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The labor market impacts of graduating from university during a recession: evidence and mechanisms

Yeonho Bae[1] · Taehoon Kim[2]

Abstract

This study explores the persistent effect of graduating from university in a recession on earnings and sheds light on underlying mechanisms focusing on the roles of educational mismatch and job instability. Using longitudinal data from South Korea, we estimate the short- and long-term effects of the unemployment rate in the province where the university is located at the time of graduation on labor market outcomes. The IV estimation results show that a 1% point increase in the unemployment rate at graduation decreases the initial monthly earnings by 8.77% and the earnings loss is persistent. A 1% point increase in the unemployment rate also increases the probability that the level of education required for work is lower than the university level by 7.58% points and the probability of being a temporary worker by 8.54% points. When the educational mismatch and job instability are accounted for, the magnitude of the initial earnings loss due to graduating from university in a recession decreases by 40.9%. Our results suggest that skill mismatch and job instability are important mechanisms through which entering a labor market in a recession has negative impacts on labor market outcomes for a considerable period after labor market entry.

Keywords Recession · Earnings loss · Skill mismatch · Job stability · Job mobility

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1 Introduction

It is essential for economic development that people accumulate human capital through education or job training and use it effectively in the labor market. For this to happen, it is necessary for young workers to match with jobs that are suitable for their skill and education levels. In particular, university students acquire advanced knowledge and skills while attending school, and they would like to have a job that can make good use of the knowledge and skills. It may be, however, difficult for university graduates to obtain a job that can fully utilize the knowledge and skills if they graduate from university in a bad economy because the opening of jobs that require highly educated workers is reduced. And if the job mismatch is not quickly resolved, graduating from university in bad economic times can have persistent negative effects on labor market outcomes. The difficulty of obtaining a stable job with high motivation for accumulating firm-specific human capital may be another factor that can lead to lasting negative impacts. In view of this importance, this study investigates the short- and long-term effects of graduating from university in a recession on labor market outcomes and sheds light on underlying mechanisms focusing on the roles of skill mismatch and job instability.

There is a vast literature that analyzed the short- and long-term impacts of graduating from college in a recession on labor market outcomes (Altonji et al. 2016; Brunner and Kuhn 2014; Choi et al. 2020; Cockx and Ghirelli 2016; Genda et al. 2010; Kahn 2010; Kwon et al. 2010; Liu et al. 2016; Oreopoulos et al. 2012; Rothstein 2021; Schwandt and Wachter 2019; Wachter and Bender 2006; Wachter 2020). These studies consistently show that graduating in a bad economy has persistent negative impacts on labor market outcomes. Although this study also analyzes the short- and long-term effects of graduating from school in a recession, we focus more on skill mismatch and job instability as important underlying mechanisms through which graduating in a recession has a negative impact on university graduates. We quantitatively evaluate how much of the earnings loss caused by graduating in a recession can be accounted for by skill mismatch and job instability.

We use the Youth Panel Survey 2007 for analysis, which is longitudinal data that surveyed education and work histories of young people aged 15–29 in 2007 for 12 y in South Korea. Using this data, we estimate the short- and long-term effects of the unemployment rate in the province where the university is located at the time of university graduation on labor market outcomes, including monthly earnings, hourly wage, work hours, employment, job mobility, job stability, and educational mismatch. Since decisions about the timing of university graduation and which university to attend can be endogenously determined by the influence of economic conditions, we employ the instrumental variables (IV) approach that uses the unemployment rate at expected university graduation in the province of residence at age 14 as an instrument for the regional unemployment rate at the time of actual graduation. The IV estimation results show that a 1% point increase in the unemployment rate at graduation decreases the initial monthly earnings by 8.77%. While the earnings loss gradually reduces, it does not disappear for a considerable period after entering the labor market. Our estimation results show that the earnings loss due to graduating from university during a recession decreases by 0.48% points each year. The reduction in the initial monthly earnings

is derived from the decrease in both hourly wages and working hours. The decrease in hourly wages gradually recovers over time, but the decrease in working hours continues without a significant change. In the analysis by gender, the negative effect of graduating during a recession on earnings is greater for men. The IV estimation results show that a 1% point increase in the unemployment rate at university graduation reduces the monthly earnings at labor market entry by 11.59% for men and 6.87% for women. On the other hand, the recovery of the earnings losses is faster for men than for women. The earnings loss for men annually decreases by 0.69% points, while that for women decreases by 0.33% points.

We also estimate the impacts of graduating from university in a recession on skill mismatch and job instability measured by whether a worker is a temporary worker. We define that skill mismatch exists when a worker subjectively evaluates that an educational level required in the current workplace is less than the university level and that a job is unstable if it is a temporary job. And we investigate how much the skill mismatch and job instability can explain the earnings loss caused by graduating from university in a recession. Previous studies point out skill mismatch and job instability as possible causes of the persistent negative effects of graduation in a recession (Kahn 2010; Oreopoulos et al. 2012). Studies that quantitatively gauge their importance, however, are rare. To the best of our knowledge, the only exception is Liu et al. (2016) that investigate the impact of graduating in a recession on skill mismatch and labor market outcomes in Norway and evaluate how much of the earnings loss caused by graduating in a recession can be explained by skill mismatch. While we also investigate the role of skill mismatch in accounting for the earnings loss due to graduating in a recession, we additionally analyze the role of job instability. Neumark (2006) reports that job stability early in the career has a significant positive effect on later wages. On the other hand, we analyze how much job instability due to graduating from the university during a recession can account for the earnings loss.

The IV estimation results show that a 1% point increase in the unemployment rate at graduation increases the probability that the level of education required for work is lower than the university level by 7.58% points. The educational mismatch accounts for 13.7% of the initial earnings loss due to graduating from university in a recession. A 1% point increase in the unemployment rate at graduation also increases the probability of being a temporary worker at graduation by 8.54% points among employed workers. When the job instability is accounted for, the magnitude of the initial earnings loss due to graduating from university in a recession decreases by 25.6%. When both educational mismatch and job instability are accounted for, the earnings loss decreases by 40.9%. These results consistently suggest that skill mismatch and job instability are critical factors that contribute to the persistent earnings losses of workers who graduated from university in bad times. Conversely, they imply that a significant portion of persistent career impacts of entering the labor market during a recession may disappear if skill mismatch and job instability are resolved. Our results have an implication that active labor market policies to mitigate skill mismatch and job instability of young workers entering the labor market during a recession are required.

The remainder of this paper is organized as follows. Section 2 describes the higher education system in South Korea. Section 3 explains the empirical strategy. Section 4

introduces the data used. Section 5 reports and discusses estimation results. Section 6 concludes.

2 Background: higher education system and job transition in South Korea

South Korea has the highest proportion of young people with higher education among OECD countries. 69.8% of the 25–34-year-old population had tertiary education in 2020, much higher than the OECD average of 45.6% (OECD, 2021).[1] Universities have a very hierarchical structure according to their fame, and students tend to enter university with a ranking (first-tier schools, second-tier schools, and so on) corresponding to their grade in high school and the score in the national college entrance exam. Most high school students study with the goal of entering university and the competition to enter prestigious universities is very fierce. In 2020, about 80% of all 12th graders in high school (346,673 of 437,950) took the national college entrance exam (CSAT: the College Scholastic Ability Test). As there are students who enter college only with high school grades without taking the national college entrance exam, the ratio of students who want to enter college may be higher than the ratio of students who took the exam.

Another distinctive phenomenon in the Korean higher education market is that there are many cases in which students take the national college entrance exam again after high school graduation to enter university or get into a better university (Kim 2021b). The college entrance exam is held once a year, and about 75–80% of the total test takers are 12th graders and about 20–25% are high school graduates retaking the college entrance exam. In the past, it was difficult to enter a university itself because there were not many universities, but recently, the competition to enter a good university is fierce as the number of universities has substantially increased since the mid 1990s and cohort size has decreased due to decreasing fertility rates in South Korea. Since university graduates occupy a large share of the labor market in South Korea, especially in the youth labor market, it is important to analyze their transition to the labor market and dynamics.

The reason why the competition to get into a good university is fierce may be due to the belief that graduating from a good university increases the chances of getting a good job. Cultural factors such as Confucianism are also pointed out. In Confucianism, it is considered a virtue to rise to a high social position and gain fame. This can be achieved by studying hard, entering a prestigious university, and getting a socially recognized job (Kim 2021a; Kim et al. 2022). As competition to get a good job is also fierce, there are many cases of delaying graduation rather than graduating from university within four years. Statistics from 2007 to 2013 show that about half of university graduates have deferred graduation (Chae 2016). Our data also show that more than 50% of university students delay graduation. Graduation deferral is not necessarily due to the labor market situation, but also for various other reasons, such as overseas

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[1] OECD (2021), Population with tertiary education (indicator). doi: 10.1787/0b8f90e9-en (Accessed on 19 April 2021).

language training, preparation for civil service exams, or the inconsistency between military enlistment time and university academic calendar[2]. There are also many cases in which students spend one or more years to get the job they want. Anecdotally, it seems that graduating 1–2 years later than expected barely sends a negative signal to the labor market since there are many university students who postpone graduation. Considering these features comprehensively, it is likely that the timing of university graduation is endogenously determined.

3 Empirical method

This study employs the following model to estimate the impacts of labor market entry conditions on labor market outcomes afterward, which is similar to the model used by Kahn (2010).

$$Y_{it} = \beta_0 + \beta_1 U R_{s(i)c(i)} + \beta_2 U R_{s(i)c(i)} \text{Exp}_{it} + X_{it}\beta_3 + \lambda_{s(i)} + \mu_{b(i)} + \xi_t + \epsilon_{it} \quad (1)$$

where Y_{it} represents labor market outcomes including log monthly earnings, log hourly wages, log work hours, employment, job mobility, stability of job, and skill mismatch of individual i at time t. $U R_{s(i)c(i)}$ is the unemployment rate in the province (s(i)) where university is located at the time of graduation (c(i)). Exp_{it} is the potential experience of individual i at time t. X_{it} is a vector of regressors including gender, the unemployment rate in the province of current residence in t, parents' education dummies, dummies of parents' occupation at age 14, experience squared, the numbers of brothers and sisters, a dummy variable that indicates whether the individual i is supposed to serve the mandatory military service, dummies of the province of residence at age 14, dummies of the province of current residence, and dummies of housing type at age 14. $\lambda_{s(i)}$, $\mu_{b(i)}$, and ξ_t represents fixed effects of the province of a university where the individual i graduated, fixed effects of expected university graduation year, and year of survey, respectively. ϵ_{it} is an error term.

The key parameters of interest are β_1 and β_2. β_1 represents the initial impact of the regional unemployment rate at the time of graduation. β_2 represents how the impact changes as potential experience increases. If β_2 is positive, disadvantages that unlucky cohorts experience decrease over time.

We also investigate the gendered effect of graduating from university in a recession on earnings. The following model is employed to estimate the gendered effect:

$$\begin{aligned} Y_{it} = {} & \delta_0 + \delta_1 U R_{s(i)c(i)} \text{Male}_i + \delta_2 U R_{s(i)c(i)} \text{Exp}_{it} \text{Male}_i \\ & + \delta_3 U R_{s(i)c(i)} \text{Female}_i + \delta_4 U R_{s(i)c(i)} \text{Exp}_{it} \text{Female}_i \\ & + X_i \delta_5 + \lambda_{s(i)} + \mu_{b(i)} + \xi_t + \epsilon_{it} \end{aligned} \quad (2)$$

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[2] Our data shows that 41.0% of women graduate later than expected and 60.9% of men graduate later than expected. We infer the reasons as follows. As there are cases where men's military enlistment time does not coincide with the end of the semester at university, some male students inevitably take one more semester off in the situations. As a result, graduation could be delayed. Male students may need more time to re-learn the skills required in the labor market, as their studies at university are interrupted by military service.

where Male$_i$ is a dummy variable that indicates men and Female$_i$ is a dummy variable that indicates women. The parameters δ_1 and δ_3 represent the initial impact of the regional unemployment rate at graduation for men and women, respectively. δ_2 and δ_4 represent the change in the impact according to a year increase in potential experience for men and women.

A potentially critical empirical issue in estimating the causal impact of initial labor market conditions on later labor market outcomes is that the timing of university graduation might be endogenously determined depending on economic conditions at graduation as university students can change their graduation time if economic conditions at the time of scheduled graduation are not good. As the choice of which university to attend can be related to the local economic conditions at high school graduation or university entrance and the local unemployment rates are serially correlated, the province where the university is located can have an endogenous relationship with the local unemployment at university graduation (Kahn 2010). Depending on the local economic conditions at the time of graduation, endogenous migration may also occur (Kahn 2010; Lehrer et al. 2022). To handle this possible endogeneity issue, we employ the instrumental variables approach. We instrument for the unemployment rate in the province where the university is located at the actual graduation with the unemployment rate in the province of residence at age 14 at the expected graduation. The expected graduation time is determined by the year of birth and the education and military system in South Korea. Women and men exempt from military service are expected to graduate at age 22, and men with military service obligations are expected to graduate at age 24. Because the expected graduation time and the province of residence at age 14 are unlikely to be determined by students' choices, the instrument is plausibly exogenous. The interaction term between the regional unemployment rate at actual graduation and potential experience is instrumented by the interaction between the regional unemployment rate at expected graduation and potential experience. In the analysis of the gendered effect, four instrumental variables generated by multiplying the above instrumental variables and the gender dummies are used.

The expected time of graduation is four years after the predicted year of university entrance for women. In South Korea, men who pass a physical examination at age 18 are obligated to serve in the military, and the service period is usually two years. In consideration of this, the expected graduation for men who are obligated to serve in the military is six years after the predicted university entrance, and that for men who are exempted from military service because of health issues is four years after university entrance. The predicted university entrance year is the year students turn 18. It is, therefore, perfectly determined by year of birth. In summary, the predicted graduation year is the year in which men turn 24 and women and men exempt from military service turn 22. For the instrument to be valid, the instrument should be exogenous and closely related to the local unemployment rate at university graduation, which is an endogenous variable. The relationship between the instrument and the local unemployment rate at university graduation can be examined in the first stage regression of the two-stage least squares estimation. The exogeneity condition requires that the unemployment rate at the expected university graduation in the province of residence at age 14 is not systematically correlated with characteristics and decisions of individuals that can affect the labor market outcomes after controlling for fixed

effects of the province of residence at age 14 and cohort effects. We believe that the instrument would satisfy the exogeneity condition because the province of residence at age 14 is likely to be determined regardless of a student's choice and the university graduation will happen about 10 y later. We also perform various robustness tests that control (1) the local unemployment rates at high school graduation and university entrance and (2) linear cohort time trends that are specific to the province of residence at age 14.

We also graphically illustrate how the impacts of labor market entry conditions on labor market outcomes evolve over time by estimating the following model:

$$Y_{it} = \alpha + \sum_{j=0}^{14} \gamma_j U R_{s(i)c(i)} I(\text{Exp}_{it} = j) + X_i \delta + \lambda_{s(i)} + \mu_{b(i)} + \xi_t + \epsilon_{it} \quad (3)$$

where $I(\text{Exp}_{it} = j)$ is an indicator variable that is equal to one if the potential experience of individual i at time t is j years, and zero otherwise. Other control variables are equal to those in Eq. (1). The parameter γ_j represents the impact of labor market entry conditions on labor market outcomes when the potential experience is j years (j y after university graduation). We also estimate Eq. (3) using the IV method. Each interaction between the regional unemployment rate at the time of actual graduation and potential experience is instrumented by the interaction between the regional unemployment rate at expected graduation in the province of residence at age 14 and the potential experience.

While Eq. (1) assumes that the impact of initial labor market conditions linearly evolves over time, Eq. (3) does not impose a functional form assumption for the dynamic effects of the initial labor market conditions. Using Eq. (1) has the advantage of being able to express the estimation results concisely in tables, whereas using Eq. (3) has the advantage of not imposing a linearity assumption. We take these advantages and disadvantages into account and use the two models complementarily.

4 Data

This study uses the Youth Panel Survey 2007 (YP2007) for analysis. The YP2007 is a longitudinal survey that has followed annually for the sample of nationally representative individuals aged 15 to 29 at the initial survey year 2007. The YP2007 is suitable data for this study because it surveys the detailed education and work histories of individuals. In this study, the data surveyed from 2007 to 2018 is used, and people who graduated from the university between 2000 and 2018 are included in the sample. And the regional unemployment rate is obtained from the Economically Active Population Survey published by Statistics Korea, which is comparable to the Current Population Survey (CPS) in the U.S.

The YP2007 also provides information about university graduation year, the province where the university is located, the province of residence at age 14, and the year of birth. The information is used to generate variables of the regional unemployment rate at graduation and the unemployment rate at expected graduation in the

province of residence at age 14. First, we construct the unemployment rate at graduation in the province where the university is located in the following way. In South Korea, the first semester of college starts in March and ends in June, and the second semester starts in September and ends in December. Most college students graduate in February and some graduate in August. For students who graduated in February, the regional unemployment rate in the fourth quarter of the year before graduation is likely to represent the economic situation at the time of graduation in the province where the university is located because they were likely to look for work in the fall semester of the year before graduation. For this reason, students who graduated in February are linked to the regional unemployment rate in the fourth quarter of the previous year, and students who graduated in August are matched with the regional unemployment rate in the second quarter of the graduation year.

Second, the unemployment rate at expected graduation in the province of residence is made as follows. University students are expected to graduate in February four years (men who are exempted from military service and women) or six years (men who pass the physical exam) after university enrollment. As students are expected to enter university at age 19, men who should serve in the military are expected to graduate at age 25, and women and men who are exempted from military service are expected to graduate at age 23. The expected graduation age and year of birth perfectly determine the expected graduation year. The unemployment rate in the province of residence at age 14 in the fourth quarter of the year before the expected graduation year is constructed as the instrument.

Other important variables in this study are the level of tasks that people do at their companies and job instability. The YP2007 annually surveys workers about the required level of education to do their task. Using this information, we create a variable that represents the education level of work that workers do. This educational mismatch variable is equal to one if university graduates answer that the level of education required for work is less than the university level and zero otherwise. Second, job instability is measured by whether a worker is a temporary worker or a permanent worker. We create a job instability variable that is one for temporary workers and zero for permanent workers.

Table 1 provides descriptive statistics for the employed, except for the employment variable that the sample that includes both the employed and the unemployed is used. We show the statistics for the sample of workers because employed workers are mostly analyzed in this study. As the survey on whether or not a temporary worker started from the 7th survey and the statistics for a variable that indicates mandatory military service is only shown for the sample of males, the sample sizes for these are different from the sample size of other variables. The mean unemployment rate at actual graduation is 3.170% and that at expected graduation is 3.367%. The higher unemployment rate at expected graduation would imply that students tend to graduate avoiding bad times. The mean of log monthly earnings is 5.433. The university location variable is a dummy variable that is one if the province of the university is the same with the province of residence at age 14, and zero otherwise. It shows that 77.7% of people entered university in the province of residence at age 14. This shows that there is a considerable tendency for students to enter university in the area where they live. The university entry timing variable is a dummy variable that is one if university entrance

Table 1 Descriptive statistics

	Mean	S.D.	N
Actual unemployment rate	3.170	0.988	16,877
Expected unemployment rate	3.367	0.881	16,877
Log monthly real earnings	5.433	0.406	16,877
Log hourly real wage	0.220	0.410	16,877
Log monthly work hours	5.212	0.227	16,877
University location	0.777	0.416	16,877
University entry timing	0.799	0.401	16,877
Educational mismatch	0.461	0.499	16,877
Potential experience (years)	5.644	3.598	16,877
Tenure (months)	35.98	33.23	16,877
Age	29.54	3.822	16,877
Gender (male = 1)	0.467	0.499	16,877
Father education (college or higher = 1)	0.341	0.474	16,877
Mother education (college or higher = 1)	0.153	0.360	16,877
Father job (professional job = 1)	0.279	0.449	16,877
Mother job (professional job = 1)	0.065	0.246	16,877
Housing (Parents own a house = 1)	0.845	0.362	16,877
Temporary worker	0.113	0.317	10,425
Mandatory military service among men	0.964	0.186	7,874
Employment (Employed = 1)	0.672	0.470	26,231

The earnings and wages are presented in 10,000 Korean won and the natural logarithm is taken

year is the same with high school graduation year, and zero otherwise. 79.9% of students entered university right after high school graduation. The mean employment rate is 67.2%. Among workers who answered whether they are temporary workers or not, 11.3% are temporary workers. A temporary worker is an employee who is supposed to leave his or her employer within a certain period. 46.1% of university graduates answered that the level of task that they do is lower than their education level. As the overall education level of people has improved in many countries, the number of cases where the level of education required for work is lower than that of their own has increased significantly (Dolton and Vignoles 2000; Groot and Van Den Brink 2000; McGuinness 2006). Since South Korea has the highest college enrollment rate among the OECD countries, the proportion of overeducated workers may be high. The mean potential experience is 5.644 y and the mean tenure is 35.98 months.

5 Results

This section presents estimation results for the impacts of labor market entry conditions on labor market outcomes by estimating Eqs. (1)–(3) using the two-stage least squares method. We present estimation results for Eqs. (1) and (2) in tables and show estimation

Table 2 First stage estimation results: impacts of the regional unemployment rate at expected university graduation and its interaction with expected experience on the regional unemployment rate at actual university graduation and its interaction with expected experience

	(1) UR at graduation	(2) UR at graduation ×potential experience
Predicted UR at graduation	1.174***	−3.452***
	(0.1385)	(1.184)
Predicted UR at graduation	0.0124	1.863***
×potential experience	(0.0099)	(0.1548)
Observations	16,877	16,877
Kleibergen-Paap rk Wald F statistic		52.55

*** $p < 0 : 01$, ** $p < 0.05$, * $p < 0.1$

Standard errors are clustered by expected graduation year

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of residence at age 14, the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors

results for Eq. (3) in figures. Then, we estimate the effect of initial labor market conditions on educational and skill mismatches at work. Finally, we investigate how much educational mismatch and job instability can account for the earnings reduction due to graduating in a bad economy.

Before reporting the estimation results, I briefly discuss the instrument relevance condition. The first stage regression results of the two-stage least squares for the sample of workers are shown in Table 2. Column (1) presents the effects of the unemployment rate at expected university graduation in the province of residence at age 14 and its interaction with potential experience on the actual regional unemployment rate at graduation. It shows that the predicted regional unemployment rate (instrument) and the actual regional unemployment rate (endogenous variable) are strongly related. Column (2) reports the estimated effects of the instruments on the interaction between the actual regional unemployment rate and potential experience. It also shows strong correlations between the instruments and the endogenous variable. The Kleibergen-Paap rk Wald F statistic is 52.55, which is sufficiently higher than its critical value of 16.38. The first stage estimation results in Table 2 clearly show that our instruments are sufficiently strong.

5.1 Earnings, employment, and job mobility

Panel (a) of Table 3 presents OLS and IV estimates of the initial effect of the regional unemployment rate at graduation on log real monthly earnings and the coefficient on the interaction between the regional unemployment rate and potential experience. The OLS estimation result in column (1) shows that a 1% point increase in the unemployment rate at graduation reduces the initial monthly earnings by 0.48%. The estimated coefficient on the interaction is 0.34, which means that the earnings penalty decreases

by 0.34% points each year. The IV estimation results are presented in columns (2)–(5). Column (2) presents the result from the baseline model. Column (3) shows the result from a model that additionally controls the unemployment rate in the province where high school is located at high school graduation and the unemployment rate in the province where university is located at university entrance to the baseline model. The reason for controlling these variables is to examine whether the instrument, the regional unemployment rate at age 14, affects the labor market outcomes through paths other than its effect on the unemployment rate at university graduation. We consider the possibility for regional economic conditions at high school graduation and university entry, which is likely to be correlated with regional economic conditions at age 14, to affect students' learning, experiences, and other choices that can affect future labor market outcomes. We additionally control for 11 occupation dummies and 21 industry dummies in column (4). The result in column (5) is from the estimation of a model that additionally controls for linear cohort trends for the province of residence at age 14. These are controlled by taking into account the possibility that cohort trends in students' skills formed before the labor market entry could vary by region.

The IV estimation result from the baseline model shows that a 1% point increase in the unemployment rate at graduation decreases the initial monthly earnings by 8.77%, and the estimate is statistically significant at 1%[3]. The estimated coefficient on the interaction term is 0.0048, which means that the initial earnings loss annually decreases by 0.48% points. The wage penalty of graduating in a bad economy is persistent for a considerable period. These estimates imply that it takes 18 years for the earnings penalty to completely disappear. The IV estimation results are quite robust to different specifications.

Panel (b) of Table 3 shows the gendered effect of graduating from university during a bad time from the estimation of Eq. (2). The estimation results commonly show that the negative effect of the economic situation at the time of university graduation on earnings is greater for men than for women in the early stages of labor market entry. The OLS estimation result shows that a 1% point increase in the unemployment rate at university graduation reduces the initial monthly earnings by 2.48% for men. The estimated effect is not statistically significant for women. The IV estimation result of the baseline model shows that male university graduates have 11.59% lower earnings at labor market entry as the local unemployment rate increases by a 1% point and the loss decreases by 0.69% points annually. On the other hand, the initial earnings loss is 6.87% and it disappears by 0.33% points each year for women. If the labor demand in jobs where men are mainly employed is more sensitive to economic fluctuations, the initial earnings loss can be greater for men, but it can disappear more quickly as the economy recovers.

The estimation results in Table 3 consistently show that the magnitude of the IV estimates is significantly greater than that of the corresponding OLS estimates. We can consider the following as possible causes of it. First, university students endogenously determine their timing of graduation. As explained before, about 50% of university

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[3] Among the control variables, the province of current residence and the regional unemployment rate in the survey year are determined after university graduation. When the fixed effects of the province of current residence are not controlled for, the IV estimate is -0.0835 (SE: 0.080). When the regional unemployment rate in the survey year is not controlled for, the IV estimate is -0.0886 (SE: 0.0275).

Table 3 OLS and IV estimates of the impact of the regional unemployment rate at university graduation on log monthly earnings

	(1)OLS	(2)IV	(3)IV	(4)IV	(5)IV
(a)All					
UR	−0.0048	−0.0877***	−0.0874***	−0.0715**	−0.1177***
	(0.0049)	(0.0276)	(0.0276)	(0.0300)	(0.0316)
UR×Exp	0.0034**	0.0048**	0.0047**	0.0029*	0.0019
	(0.0012)	(0.0019)	(0.0019)	(0.0017)	(0.0016)
(b)Gender					
Male×UR	−0.0248***	−0.1159***	−0.1135***	−0.1022***	−0.1682***
	(0.0073)	(0.0388)	(0.0380)	(0.0362)	(0.0389)
Male×UR×Exp	0.0053***	0.0069***	0.0067***	0.0050***	0.0031**
	(0.0013)	(0.0019)	(0.0018)	(0.0017)	(0.0015)
Female×UR	0.0112	−0.0687**	−0.0696**	−0.0519	−0.0923***
	(0.0082)	(0.0325)	(0.0331)	(0.0343)	(0.0354)
Female×UR×Exp	0.0021	0.0033	0.0032	0.0016	−0.0005
	(0.0012)	(0.0021)	(0.0021)	(0.0019)	(0.0014)
UR1 (high school)	N	N	Y	N	N
UR2 (university)	N	N	Y	N	N
Occup. & Indus.	N	N	N	Y	N
Cohort trends	N	N	N	N	Y
Observations	16,877	16,877	16,877	16,877	16,877

***$p < 0:01$, **$p < 0.05$, *$p < 0.1$

Standard errors are clustered by expected graduation year

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of residence at age 14, the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors.

The unemployment rate at high school graduation in the province where the high school is located and the unemployment rate at university entry in the province where the university is located are additionally controlled in column (3). 11 occupations and 21 industry dummies are additionally controlled in column (4). Linear cohort trends for the province of residence at age 14 are controlled in column (5)

students postpone graduation in South Korea. The IV estimate may be greater than the OLS estimate if students with lower grades or fewer skills have more difficulty finding a job during a recession and are more likely to delay graduation as a result. It is also possible that the selection of the province where the university is located is also determined endogenously at the time of university entry. If students with more informed and supportive parents enter universities in areas with good prospects by parental advice and there is a serial correlation between unemployment rates, this may also lead to the downward bias in the OLS estimate. Finally, as Kahn (2010) pointed out, if there are measurement errors in variables of university location and graduation time, the OLS estimate can be downward biased.

Log monthly earnings

Fig. 1 Dynamic impacts of the regional unemployment rate at university graduation on monthly earnings: each dot presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Vertical bands show 95% confidence intervals

Figure 1 illustrates the dynamic impacts of graduating in a depressed economy. It presents the IV estimates of coefficients on interactions between the regional unemployment rate at graduation and potential experience. The effect of graduating in a bad economy remains barely changed for 5 y after entering the labor market, and the effect gradually decreases thereafter. The earnings loss due to graduating from university during a recession completely disappears 13 y after the labor market entry. Figure 2 shows the dynamic impacts of graduating from university during a recession on earnings by gender. In the early stages of labor market entry, men's earnings losses are greater than women's. While men's earnings losses recover more quickly, their earnings losses are larger than women's earnings losses for 10 y after labor market entry.

Table 4 shows the IV estimates of the impact of the regional unemployment rate at graduation and its interactive effect with potential experience on log hourly wage, log working hours, employment, job change, and job tenure. For all workers in Panel (a), the regional unemployment rate at graduation is negatively associated with the labor market outcomes at labor market entry. Only the estimated effect on log working hours, however, is statistically significant. In terms of the magnitude of the effects, the hourly wage and work hours decrease by 4.6% and 4.17%, respectively, as the local unemployment rate at university graduation increases by a 1% point. Worse labor market conditions at university graduation reduce employment, job mobility, and job tenure in the early stages of labor market entry. The estimates for the coefficient

Log monthly earnings

Fig. 2 Dynamic impacts of the regional unemployment rate at university graduation on monthly earnings by gender: each dot presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience for each gender

on the interaction of the unemployment rate with experience show that the negative relationships decrease over time, but the estimates are not statistically significant. Panel (b) shows the gendered impacts on the labor market outcomes. Graduating from university during a bad time significantly decreases the log hourly wage for men and the log work hours for women in the early stages of labor market entry.

Figure 3 describes the dynamic impacts of graduating from university during a recession on log hourly wage, log work hours, employment, job mobility, and job tenure. Panels (a) and (b) show that wage losses gradually recover over time, while the reduction in working hours remains barely changed without significant changes for more than 10 years after labor market entry. Panel (c) shows that people who graduate from university during a bad time have a lower probability of being employed during the first two years of entry into the labor market[4]. Panel (d) presents that job mobility

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[4] As labor market conditions at university graduation affect the employment probability after graduation, the composition of workers can also varies depending on the labor market conditions. The effect of the unemployment rate at university graduation on earnings may reflects the composition effect. Although the composition effect may have a partial effect, we believe that it does not fully account for the effect on earnings. While the initial earnings penalty for the unlucky cohort may be explained by selectively delaying graduation by those who want to work in high-paying jobs, the persistence of the earnings penalty seems difficult to be explained: this is because, if people who want to work in high-paying jobs belonging to the unlucky cohort find the job within a few years, the earnings penalty should be completely eliminated from then after controlling for experience and job tenure. In addition, the employment rate of unlucky cohorts was significantly lower in the first two years after labor market entry, but there was no significant difference thereafter.

Table 4 IV estimates of the impacts of the regional unemployment rate at university graduation on other labor market outcomes

	(1)Log hourly Wage	(2)Log work Hours	(3)Employed	(4)Job Change	(5)Job Tenure
(a) All					
UR	−0.0460	−0.0417***	−0.0193	−0.0360	−3.123
	(0.0338)	(0.0157)	(0.0549)	(0.0431)	(3.368)
UR×Exp.	0.0045*	0.0003	0.0013	0.0038	0.3834
	(0.0023)	(0.0014)	(0.0031)	(0.0029)	(0.2810)
(b) Gender					
Male×UR	−0.0929**	−0.0230	−0.0475	−0.0077	−2.3384
	(0.0373)	(0.0221)	(0.0587)	(0.0412)	(3.5257)
Male×UR×Exp.	0.0063***	0.0006	0.0074**	0.0041	0.5661*
	(0.0022)	(0.0017)	(0.0035)	(0.0029)	(0.3148)
Female×UR	−0.0192	−0.0495**	0.0006	−0.0478	−2.9987
	(0.0408)	(0.0196)	(0.0574)	(0.0433)	(3.4225)
Female×UR×Exp.	0.0036	−0.0003	−0.0025	0.0031	0.2102
	(0.0024)	(0.0013)	(0.0034)	(0.0029)	(0.2771)
Observations	16,877	16,877	26,231	16,396	16,877

1. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. 2. Standard errors are clustered by expected graduation year. 3. Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of residence at age 14, the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors. 4.

is lower for the first three years after labor market entry, which would reflect worse labor market conditions in the early stages of labor market entry. Panel (e) shows that the job tenure of workers in unlucky cohorts tends to be lower in the early stages of labor market entry.

5.2 Skill mismatch and job instability

Workers who graduate from university in a bad economy may have fewer opportunities to work in jobs where skills they have are fully utilized. It is also more difficult for them to find a stable job. If these happen in the labor market during a recession, the skill mismatch and job instability could be mechanisms through which graduating from university in a bad economy leads to the poor labor market performance of workers in unlucky cohorts. As explained in Section 4, the YP2007 has asked workers about the level of education that is required to do their task and whether they are temporary workers or permanent workers. This provides us an opportunity to investigate the impacts of labor market entry conditions on educational mismatches and job instability.

Table 5 shows the IV estimation results. Column (1) of Panel (a) provides the estimation result for the educational mismatch for all workers. It shows that a 1% point
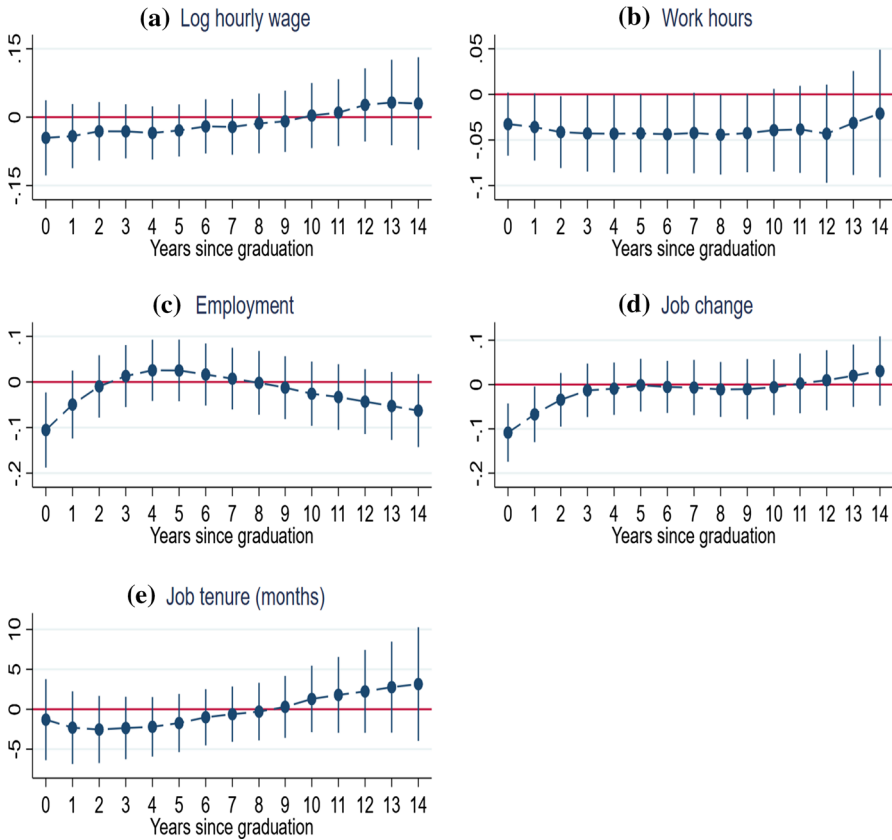
Fig. 3 Dynamic Impacts of the Regional Unemployment Rate at University Graduation on Labor Market Outcomes: **a** log hourly wage, **b** log work hours, **c** employment, **d** job change, **e** job tenure. Each dot in the figures presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Vertical bands show 95% confidence intervals

increase in the regional unemployment rate at graduation increases the probability that the level of education which is required for work in the first year of labor market entry is below university by 7.58% points, and the estimate is statistically significant at the 10% level. The estimate for the interaction between the regional unemployment rate and potential experience is −0.0014, which means that the probability of educational mismatch decreases by 0.14% points each year. Thus, these results show that when workers who graduated university in a bad economy are more likely to do work that is lower than his or her education level, and this educational mismatch is persistent. Figure 4 shows the dynamic impacts of graduating in a bad economy on educational mismatch nonparametrically. As with the estimation results in the table, it shows that there is a high level of educational mismatch at the beginning of the labor market entry and that the mismatch is maintained for about 10 years without major changes.

Column (2) of Panel (a) presents the impact of labor market entry conditions on being a temporary worker among employees (temporary worker: 1, permanent worker:

Table 5 IV estimates of the impacts of the regional unemployment rate at university graduation on educational mismatch and job instability

	(1) Educational mismatch	(2) Temporary job
(a) All		
UR	0.0758*	0.0854**
	(0.0417)	(0.0375)
UR×Exp	−0.0014	−0.0046*
	(0.0022)	(0.0027)
(b) Gender		
Male×UR	0.0447	0.0648
	(0.0435)	(0.0446)
Male×UR×Exp	−0.0001	−0.0038
	(0.0022)	(0.0027)
Female×UR	0.0940**	0.0941**
	(0.0414)	(0.0385)
Female×UR×Exp	−0.0022	−0.0049
	(0.0021)	(0.0030)
Observations	16,877	10,645

*** $p < 0 : 01$, ** $p < 0.05$, * $p < 0.1$

Standard errors are clustered by expected graduation year

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of residence at age 14, the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors

0). As explained, a temporary worker is defined by an employee who is supposed to leave his or her employer within a certain period. It generally refers to workers on short-term contracts, daily workers, and indirectly employed workers. Therefore, whether or not a worker's job is temporary work shows the instability of a worker's job well. The IV estimation result shows that a 1% point increase in the regional unemployment rate at graduation increases the probability of being a temporary at labor market entry by 8.54% points, and the estimate is statistically significant at 5%. The estimate for the interaction between the regional unemployment rate and potential experience is −0.0046, which means the impact decreases by 0.46% points each year. Figure 5 presents nonparametric estimates of the dynamic impacts of initial labor market conditions on being a temporary worker. Like the estimates shown in the table, the probability of being a temporary worker is greatest at labor market entry and then gradually decreases.

Panel (b) of Table 5 shows the gendered impacts of graduating from university during a recession on educational mismatch and job instability. The impacts are greater for female workers than for male workers. A 1% point increase in the local unemployment rate at university graduation increases the probabilities of having the educational mismatch and a temporary job at labor market entry by 4.47 and 6.48% points for male workers, respectively. They are not statistically significant. The corresponding esti-
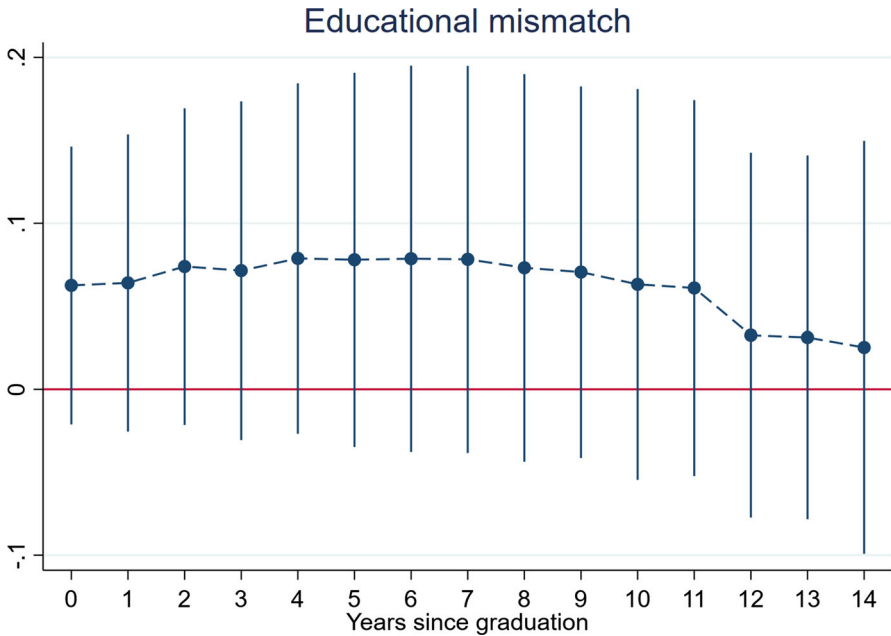
Educational mismatch

Fig. 4 Dynamic Impacts of the Regional Unemployment Rate at University Graduation on the Probability that the Level of Education Required for Work Is Less Than the University Level: Each dot presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Vertical bands show 95% confidence intervals

mates are 9.4 and 9.41% points for female workers and they are statistically significant at 5%.

5.3 How much of the earnings reduction is accounted for by educational mismatch and job instability?

Skill mismatch and job instability have been pointed out as factors that contribute to the worse labor market performance of university students graduating in a bad economy. We quantitatively investigate how much of the earnings reduction due to graduating from university in a bad economy can be accounted for by educational mismatch and job instability. In principle, we can accomplish the goal by estimating a model that additionally controls for educational mismatch and job instability. As educational mismatch and job instability are endogenous, however, we need to have separate instruments for them. In a situation where we do not have such instruments, we conduct a bounding analysis following Becker and Woessmann (2009). In the analysis, we use log monthly earnings net of the educational mismatch or job instability effect as an outcome variable:

$$Y_{it} - \bar{\phi} W_{it} = \tau_0 + \tau_1 U R_{s(i)c(i)} + \tau_2 U R_{s(i)c(i)} \text{Exp}_{it} + X_{it} \tau_3 + \lambda_{s(i)} + \mu_{b(i)} + \xi_t + \epsilon_{it} \quad (4)$$
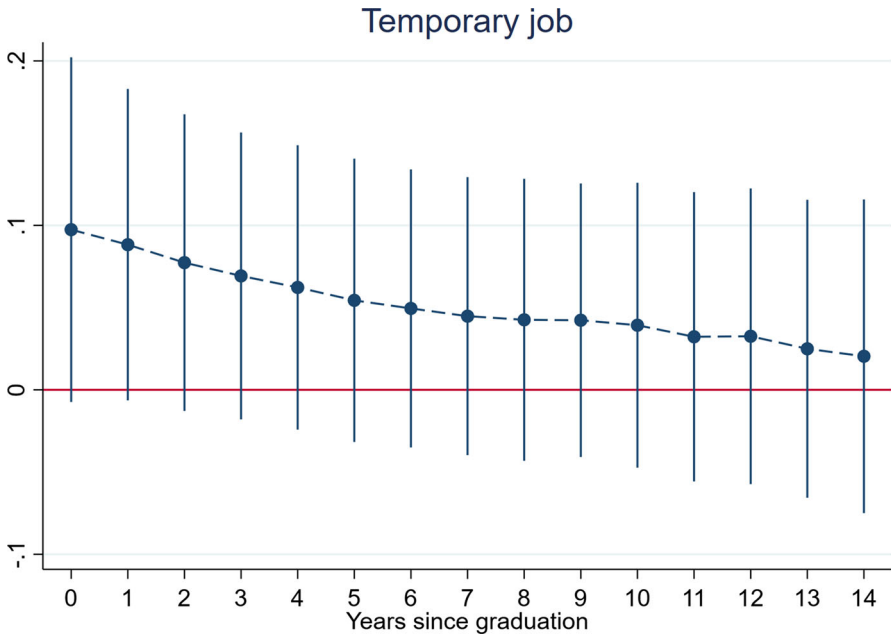
Fig. 5 Dynamic Impacts of the Regional Unemployment Rate at University Graduation on the Probability of Being a Temporary Worker: Each dot presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Vertical bands show 95% confidence intervals

where W_{it} is a mediation variable representing for educational mismatch or job instability. Other variables are equal to those in equation (1).

We first estimate the effects of educational mismatch and job instability on log monthly earnings through the OLS estimation. Other control variables in the regression are equal to those in Eq. (1). As the OLS estimates are not consistent estimates of the causal effects of educational mismatch and job instability, we estimate Eq. (4) using the method of instrumental variables by varying $\bar{\phi}$ from the OLS estimate and examine how the estimated effect of the regional unemployment rate on earnings changes as $\bar{\phi}$ varies. We perform the above process separately for each mediation variable.

Panel (a) of Table 6 reports the results of the bounding analysis in which educational mismatch is considered a mediation variable through which labor market conditions at university graduation affect the earnings dynamics for the entire sample. The OLS estimate for the effect of education mismatch on log monthly earnings is −0.1579 (SE: 0.0062). Assuming that the OLS estimate is the causal effect of educational mismatch on log monthly earnings, the magnitude of the negative impact of the regional unemployment rate at graduation on the initial monthly earnings decreases by 1.2% points from 8.77 to 7.57%, which is a 13.7% reduction, when the educational mismatch is accounted for (column 4). If we assume that the causal of educational mismatch is 20% below the OLS estimate, the magnitude of the negative impact of the regional unemployment rate at graduation decreases by 0.96% points, which is a 10.9% reduction (column 2). As the negative effect of educational mismatch addi-

Table 6 IV estimates of the impact of the regional unemployment rate at university graduation on log monthly earnings after accounting for educational mismatch: bounding analysis

	(1) Not Adjusted	(2) 20% Below	(3) 40% Below	(4) OLS Estimate	(5) 20% Above	(6) 40% Above
(a) All						
UR	−0.0877***	−0.0781***	−0.0805***	−0.0757***	−0.0733***	−0.0709***
	(0.0276)	(0.0259)	(0.0262)	(0.0256)	(0.0253)	(0.0252)
UR×Exp	0.0048**	0.0046**	0.0047**	0.0046**	0.0045**	0.0045**
	(0.0019)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
(b) Gender						
Male×UR	−0.1159***	−0.1103***	−0.1117***	−0.1088***	−0.1074***	−0.1060***
	(0.0388)	(0.0381)	(0.0382)	(0.0381)	(0.0381)	(0.0382)
Male×UR×Exp	0.0069***	0.0069***	0.0069***	0.0069***	0.0069***	0.0069***
	(0.0019)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Female×UR	−0.0687**	−0.0569*	−0.0598*	−0.0539*	−0.0509*	−0.0479*
	(0.0325)	(0.0301)	(0.0307)	(0.0297)	(0.0293)	(0.0289)
Female×UR×Exp	0.0033	0.0030	0.0031	0.0029	0.0029	0.0028
	(0.0021)	(0.0020)	(0.0021)	(0.0020)	(0.0020)	(0.0020)
Observations	16,877	16,877	16,877	16,877	16,877	16,877

*** $p < 0:01$, ** $p < 0.05$, * $p < 0.1$

Standard errors are clustered by expected graduation year

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors. The effect of educational mismatch on log monthly earnings is achieved from the OLS estimation controlling for the above common regressors. Column (1) reports the IV estimate that educational mismatch is not accounted for. Columns (2)–(6) show the IV estimates that educational mismatch is accounted for, assuming that the causal effect of educational mismatch is 80%, 60%, 100%, 120%, 140% of the OLS estimate, respectively

tionally decreases (increases) by 20% of the OLS estimate, the IV estimate further decreases (increases) by 0.24% points. On the other hand, the estimated coefficient on the interaction between the unemployment rate and experience does not significantly change.

For the analysis by gender in Panel (b), the magnitude of the negative initial impact of graduating from university during a recession decreases by 0.022% points (13.42% reduction) from 16.32% to 14.13% for men when the educational mismatch is accounted for. The decrease is 1.57% points (22.56% reduction) for women. As the increase in the probability of having an educational mismatch due to bad economic conditions at university graduation is greater for women than for men, educational mismatch accounts for a larger share of the initial earnings losses for women. As the effect of educational mismatch additionally decreases (increases) by 20% of the OLS estimate, the IV estimate decreases (increases) by 0.14% points for men and 0.29% points for women.

We also investigate how much job instability can account for the earnings loss and the results of the bounding analysis are reported in Table 7. As explained in Sect. 4, the sample used in the analysis in Table 7 is different from that in Table 6 because the survey on temporary work has been conducted only since the 7th survey. The OLS estimate for the effect of job instability on log monthly earnings is −0.3388 (SE: 0.0245). Panel (a) of Table 7 shows the results for the entire sample. Assuming that the OLS estimate is the causal effect of job instability on log monthly earnings, the magnitude of the negative effect of the unemployment at graduation on the initial monthly earnings decreases from 11.34 to 8.44% (25.6% reduction) when the job instability impact is accounted for (column 4). If the causal effect of job instability is 40% below the OLS estimate, the IV estimate is −0.096 (column 3). Its magnitude is 13.4% smaller than the estimate that job instability is not accounted for. As the effect of job instability additionally decreases (increases) by 20% of the OLS estimate, the IV estimate decreases (increases) by 0.58% points.

Panel (b) of Table 7 reports the results by gender. Assuming that the OLS estimate is the causal effect of job instability, the initial impact of graduating from university during a recession decreases by 0.0219 (13.42% reduction) from −0.1632 to −0.1413 for male workers. The impact decreases by 0.0319 (36.67% reduction) for female workers. Job instability also accounts for a larger share of the initial earnings losses for female workers. As the effect of job instability decreases (increases) by 20% of the OLS estimate, the IV estimate decreases (increases) by 0.0044 for men and 0.0064 for women.

Table 8 reports the results of the bounding analysis where both educational mismatch and job instability are accounted for. Panel (a) of Table 8 shows that the magnitude of the effect of the regional unemployment rate at university graduation on log initial monthly earnings decreases by 0.0464 (40.92% reduction) for the entire sample when the OLS estimates are assumed to be the causal effects of educational mismatch and job instability. As the effect of job instability additionally decreases (increases) by 20% of the OLS estimate, the IV estimate decreases (increases) by 0.0093. Panel (b) of Table 8 shows that the initial effect of the regional unemployment at university graduation decreases by 0.0356 (21.81% reduction) for male workers and 0.0460 (52.87% reduction) for female workers. As the effects of educational mismatch

Table 7 IV estimates of the impact of the regional unemployment rate at university graduation on log monthly earnings after accounting for job Instability: bounding analysis

	(1) Not Adjusted	(2) 20% Below	(3) 40% Below	(4) OLS Estimate	(5) 20% Above	(6) 40% Above
(a) All						
UR	−0.1134***	−0.0902***	−0.0960***	−0.0844***	−0.0786**	−0.0729**
	(0.0398)	(0.0348)	(0.0359)	(0.0340)	(0.0333)	(0.0327)
UR×Exp	0.0070***	0.0057**	0.0060**	0.0054**	0.0051**	0.0048*
	(0.0027)	(0.0025)	(0.0026)	(0.0025)	(0.0025)	(0.0026)
(b) Gender						
Male×UR	−0.1632***	−0.1457***	−0.1501***	−0.1413***	−0.1369***	−0.1325***
	(0.0526)	(0.0499)	(0.0503)	(0.0497)	(0.0496)	(0.0497)
Male×UR×Exp	0.0098***	0.0088***	0.0090***	0.0085***	0.0082***	0.0080***
	(0.0027)	(0.0027)	(0.0027)	(0.0027)	(0.0027)	(0.0028)
Female×UR	−0.0870**	−0.0614*	−0.0678*	−0.0551	−0.0487	−0.0423
	(0.0407)	(0.0362)	(0.0371)	(0.0355)	(0.0350)	(0.0346)
Female×UR×Exp	0.0053*	0.0040	0.0043	0.0036	0.0033	0.0030
	(0.0031)	(0.0029)	(0.0029)	(0.0029)	(0.0029)	(0.0029)
Observations	10,645	10,645	10,645	10,645	10,645	10,645

*** $p < 0 : 01$, ** $p < 0.05$, * $p < 0.1$.

Standard errors are clustered by expected graduation year.

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of residence at age 14, the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors. The effect of job instability on log monthly earnings is achieved from the OLS estimation controlling for the above common regressors. Column (1) reports the IV estimate that job instability is not accounted for. Columns (2)–(6) show the IV estimates that job instability is accounted for, assuming that the causal effect of job instability is 80%, 60%, 100%, 120%, 140% of the OLS estimate, respectively

Table 8 IV estimates of the impact of the regional unemployment rate at university graduation on log monthly earnings after accounting for educational mismatch and job instability: bounding analysis

	(1) Not Adjusted	(2) 20% Below	(3) 40% Below	(4) OLS Estimate	(5) 20% Above	(6) 40% Above
(a) All						
UR	−0.1134****	−0.0763**	−0.0856**	−0.0670**	−0.0578*	−0.0485*
	(0.0398)	(0.0327)	(0.0343)	(0.0312)	(0.0298)	(0.0285)
UR×Exp	0.0070***	0.0055**	0.0059**	0.0052**	0.0048*	0.0045*
	(0.0027)	(0.0025)	(0.0026)	(0.0025)	(0.0025)	(0.0026)
(b) Gender						
Male×UR	−0.1632****	−0.1347***	−0.1419***	−0.1276***	−0.1205***	−0.1134***
	(0.0526)	(0.0464)	(0.0478)	(0.0452)	(0.0441)	(0.0433)
Male×UR×Exp	0.0098***	0.0087***	0.0090***	0.0085***	0.0082***	0.0079***
	(0.0027)	(0.0026)	(0.0026)	(0.0026)	(0.0026)	(0.0027)
Female×UR	−0.0870**	−0.0462	−0.0564	−0.0360	−0.0258	−0.0156
	(0.0407)	(0.0340)	(0.0355)	(0.0325)	(0.0312)	(0.0301)
Female×UR×Exp	0.0053*	0.0037	0.0041	0.0034	0.0030	0.0026
	(0.0031)	(0.0028)	(0.0029)	(0.0028)	(0.0028)	(0.0028)
Observations	10,645	10,645	10,645	10,645	10,645	10,645

*** $p < 0:01$, ** $p < 0.05$, * $p < 0.1$

Standard errors are clustered by expected graduation year

Gender, the unemployment rate in the province of current residence in t, parents' education dummies, the numbers of brothers and sisters, dummies of parents' occupation at age 14, experience squared, dummies of the province of current residence, mandatory military service dummy, dummies of housing type at age 14, dummies of expected graduation year, dummies of the province where the university is located, and dummies of survey year are commonly controlled as regressors. The effects of educational mismatch and job instability on log monthly earnings are achieved from the OLS estimations controlling for the above common regressors. Column (1) reports the IV estimate that educational mismatch and job instability are not accounted for. Columns (2)–(6) show the IV estimates that educational mismatch and job instability are accounted for, assuming that the causal effects of educational mismatch and job instability are 80%, 60%, 100%, 120%, 140% of the OLS estimates, respectively
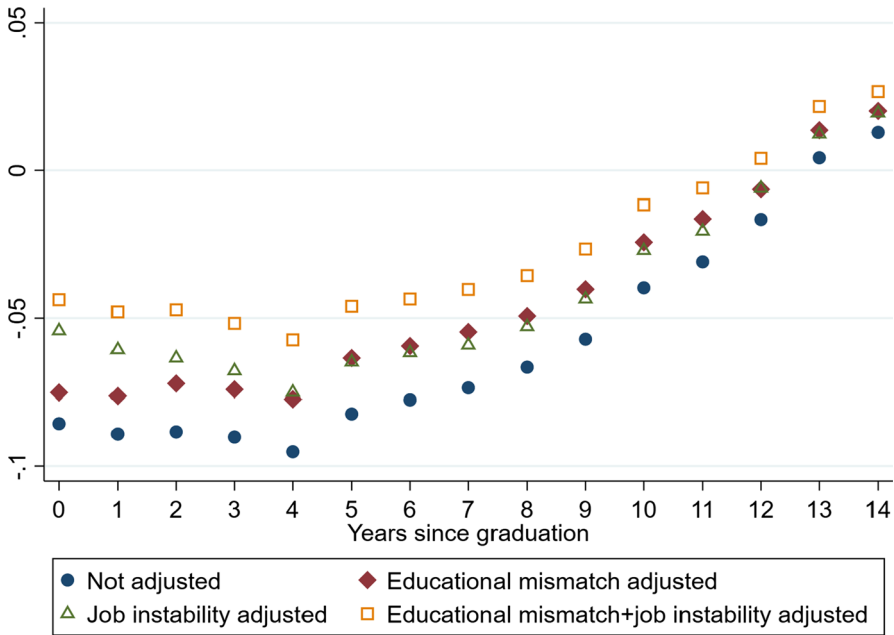
Fig. 6 Dynamic Impacts of the Regional Unemployment Rate at University Graduation on Log Monthly Earnings According to Whether Education Mismatch or Job Instability Are Accounted For: Each dot in the figure presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Round dots present estimates from the regression that education mismatch and job instability are not accounted for, and the diamond and triangle dots present estimates from the regression that educational mismatch and job instability are accounted for, respectively. The square dots present estimates when both educational mismatch and job instability are accounted for. The estimates are from the IV estimation of equation (4), assuming that the effects of educational mismatch and job instability on log monthly earnings are equal to the OLS estimates

and job instability decrease (increase) by 20% of the OLS estimates, the IV estimate decreases (increases) by 0.0072 for men and 0.0102 for women.[5]

Figure 6 compares the dynamic impacts of the regional unemployment rate at graduation on log monthly earnings according to whether educational mismatch or job instability are accounted for. The results are from the estimation of the following equation:

$$Y_{it} - \bar{\phi} W_{it} = \alpha + \sum_{j=0}^{14} \gamma_j U R_{s(i)c(i)} I(Exp_{it} = j) + X_i \delta + \lambda_{s(i)} + \mu_{b(i)} + \xi_t + \epsilon_{it} \quad (5)$$

---

[5] A job with skill mismatch is more likely to be unstable than a job without skill mismatch, and the level of education required for a temporary job may not be high, so skill mismatch is more likely to occur in temporary jobs. If this is true, the portions where the two variables account for the earnings loss could overlap. Assuming that the OLS estimates are the causal effects of job instability and educational mismatch, job instability alone accounts for 25.51% of the earnings loss, and educational mismatch alone accounts for 15.3%. The sum of the respective effects is 40.81%, which is not much different from the share (40.87%) that is accounted for when both variables are controlled. Educational mismatch and job instability each appear to independently account for a significant share of the earnings loss.
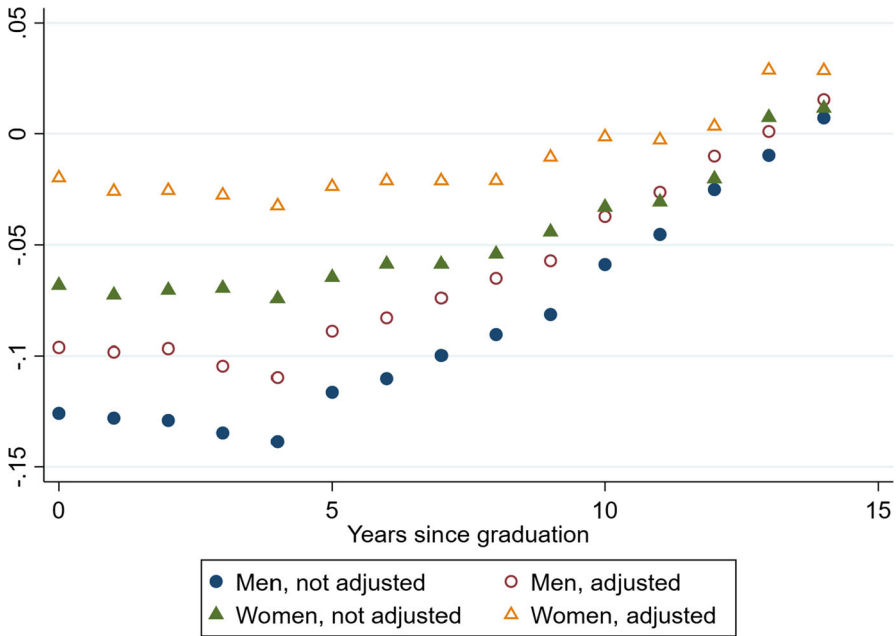
Fig. 7 Dynamic Impacts of the Regional Unemployment Rate at University Graduation on Log Monthly Earnings by Gender According to Whether Education Mismatch and Job Instability Are Accounted For: Each dot in the figure presents the estimated coefficient of interaction between the regional unemployment rate at university graduation and expected experience. Round dots and triangle dots present the impacts for men and women, respectively. Empty round and triangle dots present the impacts that education mismatch and job instability are accounted for. The effects of educational mismatch and job instability are assumed to be equal to the OLS estimates

In the above equation, the outcome variable is the log monthly earnings net of the educational mismatch effect or the job instability effect. The OLS estimates are used as the values of $\bar{\phi}$ in the IV estimations.

The rounded dots represent the dynamic effects of the regional unemployment rate on log monthly earnings when the skill mismatch and job instability variables are not accounted for. The diamond and triangular dots represent the dynamic effects when the educational mismatch and job instability variables are accounted for, respectively. The square dots show the dynamic effects when both educational mismatch and job instability variables are accounted for. Early in the career, job instability accounts for a larger part of the earnings loss than the educational mismatch. After the early years of a career, however, educational mismatch accounts for a slightly larger portion of the earnings loss than job instability. Figure 6 clearly shows that the earnings reduction due to graduating in a bad economy would have been significantly less if there were no educational mismatch and job instability.

Figure 7 shows the dynamic changes in the impact of the regional unemployment rate at university graduation by gender according to whether both educational mismatch and job instability are accounted for. While educational mismatch and job instability account for a large portion of the earnings loss for both men and women,

they account for a larger share of the loss for women than for men, which is consistent with the results in Panel (b) of Table 8.

6 Discussion and conclusion

This study investigates the impacts of labor market entry conditions on labor market outcomes. Our main finding shows that a 1% point increase in the local unemployment rate at graduation decreases the initial monthly earnings by 8.77%. The effect annually decreases by 0.48% points, which implies that the initial earnings loss is persistent for a considerable period. Our investigation of the gendered impact of graduating from university in a recession shows that the initial impact is −11.59% for men and −6.87% for women. The greater impact for men than for women is also found in other studies (Choi et al. 2020; Schwandt and Wachter 2019). The estimated effect of initial economic conditions on earnings or wages in our study is greater than that in other studies (Brunner and Kuhn 2014; Liu et al. 2016; Oreopoulos et al. 2012; Schwandt and Wachter 2019). Our estimated initial impact on wages for men (-9.29%) is comparable to the estimated effect for white men in Kahn (2010), which is -9.1% from the IV estimation using state unemployment rates. In our study, however, the initial wage loss for men recovers by 0.063% points every year, which shows a significant difference from Kahn (2010) where the earnings loss hardly changes over time.

It is difficult to ascertain the exact cause for the greater effect in South Korea because there are large differences in labor market institutions and conditions by country. Some studies argue that the volatility of the unemployment rate is not large in South Korea (Moon 2009). After the East Asian economic crisis of 1997–98, which is considered one of the most serious economic crises in the history of the Korean economy, economic indicators including the unemployment rate may have been less volatile than those of other countries. For example, for 21 y from 2000 to 2020, the mean unemployment rate in Korea was 3.6% and the standard deviation is 0.314, while the mean unemployment rate in the United States is 5.89% and the standard deviation is 1.822. This may be a result of the relatively low volatility of the economy or the unemployment rate not sufficiently reflecting the volatility of the economy. South Korea is also evaluated to have suffered less damage than other countries in the Great Recession and to overcome the crisis quickly. Between 2008 and 2009, the unemployment rate increased from 3.2 to 3.6% in South Korea, less volatile than that in the United States during the Great Recession, which rose from 5.8 to 9.3%. If a change in the unemployment rate of the same magnitude implies a larger-scale economic fluctuation in South Korea, the effect of the change in the unemployment rate of the same magnitude can be greater.

Another important finding of our study is that skill mismatch and job instability are important mechanisms by which initial labor market conditions have negative impacts on labor market outcomes. Previous research points out that an important source of earnings loss for college graduates due to graduating during a recession is the decline in employer quality, and the recovery of earnings arises from moving to better employers (Oreopoulos et al. 2012; Brunner and Kuhn 2014). Our study explains to some extent what specifically the poor quality of employers means. Our study shows that skill

mismatch and job instability account for 40.9% of the initial earnings loss when their causal effects on earnings are assumed to be estimated by the OLS estimation, and it will be a task for future research to identify factors that can explain the remaining unexplained parts.

This study also has important policy implications. Policies that support students graduating from university during a recession may be required considering the persistent impacts of entering the labor market in a recession. Currently, there are several employment promotion policies in Korea, most of which are aimed at helping already employed workers to maintain their job during poor economic conditions. The government policies that subsidize firms that maintain youth employment during a recession can be considered. Considering that young peoples' job search activities can be weakened during a recession because of the difficulty of finding a job and job mobility is an important pathway through which the earnings loss recovers (Oreopoulos et al. 2012), the government can run programs that support job search activities and connect students with jobs that match their skill and educational level. Finally, universities may also need to strengthen employment support programs for students, especially during recessions, and constantly provide education reflecting market demands so that students can acquire skills required in the market.

Data and code availability The data and STATA codes used in the analysis are available upon request.

Declarations

Conflict of interest The authors declare that we have no conflict of interest. All results in this paper are from authors' independent research.

Ethical approval This article does not contain any studies with human participants performed by any of the authors.

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