Asian Women
March 2021, Vol. 37, No. 1, pp. 1-24, https://doi.org/10.14431/aw.2021.3.37.1.1

Education-Job Mismatch and Gender Wage Gap: Evidence from Recent College Graduates in Korea

Kihong Park
Chungbuk National University, South Korea

Abstract

This article aims to explore the gender wage gap among recent college graduates in Korea by analyzing whether educational mismatch affects the gender wage gap. Unlike much prior research in the literature, two types of educational mismatch are considered in the analysis: vertical and horizontal mismatches. The Oaxaca and Ransom-type generalized decomposition is applied to examine the gender wage gap, using data from the 2015 GOMS dataset. The case of Korea may be of particular interest for the research of educational mismatch and the gender wage gap, given that on the one hand, as social and labor policies such as affirmative action have contributed to more equal opportunities between men and women, women are getting better opportunities to access the labor market, but significant gender wage inequality still remains, and on the other hand, considering the demand-side of the labor market, a non-negligible proportion of young college graduates face educational mismatch associated with a significant wage penalty. This study finds a large proportion of recent college graduates being mismatched in education, with more than 35%. By estimating the wage returns to educational mismatch, the analysis finds evidence on the contribution of educational mismatch in determining wages, and thus a source of the gender wage gap. When the analysis is run by gender, it is found that the wage effects associated with educational mismatch differ by gender, i.e., female graduates get higher wage penalties than their male counterparts for educational mismatch. A significant gender wage gap is not explained by the differences in productive characteristics but by differences in returns. Moreover, women's greater wage penalties to educational mismatch translate into greater differences in returns among educationally mismatched workers, with the component of the gender pay gap attributed to differences in returns being greater among educationally mismatched workers.

Key words

gender wage gap, educational mismatch; vertical and horizontal mismatches, decomposition

Introduction

This paper contributes to the existing labor economics literature by combining two strands of research: that which deals with the incidence and impacts of education-job mismatch (hereafter, educational mismatch), and that concerning the gender wage gap. The existence of the gender wage gap has been well documented in the labor economics literature and this strand has mainly been studied to investigate its magnitude and to identify its sources in most developed countries, with the main findings being that women generally receive lower wages than men, even after accounting for differences in productive characteristics of labor such as education and labor market experience. In a meta-analysis based on 263 international empirical research studies spanning the period from the 1960s to the late 1990s, for instance, Weichselbaumer and Winter-Ebmer (2005) report that female workers earn from 30% to 65% less, on average, than their male counterparts. The case of South Korea (hereafter, Korea) also represents no exception in spite of the significant progress experienced by women in the labor market over the past few decades, i.e., significant gender wage differentials have still remained virtually unchanged in Korea, see for example, Kang (2017). According to a recent report on gender pay gaps for full-time workers and earnings by educational attainment by the Organization for Economic Cooperation and Development (hereafter, OECD), at 34.1% in 2018, Korea's gender gap in median earnings is the highest among the 36 OECD member states (OECD, 2020). The gender pay gap in Korea has narrowed somewhat from the 1990s, when Korea saw the gap hover over 45%. Nonetheless, it is still far larger that of other OECD members (i.e., the OECD average is 13.2%) and has earned Korea the disgrace of retaining first place in this category among OECD countries for the 17th consecutive year since the OECD began compiling country data in 2002.

In the past, part of gender wage differentials could be due to differences in educational attainment between men and women (i.e., lower levels of women's education), but women have made great strides in educational attainment and have become the majority in higher education in recent decades, so the current gender wage gap in Korea can hardly be explained by the gender gap in educational achievement. Nevertheless, gender differences in rewards accruing from education may still contribute to the gender wage gap. Moreover, if one takes the demand-side of the labor market into account, one should consider the possibility that educational mismatch may exist. An educational mismatch is de-

fined in a broad manner as the mismatch between the workers' attained educational qualifications and the qualifications required for their job, so part of the skills/qualifications acquired through education could be unused. According to a recent report titled "Current Conditions and Characteristics of Underemployment" published by the Bank of Korea (BOK), the number of university graduates who have chosen a job below their qualifications (i.e., underemployed) has reached a record high of over 30% in 2019 (Oh & Kang, 2019). As per its analysis, the underemployment rate for university graduates increased steadily from approximately 22% in 2000 and reached about 30% for the first time in history last year. Moreover, in the period 2004–2018, underemployed university graduates earned approximately 38% less on average than their suitably employed counterparts.

The second strand of literature on educational mismatch covers a number of issues. Starting from the seminal contributions by Richard Freeman (1976), there is an increasing number of studies in the educational mismatch literature examining how private returns to education are affected by over-education, which describe the phenomena whereby individuals have acquired a level of education in excess of what is actually required to carry out their current job. This research trend is related to the rapid growth in global higher education. There is, however, at least one weakness with much of this literature. The existing literature regarding educational mismatch has typically identified that over-education adversely affects labor market outcomes, as it can lead to lower levels of job satisfaction, lower wages, loss of skills, loss of productivity, and problems with labor force attachment, but not with a primary focus on gender. In addition, due to data constraints, it has also until recently paid limited attention to horizontal mismatch. There are two types of educational mismatch in the literature: vertical mismatch and horizontal mismatch. Vertical mismatch refers to the mismatch between the levels of educational attainment acquired by individual workers and those required for their job, whereas horizontal mismatch refers to the mismatch between the fields of study in college studied by individual workers and those required for their job. As pointed out by Tao and Hung (2014), vertical mismatch, which results in educational resource misallocation in the labor force, is not the only concern, and horizontal mismatch has also surfaced as a major challenge currently facing educational authorities.

Despite the extensive literature on the incidence and wage effects of educational mismatch by gender on the one hand, and the even wider literature on the gender wage gap remaining resilient despite more than fifty years of equal pay legislation

on the other, little research has been conducted to investigate the relationship between educational mismatch and the gender wage gap. Moreover, these few studies provide mixed results for the role of educational mismatch in the gender wage gap; see for example, Boll and Leppin (2013) in Germany, Li and Miller (2012) in Australia, and Salinas-Jimenez, Rahona-Lopez, and Murillo-Huertas (2013) in Spain. If educational mismatch affects male and female workers to different extents and if the wage returns resulting from educational mismatch differ depending on gender, the contribution of differences in returns toward the gender wage gap could hence be even more relevant (Salinas-Jimenez et al., 2013).

The main aim of this paper is to explore the gender wage gap among recent college graduates in Korea by attempting to answer the question whether educational mismatch affects the gender wage gap. The study of the wage gap by educational attainment is often applied to control for individual heterogeneity, so the interest is on analyzing the gender wage gap separately for workers with different levels of education. Following this perspective, the paper limits the analysis to a relatively homogenous group of a graduate cohort in terms of age, level of education, and labor market experience. Although recognizing other sources of the gender wage gap (such as patriarchy, gender bias, and traditional attitudes towards gender roles), this article examines the role of educational mismatch to explain the gender wage gap in the Korean graduate labor market. While the gender gap in education has been central to a great number of earlier studies in the gender wage gap literature, this work takes the analysis a step further by using perspectives from the educational mismatch literature. Furthermore, the availability of data on horizontal mismatch allows this analysis to take both vertical and horizontal mismatches into consideration simultaneously to investigate the wage effects of educational mismatch on the gender wage gap. These extensions introduce the demand-side of the labor market and can explain part of the variation in returns on education among individuals with the same level of formal education (Johansson & Katz, 2006).

Given the changes in the educational composition of population by gender in higher education in recent decades, this analysis seems particularly apt for the case of Korea. Until the late 1990s, more men than women were students in Korea. In the 2000s, primary and secondary education had reached near gender parity. Up to the late 2000s, however, the higher education participation rate of men exceeded that of women because women were relatively disadvantaged by inequalities in accessing higher education. Interestingly, the faster increase in women's higher

education participation has reversed this trend in recent years. Since 2009,[1] women in Korea have begun outpacing men as the dominant gender in higher education participation and the difference is increasing (KOSTAT, 2010). This spreading out of higher education to women naturally raises the question of whether it is reflected in female college graduates being more likely to be mismatched in jobs which are not well suited to their educational qualifications. Given that women are more likely to engage in higher education in Korea, it might be that a greater proportion of them are educationally mismatched. Related to this, the paper seeks answers to the following research questions:

RQ 1: Does the educational mismatch phenomenon affect males and females to different extents?

RQ 2: Does educational mismatch play a large role in the wage determination process? If so, does the effect of educational mismatch on wage returns differ for males and females?

RQ 3: Is the gender wage gap explained by differences in productivity characteristics and/or by different returns associated with such characteristics?

RQ 4: Does educational mismatch make a significant contribution to the overall gender wage gap in the Korean graduate labor market?

Data and Variables

Data Source: Graduates Occupational Mobility Survey (GOMS)

This study utilizes cross-sectional survey data from the Graduates Occupational Mobility Survey among the cohort graduated in the year 2015 (hereafter, the 2015 GOMS). The GOMS is an annual census of all graduates who have completed 2/3-year courses in colleges or higher education institutions in Korea. The GOMS sample is composed of 4% of all Korean graduates, which corresponds to 18,000 individuals. The GOMS is conducted annually, and takes places three months to one year after graduation, typically in September. This national graduate survey focuses on education situation and labor market status (including employment, unemployment, and economic inactivity) of graduates from higher education institutions (hereafter, HEIs), one year after graduation. The GOMS dataset covers a wide range of graduates' characteristics, such as their labor market activities,

[1] As of 2009, females surpassed males in the gross higher education enrollment ratio in Korea with 80.5% to 77.6%.

personal and socio-economic characteristics, and information on their educational experience (past and current). The survey findings are used as a vital tool to gather information for various HEIs and as guidelines for educational and employment authorities and researchers.

In order to get a more homogenous sample, the sample used in this empirical analysis is restricted to full-time salaried graduate workers aged 20 to 34 who have provided valid information on the variables of interest, such as wages. Thus, self-employed (i.e., own-account) and unpaid family workers at the time of the survey are excluded. These exclusions, after deleting some missing data, result in a final sample size of 10,116 observations. Of the total respondents in the sample, 5,193 (51.3%) are males and 4,923 (48.7%) are females. Such homogeneity may limit any bias associated with a lack of effective controls for informal human capital such as that obtained through labor market experience and on-the-job training, thus allowing this study to more effectively isolate ability-related impacts (i.e., ability bias).

Definitions and summary mean statistics for the variables used for empirical analysis are provided in Table 1 and Table 2, respectively. As can be observed from Table 2, the raw geometric mean of the log of hourly wage is higher for men, with women's wages being on average approximately 89% of those earned by their male counterparts. It suggests that young female college graduates working full-time received, on average, nearly 11% lower hourly wages than their male peers. It can also be highlighted that men and women are basically alike in terms of productive characteristics such as age and acquired level of education (i.e., there is no major difference). Gender differences in most other characteristics such marital status, region, union membership, and type of employer are also generally small. Some differences between men and women are found in occupational characteristics and industrial sectors. Industry variables in particular are those showing the largest gender difference: men dominate the workforce in manufacturing and mining and women constitute the majority in health care, social services, recreational and cultural services, and education and research sectors.

Table 1
Definition of Variables

Variables	Definitions
LNHRW	Natural logarithm of hourly wages
FEMALE	Dummy variable: 1 if female
AGE	Workers age (years)
MARRIED	Dummy variable: 1 if married with spouse
CAPITAL	Dummy variable: 1 if living in Seoul, Incheon, and Gyeonggi-do
Level of Education	
- *SCOLLEGE*	Dummy variables: 1 if 2/3-year undergraduate degree <reference group>
- *UNIVERSITY*	Dummy variable: 1 if 4-year undergraduate degree
TEMP	Dummy variable: 1 if temporary employment position
UNION	Dummy variable: 1 if trade-union membership
Type of Employer	
- *PRIVATE*	Dummy variable: 1 if employed in private firms <reference group>
- *PUBLIC*	Dummy variable: 1 if employed in the public sector
- *SCHOOL*	Dummy variable: 1 if employed in schools (incl. colleges)
- *OTHER*	Dummy variable: 1 if the other types of employer
LARGE	Dummy variable: 1 if employed in large firms (more than 300 employees)
Occupation	
- *OCC1*	Dummy variable: 1 if managers, senior officials, and professionals
- *OCC2*	Dummy variable: 1 if clerks, administrative assistants, and secretaries
- *OCC3*	Dummy variable: 1 if service workers, marketing, sales, and customer services workers <reference group>
- *OCC4*	Dummy variable: 1 if associated professionals and technicians
- *OCC5*	Dummy variable: 1 if process, plant, and machine operators, and assemblers
Industry	
- *INS1*	Dummy variable: 1 if agriculture, fishing, etc.
- *INS2*	Dummy variable: 1 if manufacturing and mining
- *INS3*	Dummy variable: 1 if construction
- *INS4*	Dummy variable: 1 if wholesale and retail trade
- *INS5*	Dummy variable: 1 if transportation, communication, public utilities
- *INS6*	Dummy variable: 1 if finance, insurance, real estate
- *INS7*	Dummy variable: 1 if health care services, social services, recreational and cultural services <reference group>
- *INS8*	Dummy variable: 1 if education and research
- *INS9*	Dummy variable: 1 if public administration, defense, etc.

Table 2
Summary Mean Statistics

Variables	Full (1)	Male (2)	Female (3)
Natural logarithm of hourly wages	9.223	9.277	9.167
FEMALE (Females)	0.49	-	-
AGE (Age in years)	25.80	26.87	24.67
MARRIED (Married with spouse)	0.03	0.04	0.02
CAPITAL (Living in Seoul, Incheon, and Gyeonggi-do)	0.46	0.45	0.48
Level of Education			
- *SCOLLGE* (2/3-year undergraduate degree)	0.26	0.23	0.30
- *UNIVERSITY* (4-year undergraduate degree)	0.74	0.75	0.72
TEMP (Temporary position)	0.27	0.23	0.30
UNION (Trade-union membership)	0.06	0.08	0.05
Type of Employer			
- *PRIVATE* (Private firms) <reference group>	0.70	0.71	0.68
- *PUBLIC* (Public sectors)	0.11	0.14	0.08
- *SCHOOL* (Schools, incl. colleges)	0.13	0.10	0.17
- *OTHERS*	0.06	0.05	0.07
LARGE (Large firm, more than 300 employees)	0.37	0.42	0.31
Occupation			
- *OCC1* (Managers, senior officials, and professionals)	0.12	0.17	0.07
- *OCC2* (Clerks, administrative assistants, and secretaries)	0.29	0.25	0.33
- *OCC3* (Service workers, marketing, sales, and customer services workers)	0.31	0.25	0.37
- *OCC4* (Associated professionals and technicians)	0.23	0.27	0.20
- *OCC5* (Process, plant, and machine operators, and assemblers)	0.05	0.06	0.03
Industry			
- *INS1* (Agriculture, fishing, etc.)	0.00	0.00	0.00
- *INS2* (Manufacturing and mining)	0.18	0.26	0.11
- *INS3* (Construction)	0.04	0.05	0.02
- *INS4* (Wholesale and retail trade)	0.14	0.13	0.14
- *INS5* (Transportation, communication, public utilities)	0.10	0.11	0.08
- *INS6* (Finance, insurance, real estate)	0.04	0.04	0.04
- *INS7* (Services, health care, social services, recreational and cultural services)	0.27	0.20	0.34
- *INS8* (Education and research)	0.17	0.12	0.23
- *INS9* (Public administration, defense, etc.)	0.06	0.08	0.04
Observations (%)	10,116	5,193(51.3)	4,923(48.7)

Definition of Educational Mismatch

There are three common approaches to the definition of educational mismatch in the literature: (i) *worker self-assessment*, (ii) *job analysis*, and (iii) *realized matches*. The *worker self-assessment* approach is based on the worker's subjective measure of educational mismatch, while the *job analysis* and *realized matches* approaches use objective assessments of educational mismatch. The validity and choice of measurement methods generally depend on the availability and limitations of the data. In this paper, the *worker self-assessment* approach is the only available method used to define educational mismatch. As a subject indicator, unfortunately, the *worker self-assessment* approach may lead to biases arising from respondents due to outdated or inaccurate information. Nevertheless, it is worth noting that each of the approaches discussed above has its merits and drawbacks. Moreover, as noted by Hartog (2000), overall, the worker self-assessment approach is considered the best available method for educational mismatch. Indeed, key earlier studies in the educational mismatch literature adopting the *worker self-assessment* approach include Duncan and Hoffman (1981), Green and Zhu (2010), Rumberger (1987), and Sicherman (1991), among others.

The main purpose of this research is to investigate the relation between educational mismatch and the gender wage gap in the Korean graduate labor market. As noted earlier, there are two types of educational mismatch for college graduates: vertical mismatch and horizontal mismatch. Fortunately, the 2015 GOMS dataset employed here contains yearly information on both vertical and horizontal mismatches as the basis. In order to gather these two sets of information, the following two survey questions are used. The first question asks respondents directly about the appropriate level of formal education required to be qualified for their current job. The response to this question is used to assess the extent to which formal education (mis)matches the jobs, and is referred to as vertical (mis)matching status. Specifically, respondents are asked directly: "*What is the level of education required by your current job, compared to your education level?*" They can choose between five possible responses: (i) *Very Low*, (ii) *Low*, (iii) *Appropriate*, (iv) *High*, and (v) *Very High*. Individual workers claiming the first two choices (*Very Low*, *Low*) are defined as over-educated, *Appropriate* as adequately-educated, whereas *High* and *Very High* are defined as under-educated. Since the paper focuses on college graduates, the case of under-education is not considered, as this group generally has the highest level of education. In this sense, vertical mismatch as used here has the same meaning as over-education, and thus over-education and

adequately-matched in education are used to construct the degree of vertical (mis)matching status in this empirical analysis.

The other question asks respondents whether their jobs are highly, partly, or not related to their major field of study. The response to this question is used to assess the extent to which the major field of study matches the jobs, and is referred to as horizontal (mis)matching status. Horizontal mismatch is identified using the following question: "*Thinking about the relationship between your work and your education, to what extent is your work related to your college major?*" There are five choices: (i) *Not Related*, (ii) *Somewhat Related*, (iii) *Related*, (iv) *Closely Related*, and (v) *Very Closely Related*. The first two answers (*Not Related*, *Somewhat Related*) are classified as horizontal mismatch and the other three (*Related, Closely Related, Very Closely Related*) as horizontal match. Specifically, an individual who claims to be working in a job somewhat related to his/her field of study in college and working in a job not related to his/her major field are identified as being horizontally mismatched. This study considers those college graduates who are working in jobs somewhat related or not related to their major field of study as presumably using less of the knowledge, skills, and training leaned in that field of study.

There are two types of vertical (mis)matching status as well as two types of horizontal (mis)matching status. Therefore, the combination between vertical mis(match) and horizontal (mis)match leads to the four possible forms of (mis)matching categories below:

(a) *Vertically mismatched only*: The individual worker is horizontally matched, but vertically mismatched.
(b) *Horizontally mismatched only*: The individual worker is vertically matched, but horizontally mismatched.
(c) *Both vertically and horizontally mismatched*: The individual worker is mismatched in education both vertically and horizontally.
(d) *Well-matched*: The individual worker is adequately matched in education both vertically and horizontally.

Empirical Model and Methodology

Estimation Model

To examine the effects of educational mismatch on wages, two modified specifications of the semi-logarithmic Mincer equation (1974) are often used in the literature: The ORU (Over-, Required and Under-education) specification proposed

by Duncan and Hoffman (1981) and the dummy variable specification proposed by Verdugo and Verdugo (1989). This paper considers a specification with three dummies for educational mismatch, which is a special case of the Verdugo and Verdugo approach, and includes dummies both for being over-educated and being under-educated. Due to the limitation of data availability on years of education, this work is unable to perform the ORU approach. For estimating the wage effects of three forms of educational mismatch, the estimation equation is specified as:

$$\ln W_i = \alpha_i + \sum_{j=1}^{n} \beta_j X_{ij} + \gamma_1 VM_i + \gamma_2 HM_i + \gamma_3 BOTH_i + \mu_i \quad (1)$$

where i indexes individuals, $\ln W_i$ denotes the natural logarithm of the hourly wages of the individual worker i, and X is a vector of n control variables including personal and employment characteristics. *VM*, *HM*, and *BOTH* are dummy variables which take the value 1 if an individual worker is *vertically mismatched only*, *horizontally mismatched only*, and *both vertically and horizontally mismatched*, respectively, and 0 if an individual worker is adequately matched in the workplace. According to the Eq. (1), *vertically mismatched only*, *horizontally mismatched only*, and *both vertically and horizontally mismatched* workers are thus compared to workers who are *well-matched*. The coefficients of γ_1, γ_2, and γ_3 represent the average wage effects of three forms of educational mismatch in comparison to their well-matched counterparts, respectively. μ_i is a conventional mean zero disturbance.

The Blinder-Oaxaca Decomposition Approach

The second part of the paper analyzes whether the educational mismatch affects the gender wage gap. To this end, this study employs a generalized Oaxaca-Blinder decomposition model introduced by Oaxaca and Ransom (1994). In order to gain a better insight into the composition of the gender wage gap, one may consider methods of decomposing wage differentials by gender into contributing factors to analyze the contributions of different variables to the gender wage gap. Oaxaca (1973) and Blinder (1973) were the first to suggest a methodology for assessing wage differentials between sub-groups of the population. Within this framework, wage differentials are decomposed into a component that can be explained by group differences in productivity and a component (or a residual) unexplained by these observable productive differences, often interpreted as discrimination effects. Regarding the gender wage gap, there are differences in the groups' average human capital levels, and discrimination in the marketplace measured by

different rates of return on human capital is also generally prevalent.

In this empirical analysis, males (*m*) and females (*f*) identify the two separate groups, the natural logarithm of the hourly wages is the dependent variable (*W*), and several variables indicating personal background and employment characteristics are predictors. The question is how much of the mean outcome difference:

$$\bar{W}_m - \bar{W}_f = \Sigma\beta_m X_m - \Sigma\beta_f \bar{X}_f \tag{2}$$

where the upper bar indicates the mean of the variables, denotes the expected value of the dependent variable, is accounted for by group differences in the predictors. A standard decomposition of Blinder (1973) and Oaxaca (1973) is

$$\bar{W}_m - \bar{W}_f = (\bar{X}_m - \bar{X}_f)'\hat{\beta}_m + \bar{X}_f'(\hat{\beta}_m - \hat{\beta}_f) \tag{3}$$

This standard decomposition adopts the male wage structure as the non-discriminatory norm, although an alternative choice for a nondiscriminatory wage standard can also be the female wage structure. The first term on the right-hand side (hereafter, RHS) of Eq. (3) represents the component of the wage differential that is explained by group differences in the mean of the explanatory variables or endowments and is considered 'the explained part' of the wage gap. The second term on the RHS of Eq. (3) stands for the part of the wage gap that is interpreted as a measure for discrimination and is considered 'the unexplained part' of the wage gap, since it refers to differences in coefficients, or returns on productive characteristics of male and female workers. This component thus implies unequal treatment of productive characteristics in the labor market.

There are two main measurement issues raised in the standard decomposition approach. The first issue lies in the choice of the non-discriminatory wage structure. A number of researchers, including Cotton (1988), Neumark (1988), and Oaxaca and Ransom (1994), have raised this issue and have demonstrated that the results of the wage decompositions are sensitive to the choice of the non-discriminatory norm. Often researchers select the wage structures for the group of workers believed to be dominant in the labor market. Much prior research in the decomposition literature adopts the male wage structure (*m*) as the non-discriminatory benchmark. Another issue that has been raised with the standard decomposition approach lies in the fact that the standard decomposition technique estimates only relative differences. In the case of discrimination estimates, one does not know how much of the discriminatory (unexplained) wage gap arises from fa-

voritism toward one group of workers and how much arises from pure discrimination against the other group.

In order to resolve this identification issue, following Oaxaca and Ransom (1994), the nondiscriminatory wage structure is estimated from a pooled sample (both males and females) in this empirical analysis. This more general decomposition method allows the discrimination component to be further disaggregated into two parts: overpayment (favoritism) and underpayment (pure discrimination) as shown below. One implication of the standard decomposition procedure is that all of the discriminatory differentials are ascribed to underpayment of the subordinate group rather than to overpayment of the dominant group (Neuman & Oaxaca, 2004).

Let β^* be such a nondiscriminatory coefficient factor. It is based on the assumption that discrimination can be negative (against one group) or positive (in favor of other group). The outcome differences can be decomposed into explained (Q) and unexplained (U) components of the wage gap:

$$\bar{W}_m - \bar{W}_f = Q + U \tag{4}$$

where the first component Q,

$$Q = (\bar{X}_m - \bar{X}_f)' \beta^* \tag{5}$$

is the part of the wage differential explained by group differences in the magnitudes of the determinants of the wages (the quantity effect from productivity differences between analyzed groups), and the second component U,

$$U = \bar{X}_m' (\beta_m - \beta^*) + \bar{X}_f' (\beta^* - \beta_f) \tag{6}$$

is the unexplained part that describes average discrimination in favor of the group in the relatively better situation ($\bar{X}_m' (\beta_m - \beta^*)$), and average discrimination against the group in the relatively worse situation ($\bar{X}_f (\beta^* - \beta_f)$). This is usually attributed to discrimination, but it also captures all potential effects of differences in unobserved variables.

Results and Discussion

Incidence of Educational Mismatch

In order to answer *RQ1*(Does the educational mismatch phenomenon affect males and females to different extents?), Table 3 provides the incidence of educational mismatch among Korean college graduates one year after graduation for both men and women, where the educational mismatch variable is derived from a combination of vertical and horizontal mismatches. As can be observed in panel *A*, the overall share of college graduate workers mismatched in education is non-negligible in the youth labor market. The proportions of being educationally mismatched reach approximately 35% for both genders (34.6% in the case of males and 35.4% in the case of the female sample). This suggests that at least three out of ten young Korean college graduates are mismatched in the early stage of their careers (i.e., one year after graduation).

Table 3
The Incidence of Educational Mismatch (col. proportions)

Educational Mismatch	Full (1)	Male (2)	Female (3)
Panel A: Overall	3,541 (35.0)	1,796 (34.6)	1,745 (35.4)
Panel B: Types of Educational Mismatch			
Vertically Mismatched only	1,048 (10.4)	492 (9.5)	556 (11.3)
Horizontally Mismatched only	1,470 (14.5)	795 (15.3)	675 (13.7)
Both Vertically and Horizontally Mismatched)	1,023 (10.1)	509 (9.8)	514 (10.4)
Sample size	10,116	5,193 (51.3)	4,923 (48.7)

Source: 2015 GOMS, data are unweighted
Note. Standard errors in parentheses

When college graduate workers mismatched in education are disaggregated into three categories of educational mismatch in panel *B*, the results show that approximately 10% of college graduates are mismatched vertically, but matched horizontally (*vertically mismatched only*)—9.5% (resp. 11.3%) in the male (resp. female) sample. It appears that these proportions are generally comparable to or higher than those obtained in other earlier studies on educational mismatch of college graduates. Using data from the Higher Education as a Generator of Strategic Competences (HEGESCO) and the Flexible Professional in the Knowledge and

Society (REFLEX) surveys on college graduates in 17 European countries and Japan, for instance, Verhaest, Sellami, & van der Velden (2017) conclude that on average, countries had an identical early incidence of being "*vertically mismatched only*"—each at 8%. Based on data from the Household, Income and Labour Dynamics in Australia (HILDA) survey (2001–2012), Mavromaras, McGuinness, O'Leary, Sloan, and Wei (2013) show that approximately 13% of Australian graduate workers are "*vertically mismatched only.*"

Similarly, the results report that approximately 15% of recent college graduate workers consider that their current jobs are irrelevant to their studied field of discipline (i.e., *horizontally mismatched only*). These findings are also consistent with those of Verhaest et al. (2017), showing that the incidence of being mismatched in education is somewhat higher for the case of being "*horizontally mismatched only*" than for the case of being "*vertically mismatched only.*" Not surprisingly, the proportions of both vertically and horizontally mismatched appear smaller than those of the two types of educational mismatch discussed above. This relatively low proportion of both vertically and horizontally mismatched workers may suggest that there is a major lack of skilled or qualified graduate workers in the Korean labor market, although these results come from different measurement approaches.

The Wage Effects of Educational Mismatch

In order to answer *RQ2* (Does educational mismatch play a large role in the wage determination process? If so, does the effect of educational mismatch on wage returns differ for males and females?), Table 4 reports empirical evidence on the effect of educational mismatch on the natural logarithm of the hourly wages (*LNHRW*) for the whole sample as well as for men and women separately. According to the results in column (1), on the whole, the estimated coefficients for educational mismatch show that being educationally mismatched has a significant negative effect on wages, indicating that young college graduate workers mismatched in education earn lower wages than their well-matched peers with the same educational attainment level who work in jobs that fully utilize their educational qualifications. These findings mean that over-education is significantly associated with lower wages (i.e., wage penalties).

Table 4
The Wage Effects of Educational Mismatch (col. Standard errors)

Educational Mismatch	Full (1)	Male (2)	Female (3)
Vertically Mismatched only	-0.045*** (0.01)	-0.045*** (0.02)	-0.050*** (0.02)
Horizontally Mismatched only	-0.048*** (0.01)	-0.055*** (0.02)	-0.045*** (0.02)
Both Vertically and Horizontally Mismatched	-0.111*** (0.01)	-0.103*** (0.02)	-0.123*** (0.02)
F-statistics	99.63	56.13	42.90
Prob. > F	0.00	0.00	0.00
Adjusted R-squared	0.20	0.21	0.18
Sample size (%)	10,116	5,193 (51.3)	4,923 (48.7)

Source: 2015 GOMS, data are unweighted
Note. Standard errors in parentheses
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

When vertical mismatch is combined with horizontal mismatch, the coefficients on all types of educational mismatch are still significantly negative. Specifically, the results suggest that young college graduate workers who are *vertically mismatched only* (resp. *horizontally mismatched only*) appear to suffer about a 4.5% (resp. 4.6%) wage penalty. Not surprisingly, the relation between *both vertically and horizontally mismatched* and wages has the largest magnitude, indicating that the wage penalty is highest among young college graduates who are *both vertically and horizontally mismatched* at the beginning of their careers. This suggests that workers who were reported as *both vertically and horizontally mismatched* are likely to earn wages approximately 10.5% less than their well-matched counterparts.

A separate analysis is performed disaggregating the results based upon gender. The estimated coefficients for male and female samples are presented in column (2) and column (3), respectively. Similar to the results in column (1), all findings still show statistically significant negative coefficients of educational mismatch for both genders. Interestingly, the results in columns (2)−(3) point to significant gender differences in wage penalties for being educationally mismatched. Overall results show that female college graduates have a relatively higher wage penalty than their male counterparts. The wage penalty relating to *vertically mismatched only* (resp. *both vertically and horizontally mismatched*) fell from 4.9% (resp. 11.6%) in the female sample to 4.4 percent (resp. 9.8 percent) in the male sample. These findings suggest that educationally mismatched female college graduate workers appear to

suffer more severe wage losses than their male counterparts in the Korean youth labor market. As the wage effects of educational mismatch are found to differ for male and female samples, this study analyzes the gender wage gap among educationally mismatched workers as well as among well-matched workers in education.

Decomposing the Gender Wage Gap

In order to answer *RQ3* (Is the gender wage gap explained by differences in productivity characteristics and/or by different returns associated with such characteristics?)–*RQ4* (Does educational mismatch make a significant contribution to the overall gender wage gap in the Korean graduate labor market?), as a preliminary analysis, the log hourly wages for three types of educationally mismatched and well-matched workers by gender are presented in Table 5. The gender wage gap in the full sample amounts to 11%. When educational mismatch is taken into account, the gender wage gap is comparable or slightly higher among educationally mismatched workers (11.9% of the sample being classified as *Vertically Mismatched Only*, 13.0% of the sample being classified as *Horizontally Mismatched Only*, and 10.1% of the sample being classified as *Both Vertically and Horizontally Mismatched*), compared to their well-matched counterparts (10.4% of the sample being classified as *Well-Matched*).

Table 5
Log of Hourly Wages by Gender and Gender Wage Gap (col. percent)

Sample	$\overline{ln W_m}$	$\overline{ln W_f}$	Gender Wage Gap (%)
Full Sample	9.277	9.167	0.110 (11.0%)
Vertically Mismatched Only	9.253	9.134	0.119 (11.9%)
Horizontally Mismatched Only	9.258	9.129	0.129 (12.9%)
Both Vertically and Horizontally Mismatched	9.122	9.021	0.101 (10.1%)
Well-Matched	9.308	9.204	0.104 (10.4%)

To gain a better understanding of the composition of the wage gap in the sample of males and females, the gender wage gap presented in Table 5 is decomposed using the Oaxaca and Ransom-type generalized decomposition discussed in the *EMPIRICAL MODEL AND METHODOLOGY* section. In Table 4, all three types of educational mismatch have a negative wage effect and this negative effect is more pronounced for the sample of female college graduates. Thus, the general-

ized decomposition approach employed in this analysis shows that educational mismatch could be one of the main drivers of the gender wage gap in the Korean graduate labor market.

Table 6
Decomposing the Gender Wage Gap: Generalized Decomposition

Sample	Wage Differential	Explained Part (%)	Unexplained Part (%)
Full Sample	0.110	0.069 (67.7%)	0.041 (32.3%)
Vertically Mismatched Only	0.119	0.086 (72.3%)	0.033 (27.7%)
Horizontally Mismatched Only	0.130	0.083 (63.8%)	0.047 (36.2%)
Both Vertically and Horizontally Mismatched	0.101	0.052 (51.5%)	0.049 (48.5%)
Well-Matched	0.104	0.089 (85.6%)	0.015 (14.4%)

The generalized decomposition results are provided in Table 6. The results are shown for the full sample (*Full Sample*), for the three sub-samples of recent college graduate workers who are educationally mismatched (*Vertically Mismatched Only*; *Horizontally Mismatched Only; Both Vertically and Horizontally Mismatched*), and for those who are adequately matched (*Well-Matched*). Overall, the explained component (i.e., the gender wage gap in productivity characteristics or endowments) accounts for a major part of the gender wage gap, with more than 50%. Also, the explained component is positive among all three types of educationally mismatched workers as well as among well-matched workers. This indicates that average observable male labor market characteristics are better that those of females.

In term of the unexplained (or coefficients) component, the results indicate that the gender wage gap in different returns to productivity characteristics is also non-negligible among three types of educationally mismatched workers. This unexplained component of the gender wage gap is usually attributed to discrimination in the literature. The fact that the unexplained wage gap is not justified in terms of labor productivity is usually known as gender wage discrimination. In addition, the unexplained component shows the hypothetical wage gain for females if their own features were remunerated like those of their male counterparts. As this term is positive for both educationally mismatched and well-matched workers, but is higher among educationally mismatched workers, this suggests that gender wage discrimination among the educationally mismatched is more important than among the well-matched. The unexplained component

among educationally mismatched workers accounts for at least 27.7%, compared to 14.4% among well-matched workers.

Summary and Conclusions

The paper explores educational mismatch and the gender wage gap in the Korean graduate labor market. The main aim of this study is to examine the gender wage gap among recent college graduates in Korea by analyzing to what extent educational mismatch has an impact on the gender wage gap. Unlike much prior research in the educational mismatch literature, two types of educational mismatch are considered in this analysis: vertical mismatch, which refers to a worker's education level that either exceeds or is below the required education level for their jobs, and horizontal mismatch, which refers to a worker's type/field of study in college being inadequate for the job the worker holds. The generalized decomposition framework of analysis developed by Oaxaca and Ransom (1994) is applied to examine the gender wage gap, using data from the 2015 GOMS dataset.

The case of Korea may be of particular interest for the study of educational mismatch and the gender wage gap, given that on the one hand, as social and labor policies such as affirmative action have contributed to more equal opportunities between men and women, women are getting better opportunities to access the labor market, but significant gender wage inequality still remains, and on the other hand, considering the demand side of the labor market, a non-negligible proportion of young college graduates face educational mismatch associated with a significant wage penalty in the workplace, suggesting that part of the knowledge, skills, and abilities acquired through education are underused in the workplace (Kim, Ahn, & Kim, 2016; Lee, Lee, & Song, 2016; Park & Shahiri, 2015). These are important issues in terms of developing policies. In this context, the paper attempts to analyze the gender wage gap focusing on the role of educational mismatch in the Korean graduate labor market.

The major findings presented in this analysis are as follows. First, this study finds a large proportion of young college graduate workers, more than 35% on average, being educationally mismatched in Korea. Second, by estimating the wage returns resulting from educational mismatch, the analysis finds evidence of the contribution of educational mismatch in determining wages, and thus a source of the gender wage gap. When the analysis is run by gender, it is found that the wage effects associated with educational mismatch differ by gender, i.e., young female college graduates suffer higher wage penalties than their male counterparts for ed-

ucational mismatch in Korea. Third, the Oaxaca and Ransom (1994) type-generalized decomposition reveals that a significant gender wage gap is not explained by the differences in productive characteristics but by differences in returns. Moreover, women's greater wage penalties resulting from educational mismatch translate into greater differences in returns among educationally mismatched workers, with the element of gender differences in wages due to differences in returns being greater among educationally mismatched workers

Despite the success of longstanding government efforts in Korea to make significant progress in women's educational attainment over the last six decades, this has not necessarily translated into higher women's labor market outcomes such as wages, unemployment rates, and labor-force participation. Therefore, although educational policies have contributed to facilitating and supporting the equal access of women to employment and income opportunities, other welfare policies and incentives are needed to ensure equal access to labor market opportunities for all those women and men who are available for work to reduce existing gender wage differentials. Among them, for instance, implementing performance-based pay systems oriented to eliminate gender bias in returns paid, and policies to promote women's access to more and better quality jobs such as high-skilled employment and senior management positions under similar conditions as men to eliminate occupational/sectoral segregation by gender seem to be required. Also, achieving a better match between the supply and demand sides of the labor market could contribute to reducing the gender pay gap, given female workers face greater penalties than their male counterparts as a consequence of the educational mismatch. This better job match would not only be useful to reduce the gender wage gap but also to avoid the qualifications and skills acquired through education being underused and to take advantage of the significant effort made by the economy to increase the educational levels of its workforce (Salinas-Jimenez et al., 2013).

Finally, this paper uses cross-sectional data to conduct empirical analysis. Although the analysis is based on a relatively homogenous sample of recent college graduates in terms of age, level of education, and labor market experience, it is unclear whether unobserved individual heterogeneity will bias the results (i.e., the problem of endogeneity bias), which is the main limitation of this study. Some earlier studies in the literature on educational mismatch (Sicherman, 1991) have criticized empirical approaches that do not address the potential for endogeneity bias, that is, non-random self-selection into educational mismatch, provided that any estimated wage impacts of educational mismatch are free from endogeneity bias. Thus, future research may attempt to resolve this econometric issue.

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Biographical Note: **Kihong Park** is a Professor of Economics at Chungbuk National University (CBNU). He received his PhD in economics from the University of Arizona, USA in 2011. Kihong's research interests are labor economics and applied microeconomics, including the economics of education, labor market impact of job mismatch (incl. skill/educational mismatch), gender differences in labor market outcomes, and the economic status of minorities (incl. people with disabilities). Recent publications include "Qualification, job mismatch, and workers with disabilities" (2020), "A hedonic wage regression model for vulnerable workers in Malaysia: The use of exclusion restriction as a remedy for self-selection bias" (2020), "The wage effects of over-education among young STEM graduates" (2019), "Educational mismatch and skill mismatch in the youth labor market: Panel evidence from South Korea" (2019), and "Vertical and horizontal mismatches and career mobility: Evidence from young female college graduates" (2018). Email: khpark@chungbuk.ac.kr

Appendix A1

The Wage Effect of Educational Mismatch

Variables	Full (1)	Male (2)	Female (3)
FEMALE	-0.009	-	-
AGE	0.029***	0.031***	0.024***
MARRIED	0.052**	0.060**	0.022
CAPITAL	0.044***	0.031***	0.059***
Level of Education (ref. *SCOLLEGE*)			
- *UNIVERSITY (ref. SCOLLEGE)*	0.063***	0.054***	0.078***
TEMP	-0.158***	-0.178***	-0.128***
UNION	0.158***	0.176***	0.113***
Type of Employer (ref. *PRIVATE*)			
- *PUBLIC*	-0.022	-0.025	-0.017
- *SCHOOL*	-0.031*	-0.118***	-0.026
- *OTHER*	0.011	-0.002	0.018
LARGE	0.097***	0.105***	0.089***
Occupation (ref. *OCC3*)			
- *OCC1*	0.258***	0.221***	0.265***
- *OCC2*	0.056***	0.043***	0.065***
- *OCC4*	0.071***	0.030***	0.126***
- *OCC5*	0.046**	0.036	0.034
Industry (ref. *INS7*)			
- *INS1*	-0.022	-0.039	0.015
- *INS2*	0.083***	0.087***	0.075***
- *INS3*	0.029	0.042*	0.016
- *INS4*	-0.028**	-0.014	-0.045***
- *INS5*	0.056***	0.058***	0.061***
- *INS6*	0.138***	0.153***	0.126***
- *INS8*	-0.090***	-0.085***	-0.078***
- *INS9*	-0.027	-0.039	-0.014
Educational Mismatch (ref. Well-Matched)			
- *Vertically Mismatched only*	-0.045***	-0.045***	-0.050***
- *Horizontally Mismatched only*	-0.048***	-0.055***	-0.045***
- *Both Vertically and Horizontally Mismatched*	-0.111***	-0.103***	-0.123***
Constant	8.358***	8.347***	8.438***
F-statistics	99.63	56.13	42.90
Prob. > F	0.00	0.00	0.00
Adjusted R-squared	0.20	0.21	0.18
Sample size (%)	10,116	5,193 (51.3)	4,923 (48.7)

Source: 2015 GOMS, data are unweighted
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$