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Mismatches in the Labor Market for College Graduates: Focusing on Field-of-Study Choice

Joseph Han, Fellow at KDI

“The intense major-occupation mismatch is attributed to difficulties in adjusting admission quotas within universities, insufficient labor-market information at the department level, and uniform timing of decisions on college majors. To cope with the rapidly changing technological and industrial landscapes, efforts are needed to make meaningful improvements in quota regulation, career education, and university-level curricula.”

I. Issues

Educational innovation has become a crucial agenda amid today's rapidly changing technological and social landscapes. Besides the increasing attention on re-training and lifelong learning as a means of tackling the challenges posed by population aging and the Fourth Industrial Revolution, urgent calls are being made for changes in K-12 and higher education to cultivate human capital that is compatible with the coming era. In particular, with the swift developments in AI and IoT, much of the emphasis has shifted away from acquiring existing knowledge to fostering the 4Cs—creativity based on a deep understanding, critical thinking, collaboration and communication. As the demand for a workforce equipped with such competencies is expected to mount across all industries including manufacturing, governments are trying hard to innovate K-12 education and promote university education.

However, Korea is in quite a different situation from other countries. While about 70% of high school graduates continue their study at colleges and universities, more than a quarter of young college graduates are without jobs. Moreover, the majority of those who do find a

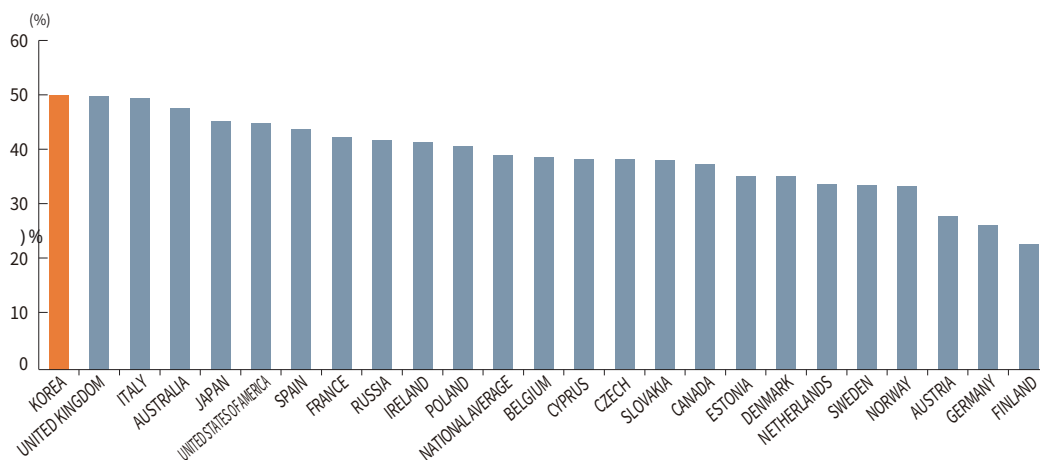
The accelerating pace of progress in technology and industry has highlighted the need for change.

The mismatch between occupation and major in Korea nears 50%, the highest among the surveyed OECD members.

job are in fields that are unrelated to their chosen majors. According to a recent OECD survey (2015), the mismatch between occupation and college major in Korea is approximately 50%, the highest among OECD countries (Figure 1). Nonetheless, secondary education has become so entangled with university admissions that there is little room to cultivate new competencies that meet future demands.

This study examines the problems within Korea's education system, focusing on the choice of college major. The employment rate and mismatch varies significantly depending on the respective major, and choosing what to learn has become more important with the rapid changes in the world of work. Based on the empirical results, the directions for educational reform are discussed.

[Figure 1] Major-Occupation Mismatch Among College Graduates (25-34 yrs)



Note: The major-job mismatch was calculated as the share of wage workers (OECD PIAAC) aged 25-34 who completed higher education (incl. 2-year colleges) in a major that is unrelated to their occupation.

Source: Reconstruction of Figure 1 from Montt (2015), p.11. Recited from Han (2018).

II. Constraints on Field-of-Study Choice in Korea

1. Enrollment Controls

Enrollment controls serve as the most direct obstacle in field-of-study choice in four-year universities. Such regulations, combined with the hierarchy of universities and majors—specifically, the double-fold selection processes at admissions and labor market entry (Kim and Kim, 2012)—force many students into fields in which they had no interest.

A) Regulations in the Seoul area

Despite the fact that the establishment and operation of colleges and universities in Korea are based on the principle which respects autonomy, there are a few exceptions. For example, universities in the Seoul area are subject to a regulation on total freshman enrollment (i.e., admission quota), which is an antiquated directive aimed at curbing overcrowding in the region. Although the enrollment regulation controls the number of admitted students at the university level and not at the department level, it limits the speed of quota adjustment across departments because there is less incentive to respond to student demand, even under

Total student quotas for universities in the capital-region serve as a significant constraint on the adjustment of quotas for respective majors.

centralized decision-making. Furthermore, intense conflicts of interest can arise between departments with increased quotas and those with reduced quotas. Indeed, it is difficult to convince parties that a cutback is needed when there is excess demand. While quota adjustments across similar or adjacent majors occur frequently, it is rarely observed that quotas are adjusted across different majors.

<Table 1> analyzes whether admission quotas of each department at four-year universities is adjusted according to the “competition rate” of the previous year, which is the ratio of applicants to admission quota. A high competition rate, which is widely referred to as high demand, is likely to raise the quota if educational supply responds to educational demand. According to the empirical results, some level of adjustment¹⁾ occurs at private universities outside of the Seoul area (column ②) but barely in those in the Seoul area (column ③). Similar results were observed in various analyses that took into account university ranking and geographical proximity.

This phenomenon would not be an issue if there was no strict university hierarchy. However, due to a strong preference for universities in the Seoul area, many students give up their preferred field to enter into a highly-regarded university. This causes a deviation from the social optimum which is achieved by placing the right person in the right position; especially in terms of the cultivation of a talented workforce that can spearhead future innovation.

<Table 1> Changes in the Student Admissions Quota by Department at Four-year Private Universities

Dependent variable: a time-differenced logged quota ($\Delta \ln q$)	①	②	③
	Total	Non-capital region	Capital region
Competition rate for previous year (= no. of applicants/admissions quota)	0.0032** (0.0008)	0.0026** (0.0007)	0.0003 (0.0003)
Competition rate for previous year x dummy for quota regulation	-0.0029** (0.0009)		
University-by-year fixed effects	Y	Y	Y
No. of observations	23,867	14,725	9,142

Note: This analysis only includes private universities and excludes national and public universities where all department-level enrollments are controlled. The admissions quota for the previous year was controlled, and similar results were obtained when this variable was not controlled or when the university's fill rate or the number of full-time faculty per student was additionally controlled. The numbers in the parentheses are standard errors and campus-level clustered data was used. *: $p < 0.05$, **: $p < 0.01$.

Source: Panel data on the campus-major (middle-level category) unit of four-year universities nationwide (2006-2017) constructed based on the original data from University Statistics by the Korean Educational Development Institute (KEDI). Revised and cited from Han (2018).

B) Regulations on special academic majors

Meanwhile, colleges and universities are prohibited from adjusting the admission quotas of special majors such as health and education (Article 28 (3) of the Enforcement Decree of the Higher Education Act). This is closely tied to the entry regulations for relevant occupational groups. For example, medical practitioners are required to have qualifications or licenses issued by the Ministry of Health and Welfare. In order to be eligible for the pertinent tests and examinations, they must first complete a qualified program in the relevant field. This dual-track qualification regulation is intended to guarantee a minimum level of expertise while also

1) This estimate means that an increase of 1 in the previous competition rate (increase in the previous year's applications that corresponds to 100% of the previous admission quota) leads to a 0.25% increase in the current admission quota.

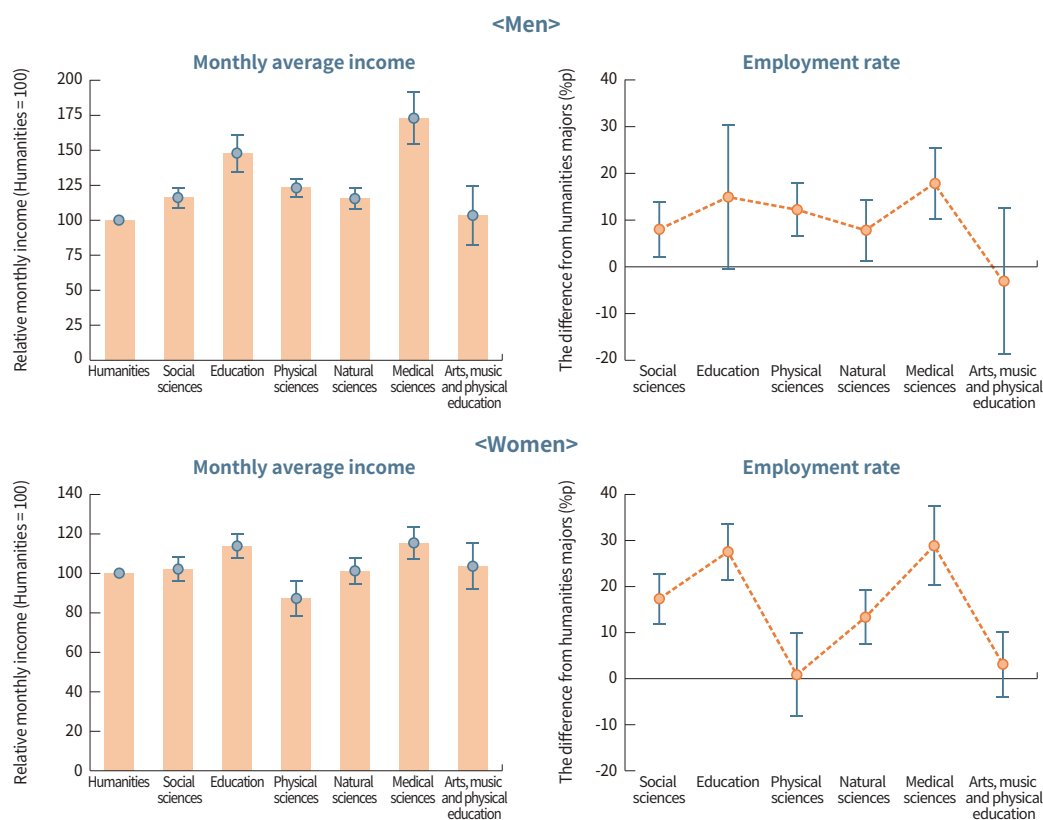
The gap in income and stability resulting from student quotas for special majors has incurred a herd behavior towards certain majors.

servicing to improve the income and stability of workers in the field.

Based on the Korean Labor and Income Panel Study (KLIPS) data, [Figure 2] shows the estimated gap between lifetime income and employment rate by major. It summarizes the results of tracking the labor market performance of those born in the 1970s for roughly 20 years after graduation. The income of health and education majors, irrespective of gender, is notably high with strong statistical significance. Moreover, the employment rate of female graduates from these majors is also remarkably high. Although it is certainly true that the people who choose such majors may have higher work ability, the results after controlling for the percentile score in the national entrance exam and parents' education still show an income gap of 70% (or more in some sub-fields).

The regulations on both major-specific quotas and pre-test requirements, to some degree, restrict the freedom of occupational choice. Nonetheless, these regulations are justified because of the need for ensuring quality. Informational asymmetry facing consumers in those fields can necessitate the qualification standards that require a certain level of education.²⁾

[Figure 2] Labor Market Outcomes by Fields of Study



Note: The table above shows the difference between monthly average income and employment rate by field of study, controlling for a cubic in potential experience, the percentile for the national exam score, educational years of parents and year fixed effects. The base is the field of humanities. Meanwhile, monthly income surveyed each year was used as the income, and the presented gap denotes the average income gap over the past two decades since graduation. The employment rate was defined as the ratio of full-time workers to population. The gap presented denotes the average gap in employment over the past two decades since graduation. The vertical range shows a 95% confidence interval (CI) of the difference from the base.

Source: KLIPS, wave 1-19. Revised and cited from Han (2018).

2) For example, the Constitutional Court Decision 2009 Hun-ba 23 (Oct. 28, 2010), Constitutional Court Decision 2016 Hun-ma 713 and 2018 Hun-ma 48 (integrated, Feb. 11, 2018).

However, if the gap in lifetime earnings and employment stability widens beyond a reasonable level, it is highly likely to incur side effects such as mismatches between talents and occupations. That is, students who have talents in other fields such as natural sciences and engineering would more likely choose medical school due to the relatively high income. Those who demonstrate a talent for humanities and social sciences may also lean towards education through which they can become teachers and obtain stronger job security. Such inclinations are also verified in the survey results of college freshmen (Table 2).

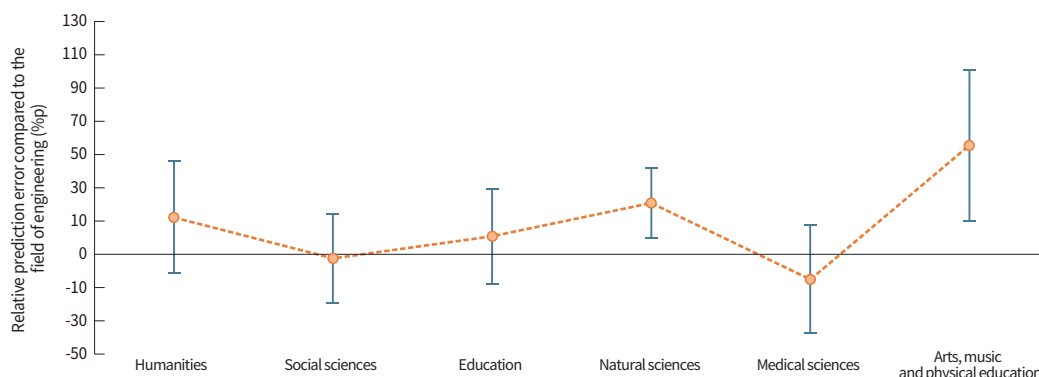
2. Insufficient Labor-market Information

Another constraint in the selection of majors is the insufficient information students have about the labor market. Due to fierce competition to gain entrance into university, students are often ignorant about what type of job or career is possible from the major they choose and the possible earnings in particular. Thus, choosing a major under such conditions may vastly differ from a situation in which students receive ample information (Wiswall and Zafar, 2015).

In a 2018 nationwide KDI survey of 1,000 freshmen at four-year universities,³⁾ students were asked to estimate their earnings after graduation in the field they have chosen. Their answers were compared with the results from the Graduate Occupational Mobility Survey (GOMS) by the Korea Employment Information Service, an annual survey on the real income of about 20,000 graduates. The results reveal that the expected income and actual income are very close. Especially considering the changes in nominal income due to inflation, there are almost no differences between the two in the statistical sense.

The expected income of freshmen from four-year universities is similar to the actual average income of graduates, but this masks heterogeneity across college majors.

[Figure 3] Analysis of the Difference between the Expected Income and Actual Income



Note: Many other factors including family backgrounds and university fixed effects are also controlled for. The base is the field of engineering. The vertical range shows a 95% confidence interval (CI) of the difference from the base.

Source: KDI Survey of University Freshmen (2018). Revised and cited from Han (2018).

This, however, does not hold true for all majors. Analyses on the error rate, which is the difference between the expected and real values divided by the real value, show that freshmen in natural sciences, and art, music, and physical education are more optimistic about their future income than their peers in different fields at the university with similar backgrounds (Figure 3).

3) From the population of 144,550 freshmen from four-year universities whose admission quota was above 2,500 as of 2018, this survey drew a sample of 1,000 freshmen (25 universities) through a stratified sampling method by university type. Face-to-face investigations were conducted during May 2018.

Furthermore, according to a more detailed analysis of the error rate (Han, 2018), the error rate is strongly affected by parents' income, the current major's connectedness with the desired career, and the influence scores from private tutors, siblings or relatives on career decisions. These are consistent with the view that there is a considerable number of students who lack information about the labor market at university entrance.

3. Uniform Timing of Field Decisions

Another restriction on the choice of college majors is the uniformity of timing. Indeed, while some students decide on their future path quite early on, the vast majority take longer to discover their abilities and interests, with some remaining uncertain even after they enter university. However, if every student is forced to make a decision which is difficult to reverse at a given time, there will inevitably be regrets. This could occur even with sufficient knowledge about the labor market.

According to the aforementioned KDI survey (2018), about 28.2% of university freshmen wanted to change their current major. In terms of the subjective possibility of switching, there were vast differences between majors, with humanities at the top, and natural, social, and physical sciences following in sequential order (Table 2).

<Table 2> Share of Freshmen Wanting to Change Majors

(%)

From \ To	Total	Humanities	Social sciences	Education	Physical sciences	Natural sciences	Medical sciences	Arts, music and physical education
Humanities	42.5	9.9	9.4	11.9	1.0	1.9	2.7	5.7
Social sciences	30.0	1.7	19.6	3.8	2.7	0.2	0.6	1.5
Education	16.6	4.7	6.6	4.2	0.0	0.0	0.4	0.6
Physical sciences	25.8	0.7	2.8	0.2	14.8	1.5	4.9	0.9
Natural sciences	35.7	2.7	1.0	1.2	6.5	7.7	16.2	0.5
Medical sciences	16.9	0.0	0.0	4.8	0.0	0.0	8.7	3.4
Arts, music and physical education	12.7	1.3	2.0	1.3	0.0	2.0	0.6	5.5

Note: Shaded boxes denote the most chosen major by students looking to transfer.

Source: KDI Survey of University Freshmen (2018). Revised and cited from Han (2018).

For the target major of possible switching, most in humanities chose education while those in natural sciences chose medical sciences. This is consistent with the aforementioned "rushing" into protected majors. The majority in social and engineering chose a different sub-field within the same field of study. While this is partly due to the fact that some sub-fields are more popular than others, it is also due to department-level admissions quotas for social and engineering in many universities. Students who want to study these fields often have difficulties in differentiating between the specific majors before actually beginning their studies.

A more detailed analysis on the subjective probability of switching majors confirms the significance of admission units' breadth. For instance, even with a comprehensive set of control variables—personal characteristics, family background, year and location of high school graduation, national exam grades, current major, location and type of current university, type of admissions process and the number of received acceptances—the probability of switching majors when admission units are colleges or groups of majors was found to be much less than when these units are departments.

In a similar vein, in terms of whether students regretted their choice between liberal arts and natural sciences in high school, a statistically significant relationship was found with the subjective probability of switching majors in university. To the question on the reasons for their field choices in high school, over 20% of respondents answered that they were only thinking about getting into university or just following what others were doing. A particularly high percentage of these students expressed strong regrets over their choice in high school (Table 3). These results suggest that, due to the rigidity of the period for career decisions, some students are forced to make decisions too early, and which they will later regret.

Many students struggle with regret over their forced decision between liberal arts and natural sciences in high school and their major in university.

<Table 3> Reasons for Choosing a Field of Study in High School and Share of Students with Regrets

(% , %p)

Reasons	%	% of students with regrets	Difference with ① (%p)
Total	100	21.2	-
① Aptitude	57.8	14.8	-
② University admissions	14.6	36.9	22.1**
③ Future career prospects	11.4	26.0	11.2*
④ To fulfill a dream	8.7	11.7	-3.1
⑤ Followed others	6.3	46.1	31.3**
⑥ No choice of field	0.4	0.0	-14.8**
⑦ Other	0.7	50.9	36.1

Note: The last column shows the difference with ① with separately expressed statistical significance levels: *, p<0.05, **, p<0.01.

Source: KDI Survey of University Freshmen (2018). Cited from Han (2018).

III. Suggestions for Institutional Improvements

1. Reconsidering Enrollment Regulations

The current enrollment regulations need a thorough review. For the enrollment cap on universities in the Seoul area, a close inspection is required on how a complete lift of the control would affect the balanced regional development. Nonetheless, a partial lift is immediately possible. For instance, universities can be allowed to determine their admission quotas for the majors related to emerging industries, irrespective of the total enrollment cap. In this case, the number of students in these majors would increase accordingly in the prestigious universities in Seoul, mitigating the distortions in the selection of college majors. Meanwhile, as freshman enrollments in other majors remain subject to the regulation, there would be no

major repercussions to regional development. For certainly, as it is the unusually-strict ranking of universities that is most at fault for the distortion, concerted efforts should follow to alleviate the problem in the mid- to long-term.

As evident from the past experience of the Program for Industrial needs-Matched Education (PRIME, 2016-2018), there can be ramifications due to estimation errors and fairness issues over selecting targets of support if the government sets an arbitrary target and pushes for a sharp increase in quotas in certain majors. It is difficult to predict technological progress and change, and if political consideration weighs heavily in such selections, departments may become inclined to stay afloat through subsidies. In the recent discussions on the establishment of AI-specialized graduate schools and software major programs, it is a better approach to promote competition to attract outstanding teachers and to improve the quality of education through regulatory reforms than conventional approaches in terms of fostering core human resources and retaining them through pertinent rewards. In this case, the choice of fields by students, who are likely to think most deeply about their future, can naturally adjust skill supply.

For special majors, such as health and education which are under direct government control, the appropriateness of current admission quotas should be regularly reviewed from the perspective of the general society in consultation with relevant experts. For instance, a quota increase may be necessary for the medical field, which is expected to be in growing demand due to population aging (Lee and Hwang, 2015). It is also a reasonable direction in terms of correcting imbalances in college major choices. However, the complexity of the medical system also requests a highly prudent approach. On the other hand, in the field of education, where demand for teachers is declining due to a shrinking school-age population, a reduction is unavoidable. Some argue that the quota should be maintained in order to improve the quality of education, but a thorough empirical examination is still required on the actual benefits of reducing class sizes (Han and Ryu, 2017).

2. Reinforcing Career Education

Korea's career education has made great strides through such initiatives as the Career Education Act (2015), establishment of career courses, and assignment of relevant teachers. Regardless, according to the above analysis, the freshmen of 2018 were not fully informed of career-related information, implying that there is still room for improvement.

Students preparing for higher education are often faced with a situation that is similar to the 'prisoner's dilemma.' That is, deeply immersed in the pending competition to enter university, they do not have enough time to explore career options. To tackle this, it may be effective to make career exploration obligatory within the current education system. There is no doubt that a semester dedicated to careers is needed, but it is also important to develop a concise and focused curriculum for course subjects and work experience activities.

Additionally, as the current system allocates only one dedicated teacher per school, more teachers should be assigned according to the number of students. When students are counselled about university admissions and career options, they should be provided with more realistic and specific information such as earnings, than merely the employment rates released by each university or department.

A partial lift of the enrollment control is needed for capital-region universities while regular reexaminations are conducted of the appropriateness of student quotas for special majors.

To reinforce career education, a semester dedicated to careers is needed on a more substantial scale. In addition, more teachers should be assigned, and information on the performance of the labor market at a department level should be provided.

3. Allowing More Flexibility in College Major Choices

Lastly, more flexibility must be granted to students when they are choosing or changing majors. Students who have already decided on their careers should be provided with advanced education in the field of their choice while those who have not should be given opportunities to extensively explore their career paths. In particular, considering that the traditional academic tracks in general high school—liberal arts and natural sciences—were integrated in 2019 and a comprehensive high school credit system is to be initiated in 2025, there should be sufficient consideration for both types of students. To reduce the costs of switching majors afterwards, the range of mandated academic subjects needs to be extensive enough. At the same time, meaningful in-depth courses need to be provided through high school associations and/or collaboration with local universities. To further promote career exploration, evaluation methods at high school should be designed in a way that early mistakes lead to no critical disadvantages at university admissions.

On the other hand, admission units should be integrated to enable students to sufficiently explore fields after university admissions. However, it should also be noted that there may be unexpected side effects if the integration of admission units are forced on universities without consideration on their unique circumstances. For example, as shown in the past case of the admission units' integration policy (1998-2008), a rationing of respective majors based on student GPA occurred at the stage of major declaration due to the remaining quotas for respective majors. A large number of students ended up majoring in subjects they had no interest in. The policy discouraged career exploration, contrary to its intended goal.

In the meantime, some universities—mainly institutes of science and technology—have implemented a system in which students are admitted without a major and allowed to freely select and change their majors thereafter without limits. Some programs are even without any field declaration, which has been an important factor of increasing the attractiveness of those universities. While maintaining the principle of autonomy, the government needs to provide enough incentives for universities to expand the choice sets of students through internal discussions that consider the unique circumstances facing each university.

Policies concerning the timing of college major choices must give proper consideration to both students who decide on their career path early and those who remain undecided.

Under the principle of autonomy, more encouragement is needed to broaden college major choices.

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