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Brain Korea 21 Phase II

A New Evaluation Model

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Prepared for the Korea Research Foundation

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Summary

In the late 1990s, the Korea Ministry of Education and Human Resource Development (MoE), in response to concern over the relatively low standing of the nation's universities and researchers, launched the Brain Korea 21 Program (BK21).

BK21 seeks to nurture globally competitive research universities and graduate programs and to breed high-quality research manpower in Korea. It provides fellowship funding to graduate students, postdoctoral fellows, and contract-based research professors who belong to research groups (*sa-up-dan*) at top universities. Recipients are selected on the merit of the research groups and universities to which they belong, not on individual merit. Although the department-level research group is the unit of support, the program does not support the labor cost of faculty members participating in the research groups or capital costs of university research and development (R&D). These costs are supposed to be financed by sources other than BK21. BK21 funding for a selected research group is proportional to the number of graduate students and young researchers in the group.

The program has had two phases so far. In Phase I, which ran from 1999 to 2005, BK21 allocated about US$1.4 billion. In Phase II, which began in 2006 and is scheduled to run through 2012, BK21 will allocate an additional US$2.1 billion. The Phase I and Phase II programs are not much different from each other in their goals and missions, funding rules, and selection criteria. The few differences between the two phases are subtle and nuanced in emphasis. Whereas Phase I emphasized university-level excellence, Phase II emphasizes

department-level excellence. Phase II emphasizes the university-industry link more than Phase I does, and institutional reforms are emphasized in Phase I more than in Phase II. A Phase II research group is based on a department of a single university, whereas Phase I research groups originally started with investigators from multiple universities in the same academic discipline—a leading university and one or more participating universities. However, during the course of Phase I, investigators in each university were regarded as a separate research group and each university accounted for its performance at the end of the Phase I program, which is basically the same as in Phase II.

BK21 has attracted a great deal of attention, in part because of its strategy of concentration that results in relatively large awards and because of the prestige it confers on recipients. Given the high profile of the program, there is great interest in the program and in determining its effects on universities and human resource development.

In this study, we develop an evaluation model to assess the net effect of the BK21 Phase II program. The evaluation model includes a logic model, a quantitative model, and evaluation metrics. We also suggest prototype database structures that would allow assessment of the BK21 Phase II program achievement in the future. Based on the findings of the evaluation model and database structures and also on our knowledge of research and educations systems in the United States, we derive policy implications for the future management of the program and for the university research sector more generally. The task of deriving broader policy implications beyond the findings of the evaluation model and database structures was specifically requested by the sponsors.

Lessons from Previous Evaluations

Although there were several evaluations of BK21 Phase I, they were not designed to answer the critical accountability question of the program's net contribution to R&D capability and manpower production compared with those of other programs. Data were generally limited to information gathered from institutions that received Phase I funding during the program period only and hence could not reveal net effects of the program. Previous evaluations largely lacked models that were sophisticated enough to show the program's net effects.

Previous analyses did suggest several options for improving evaluations. These included suggestions to improve the balance between quantity and quality indicators of the program performance, further development of the proper metrics to assess human resource development, focusing on a more narrow set of evaluation metrics for core performance indicators to measure quantity and quality of research outputs and manpower production, assessing net program effect instead of showing gross increase in performance indicators, and designing evaluation systems that will both measure the extent to which the program achieves its goals and monitor program progress.

A Logic Model to Identify Program Goals and Dynamics

We propose a logic model to identify the goals and missions, inputs, incentives, activities, outputs, and outcomes of the program and to explore the logical linkages among these elements (see Figure 3.1). Based on our review of relevant literature and interviews with BK21 stakeholders, we develop the logic model to understand underlying policy intentions and program dynamics. The logic model serves as a conceptual framework for identifying the goals of the study as well as for the evaluation metrics and quantitative assessment model we develop.

The goals of BK21 are (1) developing research manpower and (2) strengthening graduate programs to be globally competitive. Missions undertaken to accomplish these goals include improving the research capabilities of faculty and graduate students, enhancing the quality of research and training, and helping establish infrastructure of graduate schools. An additional mission, promoting regional universities, also seeks to build regional innovation clusters.

The goals and missions of BK21 direct the inputs, such as program resources and rules. The program allocates resources by using a concentration strategy, which results in awards much larger than those for other project-based funding programs. Even though the total BK21 budget is relatively small compared with other sources of R&D funding to universities, the concentration strategy makes the individual award size attractive enough for universities to put priority on obtaining BK21 funding—and hence on meeting the goals of the program.

BK21 also encourages specialization within the recipient universities so that they can concentrate their resources and support on selected areas of particular academic fields. Applicant universities are supposed to choose their academic areas of concentration, make a commitment to investing in the infrastructure needed to promote those areas of concentration, and plan for such reforms as improving the accountability over research funds and the faculty evaluation system.

Because award selection is based on academic and institutional merit rankings, the comparative rankings of universities and departments in Korea should become more obvious than before in Korea, which may induce stronger competition among them.

BK21 funding offers incentives for both recipients and those affiliated with them. For students, it lowers the expected cost of obtaining advanced degrees and thereby provides more incentive to pursue them. For postdoctoral researchers, BK21 funding provides stability in their transition to permanent academic jobs. For faculty, BK21 provides free manpower for research activities. For both faculty and universities, BK21 funding offers both prestige and incentives to align their decisions with the goals of the program. In addition, BK21 funding gives recipients flexibility to carry out broader research agendas and so develop university or department excellence.

Outputs and outcomes include impacts directly linked to the program as well as to its intended and unintended long-term effects. In addition to increased research, many program stakeholders claim that BK21 has led to structural reform of Korean universities, such as downsizing or closing weak departments and encouraging weak faculty members to leave the university, including those not gaining funding but seeking to do so in future rounds.

Some outcomes, such as greater international prestige for Korean universities, may take more time to emerge and may have broader causes than BK21 funding.

Quantitative Model for Assessing Net Program Effects

The quantitative model aims to assess the net effect of the program. It is specifically aimed at measuring the extent to which BK21 results in net improvements to the recipient groups' R&D outputs and human resource production compared with those of nonrecipients. We also discuss quantitative methods for isolating some of mechanisms by which BK21 affects various outcomes.

Several statistical methods could be used to examine treatment effects: ordinary least squares, matching, propensity scores, fixed effects, difference-in-differences, regression discontinuity, instrumental variables, and the Heckman selection correction.

We discuss the pros and cons of each method and conclude that the fixed-effects estimation procedure is the best strategy for examining the effects of BK21.

Despite being the best option, fixed-effects estimation does present some challenges. Compensatory funding changes, either for groups not receiving BK21 funding or in other sources of funding for BK21 recipients, can complicate estimation of the net effects of BK21, as can the effects of BK21 on both recipients and nonrecipients (such as those resulting from enhanced competition), other heterogeneous characteristics of both groups, and lags in program effects. For some of these problems, solutions are available; for others, awareness of model limitations is necessary to interpret the results appropriately.

The quantitative model used in the study is appropriate for a broad range of measures including, among others, total publications and high-impact publications, the faculty composition of research groups, number of PhD graduates, and number of patents. We demonstrate how the model will work in the future by using historical data on funding levels for both Phase I and Phase II, the number and quality of journal publications, and other quality indicators of Phase I. We explore some variations in the model specifications to evaluate Phase II impacts and to examine differential impacts by research area, lags in treatment impacts, and nonlinear treatment effects.

The analysis on quantitative model leads to several specific suggestions for database design. To understand fully the effects of BK21, data needs to be collected from universities and departments that received funding through the program, from those that applied but did not receive awards, and from those that never applied over the periods of pre-BK21, Phase I of BK21, and Phase II of BK21. The data requirements are broader than the scope of the data compiled in previous evaluations in Korea.

Evaluation Metrics and Measures

We next suggest relevant metrics and their measures that allow both quantitative and qualitative assessment of program effects. Metrics to evaluate BK21 Phase II program effects should be derived directly from the intended goals of the program. The evaluation must look at different levels of action and effect to make fully clear the degree to which BK21 has succeeded and through what means it has done so. Taking these two principles together, we suggest a set of metrics for both the outputs and outcomes sought within the context of the program's three major goals as shown in Table 5.1.

Having framed the evaluation metrics, we next construct appropriate measures. A metric is a criterion for evaluation; a measure is the practical means used to estimate the value of that metric. For a measure to be applicable to a particular metric, the necessary data must be available and the cost of collection should not be prohibitive. In addition, measures need to be valid, so that we are actually measuring the phenomenon we wish to measure. Finally, we may have to rely on proxy variables to represent what we can observe directly.

We propose at least one measure—often several—for each metric (Table 5.2). Multiple measures may provide a means of checking the accuracy of any one and allow evaluators to determine the level of detail at which to evaluate the metric. For example, to assess research quality, evaluators may wish to look at both the number of times a paper is cited by other researchers and peer assessments of the research (learned through surveys).

Prioritizing Measures

Not all candidate measures for evaluating BK21 are equally important. Evaluators should prioritize these measures taking into account the effort needed to assess them. We explore two ways for doing so. (Table 6.1). The first is assigning a relative raw importance to the measures, based on how closely related measures are to what evaluators consider to be most crucial. The second is determining the ease (or difficulty) of gathering the necessary data.

Measures that are the most important and for which it is easy to gather data could be given top priority. Those that are important but for which it is difficult to gather data could be given second priority; those that are less important but for which data gathering is easy could be given third priority; those that are less important and for which data gathering is difficult could be given the lowest priority. This system is notional and could be used as a starting point in assessing which measures to gather, but it is unlikely that the distinctions among measures will be so clear.

Obtaining comparative data from nonrecipients and nonapplicants may be a particularly vexing issue. Greater availability of data for applicants and recipients (through their program participation) could result in a structural bias in the evaluation. This suggests that evaluators will need to deliberate carefully before excluding a measure from the evaluation model because of difficulties in gathering the needed data or in using measures for which data are obtainable only from recipient institutions.

Database

The database of measures we suggest comprises four groups: (1) education, (2) noninstructional activities related to scientific and academic inquiry, (3) research and development activities with industry, and (4) other, or "general." In determining which data to gather, evaluators should assemble information that includes a unique identifier for each data series, an assessment of data-gathering difficulty, an ideal time period between observations or data collection, the evident qualitative differences (e.g., between BK21 recipients and nonrecipients), the level at which data are to be gathered, a listing of measures each data series would support, and possible data sources. We develop a suggested format for gathering this information, including a format for data series necessary to support the measurements presented in this report.

Future Development of BK21 and the University Research Sector

Although ultimate analysis of the BK21 Phase II program will have to await gathering of data to measure program effectiveness, BK21 program administrators also need to consider how to allocate program resources when making ongoing decisions. As the sponsor requested, we offer guidance on several topics related to BK21 and the research university system in Korea, including the research group (*sa-up-dan*) as the unit of support, award selection based on rankings of scientific merit, and the optimal number of research universities in Korea.

Addressing these topics required us to go beyond the findings of the evaluation model and database of this study. We base our analysis of these topics on our understanding of the BK21 program, the findings presented in this report, and other studies, particularly those in the United States, on research and education systems.

We recommend that Korea increase the role of merit-based competition in funding and award funds on an individual project basis. The *sa-up-dan* is not an optimal unit for support, even for graduate fellowships, because it does not promote full competition at the project and individual level. While there are valid reasons for the use of the *sa-up-dan* as a transitional strategy to improving academic and research capabilities, we recommend using smaller groups or individual projects to increase competition both among and within universities in the future. Project funding mechanisms, including size and length of funding, should be adapted to different fields of science. Although competition is important, it is also desirable to give researchers some stability in funding so that they can plan their programs. Awarding funds based on merit while allowing the best researchers to obtain grants of up to five years is a good way to balance competition and stability.

Similarly, granting portable fellowships for individuals to pursue graduate study will further increase competition and promote excellence. To finance infrastructure and facilities, Korea may also wish to promote the development of an efficient financial market where universities can borrow for construction. These loans would be repaid from overhead recovery on future projects performed in the new facilities. Until the required financial markets can operate effectively, however, Korean may prefer to use a competitive system of grants for facilities and infrastructure to spur university development in this area.

The U.S. system also offers some lessons to help more Korean universities attain research university status. The largest Korean universities currently have research expenditures on a scale similar to that of American research universities, but there is room for more Korean universities to reach this level. Given differences in the American and Korean economies, as well as in the composition of their populations, we estimate that Korea could support about 16 major research universities comparable with those in the United States. Korean university research could be stimulated further through a combination of competitive awards for project funding, fellowships for graduate students who select their universities, and university access to capital for construction of first-rate research facilities.

It may take a number of years to implement all these changes. Until that time, transition arrangements may be appropriate to encourage the university research system to become more responsive yet avoid abrupt shocks and dislocations.