Effect of College Major on Earnings and Gender Gap in Labor Markets: Evidence from Young Adults in South Korea

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Research Questions

- To what extent does college major affect labor market outcomes in young Koreans?
- Do girls choose college majors differently from boys and if so to what extent does that difference account for the gender gap in labor market outcomes?

Motivation

- General
  - Important implications for labor market outcomes
  - Substantial gender gap in major choice
  - e.g., Hamermesh and Donald, 2008, Altonji et al., 2012, and Goldin, 2014

Motivation

- South Korea
  - College major quota:

    - Heavily regulated by Ministry of Education

    - Potential policy instrument
  - College major matters in employment:

    - "Engineering" rules!: article by a former human resources officer, popular in SNS and cited in major news media (e.g., Chosun-ilbo, March 15, 2014)

Motivation

- South Korea
  - Need for efficient human capital investment (college major):
    - Aging population
    - Low employment among young adults and women
  - Large gender gap in labor market outcomes:
    - Earnings: worst among the OECD countries (37% in 2012)
    - Female labor force participation rate: bottom among OECD

Data

- Sample
  - Graduates Occupational Mobility Survey (GOMS)
  - 4-year college graduates in Korea (2004-2008 cohorts)
  - Labor market outcomes 1 year and 3 years after graduation

Empirical Framework

- Identification assumption
  - No unobservable heterogeneity conditional on CSAT scores and other observables.
  - Reasonable in the Korean setting given limited knowledge of college majors

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- Framework

  Person i who majored in j, graduated from a college in year c, lives in location l and was surveyed in round r

  - Log monthly earnings: Mincerian

$$Y_{ijclr} = \alpha_r female + \beta_r CSAT + X_{ir}'\lambda_r + \phi_{j,r} + \varphi_{c,r} + \theta_{l,r}\epsilon_{igcst}$$

  - Employment, having a regular position ...: probit specification

Summary Statistics

- College major: 7 groups
- Substantial gender difference

	Initial	
	Male	Female
No. of obs.	22,953	18,305
Age	27.96	25.62
Married (%)	10.75	7.25
College major (%)		
- Humanities	9.21	18.96
- Social Science	22.85	22.81
- Education	4.86	14.02
- Engineering	39.91	10.12
- Natural Science/Mathematics	13.28	16.32
- Medicine/Public Health	3.18	5.12
- Arts/Athletics	6.73	12.65

Summary Statistics

- College major: 7 groups
- Substantial gender difference
- Stable between initial and follow-up surveys

	Initial		Follow-up	
	Male	Female	Male	Female
No. of obs.	22,953	18,305	19,382	14,568
Age	27.96	25.62	29.91	27.56
Married (%)	10.75	7.25	28.79	19.16
College major (%)				
- Humanities	9.21	18.96	9.13	18.16
- Social Science	22.85	22.81	22.84	22.80
- Education	4.86	14.02	4.54	15.16
- Engineering	39.91	10.12	40.51	10.19
- Natural Science/Mathematics	13.28	16.32	13.46	16.44
- Medicine/Public Health	3.18	5.12	3.10	5.14
- Arts/Athletics	6.73	12.65	6.43	12.12

Summary Statistics

- Substantial gender difference in job qualities
- CSAT score: imputed based on college major and location

	Initial		Follow-up	
	Male	Female	Male	Female
In the labor force (%):	78.47	75.71	88.64	81.97
Employed among LF participants(%)	96.07	95.40	86.10	84.79
Among those employed:				
- Monthly Earnings (10,000 2010 won)	244.00	192.65	280.26	217.64
- Irregular position (%)	16.86	26.10	9.73	16.95
Among regular position (%):				
- Working at a large-scale firm	47.24	30.99	48.00	31.66
Imputed SAT score (standardized)	-0.07	0.09	-0.07	0.10

College Major and Earnings

- Omitted major: engineering
- Controls: gender, CSAT, age, age-sq, dummies for college major, marital status, year, and region.

College major	log(earnings) Initial survey	log(earnings) Follow-up	△ log(earnings) Both surveys
No. of observations	30,242	24,767	22,717
- Humanities	-0.207***	-0.195***	0.010
	(0.009)	(0.009)	(0.009)
- Social Science	-0.048***	-0.058***	-0.012
	(0.007)	(0.007)	(0.007)
- Education	-0.049***	-0.104***	-0.060***
	(0.011)	(0.010)	(0.010)
- Natural Science/Mathematics	-0.151***	-0.115***	0.036***
	(0.009)	(0.008)	(0.008)
- Medicine/Public Health	0.134***	0.101***	-0.003
	(0.013)	(0.013)	(0.013)
- Arts/Athletics	-0.329***	-0.303***	0.011
	(0.010)	(0.010)	(0.010)

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College Major and Earnings

- Significant and widening gender gap in monthly earnings
- College major accounts for over 24% of the gap, but not much of the growth rate.

	log(earnings) Initial survey	log(earnings) Follow-up	△ log(earnings) Both surveys
A. without college major			
Female	-0.121***	-0.191***	-0.052***
	(0.008)	(0.007)	(0.008)
Imputed CSAT	0.081***	0.067***	-0.015***
	(0.003)	(0.003)	(0.003)
B. with college major			
Female	-0.078***	-0.146***	-0.050***
	(0.008)	(0.007)	(0.008)
Imputed CSAT	0.078***	0.069***	-0.009***
	(0.003)	(0.003)	(0.003)

College Major and Employment

- Findings from earnings are consistent with employment status

Dep. variable	1: employed	1: regular workers conditional on employed	1: switching employers
- Humanities	-0.026***	-0.134***	0.107***
	(0.005)	(0.010)	(0.012)
- Social Science	-0.019***	-0.032***	0.030***
	(0.004)	(0.007)	(0.009)
- Education	-0.005	-0.043***	-0.038**
	(0.005)	(0.011)	(0.012)
- Natural Science/Math.	-0.035***	-0.095***	0.074***
	(0.006)	(0.009)	(0.011)
- Medicine/Public Health	-0.029***	-0.114***	0.042**
	(0.008)	(0.014)	(0.016)
- Arts/Athletics	-0.140***	-0.183***	0.186***
	(0.010)	(0.012)	(0.014)

College Major and Employment

- Gender gap in likelihood of being employed, and being a regular worker

Dep. variable	1: employed	1: regular workers conditional on employed	1: switching employers
A. without college major			
Female	-0.020***	-0.031***	0.025**
	(0.003)	(0.007)	(0.009)
B. with college major			
Female	-0.011***	-0.006	0.005
	(0.003)	(0.007)	(0.009)

Summary of Key Findings

- Premiums in majoring in engineering: earnings, employment, job stability
- Yield for majoring in natural science and math is low
- Significant gender gap found even among young educated workers
- College major accounts for a substantial portion of gender gap

Robustness Check: Identification Assumption

- Exogeneity conditional on high-school track choice
  - Subsample analysis: humanities/social science vs. math/science
  - Findings hold qualitatively
- Survey of college major preference
  - Korean Education and Employment Panel (KEEP):
    - High-school seniors in 2004 (till 2011)
    - Much smaller sample size but info on "preferred college major"
  - Findings hold qualitatively

Robustness Checks

- Imputed CSAT score vs. actual CSAT
  - KEEP
  - Imputed CSAT generates results comparable to those based on actual CSAT
- Discouraged workers
  - Individuals who look for a job but technically are not in the labor force
  - Use unconditional probability of employment as an outcome instead of employment rate
  - Qualitative results remain the same

Conclusions

- College major
  - Matters in earnings, employment, employment quality
  - Accounts for a significant portion of gender gap in labor market outcomes
- Policy implications and future research
  - Efficiency in allocation of college major quota
  - Need to understand determinants of college majors:
    potentially effective policy tools to reduce the gender gap

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Abstract

This paper measures the impact of college major on employment and earnings. We use a nationally representative dataset from Korea, where there is little concern for endogenous major choice due to the nature of the college admission system and high school curriculum. We find that "Engineering" and "Medicine and Public Health" majors dominate in all labor market outcomes, but, different from existing studies of the U.S., in South Korea, graduates with an "Education" degree perform better than those who majored in "Natural Science or Mathematics." Finally, the large gender disparity in choice of major may account for approximately 50 percent of the gender gap in labor market outcomes.

JEL Classification: C39, C42, J31

Keywords: Economics of education, College Major, Degree, Returns to Schooling, Korea

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I. Introduction

The impact of college major on earnings has attracted substantial attention from economists, sociologists and educational researchers (see Hamermesh and Donald, 2008, and Altonji et al, 2012, for overview of the literature). College graduates majoring in engineering are consistently found to have the highest earnings, usually followed by business and science in the United States, and graduates majoring in humanities and education earn the least.[1] The impact of college major on earnings has important implications for the gender gap in labor market outcomes because of the large gender disparity in choice of major and the disproportionate fraction of women who choose majors with low earnings potential for both sexes (e.g., Turner & Bowen, 1999; Joy, 2003; Gemici & Wiswall, 2013; Goldin, 2014). Despite the extensive examination of the relationship between college major and earnings, there is a need for additional research on this topic particularly because little research in this area accounts for endogenous selection into college major (see more in Hamermesh & Donald, 2008; Altonji et al., 2012). A few exceptional studies that address endogeneity include Kinsler and Pavan (2013), who use a structural model to account for college major choice, and Hastings et al. (2013), who apply a regression discontinuity approach to Chilean administrative datasets.

This paper aims to contribute to this literature by examining a setting where there is little concern for endogenous major choice. In South Korea, high school seniors have to select their college majors when they apply to a college, and switching their college major is extremely difficult, although they can select a secondary major to study a subject

[1] For example, Kinsler and Pavan (2013) report that college graduates with a science or business related degree earn up to 25% higher wages than other college graduates in the United States.

of interest. Moreover, in high school, students have virtually no opportunity to learn what they could expect from a specific college major in terms of course work and career prospects. For example, the Korean Ministry of Education tightly regulates the high school curriculum, which leaves no discretion to high schools in terms of subjects they would like to provide. The current high school curriculum does not include career sessions or advanced studies that can influence students' choices of college majors. While, in theory, students can gather such information outside the formal school system, this is unlikely because the college admission system in Korea is extremely competitive and students devote as much time and effort as possible into achieving the highest possible score on the nationwide academic test.

Due to these institutional features, we can measure the effect of college major on labor market outcomes by regressing the outcomes on college major, controlling for students' characteristics at high school and local labor market conditions. We use the dataset from the "Graduates Occupational Mobility Survey (GOMS)," a nationally representative survey of young adults in Korea who graduated from either a 2-year or 4-year college program in a given survey year. Our sample consists of individuals who graduated from a college in August 2004 to February 2008 and includes their outcomes 20 months since the year of college graduation and 2 years afterward. We classify college majors into 7 groups: Engineering, Humanities, Social Science, Education, Natural Science and Mathematics, Medicine and Public Health, Arts and Athletics. The labor market outcomes we examine include labor market participation, employment status, job quality,[2] wages, and wage growth.

We find that, for young adults in our sample, college major makes fairly little impact on labor market participation and employment rate, but its impact is significant in terms of earnings and whether a college graduate works in a long-term fulltime position or works for a large company. For example, upon graduation, an engineering major is 13.4 percentage points more likely to be a long-term contract worker than a humanities major, conditional on nationwide college entrance test score, gender, age, survey year, and other characteristics. Conditional on having a long-term contract, an engineering major is 17.9 percentage points more likely to work for a large firm with 100 or more employees than a humanities major. As for earnings, an engineering major earns 20 percent more than his/her counterparts who majored in humanities. Such gaps between college majors persist 2 years after graduation. In our sample, engineering majors are comparable in labor market outcomes to those who majored in health-related fields to be trained as medical doctors, nurses, pharmacists, physiologists, chiropractors, dental hygienists, nutritionists, therapists, and other healthcare providers. They are followed by individuals who majored in either social sciences or education, then by those who majored in natural sciences or mathematics, in terms of having a regular job and earnings. Arts and athletics majors are the lowest and humanities majors are the second lowest in terms of labor market outcomes. The finding that engineering majors have better labor market outcomes than the rest of the majors in our sample is consistent with the findings in the literature explained earlier. However, contrary to the findings in the U.S., we find

[2] Specifically, we measure whether a person has a job at a firm whose number of employees is greater than 100 individuals and works for a full-time job with long-term labor contracts (i.e., regular jobs instead of "irregular jobs").

that those who majored in natural science or mathematics have worse outcomes than those who majored in social sciences or education.

Finally, we examine the effect of college major in explaining the gender gap in labor market outcomes. We conduct this analysis because South Korea is known for its large gender disparity in labor market outcomes; such a gap persists even after gender equality is achieved in educational attainment (OECD, 2010)[3]; and the South Korean government has been developing various incentives for firms to hire and maintain female employees, which appear to have had limited impact so far. Although our sample consists of young adults, almost all of them are single and have no children. Women exhibit weaker labor market performance than their male counterparts in terms of employment rate, having a long-term job, and earnings. For example, 20 months after the year of college graduation, women are 2 percentage points less likely to be employed, 10 percentage points less likely to work for a large firm with a long-term contract, and have 12 percent less earnings than their male counterparts. We find that controlling for college major reduces these gender gaps by 50 percent. However, college majors account very little for the gender gap in wage growth. These findings suggest that gender equality in college major choices can significantly reduce the gender gap in employment and having a quality job, but not the growth rate of earnings.

Our work proceeds as follows: section 2 presents the institutional background and data. Section 3 and Section 4 present the empirical framework and the main results,

[3] The gender pay gap in South Korea was about 39 percent, which was 2.6 times larger than 15 percent, the average among the 28 OECD countries, followed by Japan, which was 21 percent, according to 2010 OECD statistics. It was reported as 29 percent in Germany and Israel, [this doesn't seem to make sense: if Germany and Israel had 29 percent, wouldn't they be second-highest, not Japan with 21 percent?] and 19 percent in the U.S., Finland, Switzerland, and Austria. In the U.K. and Czech Republic, women were paid an average of 18 percent less than men. In contrast, the lowest gender pay gap, 6 percent, was in Hungary, Poland, and Spain.

respectively. Section 5 examines the sensitivity of our results. Finally, section 6 concludes.

II. Institutional Background and Data

II.1 Institutional Background

This section conducts brief overview of the Korean education system, focusing on when and how a person chooses his/her college major. At a senior year at high school, a student needs to apply for a college as well as a major in Korea. Admission outcomes depend on an applicant's test score from the nationwide college entrance exam which is called the College Scholastic Ability Test (CSAT), relative academic performance at his/her high school, and academic and non-academic performances outside his/her school (e.g., award at the Mathematical Olympiad, and volunteer work). The format of CSAT managed by the Korea Institute of Curriculum and Evaluation is similar to the scholastic assessment test (SAT) in the U.S. The test is offered one time per year, typically in November. In general, high school graduates take CSAT in the beginning of November and receive the result in the end of November. They begin to apply for colleges with a specific major in the mid December. Those who pass the initial screening process based on certain criteria for each college receive an in-person interview or/and an essay exam in January. The admission results are announced in the beginning of February and admitted students should confirm their intention to enroll in the program by late February.

The institutional autonomy is constrained in Korea (OECD, 2003). The Ministry of Education predetermines the number of seats in colleges and universities located within the National Capital Region (NCR)[4] as well as public universities instead of meeting the demand by students. The Ministry of Education also predetermines the number of seats in majors in health professions or teaching. Although private colleges and universities in local area have autonomy of the number of seats in other majors, they still need to submit a proposal for admission seats to the Ministry of Education. They can proceed in accordance with their plan upon the Ministry of Education's acceptance (Ministry of Education, 2013).

In Korea, a college has to announce the total number of seats across different majors before the college application process begins and the policy on how to evaluate applicants in terms of relative weight on each of the three categories. The collective evaluation is heavily weighted by CAST scores in general although it varies across colleges. A college can offer admissions only up to the seats allocated to each major. If an offer is turned down, then college can offer admissions to the next best applicant. Upon admission, students are technically allowed to change their majors or select additional major as their "double" major or "minor". Although some universities allow for change in major, it is practically impossible for a student to move to any popular major because of high competition and requirements for transfer application. To be eligible to change major, students must be in good academic standing and have completed one or two continuous academic years in a full-time degree program. A written exam or/and a personal interview are usually required and the number of permitted students is limited to less than 20 percent of each program. Students cannot change their major to any majors in teaching or health professions such as nursing,

[4] The NCR is referred to Seoul and surroundings area where the colleges tend to be ranked higher than other area colleges.

medicine, and pharmacy. Besides, the original major mostly matters in practice regardless of the double major or minor. Students are supposed to spend most of their time in taking classes of the original major while declaring double major or minor requires taking much smaller number of courses and moreover, the student's academic rank for merit-based scholarships or fellowships informing how well he/she performed at college is determined based on the original major.

These institutional features imply that choice of college majors in our setting is relatively more exogenous in labor outcomes compared to the U.S. setting for two reasons. First, students need to make their decisions on college major without knowing much of what coursework and job opportunity a major has. In Korea, the opportunity of taking advanced classes such as honors classes, advanced placement (AP) courses, and the international baccalaureate (IB) program courses is not provided; high school curriculum is designed to put heavy weight on reading and literature, English, and mathematics, and other subjects unrelated to CSAT are so briefly taught in class that students do not get much of information regarding college majors and careers. Compulsory education time for high school averages 29.17 hours per week[5] that does not account for additional time spent in non-compulsory instruction time like self-study time after regular school hours and extra classes with private tutors and in private educational institutions, so-called *hagwon*. The proportion of the compulsory curriculum is devoted to reading and literature, English, and mathematics (38.29%).

Furthermore, career prospect is in some sense not a first order concern when a student chooses a major. For instance, consider a student who is good but not great to the point that she can get into some unpopular majors at the Seoul National University (SNU),

[5] Authors' calculations: 50 minutes per class × 7 classes per days × 5 days per week

considered the top university in Korea but cannot get into the college of medicine[6] at the SNU. Then, her choice will be made between an unpopular major at the SNU and the college of medicine at a less prestigious university regardless her interests or aptitude. These two factors make differences in the choice of college majors that reduce the issue of endogeneity. Thus, we do not address the causes of the ability sorting across majors.

II.2 Data and Summary Statistics

This study relies on two data sources. One is the Graduates Occupational Mobility Survey (GOMS), a nationally representative survey of young adults in Korea who graduated from either a 2-year or 4-year college program. The GOMS is a short-term panel that contacts survey participants after 2 years for follow-up. The data includes demographic information of individuals and their labor market outcomes 20 months after the college graduation and 2 years from the initial survey. Our sample consists of three waves of GOMS from 2005, 2007, and 2008. The 2005 GOMS includes individuals who graduated from a college in August, 2004 or February, 2005 and it surveys their initial labor market outcomes in 2005 and then conducts the follow-up survey after 2 years in 2007[7]. Note that the 2006 GOMS does not exist because of reconstructing the survey design in 2007 and the 2008 GOMS is the latest wave available to the public. 85.1 percent in the 2005 GOMS, 81.6 percent in the 2007 GOMS, and 85.0 percent in the 2008 GOMS survey participants re-participated in the follow-up survey. We narrow our

[6] In Korea, the colleges of medicine were comprised of 2-year premedical courses and 4-year medical program as an undergraduate program unlike the U.S. The new medical education system, so-called "4+4" system, 4-year medical program after bachelor's degree awarded, was introduced since 2006 but decided to abolish from 2015.
[7] In Korea, the academic year begins in March and continues through December. An academic year had two regular semesters of spring and fall so that students graduate in February.

sample only to 4-year college graduates (66.81 percent of the survey participants) for two reasons. First, for 4-year colleges, we have reliable information of their quality of students measured at the admission. Therefore, we will use that information to control for students' underlying cognitive ability that can affect students' major choice. Second, 2-year colleges in Korea are vocational schools typically tied to certain firms where they send their graduates to work, and vocational and 4-year colleges are not comparable to each other even if they provide the same major. By combining the initial and follow-up data, we conduct analysis of the dynamic effect of gender gap in the labor market outcomes in terms of employment status, wage level and growth as well as job mobility.

The second data source is the reports of college rankings from 2006 to 2013, which informs the minimum academic qualification for students to get an offer from a specific major in a college. There is no formal document informing college rankings based on CSAT scores but informal reports analyzed by large-scale *hagwons* with reputable brand name are distributed to help students applying to college. There reports suggest estimated cutoff points for admission based on CSAT score distribution in prior year. Three variables are available to identify CSAT proxies in GOMS: the regions where college is located, school types informing whether college is private or national/public, and school characteristics informing whether college is regular or a college of education[8]. Using 2006 data, we construct the index for mean rankings[9] over dummies for regions, school types, and school characteristics and test its validity using the ordinary least squares (OLS) regression and a Spearman's rank correlation with the CSAT proxies in

[8] There are 11 colleges of education where provide specifically public elementary school teacher training programs. These colleges are government-run institutions.
[9] A sorting algorithm is implemented by ranking them from the highest number to the lowest for a given year. The higher number means the higher ranked-institution.

other years. Table A.1 shows summary statistics of the input data. Nearly 35 percent of 4-year colleges are located in Seoul or Gyeonggi province. 81 percent are private colleges and 6 percent are special colleges of education. When we regress rankings of average minimum scores for each college over dummies for regions, school types, and school characteristics, R-square is 0.527 as seen in Table A.2. The R-square is high enough to believe that our CSAT proxies are in fact predicted by regions, school types, and school characteristics. The correlation and Spearman's rank correlation of our CSAT proxies with ones in other years show that there is a statistically significant correlation between measurements at 1 percent level of significance (see Table A.3 and A.4).

Table B.1 reports summary statistics from the initial and follow-up surveys, respectively. Before we explain details of those tables, several variables require explanations. We consider a person is employed if the person works at least 1 hour in the previous week from when the survey was conducted or has a job but not working due to family and childcare, strike, or stoppage of operation. Among employed, a person holds a "irregular position" if the person has a fixed-term contract, part-time job, or freelancer. "A large-scale firm" refers to a firm hiring 100 or more employees. A person's earning is reported in a yearly, monthly, weekly or hourly basis in GOMS. We convert the reported earnings to monthly basis using reported hours of work. Finally, for college majors, we classify college majors into 8 groups: humanities, social science, engineering, education, natural science/mathematics, medicine/public health[10], and arts/athletics.

Initial survey is composed of 22,953 male and 18,305 female respondents, while follow-up survey contains smaller number of respondents due to attrition. On average,

[10] Medicine/public health includes veterinary medicine, nursing, and pharmacy.

male respondents are two years older than female respondent in both surveys. This is because Korean men over the age of 18 have to provide about 2-year compulsory military service unless they are disabled or under special condition. Thus, men enter the labor market 2 years later than women in common. A notable gender-gap was observed in labor market outcomes between men and women. For example, the average monthly earnings are 2,440,000 won[11] for men, over 30 percent higher than that of female employees. Labor force participation rate was higher for male respondents and employment rate was slightly higher for male respondents in both surveys while female respondents have higher imputed CSAT score compared to male respondents. Male respondents are shown to be more likely to earn more, to hold regular position, and to be employed at large-scale firm. In other dimensions, male college graduates outperform female graduates in the sense that the former are more likely to have a regular position and working for a large-scale firm that tend to provide higher earnings and more job security. All of these differences are statistically significant at 1 percent level, based on two-sided t-tests. Overall, the labor market participation rate, the proportion of regular workers, the likelihood of working at large firm, and average monthly wage are increased in both men and women but the gender-gap in the labor market outcomes remains similar in the follow-up surveys.

For the rest of this paper, we decompose the gender gap in the labor market outcomes so that we can examine the extent to which the gender-gap in college majors may account for. Among male respondents, more than 75 percent majored in engineering (40%), natural science/mathematics (13%), or social science (23%). On the other hand, female respondents' college majors are distributed across humanities (19%), education

[11] Approximately, 2,440 dollars.

(23%), education (14%) or natural science/mathematics (16%). The distribution of college majors among men is different from that of women at 1 percent significance level, based on the Kolmogorv-Smirnov test. The difference in college majors could account for gender gap if a college major may attribute to different types of human capital and their values in the labor markets are different. To discuss gender differences in the labor market outcomes more in detail, we perform probit analyses on the data. We establish the link between the difference in college majors and labor market outcomes between men and women. This paper discuss what extent college majors explain the gender gap in labor market outcome in terms of employment status, wage level and growth, and job mobility across firms and industries.

III. Empirical Framework

We estimate probit models to examine the role of college major on labor market participation, employment, and likelihood of having a quality job. We denote by $Y_{i,j,c,l,t}$, a labor market outcome of person *i* who majored in *j*, graduated from a college in year *c,* lives in location *l* and was surveyed in round $r \in \{0,1\}$:

$$Y_{i,j,c,l,r} = 1(Y^*_{i,j,c,l,r} > 0)$$

$$Y^*_{i,j,c,l,r} = \alpha_r female_i + \beta_r CSAT_i + \gamma_r age_{i,r} + \delta_r age^2_{i,r} + \theta_{j,r} + \rho_{c,r} + \mu_{l,r} + \varepsilon_{i,j,c,l,r}, \quad (1)$$

where $female_i$ is 1 if person *i* is female and 0 if male; $CSAT_i$ is person *i*'s test score for college admission tests, and $age_{i,r}$ is the persons' age at survey round *r*. Round *r* is 0 if the survey is conducted 20 months since the year of college graduation, and 1 if it is conducted 2 years after the initial survey. Variables $\rho_{c,r}$ and $\mu_{l,r}$ capture cohort and location specific fixed effects, respectively. The parameters are allowed to vary by survey rounds. The parameter of interest is $\theta_{j,r}$ that measures the relationship between a person's college major and his/her labor market outcomes. The identification assumption is that conditional on a person's CSAT score and other observable characteristics, a person's choice of college major is exogenous. Such assumption is likely to hold because students have very limited information of college major at the time of their choice and thus it is unlikely that students will sort themselves according to their comparative advantage as explained in Section 2. When we analyze earnings, we estimate Mincerian equations that regress the logarithm of income on college major and other observables (Mincer, 1976).

IV. Findings

IV.1 Employment

Table B.2 and Table B.3 show the effect of college major on employment status in initial and follow-up surveys, respectively. We calculate the distribution of labor market status depending on a person's college major and regress employment status on college majors using a probit model. The results in the initial survey and the follow-up survey are similar to each other. Test score shows no significant effect on labor force participation or employment but has significantly positive effect on the probability to be a regular worker and to work at big firm. College major shows significant effects, especially on employment related probabilities.

Surprisingly, the probability to be in the labor force is higher for female in initial survey while it is lower for female in follow-up survey. Medicine/public health major has the highest likelihood to be in the labor force in both surveys. On the other hand, natural science/mathematics and humanities majors have the lowest likelihood to be in the labor force in initial and follow-up survey, respectively. Among those in the labor force, employment probability is lower for female. Engineering major are the most likely to be employed and arts/athletics are the least likely to be employed. Among those employed, the probability to be a regular worker is the highest for engineering major in both surveys while it is the lowest for arts/athletics in initial survey and medicine/public health in follow-up survey. Among regular workers, medicine/public health major has the highest likelihood and education major has the lowest likelihood to work at big firm in both surveys. On average, females have lower probability to be a regular worker and to work at large-scale firm.

Then, we explore to what extent college majors explain labor market outcomes using delta method with estimates from probit regression models. As seen in Panel B of Table B.2, the size of f coefficients of female dummy significantly decreases as compared to ones in Panel A. In Panel C of Table B.2, the large gender disparity in choices of major account for approximately 38 percent and 81 percent of the gender gap in employed status and regular worker status among the employed at 1 percent significance level. Approximately, 48 percent of the gender gap in regular worker at large-scale firm status can be explained by college majors. After 2 year, nearly 12 percent of the gender gap for labor market participation can be revealed by college major choice. Around 40 percent of the gender gap for employed status and regular worker status can be captured by the gender gap in college major choice as reported in Panel C of Table B.3. The gender disparity in choices of major can explain approximately 50 percent of the gender gap for regular worker status at large-scale firm.

IV.2 Wages

Table B.4 shows the returns to postsecondary education with respect to college majors (columns 1 & 2) and the wage growth between the initial placement and 2-year later. The sample is restricted to employed workers. We regress wage level and growth on college majors using an OLS regression model. On average, female workers earn less and experience slower wage growth compared to male workers. Test score has significantly positive effect on the level of earnings but has significantly negative effect on the growth of earnings. Age as a proxy for work experience has significantly positive effect on wage level but negative effect on wage growth. Married workers earn higher income but experience slower wage growth, which can be attributed to longer work experience of married workers. With respect to college major, medicine/public health majors earn the highest level of income while arts/athletics majors earn the lowest level of income in both surveys. Natural science/mathematics majors experience the fastest wage growth while education majors experience the slowest wage growth. The gap also widens for education major over two years. This is because teacher's wage has not experienced a dramatic increase at the early period of work experience. The statistically insignificant coefficients in column 3 reveal that there is a hierarchy of wage structure for each occupation. That means there is a similar wage growth within same firm regardless of workers' college majors based on their seniority.

Except female dummy, most point estimates do not show notable change when college major dummies are included. That is, the downward bias of estimate for female dummy, which can be attributed to different college major choice by gender, is relieved by the inclusion of college majors. Nearly 35 percent and 23 percent of the gender gap between wages in initial placement and 2-year later can be explained by differences in college major choice by gender as presented in Panel C of Table B.4. College majors, however, do not have a statistically significant impact on wage growth.

IV.3 Dynamics

Table B.5 show the job mobility between the initial placement and 2-year later. The sample is restricted to who are employed in both initial year and the follow-up years to see the chance to change their firm or industry. We regress job mobility across firms (column 1) and industries (column 2) using a probit model. When a worker is employed in both periods, not including college major dummies, the probability to change a firm is higher for female workers but becomes insignificant once we control for college major. Higher test score is associated with lower probability to change a firm regardless of inclusion of major dummies. Arts/athletics majors show the highest likelihood while education majors show the lowest likelihood to change a firm. This is because public school teachers have to teach for 4 years in one school and then can move to another school while private school teachers are unlikely to move to another school. Surprisingly, approximately 77 percent of the gender gap for changes in firm can be explained by gender differences in college major choice.

On the other hand, female workers face lower probability to change industry regardless of the inclusion of college major dummies. Higher test score is associated with lower likelihood to change industry. With respect to college major, arts/athletics majors are the most likely to change industry while education majors are the least likely because of the college major specific human capital. It is an interesting feature that humanities, social science, and natural science/mathematics majors are less likely to change industry rather than engineering majors. When dummies for college major are included, 28 percent for the gender gap of change in industry can be explained by gender-specific college major choice.

V. Robustness Checks

Two robustness tests for our results are studied in order to address validity in this section. First, we include individuals who are not in the labor force to simply test two concerns. One is that in Korea, young adults try to stay at a graduate school or other form while they look for a job. They are considered effective unemployed but shown as not in the labor force. The other is that for the policy makers point of view, not in the labor force could be a cost in that not supplying for qualified labor forces to the labor market especially considering the fact that Korea has been experiencing drastic aging of workers. The coefficients are not significantly different across these two distinct definitions of employment status.

Second, we conduct a simple robustness check to allow for differences in high school tracks. In Korea, students choose a curriculum track between humanities/social science track and mathematics/science when they become sophomores in high school. Reading, literature, and English are more emphasized in the humanities/social science track while mathematics and natural science education is more highlighted in the mathematics/science track. The CSAT subject tests that students take are based on their high school track. A large proportion of male students choose the mathematics/science track while many female students are inclined to choose the humanities/social science track. Throughout, we report regression results with two different high school tracks in Tables B.6, B.7, and B.8.

Regardless of both tracks, we observe that the probability to be in the labor force, to be employed, to be a regular worker, and to be a regular worker at large-scale firm is lower for female workers as reported in Table B.6. According to Table B.7, female workers earn less and experience slower wage growth compared to male workers in both high school tracks. In Table B.8, no statistically significant gender gap is observed in humanities/social science track, while female workers face lower likelihood to change employer or change industry in mathematics/science track. The magnitude is larger in the follow-up survey compared to the initial survey. The overall tendency for estimates to shrink toward zero is common across surveys and tracks when college major dummies are included. The proportions of gender gap for labor market outcomes in terms of employment status, wage level and growth, and job mobility that can be explained by gender differences in college major choices are also similar to our results.

VI. Conclusion

Using a nationally representative datasets of young Korean adults, we have examined the impact of college major on labor market outcomes and its role in accounting for gender gap. We find sizable returns from majoring in engineering and medicine/public health, followed by social science and education, then by national science/mathematics. Majors of humanities, arts/athletics pay the least. These variations across college major account for approximately 50 percent of the gender gap in employment, working for a long-term contract job, and earnings.

A limitation of our current study is that we focus on the labor market outcomes up to three years after the college graduation, because of data availability. Within this three-year window, we find that the gap across college major and gender persisted and often widened. Therefore, it will be an important future research of examining a longer-term effect of college major on labor outcomes and gender disparity. Another related issue for further research is to examine if students optimally choose college major and if not, what would be policy tools to improve the efficiency. A few recent studies report that a person's subjective expectation on earnings plays an important role in selecting college major in the U.S. (e.g., Betts, 1996; Arcidiacono et al, 2012; Zafar, 2012; Zafar and Wiswall, 2013). Therefore, it will be important to examine the accuracy of such expectation and the gender gap in forming accurate expectation associated with college major choice.

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Appendix A. CSAT Proxies

Table A.1. Summary Statistics

Region (%)		Found (%)		School (%)	
- Seoul	20.62	- Private	80.93	- Regular	94.33
- Busan	6.70	- National/Public	19.07	- Colleges of Education	5.67
- Daegu	1.55				
- Incheon	3.61				
- Gwangju	3.61				
- Daejeon	4.12				
- Ulsan	0.52				
- Gyeonggi Privince	13.92				
- Gangwon Privince	5.15				
- North Chungcheong Privince	5.15				
- South Chungcheong Province	9.79				
- North Jeolla Province	4.64				
- South Jeolla Province	5.15				
- North Gyeongsang Province	9.79				
- South Gyeongsang Province	4.12				
- Jeju Province	1.55				

Table A.2. CSAT Proxies

Rank 2006	
Private	-42.784***
	(9.169)
University of Education	63.212***
	(14.899)
Region (Reference to Seoul)	
- Busan	-65.979***
	(13.164)
- Daegu	-50.921*
	(24.763)
- Incheon	-17.058
	(16.679)
- Gwangju	-90.058***
	(16.679)
- Daejeon	-50.634**
	(15.680)
- Ulsan	-52.661
	(40.950)
- Gyeonggi Privince	-45.513***
	(10.092)
- Gangwon Privince	-85.317***
	(14.415)
- North Chungcheong Privince	-67.817***
	(14.415)
- South Chungcheong Province	-69.702***
	(11.274)
- North Jeolla Province	-87.724***
	(15.067)
- South Jeolla Province	-101.974***
	(14.646)
- North Gyeongsang Province	-95.638***
	(11.282)
- South Gyeongsang Province	-82.731***
	(15.852)
- Jeju-do	-84.921***
	(24.763)
R-square	0.527
No. of observations	194

Notes: OLS regression model. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.3. Correlations

	rank 2006	rank 2009	rank 2010	rank 2013	rank 2014
rank 2006	1.000				
rank 2009	0.850	1.000			
rank 2010	0.853	0.986	1.000		
rank 2013	0.903	0.894	0.893	1.000	
rank 2014	0.917	0.883	0.880	0.980	1.000

Table A.4. Spearman's Rank Correlation Coefficients

	rank 2006	rank 2009	rank 2010	rank 2013	rank 2014
rank 2006	1.000				
rank 2009	0.850***	1.000			
rank 2010	0.843***	0.978***	1.000		
rank 2013	0.900***	0.903***	0.905***	1.000	
rank 2014	0.913***	0.904***	0.900***	0.971***	1.000

Notes: The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Appendix B. GOMS

Table B.1. Summary Statistics

	Initial Male (1)	Survey Female (2)	Follow-up Male (3)	Survey Female (4)
No. of observations	22,953	18,305	19,382	14,568
Age	27.96	25.62	29.91	27.56
Married (%)	10.75	7.25	28.79	19.16
College major (%)				
· Humanities	9.21	18.96	9.13	18.16
· Social Science	22.85	22.81	22.84	22.80
· Education	4.86	14.02	4.54	15.16
· Engineering	39.91	10.12	40.51	10.19
· Natural Science/Mathematics	13.28	16.32	13.46	16.44
· Medicine/Public Health	3.18	5.12	3.10	5.14
· Arts/Athletics	6.73	12.65	6.43	12.12
In the labor force (%):	78.47	75.71	88.64	81.97
Employed in the labor force (%)	96.07	95.40	86.10	84.79
Among those employed:				
- Monthly Earnings (10,000 2010 won)	244.00	192.65	280.26	217.64
- Not regular position (%)	16.86	26.10	9.73	16.95
- Regular position (%)	83.14	73.90	90.27	84.79
- Among regular position (%):				
· Working at a large-scale firm	47.24	30.99	48.00	31.66
Imputed SAT score (standardized)	-0.32	-0.19	-0.31	-0.18

Notes: All gender differences are statistically significant at 1 percent level (average is based on t-test and the distribution of college majors is based on Kolomogrow and Smirnov test).

Table B.2. Gender Gap in Employment: Initial Survey

Dependent variable	1: labor force 0: not in the labor force	1: employed 0: not employed but in the labor force	1: regular workers 0: not regular workers but employed	1: regular at big firm 0: not regular workers at big firm but regular workers
	(1)	(2)	(3)	(4)
No. of observations	41,258	31,796	30,454	24,100
Panel A: No Major Controls				
Female (a)	0.018**	-0.020***	-0.031***	-0.105***
	(0.006)	(0.003)	(0.007)	(0.010)
Test score	0.002	0.006***	0.032***	0.047***
	(0.003)	(0.001)	(0.003)	(0.004)
Pseudo R-square	0.016	0.062	0.054	0.046
Panel B: Major controls				
Female (b)	0.019**	-0.011***	-0.006	-0.054***
	(0.006)	(0.003)	(0.007)	(0.010)
Test score	0.004	0.002	0.028***	0.094***
	(0.003)	(0.001)	(0.003)	(0.005)
College major (Reference=Engineering)				
Humanities	-0.023**	-0.026***	-0.134***	-0.179***
	(0.007)	(0.005)	(0.010)	(0.010)
Social Science	0.005	-0.019***	-0.032***	-0.131***
	(0.006)	(0.004)	(0.007)	(0.008)
Education	0.007	-0.004	-0.042***	-0.394***
	(0.008)	(0.005)	(0.011)	(0.006)
Natural Science/Mathematics	-0.070***	-0.035***	-0.095***	-0.130***
	(0.007)	(0.006)	(0.009)	(0.010)
Medicine/Public Health	0.099***	-0.029***	-0.114***	0.067***
	(0.009)	(0.008)	(0.014)	(0.018)
Arts/Athletics	0.029***	-0.140***	-0.183***	-0.258***
	(0.008)	(0.010)	(0.012)	(0.009)
Pseudo R-square	0.022	0.112	0.069	0.102
Panel C: Gap explained by Majors				
1 - (b)/(a)	-0.058	0.381***	0.813***	0.480***
	(0.096)	(0.074)	(0.195)	(0.058)

Notes: Probit model, marginal effects reported. Sample of the 2005-2008 GOMS1. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.3. Gender Gap in Employment: Follow-up Survey

Dependent variable	1: labor force 0: not in the labor force	1: employed 0: not employed but in the labor force	1: regular workers 0: not regular workers but employed	1: regular at big firm 0: not regular workers at big firm but regular workers
	(1)	(2)	(3)	(4)
No. of observations	33,950	29,112	24,909	21,754
Panel A: No Major Controls				
Female (a)	-0.052***	-0.024***	-0.049***	-0.158***
	(0.005)	(0.005)	(0.006)	(0.009)
Test score	0.008**	0.010***	0.026***	0.043***
	(0.003)	(0.003)	(0.003)	(0.005)
Pseudo R-square	0.017	0.071	0.039	0.041
Panel B: Major controls				
Female (b)	-0.045***	-0.013*	-0.028***	-0.076***
	(0.005)	(0.005)	(0.006)	(0.010)
Test score	0.007*	0.007*	0.022***	0.091***
	(0.003)	(0.003)	(0.003)	(0.005)
College major (Reference=Engineering)				
Humanities	-0.057***	-0.024**	-0.094***	-0.194***
	(0.008)	(0.008)	(0.010)	(0.010)
Social Science	-0.023***	-0.013*	-0.021**	-0.121***
	(0.006)	(0.006)	(0.007)	(0.009)
Education	0.015*	-0.007	-0.032***	-0.405***
	(0.007)	(0.008)	(0.010)	(0.006)
Natural Science/Mathematics	-0.053***	-0.055***	-0.073***	-0.137***
	(0.007)	(0.008)	(0.009)	(0.010)
Medicine/Public Health	0.046***	-0.001	-0.137***	0.071***
	(0.009)	(0.011)	(0.015)	(0.019)
Arts/Athletics	-0.034***	-0.129***	-0.125***	-0.249***
	(0.008)	(0.010)	(0.012)	(0.011)
Pseudo R-square	0.024	0.083	0.055	0.099
Panel C: Gap explained by Majors				
1 - (b)/(a)	0.123***	0.444***	0.422***	0.522***
	(0.034)	(0.118)	(0.061)	(0.040)

Notes: Probit model, marginal effects reported. Sample of the 2005-2008 GOMS3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.4. Gender Gap: Earnings

Dependent var.	Log monthly earnings	Log monthly earnings	Change in the log monthly earnings
Sample	Employed, Initial survey	Employed, Follow-up survey	Employed, Both surveys
	(1)	(2)	(3)
No obs.	30,242	24,767	22,717
Panel A: No Major controls			
Female	-0.121***	-0.191***	-0.052***
	(0.008)	(0.007)	(0.008)
Test score	0.104***	0.086***	-0.018***
	(0.004)	(0.003)	(0.003)
Age	0.089***	0.076***	-0.018**
	(0.006)	(0.006)	(0.006)
Age-squared	-0.001***	-0.001***	0.000
	(0.000)	(0.000)	(0.000)
Married	0.105***	0.090***	-0.035***
	(0.010)	(0.006)	(0.009)
R-squared	0.138	0.161	0.015
Panel B: Major controls			
Female	-0.078***	-0.147***	-0.050***
	(0.008)	(0.007)	(0.008)
Test score	0.100***	0.088***	-0.011**
	(0.004)	(0.003)	(0.004)
Age	0.084***	0.076***	-0.017**
	(0.006)	(0.006)	(0.006)
Age-squared	-0.001***	-0.001***	0.000
	(0.000)	(0.000)	(0.000)
Married	0.097***	0.081***	-0.033***
	(0.010)	(0.006)	(0.009)
College major (Reference=Engineering)			
- Humanities	-0.207***	-0.196***	0.010
	(0.009)	(0.009)	(0.009)
- Social Science	-0.048***	-0.058***	-0.012
	(0.007)	(0.007)	(0.007)
- Education	-0.049***	-0.102***	-0.060***
	(0.011)	(0.010)	(0.010)
- Natural Science/Mathematics	-0.151***	-0.115***	0.036***
	(0.009)	(0.008)	(0.008)
- Medicine/Public Health	0.134***	0.102***	-0.003
	(0.013)	(0.013)	(0.013)
- Arts/Athletics	-0.329***	-0.303***	0.011
	(0.010)	(0.010)	(0.010)
R-squared	0.186	0.208	0.019
Panel C: Gap explained by Majors			
1 - (b)/(a)	0.350***	0.233***	0.030
	(0.031)	(0.016)	(0.036)

Notes: OLS regression model. Sample of the 2005-2008 GOMS1 & 3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include age, age-squared and dummy for being married.

The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.5. Gender Gap in Job Mobility

Dependent variable	1: firm change 0: not change	1: industry change 2: not change
Sample	Employed, Both surveys (1)	Employed, Both surveys (2)
No. of observations	22,985	22,985
Panel A: No Major Controls		
Female (a)	0.026**	-0.019*
	(0.009)	(0.008)
Test score	-0.074***	-0.041***
	(0.004)	(0.003)
Pseudo R-square	0.047	0.027
Panel B: Major controls		
Female (b)	0.006	-0.024**
	(0.009)	(0.008)
Test score	-0.065***	-0.030***
	(0.004)	(0.004)
College major (Reference=Engineering)		
Humanities	0.107***	0.038***
	(0.012)	(0.009)
Social Science	0.030***	0.020**
	(0.009)	(0.007)
Education	-0.040***	-0.101***
	(0.012)	(0.008)
Natural Science/Mathematics	0.073***	0.038***
	(0.011)	(0.009)
Medicine/Public Health	0.042**	-0.054***
	(0.016)	(0.011)
Arts/Athletics	0.186***	0.091***
	(0.014)	(0.012)
Pseudo R-square	0.059	0.042
Panel C: Gap explained by Majors		
1 - (b)/(a)	0.771***	-0.288*
	(0.292)	(0.166)

Notes: Probit model, marginal effects reported. Sample of the 2005-2008 GOMS1 & 3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.6. Gender Gap in Employment by High School Track

Dependent variable	1: labor force 0: not in the labor force	1: employed 0: not employed but in the labor force	1: regular workers 0: not regular workers but employed	1: regular at big firm 0: not regular workers at big firm but regular workers
	(1)	(2)	(3)	(4)
Panel A: Humanities and Social Science Track – Initial				
Female with no majors (a)	-0.005	-0.016***	-0.029**	-0.062***
	(0.009)	(0.005)	(0.011)	(0.015)
Female with majors (b)	-0.001	-0.012**	-0.017	-0.060***
	(0.009)	(0.004)	(0.011)	(0.015)
Gap explained by Majors: 1 - (b)/(a)	0.760	0.143*	0.418**	0.017
	(1.338)	(0.082)	(0.176)	(0.075)
No. of observations	18,159	14,078	13,419	10,317
Panel B: Humanities and Social Science Track – Follow-up				
Female with no majors (a)	-0.040***	-0.026***	-0.055***	-0.147***
	(0.007)	(0.008)	(0.008)	(0.014)
Female with majors (b)	-0.035***	-0.015	-0.037***	-0.082***
	(0.008)	(0.008)	(0.009)	(0.015)
Gap explained by Majors: 1 - (b)/(a)	0.117*	0.407***	0.322***	0.441***
	(0.062)	(0.156)	(0.068)	(0.057)
No. of observations	14,305	12,170	10,354	9,023
Panel C: Math and Science Track – Initial				
Female with no majors (a)	0.043***	-0.010*	-0.003	-0.096***
	(0.009)	(0.004)	(0.010)	(0.015)
Female with majors (b)	0.048***	-0.004	0.019	-0.046**
	(0.009)	(0.004)	(0.009)	(0.016)
Gap explained by Majors: 1 - (b)/(a)	-0.112*	0.498**	6.490	0.516***
	(0.059)	(0.250)	(19.152)	(0.105)
No. of observations	19,274	14,667	14,204	11,644
Panel D: Math and Science Track – Follow-up				
Female with no majors (a)	-0.051***	-0.020*	-0.044***	-0.158***
	(0.008)	(0.008)	(0.009)	(0.015)
Female with majors (b)	-0.047***	-0.013	-0.021*	-0.073***

Dependent variable	1: labor force 0: not in the labor force	1: employed 0: not employed but in the labor force	1: regular workers 0: not regular workers but employed	1: regular at big firm 0: not regular workers at big firm but regular workers
	(1)	(2)	(3)	(4)
Panel A: Humanities and Social Science Track – Initial				
	(0.008)	(0.008)	(0.009)	(0.016)
Gap explained by Majors: 1 - (b)/(a)	0.077	0.352*	0.494***	0.545***
	(0.051)	(0.190)	(0.118)	(0.066)
No. of observations	14,755	12,784	11,025	9,677

Notes: Probit model, marginal effects reported. Sample of the 2005-2008 GOMS1 & 3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include test scores, age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.7. Gender Gap: Earnings by High School Track

Dependent variable	Log monthly earnings: Initial Survey	Log monthly earnings: Follow-up survey	Change in the log monthly earnings
Sample	Employed, Initial survey	Employed, Follow-up survey	Employed, Both surveys
	(1)	(2)	(3)
Panel A: Humanities and Social Science Track			
Female with no majors (a)	-0.120***	-0.194***	-0.033**
	(0.012)	(0.010)	(0.012)
Female with majors (b)	-0.098***	-0.155***	-0.034**
	(0.012)	(0.010)	(0.012)
Gap explained by Majors: 1 - (b)/(a)	0.181***	0.200***	-0.045
	(0.031)	(0.022)	(0.055)
No. of observations	13,328	10,300	9,730
Panel B: Math and Science Track			
Female with no majors (a)	-0.057***	-0.168***	-0.067***
	(0.012)	(0.010)	(0.012)
Female with majors (b)	-0.030**	-0.128***	-0.064***
	(0.012)	(0.010)	(0.012)
Gap explained by Majors: 1 - (b)/(a)	0.471***	0.240***	0.042
	(0.117)	(0.026)	(0.041)
No. of observations	14,109	10,974	10,968

Notes: OLS regression model. Sample of the 2005-2008 GOMS1 & 3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include test scores, age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table B.8. Gender Gap in Job Mobility by High School Track

Dependent variable	1: employer change 0: not change	1: industry change 2: not change
Sample	Employed, Both surveys	Employed, Both surveys
	(3)	(4)
Panel A: Humanities and Social Science Track		
Female with no majors (a)	0.012	-0.008
	(0.014)	(0.012)
Female with majors (b)	0.002	-0.010
	(0.015)	(0.012)
Gap explained by Majors: 1 - (b)/(a)	0.851	-0.373
	(1.051)	(0.706)
No. of observations	9,846	9,846
Panel C: Math and Science Track		
Female with no majors (a)	0.026	-0.037***
	(0.014)	(0.011)
Female with majors (b)	0.014	-0.035**
	(0.014)	(0.011)
Gap explained by Majors: 1 - (b)/(a)	0.436	0.031
	(0.271)	(0.080)
No. of observations	11,091	11,091

Notes: Probit model, marginal effects reported. Sample of the 2005-2008 GOMS1 & 3. Dummies for entrance years, survey years, and residence fixed effects are included. Other controls include test scores, age, age-squared and dummy for being married. The standard errors are in parentheses. The asterisks *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.