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China, "laboratory to the world?"

This study was prepared under the authority of the Treasury and Economic Policy General Directorate and does not necessarily reflect the position of the Ministry for the Economy, Industry and Employment.

- Technological innovation is increasingly contributing to China's industrial and economic growth. The dominant pattern, in the early stages of the country's opening up starting in 1978, consisted in acquiring technologies from subsidiaries of foreign companies doing business in China.

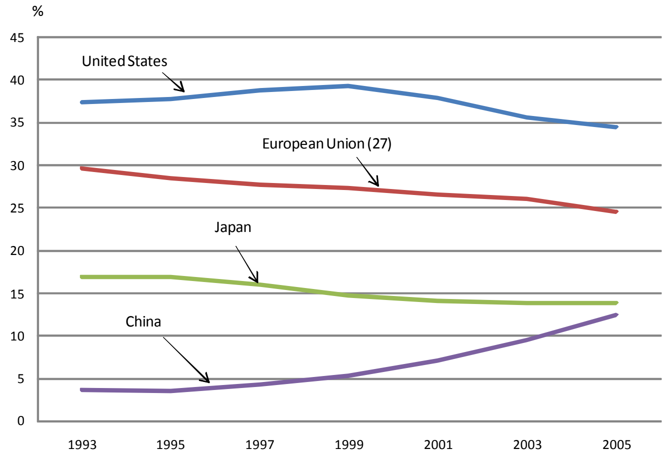
- China's own research has flourished since 2000. This is due to an industry-oriented public policy, backed up by the necessary resources, aimed at achieving independence in terms of innovation.

- However, China still lags rather behind the United States and Europe, especially in terms of results. Shortcomings remain, including insufficient emphasis on basic research and a still-modest presence in the high-tech sector, where foreign firms continue to predominate.

- China nevertheless has an ambitious, proactive research and development policy, both financially and in human terms (e.g. students and researchers, etc.), as well as with respect to its goals for 2020. China plans to boost its R&D spending as a share of GDP from 1.43% in 2006 to 2% in 2010, and to at least 2.5% in 2020, implying an annual growth rate in spending of between 15 and 20%.

- The aim of this policy is to make technological innovation a key driver of China's industrial development in the coming years. The authorities intend to transform China from its current position as "workshop to the world" to that of "laboratory to the world."

Change in share of R&D spending in the United States, the European Union, Japan and China, among the enlarged OECD



Sources: OECD and Eurostat; OST figures and estimates (2008)

DIRECTION GÉNÉRALE DU TRÉSOR ET DE LA POLITIQUE ÉCONOMIQUE

1. Technology catch-up is a feature of China's industrial policy

The emergence of Chinese research onto the global scene has recently been underscored by two reports published by the Observatoire des Sciences et Technologies (OST)[1] and the OECD[2]. They illustrate the **importance the Chinese authorities place on research and, more generally, on the acquisition of technologies, in order to support economic growth and help it to catch up in priority and sensitive sectors between now and 2020**.

China is broadly following the pattern adopted by its Asian predecessors - Japan, South Korea and Taiwan - where research and technological innovation are concerned. The development of its industry, especially its globalisation, bringing it into competition with foreign firms in China, followed by Chinese corporations' expansion abroad, is pushing it in a number of directions, namely:

- Enhancing its competitiveness through technological innovation;
- Taking its industry up-market, from highly labour-intensive goods to higher value-added high-tech products. Current developments in Guangdong illustrate this trend (see Box 1);
- Appropriation of technologies by national firms; foreign firms still accounted for 90% of high-tech exports in 2008.

Box 1: **Guangdong's development illustrates the Chinese approach**

Guangdong wants to discard its model based on often polluting, low value-added export industries employing low-skilled labour, in favour of higher value-added activities. It is seeking to do so by means of tax incentives, including reduced export rebates, pollution taxes, increased labour costs, tax exemptions for innovative industries, etc.

The global crisis and weaker international demand, which have directly hit its exporting firms, have exacerbated trends visible since the summer of 2007, with the closing of the first dyeing plants, shoe manufacturers and other factories producing low-end products in the Pearl River Delta, particularly in the city of Dongguan. This slowdown came as a further wake-up call to the authorities as to the model's weakness and the need to jettison it in favour of more capital-intensive industries employing new technologies and higher value-added services.

This development is supported by a three-pronged process of economic integration now taking place between 1/ Guangdong, Hong Kong and Macao, 2/ Guangdong, Guangxi and the ASEAN countries, and 3/ Guangdong, Fujian and Taiwan. The economy of these regions is increasingly interlocking, with Guangdong as the epicentre, supported by the central authorities in Beijing.

The area is now a major economic powerhouse benefiting from scale effects: the Canton-Foshan cluster has a population of 17 million, and the Shenzhen-Hong Kong cluster, two hours away by train, 19 million. Leaving aside Hong Kong, these two areas grew by more than 10% in 2008. Canton had a per capita GDP of USD 11,700 USD in 2008.

Beyond all of this, the creation of new industrial parks and spending on higher education illustrate the authorities' emphasis on moving up-market. The new Canton University Campus already has 80,000 students and has a capacity of 200,000. This campus together with the Zhuhai university cluster will supply skilled labour to the regional economy. Guangdong was already spending RMB 24.4 billion (USD 1 = RMB 6.83) on R&D in 2005, making this the 3rd-largest R&D budget after Beijing (RMB 38.2 billion) and Jiangsu (RMB 27.0 billion), but ahead of Shanghai (RMB 20.1 billion), Shandong (RMB 19.5 billion) and Zhejiang (RMB 16.3 billion).

1.1 A technology catch-up initially dependent on foreign firms

Foreign direct investment (FDI) brings with it more than just capital[3]. China's authorities and Chinese firms used these foreign firms to obtain technology transfers and boost the nation's level of technology. In addition, the authorities often secured technology transfers or the setting up of local plants when negotiating contracts in strategic areas such as aerospace or nuclear power, for example.

The obligation to form joint ventures has disappeared in many sectors following China's accession to the World Trade Organisation (WTO). However, it is still in place in sectors deemed strategic. Tax incentives favour the creation of firms in sectors where China is seeking to catch up technologically. In addition, Chinese companies are acquiring technologies abroad, spending USD 19 billion in 2005 (62.2% on technology, 37.9% on equipment)[4].

In the telecom sector, Alcatel Shanghai Bell (ASB) is a successful illustration of this strategy (Alcatel has deliberately opted to remain part of a joint venture even though it is no longer obliged to do so). Through this alliance, Shanghai Bell has gained access to global technologies as well as to Alcatel's R&D and markets. Many such joint ventures have failed, however.

(1) Observatoire des Sciences et Technologies: *Indicateurs de Sciences et Technologies (2008)* (Science and Technology Indicators-available in English online at http://www.obs-ost.fr/en/know-how/etudes-en-ligne/studies-2008/biennial-report-2008-edition.html#c700).

(2) Schaaper, M., Measuring China's Innovation System - National Specificities and International Comparisons. OECD, STI Working paper 2009/1.

(3) FDI has increased from USD 636 million in 1983 to USD 108.3 billion in 2008, representing a stock of almost USD 870 billion at the end of 2008; however, this figure is overestimated since certain Chinese investments are made from Hong Kong (37% of total FDI), to benefit from the tax breaks granted to FDI (this practise is known as round-tripping). Investors include major technology-intensive corporations such as the American firms Motorola (USD 5.8 billion in sales in 2003), General Motors (USD 2.2 billion), Dell (USD 2.1 billion), Hewlett Packard (USD 1.3 billion) and Kodak (USD 0.6 billion). The majority of this FDI (55%) is invested in industry, with property accounting for a further 23.7%).

(4) The main vendors were Germany (26.2%), Japan (20.3%), the United States (17.8%) and France (7.1%).

Foreign companies are setting up increasing numbers of R&D centres in China – over 750 of them at the end of 2008, more than the number of Chinese R&D centres (500) – including as part of their global networks. They benefit from a range of advantageous terms for this, including tax incentives, relatively low costs, increasingly well-trained scientists, and proximity to production facilities[5].

Technology transfers also occur when Chinese firms expand abroad. Chinese foreign investment[6] is pursuing a number of goals, including gaining access to energy and mineral resources, and investing current account surpluses. It is also seeking, for companies whose technologies are often less advanced, to move from being a subcontractor in the international arena to acquiring full mastery of the entire value chain (spanning brands, distribution and technology). This aim at least partly explains the acquisitions of Rover by Nanjing Motors, of Ssanggyong Motors by SAIC, of the TV set manufacturer Thomson and Alcatel cellphones by TCL, and of IBM computers by Lenovo. Lenovo's acquisition of IBM appears to be running into trouble, however. The difficulties encountered by these deals augur ill for future acquisitions.

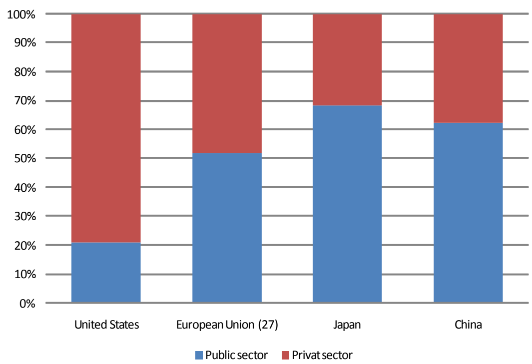
1.2 At the same time, China is building up its research capabilities, especially in the private sector

China's successes in space, with the launch of a manned vehicle, or the less publicised manufacture of one of the world's ten most powerful supercomputers, the Dawning 4000 A, illustrate the emergence of China's research under the impetus of the authorities. Its R&D spending as a percentage of GDP ranked 8th in the world in 2005[7], but 4th in terms of volume. China nevertheless narrowed the gap with advanced countries[8], doubling its spending between 2000 and 2005 and increasing its share of total world spending from 6.2% to 11.8%. In addition, venture capital funding, which has been particularly strong for SMEs, rose to USD 7.7 billion in 2005, ranking second in the world, far behind the United States (USD 22.8 billion), but ahead of the United Kingdom (USD 6.6 billion), France (USD 1.8 billion) and Germany (USD 1.6 billion).

China is the country with the largest number of students in the world (25 million, out of a world total of 140 million[9]), ahead of the United States (17.3 million). The number of enrolments and graduates has grown by 20% a year since 1999. The quality of higher education has improved, with a growing number of students continuing their studies abroad[10]. The authorities are encouraging students to do so; grants from the China Scholarship Council, for example, finance education abroad for the best students (12,400 in 2007[11]). A total of 365,000 students were accepted to study for Master's degrees in 2005, which is 2.8 times as many as in 2000. Projects 985 and 211 provide for the building of 100 new universities, many of them world-class.

Similarly, the number of researchers in China (1.1 million, or +61% between 2000 and 2005, out of a world total of 6 million[12]) is closing the gap with the United States (1.4 million) and the European Union (1.3 million). China has doubled the number of publications between 2001 and 2006, gaining three places to rank third in the world, with 7% of the world's total and close to Japan (7.6%), albeit far behind the European Union (33.3%) and the United States (26.2%). Finally, Chinese applications for European patents have more than doubled, especially in electronics and electricals.

Chart 1: Share of private-sector researchers in the United States, the European Union, Japan and China



Sources: OECD and Eurostat (2005); OST figures and estimates (2008)

The State has played a key role in this process: it began by carrying out research itself, then acted more via a system of incentives, including technology parks or clus-

(5) For example, the number of R&D centres located in Shanghai grew from 244 at the end of 2007 to 274 at the end of 2008, including 30 or so French centres; around 40% of these are concentrated in eastern China.

(6) This is fairly modest in scale (USD 18.7 billion in 2007), but growing rapidly (USD 40 billion (est.) in 2008).

(7) At 1.31%, behind Israel (4.53%), Japan (3.21%), Switzerland (2.75%), the United States (2.46%), Australia/New Zealand (2.10%), Canada (1.86%), and the EU27 (1.74%). The global average is 2.15% and the average for the OECD 2.1%.

(8) China almost certainly overtook Japan in 2008. In addition, its share is further enhanced due to uncertainty surrounding its military spending, which is unknown. Conversely, the United States dominates funding for military R&D, with 80% of OECD countries' R&D spending in 2005. The European Union accounts for a further 12.7%. Japan's share is negligible.

(9) 40.3% in Asia, 25.8% in Europe, 15.3% in North America, 9% in Central and South America, and 5.6% in Africa.

(10) Chinese students account for the largest proportion of foreign students in the European Union, the United States and Japan combined: they accounted for 13.6% of all foreign students enrolled in the European Union in 2005 (their main destination since 2004, with 109,000 enrolled in 2005, versus 92,000 in the United States).

(11) Including 5,130 in the United States, 1,500 in the United Kingdom, 800 in Germany and 460 in France, where the grant is nearly €1,000 per month.

(12) 35.2% in Asia, 32.8% in Europe and 25.4% in North America.

ters, incubators, organising technology markets, and offering grants and tax breaks. In 1999, the authorities turned the 242 public research centres run by the Committee for the Economy and Trade into autonomous institutions. Five thousand more followed in the years leading up to 2004.

Public-sector budgets and staffing levels have declined, while those in the private sector, which now plays a predominant role in research[13], have increased. The share of universities and research institutes in the R&D budget has gone from 10.4% and 42.5% respectively in 1998 to 10.1% and 27.3% in 2002, when the share of private firms had risen to 61.2% of the total. In 2005, companies financed 91.2% of their R&D spending in China, versus 98.3% in Japan, 90.3% in the United States, and 82% in the European Union. In 2005, the private sector accounted for a greater share of R&D spending in China (67%) than in Europe (52.2%) or the United States (64%), but less than in Japan (76.1). Altogether, 13.4% of total private sector R&D funding (€507 billion for all OECD countries) came from Chinese firms, versus 35.2% from American firms, 21.2% from European firms, and 16.9% from Japanese ones.

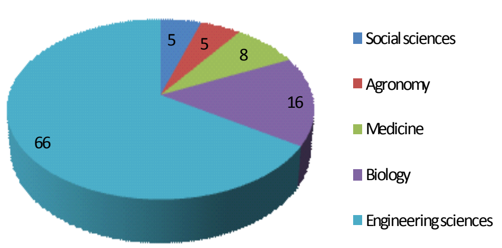
There is increasing cooperation between public-sector research and business: in 2004, the latter were involved in 90% of public research programmes; 80% of large firms were engaged in cooperative ventures with universities. The private sector provided 36.6% of universities' R&D spending (RMB 10.1 billion, or 4.2 percentage points more than in 2000). In general, the transfer of the benefits of public research (i.e. technology and patents) to the private sector, including via the formation of start-ups, is expanding continuously.

Table 1: R&D spending, stakeholders and sources of funding (2006), in RMB Bn and in %

	Total spending	Corporate funding	Public funding	Foreign funding
Total	300.3	207.4 (69.1%)	74.2 (24.7%)	4.8 (1.6%)
Corporate	213.5	194.6 (91.2%)	9.7 (4.5%)	4.2 (2.0%)
Research institutes	59.2	2.6 (4.5%)	49.4 (83.5%)	0.3 (0.5%)
Higher education	27.7	10.1 (36.6%)	15.2 (54.7%)	0.4 (1.4%)

Similarly, the share of universities, research institutes and companies in total personnel assigned to R&D has gone from 22.4%, 30.1% and 35.8% respectively in 1998 to 17.5%, 19.9% and 41.0% in 2002[14]; the share of R&D personnel employed in the private sector has continued to grow, rising to 60% in 2007.

Chart 2: Breakdown of research project budgets by specialisation



Sources: MOST data (2006), data processed by the World Bank (2009)

The medium- and long-term plan for 2006-2020[15] reflects industrial priorities in seven areas: integrated circuits and software, networks of the future, leading-edge IT, biotechnologies, aeronautics, aerospace, and new materials. This plan targets a reduction in the share of imported technologies to below 30% by 2020[16], and will seek to develop clusters along the lines of Silicon Valley, Tsukuba in Japan or Hsinchu in Taiwan. The original purpose of these clusters was to convert the national centres around Beijing[17]. They were then extended, at the instigation of local authorities and firms. Parks connected with universities, e.g. the Tsinghua Science Park, have acted as incubators for companies leading to the emergence of fully-fledged corporations such as Tsinghua Holdings. By 2005, 50 "university clusters", home to 6,075 start-ups, had been created.

China is clearly bidding to become technologically independent, through increased R&D, the emergence of national champions such as ZTE and Huawei in telecoms, competitors with Alcatel Shanghai Bell, and adopting world-class technological standards, e.g. 3G and 4G in telephony, along with TD-SCDMA, competing with the European and American standards; or Blu Ray (for DVDs) and WiFi, RFID, etc. This policy is also reflected in the priority given in the budget to the engineering sciences (66% of R&D and 62% of university education spending).

(13) This is a surprising observation for a country where the State still plays an essential role not only in the definition, but also the running, of the economy. But this should be seen against the fact that many of these private firms comprise a public law body- often a local authority - among their shareholders.

(14) Mu Rongping (2004), *Development of Science and Technology Policy in China*, Academy of Social Sciences.

(15) National Guidelines for the Medium- and Long-term Plan for Science and Technology Development (2006-2020).

(16) Defined as the ratio of spending : imported technology / [(national R&D + (exported technology - imported technology)]

(17) .Beijing continues to have by far the largest budget in China in both absolute (RMB 38.2 billion in 2006) and relative (5.55% of GDP) terms; this is followed by Jiangsu (RMB 27 billion, 1.47%); Guangdong (RMB 24.4 billion, 1.09%, putting its image as a low-cost manufacturing zone into perspective); Shanghai (RMB 20.8 billion, 2.28%); Shandong (RMB 19.5 billion, 1.05%); and also provinces such as Liaoning, Shaanxi, Sichuan and Hubei, etc.

One sign of the vigour of China's national technological innovation is **the growing number of Chinese firms embroiled in disputes with other Chinese firms over intellectual property** (reportedly 90% of disputes). On that score, the greater protection given to patents in the recently enacted law reflects less a response to the demands of foreign investors than the need to create a propitious framework for the research carried out by Chinese firms. Moreover, technology imports[18], after rising steadily to reach RMB 41 billion in 2003, have since tapered off with the growth in national R&D spending.

Box 2: **The Yangtze Delta and Shanghai move up-market**

The Yangtze Delta (embracing the provinces of Jiangsu and Zhejiang, and still more the city of Shanghai, which acts as the service centre for the area) illustrates the region's up-market ambitions. Typically, in the different reports and talks given by its leaders, Shanghai is forging a vision aimed at making (or rather, remaking, since it outclassed Tokyo, Beijing, Singapore and Hong Kong in the 1920s and 30s) this city the London of this part of Asia.

The model depends in the development of services, which are planned to represent around two-thirds of the city's GDP by 2020. Shanghai is unlikely to have become a global financial centre by then, since the central authorities are probably not yet ready to make the necessary regulatory changes. On the other hand, the city will be a regional powerhouse by virtue of its services to business, logistics and port services especially, within the framework of the integration of the Yangtze Basin, towards which Shanghai has been working for several years. The scale of the transit trade (USD 284 billion in 2008, which is close to the volume of its home-grown trade, i.e. USD 322 billion) illustrates the importance of the logistics services supplied by Shanghai to the rest of the Delta.

In addition, industrial production will focus on advanced, higher value-added industries. The example of the Shanghai Automobile Industry Corporation (SAIC) is typical of the direction in which the authorities want to move: SAIC has acquired Nanjing Automobile Group Corp., which belonged to the city of Nanjing, and shifted the Santan 3000 production plant there. Conversely, SAIC has concentrated its R&D and corporate activities in Shanghai. Foreign firms are playing a central role in this trend. Services attracted 73.3% of FDI in 2008. In manufacturing, the share of electronics and specialty chemicals has increased. Shanghai now hosts 274 foreign R&D centres, roughly half of the total for China as a whole, plus 224 regional headquarters, and 178 holding companies' headquarters.

Finally, Shanghai plans to become a front-rank cultural and tourist centre for China and Asia. In addition to the 2010 World Expo, the future Disney Park-for which the agreement has practically been signed and which will be four times larger than Hong Kong's Disneyland-and the new international convention centre, covering 100,000 sq. metres and with a capacity of 100,000, making it the world's largest, will further confirm this ambition.

2. However, the place and results of Chinese research need to be seen in perspective

2.1 China's research performance still ranks below those of Europe, the United States and Japan

Putting China's performance into perspective: while the number of publications has grown sharply, their impact remains weak[19]. Where patents are concerned, the number of applications filed by China in the United States, Japan and the European Union has admittedly soared (by 261% since 2000); yet the United States, Japan and the European Union remain far ahead, with 51.3%, 21.3% and 14.7% respectively of patent applications; China filed a mere 0.4%. The same holds for patent applications filed in Europe (28.9%, 17.8% and 37.3%, respectively, while China accounts for just 1.3%[20].

China is less attractive than the western countries when it comes to education and jobs for graduates, judging by the rate of return: 700,000 highly-qualified Chinese have settled in the OECD countries, 57% of them in the United States, the most attractive country (before the current crisis, at least)[21]. Where research is concerned, the number of Chinese researchers set against the size of the population is low (1.43 per 1,000 people of working age, versus 10.6 in Japan, 9.21 in the United States and 5.7 in the European Union). Moreover, the ratio of researchers (1.1 million) to total research personnel (1.36 million) is low, suggesting that researchers are under-utilised, being employed on less productive tasks.

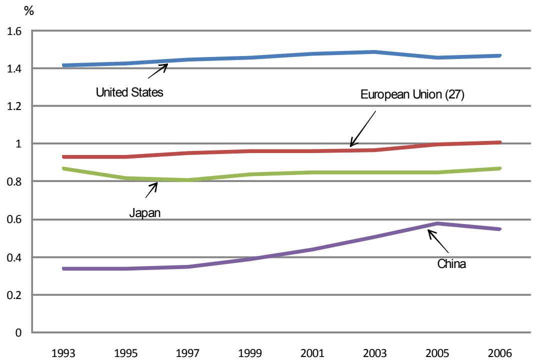
(18) Defined as the purchase abroad of patents, models, industrial designs and know-how, together with equipment and instruments.

(19) Measured by the number of citations in a subsequent article: for a global average of 1, the index is 0.55 for China, 1.40 for the United States, 0.95 for Europe, and 0.87 for Japan.

(20) Ranking 12th, despite a 124% increase.

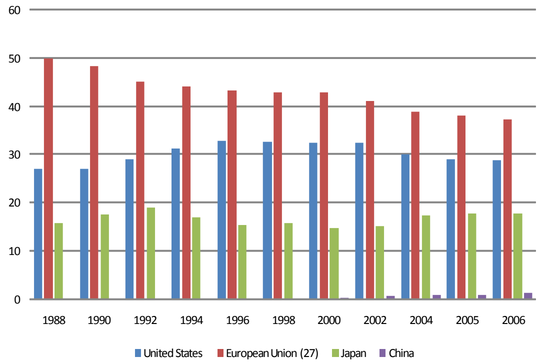
(21) To such an extent that the authorities are now offering huge rewards and highly attractive working conditions to incite students to return, as part of the Chinese Academy of Science's "100 talents" policy and the Education Ministry's "1,000 talents" programme.

Chart 3: Index of immediate impact (measurement of impact) of publications



Sources: Thomson Reuters; OST figures and estimates (2008)

Chart 4: Geographic origin of European patents



Sources: European Patent Office; OST figures and estimates (2008)

2.2 In addition China still suffers from shortcomings in many key areas for the future

Chinese high-tech firms also continue to spend less on research than their OECD counterparts[22]; their effort is scarcely greater than in traditional firms (aerospace excepted), unlike in the United States or Japan. China is still a minority player in the ICT sector, which play an increasingly important role in industry. High-tech firms located in China remain confined to an assembly role, importing electronic components from Japan, Korea and Taiwan, then re-exporting the assembled products to the developed countries. This processing trade accounts for 95% of the ICT sector, 85% of the telecom equipment sector, 81% for office equipment, and 78% for electronic components[23].

Table 2: Import content of exports (2008) (%)

Sector	%	Sector	%
IT	95	Shipbuiding	43
Telecom equipment	85	Metalworking	42
Office equipment	81	Papermaking	41
Electronic components	78	Transport equipment	40
TV sets	64	Non-ferrous metals	34
Electrical equipment	63	Apparel	33
Plastics	63	Vehicle manufacturing	32
Recording equipment	58	Textiles	31
Electrical equipment	54	Fibres	30
Furniture	51	Paint	30
Chemicals	50	Wool	30
Toys	47	Aggregate manufactured goods	46

In addition, **China's research is targeted towards industrial development** (78% of spending) **at the expense of basic research.** The latter received only 5.2% of credits in 2006, this share having remained constant since 1995, versus 10%-20% in the OECD countries. Similarly, the combined share (22%) of basic and applied research (16.8% in 2006) is far below the OECD average of 50%. For the immediate future, this closeness to industry and the private sector represents a source of support for firms. In the longer run, though, it will hamper China's expansion in leading-edge industries relative to its European, American, Japanese and Korean rivals.

Similarly, only 11% of the patents applied for by Chinese firms in China in 2006 represented genuine technological breakthroughs, compared with 74% for foreign firms. The latter, moreover, continued to own 47% of patents in China between 2001 and 2003; the share is declining, but it is still larger than the 16.7% share for the European Patent Office (EPO), and at comparable levels in the United States and Japan.

(22) The same goes for services, which received only 5-10% of R&D budgets in China in 2000, compared with 35-40% in the United States.

(23) Artus, P. (2009), "Du RMB fort au RMB faible: le changement de la stratégie de croissance de la Chine" (From a strong RMB to a weak RMB: the shift in China's growth strategy). *Natixis Flash Economie.*

Moreover, **China's research effort and the development of science parks are not immune to the shortcomings that afflict its industrial development,** namely that it is very unevenly distributed across the country-with resources heavily concentrated around Beijing-and, conversely, a proliferation of organisations linked to local authorities and a duplication of programmes, which are a potential source of waste, as illustrated by the example of the Yangtze Basin[24].

Finally, although foreign firms' R&D spending is concentrated in medium and high technologies, their effort appears to be no greater than that of their national competitors[25]. Consequently, China's expanding research activities have not yet followed the same course as the development of manufacturing, even in leading-edge sectors. Risks surrounding intellectual property protection have certainly helped hold the country back in this regard.

2.3 China's research is nevertheless bound to become a driving force behind the country's industrial development

These limitations should not blind us to China's rapid emergence. The country will consolidate its position on the global research scene, and technological innovation will contribute increasingly to its economy. For that, China can count on the arrival of a large number of graduates that have come through a high-quality, increasingly selective[26] educational system, whereas the dearth of skilled labour hindered companies' growth in the early-2000s. The percentage of students studying engineering, medicine or science subjects will rise to 50% (compared to 13% of those studying for Master's degrees in the United States and 40% in Europe). China will ultimately have as many students in these subject areas as Europe and the United States combined. In 2007, China overtook the United States as the world's leading producer of scientific and technical theses (78,200) indexed with the Engineering Index. These resources are directly applicable and will bolster the country's industrial development.

This policy is being implemented resolutely: confronted with the current economic slowdown, China has decided to step up, rather rein in, its research effort, seeing it as a vital source of support for its industry. In January 2009 the Prime Minister announced that he was speeding up execution of the USD 88 billion budget earmarked for the 2006-2020 programme for 16 priority projects, including water treatment, semi-conductors, WiFi, and energy. Contributions from companies and from local and provincial authorities will double this budget.

Over the longer term, the evolution of China's economy is bound to place increasing importance on technological research and innovation: the economy will come under increasing pressure to move up-market as the Chinese currency strengthens and production costs rise, thereby eroding China's price-competitiveness vis-à-vis new competitors such as Vietnam and Bangladesh, etc. The Yuan's appreciation after 2005 was a blow to firms manufacturing low-quality, highly labour-intensive goods, and many closed as a result. The return to a fixed parity with the US dollar in 2008 brought some respite, but this should not obscure the fact that, as for Japanese firms in the 1960s, and for Korea's and Taiwan's companies in the 1980s, Chinese firms will have no choice but to move up-market, making technological innovation an ineluctable necessity for China. The authorities fully understand this and have translated this challenge into a resolute public policy aimed at turning the country from "workshop to the world" into the "laboratory to the world".

Alain BERDER, François BLANC,
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(24) Rousseau J.-M. (2008). Mission cartographie: innovation - axe du Yangzi. Partie 1: *En remontant l'axe du Yangzi. 73 pp.* Partie 2: *L'innovation aux sources de la compétitivité. 134 pp.* (Mapping mission: innovation-the Yangtse axis. Part 1: travelling up the Yangtse axis. Part 2: Innovation at the root of competitiveness), *ADIT.*

(25) With the major exception of the ICT, where it amounts to 4.3% of revenue, versus 0.7% for Chinese firms (2006).

(26) There were 10 million applicants for 5.4 million university places in 2008. Tsinghua University, one of the most prestigious, has 1,600 applicants for each place, making it more selective than Harvard or MIT.

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