

- In the case of functional skills, the bridging of gender gaps in characteristics led to a decrease in the discrepancy between the controlled and uncontrolled wage gaps among the low and mid-level skill groups. In contrast, however, controlling for individual and workplace characteristics had virtually no effect on wage gaps among the high-level skill group. This might be attributable to one of this study's limitations, in that workplace size was unavailable for use, or possibly to the effects of policy changes that are not readily apparent in the data.



(unit : %)

Note : All coefficient estimates were statistically significant at the 1% level.

Source: KNOW and RES, matched data (*Uncontrolled , Controlled for Demographic & Industrial Characteristics)

[Figure 5] Evolution of Gender Wage Gap by Skill Level, before and after Controlling for Characteristics (Functional Skills)

- Looking at the wage gaps across quantiles from 2008 to 2019, we found that the gaps closed somewhat in the lowest decile and the middle quantile (p50), while the gap remained the same in the top decile. Thus, compared to 2008, the wage gaps in 2019 were bridged among the mid/low wages while remaining stagnant among the high wage group. This suggests that the overall improvement in the gender wage gap was largely attributable to the mid/low wage groups.

3. Gender Wage Gaps and Changes in Skills

- Using the Oaxaca-Blinder decomposition to identify the key determinants behind the gender wage gap, we found that for both 2008 and 2019, functional skills explained the largest portion of gender wage gaps. However, during this period, the explanatory power of years of tenure was diminished while those of cognitive and functional skills became stronger.

- The above analysis looks at which factors explain variations in the gender wage gap for each year. Looking further at which factors played important roles in closing the gap between 2008 and 2019, we found that cognitive skills played the greatest role. Thus, while functional skills had the greatest explanatory power regarding the wage gap for each year, cognitive skills played the most important role behind the long-term decline in the time series of the wage gap since 2008. This is mainly attributable to the compositional growth in the share of women with high-level cognitive skills, who earn relatively higher wages.
- While cognitive skill played a role in closing the gender wage gap over the long run, we should note that its degree of influence has recently been diminishing while that of functional skill remains strong. This is because rising market demand for functional skills in university-educated women, coupled with the importance of functional skills in explaining women's wages, could help bridge the gender wage gap in the long run.

V. Conclusion and Policy Implications

- In this study, we have shown that there are gender differences regarding the skills demanded in the labor market, and that such differences also manifested across skill levels. Since 2008, there has been substantial demand for cognitive skills in the female labor market, thus driving an increase in the number of high-skilled employment among women. Furthermore, we have seen that there is rising demand for functional skills among highly educated women.

- These changes may be interpreted as reflecting a rise in high-level cognitive skill among women, in relation to shifts in labor demand arising from the onset of the 4th industrial revolution or the digitization of work due to IT-centric tech advancements. While in the case of functional skills, employment was focused in the high-level skill group for men and in the mid-level skill group for women, in the labor market there has been a strong trend of rising demand for functional skills in women with university or higher diplomas. This shift, where demand for functional skills has intensified in professional / clerical occupations, appears to have affected the labor market for women in various ways over the past decade. Thus, in that they reflect the directions along which labor demand is evolving, these results hold implications for labor-related policy in the future.
- As a consequence of the labor market shifts described above, cognitive skills played a key role in closing the gender wage gap during the 2008~2019 period. However, given the diminishing influence of cognitive skill, strengthening cognitive skills is unlikely to yield substantial progress in bridging the wage gap. On the other hand, focusing on the growing influence of functional skills may prove to be helpful.
- The 'work performance ability' items that were categorized under 'functional skills' in this study include occupational tasks such as technical analysis, technical design, equipment selection, installation, quality management analysis, operation / control, equipment maintenance, detection and repair of malfunctions, operation diagnostics, analysis / evaluation of organizational structures, precise

movement, and control of movement. These were the work abilities that strengthened functional skills. In designing labor policies in the future, there will be a need to consider the demand for jobs where the aforementioned skills are required. Furthermore, from a labor supply standpoint, vocational training or employment assistance policies should be designed with a view to fostering such skills.

