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THE TRAJECTORY OF CHINESE DOCTORAL EDUCATION AND SCIENTIFIC RESEARCH

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ABSTRACT

To understand the current graduate education and scientific research situations in China, one has to understand the country's scientific research system and the development of graduate education. All the major issues in graduate education in China are closely related to the country's scientific policy and education reforms. China began economic reform in 1978 and since then the Chinese higher education system has experienced a series of changes including the establishment of graduate education program with masters and Ph.D. degrees. This paper will mainly discuss the development of Doctoral education and its current problems.

Graduate education in China

In the past 30 years, higher education in China experienced a remaking process. System expansion, diversification and massification of Chinese higher education are the concepts used frequently to describe the changes. The establishment of graduate education is one of the key elements for leading Chinese universities in academic development and scientific research. Higher education system expansion helps the development of graduate education in China. In 1978, there were only 405 higher learning institutions in China, including three-year vocational training colleges. By 2006, there were already 1867 public universities and colleges, with 444 public adult higher learning institutions as well. System diversification also provides the possibility for high school students to get a tertiary education in the private sector. Now in China, there are 278 private (Minban in Chinese) colleges and universities which have already been certified by the Ministry of Education, with 994 more institutions which are ready for certification, and 318 independent colleges that have some kind of affiliation with public universities. Now, China has 3901 higher learning institutions with a gross enrollment rate of 22%. The total number of students is 23 million, making the higher education system one of the largest in the world. The massification of higher education in China provides an opportunity for the development of graduate education in China. As a matter

of fact, before 1978, there was virtually no graduate education with academic degrees in the country.

Generally speaking, graduate education with academic degrees in China only has a history of 30 years. In 1980, the State Council issued a document on the regulation for graduate education and graduate degrees, which is of the first and utmost important document for the development of graduate education. It states that Chinese academic degrees include bachelor, master and doctoral degrees. Those students who have a bachelor degree or equivalent could take the exam for entering a masters degree program, and those who have a masters degree or equivalent could be admitted into a Ph.D. program. Actually in 1978, a few universities had already started to establish graduate education programs by enrolling a few master degree students. By the time the regulation was issued, these students were ready to get master degrees. And in 1981, Peking University enrolled three Ph.D. students.

Due to higher education system expansion, there was a growing need for qualified professors and researchers. Especially in the middle 1980s, when university research became an important part of China's scientific research system, there was a great need for highly educated and well trained professors and researchers. But due to limited access to graduate education in China, many Chinese students and scholars rushed to the United States and other developed countries for advanced knowledge and graduate education. Statistics shows that in 1983, there were only 19 students got Ph.D. degrees. In 1987, the total number of students in Ph.D. programs was only 8,969,

After two decades of development, the situation improved greatly. In 2002, 14,706 students got Ph.D. degrees.¹ In 2005, the total enrollment of graduate students was 364,800. Of this number 54,800 students were in Ph.D. programs. In the same year, 27,700 students got Ph.D. degrees.² Now there are 766 institutions offering master and Ph.D. degrees. These 766 institutions consist of 450 public universities and 316 research institutes. Currently, China's Ph.D. education is the third largest in the world after the United States and Germany. The quick development of the Ph.D. programs and large growth in number of students are the result of great demand in society.

Ph.D. student recruiting strategies

Though China has adopted the three-degree system according to the US model, student recruiting procedure or method is quite different. In the United States, application and recommendation are the most important elements for student recruiting. In China, examination and test scores are the most important criteria. Theoretically, if a student passes the examination, he could not be turned down. Superficially, this is considered as the only fair recruiting strategy to every applicant. But the problem of using examination for the selection of students is obvious, and it has been criticized for many years because it is really hard to tell who is the most creative and intelligent just with the reference of test scores. Many cases prove that examination is not the best method for recruiting students, especially for the selection of creative students, but so far there does not seem to be any other better substitutive method. In global competition, Chinese

¹ Report on the development of Academic degrees and graduate education in China, (2002) Higher Education Press, p.24.

² Report on China's education statistics, 2005.

universities face great challenges, even in retaining the best graduate students. At Peking University, there used to be a popular saying to describe the quality of Ph.D. students it recruited: “The undergraduate students are first rate, the masters students are second rate, and Ph.D. students are third rate.”

How do we understand this? During the 1990s, in Peking university, there appeared such a situation that the top 1/3 of its undergraduates went abroad for graduate education. In most cases only the second top 1/3 went to domestic graduate schools or professional training for master degrees. After they got their master degrees, the top 1/3 of master students went abroad either to pursue a Ph.D. degree, or for professional training. Research in 2000 shows 76% of the students in high tech fields at Peking University and 82% of the students in the same field at Tsinghua University went to the United States.³ From these descriptive percentages, one can see that for China, the brain-drain issue is already happening from the beginning of graduate education.

The cause of the problem is complex. Many reasons contribute to the situation, and one of them is the problem of recruiting. In China, for a student who wants to get a Ph.D. degree, as mentioned above, he has to take three exams. The first exam he must take is the national examination for university admission in order to get undergraduate education for a bachelor degree; the second is for the admission to master degree programs; and the third is for the admission of Ph.D. programs. These examinations not only cost a lot of time for students to prepare, but also create a lot of anxiety and psychological stress. It is obvious that no students would like to take such tedious memorizing exams. Now, people can understand why so many students want to go abroad for graduate education. To avoid psychological stress is one important reason.

Many researchers show that Chinese universities have no autonomy, and this makes them less competitive. And many Chinese university presidents complain that because of the lack of autonomy they cannot do things better, including recruiting Ph.D. students. In reality, the issue is far more complicated. Facing the problem of recruiting graduate students, new strategies have been put in place. In order to make sure the best students have a chance to get master and Ph.D. education inside the country, in 1985, 169 universities got the privilege to have students directly entering the graduate education program by application and recommendation. In Peking University, the strategy of combining recommendation and examination has been adopted for many years. The following figure shows the number of Ph.D. students the universities recruited in different years with different strategies.

Table 1:

Ph.D. Students recruited with different strategies at Peking university in 2002, 2004 and 2006

³ Feng, Zhaokui, (2000) How Could China win the global competition for talents in Liaowang, no. 32.

Years/number of students	2002	2004	2006
By direct recommendation to Ph.D program	107	255	225
By master and Ph.D combined recommendation	354	526	413
By examination	799	645	726
Total	1250	1426	1364

Sources: the numbers come from the Website of Graduate School, Peking University

Of course, there are debates on the eligibility and fairness in recruiting students by recommendation. And just recently, Peking University was challenged again for having more than half of its graduate students recruited by recommendations. The major concern is public fairness or academic accountability for having more of its own students into Ph.D. programs. The criticism is largely concerned with equal opportunity to students of other universities who want to get into Peking University.

The intention of adopting recommendation strategies is to keep the best students in the university or at home, though there is a danger of knowledge in-breeding in Ph.D. education. In fact, faculty inbreeding has been a serious problem in Chinese universities. And in order to facilitate graduate students with international perspective and to avoid serious academic in-breeding, Peking University has used many strategies to send students abroad for short term or long term study. And just earlier this year another project was launched by the Ministry of Education: the universities in the 211 and 985 projects are provided more opportunities to send their graduate students to study abroad for one or two years as visiting scholars with government financial support. This policy provides Peking University an opportunity to send three hundreds graduate students abroad every year.

Scientific Research in Chinese Universities

Most Chinese students abroad in Ph.D. programs have fellowships as RAs and TAs. This not only provides opportunities for them to assist their advisers and get financial support, but also for them to provide valuable insights for research. In Chinese universities, there is also an effort to bring research and academic training together. But China's scientific research system is different from the U.S. In 1952, China adopted a scientific research system that separates scientific research from teaching. Serious scientific research is mostly conducted in specialized research institutes in the Chinese Academy of Sciences. University research was considered important only for the promotion of teaching and learning. In August 1977, Deng Xiaoping, Vice Chairman of the CCP Central Committee, published his speech "A Few Suggestions on the Work of Science and Education." He pointed out that if China wants to catch up with the world, there is a need to develop science and education. Universities, especially key universities should be one of the major forces for scientific research. To begin with, China should first build key universities. It is only after his speech that scientific research in universities started to get more attention.⁴

⁴ Deng, Xiaoping, speech made on "Symposium on the Work of Science and Technology", August, 4-8, 1977.

Afterwards, universities started to develop graduate programs. But it took quite a few years for universities to get into the country's scientific research system. In the "Decision for the Reform of Chinese Higher Education" issued in 1985, leading universities were identified as "the center for student training and the center for scientific research". In 1986, the first national key research laboratory was established at Peking University. This marked the beginning of university research with R&D funding in nationally sponsored laboratories on university campuses.⁵ And it also marked the beginning of university research as part of the nation's basic scientific research system. The idea of establishing national key laboratories at universities actually came from the model of research universities in the United States. The American federal government's financial support for university research was very influential concerning the scientific research system reform in China during the late 1980s and early 1990s. The most commonly used examples are the Lawrence Berkeley National Laboratory, the Lawrence Livermore National Laboratory, and Los Alamos National Laboratory in the University of California system. But the national key laboratories at Chinese universities are mostly discipline-based, with the goal of creating centers of excellence in related areas of study.

Based on information provided by the China Education and Research Network, up to 2002, there were 91 national key research laboratories at the leading universities. Peking University alone now has 13 such national key laboratories, whose research projects are closely linked to the country's most urgent problems in development. To administer the country's R&D fund, the Chinese National Science Foundation was established in 1985 as a sponsoring organization for research in science and technology, both in universities and in the Academy of Sciences. In 1986, a famous national scientific research project, the "863 plan", was established. The plan was intended to pursue advanced research in such areas as information technology, automation, energy, new materials, biotechnology by using the country's R&D fund, and it also intended to bring scientists in the Chinese Academy of Sciences and university professors together in the above mentioned areas.

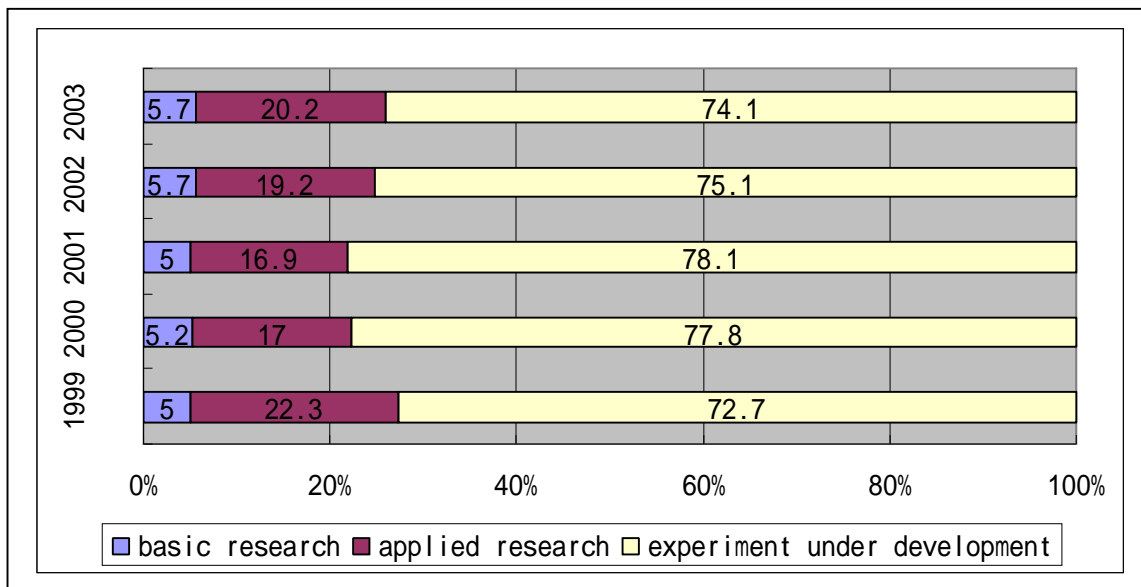
The establishment of national key laboratories at universities has increased university research capacity and the quality of Ph.D. training in science and technology. Statistics show that in 1998/99, nine leading universities awarded 2,465 doctoral degrees; 5,891 research papers were indexed in SCI in 2000; and in 2002, those 9 universities had 295 key research disciplines. In the same year, university research received 78% of national technology invention awards and 49% of national technology progress awards. Among the 6,118 patents, 32.4% came from the 9 leading universities (Zhao 2003).

But in comparison, one can easily find that university research and Ph.D. education in China are not well funded because the amount of the national R&D fund in basic research itself is very small. Table 2 shows the exact percentage of national R&D funds in basic research.

⁵ Ma, Wanhua (2007), "The Flagship University and China's Economic Reform" in Albtach & Balan (ed). *World Class Worldwide: Transforming Research Universities in Asia and Latin America* The Johns Hopkins University Press.

Table 2

The distribution of national R&D fund between 1999-2003⁶



The table shows that in China, most of its national R&D fund is used in development and applied research, and the national R&D fund used in basic research is much smaller than the other two parts. Between 1999 and 2003, funds for basic research only increased 0.7%. According to a report from National Statistics Bureau in 2004, the proportion for the three categories changed, and the situation for basic research was not much better. The fund for basic research increased slightly to 6.0%, while applied research took 20.4% and experiment under development 73.6%.⁷

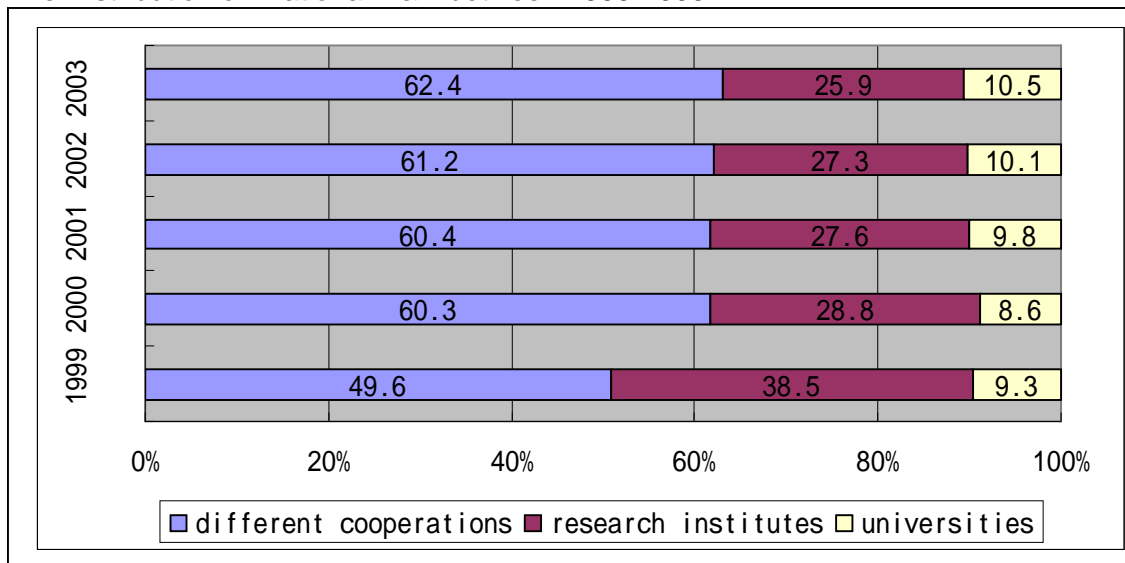
And even with the small basic research fund, universities have to compete with the Chinese Academy of Sciences. As to the allocation of the research fund, the following table shows that in 2003, university research used only 10.5% of the national R&D fund, while research institutions in the Chinese Academy of Sciences used up 25.9%, and enterprises or industries used up 62.2%. But comparatively speaking, annual R&D funds in university research kept increasing: in 2000, it was only 8.6% and in 2005, it increased to 10.5%.⁸

The following table shows how the country's R&D fund was distributed among three categories of research organizations from 1999-2003

⁶ Report on the Development of Academic Degrees and Graduate Education in China. Beijing: Higher Education Press, 2006. p.35.

⁷ <http://www.ilib.cn/Abstract.aspx?A=qqkjilw200505013>

⁸ Report on the Development of Academic Degrees and Graduate Education in China, Higher Education Press, 2005, p.35.

Table 3The Distribution of National R&D between 1999-2003⁹

To convert the 10.5% of the university research money into US dollars, it was only 1.06 billion, while in the same year in the United States, it was 47.7 billion, and in Japan in 2002 it was 17.2 billion.¹⁰ There is such a big difference between those countries. Now one can imagine why scientific research is so much behind in comparison with the speed of economic growth. Lack of investment in basic research is certainly an important reason.

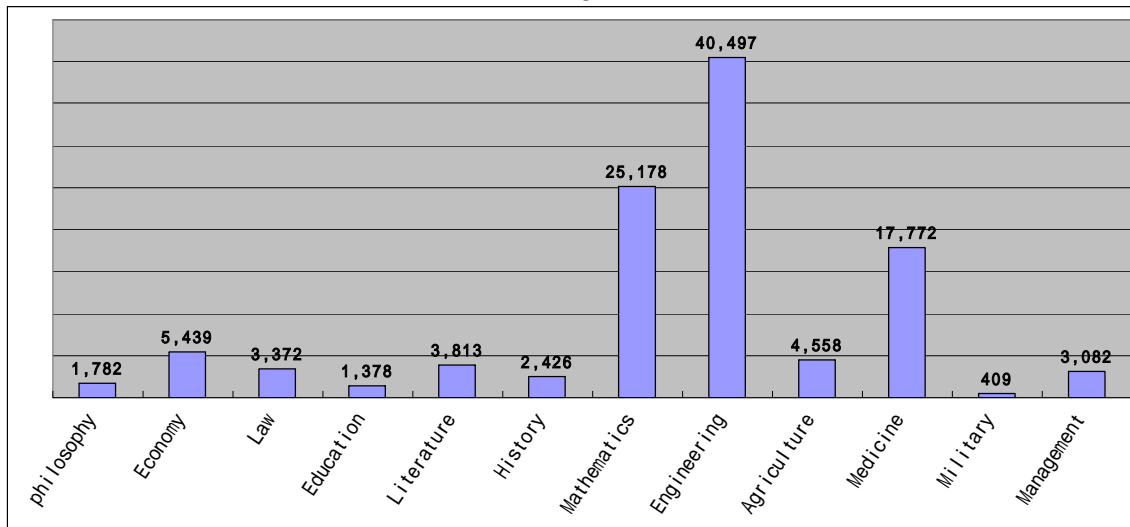
For basic research in the Chinese Academy of Sciences, the situation is not much better. In 2005, the Chinese Academy of Sciences had a total operational research fund of 10.656 billion RMB (around 1.3 billion dollars). Of this amount, basic research took 34.3%, applied research 58.41%, and experiments 7.3%.¹¹ This set of figures also reveals that currently the Chinese Academy of Sciences mostly focuses its attention on applied research, not on basic research. As a result, most of the degrees conferred are in applied fields.

The following table shows the disciplinary distributions of Ph.D. degrees awarded by both universities, the Chinese Academy of Science and the Chinese Academy of Social Science between 1982-2003. It reflects a general trend between applied research and basic research in higher level human resources development.

⁹ Ibid.

¹⁰ <http://www.ilib.cn/Abstract.aspx?A=qkjjjw200505013>

¹¹ The Chinese Academic of Sciences, Annul Report 2006. p.12.

Table 4Distribution of awarded master and Ph.D.degree between 1982-2003¹²

* The numbers in the table only refer to research Ph.D degrees, It does not include professional degrees

From the table, one can tell that from 1982 to 2003, engineering, mathematics and medicine offered more Ph.D. degrees than any other field. It reflects China's emphasis on scientific research and economic development needs.

And even now the situation does not seem to have changed much; most of the national R&D fund goes to the Chinese Academy of Sciences, though the importance of university research has been emphasized frequently. Less funding means fewer Ph.D. students in the field and less research opportunities for Ph.D. students. Lack of creativity in Chinese Ph.D. students is a common phenomenon in comparison with the United States and Japan. And that is one of the reasons Chinese students still prefer to go abroad for Ph.D. education, especially for the universities in the United States with good research facilities and more research opportunities.

A survey in 2004 shows that only 46.9% of Ph.D. students' thesis topics came from national R&D supported fields and related projects, and 11.4% came from local government and industry.¹³ This finding reveals the problem of separate graduate education and scientific research. It may provide an explanation why Chinese Ph.D.

¹² *Report on the Development of Academic Degrees and Graduate Education in China*. Beijing: Higher Education Press. P.147.

¹³ *Report on the development of Academic Degrees and Graduate Education in China*, Higher Education Press, 2005. p180

students are less productive in knowledge creation and research in comparison with Chinese Ph.D. students who study abroad. Ph.D. students in China have fewer opportunities to work in the laboratories and solve real problem in scientific advancement.

Graduate Education Financing in China

Since China's economic reform, its economic structure has changed greatly; the market oriented economy pushes both the government and universities to pay more attention to the quality of Ph.D. education. But quality control of graduate education in China is highly centralized. Originally even the selection of doctoral student advisers had to be approved by the Ministry of Education. Now a few universities are given opportunities to set criteria for Ph.D. students' advisors. At Peking Universities, all of the full professors could direct Ph.D. students, under the condition that the professor should hold a Ph.D degree. But even now if a university wants to recruit one more Ph.D. students, the university still has to report to and get approval from the Bureau of Graduate Education in the Ministry of Education because the Ministry controls the financing of the student.

The governance of graduate education in China is very complicated. In Dec. 1980, an academic committee was established under the State Council, and this committee is in charge of setting standards for graduate education and providing guidelines in the quality of graduate degrees. Any policy change related with academic degrees has to be reported to this committee. In 1983, the Ministry of Education established a bureau of graduate education to coordinate the implementing activities of the degree regulation between universities and the State Council's Academic Committee. Also, for quality insurance, universities are allowed to establish graduate schools to regulate student and faculty activities in Ph.D. education. The graduate school at Peking University is one of the first graduate schools in China.

So for the quality control of Ph.D. education, the State Council takes care of quality and makes guidelines for conferring the degrees, and the National Development and Reform Commission decides the number of students admitted each year. Based on the number of students each university is allowed to admit, the Ministry of Education allocates graduate education funds to universities.

Roughly, for each masters student, the university would get 10,000 RMB (\$1300), and for each Ph.D. student, it would be 12000 RMB (\$1,400). This amount will cover student tuition and provide a living stipend. The money goes to the university directly. Then the university would provide each student a minimum of 290-300 RMB (\$40) a month for living expenses. In the 1980s and 1990s, the graduate student's financial support were considered to be enough for the students basic living expenses. But in recent years, that amount seems to be not enough for students' monthly bills, and many students have to either work for their advisers or do other part time jobs in order to maintain a living. Some students from well-to-do families may still be dependent on their parents during their studies.

Government allocation of funding for graduate education follows a flat scheme, without considering the regional or disciplinary differences between Ph.D. programs, and a graduate student in a province university in a less developed area would cost much less

than a graduate student in a large city. That is one of the reasons why top universities in Beijing and other economically developed cities tend to have smaller and stronger Ph.D. programs, and provincial or local universities tend to have larger Ph.D. programs. As to how top universities support their Ph.D. programs, different universities adopt different strategies. In China, universities are allowed to open enterprises to transfer university research and inventions into productivity. This way, universities are supposed to get a certain percentage back in order to support basic research. By 2005, Peking University had 10 large companies, as does Tsinghua University. These university enterprises serve as extensions of university research and teaching by providing graduate students with internship opportunities. Statistics show that in 1997, about 520,000 students worked or carried out their research in university enterprises—among them, 1,419 students earned their doctoral degrees and 2,817 students earned their master's degrees (Ma 2004).

University enterprises are not trouble free. For lack of control and regularity in auditing, nobody knows how many resources have drifted to university enterprises from universities and what has been used for private benefit. In June 2006, a top CEO in one of the Nankai University enterprise disappeared with 110 million RMB (14 million USD) from the enterprise, and 300 million in mis-investment. In total the university lost over 400 million RMB. And just a few months before this incident, Tianjin University, which is Nankai's next door neighbor, came across a similar problem. The seriousness of the problem has caught a lot of attention. It seems in the near future, there will be some kind of legislation to regulate university and university enterprises' financial conduct.

Commercialization and the effect on Ph.D. education

In China, there is severe competition among universities for establishing Ph.D. programs in order to raise the academic status of the university. However, there is less quality assurance. Many universities pay more attention to developing continuing education and non-degree professional training programs. Commercializing knowledge and training programs for higher fees and tuition is a common choice for many universities hoping to release financial pressure.

The appearance of "independent colleges" is one of the phenomena of universities' commercializing behavior. In China, private institutions appeared during the 1980s. Since the concept of "private" has some connotation with capitalism, the term "Minban" was used as a substitute. For quite some time, Minban colleges and universities were allowed to exist, and some even made a good fortune. But somehow due to ideological differences, it took a long time for those colleges and universities to be legally accepted. Since there was money to make, some public universities started to establish independent colleges. They are called "independent," because in theory, they are independent from the mother institution in student admission, quality control and degree granting practices, but they should pay back to the mother institution for using the mother institution's name and prestige. In many cases, such institutions are the results of cooperation between public institutions and private education enterprises. And now there are 295 such colleges with a student population of 1.05 million.

People might ask why public universities should take the trouble to work with private ones since there is a great demand for public college education. In most cases, independent colleges in China are allowed to collect higher fees and tuitions. While

resources are limited, some public universities considered this the fastest way to make money. At first, opening an independent college was seen as an aspect of the mother university's investment behavior. And many parents seem to like the idea of paying higher fees and tuition to send their children to such colleges because of those independent colleges' affiliation with their mother institutions. What they do not know is that the independent colleges have nothing to do with the mother institution in academic quality control. They are independent academically from the mother institution, though graduate students and faculties from the mother institutions might be able to teach in those independent institutions.

It is only after four years, when parents and students found out that they could not get a degree from the mother institutions, and that they have difficulty being recognized as college educated students on the job market, that they feel that they were cheated. The student riot in one university in Zhengzhou, the capital of Henan Province in 2005, was such a case.

For top universities, instead of developing "independent colleges", they develop professional training programs. The training programs include part time, short term, and long term degree programs; schools or departments can charge tuition and fees themselves directly to students. In most cases, those programs are much more expansive than regular programs. The fees and tuition go directly to the university and school. Now the proliferation of training programs on campus or off campus are a common phenomenon. And often those programs are clearly targeting those who have the means. Though the current discussion in China about access and equality mostly deal with post secondary education, at the graduate level, these are also issues that need to be addressed.

Other Issues concerning Ph.D. education

In 1996, Chinese universities started to collect tuition and fees for undergraduate students. Government loans, work study programs, and part time work programs seem to play a very important function helping those poor students who could not pay for an undergraduate education. But for graduate education, there has been a long time to consider whether to charge tuition and fees, since the budget from the government does not guarantee the quality of graduate education. Why not charge tuition and fees from the students? A very important argument is that whoever benefits from the education, they should pay. So a policy has been adopted that starting this year, whoever joins graduate education programs need to pay their share of the cost. It seems to be fair to everyone, to universities and the students themselves. Then comes the question of how much students should pay and what about those who could not afford it. In the past ten years, there was a constant increase in the number of students taking part in the national examinations for graduate education, but this year, the number of participants has gone down. Some critics said that students become more rational about graduate education, which might be partly true, because they can no longer enjoy the "free party" and they worry if they could really pay out of their own pocket.

In China, on the one hand, universities and colleges are considered as the engines or locomotives for the country's economy, and policy and strategies have been adopted to enforce and reinforce the university's function in the country's economic transitions. Graduate education is considered as an important part in contributing highly qualified

personnel to the country's social and economic transition. On the other hand, they become targets for criticism. Last year a survey asked people to express what were the three important issues that concerned them. It was found out that higher education is the number one issue people are not satisfied with, higher tuition, lower quality, lack of equity and academic corruption all of the other criticisms Chinese higher education faces. Some critics then started to call for attention from the central government and that related organizations pay attention to the problem, because it is taken as an important factor to influence the "social and economic stability" of the country. Now no matter it is in economy or in education, to maintain "social stability" is the number one concern, including reforming graduate education financing.

To conclude the discussion, Chinese graduate education is still in its developing stage, and it faces many challenges. There is a need to increase enrollment, and there is also a need to improve its quality, especially in students' capacity of conducting scientific research. When one looks at statistics, one can find that the number of foreign graduate students in Chinese universities is increasing, but most of them are in language programs and humanities. In Chinese universities, graduate students in science and technology seldom have the opportunity to study with foreign students. In this case, most Chinese graduate students do not have much multi-cultural experience. The governance of graduate education in China is highly centralized and lacks flexibility. The problem has been consistently discussed, and now universities are given more freedom in student selections and have more opportunities to explore different resources to finance graduate education. The question is how and who should regulate universities commercial activities, in order to ensure equality, access and quality in graduate education.