Classifying higher education institutions in Korea: a performance-based approach

Jung Cheol Shin

Abstract The purpose of this study was to classify higher education institutions according to institutional performance rather than predetermined benchmarks. Institutional performance was defined as research performance and classified using Hierarchical Cluster Analysis, a statistical method that classifies objects according to specified classification factors. In the analysis, 47 Korean universities with doctoral programs were classified as research universities (seven universities), research active universities (14 universities), and doctoral universities (26 universities). In the detailed discussions, profiles of each group were analyzed and discussed; and, disciplinary classifications were conducted in engineering, natural science, and social science and humanities. In addition, to validate the classifications, the research performances of these categories were compared with those of U.S. peers. In the comparisons, the research performance of Korean universities was similar to that of U.S. peers. From the analysis, the classification results emerging from the performance-based approach were shown to be equivalent to that of conventional classifications using predetermined benchmarks.

Keywords Mission classification · Research performance · Research university · Korean university

Introduction

Classifying higher education institutions is an efficient strategy for controlling for institutional characteristics in academic research and for developing institution-based policy for different types of institutions in centralized governance systems such as South Korean higher education. Thus, academic researchers as well as policymakers have used diverse criteria, such as institutional size, location (e.g., urban, rural etc.), mission focus (e.g., teaching, research etc.), and focus of education (e.g., religion education, minority education) to develop typologies for higher education institutions. Among these, classification by

J. C. Shin (✉)
Seoul National University, Seoul, South Korea
e-mail: jcs6205@snu.ac.kr

mission focus (hereafter, "mission classification") is the most widely applied in academic research (e.g., Toutkoushian and Smart 2001; Volkwein and Sweitzer 2006; Weerts and Ronca 2006) as well as policy practice. A representative example is the Carnegie Classification, which was developed in 1971 by the Carnegie Foundation for the Advancement of Teaching (hereafter, "Carnegie Foundation"). Since then, the Carnegie Classification has been extensively used in academic research as well as policy development in the U.S.

In academic researches, Carnegie Classification has been used as control variables or grouping higher education institutions in diverse research topics. For instance, researchers use the classification as main variable in studying tuition (e.g., Shin and Milton 2006), faculty teaching and research (e.g., Glassick et al. 1997; Henderson and Buchanan 2007), faculty salary (e.g., Burke et al. 2005; Hanley and Forkenbrock 2006), further in comparing socio-psychological characteristics of faculties (e.g., Bland et al. 2006). The Carnegie Classification is used in state or/and federal level in diverse policy contexts. Majority of states apply different college admission criteria, tuition rates, governance systems, and faculty evaluation systems according to institutional mission focus. For instance, governance systems of research university tend to be less tight than that of teaching-focused university because academic freedom is critical in enhancing research productivity.

Meanwhile, few researchers in countries outside the U.S. have attempted the classification of higher education institutions despite its utility in academic research and policymaking. South Korea, among them, is one country where policymakers and researchers alike have a great interest in classifying higher education institutions (hereafter, "HEIs"). However, because many of four-year institutions in South Korea are pursuing to be research universities, the creation of a hierarchical classification system is a very sensitive issue among HEIs there. Actually, the Korean Government has tried to reflect mission differences in policies—such as those involving funding—since the mid-1990s. But the related controversy has left South Korea with no such classification scheme for academic researchers or policymakers in South Korea.

The lack of a classification scheme for HEIs raises limitations in academic research as well as in policy development. In many international comparative studies, for example, researchers examine comparable groups of HEIs. Without a classification scheme for South Korean HEIs, researchers must work with a relatively arbitrary selection of comparable groups that might lead to inappropriate or inconsistent conclusions. In policymaking practice, in addition, the lack of a mission classification results in inefficiencies in policy implementation. Further, and even worse, this lack results in unilateral policies that produce unintended regulations for HEIs because the government develops and implements these policies based on the notion of average institutions (Shin et al. 2007). In 1999, when the Korean government decided to allocate special research funds to research universities as part of its "Brain Korea 21" (hereafter, "BK 21") project, a major political dispute ensued about which universities are research universities. In the end, the Korean government struck a compromise by allocating the research funds to most of the HEIs with Ph.D. programs (Korean Ministry of Education & Human Resource Development (KMOE & HRD 2006)).[1]

Within this context, therefore, this study seeks to classify Korean HEIs in order to construct a reliable typology based on institutional mission. In this process, two special considerations will be given. First, mission classification will be based on institutional performance rather than any predetermined benchmark. In many classification

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[1] The name of the ministry was changed from Korean Ministry of Education & Human Resource Development to Ministry of Education, Science and Technology in March 2008.

studies—including those using the Carnegie Classification—the classification agency or individual researchers predetermine the benchmark criteria (e.g., number of Ph.D. programs, number of Ph.D.s awarded, amount of external research funds) and then classify the HEIs accordingly. In South Korea, this strategy brings with it a great deal of controversy because each HEI is very sensitive about the setting of such a benchmark. Thus, approaches to HEI classification that are useful elsewhere might not be applicable in South Korea.

In order to overcome such controversy and enhance the reliability of the classification results, scientific classification methods will be applied in the mission classification process conducted for this study. In order to validate the classification, in addition, the institutional performance of Korean HEIs will be compared with that of U.S. peers. Thus, the research performance of Korean research universities will be compared with that of U.S. research universities, Korean doctoral universities with U.S. doctoral universities, and so on. This validation will increase the credibility of the classification results. It is hoped that this analytic approach will enhance the acceptance of this mission classification by academic peers and policymakers in South Korea.

The second consideration guiding this study concerns the disciplinary differences of mission focus. Most of previous academic researches, even in Carnegie Classification, have focused on institution-level differences rather than on disciplinary differences in mission classifications. For instance, a research university might have a competitive program in engineering and science, but might also be relatively less competitive in humanities. In this case, any typology would have limitations in applying the mission classification across all academic disciplines. This notion of disciplinary differences was proposed and supported by researchers (Becher 1989; Biglan 1973; Feldman et al. 2001) who identified disciplinary differences on academic culture, epistemological bases, belief on teaching and research etc. Recently, further, Hermanowicz (2005) found that mission at departmental level is different from that at institution level in his study of 60 institutions in the U.S. Thus, a discipline-level analysis will provide in-depth information for each of the HEIs in this study.

In this study, based on these considerations, four research questions were generated:

First, how many mission types can be identified among Korean higher education institutions?
Second, how many institutions are grouped in each type of mission?
Third, are these institutional classifications consistent across disciplines?
Fourth, are the institutional performances of Korean higher education institutions equivalent to that of international peers?

Background

In this section, a brief introduction is provided on efforts by the Korean government to classify HEIs. In addition, the mission classification criteria and typology will be offered as a practical and theoretical basis of this study.

Governmental efforts to classify universities

According to the Higher Education Act of 1997, four-year (or greater) Korean higher education institutions are classified as one of the following: (conventional) university,

teachers' university, polytechnic university, or open university.[2] This legal classification establishes clear distinctions between these four types of universities. For instance, the mission focus of teachers, polytechnic, and open universities is narrowed to pre-service training for teachers in teachers' universities, manpower training for industry in polytechnic universities, and lifelong education for adults in open university. Mission focus or mission classification, then, is not a concern for these types of universities. It is among conventional universities, where mission foci are frequently ambiguous, that mission classification is a serious issue.

In Korea, there are 221 four-year or greater HEIs in 2006. Among them, 175 are conventional universities, 11 teachers' universities, 14 polytechnic universities, one open university, and 20 other types' of HEIs (KMOE & HRD 2005a). Of the 175 conventional universities, 124 have Ph.D. programs, a critical factor in mission classification of this study. Given that the majority conventional universities conduct research and contain doctoral programs, a critical issue in classifying these conventional universities involves deciding which are more-or-less research oriented. The need to identify the extent to which each conventional university focuses on research among its traditional functions (teaching, research, and service) provides direction in classifying HEIs. Because many of these conventional universities define themselves as research universities, we can use research performance in developing a classification system for them. Such a classification approach might produce a hierarchy of conventional universities according to research performance.

In Korea, still there is no official classification or widely accepted classification despite the efforts of the Korean government to classify HEIs according to their mission focus. This effort has been initiated by the Korean government at least three times since the mid-1990s, when the Presidential Commission on Education Reform proposed the idea of cultivating world-class research universities in Korea (Korean Presidential Commission on Education Reform 1995). The first initiative by the Presidential Commission was not activated, however, because there was no financial support to implement the plan. A second higher education initiative was the Brain Korea 21 Project, which allocated special research funds (1.4 billion U.S. $ between 1999 through 2005) to build world-class research universities. The third initiative was proposed in 2005 when the Korean government designed a second BK 21 project, in which the Korean government decided to assign 2.1 billion U.S. $ from 2006 to 2012 and proposed building approximately ten research universities by the year 2010 (KMOE & HRD 2005b).

In these initiatives, mission classification of HEIs should have provided a theoretical and practical basis. Despite these policy efforts, however, the impacts of these initiatives were relatively limited because there was not widely accepted classification scheme in South Korea. Without a mission classification to guide the allocation of funds, most universities with Ph.D. programs received special research funds from the BK 21 project. While this allocation enhanced research performance nationwide, it might fail to achieve the original goals of the BK 21 Project—the building of very selected, world-class research universities. Thus, the classification of Korean HEIs will likely contribute to more effective policy development in the future.

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[2] These four types of HEIs are often discussed in academic research though there are other types of HEIs such as online institutions (15 institutions), technical institution (one institution), and others (four institutions) in Korea.

Classification criteria and types of mission

In many classification studies, the main criteria are the size of the programs and the number of graduates at each level (e.g., Ph.D. programs, Master's programs, Bachelor's programs, two-year higher education programs). The Carnegie Classification of 2005 (Carnegie Foundation 2008), for instance, classifies U.S. HEIs according to the number of program and number of graduates at each level. This benchmark-based approach was applied by Amano and Chen (2004), who classified Japanese HEIs according to the size of each level of program. Research performance also has been used as classification criteria in some studies. For instance, Liu and Liu (2005) classified Chinese HEIs according to the total amount of governmental research funds and article publications in international journals such as Science Citation Index Expanded (SCIE) and Social Science Citation Index (SSCI) journals.

Ramsden's (1999) research has a special meaning for this study because he applied discriminant analysis to classify Australian HEIs according to institutional research performance. In his classification study, research performance was measured by externally-financed research funds, number of graduates at each level, and number of publications. Although the goal of Ramsden's study was not classification itself, it provided meaningful information about the current classification approach and measures of research performance.

As discussed above, the main criteria for classification purposes in most studies include number of programs, number of graduates at each level, and some selected research performance measures, such as research publications and externally-financed research funds. Based on these classification criteria, HEIs in South Korea might be grouped into several categories no matter what the name of each category is. Diverse classification categories exist, as well as a hierarchy of types of grouping. For instance, the Carnegie Classification classifies HEIs into 20 categories (from "very high research active university" to two-year colleges); Liu and Liu (2005) classified Chinese higher education institutions into nine categories; similarly, Amano and Chen (2004) grouped Japanese higher education institutions into five categories.

In categorizing HEIs, special attention should be paid to institutions with specializations such as science and engineering because these universities have different characteristics from that of other types of Ph.D. granting universities. For instance, the Massachusetts Institute of Technology (MIT) and the California Institute of Technology (CalTech) have different characteristics from that of other research universities; thus, classifying these universities into different categories from the conventional research university might provide more meaningful information. In Korea, the Korea Advanced Institute of Science and Technology (KAIST) and Pohang University of Science and Technology (POSTEC) are also focusing on science and engineering because these universities benchmarked MIT and CalTech.

Method

Population and classification variables

The main purpose of this study was to classify conventional universities with Ph.D. programs into different types according to their research performance, and 124 of 175 four-year universities were considered in the analysis. For efficiency, the only conventional

universities that were included were those that awarded more than 20 Ph.D.s per year (the average number of Ph.D.s awarding between 2003 and 2005)[3] and published more than 100 articles per year in international journals (SCI, SCIE, SSCI, and Arts and Humanities Citation Index (AHCI)) during 2003–2005.[4] According to these selection criteria, only 47 universities were included in the analysis. This selection strategy will not skew the classification results because mission classification in this study is a matter that concerns upper-level universities. Thus, those universities with Ph.D. programs that were not included in the analysis will be categorized at a lower level (e.g., comprehensive universities). This strategy was applied because the goal of this classification is to distinguish high-performing research universities from others.

As the classification variable, frequently-used research performance measures such as research publications and externally-financed research funds by institution will be used. Among both classification variables, the total amount of externally-financed research funds has been used as classification criteria in an earlier version of the Carnegie Classification (e.g., Carnegie Classification of 1994). In measuring research publications, I included journal articles published in the journals indexed by the SCI, SCI Expanded, SSCI, or AHCI because article publications in these journals are main method of comparing HEIs worldwide (e.g., King 2004; Toutkoushian et al. 2003). Thus, books and domestic journal publications were not included in measures of number of publications. The other clustering variable, the amount of externally-financed research funds, was measured by the research funds from governments, research foundations (e.g., Korea Research Foundation, Korea Science Foundation), or the private sector, but excluded institutional research funds.

Analytical method

To classify higher education institutions, classification methods such as discriminant analysis, cluster analysis, or multidimensional scaling analysis were considered as possible analytical methods. Each analytical method has conditions (e.g., specific data structure, purpose of analysis) that indicate its appropriateness as an analytical method. Considering discriminate analysis is applied when each object was classified by given criteria to verify the classification through the statistical processes and multidimensional scaling analysis is mainly applied to classify objects without predetermined theoretical factors; thus, in this study, hierarchical cluster analysis, a statistical method designed to cluster individual observations into several groups according to the clustering variables, was applied [for details of applying cluster analysis and discriminant analysis, see other articles such as Patrick and Stanley (1995), Hekelman et al. (1995)].

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[3] The Carnegie Classification also classifies the institutions that award at least 20 doctoral degrees per year as the "doctoral granting university."

[4] Twenty-one universities that awarded more than 20 Ph.D.s per year (the average number of Ph.D.s awarding between 2003 and 2005) were excluded because these universities published less than 100 articles per year between 2003 and 2005 in international journals (SCI, SCIE, SSCI, and AHCI journals). These 21 universities are Sangmyung University, Incheon University, Sangji University, Chongju University, Sungshin Women's University, Mokpo National University, Suwon University, Kosin University, Seoul Women's University, Hannam University, Kyungsung University, Dongshin University, Hoseo University, Korea Maritime University, Korea National University of Education, Daegu University, Kyungnam University, Daejeon University, Hankuk University of Foreign Studies, Kyungwon University, and Kyonggi University. In addition, Information and Communications University (ICU) and Kwangju Institute of Science and Technology were not included in the analysis because there was no data on the number of Ph.D.s awarded on both universities at the KMOE & HRD website.

The rationale for this choice emerged from the main purpose of this study, which was to group higher education institutions in South Korea according to the research performance of each institution. In the analysis, the main strategy involved differentiating and grouping individual institutions into mission classification schemes (e.g., research university, research active university, doctoral university etc.) according to institutional research performance. With this strategy in mind, it becomes clear that the analysis conducted for this study is somewhat different from that for a conventional cluster analysis, which focuses on grouping individual observations. For the strategic purposes, I will classify 47 Ph.D. degree-awarding Korean universities into several groups, although many of these universities sought to be research universities.

Further, the classification strategy was applied to disciplines such as engineering, natural science, and social science and humanities in order to analyze how the clustering differs according to academic discipline. This approach is also relevant to the Korean context because the KMOE & HRD has encouraged universities to focus on selected fields depending on the strength of their programs within the university rather than a variety of academic programs; thus, the principle of "selection and concentration" has been applied at the university level. Thus, the clustering of research-oriented universities within each field might show different results than of the clustering of universities in general. Finally, the classification results will be verified through international comparisons in which the research performance of Korean research universities was compared with that of U.S. universities.

Data sources

Data on Ph.D.s awarded and number of Ph.D. programs, number of faculty, and externally-financed research funds were available from the KMOE & HRD. The number of faculty and Ph.D.s awarded are described at the both the discipline level for each institution as well as at the individual institution level, and thus enabled a discipline-level analysis. International comparison data was also available at diverse data sources. The number of full-time faculty in the U.S. institutions was available from the Integrated Postsecondary Education Data System (IPEDS) of the U.S. Department of Education; externally-financed research fund data was available from WebCasper database of the National Science Foundation (NSF) in the U.S. In addition, the data on research publications at both Korean and U.S. universities was available from the ISI Web of Science or CD-ROM.[5]

Findings and discussions

Descriptive statistics on research productivity

From 2003 to 2005, 47 Korean universities published a yearly average of 609 articles that were listed in international journals including SCI, SCI Expanded, SSCI, and AHCI. In 2005, South Korean higher education institutions received an average of $39,071 thousand U.S. dollars in research funds from external funding agencies (government and private sectors). Each higher education institution awarded an average of 160 Ph.D.s to graduate

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[5] In counting the number of publications of each institution, the number is a little bit different depending on the method of counting. For details on the counting method, see other articles such as Toutkoushian et al. (2003).

Table 1 Descriptive statistics of classifying variables

Classification variable	Number of case	Definition	Mean	S.D.
Publication (2003–2005)	47	Average (2003–2005)	609.95	702.14
External research fund (1,000 U.S. $)	47 47	Total Fund (2005)	39,071.00	40,416.00
Number of Ph.D. awarded	47	Average (2003–2005)	159.9	154.82
Number of full-time faculty	47	Average (2003–2005)	658.22	306.82
Per faculty publication	47	Ph.D. per faculty	0.88	0.87
Per faculty external fund (1,000 U.S. $)	47 47	Fund per faculty (2005)	60	60
Per faculty Ph.D. awarded	47	Publication per faculty	0.23	0.16

* Exchange rate: $1.00 is 1,000.00 Korean won

students per year. These measures were divided by the total number of full-time faculty to analyze the efficiency of research performance as shown in Table 1.

It is interesting that the standard deviation (S.D.) of journal publications among universities was quite large, which means that the number of journal publications among higher education institutions varies greatly. Similar patterns were identified for externally-financed research funds. This descriptive statistics may support the relevance of classifying HEIs for policy purposes. The differences between higher education institutions will be minimized within a category when the universities were classified into different categories according to institutional performance.

University-level mission classification

The mission of higher education institutions was classified by the research performance measures—number of article publications and externally-financed research funds. To cluster higher education institutions according to institutional research performance, hierarchical cluster analysis (HCA) was applied. In order to measure the distance between objects, a squared Euclidean distance was applied, which is the sum of the squared differences without including the square root in the calculation. As the agglomerative hierarchical clustering method, Ward's method which focused on increase in variance for the cluster being merged was applied. I also standardized raw data by Z-scores to minimize inconsistencies when the scales of the variables were different.

The result of the HCA is shown on Table 2. In clustering groups, agglomeration coefficients were observed to evaluate the changes within cluster sum of squares at each stage of the hierarchical procedures. The agglomeration coefficient provides information on how much to increase in variance by adding each cluster. At stage of 44, for instance, the agglomeration coefficient was increased from 6.921 to 14.602, which means the variance was increased 7.681 by adding a cluster at state 44. Thus, the agglomeration coefficients of 92.00 means that the total variance by Ward's method is 92.00 when all the 47 HEIs are grouped one. The agglomeration coefficients show that there is no considerable change until stage 43, but considerable changes occur between stages 43 and 44, which imply that there is a substantial decrease in similarity at this stage. As cluster analysis shows, the final stage has the highest increase in variance (55.941), which means that the final cluster is the most heterogeneous cluster compared to the others. In this study, Seoul National University had an appreciably different performance than others.

Table 2 Agglomeration coefficients by Ward's method

Stage (number of cluster)	Cluster combined		Coefficients	Variance explained at each stage
	Cluster 1	Cluster 2		
1 (46)	12	13	0	0.000
…	…	…	…	…
31 (16)	37	39	0.385	0.004
32 (15)	1	14	0.470	0.005
33 (14)	37	41	0.558	0.006
34 (13)	42	43	0.682	0.007
35 (12)	1	17	0.877	0.010
36 (11)	27	32	1.075	0.012
37 (10)	45	46	1.340	0.015
38 (9)	1	8	1.645	0.018
39 (8)	27	31	1.969	0.021
40 (7)	37	38	2.470	0.027
41 (6)	42	45	3.369	0.037
42 (5)	1	2	4.519	0.049
43 (4)	27	37	6.921	0.075
44 (3)	1	27	14.602	0.159
45 (2)	42	47	36.059	0.392
46 (1)	1	42	92.000	1.000

Considering that the main purpose of this study is to group institutions according to research performance, a cluster solution was sought. In the cluster solution, three to five cluster solutions were considered because conventional mission classification typologies of HEIs with doctoral programs typically include several categories such as research, research active, and doctoral universities. In addition, there was a possibility that research universities might have been classified into different sub-categories such as research 1 and 2 if necessary; thus, in this study, three to five cluster solutions were considered to be a flexible classification. As Table 3 shows, Seoul National University (SNU) is separate, followed by Korea, Yonsei, Sungkyunkwan (SKK), and Hanyang Universities, and KAIST and POSTECH.

Given this situation, one strategy was simply to classify higher education institutions into three groups; another strategy was to adopt a four-cluster solution to reflect the diversity of higher education institutions. If a three-cluster solution had been selected, only two clusters would have remained in practice because one cluster is represented by one university (SNU). Temporarily, then, the four-cluster solution was selected. In addition, "elbow" criterion which implies substantial decrease in similarity among clusters shows that four-cluster solution was recommended as Fig. 1 shows. As the Table 3 shows, in addition, the proportion of total variance explained at each stage began to increase rapidly at stage 44. This rapid increase of variance explained was reflected in the Fig. 1 at four-cluster solution where rapid increases in the proportion of variance explained began from four-cluster to two-cluster direction.

In making this decision, another consideration was how to classify KAIST and POSTECH, which showed greater efficiency in research performance even than SNU, as Fig. 2 shows. KAIST and POSTECH are science and engineering focused universities and their

Table 3 Cluster solutions and mission classification

| University	Cluster solution			Mission classification
	5 cluster	4 cluster	3 cluster	
Other 26 universities*	1	1	1	Doctoral
Chungang Univ.	2	2	1	Research Active
Konkuk Univ.	2	2	1	Research Active
Chungbuk National Univ.	2	2	1	Research Active
Ajou Univ.	2	2	1	Research Active
Catholic Univ. of Korea	2	2	1	Research Active
Ewha Womans Univ.	2	2	1	Research Active
Chonbuk National Univ.	2	2	1	Research Active
Kyunghee Univ.	2	2	1	Research Active
Chungnam National Univ.	2	2	1	Research Active
Ulsan Univ.	2	2	1	Research Active
Inha Univ.	3	2	1	Research Active
Chonnam National Univ.	3	2	1	Research Active
Pusan National Univ.	3	2	1	Research Active
Kyungbook National Univ.	3	2	1	Research Active
POSTECH	3	2	1	Research Group 3
KAIST	4	3	2	Research Group 3
Hanyang Univ.	4	3	2	Research Group 2
Sungkyunkwan Univ.	4	3	2	Research Group 2
Korea Univ.	4	3	2	Research Group 2
Yonsei Univ.	4	3	2	Research Group 2
Seoul National Univ. (SNU)	5	4	3	Research Group 1

* These 26 universities are Kangwon National Univ., Kyeongsang National Univ., Keimyung Univ., Kwangwoon Univ., Kookmin Univ., Dankook Univ., Catholic Univ. of Daegu, Dongguk Univ., Donga Univ., Dongeui Univ., Myongji Univ., Pukyong National Univ., Sogang Univ., Univ. of Seoul, Sejong Univ., Sookmyung Wowen's Univ., Soonchunhyang Univ., Soongsil Univ., Yeungnam Univ., Wonkwang Univ., Inje Univ., Cheju National Univ., Chosun Univ., Changwon National Univ., Hallym Univ., and Hongik Univ.

research performance is known worldwide by higher education magazine such as the Chronicle of Higher Education (Brender 2004). In addition, KAIST and POSTECH are members of the Association of East Asian Research Universities (Association of East Asian Research Universities 2008). These various factors led to a decision to assign these institutions to a different group, although they were in group 2 or group 3 in the total performance cluster. In the end, then, Korean higher education institutions were classified into five clusters according to their research performance.

Based on this HCA and the strategy for this study, each cluster was named to represent a profile of its group, as Table 3 shows. SNU was labeled as the "research group 1" university because its research productivity is comparable to leading universities worldwide. Korea University, SKK University, Yonsei University, and Hanyang University were named "research group 2" universities because the research performance of these universities is greater than any except SNU. KAIST and POSTECH were named "research group 3" universities since both are relatively smaller in size, but very efficient in research productivity, and mainly focus on science and engineering. These three types of
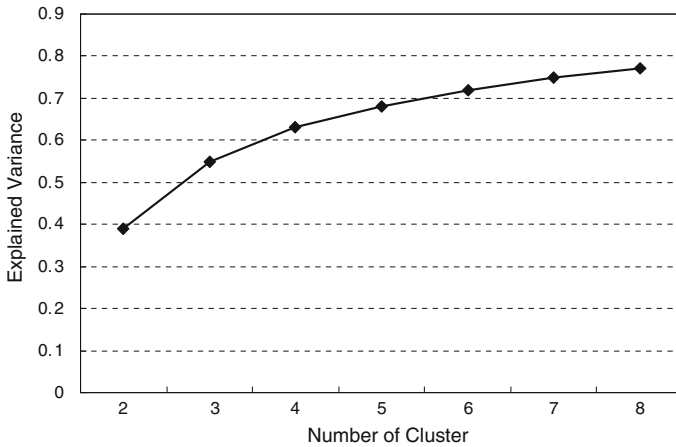
Fig. 1 Proportion of explained variance by cluster solution
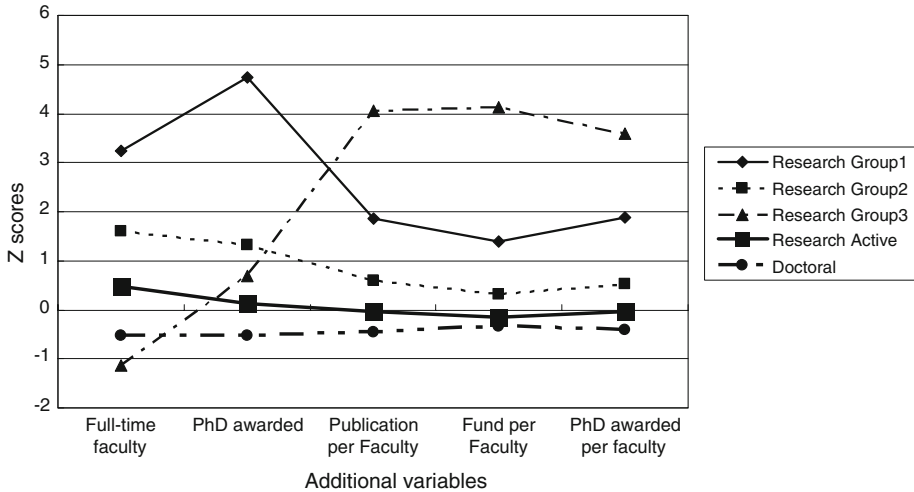
Fig. 2 Variable profiles of five clusters

universities—research group 1, 2, and 3—represent different levels of research perfor-
mance, but their performance might be equivalent to "very high research active"
universities in the U.S and will be named together as "research university" as shown in
Tables 4 and 6. The following 14 universities were named "research active" universities
because they demonstrated a relatively lower performance in research performance despite
an abundance of doctoral programs. The other 26 universities that were included in the
analysis, but evidenced a lower performance were named "doctoral" universities. (All the
other 77 universities with Ph.D. programs but not included in this analysis might be named
"comprehensive," "master," or "baccalaureate" universities depending on their classifi-
cation criteria. To classify these 77 universities, researchers might apply different types of
performance measures such as total number of Ph.D. awarded rather than international
journal publications or external research funds because these 77 universities emphasize less

Table 4 Average performance of each type of classification

Variable	Research university			Research active university	Doctoral university
	Research group 1	Research group 2	Research group 3		
Number of publications*	4,141	1,622	1,328	673	229
External funds (1,000 $) (2005)	240,490	92,058	91,946	40,460	18,357
# of Ph.D. programs (2006)	75	70	18	55	39
Number of Ph.D.s awarded*	894	364	268	182	80
# of full-time faculty*	1,653	1,152	307	801	494
# of universities	1	4	2	14	26

* Average of 3 years from 2003 to 2005

on publishing in international journals or bringing external research fund than doctoral or upper level of mission types though these univerities have Ph.D. programs.)

The classification and naming of each cluster might prove controversial in both policy-making and academic circles. It was thought that the controversies related to clustering could be addressed further with empirical evidence such as the statistical test of research performance on these five groups. For this purpose, an Analysis of Variance (ANOVA) test was conducted. According to the ANOVA results, the group means of the four clusters (excluding research group 1 univeristy because it has only one university) were different across research productivity measures. More specifically, these four clusters differed on the number of international journal publications ($F = 96.75$, $p < .001$) and the total amount of externally-financed research funds ($F = 57.82$, $p < .001$). Thus, according to the test results, the classification of five clusters was statistically significant and the conclusion that the five clusters are different in research performance was supported by empirical data and statistical tests.

In addition, a graphic expression of the profiles of each group was created in order to visually express how these clusters are different on other variables that were not used in the classification. To this end, four additional variables—number of Ph.D. awarded, research performance per faculty (publication per faculty, external fund per faculty), and number of full-time faculty—were described in a profile after transforming the scores into Z-scores. The number of Ph.D. awarded is a main criterion in benchmark-based approach such as Carnegie Classification; the number of full-time faculty represents the size of graduate programs; and research performance per faculty measures efficiency of research performance of HEIs. As Fig. 2 shows, the research group 1 university shows a considerable departure from the other groups. In addition, the other four clusters show noticeable departure from each others on these four variables, which means that these five clusters have different characteristics from each other on additional four variables; and thus, the profiles support that the mission classification was grouped well by the HCA. An interesting fact is that, the gaps between groups on per-faculty performance have been narrowed except research group 3 when the research performance was measured by per-faculty measure as shown on Fig. 2. Another noticeable fact is that the research group 3 shows outstanding performance when the research performance was measured by per-faculty measure. This fact implies that these two universities, KAIST and POSTECH should be classified differently from the research group 1 or 2.

Therefore, as Table 4 shows, the average research performance of each of these five groups is different. The differences between groups are apparent between research group 1

and the other four groups; and the differences are less between research group 2 and research group 3 universities. The research group 1 university, SNU, is the leading university, with the best reputation in Korea. The faculty size of SNU is the largest (average 1,653 from 2004 to 2005); student admission is very selective and no one questions the quality of faculty and their research performance in Korea. The university was built as the first national university in 1948, when the Korean government was established. Since then, SNU has been the leading university and its graduates are the elites in politics, academia, business, and elsewhere. In addition, SNU has taken a leading role in academic policy and many other universities are benchmarking SNU (Kim and Nam 2007). Thus, SNU is considered a state building, a flagship, and a research university (for details, see Shin 2008).

Four high performing universities—Yonsei, Korea, Sungkyunkwan (SKK), and Hanyang universities—were classified as research group 2 universities. Among them, Yonsei University and Korea University are the best-known private universities. Despite their status as long-time rivals, no one objects that both universities are top universities second only to SNU. Both universities have competitive professional schools (medical schools, law schools, management and business administration etc.) as well as science and engineering, humanities, and social science programs. A surprising result of the classification is the inclusion of SKK University and Hanyang University as research group 2 universities. Since the mid-1990s, the growth of research performance in both SKK University and Hanyang University has attracted attention. For instance, SKK University has competitive programs in social science and humanities; and Hanyang University has competitive engineering programs.

Two research group 3 universities, KAIST and POSTECH, are science and engineering focused universities and leading research universities along with SNU. Both universities are frequently mentioned as competitive research universities in Korea. As Fig. 2 shows, both universities are the most efficient in research performance per capita; however, because of the small size of their faculty, their research performance is underestimated when only summative performance measures are used. Nevertheless, no one questions that both universities are leading research universities in Korea (Kim and Nam 2007). KAIST was built in 1978 as a government funded university and it has led technology development and contributed to the development of the national economy since its establishment. POSTECH was established as a private university by Pohang Iron and Steel Company (POSCO) in 1987, and then became a leading engineering school with KAIST. Thus, although both universities are lower performers than research group 1 or 2 universities in terms of quantity, these universities are highly competitive when research performance is measured by per capita.

Fourteen universities classified as research active also have excellent reputations; however, their research performance is relatively less than that of competing universities such as research group 2 or research group 3 universities. As Table 4 shows, these universities have a similar number of Ph.D. programs to research group 1 or research group 2 universities, but produce quite less Ph.D.s than research group 1 or 2 universities. In addition, research active universities bring in less external research funding and produce fewer international research publications. To be upgraded to the research group 2 university category, then, these research active universities must enhance their research performance, especially in terms of attracting research funds or/and publishing more in international journals.

Although the classifications produced for this study are reasonable and expected by many people, one disappointing finding was the gap between the research group 1 and research group 2 universities—because the research performance, especially international publication of research group 2 universities was only one-third of research group 1 university as shown in Table 4. From the policy point of view, the Korean government has

Table 5 Discipline-level mission classification

Disciplines	Research university		Research active
	Research group 1	Research group 2	
Engineering	SNU	Korea, Yonsei, Hanyang, KAIST, POESTECH, SKK, *Kyungpook National*, *Chonnam National*, *Inha*, *Myongji* (ten universities)	Chungnam National, Pusan National, Kyunghee, Chungbuk National, Chungang, Chonbuk National, Ajou, Konkuk, *Yeungnam*, *Pukyong National*, *Sejong*, *Donga*, *Dongguk*, *Dankook*, *Kyeongsang National* (15 universities)
Natural Science	SNU	Korea, Yonsei, KAIST, POESTECH (four universities)	Hanyang, Chonnam National, Ewha, Inha, Pusan National, Kyunghee, Kyungpook National, *Pukyong National*, *Myongji* (nine universities)
Social Science & Humanities	SNU	Korea, Yonsei, SKK, Hanyang, *Ewha Women'* (five universities)	Chonnam National, Chungnam National, Pusan National, Ajou, Inha, Kyunghee, Kyungpook Natinal, Chungang, Ewha, Chungbuk National, *Konkuk*, Chonbuk National, *Univ of Seoul*, *Kangwon National*, *Donga*, *Yeungnam*, *Sogang*, *Dongguk*, *Dankook* (19 universities)

sought to build about ten competitive research universities worldwide. However, the results are a little bit disappointing because the quantity of research performance of these research group 2 universities does not quite reach that of research group 1 university, SNU.

Discipline-level mission classification

To explore whether a mission classification at the university level is consistent with such a classification at the discipline level, a discipline-level analysis was conducted. To do this, a mission classification of engineering, natural science, humanities and social science was conducted. In the analysis, engineering and natural science were classified by only external research funds obtained. Among the classification variables, international journal publications was not included in the analysis because faculties in engineering, natural science, and medicine publish their articles in SCI journals together; thus, it is difficult to differentiate each publication by each faculty's affiliated discipline. In clustering social science and humanities, however, external research funds and international journal publications were all included as classification variables. In the clustering, four cluster solution was applied because the institutional characteristics of science and engineering focused universities, KAIST and POSTECH, were already represented in discipline-level classification. Thus, inclusion of research group 3 might lead to duplication of classification.

As Table 5 shows, research group 1, 2, and 3 universities were also classified as very competitive in the disciplines of engineering, natural science, and/or social science and humanities. More specifically, however, the table shows that each university has relatively specialized areas—except SNU, which was very competitive across the three areas considered in this study. Among research active or doctoral universities at institution level analysis, for instance, Kyungpook National University, Chonnam National University, Inha University, and Myongji University have specialized programs in engineering, and

Table 6 Comparison of average research performance with U.S. peers

Country	Variable	Research university	Research active university	Doctoral university
U.S.	# of publications	2246.24	541.61	195.89
	External fund (thousand $)	269,577.00	49,075.00	8,548.00
	Ph.D.s awarded	314.83	114.96	47.22
	Full-time faculty	1928.45	933.14	596.89
	Number of universities	61	41	9
Korea	# of publications	1,897.95	672.83	229.32
	External fund (thousand $)	113,231.00	40,460.00	18,357.00
	Ph.D.s awarded	412.10	182.21	79.99
	Full-time faculty	982.33	800.98	494.09
	Number of universities	7	14	26

* The U.S. data is based on the average of 3 years from 2003 to 2005, and the HEIs included are based on data availability from the 281 HEIs in these three categories

Ewha Women's University has competitive programs in social science and humanities. Among doctoral universities in an institution-level classification, several universities were classified as research active universities. For instance, Yeungnam University, Pukyong National University, Sejong University, Donga University, Dongguk University, Dankook University, Kyeongsang National University have relatively competitive programs in engineering, though these universities were doctoral universities in the institution-level classification. On the contrary, SKK and Hanyang University, research group 2 universities, are less competitive in natural science while have competitive programs in engineering, social science and humanities.

Therefore, this finding implies that each university has relatively strong programs in some areas while not in others. Thus, although a university is classified as a research group 2, research group 3, or research active university, the classification does not guarantee that the university performs well in all areas. This finding has important implications for policymakers as well as academic researchers. For instance, policymakers might diversify their policies according to each university's strengths and weakness in detail as well as their mission focus in general.

Comparison with U.S. universities

A potential weakness of the performance-based approach is that it doesn't guarantee a certain level of performance even if an institution is classified in the category of research group 1 university, because this approach focuses only on performance differences between the clustered groups. Thus, if a university is classified as a research group I university, it only implies that the university is a relatively high performer, but doesn't guarantee whether its institutional performance is comparable with international peers or whether the institutional performance is in the upper level. To overcome this limitation, a comparison with U.S. peers was conducted to validate the performance-based classification. In this comparison, the averages of institutional performance of Korean universities were compared with that of U.S. peers.

For the comparison, the missions of Korean universities were matched with the Carnegie Classification for the U.S. universities. Conceptually, in the Korean classification,

research group 1 and 2, and 3 universities are equivalent to the "very high research active universities" in the Carnegie Classification of 2005. Korean research active universities are equivalent to "high research active universities"; and Korean doctoral universities are to "doctoral/research universities." Based on the comparison scheme, research group 1, 2, and 3 universities in Korea were grouped as research university in the Table 6. The others were categorized as research active universities and doctoral universities. In these three categories, the average institutional performance was compared in each category.

The findings indicate that, first, Korean universities produce more Ph.D.s across all three categories though the number of full-time faculty is much smaller in Korean than in U.S. universities. This might raise disagreement on the quality of Ph.D.s in Korean universities because producing more Ph.D.s with half the size of the faculty might result in a low quality education. Conversely, the differences might be explained by student demographic characteristics, in that most Korean graduate students are full-time students, while a considerable portion of U.S. graduate students are part-time students. Thus, Korean graduate students might concentrate more intensively on their studies and thus tend to complete their degrees within a given time frame.

Second, compared to U.S. peers, Korean research universities bring in less than half the amount of external research funds from external funding sources while research active universities and doctoral universities bring similar or more funds from external funding sources. This pattern implies that research funds are allocated to selected research universities in the U.S. while research funding is distributed relatively more equally in Korea. The differences might be attributable to the different research funding policy in each country. In its research funding decisions, for instance, the Korean government emphasizes equal distributions between regions, universities, and academic disciplines. Even the BK 21 program, a representative research funding program in Korea, gave special consideration to regional balance in its funding (KMOE & HRD 2006). To the contrary, in the U.S. research funding allocations are prioritized based on institutional support and the research capability of individual researchers rather on a policy of balancing regions, disciplines, and such (Gladieux et al. 2004).

Third, Korean universities publish similar number of publications to U.S. peers across the three classification categories. Although research publications were measured by quantity, research publications by faculty from Korean universities are noteworthy because they are all written in English and published in SCI, SSCI, and AHCI listed journals. Beside these international journals, Korean scholars publish many more articles in domestic journals. Thus, the number of research publications shows the extent to which Korean scholars publish in international journals. The research publications of Korean universities have been highlighted in publication research, such as that by Leydesdorff and Zhou (2005).

By comparison with U.S. peers, therefore, the performance-based approach that this study applied is as effective as a predetermined benchmark-based approach, and the results of the mission classification are also comparable. Thus, this performance-based approach might be used in some situations where serious controversies on classifications exist, such as in Germany, India, and Japan. Details on applying this performance-based approach are discussed in the following section.

Implications

In this study, Korean conventional universities were classified in five categories (research group 1, 2, and 3 university, research active university, and doctoral university) according

to institutional research performance. This classification has diverse applications for academic research and policymaking as well. First, in academic research, a mission classification might be used as a critical variable in explaining institutional characteristics in diverse research areas. In higher education research in Korea, so far, researchers have mainly controlled institutional characteristics by location of institutions (e.g., the metropolitan Seoul area versus non-metropolitan areas), sector of institutions (e.g., private vs. public) and some other characteristics; however, these variables have limitations in academic research, especially in comparison with international peers. The current classification will explain the dimensions of HEIs that were not reflected in previous control variables. Thus, this classification can be used widely in higher education research of both a domestic and international nature.

Korean policymakers might consider mission differences between HEIs in crafting their policies. For instance, governance systems of national universities might be designed differently based on mission differences between national universities. Also, tuition level might be established according to the mission focus of a university because college costs for research universities are significantly more expensive than at teaching-focused universities (Altbach 2007). Further, this classification might have an effect on faculty hiring and promotion criteria. In most Korean HEIs, research performance is of great importance in faculty hiring and promotion processes; however, HEIs are encouraged to develop diverse criteria such as teaching and learning, application of knowledge, and integration of knowledge as well as discovery of knowledge in their hiring and tenure decisions (e.g., Boyer 1990; Glassick et al. 1997; O'Meara and Rice 2005). Thus, universities, especially research active or doctoral universities, are encouraged to develop diverse criteria for faculty evaluations.

The strategy applied in this study has implications for other countries where there are controversies between HEIs related to the application of a classification scheme. For instance, Germany has experienced controversies in supporting so-called "elite research universities" recently; India also experienced a serious internal disagreement when the Indian government sought to establish a world-class research university in the early 1960s (Jayaram 2007); and, Japan experienced controversies when the Japanese government designed its Center of Excellence program in 2001 (Yonezawa 2007). The U.K. and Australia may find it potentially useful to apply the performance-based approach, since a legal typology between different types of HEIs was discarded in both places in 1992 and 1988, respectively (Patrick and Stanley 1995; Ramsden 1999). Instead of a legal typology, then, a performance-based classification might explain how much does the new policy adopted in both countries bring changes in their HEIs since each country abandoned conventional typology. Thus, the performance-based approach might be widely applicable in these countries.

However, to apply the performance-based approach, there are two preconditions. First, there should be a great number of HEIs to classify universities. If there is not a great enough number of HEIs, mission classification using statistical software might not be applicable. Second, research performance should vary between HEIs and their research performance should be equivalent to reference country in order to make comparisons with international peers. If research performances between HEIs do not vary enough, universities might not agree with the classification results; in addition, if their research performance is not equivalent to a reference country, the classification results might not be validated by comparisons with international peers. If these conditions are not satisfied, a conventional approach might be more effective than the performance-based classification strategy.

Conclusions

In this study, a performance-based approach was applied and institutional performance was classified using Hierarchical Cluster Analysis. This approach is quite different from that producing conventional mission classification, which typically determine a benchmark and then classify institutions according to the pre-determined criteria. Korean higher education institutions were classified into research university (seven universities), research active university (14 universities), and doctoral university (26 universities). To validate the results of the classifications, the research performances of these categories were compared with those of U.S. peers. In the comparisons, the research performance of Korean universities was similar to or higher than that of U.S. peers. From the point, the classification results emerging from the performance-based approach were shown to be equivalent to that of conventional classifications using predetermined benchmarks.

Although this classification of Korean universities is based on empirical data and statistical methods, academic researchers and policymakers are recommended not to over rely on the results. As the discipline-level analysis shows, each institution has its own strong programs; thus, the classification results might be more applicable in some areas than in others. Thus, if policymakers develop national policy based on this classification, the results might harm institutional performance unless institution- specific contexts are considered. In addition, it is recommended that academic researchers recognize that mission type represents limited dimensions of each institution, even though this variable accounts for a significant portion of institutional characteristics. Special attention, in addition, should be given to research group 3 universities like KAIST and POSTECH, because both universities are small in size, well-known and competitive in their research performance.

In concluding this study, I would remind readers that the mission classification is a relative weight between diverse functions of higher education; thus, teaching and service functions should not be neglected though a university is classified in a particular mission category. Rather, research universities should pay more attention to teaching and service because these functions might be given less emphasis in these universities. In addition, the classification results of this study were based on current data and the strategy applied in this study; thus, this classification might be updated in the same way that the Carnegie Foundation has been updating its classification continuously. Hopefully, academic researchers who apply this classification in higher education research will provide in-depth information for the revision of this typology. I would also remind that this study classified only 47 HEIs among 124 universities with Ph.D. programs. By considering different performance measures, thus, the classification scheme might be expanded to the rest of 77 HEIs with Ph.D. programs, which were not included in this study; further, to the other 51 HEIs without Ph.D. programs.

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