Enhancing the Link between Higher Education and Employment : An Empirical Study

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I. Purpose and Significance of this Study

- Purpose

  - to improve Efficiency of the Fiscal Assistance Programs (FAPs)for Higher Education to improve graduate Employment Rates

  - to find Determinants of graduate Employment Rates

  - so that future FAPs focus on the educational management indicators that determine graduate employment rates

Significance of this Study

- **College graduates employment rate** is low in recent years– -a world-wide phenomenon – -many advance countries have adopted **Fiscal Assistance** programs for higher education
- Korean government also **adopted Fiscal Assistance Programs**. However, Korean government's assistance to higher education is lower than the average of OECD members due to fiscal constraints. – We need to improve efficiency of the current fiscal assistance programs for higher education
- The current fiscal programs do not understand the **Determinants of college graduates Employment Rate,** and use some sets of educational management indicators for selection, monitoring , and assessment of higher educational institutions for the fiscal assistance programs.
- The Fiscal Assistance Program and its indicators are indirectly forcing higher educational institutions to focus **their management around those indicators**
- To Improve Efficiency of the Fiscal Assistance Programs and Management of higher educational institutions, **ascertaining the determinants of graduate employment rates** is a **high priority prerequisite** to a sound design and operation of the fiscal assistance programs.

II. Issues and Hypotheses to be Tested

- Are the Educational Management Indicators used in the current Fiscal Assistance Programs for Higher Education significant **Determinants of College Graduate Employment Rates**?
- Which of the indicators are more instrumental than others?

III. Literature Review (1/5)

- Educational Production Function Studies

- Educational Outputs: most studies use Achievement level and Graduation level;

only a few studies use Graduate Employment rate

- Educational Inputs: Hanushek(1989,95): student-teacher ratio, teacher educational level, teacher experience level, teacher compensation level, per-student educational expense, school management, and school facilities.

: Coleman (1996): school-related factors, peer groups, individual cognitive ability, and family background factors.

- Educational production function studies in Korea

- College Information Opening system (2008)

- Choi (2008) using such financial input indicators as scholarship recipient rates and tuition dependency rates, and such personnel input indicators as instructional hours. Scholarship recipient rates and private university are significant determinants. → misses many other variables.; 1-year data.

- Jang (2004): student-teacher ratio and personnel expenses are significant →non-personnel expenses, esp. investment in facilities may improve educational quality and employment rate in the long run.

III. Literature Review (2/5)

- Fiscal Assistance Programs in Korea

  -Since Higher Education Law (1997), general Fiscal Assistance Programs (FAP) have operated for all higher educational institution

  -Since 2004, selective and discriminatory FAP upon assessing institutions by certain educational management indicators

- FAPs:

  Brain Korea 21 (BK21) (2006~12), Educational Capacity Strengthening(**PEUEC**) (2008~), World-Class University(WCU) (2008~13), Restructuring Higher Educational Institutions (2005~), Balanced Provincial College (NURI) (2009~), Leaders in Industry-University Cooperation (LINC) (2012~), New University for Regional Innovation (**NURI**) (2004~08).

- **PEUEC and NURI** use employment rates explicitly for FAP.

III. Literature Review (3/5)

- **PEUEC and NURI uses the following Educational Management Indicators:**

Achievement Indicators		Management Indicators							Total
Employment Rate	Enrollment Ratio	Internationalization Index	Full-time Faculty Ratio	Management of Curriculum and Academic Affairs	Per-student Educational Expenditure	Scholarship Rate	Educational Expense Ratio to Total Tuition	Admission Test Index	
20%	20%	5%	10%	10%	10%	10%	10%	5%	100%

III. Literature Review (4/5)

- Shortcomings of Previous Studies (Park 2010, Jung 2008, Ryu et al 2008, etc.)

  - They confirmed positive impacts of FAPs on the employment rate, but do not shed light on the causal relationship between educational management indicators and the employment rate itself.

  - They do not clarify whether and how FAP affects educational management indicators, or whether educational management indicators have equal or differing effects on the employment rate.

  - They cover only a few Educational management indicators in the analysis.

  - They do not show How educational input indicators affects employment rates: e.g. interactively and with increasing return?

  - They consider only one FAP's impact on employment rates; do not allow for interaction among FAPs.

  - They consider mainly impact on universities participating in a FAP, not include impact on non-participating universities.

III. Literature Review (5/5)

- Proposed Study will :

  - identify the educational input indicators that determine the employment rate.

  - include all educational management indicators that have been used in the selection, monitoring, and assessment of higher educational institutions involved in fiscal assistance programs aimed at enhancing the employment rate.

  - covers all higher educational institutions and tries to determine whether institutions' characteristics influence the employment rate.

  - allow for non-linear and interactive effects of educational indicators on employment rates

IV. Model, Data, and Estimation Method

- Model (1):

$$Y = a_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_7 + e$$

- **Y**: college graduate employment rate
- : constant term
- : the university type (public:0 or private:1)
- : the university location (Seoul metropolitan area: 0 or other areas: 1)
- : the scholarship rate
- : per student educational expense
- : the number of students per full-time faculty member
- : the number of students per industry-academe liaison officer
- : year (2010 or 2011)
- : error term

Data and Method

- Data are from the Higher Education Statistics of the KEDI (2010-2011)

Type of Colleges	Location of Colleges		Total
	Seoul Metro. Area	Other Areas	
Private	91	134	225
Public	6	37	43
Total	97	171	268

- The model was estimated with OLS

Descriptive Statistics

Variable		Min.	Max.	Average	S.D.
Dependent	Employment Rate (Unit: %)	22	100	53.48	8.837
Independent	College Type(Dummy)	0	1	0.16	0.368
	College Location(Dummy)	0	1	0.64	0.481
	Scholarship Rate (%)	0	466.24	20.70	28.110
	Per Student Expense (Unit: thousand Won)	0	33439.5	9174.94	3681.794
	Number of Students per Instructor (Unit: person)	9.3	56.6	32.92	7.923
	Number of Students per I-U Co operation professor (Unit: person)	0	983.3	414.01	868.838
	Year (Dummy)	0	1	0.50	0.501

Employment Rates by Type and Location

Variable		2010		2011	
		No. of Obs.	Employment Rate	No. of Obs.	Employment Rate
Type of Colleges	Public	22	53.0	21	55.3
	Private	112	51.7	113	55.0
Location of Colleges	Seoul Metropolitan	48	50.8	49	53.4
	Other Areas	86	52.5	85	56.0
Total/Average		268	51.9	268	55.1

V. Empirical Results (1/4)

Independent Variable	OLS Estimation of Equation (1)	
	B	Beta
Constant	50.374	
Type of Colleges (Public vs. Private)	-3.475 (1.447)	-.145*
Location of Colleges (Seoul Metropolitan vs. Other Areas)	3.462 (1.131)	.189**
Scholarship Rate	2.376E-02 (.018)	.076
Per-Student Expense	7.336E-04 (.000)	.306***
Number of Students per Instructor	-.212 (.079)	-.190**
Number of Students per I-U Cooperation Officer	-2.09E-04 (.001)	-.040
Year (2010,2011)	2.757 (.956)	.156*

R^2: 0.228
Dependent variable: Employment Rate
( ): standard errors
***: p<.001,**: p<.01,*:p<.05

Findings based on Model (1)

- Statistically Significant Coefficients
  - University Characteristics

    (Public univ. with higher employment rate: contradicts previous studies)

    (Outside the Seoul Metro Areas with higher employment rate: confirm previous studies)
  - Students vs. Full-Time faculty Ratio (negative coefficient)
  - Per Student Expenses (positive coefficient)
- Non-Significant Coefficients
  - Students per University-Industry Liaison Professor
  - Scholarship Rate
- Need to modify the Model (1)

  - Linear vs. Non-Linear relationship between employment rate and two significant variables

  - an Interactive Term (between two significant variables)

Model 2

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_4^2 + b_9x_5^2 + b_{10}x_4x_5 + e$$

x_4^2 : per student expense)^2

x_5^2 :(the number of students per faculty member)^2

x_4x_5 : (per student educational expense) x (the number of students per faculty member)

The rest of the symbols are defined in the same way as in Model (1).

Findings based on Model (1) and Model (2)

Independent Variables	Equation (1)	Equation (2)
	R^2=.228	R^2=.324
Type of Colleges (Private vs. Public)	-.145* (1.447)	-.159** (1.364)
Location of Colleges (Seoul Metro. Vs Others)	.189** (1.131)	.241*** (1.060)
Scholarship Rate	.076 (.018)	-.052 (.021)
Per-student Education Expense	.306*** (.000)	0.193 (.001)
Number of Students per Full-time Instructor	-.190** (.079)	-.964** (.0430)
Number of Students per I-U Cooperation Officer	-.040 (.001)	-.006 (.001)
Year (2010 vs. 2011)	.156* (.956)	.127** (.895)
(Per-student education expense)^2		.797** (.000)
(Number of Students per Full-time Instructor)^2		.891** (.007)
(Per-student education expense) x (Number of Students per Full-time Instructor)		.861*** (.000)

Findings on Model (2)

- Statistically Significant Coefficients
  - University Characteristics
  - Students vs. Full-Time faculty Ratio (negative coefficient)
  - Non-Linearity of Students-Teach Ratio and Per Student Expenses (positive)
  - Interactive Term (positive)
- Non-Significant Coefficients
  - Per Student Expenses
  - Students per University-Industry Liaison Professor
  - Scholarship Rate
- Need to modify the Model (1)

  - Non-Linear relationship between employment rate and two significant variables: significantly positive

  - an Interactive Term (between two significant variables): significantly positive

Findings: Marginal Effects of Per Student Expenses

- The Coefficient of **Per Student Expenses** is statistically insignificant.
- However, its marginal effects should be derived from Equation (2) as follows (i.e. take the first derivative with respect to student expense):

  - If we take the average of X_4 and X_5 and the estimated coefficients of b_4, b_8 and b_{10}, the marginal effect of per student expenses is a **Positive** value.

$$\frac{\partial Y}{\partial x_4} = b_4 + 2b_8 x_4 + b_{10} x_5$$

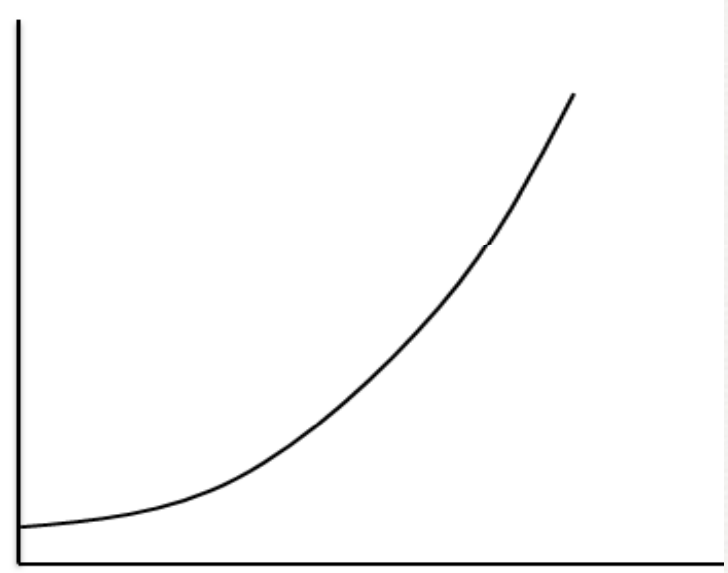
- Therefore, the per student expense variable **positively** affects employment rates.

Findings of Model (2): Non-Linearity of Two Variables(3/4)

Figure 1. Relationship between per-student expense or the number of students per faculty and the employment rate:

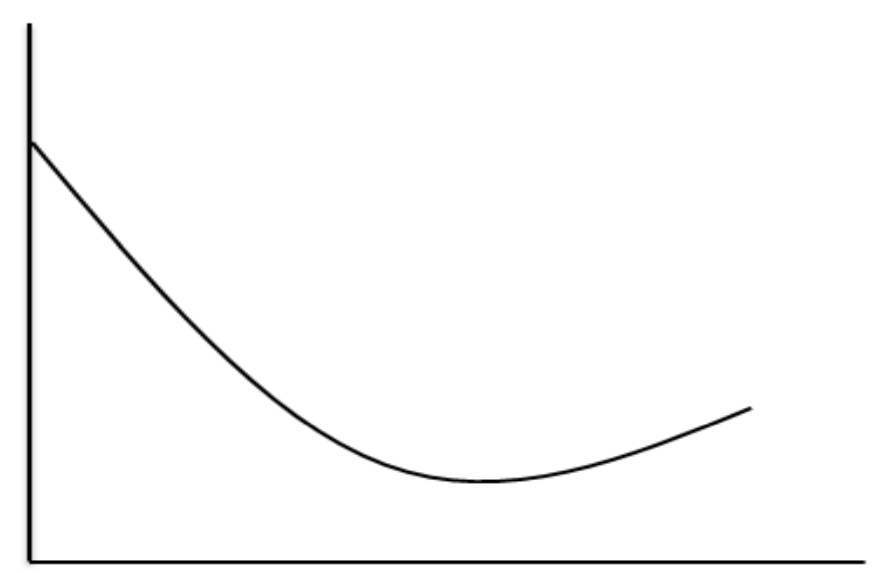
Increasing Return on Employment Rates

Employment rate



Educational expenses per student

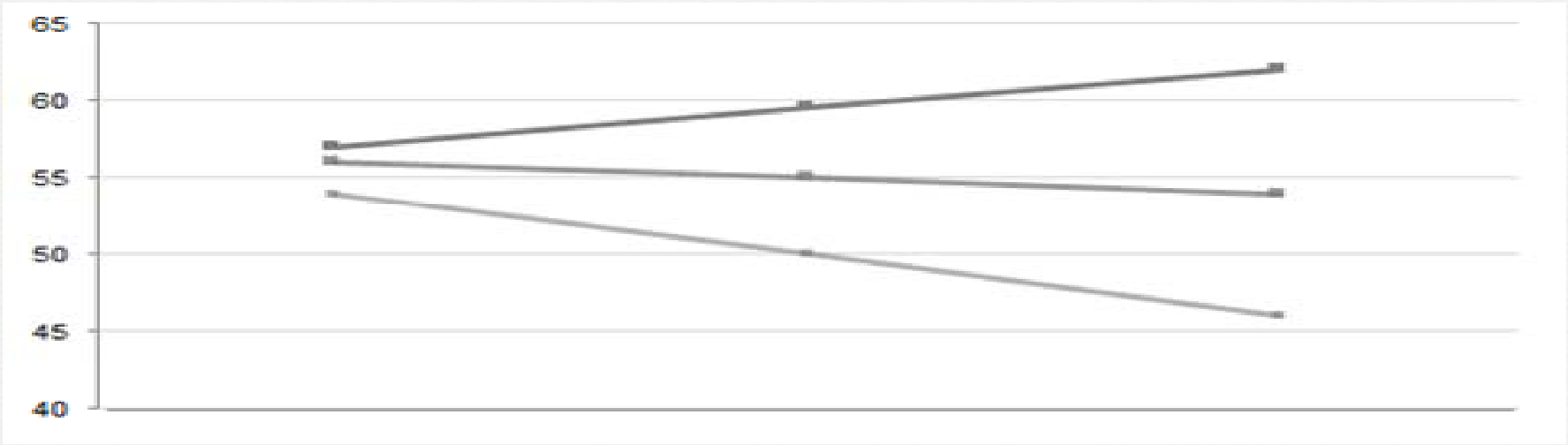
Employment rate



Number of students per full-time faculty member

Findings: Interactive Term Effect on Employment Rates (3/4)

- When the per student expense is at the relatively higher level (>$12,800), employment rates keep increasing, even as the student-teacher ratio increases.
- When the per student expense is at the relatively lower level (<$5,500), employment rates keep decreasing, as the student-teacher ratio increases.
- →the relatively higher per-student expense was achieved not by increasing the number of faculty members, but by recruiting better-quality instructors, raising faculty compensation, or improving educational facilities and equipment.



VI. Conclusions and Implications (1/2)

- Among the management indicators used by the current fiscal assistance programs for higher education,

- Per Student Expense and Student-Teacher Ratio variables affect the employment rate significantly even after the type and location of higher educational institutions are controlled.

- These variables affect employment rates positively at an increasing return and interactively. The per student expense variable is most instrumental.

- The variables of student/industry-academe liaison officer ratios and scholarship rates do not affect the employment rate in any statistically significant way.

- To make fiscal assistance programs for higher education more efficient, Priority and a greater weight should be given to Per student expense, and then the Student-teacher ratio.

VI. Conclusions and Implications(2/2)

- Future Studies on this topic should be made, using

  - employment rates by major (not by institution)

  - type of employment (regular, non-regular0

  - time-series and cross-section panel data.

Thank You!

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Enhancing the Link between Higher Education and Employment

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Enhancing the Link between Higher Education and Employment

요약:

본 연구는 대학에 대한 재정지원사업의 중요한 목표 중의 하나인 대학청년층의 취업률 제고를 위하여 대학졸업생의 취업률 결정요인을 실증적으로 분석함으로써 장래의 재정지원사업의 효율성 제고에 기여함을 목적으로 한다. 2010-2011 년의 고등교육통계자료를 이용한 분석결과에 따르면 대학소재지와 대학유형을 통제한 후에도 취업률에 일관되게 큰 영향을 미치는 변인은 학생 1 인당 교육비와 전임교수 1 명당 학생 수임을 알 수 있었다. 또한 두 변수가 취업률에 미치는 영향은 각각 체증하는 것으로 나타났으며, 또 두 변수가 서로 상호작용하여 취업률에 대한 영향을 확대시킨다는 것을 확인하였다. 학생 1 인당 교육비가 비교적 높으면, 전임교수당 학생수가 증가해도 취업률이 증가하며, 반대로 학생 1 인당 교육비가 낮은 경우에는, 전임교수당 학생수가 많아짐에 따라서 취업률이 감소한다는 결과를 확인했다. 또 산학협력전임교수 당 학생수와 장학금지급률은 취업률에 대하여 통계적으로 유의한 영향을 미치지 않는다. 대학에 대한 재정지원사업은, 이러한 취업률의 중요 결정요인에 더욱 높은 비중을 두고 대학을 선발하고 평가하여야, 취업률제고에 기여할 것이다.

주제어: 취업률, 대학재정지원사업, 대학교육의 질, 효율성

Abstract:

This study aims to improve the efficiency of fiscal assistance programs for higher education by investigating variables that influence college graduates' employment rates. An empirical analysis of 2010-2011 higher education statistics shows that two variables -- educational expenditure per student and the number of students per full-time faculty member -- consistently and significantly affect college graduates' employment rates, even after location and type of school are controlled. (In contrast, scholarship rates and the number of students per industry-academe liaison officer do

not have a statistically significant effect.) Moreover, as educational expenditure per student or the student/faculty ratio increases beyond a certain level, graduate employment improves at an increasing rate. The two variables also affect the employment rate interactively. At a relatively higher level of per-student expenditure, employment rates increase even as the student/faculty ratio rises. However, at a relatively lower level of per-student expenditure, employment rates decline as the student/faculty ratio rises.

The policy implication is that fiscal assistance programs for higher education should accord a much greater weight to these two key variables when selecting and assessing institutional recipients.

Key Word: employment rates, fiscal assistance programs, higher education quality, effectiveness

JEL: J23, I22, I28

Enhancing the Link between Higher Education and Employment

I. INTRODUCTION

This study aims to improve the efficiency of fiscal assistance programs for higher education with the goal of raising college graduates' employment rates. The low employment rate of college graduates is a world-wide phenomenon, and many governments have responded by trying to enhance macroeconomic growth rates, labor market flexibility, and higher-education quality.

The Korean government has also tackled the problem with a series of fiscal assistance programs for higher education institutions. However, despite a steady increase in fiscal support, graduate employment rates have remained stagnant, barely exceeding 50%. Since the enactment of Korea's Higher Education Law of 1997, government fiscal assistance has reached almost 10% of total education expenditures or ₩5 trillion (Ahn 2010). Furthermore, due to fiscal constraints, the level of fiscal support for higher education stands only at 73% of the OECD member countries' average. Under the circumstances, Korea should improve the efficiency of the fiscal assistance programs for higher education.

Understanding what determines graduates' employment rates is essential to this goal, but literature on these determining factors is sparse, and a rigorous analysis of the links between institutional fiscal assistance and employment has not been carried out.

Existing fiscal assistance programs have used sets of educational indicators to select and assess the colleges involved in the fiscal assistance programs; this practice incentivizes schools to prioritize those criteria. As a result, higher education quality is in fact managed around these indicators. Ideally, college education should be assessed based on output indicators, such as the employment rate. The current assessment practice includes both educational output and input indicators with some intuitive or arbitrary weights assigned to them and without a clear understanding of the theoretical and practical relationship between the input and output indicators.

It is critical to define the causal relationship between the educational management indicators as inputs and the employment rate as an output. However, no critical analyses have yet been made on whether such a relationship exists between these management indicators and graduate employment rates. In the absence of such studies, political proposals to help students, such as

halving college fees and tuition, or improving the quality of college education to balance the demand for and supply of college graduates, lack an empirical basis.

In order to ensure the effectiveness of the fiscal assistance programs for higher education, the selection and assessment of participating colleges should be made on the basis of the essential educational management indicators that would efficiently raise education quality and college graduates' employment rates.

Table1. Assessment-Related Higher Education Management Indicators and Their Weights

Indicators/ Programs	Emplo-yment Rate	Rat of Enrollment to Authorized Capacity	Full-Time Faculty Rate	Rate of Education Expenses to Tuition	Management of Academic Affairs	Rate of Scholarship to Tuition	Student Loan Repayment Rate	Moderation of Tuition Burden	Corporate Indicators	Total
Educational Capacity Strengthening Program	20	20	10	10	20	10	-	10	-	100
Eligibility for Fiscal Assistance Programs	20	30	7.5	7.5	10	10	-	10	5	100
Eligibility for Students Loan Program	20	30	7.5	7.5	5	5	10	10	5	100

Source: Kim, Soo Kyung (2013)

Accordingly, this study will analyze the determinants of college graduates' employment rates, not at an individual student level, but at the higher educational institution level, and compare the results with the educational management indicators actually used in Korean fiscal assistance programs.

This study consists of the following sections. Section 2 of this study will review earlier studies on educational productivity and examine Korea's fiscal assistance programs for higher education and related studies. Section 3 will explain how the methodology and data of this study can overcome the limitations of earlier studies. Section 4 will discuss the results of the empirical analysis, and the last section will summarize the analysis and explain the policy implications for enhancing college

graduates' employment rates.

II. REVIEW OF LITERATURE AND FISCAL ASSISTANCE PROGRAMS

1. Literature on Educational Productivity

The conceptual approach to the relationship between higher education inputs and outputs began with the theory of educational production functions. This economic approach regards schools as sites where various educational resources interact to produce educational outputs. Under this model, if educational investment is efficient, productivity will be high, resulting in a high level of educational quality (Ban 1994).

Investigating scholars differ on the nature of educational inputs. Hanushek (1989, 1995) divides educational inputs into 7 groups: student-teacher ratio, teacher educational level, teacher experience level, teacher compensation level, per-student educational expense, school management, and school facilities. U.S. educational sociologist Coleman (1996) classifies educational inputs as school-related factors, peer groups, individual cognitive ability, and family background factors. Hadderman (1998) uses six educational inputs: per-student educational expenses, student-teacher ratio, teacher educational level, teacher compensation level, school facilities, and school management.

Scholars also differ on educational outputs. In general, educational achievement level is used in many educational production function analyses. However, studies that use the employment rate as the educational output are few. Many U.S. studies have used the graduation rate as the educational output at different levels of education.

In Korea, there have not been many empirical studies that analyze the relationship between educational input and output indicators at the college level. Moreover, very few studies have analyzed college graduates' employment rates as an educational output, as the amount of educational input and output data has been insufficient for meaningful analyses. For example, Ban (1998) estimates the rate of return to higher education as an educational output by using such financial inputs as scholarship recipients and per-student educational expenses. Jun and Min (2009) also analyze the rate of return to higher education by using such financial inputs as instructors and school facilities. They find that as the student-teacher ratio declines, the school facility size increases, and the return to educational investment increases.

The launch of the College Information Opening System (2008) enabled scholars to evaluate

educational outputs more rigorously, especially the employment rate. Choi (2008), for example, analyzes variations in college employment rates by using such financial input indicators as scholarship recipient rates and tuition dependency rates, and such personnel input indicators as instructional hours at both individual and college levels. The study finds that the scholarship recipient rate consistently influences the employment rate positively, and private universities show higher employment rates than public universities. However, this study uses only one-year data and does not cover such important educational management inputs as per-student expense, student-teacher ratio, and student to industry-academe liaison officer ratio, and their influence on the employment rate.

Jang (2004) also studies educational inputs in relation to college graduates' employment rate. This study shows that increases in the student-teacher ratio have negative effects on the employment rate, and recommends more investment in the teaching force and imposing an upper limit on the student-teacher ratio. The study also argues that per-student educational expenses should be divided into personnel and non-personnel expenses, and that personnel expenses have statistically positive effects on the employment rate, while non-personnel expenses, especially school facility expenses, tend to reduce personnel expenses and affect the employment rate negatively in the short run. In the long run, however, investment in school facilities helps improve the quality of educational services and in turn enhances the employment rate. Therefore, this study fails to establish a clear-cut priority for educational investment.

2. Fiscal Assistance Programs

From the mid-1990s to the beginning of the 2000s, the Korean government provided fiscal assistance to improve the quality of all higher educational institutions. Since 2004, however, the government ceased to provide general fiscal assistance and instead has offered selective and concentrated fiscal assistance through monitoring and evaluation of higher educational institutions. In particular, the government established a college/university evaluation system covering both achievement and accreditation evaluation aspects. For example, the colleges/universities participating in the Educational Capacity Strengthening Program are selected and provided additional fiscal assistance on the basis of the evaluation system. The incentive system based on the evaluation formula naturally promotes competition among higher educational institutions. The selective fiscal assistance programs that have been carried out to date are summarized in Table 2.

Table 2. Selective Fiscal Assistance Programs

Programs	Objective	Period	Budget	Client Colleges/ Univ	Features	Core Assessment Indicators

Brain Korea 21 (BK21)	Fostering research capacity	2006 ~2012	₩1.5T	Research Univ.		Student-teacher ratio Full-time teacher ratio 70% or higher faculty participation
Educational Capacity Strengthening (PEUEC)	Strengthen colleges' educational capacity	2008 ~ Present	₩296B	All higher education institutes	Selective focus; formula funding	Employment rate Enrollment rate Full-time faculty rate Scholarship rate Per-student educational expense
World-Class University (WCU)	Fostering world-class colleges	2008 ~13	₩625B	Research-oriented colleges		Research records Panel review Overseas peer review Overall assessment
Restructuring Higher Educational Institutions	Restructure and improve quality	2005 ~present	₩321B	All higher educational institutions	Formula funding	Employment rate Enrollment rate Full-time faculty ratio Educational expenses and tuition ratio
Balanced Provincial College	Fostering provincial colleges' competitiveness	2009 ~ present	₩621B	Provincial colleges	Formula funding	Employment rate Enrollment rate Full-time faculty ratio Scholarship rate Per-student educational expense
Leaders in Industry-University Cooperation (LINC)	Fostering LINC colleges	2012 ~ present	₩170B (₩552B, including on-going program)	Industry-university centered institutions	Integrate existing programs of similar nature	Employment rate Patent applications per faculty member Ratio of faculty members with practice experience Industry-university cooperation officers Per-faculty research projects and funds

						Per-faculty technology transfer contracts
New University for Regional Innovation (NURI)	Regional development through growth of provincial universities	2004 ~08	₩1.2T	Industry-University Cooperation centered colleges	Predecessor of the LINC Program	Full-time faculty rate Enrollment rate Employment rate Curriculum development records Industry-University cooperation records

Source: Ministry of Education

Among the fiscal assistance programs listed above, the NURI and PEUEC are selected for a detailed review of their characteristics and evaluation studies since these programs include college graduates' employment rates as an indicator of monitoring and evaluation.

2.1 The New University for Regional Innovation (NURI)

The NURI fiscal assistance program aims to achieve regional development by promoting enterprise-college cooperation and professional human resources development. During 2004-2008, a total of ₩1.24 trillion was invested outside the Seoul Metropolitan area. The program fund was distributed to colleges in 13 regions selected on the basis of enrollment rate, which must be at least 60% of the authorized capacity for a college alone, and above 90% for a group of participating colleges. In addition, participating colleges must satisfy required and elective achievement indicators. The required achievement indicators are: faculty recruitment rate, student enrollment rate, and graduate employment rate. The elective achievement indicators are: human development, exchange among participating colleges, industry-academe cooperation, employment promotion, employment rate, scholarship, etc. It is questionable whether these indicators represent achievement (outputs) or management (inputs) by nature.

Among the NURI evaluation reports, Jung (2008) regards the graduate employment rate as the core achievement indicator and finds NURI had a positive impact on that rate. Ryu, et al (2010) compare the participating colleges and non-participating colleges, using the difference-in-difference approach, and find that colleges selected for the NURI program on average show a

considerably higher employment rate than the control group. The study also reveals relationships between the employment rate and the educational management indicators. For example, while the per-student NURI assistance amount exerts a positive effect on the employment rate, the per-instructor assistance amount shows insignificant effects, indicating it would be desirable to increase NURI assistance for individual students rather than for instructors. The study also indicates that the type of college also affects the employment rate, i.e., private colleges achieved higher employment rates.

2.2 The Program for Enhancing Universities' Educational Competency (PEUEC)

The PEUEC program was launched in 2008 to strengthen the educational capacity and competiveness of colleges/universities. While earlier fiscal assistance programs were based on college/university applications, this program selected recipients based on an educational capacity assessment formula and provided fiscal assistance in a discriminatory manner, thus inducing schools to improve competitively. The capacity assessment formula is a set of quantitatively measurable educational achievement and management indicators that have been refined over time. A special feature of the formula is that almost all educational management indicators are weighted equally. This means that each indicator affects the achievement indicator equally, an assumption or policy that needs to be tested with empirical analysis. Another feature is that the achievement indicators comprise two quantitative and qualitative indicators: the ratio of enrollment to authorized capacity and the graduate employment rate. However, it is questionable whether the enrollment ratio is an achievement indicator.

Table 3. PEUEC Indicators (2011)

Achievement Indicators		Management Indicators							Total
Employment Rate	Enrollment Ratio	Internationalization Index	Full-time Faculty Ratio	Management of Curriculum and Academic Affairs	Per-student Educational Expenditure	Scholarship Rate	Educational Expense Ratio to Total Tuition	Admission Test Index	
20%	20%	5%	10%	10%	10%	10%	10%	5%	100%

Source: Hong (2012)

Park (2010) analyzes the impact of the PEUEC on the educational achievement and management indicators. The average graduate employment rates of participating universities improved more than those of non-participating universities when compared before (2007) and after (2008) the program's implementation. The study also shows that the participating universities experienced

improvement in such indicators as the enrollment ratio, full-time faculty ratio, and scholarship ratio when compared with the year before the program. Participating universities also spent twice as much on per-student educational expenses as non-participating schools. However, the impact evaluation requires a more rigorous and scientific comparison between participating and non-participating universities over the time before and after the program's implementation.

In sum, the previous studies have weaknesses. First, although existing studies have confirmed positive impacts of fiscal assistance programs on the employment rate, they do not shed light on the causal relationship between educational management indicators that would affect the employment rate and the employment rate itself. Consequently, the studies do not confirm whether improving the educational management indicators is necessary. Moreover, the studies do not clarify whether educational management indicators have equal effects on the employment rate.

Second, although previous studies cover the impact of fiscal assistance programs on some educational management indicators (e.g. fiscal support expenses per student or instructor), their coverage is limited. It is necessary to include all the educational management indicators involved in the selection, monitoring, and assessment of colleges in the fiscal assistance program, and whether and to what degree these indicators have influenced the employment rate. Moreover, it is too simplistic to assume that individual educational indicators would affect the employment rate at the same rate and independently. It is possible, for example, that they would affect the employment rate at an increasing or decreasing rate (non-linear effects) and in interaction with other indicators (interactive effects). Therefore, impact evaluation studies should include a squared term and interactive terms of various educational indicators.

Third, existing studies focus on the evaluation of an individual fiscal assistance program. However, there have been several fiscal assistance programs for higher education at one time. It is more reasonable to assume that the several fiscal assistance programs together would have influenced the educational quality and employment rate with a scale effect and in interaction with each other. Consequently it is desirable to include all fiscal assistance programs in an impact analysis.

Fourth, previous studies focus on the colleges and universities participating in various fiscal assistance programs. However, the determinants of employment rates could be different between participating and non-participating schools, depending on the institutions' characteristics. Therefore, it is desirable to include all higher educational institutions in impact evaluation studies.

This study therefore aims to overcome the weaknesses of existing studies and complement their findings. Accordingly, before carrying out any impact evaluation study of fiscal assistance programs, this study, first, seeks to identify the educational indicators that determine the

employment rate, which is the critical achievement indicator of the fiscal assistance programs. Second, this study includes all educational management indicators used in the selection, monitoring, and assessment of higher educational institutions involved in fiscal assistance programs aimed at enhancing the employment rate. Third, this study covers all higher educational institutions and tries to determine whether institutions' characteristics influence the employment rate. Finally, this study analyzes the impact of the educational indicators on the employment rate, allowing for non-linear and interactive effects of educational indicators. The findings of such analyses would help construct sound design, implementation and assessment frameworks to improve graduate employment rates.

Ⅲ. METHOD AND DATA

The estimation model used in this study for the college graduate employment rate is specified in the following functional form:

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + e \quad \text{.....(1)}$$

where

Y: college graduate employment rate
a_0: constant term
x_1: the university type (public or private)
x_2: the university location (Seoul metropolitan area or other areas)
x_3: the scholarship rate
x_4: per student educational expense
x_5: the number of students per full-time faculty member
x_6: the number of students per industry-academe liaison officer
x_7: year (2010 or 2011)
e: error term

The dependent variable is the college graduate employment rate and is defined in the Higher Education Statistics on the basis of health insurance system statistics, as follows:

College Graduates' Employment Rate =

$$\frac{\text{Health Insurance System Members based on Employment with Employers}}{\text{Graduates} - (\text{further education} + \text{military service} + \text{foreign students} + \text{disabled})} \times 100$$

The independent variables used in this study are selected from the list of educational management indicators considered to affect the employment rate in the design and study of the fiscal assistance programs. The independent variables are grouped into four categories: university characteristics, financial indicators, faculty indicators, and industry-academe liaison indicators. Each of the independent variables is explained in the following table.

Table 4. Explanations of the Independent Variables

Group	Variable	Explanation	Programs using Indicators
Characteristics Variables	Type of college (Dummy)	Public=0, Private=1	Considered in all fiscal assistance programs
	Location of college (Dummy)	Seoul Metropolitan=0, Others =1	
Financial Variables	Scholarship rate	(Total scholarship/Tuition and fees) * 100	PEUEC, Structural Adjustment
	Per-student educational expenditure	(Net operating expenses+depreciation)/total number of students	PEUEC, Structural Adjustment, OECD educational statistics
Faculty-related Variables	Number of students per full-time faculty member	Total number of students/Total number of full-time faculty members	PEUEC, OECD educational statistics
Industry-University Cooperation Variables	Number of students per Industry-University Cooperation Officer	Total number of Students/Total number of Industry-University Cooperation Professors	LINC
Year	Dummy	2010=0, 2011=1	

The university characteristics variables are not an indicator included in fiscal assistance programs' assessment formulas. However, many fiscal assistance programs in fact consider these characteristics, and earlier studies also indicate that the employment rate varies in response to the characteristics. Therefore, these dummy variables are included. The type dummy variable assigns 0 for public universities and 1 for private universities. The location dummy variable assigns 0 for the Seoul metropolitan area and 1 for outside areas.

The scholarship rate variable is the ratio between scholarship amounts and total tuition and fees. Students consider this variable to indicate financial soundness and quality of a university, since most scholarships are based on students' academic achievements. Therefore, a higher scholarship rate means a greater proportion of academically superior students. Since the employment rate is regarded as a proxy of the quality of a university, a positive sign is expected in our estimation.

Per-student educational expense is a core indicator of the quality of a university. Per-student expense is the total educational expenses that a university spends on a student in a year and therefore includes tuition and fees, as well as contributions made by the university, government and other entities. In general, it is assumed that higher per-student expense leads to greater educational services for students; hence, a higher level of educational quality. Therefore, a positive sign is expected in the estimation of the variable.

The number of students per full-time faculty member is most often used in OECD analyses, together with per-student expenses. The fiscal assistance programs adopt the rate of full-time faculty members, which means the ratio between the number of full-time faculty members recruited and the total number of full-time faculty positions authorized. However, since this rate does not indicate how the full-time faculty members are actually utilized for education, the number of students per full-time faculty member is a better indicator of educational quality. Since it is generally understood that reducing the number of students per instructor will improve educational quality, a negative sign is expected in the estimation.

The number of students per industry-academe liaison officer has not been used in earlier studies as a determinant of the employment rate. However, this indicator is included in the estimation model since it is used in the LINC program, which succeeded NURI, and aims to enhance the employment rate by increasing relevance of higher education to the real world of work. It is expected to show a positive sign in the estimation.

In addition, a year dummy variable is used to see if there is any difference in the employment rate between the two years, 2010 and 2011, when the two-year data are pooled for estimation.

The data used in this study come from the Higher Education Statistics: 2010 and 2011, compiled

by the Korea Education Development Institute (KEDI). Earlier annual data are not used mainly because the employment rate definition changed in 2010. The Higher Education Statistics are used since they include educational management indicators available from higher educational institutions.

The total number of Korean higher educational institutions is 268 colleges and universities. Excluded from the Higher Education Statistics are micro higher educational institutions, which have total enrollments of fewer than 1,000 students, annual intake of fewer than 300 students, or only one college. Also excluded are special purpose institutions, such as educational, religious, and medical colleges, and new colleges/universities, which have not yet produced any graduates. These institutions may have extreme values that could distort the overall estimation.

The total number of higher educational institutions classified by type and location is as follows.

Table 5. Higher Educational Institutions Classified by Type and Location

Type of Colleges	Location of Colleges		Total
	Seoul Metro. Area	Other Areas	
Private	91	134	225
Public	6	37	43
Total	97	171	268

IV. ANALYSIS RESULTS

1. Descriptive Statistics

The average employment rate of all higher educational institutions is 53.5%, the scholarship rate 20.7%, per-student annual educational expense ₩9,175,000, the number of students per full-time faculty member 32.9, and the number of students per industry-academe liaison officer 414.0 students.

Table 6. Descriptive Statistics of the Regression Analysis

Variable	Min.	Max.	Average	S.D.

Dependent	Employment Rate (Unit: %)	22	100	53.48	8.837
Independent	College Type(Dummy)	0	1	0.16	0.368
	College Location(Dummy)	0	1	0.64	0.481
	Scholarship Rate (%)	0	466.24	20.70	28.110
	Per Student Expense (Unit: thousand Won)	0	33439.5	9174.94	3681.794
	Number of Students per Instructor (Unit: person)	9.3	56.6	32.92	7.923
	Number of Students per I-U Cooperation professor (Unit: person)	0	983.3	414.01	868.838
	Year (Dummy)	0	1	0.50	0.501

The employment rate by the type and location of higher educational institutions is as follows:

Table 7. Employment Rates by Type and Location of Higher Educational Institutions

Variable		2010		2011	
		No. of Observation	Employment Rate	No. of Observation	Employment Rate
Type of Colleges	Public	22	53.0	21	55.3
	Private	112	51.7	113	55.0
Location of Colleges	Seoul Metropolitan	48	50.8	49	53.4
	Other Areas	86	52.5	85	56.0
Total/Average		268	51.9	268	55.1

The employment rate was higher in the non-capital city (provincial) areas than in the Seoul metropolitan area, which is consistent with earlier studies. However, the employment rate was higher among public higher educational institutions than private ones, which contradicts the findings of earlier studies (Ryu, et al 2010, Choi 2008).

The OLS estimation of equation (1) shows that the set of the independent variables explains the variations in the employment rate by 22.8%.

Table 8. The Results of the OLS Estimation of Equation (1)

Independent Variable	OLS Estimation of Equation (1)	
	B	Beta
Constant	50.374	
Type of Colleges (Public vs. Private)	-3.475 (1.447)	-.145*
Location of Colleges (Seoul Metropolitan vs. Other Areas)	3.462 (1.131)	.189**
Scholarship Rate	2.376E-02 (.018)	.076
Per-Student Expense	7.336E-04 (.000)	.306***
Number of Students per Instructor	-.212 (.079)	-.190**
Number of Students per I-U Cooperation Officer	-2.09E-04 (.001)	-.040
Year (2010,2011)	2.757 (.956)	.156*

R^2: 0.228

Dependent variable: Employment Rate

( ): standard errors

***: p<.001,**: p<.01,*:p<.05**

As expected, per-student educational expense and the number of students per full-time faculty member variables affect the employment rate at the usual level of statistical significance. The employment rate rises as per-student educational expense increases and as the number of students per full-time faculty member decreases. The location and type of institutions, and the year variable also affect the employment rate at the statistically significant level. However, the scholarship rate and the number of students per industry-academe liaison officer variables do not produce statistically significant effects.

The independent variable that affects the employment rate at the highest level is per-student expense. As per-student expense rises by 1%, the employment rate increases by 30%. Also, as the number of students per faculty member rises by 1%, the employment rate decreases by 19%. Therefore, to increase the employment rate, priority should be given to increasing per-student educational expenses. Also, if other conditions are equal, fiscal assistance programs should allocate resources in such a way that colleges reduce the number of students per faculty member.

2. Increasing Return and Interactive Effects on the Employment Rate

The estimation model adopted in equation (1) assumes that the relationship between various inputs and the output (the employment rate) are sustained over the whole range of the changes in inputs. However, the production function theory in economics shows that as input increases, output can increase either at an increasing or decreasing rate. Likewise, per-student educational expense and the number of students per faculty member may not be linearly related to the employment rate over the whole range of the changes in these educational input variables. Therefore, to test whether the employment rate changes at a steady, increasing, or decreasing rate over the whole range of these input variables, a squared value of these two input variables can be added to the estimation equation (1).

The two input variables may also affect the employment rate by interacting with each other. For this purpose, an interactive term of the two input variables can be added to equation (1). Paek (2000) argues that although both human resources and physical resources contribute to educational output, they have both complementary and substitute relationships in producing educational outputs. The number of students per faculty member is a human resource indicator, while per-student educational expense is an indicator that combines both human resources and physical resources.

As discussed earlier, to enhance the employment rate, per-student expenses can be increased and/or the number of students per faculty member can be decreased. To raise the level of per-student expenses, a policy maker should decide whether physical resources (educational facilities, equipment or materials, etc.) or human resources (the number of instructors or their compensation level, etc.) should be increased. If per-student educational expense is raised through increases in the number of instructors, the number of students per instructor will decline, which will improve the employment rate at an increasing rate. If per-student educational expense is raised by increasing compensation, the number of students per instructor will not change, which will not increase the employment rate at an accelerated rate. Therefore, depending on the nature of interaction of the two educational input variables (per-student expense and the number of students per instructor), the effects on the employment rate will be different, and it is desirable to add an interactive term of two educational input variables to equation (1).

Equation (2) shows the revised estimation model.

$$Y = a_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_4^2 + b_9x_5^2 + b_{10}x_4x_5 + e \text{.....(2)}$$

where

x_4^2: (per student expense)^2

x_5^2: (the number of students per faculty member)^2

x_4x_5: (per student educational expense) x (the number of students per faculty member)

The rest of the symbols are defined in the same way as in equation (1).

The results of the OLS estimation of equation (2) are presented in comparison with equation (1), as follows.

Table 9. Results of the OLS Estimation of Equation (2) with Squared and Interactive Terms

Independent Variables	Equation (1)	Equation (2)
	R^2=.228	R^2=.324
Type of Colleges (Private vs. Public)	-.145* (1.447)	-.159** (1.364)
Location of Colleges (Seoul Metro. Vs Others)	.189** (1.131)	.241*** (1.060)
Scholarship Rate	.076 (.018)	-.052 (.021)
Per-student Education Expense	.306*** (.000)	0.193 (.001)
Number of Students per Full-time Instructor	-.190** (.079)	-.964** (.0430)
Number of Students per I-U Cooperation Officer	-.040 (.001)	-.006 (.001)
Year (2010 vs. 2011)	.156* (.956)	.127** (.895)
(Per-student education expense)^2		.797** (.000)
(Number of Students per Full-time Instructor)^2		.891** (.007)
(Per-student education expense) x (Number of Students per Full-time Instructor)		.861*** (.000)

Dependent variable: employment rate

( ): standard error

***: p<.001, **: p<.01, *: p<.05

The results of the analysis show that R^2 increased (ΔR^2= 0.096), and therefore the squared and interactive terms, which were added to equation (1), must have affected the employment rate. As in the estimation of equation (1), the university characteristics (type and location) and the year dummy variables all have a statistically significant coefficient. Also, as in equation (1), the coefficient of the scholarship rate and the number of students per industry-university cooperation officer is statistically insignificant. Further, as in equation (1), the number of students per instructor also has a statistically significant negative sign.

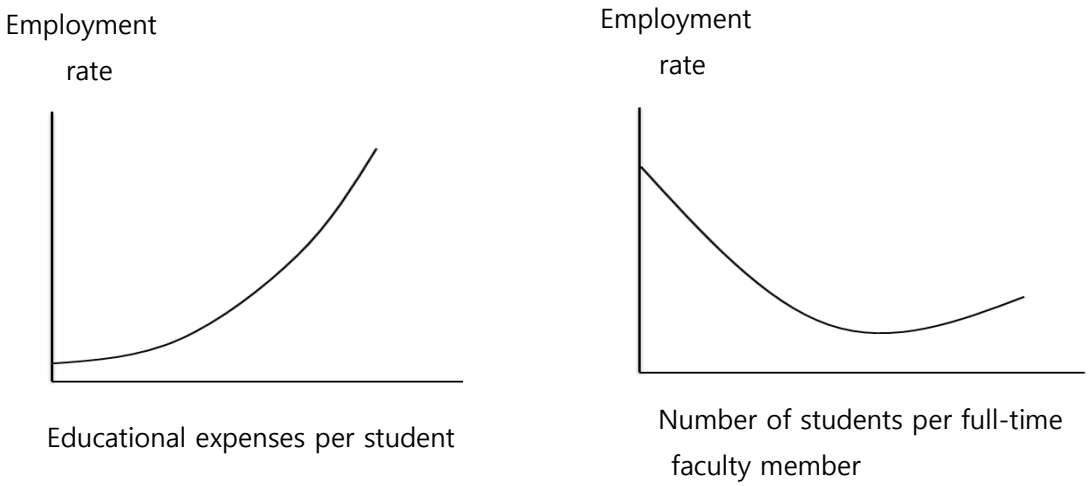
The only difference is that although per-student educational expense has a statistically significant positive sign in equation (1), it has a statistically insignificant positive sign in equation (2). However, it cannot be interpreted that per-student expense has no relationship with the employment rate. This is because the interactive term between per-student expense and the number of students per instructor has a statistically significant positive sign. This means that although per-student expense alone cannot affect the employment rate, it affects the employment rate in interaction with the number of students per instructor. Therefore, the impact of per-student expense cannot be judged by the per-student expense variable alone, but by its marginal product (E_a) of the employment rate, which can be derived from equation (2) as follows.

$$E_a = b_4 + 2b_8x_4 + b_{10}x_5 \quad \text{.....(3)}$$

The statistically significant coefficients b_8 and b_{10}, and the average value of x_4 and x_5 can be taken from Table 6 to estimate equation (3). The result is a positive value, and therefore the per-student educational expense variable has a positive relationship with the employment rate.

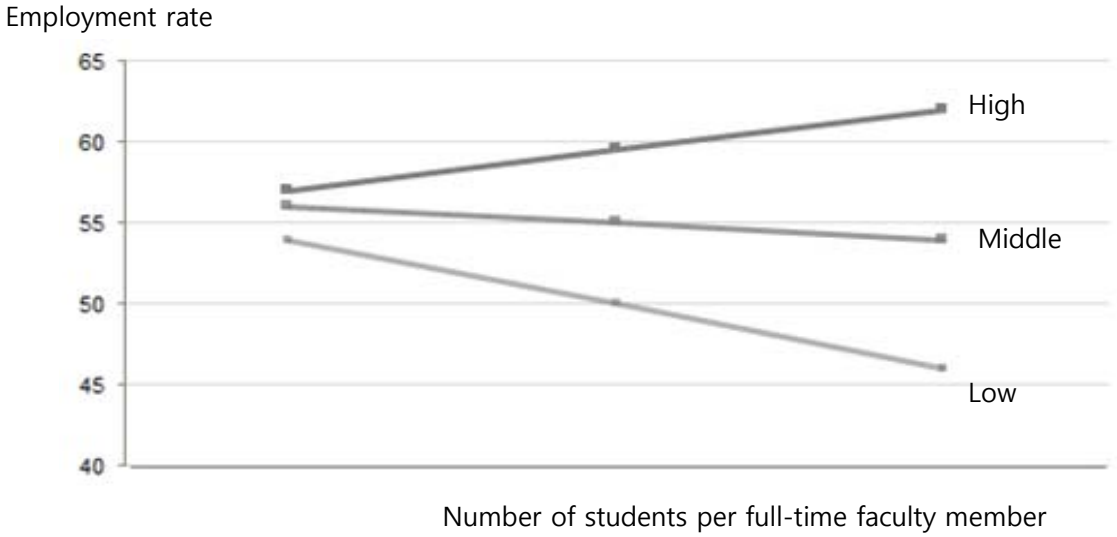
Among the three added variables, the two squared variables (square of per-student expense and square of the number of students per faculty member) have a statistically significant positive coefficient. This means that per-student expense and the number of students per faculty member each brings an increasing return on the employment rate. On the one hand, although per-student expense has a statistically insignificant positive effect on the employment rate, as the level of expense rises, its effect on the employment rate increases at a statistically significant increasing rate (i.e. it increases non-linearly). On the other hand, as the number of students per faculty member increases, the employment rate declines. However, if the number of students per faculty member increases above a certain level, the employment rate starts rising. The negative effects of the high number of students per instructor must have been offset by the increases in per-student expense brought about by the sharp increases in the number of students per instructor, resulting in the positive net effect on the employment rate. Figure 1 shows the relationships that per-student education expense and the number of students per faculty member have with the employment rate.

Figure 1. Relationship between per-student expense and the number of students per faculty with the employment rate



The estimation of equation (2) also confirms the existence of the interactive effect of two educational input indicators on the employment rate. The interactive term of per-student expense and the number of students per faculty member has a statistically significant positive coefficient (0.861). Figure 2 depicts the interactive effects visually.

Figure 2. Interactive effects of per-student expense and the number of students per instructor



When per-student educational expense is relatively high (₩12,800,000 and higher), even as the number of students per faculty member increases, the employment rate keeps increasing. Per-student expense must have offset the negative effect of the higher number of students per

instructor on the employment rate, and the net effect of the interactive term on the employment rate is still positive. This indicates that the relatively higher per-student expense was achieved not by increasing the number of faculty members, but by recruiting better-quality instructors, raising faculty compensation, or improving educational facilities and equipment.

When per-student educational expense is relatively low (₩5,500,000 and lower), as the number of students per faculty member increases, the employment rate declines. This result can be explained as follows: When educational expense is relatively low, it cannot offset the negative effects of the increasing student-faculty ratio on the employment rate, and consequently the net effect of the interactive term on the employment rate is negative. This also indicates that the relatively lower per-student expense was achieved by a low investment in quality instructors, faculty compensation, or educational facility and equipment.

V. CONCLUSION

As higher educational institutions are responsible for fostering the high-level human resources needed for national development, almost all countries provide fiscal assistance to such institutions to enhance their educational quality. The Korean government has focused on the graduate employment rate at higher educational institutions as an important indicator reflecting educational quality. The need for enhancing the higher education quality and therefore the graduate employment rate is accentuated by the relatively low employment rates in recent years.

However, the government has carried out various fiscal assistance programs without clearly understanding the determinants of the graduate employment rate. Such an understanding, and a creative strategy for enhancing the employment rate based on that understanding, are prerequisites for sound program design and efficient operation. As Korea's level of assistance for higher education is relatively lower than in other OECD countries, efficient design and operation of the fiscal assistance programs are needed to ensure good educational outcomes.

This study empirically analyzes the determinants of the employment rate at higher educational institutions based on 2010-2011 data. The study results show that the two factors consistently contributing to employment rate determination are the educational expenditure per student and the number of students per full-time faculty member.

These variables affect the employment rate significantly even after the type and location of higher educational institutions are controlled. To check the consistency of their influence on the employment rate, their squared variables are added to the estimation model. The regression

results show that as the values of these two variables increase, the employment rate improves at an increasing rate.

Also, to check whether these two variables interact and increase their influence on the employment rate, an interactive term of these two variables is added to the estimation model. The regression results show that when the educational expenditure per student is at the relatively high level, the employment rate keeps increasing, even as the number of students per faculty member rises. Such phenomena can be explained by the theory that the relatively high educational expenditure per student is driven not by increases in the number of faculty members, but by recruitment of high quality faculty, greater compensation to existing faculty, or improvements in educational facilities and equipment. Accordingly, the positive effects of the rise in per-student educational expenditures on employment rates more than offset the negative effects of the increase in the student/faculty ratio on the employment rate, resulting in net positive effects. In contrast, when per-student educational expenditure is at the relatively low level, the employment rate keeps declining, as the number of students per faculty member increases. The relatively low educational expenditure per student must have been driven initially, not by measures to improve the quality of education, but by increases in the number of students per instructor.

The variables of student/industry-academe liaison officer ratios and scholarship rates do not affect the employment rate in any statistically significant way.

On the basis of this study, the following policy recommendations can be made. Priority should be given to educational expenditure per student and the number of students per full-time faculty member when selecting and monitoring educational institutions in the fiscal assistance programs. In particular, the government should give greater weight to educational expenditure per student, since that variable raises the employment rate irrespective of the number of students per faculty member through the effect of interaction with the number of students per instructor, resulting in net positive effects on the employment rate. When the educational expense per student is relatively high, even the increases in the number of students per faculty member will result in rises in educational budgets per student, which will keep increasing the employment rate.

Further investigations should follow up this study. The unit of observation in this study is the individual higher educational institution, and the available employment data for these institutions distinguish neither between regular and temporary workers, nor between the majors of studies. Future studies of employment rates should distinguish between the two. Also, this study does not utilize a time-series data set since the definition of the employment rate was modified in 2010. Future studies should be conducted on the basis of a panel data, which may shed better light on this study's topic.

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