CHAPTER 15

The Impact of China's Economic Rise on Global Higher Education

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INTRODUCTION

China's continuous economic rise in the last three decades has been one of the most dramatic events in world history. In addition to lifting hundreds of millions people out of poverty, creating a huge middle class with increasing disposable income and modernizing China's economic structure, this rise has also affected the rest of the world in many ways. This paper focuses on the impact on global higher education, from a personal perspective, specifically in terms of competition for talents (both faculty and students), university governance, science and technology research, and entrepreneurship/innovation culture. My observation is based on being the president for the last six years of a public university in Hong Kong, which in itself is governed by the "One Country, Two Systems" framework, and which has afforded me a front-row seat to observe this impact from both inside and outside perspectives.

CHINA'S ECONOMIC RISE

Surging Global Position of China

With the world's largest foreign reserve of US$3.9 trillion and the second-largest economy by GDP, China has achieved an unprecedented breakthrough

in economy over the past three decades. While establishing an innovation-driven economy, China has re-oriented the world economy to the East and is on its way to overtaking the U.S. as the world's biggest national economy, as projected by the International Monetary Fund.

The Chinese government has set a goal of forming a comprehensive and moderately prosperous society with a well-established middle class, to be achieved by the 100th anniversary of the Communist Party of China in 2021. General Secretary Xi Jinping reiterated the sentiments of the country and the determination to rewrite its destiny with an elevated ambition — the "China Dream": national rejuvenation, improvement of people's livelihoods, prosperity, construction of a better society and military strengthening.

Higher education is a vital element of this national plan. China's government realizes that developing a modern and effective higher education system is essential to drive the country's economic advancement based on development of human capital, investment in research, cultivating an entrepreneurial culture and building a new economy based on innovation rather than low-cost labour.

As one of the world's largest higher education systems, China has close to 2,500 accredited universities and colleges, with a total student enrolment of 35 million (Ministry of Education in China, 2014) and 7.2 million graduates in one single year.

Hong Kong: One Country, Two Systems

Hong Kong has been in a unique position during China's economic rise. After over 150 years as a British colony, Hong Kong has developed a very British, indeed Western, way of life and business. The population is mainly Chinese, but with a significant expatriate population, some of whose families have been in Hong Kong for generations. Since 1997, Hong Kong has been "handed back" to China and is now governed under a "One Country, Two Systems" framework. Essentially, except for national defence and foreign affairs, Hong Kong is governed under "Two Systems". It has its own legal system, currency and passport, and its residents pay no tax to the Central government. In particular, its education system is separate from the Mainland's and most of its universities are modeled after Western ones, mostly British and American. The national examination and university admission systems are different, the use of instructional language is different, with Hong Kong using mainly English, and, perhaps most importantly, the university governance systems are different.

Yet, because of "One Country" and geographic proximity, as well as cultural affinity, there is frequent interaction between universities in Hong Kong with our counterparts in the Mainland. This takes place at all levels: student and

faculty exchanges, faculty research collaboration, joint research proposals and annual meetings of university presidents.

Thus "One Country, Two Systems", as applied to higher education, gives Hong Kong universities a unique vantage point to observe the rapid change in the Mainland's higher education system. For HKUST (Hong Kong University of Science and Technology) in particular, with our vision of developing into a leading international research university with a strategic position in China, this special situation gives me as its president a front-row seat, but relatively objective, view of the impact of the rapid changes of China's higher education system on the rest of the world.

GLOBAL COMPETITION FOR TALENTS: FACULTY

Brain Reclaim

In its quest to develop rapidly a modern university system on China's scale, one of the scarcest resources is faculty. Because China's higher education system suffered a major setback and disruption during the Cultural Revolution, it simply has not yet developed either the capacity or the quality of the huge demand for qualified faculty members of its rapidly expanding universities. Thus China has turned to attracting talents from overseas, in particular its huge diaspora of talented students who had gone overseas for university studies and graduate education starting in the early 1980s, many of whom are now established faculty members at major universities in the West, some at the most prestigious ones. Deng Xiaoping has famously said, when asked why China allowed so many of its brightest students to study overseas, causing a "brain drain", that China has many talents that it can afford a small fraction to leave, and he predicted some of them will return one day. Well, it appears that now is the time!

China's Double-Edged Sword

One reason for these "returning sea turtles" is the fact that the material conditions in China, both living and academic, have dramatically improved in the last decade. Anybody who has recently visited major Chinese cities should have seen the rapid development of high-rise apartments with modern amenities, a world-class highway system and increasing middle-class car ownership (with huge environmental impact), abundant availability of consumer goods (most domestically made, but also global luxury goods) and the large number of international schools for children of expatriates and returnees. The Chinese government has also created special schemes, such as the famous "Thousand Talent Scheme" to attract returnees with Western-level salaries, housing

benefits and other perks. Enhanced internet communication and air travel have also shortened physical distances and allowed the returnees to retain contact with their professional networks worldwide. The Western, especially American, university system of long and frequent university teaching breaks during Christmas, winter and summer allows these academics to take frequent visits to China without affecting their duties at the home institution.

Another motivating factor to return is rising research spending. Many Asian countries offer international talents generous research funding, lab space and other resources often superior to those available in Western countries, in addition to the capacity to explore new and unexamined topics. At the same time, research labs from western science and technology (S&T) corporations, built recently in China to tap into the huge market and talent pool, provide industrial research support and internship opportunities for students. Considering the impact aggravated by external factors in some Western countries post the recent financial crisis, resulting in cutbacks in public university and national research budgets, the attraction is enhanced even more.

A related development which has added to the demand for faculty is the recent rise of branch campuses of Western universities in China, with motivation ranging from spreading the educational vision of the home campus, to tapping into the huge student talent pool, to profit generation. Examples include the University of Nottingham in Ningbo, University of Liverpool in Suzhou, NYU in Shanghai, Duke University in Kunshan, the Technion Guangdong Institute of Technology and the University of Melbourne's graduate school in Shanghai. In addition, China itself is starting new universities, many aimed at a high international level, all needing top-quality faculty members. Examples include the ShanghaiTech University and the Southern University of Science and Technology of China in Shenzhen.

All of the developments above generate a huge demand for quality faculty and will continue to have significant impact on higher education systems worldwide. I would venture to say that most of the top academic faculty in Western universities who are part of this Chinese diaspora have already been approached by Chinese universities, often their alma mater, to take up either short-term visiting positions or full-time positions. How to reconcile this big draw from China with the home university's own governance and policy poses a big challenge for many universities in the developed world.

But China's plan to recruit top faculty is not without challenges — in fact it is well known and documented that schemes such as the Thousand Talent Scheme are not working as effectively as the government had hoped. There are many possible reasons. Senior faculty, especially those well established in prestigious institutions in the West, are often reluctant to give up their secure, tenured positions to return full-time to China. They are glad to accept part-time positions, taking advantage of the flexible academic calendar in their

home institutions, to travel to China as often as their academic duties and family obligations allow. There are many potential benefits: they can recruit top graduate students directly, apply for research grants, and make use of major research facilities available in China. They can also visit their parents and close family members more often and get personal satisfaction in partaking in the rapid development of China, helping their home country. But an academic department cannot be built based on just a few part-time academic stars. Their much higher salaries and other perks often cause resentment among "domestic" colleagues. Younger faculty face a different reality. They are less established professionally and thus much more susceptible to internal politics in an unfamiliar academic department and research funding system. Even though they may have completed undergraduate degrees in China, they received their doctoral training, and some have begun careers, in the West, making them more familiar and more at home in a Western academic setting than in China. Coupled with scepticism about the pace of academic reform in China and their perception of the difficulty of returning to the West if things do not work out, these younger academics are often hesitant about returning. For them, the professional risk of returning is much higher than for an established academic. Finally, for any academic with young families, environmental concerns, such as air pollution and food safety, are often additional deterrents.

Impact on Hong Kong and Beyond

Interestingly, Hong Kong has benefited from the above considerations and been successful in recruiting some top talents from this Chinese diaspora over the last two decades. In a real sense, Hong Kong has the best of both worlds. On one hand, Hong Kong is an international city, its academic system is Western and thus familiar to members of the Chinese academic diaspora, the salary level is internationally competitive, academic freedom is enshrined in employment contracts, like at HKUST, information, including Facebook, Google and YouTube, flows freely, and basic academic support is more than adequate. On the other hand, Hong Kong is now part of China, culturally familiar, geographically close to parents and other family members, and Hong Kong academics have access to China's abundant academic resources in human talents and research funding. Of course, this relative advantage may not last forever, as China continues to develop and reform its higher education system, but for now Hong Kong continues to benefit from this "arbitrage".

The emergence of China's huge demand for quality faculty has already had, and will continue to have, a big impact on the global higher education system. Any university with top-quality faculty from the Chinese diaspora potentially faces losing some of its stars, either full-time or part-time,

to China. More generally, beyond the Chinese diaspora, there will be more competition for faculty in the marketplace, making it more difficult to attract talents. There may be more requests from existing faculty for split-time positions with Chinese universities and new university policies may be needed to accommodate such requests. Denying them may run the risk of losing these faculty members. On the other hand, having faculty who can serve as a bridge to China may actually be beneficial to the home university. Each university will have to develop its own strategy that aligns with its international vision and competitive position.

GLOBAL COMPETITION FOR TALENTS: STUDENTS

New International Student Ecosystem in Motion

The competition for students has also become more intense due to China's emergence in higher education. Only a decade ago, the flow of university students was mostly from the East to the West. The best students sought study at the West's venerable institutions, with quality and tradition that was simply not available at home. Other students simply sought university education, which often was not available at home due to an inadequately developed and under-capacity higher education system. More recently, as countries in the East develop their economies, they are expanding their higher education systems, realizing that continuing economic growth depends on investment in education. As the quality and capacity of these higher education institutions increase, they are offering increased opportunities not only for domestic students, but also increasingly for some students from the West, who are drawn to these developing countries because of the economic and cultural prospects they offer. Thus the playing field of international student flow is now a bit more level.

On one hand, Asian universities have recorded a significant growth of 45% over five years in enrolling international students. China alone has seen a six-fold increase since 1998, reaching 240,000 in 2009 (Sharma, 2012) and is expecting to reach 500,000 by 2020, with 150,000 in higher education (China's National Plan for Medium and Long-term Education Reform and Development, 2010-2020).

On the other hand, with a rising middle-class in Asia, many families can now afford to send their children overseas for university studies, often paying full tuition. Amidst the enlarged scale with increasing demand from the emerging markets and the East, the number of internationally mobile students doubled over 10 years (2000-11), with Asian students making up more than 50% of all students studying abroad worldwide. The largest numbers of international students are from China, India and Korea, with almost 4.5 million

tertiary students enrolled outside their country of citizenship today (Education at a Glance, OECD, 2014). While there has been continuous growth in the number of international students in higher education in the U.S. for seven consecutive years, most of the growth is driven by China, accounting for 31% of all international students in the U.S. (Clayton & Witherell, 2014).

How sustainable and stable is this new international student eco-system? Of course, no one knows for sure, but there are some danger signs and challenges. With the increasing number of Chinese students studying in foreign universities, mostly those in the U.S. and Commonwealth nations, most paying full tuition, these universities are increasingly dependent on international student tuition as an important source of income. For public universities, they run the danger of a taxpayer backlash as these international students often displace domestic students in flagship campuses with a limited enrolment. Over-relying on one source of income is also risky, as the flow of international students can notoriously change quickly, due to economic and political forces beyond the control of the higher education sector. The Australian university sector, which ranks third among the country's economic sectors by revenue, has recently faced crisis caused by factors involving Indian and Chinese students. Another uncertainty is that as the quality of the higher education system in developing countries increases rapidly, they offer an attractive, often at a much lower cost, alternative to studying overseas. Improving economic opportunities at home also give incentives for students to choose to study domestically, with the added advantage of building a personal network that will be useful for career advancement. Finally, it has been widely reported recently that a surprisingly large percentage of this new wave of Chinese students abroad, who are in most cases the only child in the family under China's long-standing One Child per Family policy, have difficulty adapting to the new academic and cultural environment, leading to high dropout rates. If this condition persists, then it would discourage more students from studying overseas.

Institutional Implications: Case of HKUST

HKUST has benefited from this recent more balanced two-way flow of East and West students. On one hand, Mainland Chinese students are attracted to study at our university because of our high academic standards and global rankings, proximity to home, all-English instruction, relatively low tuition (our non-local tuition is about the same as University of California's in-state tuition), and a very safe living environment. Hong Kong also has a very liberal immigration policy, requiring only seven years of legal residency (including as a full-time student) leading to permanent resident status. Students can also legally seek employment in Hong Kong after graduation and a not

insignificant fraction of our Mainland students choose to work in Hong Kong after graduation. Both local and international employers like these cream-of-the-crop students who speak fluent English, Putonghua and Cantonese, and understand the cultures of Hong Kong and Mainland China, augmented by a global perspective and experience (e.g. over 40% of our undergraduates have exchanged overseas for at least one semester before they graduate.) For the period 2011-2014, the number of Mainland applicants to our undergraduate program averages about 6,000, all with Gaokao (China's national high school graduate examination) scores that would admit them to the top 10 universities in the Mainland. From this large number of applicants, we admitted on average about 180 — a very fierce competition indeed!

On the other hand, our university has been very attractive to international students as well, for mostly the same reasons as for Mainland students, but with proximity to home replaced by gaining a study experience in China but in a Western system that they are familiar with. For the same period of 2011-2014, we admitted on average 193 international students with close to 3,000 applications received in 2014. The top home countries are Korea, Indonesia, Malaysia, India and Pakistan, but also increasing applications from Europe.

These two cohorts of Mainland and international students, together with a large number of international exchange students, have greatly increased the cultural diversity of our student body, benefiting our local students with a global perspective even if they choose to stay home. Hong Kong has been rated as the 7th-best city globally for students (2nd in Asia) and has the largest number of top-ranked universities normalized by GDP in the world, according to a survey by QS.

What are the implications of the rapidly rising number of Chinese students flooding the global higher education market? Each university will have to decide whether to catch this wave and increase the percentage of Chinese students in its student body. Doing so may bring an immediate financial windfall, but also runs the risk of political pushback from existing constituents and potential financial instability by over-relying on one source of income. Not doing so runs the risk of missing out on opportunities presented by one of the biggest historical shifts in international student mobility.

REFORM

China's Higher Education: From Late Starter to International Spotlight

The full impact of China's economic rise in global higher education is difficult to fully assess because China has embarked on a series of major reforms of its higher education system, the full impact of which is still evolving.

China's higher education system has had a relatively late start. The oldest universities, such as Peking University (Beida), are just over 100 years ago. Some of them, like Tsinghua, were modelled after Western universities. This late start was further disrupted by major historical events. During WWII, whole universities, e.g. Zhejiang University, were uprooted and moved from coastal regions to further inland to avoid the Japanese invasion. During the Cultural Revolution, the Gaokao was suspended and university education was essentially stopped. The restart of higher education only began in earnest in the early 1980s. At that time, for example, only a very small number of professors nationally were allowed to be Ph.D. thesis advisors. Since then, the higher education system has ridden the economic wave of the country and has gone through many stages of reform and self-improvement. As an example of the dramatic change that has taken place, who would have predicted even as recently as a decade ago that a Chinese university would publish an Academic Ranking of World Universities, as the Shanghai Jiao Tong University (SJTU) does, that exerts enormous influence on higher education globally, including in developed Western countries?

Several reform plans have been initiated in the past two decades. Project 211 is the Chinese government's new endeavour aimed at strengthening about 100 institutions of higher education and key disciplinary areas as a national priority for the 21st century. Project 985, started in May 1998, is a constructive project for founding world-class universities in the 21st century. A huge increase in university funding was invested by the central government, with a corresponding rapid upgrading of campus infrastructure, as well as in research spending. In 2012 alone, more than RMB700b. was spent by the Central government on higher education. New universities are being formed, the most recent ones include the ShanghaiTech University as à la Caltech, University of Science and Technology of China (USTC) as part of the Chinese Academy of Sciences, Southern University of Science & Technology of China in Shenzhen, also an investment by the city of Shenzhen, partially-modelled after HKUST, with its first President Zhu Qingshi, former President of USTC, and current President Chen Shiyi, former Vice-President of Beida. These new universities represent attempts to build a new kind of university to compete with the best around the world and supply the elite graduates who will lead the continuing economic growth of the country. Most of the top universities in China are now true research universities in the von Humboldt sense. A new generation of university presidents is in place, most educated post-Cultural Revolution and with extended overseas experience, some with foreign-earned doctoral degrees. Thus the seeds have already been planted for sustaining this continuing reform.

One area of reform is the structure and role of higher education institutions. After WWII, China adopted the Soviet system of higher education.

Research was done at specialized research institutes and national academies, whereas teaching was done at large, state-run universities. Moreover, universities themselves were specialized into specific disciplines, e.g. universities of medicine, communication, petroleum, mining, etc. The von Humboldt model of a research university, where teaching and research are both conducted while complementing each other, was not adopted. The situation has changed and China has moved towards a more Western model, but the process is still not complete by any means, and probably will never be an exact copy of any particular Western model. The C9 universities, i.e. China's nine elite universities, are more similar to their American counterparts, with some being comprehensive universities, such as Beida, and others more specialized, typically only in S&T like USTC. Several have gone beyond their perceived and more specialized roles and transformed themselves into more comprehensive universities, like Tsinghua and SJTU. Some others have introduced a tenure system for faculty, and more generally different career tracks in teaching, research and tenured.

They are also turning increasingly global, in terms of attracting faculty from overseas, in sending their own students overseas for exchanges, in seeking strategic partners across the world, and generally in increasing their global profiles and branding, e.g. joining members of global alliances such as the Association of Pacific Rim Universities (APRU) and the Association of East Asian Research Universities (AEARU) — HKUST is a member of both. Some have started to offer more courses in English, with an eye towards attracting more international students. Some have started special colleges within their larger university, such as the Yuan Pei College in Beida, as an initiative to reform its undergraduate education by strengthening liberal studies. Other initiatives are designed to encourage cross-disciplinary studies, encouraging creativity rather than rote learning.

A relatively new development is the building of branch campuses of foreign universities in China. Examples are Nottingham-Ningbo, Liverpool-XJTU, NYU-Shanghai, Duke-Kunshan, Technion Guangdong Institute of Technology in Shantou, and Melbourne-Shanghai. These new universities all aim to bring the DNA of the educational culture of their home campuses to China. Some are also planned to be part of a global network of campuses based on the home campus. The Central government requires a domestic partner in all these new ventures and heavily subsidizes some of them, but also keeps a close eye on them, while all claim to have full academic autonomy. Hong Kong is not foreign, but falls under the same rules. As of now, only the Chinese University of Hong Kong has started such a joint venture — a new university in Shenzhen partnering with the University of Shenzhen. Many of these joint ventures are relatively new and it remains to be seen whether they will be successful.

Reciprocally, we may start seeing a trend for Chinese universities to open "branches" overseas. In June 2015, it was announced that Tsinghua University is partnering with the University of Washington to create the Global Innovation Exchange (GIX), a new institute to be built in Seattle to facilitate academic and corporate integration for technological innovations, partially funded by US$40m. from Microsoft. Tsinghua is expected to send faculty members to teach at GIX and also to help recruit Chinese students, providing an important global aspect. This will be the first time a Chinese university has a physical presence in the U.S.

Challenges Ahead

Despite these on-going reforms of China's higher education system, there are serious challenges and roadblocks. First, is the top-down, centrally-controlled system of higher education governance which compromises academic autonomy, at least in the normally understood meaning in the West. As is well known, every university in Mainland China has a Party Secretary, in addition to the President; how well a university can move forward to realize its academic plans depends on the working relationship between these two people. Both are appointed directly from the Central government — there is no counterpart to a "Board" or "Council" that governs Western universities. Student numbers and degrees at universities are also controlled centrally. For example, universities need central approval and an allocated quota before they can start a Ph.D. program. Occasionally, the Central government does issue "guidelines" to universities which in the West would be viewed as interfering with academic autonomy, although this sometimes does not prevent politicians in the West from interfering anyway. In 2013, there were unconfirmed media reports about a confidential internal directive widely circulated within high-level government departments, *Concerning the Situation in the Ideological Sphere*, prohibiting discussion of seven topics. Included on the list of prohibited topics were: western constitutional democracy, universal values of human rights, western conceptions of media independence and civil society, pro-market neo-liberalism and "Nihilist" criticisms of past errors of the party. Earlier this year, the Minister of Education publicly called for a ban on textbooks that promote Western values. Such edicts from the government are seen in the West as infringing on academic freedom, but one also has to understand that this system is designed for China's specific needs and constraints. Given China's history of university student-led unrest and the government's desire to promote societal harmony, I do not believe that the system will change in the near term. It may yet prove to be successful in the long run, but during the process there is an unavoidable tradeoff between public accountability and institutional autonomy.

A second challenge is the fact that sometimes Chinese regulations can have unintended consequences which may adversely affect universities. Recently, China released a draft law on Foreign/Overseas Non-Governmental Organizations (NGOs) Management, under which foreign NGOs (which most interpret to include universities) are required to seek approval of an official government sponsor and registration with the Ministry of Public Security before engaging in any local activities, including raising local funds. The proposed law is regarded by some (including Harvard University and New York University, which have openly commented on this) as potentially impeding transnational faculty and student collaborations, and undermining the ability of foreign universities to operate in China according to principles of academic freedom.

A third challenge is the fact that too many resources in too short a time can actually distort academic value and culture, leading to over-emphasis of faculty on publishing without due consideration for quality, sometimes even resorting to faking data and multiple submissions of the same work to different journals, as widely reported.

Finally, there are also expectations and challenges. With the rapid increase in the number of university graduates in recent years, the job market does not quite match the job expectation of the graduates, who expect to have high-level, white-collar jobs waiting for them upon graduation. The Central government has recently announced plans to convert some universities to polytechnics and vocational training schools.

What impact will these reforms and challenges have for universities outside China? Certainly, the modernization (or Westernization) and globalization of Chinese universities should open up many opportunities for universities from other countries who are interested to be more engaged with this emerging world power. Their students and faculty can potentially benefit tremendously. The huge amount of financial resources invested in Chinese universities can potentially benefit their international partners, in both research and education. On the other hand, foreign universities will have to realize that the Chinese university system is fundamentally different from theirs and they will have to adjust their expectations, as well as operational procedures, if they do decide to engage with Chinese universities.

SCIENCE, TECHNOLOGY AND RESEARCH

Unprecedented Infrastructural Strides

In addition to higher education, China has also been investing heavily in S&T development, seeing both as key to its future economic growth. These two efforts are also complementary, as much of the research is done at

universities. China is shifting its economy from low-cost manufacturing and export-based to high-value added advanced manufacturing, design and global brand-building, and domestic-based. In May this year, China's cabinet said it would seek to boost automation in Chinese manufacturing, innovation and environmental sustainability, as well as upgrade railway equipment, engineering machinery and internet-connected factories.

In terms of technological infrastructure, China has been making historically unprecedented strides in a very short time, basically within the last decade. Examples are: the world's largest highway system — bigger than the U.S. — and high-speed rail network — larger than the E.U. — and the world's biggest internet usage and mobile phone penetration with 1.2 billion cellphone users.

Earlier this year, China announced its "One Belt, One Road" (the New Silk Road Economic Belt and 21st-Century Maritime Silk Road) initiative, aiming to strengthen ties between Asia and Europe and develop trade and infrastructure in the region. More recently, China persuaded many Western countries, with the notable exception of the U.S. and Japan, to join its Asian Infrastructure Investment Bank to provide finance to infrastructure projects in the Asia region. In S&T development, China now ranks the 2nd-highest after the U.S. in the world in government research and development (R&D) spending of US$258b. in 2013. In its current National 12th five-year Plan, R&D spending is being increased to 2.2% of GDP by 2015. The prediction is that China's R&D spending could surpass that by the U.S. by 2020. China now has one of the world's largest numbers of "science parks", the most famous is probably Zhongguancun outside Beida and Tsinghua in Beijing. Three of the world's largest five internet companies are Chinese, including Alibaba, Baidu and Tencent, and the world's biggest telecommunication company is Chinese — Huawei.

Chinese Investment in Big Science

China is also making a major investment in Big Science, and taking a page out of the U.S. playbook: supporting basic science leads to technological leadership, as well as attracting the brightest minds to pursue S&T fields. Some examples are:

- Deep-Sea Research: Jiaolong is one of the most advanced manned research vehicles in the world, which can dive to a depth of over 7,000m;
- Supercomputing: Tianhe 2 has been the fastest in the world for over a year;
- Human Space Exploration: Shenzhou, Tiangong-1 and Chinese Lunar Exploration Program are in full development, and a Mars program is being planned;

- Next-generation Super Collider: Higgs Factory; US$3b., 52km circumference by 2028, which would overtake that of the European Organization for Nuclear Research of 27km;
- Super Telescope: The 500m Aperture Spherical Telescope in Guizhou Province; the world's largest and most sensitive; three times more sensitive than the "Arecibo";
- Magnetic Confinement Plasma Physics: China is one of the seven members in constructing the "International Thermonuclear Experimental Reactor";
- Building 1st China Spallation Neutron Source in Dongguan; targeted to operate in 2018, it will be one of only four such facilities in the world;
- Next-generation Gravitational-wave detector will be one of the world's three high-frequency detectors;
- Experimental Advanced Superconducting Tokomak will be world's first fully superconducting experimental Tokomak fusion device ever put into operation;
- The energy emission of SH Synchrotron Radiation Facility is ranked 4th in the world;
- Daya Bay Reactor Neutrino Experiment: Top 10 Breakthroughs of 2012 (*Science*, June 2013).

Of course, making an investment in S&T research and infrastructure, even as large as China's, does not guarantee technological leadership, or a proportionate return on investment in the economy. In China, everyone knows well the "X.S. Qian question" (Qian was the Caltech aerospace professor who was famously prosecuted by Joe McCarthy and left the U.S. to return to China, subsequently becoming the leader in China's space program): will China ever produce its genuinely "home-grown" Nobel Laureate? Much criticism, as well as self-doubt, has been laid at the ability, or the lack of it, to innovate and be creative and lead. China is trying very hard to address this issue. Whether it will succeed eventually is one of the biggest questions in the scientific "race of the nations".

What are the implications of China's rapid advance and huge investment in S&T R&D for the rest of the world? Certainly, to the extent that advances in basic science benefit all humankind, China's contribution should be welcome. There will be an element of competition and national pride — but some competition can also be beneficial to all. S&T journals will see a dramatic increase in paper submission from China, with widely-varying quality level, stressing the refereeing system. But I predict that the high-quality papers coming from Chinese institutions will increase rapidly in both quantity and quality in the near future. Boosted by rapidly increasing research funding, the

global rankings of Chinese universities will surely increase dramatically in the near future. Finally, it is not too far-fetched to predict that in the not-too-distant future, Western scientists may travel to China to make use of its major, world-leading scientific facilities, just as scientists all over the world now go to the U.S. and Europe for the same purpose.

INNOVATION AND ENTREPRENEURSHIP

From Counterfeiting to Innovation Giant

Universities today are expected to return to society the results of the public's investment. Technology transfer has become a pivotal key performance indicator for universities. Innovation and entrepreneurship have become key components of strategies adopted by many universities to achieve this mandate. Thus most countries with any ambition in S&T want to build their own Silicon Valleys, and most research universities want to imitate Stanford and UC Berkeley. If only matters were that simple!

Like most countries, China certainly wants to foster innovation and entrepreneurship. It is in a good position to do so: huge talent pool, financial resources and domestic market, as well as increasingly excellent educational institutions and technological infrastructures. Some of its most successful technological companies are indeed global leaders. So what's the challenge? One is the criticism that Chinese, indeed Asian, culture is not conducive to innovation and entrepreneurship, with its Confucius values of exam-centric, risk-averse, group-focused and high value placed on social harmony. So even though many Chinese have succeeded well when they moved to the U.S. to study or start their business, there have been relatively few domestically originated and globally recognized entrepreneurs. Even the big three of Alibaba, Baidu and Tencent have been criticized as following the pioneering trail set by eBay, Google and Twitter/WhatsApp.

My own thinking is more optimistic for China. First, sheer scale helps. With so many talents and such a huge domestic market, the opportunity for budding entrepreneurs with innovative ideas is enormous. Second, China's domestic market is not just huge but also has its own peculiarity and special culture, and out of this mix something innovative is bound to emerge. Third, the business of innovation is global and money goes where good ideas and people are. Increasingly, such opportunities are to be found in China and smart money, including that in Silicon Valley, has been making its way to China. Sir Michael Moritz, Chair of Sequoia Capital, told me that he thinks Shenzhen is the Silicon Valley of China, and Sequoia has been investing in China for over a decade. Wen Hsieh, a partner of Kleiner, Perkins, Caulfield and Byers, told me recently that he thinks the prospect for good investment in Shenzhen is

even better than that in Silicon Valley. Finally, even the Confucius cultural barrier is succumbing to enormously successful entrepreneurial role models, not just Jack Ma, Robin Li and Pony Ma, but also HKUST alumnus Frank Wang, whose drone company Dajiang Innovations (DJI) is a true technological innovator and leader, also being one of China's first, and owns 70% of the worldwide market. With Wang as a new kind of role model, more young people will follow and some of them will be successful.

Trends and Responses: Case of HKUST

HKUST has benefited from our proximity to Shenzhen, and we are in fact part of the broader surrounding region known as the Pearl River Delta, which includes Guangzhou, the capital of Guangdong province. We were among the first Hong Kong universities to set up an "Industry, Education and Research" (IER) base in Shenzhen more than a decade ago and now we have built a second IER building in Shenzhen. DJI in fact was headquartered in this newer building a few years ago when it was still relatively small. We also have a larger suburban research base in Nansha, which is a district of Guangzhou, and which now is designated as one of six national developmental zones, while Pudong in Shanghai was similarly designated two decades ago.

Hong Kong itself has recently seen a surge of entrepreneurial activities. The government is trying to set up a new Innovation and Technology Bureau. There has been a mushrooming of private co-working spaces (over 30 now) where entrepreneurs can pay modest rental fees for "startup space". A number of large Mainland technology companies have set up R&D labs in Hong Kong, taking advantage of Hong Kong's advantages of low tax, excellent intellectual property rights protection, and attraction to international talents and excellent local universities. At HKUST, we are working hard in creating an enhanced entrepreneurial environment for our students and faculty. We just completed our 5th annual HK$1m. Entrepreneurship Competition. We run a "Build your own Business" seminar series. We are completing an on-campus space devoted to student entrepreneurship activities, to be run by students. And we have introduced an entrepreneurship minor for all majors. We hope to produce more Frank Wangs and DJIs!

CONCLUSION

In this paper, I have given my personal view of the impact of China's economic rise on the Chinese higher education system, and, in turn, on higher education systems in the rest of the world. I emphasize again that I only have a front-row seat, but I am not part of Mainland China's higher education system and I do not pretend, or have the authority, to speak on behalf of the Chinese

official government position. My view is that this recent rapid change in the Chinese higher education system is not only good for Chinese citizens, but also presents tremendous opportunities for universities worldwide. Whether China will succeed in the ambitious reform of its higher education system is anybody's guess, but there is also no doubt that China is determined to pursue its goal. The whole world should welcome this development and will also benefit indirectly from it.

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