Journal of the Korean
OR/MS Society
Vol. 10, No. 2, Oct. 1985

— Research Paper —

A Comparative Analysis of Domestic vs. Overseas Postgraduate Education in Science and Technology

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Abstract

Domestic versus overseas postgraduate education in science and engineering has its own advantages and disadvantages. One of the issues involved in developing countries is the problem of brain drain. This study deals with the cost and benefit of domestic and foreign education, problems in brain drain and the social and private rate of return analysis in postgraduate science and technology education in Korea.

1. Introduction

Education in science and engineering seems to be important for technological development. Some of the problems at issue are the level of education and where to educate – overseas or at home. It is evident that the growth rate of Korean science and engineering postgraduate education has increased far more steeply than the growth rate in other higher parts of education, and the rate is expected to increase in the near future. This study is concerned with how a developing country can establish its own postgraduate education in applied science and engineering as an alternative to foreign postgraduate education.

This paper intends to find how domestic education contributes to the country or society compared with foreign education. Though certain economic analyses were made for general education [13] or undergraduate level [8] in developing countries, studies for the postgraduate education in science and technology were relatively rare.

One of this study's objectives is to compare the cost and benefit of a domestically educated person at the Korea Advanced Institute of Science and Technology[1] with those of a person trained abroad and analyze what the pros and cons of each are. In terms of cost analysis, the Institute of International Education's published guidelines of the average cost of living and monthly maintenance rates [6] for advanced degree work in the U.S.A. are used whereas costs for KAIS students were obtained from the appropriate sources.

1) Although the Korea Advanced Institute of Science (KAIS) and the Korea Institute of Science and Technology (KIST) are merged into the Korea Advanced Institute of Scince and Technology(KAIST), educational function of the former KAIS is this study's principal concern. Therefore KAIS is used here instead of KAIST.

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2. Cost and Benefit of Education

It is difficult to calculate the exact cost of KAIS student without considering opportunity cost of an education. There have been many cost factors involved including fixed assets, foreign assistance, government foreign exchange reserve, direct, indirect and general supporting costs, etc. A summary of these costs is shown in Table 1.[2]

Table 1. Average Annual Cost[3] per Student in KAIS

Year	M. S.	Prof. Eng.	Ph. D.
1977	8, 512	8, 564	7, 138
1978	8, 705	8, 762	8, 388
1979	8, 372	8, 432	7, 948
1980	7, 045	7, 575	7, 149
1981	9, 810	10, 524	10, 837

Source : KAIS, Ministry of Science and Technology
Unit : U. S. $

The average cost of KAIS in 1978/1979 amounted to about $8,435 while the cost of overseas education amounted to $8,472 using monthly guidelines [6] and estimated average annual tuition of $3,000 in the U. S. It is not clear at this point that the cost of one is significantly higher than the cost of the other. When we consider the fact that Stanford University's electrical engineering department spends approximately $50,000 per Ph. D. student per year including research fund expenditure, the KAIS cost is not expected to be excessive in terms of a cost comparison with other schools in industrialized countries.

Education is often considered as one of the most important factors in a person's economic and social success, asserting that education is highly related to income and success described in Figure 1. This is consistent with the neo-classical economic theory, namely the marginal productivity theory, which says that wages are determined by the worker's marginal contribution to the revenues of the firm. Another important factor of the human capital approach is that it deals with an investment in on-the-job-training (OJT) and the criteria determining who will pay for such training and who will benefit therefrom.

2) One of the reasons to use late 1970s cost figures is the Korean won compared to the U. S. dollar at that time was strong enough not to be severely distorted by other factors. Korean exchange rate then was under pressure to be appreciated internationally.

3) Only direct, indirect and general supporting costs for students based on the budget allocated by the Economic Planning Board (EPB) are considered excluding construction, fixed asset, installation and loan costs.
Direct cost consists of laboratory, thesis preparation, field training, stipend, room and board, medical insurance, etc.
Indirect cost consists of faculty and staff salary, research fund, faculty recruiting expense, academic activity supporting fund, maintenance, etc.
General supporting cost consists of general facilities maintenance, administration staff salary and others.

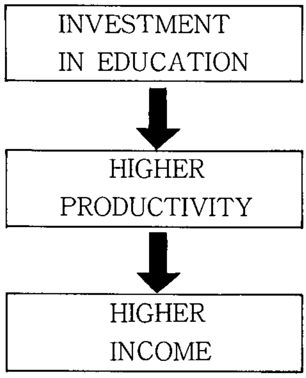

Fig. 1: The Human Capital Approach

Educational benefits are classified by the private and the social ones. The former includes benefits retained by an individual while the latter includes those which an individual cannot appropriate. Additional benefits of education can be nonfinancial. An example can be found from college professors in the U. S. who do not necessarily have more income than other professions may have. This is shown in Figure 2.

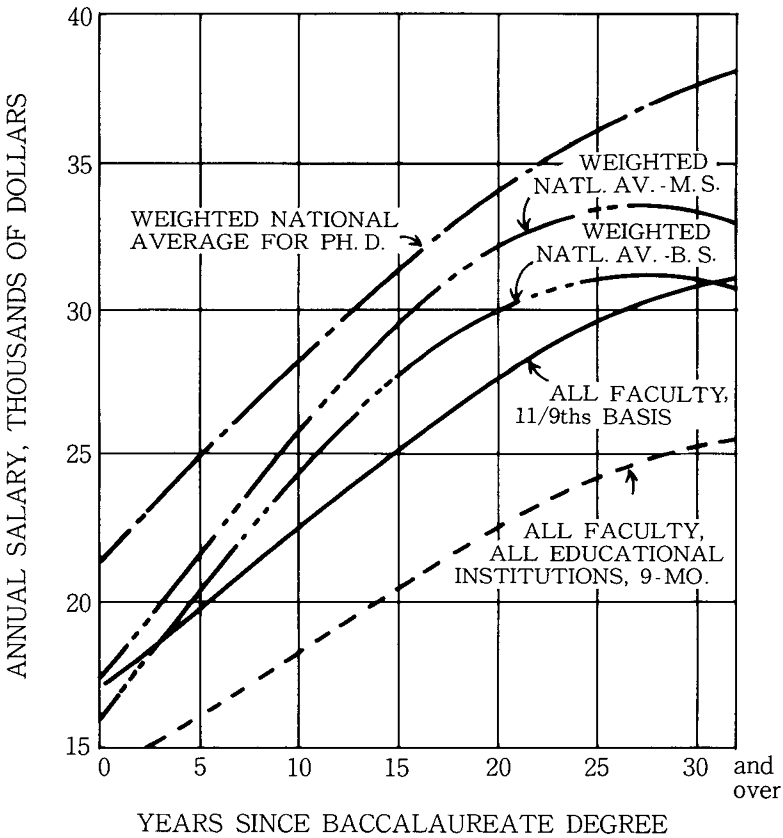

Fig. 2 : Comparison of Median U. S. A. Salaries
Source : Engineering Education, April 1980.

Yet it is not surprising that many people choose teaching in universities despite lower financial return when they enjoy certain degrees of freedom and flexibility to work. When there is not a big financial difference between industrial and academic work, this nonfinancial option becomes all the more attractive. This seems to be the case for highly educated scientists and engineers in Korea. In addition, a professorship carries social respect as well as prestige in Korea, which may not be so strong in India or Pakistan, for example.

3. Brain Drain and Questionnaire Outcome

The assumptions of this comparison study are the following:

1. The talent level is equal for KAIS and foreign educated students.
2. The school years are counted on the base of two years for Master's degree and additional three years for Doctoral degree.
3. There is no discrimination from the employer provided employees have the same level of degrees and experience.
4. KAIS graduates are more aware of what the real problems in Korea are and are being trained to solve them directly toward current problems in Korea. However foreign educated people are more likely to have had opportunities for training with recently developed technologies.

Based upon these, this study tries to find out related figures or data about the loss of appropriately educated brains. Education generally takes long time, efforts and cost as well. Therefore brain drain is not only a migration of people but also taking one's educational investment at the same time. However, collected information so far shows a decreased rate in the brain drain.

From Niland's [11] study in Figure 3 the estimated Korean brain drain rate was about 88 percent in the mid-1960s while Japanese rate was 28 percent. Also his study reported that 38 percent of Korean students who were within the first 6 months of entering graduate schools in the United States decided they would 'drain' whereas only 11 percent of Japanese students who were within the first 6 months of entering graduate schools decided they would drain in the mid-1960s. Korea had more than 3 times the drain rate of Japan. However, my questionnaire survey showed that approximately 90 percent[4)] of the people who planned to have overseas training/education intended to return to Korea. In other words only about 10 percent intended to drain in 1982. This seems to be a clear change compared to the 38 percent in the mid-1960s.

Also cross sectional data of labor statistics in Figure 4 show that scientists like KAIS graduates who have advanced education and training receive higher salaries in the long run, though they may not start with high salaries. This becomes more evident from the salary comparison by schooling in Table 2 despite an absence of the postgraduate educated number. In the table, Japan shows less salary discrimination against higher level educated manpower while U. S. A.

and Korea have more discrimination based on schooling. Korea gives the biggest salary difference among the three depending upon whether he has a diploma or not. This may make an interpretation possible that there seems to be decent job opportunities more for the highly educated scientists and engineers.

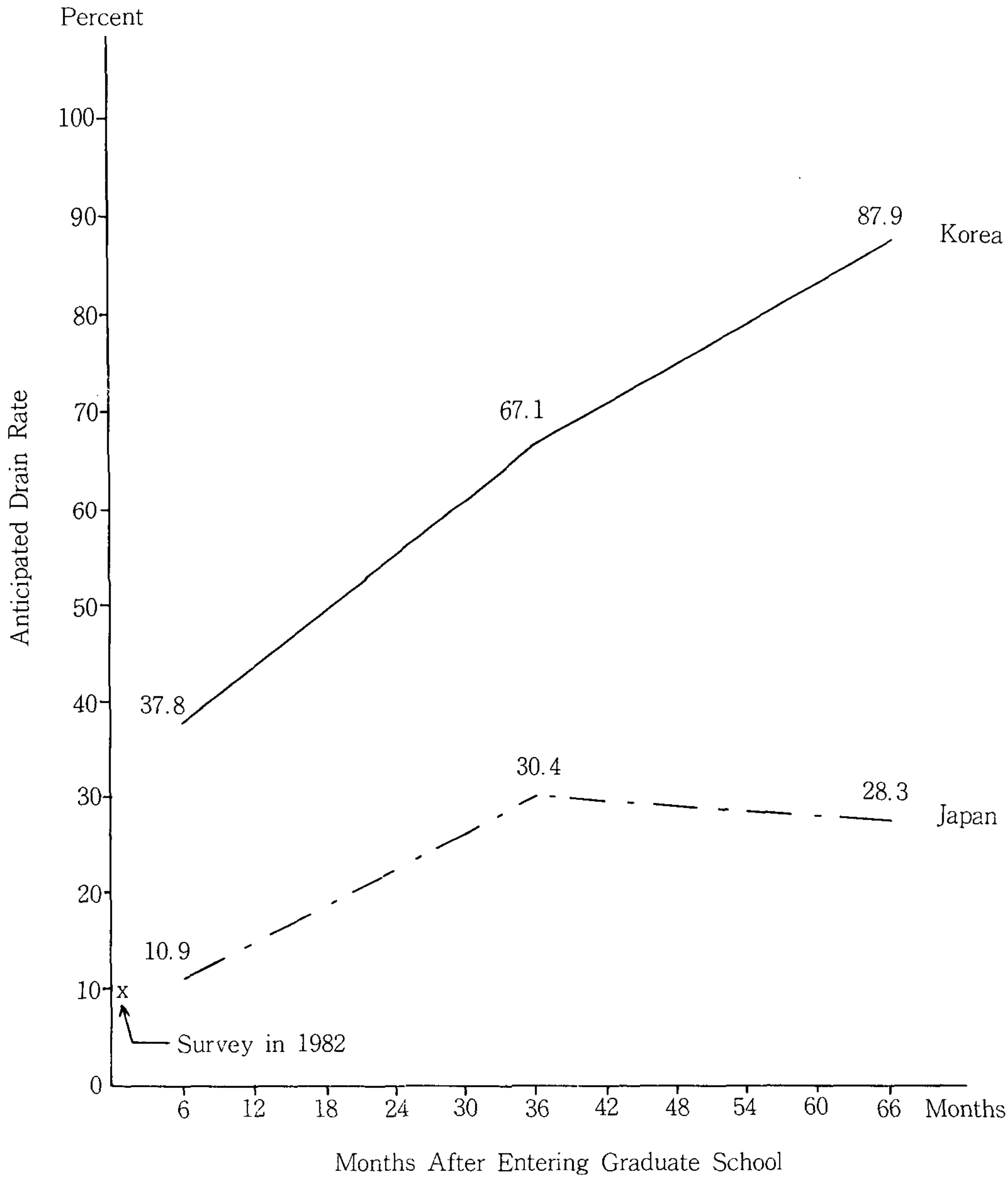

Fig. 3 : Anticipated-Actual Rate of Drain vs. Months in U.S.A. (Mid-1960s)

4) There exists cross-sectional time difference for this percentage. Because of the difficulty to get responses from the students studying in the United States of America, I compared the percentage of within 6 months from the Niland's report with the result of my questionnaire. The surveyees were scientists and engineers in Korea who planned to have overseas education/training in 1982.

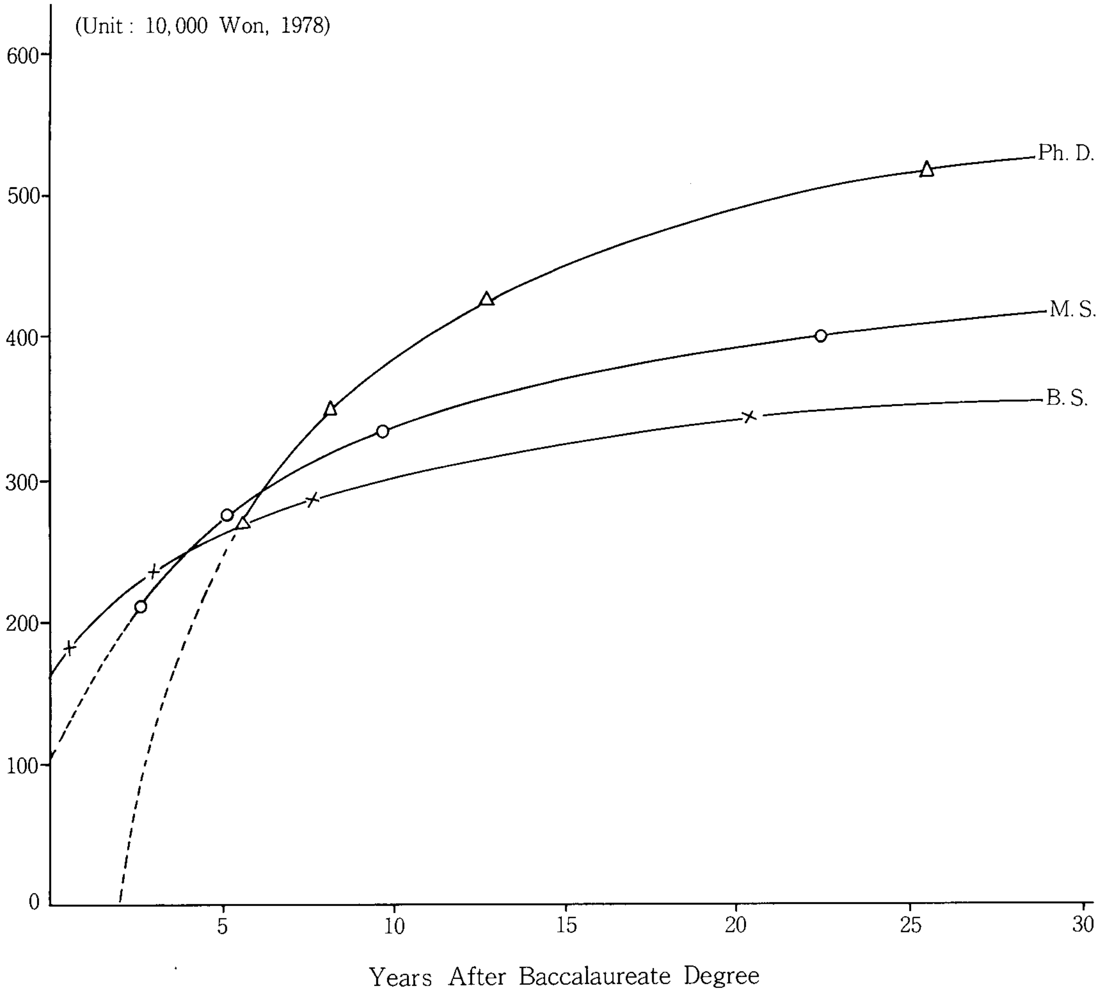

Fig. 4 : Lifetime Earnings by Level of Education

Table 2. Average Salary Comparison by Schooling

Country	College	High School	Middle School
U. S. A.	100	60	40
Japan	100	82	68
Korea	100	43	28

Source: The Dong-A Ilbo Daily, No. 18482

4. Cost-Benefit Comparison in PH. D. Case

Table 3 shows the average salary of engineers in Korea's three leading electronics corporations. Since the electronics industry is currently one of the leading industries in Korea, it is reasonably worthwhile to compare these salaries with the salary at the leading academic institute. Thus a starting assistant professor's salary at KAIS was compared to the 6th year salary of electronics engineer.

The assumptions are the following:

1. A faculty member has spent 5 years to get his Ph. D. degree after his B. S. degree.
2. Both faculty and industry employed engineers have served in the military for 3 years.
3. Each starts his 6th year in industry or his first academic career at age 30 because 3 and 5 years are added for the military service and the first 5 years' career or study after B. S. degree respectively.
4. Comparison periods are assumed to be 30 years because 60 is a common retirement age.
5. Cost for acquiring Ph. D. degree is assumed as $8,435 per year.
6. Linear difference in constant Won value is assumed although the cross sectional data in Figure 4 show cumulatively bigger differences between Bachelor's and Ph. D. degree holders. This is because salary increases in an academic society are relatively flatter than in an electronics industry at later ages, thus the difference between industry engineer and faculty remains less than the national average shown in Figure 4[5).

Table 3. An Engineer's Monthly Salary in the Electronics Industry (1983)

Year[1]	Company X	Company Y	Company Z
1	373	409	397
2	468	453	467
3	491	500	520
4	610	604	599
5	647	621	626
6	674	741	785
7	753	769	806
8	792	806	832
9	822	833	856
10	930	868	962
11	972	902	980
12	1,004	1,097	1,006
13	1,074	1,135	1,103
14	1,122	1,174	1,139
15	1,158	1,221	1,176

* Three leading electronics companies are chosen.
Unit is 1,000 Won and bonuses are included.

1. Years after bachelor degree.

5) This trend is similar in the United States. See, Chesson in *Engineering Education* April 1980. p. 733-735

When we compared the above salary differences, the additional inflation-adjusted benefit for the faculty member was greater than the cost of his study, namely an addition of $1,550/year in 1978/79 dollars during his career period. This justifies the cost of education by an annual benefit of $9,280 versus the education cost of $8,435/year during the 5-year study period. The opportunity cost (income foregone) is not included in these estimates; therefore, an additional annual benefit may be less than the annual cost.

To get an internal rate of return for the education of a faculty member,

$$PW = 0 = -\sum_{n=1}^{5} A_n(P/A,\ r,\ n) + \sum_{n=6}^{35} A_n\{(P/A,\ r,\ 35) - (P/A,\ r,\ 5)\}$$

This gives a negative rate of return of −2.3% from Table 4[6].

Table 4. Cost-Benefit Between Electronics Engineer and Faculty Member

Year	A	B	C	D
1	-$4,437[1]	-$8,435[2]		-$12,872
2	-5,224[1]	-8,435[2]		-13,659
3	-5,688[1]	-8,435[2]		-14,123
4	-6,829[1]	-8,435[2]		-15,264
5	-7,113[1]	-8,435[2]		-15,568
6-35	8,283[3]		$9,831[3]	1,548

A : Annual salary of an electronics engineer in 1978/79 dollar
B : Annual education cost
C : Annual faculty member salary
D : Cost and benefit flows of income

1. Income foregone
2. Average annual education cost
3. Linear difference of the career income flow

However the private rate of return turns out to be positive but low 2.9%.[7] This positive rate of return may provide an additional incentive for students to pursue their Ph. D. degrees at KAIS because of full scholarships unless an equivalent or better financial assistance is provided by other education institutes. Several studies present between 3.5 percent and 23.6 percent[8] range of the private internal rate of returns to the graduate education in the United States.

6) This is based upon the cost of education, income foregone and the assumed linear difference of the career salaries.

7) This comes from the fact that KAIS students do not pay any education cost except income foregone for their training. Thus the direct annual education cost in Table 4 is zero for the first five years.

8) See, Elchanan Cohn's "The Economics of Education," 1979, p. 118

5. Conclusion

As an assumption of the equivalent talent level was made earlier, the final product of educated manpower should be the same. Although the difference should be judged by the employer, the outcome of questionnaire survey showed that supervisors/employers generally did not discriminate against KAIS graduates nor favor foreign educated ones provided they paid the same salaries to both. Less than a quarter of the supervisor/employers said they gave an average of about 20 percent more salary to foreign educated people because of the industrial technology they acquired overseas. The industries which offered more salaries were mostly electronics, heavy machinery and shipbuilding companies.

When supervisors and employers were asked who would be employed with higher salary, two thirds of them favored domestic graduates and one third favored foreign graduates. Among domestic graduates, close to two thirds of them were KAIS graduates who were favored by the employers because of their potential abilities while the rest of domestic graduates were favored by the employers for various reasons including keeping harmony among the employees. On the other hand, foreign graduates were much favored for their skills in foreign languages as well as for their advanced technology acquired overseas. Since one of the KAIS objectives has been to supply appropriate, qualified and well-educated postgraduate scientists or engineers to meet the needs of Korean society, the above outcome shows KAIS has fulfilled its intended role to meet society's need.

Thus it can be said KAIS has played very important role to keep many young talents, who otherwise might have drained, from going abroad for good and thus to exert their abilities to contribute to the society. Also this approximate 10 percent of initial intended drain rate in Figure 3 is almost the same number as Japan's 11 percent in the mid-1960s. Although the actual drain rate of Korea is most likely to be much higher than the above initial 10 percent (so was Japan's actual drain rate of 28 percent in the mid-1960s), this is undoubtedly an encouraging sign for the Korean society as well as for the Korean scientists and engineers themselves.

Although more Korean scientists have successfully been recruited and repatriated in the past two decades than in the 1950s and early 1960s, this has not been made with ease. The most important thing has been the expansion of good job opportunities for the scientists repatriated. Then these returning scientists might have set good examples to many promising young Korean students to intend to return instead of staying abroad after their studies as shown in Figure 3.

The positive private rate of return and military service exemption privilege are believed to be the most important reasons along with the nonfinancial reasons which were previously given. A positive private rate of return in the Ph. D. education for the Korean scientists has continued even though the relative salary advantage of KAIS faculty members to others has dwindled in the recent years.

This can be said to justify the zeal and investment for postgraduate education in science and technology in private terms even though the social rate of return turns out to be negative. In addition it is explained in terms of social demand approach to education regardless of an economic justification of educational investment in certain parts of education, particularly in tertiary education.

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