Country Fiche/P. R. China
under Specific Contract for the Integration of INNO Policy TrendChart with ERAWATCH (2011-2012)

Li Tang
School of Public Policy
Georgia Institute of Technology
1    OVERVIEW

1.1 Basic characterisation of the Research System

Founded in 1949, the People's Republic of China followed the former Union of Soviet Socialist Republics (USSR) in establishing a science and technology (S&T) system with a highly centralised structure with low R&D investment. In broad terms, the Chinese research system is composed of three parts in an administrative hierarchical order: the top decision-making body (the State Council, particularly the National Steering Group for S&T and Education), the implementing and coordinating agencies (such as the Ministry of Science and Technology, the Chinese Academy of Sciences, the Ministry of Education, and other ministries and agencies), and R&D institutions (universities, research institutes, and enterprises).

Since the 1980s, however, China has embarked upon a broad programme of transition from a centrally planned economy to a more market-oriented economy. The S&T system has also undergone reform towards a more decentralised system. The central government is changing its role from managing R&D projects to coordinating S&T development on a macro level. Research institutions are being given more authority to set their own research activity agendas in the context of the national Five-year Plans (now the 12th Plan, 2011-2015).

China’s R&D expenditure has been escalating since the 1990s. In 2005 it overtook Japan and became the second largest investor in R&D with 245 billion Chinese Yuan (€ 24.5 billion), second only to the USA. The number of R&D full-time staff equivalent reached 2,291 thousand person-years in 2009, among which 1,152 thousand person-years researchers, also second to the USA. R&D intensity - the proportion of R&D expenditure in GDP - remains relatively low in China, but has increased from 0.74% in 1991 to 1.75% in 2010. China’s R&D expenditure reached 698 billion Yuan in 2010 and is expected to reach 900 billion Yuan in 2020, i.e. about 2.5% of GDP.

Research institutes and universities are major actors in the research system of China. Although over two-thirds of GERD was performed by the industry in 2009, the overall research performance of the business sector is still lagging behind western counterparts. However, the transformation of state-owned research institutes into enterprises, starting in 1999, has strengthened R&D capabilities in industry.

China’s research policy development is based on large multi-annual plans. The Medium- and Long-term National Plan for Science and Technology Development 2006-2020 (hereinafter MLP) is a guide for the S&T development strategy in China for the first 20 years of the 21st century. Two priorities proposed in this national RDI strategy are: 1) promoting S&T development in selected key fields; and 2) enhancing innovation capacity. The MLP calls for more than 2.5% of GDP to be invested in R&D, for the contribution of S&T progress to economic growth to be at least 60%, and for dependence on foreign technologies to be reduced below 30%. It also sets the goal for China to rank in the top five in the world in terms of invention patents and international paper citations.
<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>R&amp;D intensity (GERD as % of GDP)</strong></td>
<td>1.42</td>
<td>1.44</td>
<td>1.54</td>
<td>1.62</td>
<td>1.75</td>
</tr>
<tr>
<td><strong>R&amp;D personnel (10,000 person-years)</strong></td>
<td>150.2</td>
<td>173.6</td>
<td>196.5</td>
<td>229.1</td>
<td></td>
</tr>
<tr>
<td><strong>GBAORD (€ million)</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Government S&amp;T appropriation (€ million)</strong></td>
<td>16885</td>
<td>21135</td>
<td>25818</td>
<td>32249</td>
<td></td>
</tr>
<tr>
<td><strong>Share in total government expenditure (%)</strong></td>
<td>4.18</td>
<td>4.25</td>
<td>4.12</td>
<td>4.23</td>
<td></td>
</tr>
<tr>
<td><strong>GERD per capita (€)</strong></td>
<td>22.8</td>
<td>28.1</td>
<td>34.7</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>GBAORD as % of GDP</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>BERD as % of GDP</strong></td>
<td>1.01</td>
<td>1.04</td>
<td>1.12</td>
<td>1.17</td>
<td></td>
</tr>
<tr>
<td><strong>GERD financed by abroad (€ million)</strong></td>
<td>484</td>
<td>500‡</td>
<td>572</td>
<td>781</td>
<td></td>
</tr>
<tr>
<td><strong>GERD financed by abroad as % of total GERD</strong></td>
<td>1.61</td>
<td>1.35</td>
<td>1.24</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td><strong>R&amp;D performed by higher education institutes (€ million)</strong></td>
<td>2768§</td>
<td>3147⁹</td>
<td>3902¹⁰</td>
<td>4682¹¹</td>
<td></td>
</tr>
<tr>
<td><strong>R&amp;D performed by HEIs (% of GERD)</strong></td>
<td>0.13</td>
<td>0.12</td>
<td>0.12</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td><strong>R&amp;D performed by PROs</strong></td>
<td>567.3¹²</td>
<td>687.9¹⁴</td>
<td>811.3¹⁵</td>
<td>995.9¹⁶</td>
<td></td>
</tr>
<tr>
<td><strong>R&amp;D performed by Business Enterprise sector (€ million)</strong></td>
<td>21345¹⁷</td>
<td>26819¹⁸</td>
<td>33817¹⁹</td>
<td>42486²⁰</td>
<td></td>
</tr>
<tr>
<td><strong>New doctorate graduates (ISCED 6) per 1000 population aged 25-34</strong></td>
<td>41464²¹</td>
<td>43759²²</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Percentage population aged 30-34 having completed tertiary education (Eurostat)</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Employment in Knowledge-Intensive Activities (manufacturing and services) as % of total employment (EUROSTAT)</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Annual Average Number of Employed Personnel of Enterprises of High Technology Industry (million person)</strong></td>
<td>7.44</td>
<td>8.43</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>


2 Note: The classifications of revenue and expenditure accounts have been adjusted largely in 2007. Government S&T appropriation includes both the item of "expenditure for science and technology" and S&T expenditure in other items. Source: [http://www.sts.org.cn/sjl/kjtjdt/data2010/dt2010.htm#1](http://www.sts.org.cn/sjl/kjtjdt/data2010/dt2010.htm#1).

3 The GERD per capita is calculated by the author based on information provided by China S&T Statistics Data Book 2008 and China Statistical Yearbook 2008. GERD per capita = GERD / population.


The total amount of China R&D expenditure in 2010 was ~€69.8 billion. Over 70% of R&D funds came from the business sector and about one quarter from the government. In terms of R&D expenditure, over 70% were spent by business enterprises, while research institutes and universities spent 17.2% and 8.1% respectively. Research institutes and universities were the main target (85%) of government funds, while around 13% of government funds went to the business sector.
1.3 Structure of the research system

Organisations

Abbreviations:

National Reform and Development Commission  NDRC
Ministry of Education  MOE
Ministry of Science and Technology  MOST
Ministry of Industry and Information Technology  MIIT
Ministry of Finance  MOF
Ministry of Agriculture  MOA
Chinese Academy of Sciences  CAS
Chinese Academy of Engineering  CAE
National Natural Science Foundation of China  NSFC

China has a highly centralised research system organised and controlled by the central government. Decisions related to S&T go through agencies and organisations in a hierarchical order. The National Steering Group for S&T and Education in the State Council is the highest ranked organisation in China coordinating all education, research, and innovation related activities. It has nine member ministries or agencies as indicated above: 1) National Reform and Development Commission (NDRC), 2) Ministry of Education (MOE), 3) Ministry of Science and Technology (MOST), 4) Ministry of Industry and Information Technology (MIIT), 5) Ministry of Finance (MOF), 6) Ministry of Agriculture (MOA), 7) Chinese Academy of Sciences (CAS), 8) Chinese Academy of Engineering (CAE), 9) National Natural Science Foundation of China (NSFC).

MOST, formerly known as the State Science and Technology Commission, is the leading ministry and works with other ministries or agencies to coordinate S&T activities. In particular, MOE plays a role in policies for S&T talent and managing R&D activities in universities; MOF helps to develop fiscal policies to promote R&D activities especially in enterprises; NSFC develops S&T programmes and provides funding for basic and some applied research; CAS is comprised of high-level research institutes and together with CAE has academic divisions of science and engineering; NDRC develops strategies and policies with a focus on the economic and social aspects of S&T; MIIT and MOA manage R&D activities related to industrial sectors including IT and agriculture respectively.
2 RESEARCH POLICY

2.1 Highlights
The Medium- and Long-term National Plan for Science and Technology Development 2006-2020 (MLP) outlines ten prioritised fields in research policies. Each prioritised field has a subset of prioritised topics. The prioritised fields are: energy (5 topics), water and mineral resources (7 topics), environment (4 topics), agriculture (9 topics), manufacturing technologies (8 topics), transportation (6 topics), information technology (7 topics), population and health (5 topics), urbanisation (5 topics), and public security (6 topics).

In addition to these prioritised fields, eight frontier technologies have been selected as priorities for funding: biotechnology (5 topics), information technology (3 topics), new materials and nanotechnology (3 topics), advanced manufacturing technologies (3 topics), advanced energy technologies (4 topics), ocean technology (4 topics), laser technology, and aeronautics and astronautics. Key issues in basic research were also put forward.

2.2 Recent Research Policy Developments

In order to realize the goals set in the MLP, China accelerated introduction of concrete measures to encourage innovation and promote sustainable research development.

The medium-and long-term development plans for talents and education were promulgated in June and July 2010.

In July 2010, the Ministry of Science and Technology, the National Development and Reform Commission, the Ministry of Finance, and the State Intellectual Property Office jointly promulgated the “National Interim Provisions on Intellectual Property Management of Major Projects” (hereinafter referred to as Interim Provisions).

In December 2009, the first national intellectual property demonstration park of China was established as the State Intellectual Property Office (SIPO) at Donghu New Technology Development Zone in Wuhan, the capital of the eastern province.

China’s Supreme Court has been strict in enforcing its fight against the infringement of intellectual property (IPR). According to the Supreme People's Procuratorate, in the first ten months of 2010 alone, Chinese prosecutors have indicted over 4,300 people in about 2,000 cases of intellectual property rights (IPR) violation and the production and sale of counterfeit or shoddy goods. 25

On 13 July 2011, the 12th Five-Year Plan for S&T Development was officially released by the Ministry of Science and Technology, in collaboration with the National Development and

Reform Commission, Ministry of Finance, Ministry of Education, Chinese Academy of Sciences, Chinese Academy of Engineering, National Natural Science Foundation of China, Chinese Association of Science and Technology, and State Administration of S&T and Industries of National Defence. The plan set out the goals for S&T development in the next five years and proposed the realization of the national innovation system. According to the plan, the GERD/GDP ratio will reach 2.2% in 2015, the national comprehensive innovation capacity will be ranked the 18th in the world from the current 21st, the contribution of S&T progress will reach 55%, and concrete progress shall be achieved in forging an innovative country. The plan highlighted the role of innovation as a driving force for development and underlined as the core of strategies the enhancement of independent innovation capacities.

2.3 Research Policy goals

Enhancing the competitiveness of enterprises and promoting independent innovation are the two major aims of Chinese research policy in the next fifteen years as specified in two main policy documents: the Medium- and Long-term National Plan for Science and Technology Development 2006-2020 and China’s National S&T Development Plan for the 12th Five-year Period 2011-2015.

Some specific quantitative indicators are also proposed in these plans. These include: R&D/GDP reaches 2.2% in 2015 and 2.5% in 2020; the level of reliance on foreign technology drops to 30% in 2020; the share of contribution to economic growth from S&T reaches 55% in 2015 and 60% in 2020; being a "Top 5" country in 2015 in terms of the number of scientific publication citations.

The main targets of Science and Technology in the 12th Five-year Plan for S&T Development are:
- Greatly increase the R&D input intensity
- Remarkably upgrade the original innovation capacity
- Closer integration of S&T and economy
- More benefits for the livelihood
- New progress in forging innovation bases
- More empowered S&T human resources
- Constantly improved S&T and innovation mechanisms

Specific indicators for 2015 are the following:

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERD / GDP (%)</td>
<td>1.75</td>
<td>2.2</td>
</tr>
<tr>
<td>R&amp;D personnel per 10,000 employees (person year)</td>
<td>33</td>
<td>43</td>
</tr>
<tr>
<td>World ranking of international scientific paper citations</td>
<td>8th</td>
<td>5th</td>
</tr>
<tr>
<td>Number of invention patents per 10,000 persons (pieces)</td>
<td>1.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Number of applications of invention patents of R&amp;D personnel (pieces / 100 person year)</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Total value of contractual transactions in national technology market (100 million Yuan)</td>
<td>3906</td>
<td>8000</td>
</tr>
<tr>
<td>Percentage of added value of high tech industries in manufacturing industries (%)</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Basic scientific qualifications of citizens (%)</td>
<td>3.27</td>
<td>5</td>
</tr>
</tbody>
</table>

Other goals summarised in the above national S&T guideline documents are as follows:
- Advancing key technologies: The development of key technologies in the manufacturing industry, the information technology and the agriculture industry is a
priority of research policy. China expects to be one of the leading countries in these key technologies in the near future in order to ensure the country’s competitiveness.

- **Addressing environmental issues**: China’s energy consumption is increasing rapidly as the economy grows, raising significant environmental concerns. China aims to develop energy efficient and clean energy technologies to reduce energy consumption and optimise energy structure. A cyclic economy model will be piloted in selected cities and industries to explore the potential of establishing an environmentally friendly society.

- **Human resource development**: High quality human resources are regarded as the basis of S&T development in China. The share of scientific and technical personnel as a percentage of the population is expected to increase significantly. China also aims to develop top level universities, research institutes, leading scientists, and research teams.

- **Enforcing human health**: China also seeks to develop technologies important to human health. These include improving capabilities to deal with major disease and promoting breakthroughs in pharmaceutical and medical equipment technologies.

### 2.4 Research policy focus

#### 2.4.1 Thematic R&D priorities

Traditionally, S&T in China has been viewed as a practical economic activity. Differentiated by activity types, the largest category of GERD is experimental development (82%), followed by applied research (13.3%), and basic research (4.7%). The sector of electronic and telecommunication equipments makes up the largest share of R&D investment with €4,029 million, accounting for more than 60% of all R&D expenditure in high-technology industry. Computers & office equipments and pharmaceuticals are two other R&D intensive sectors, comprising about one quarter of R&D expenditures collectively.

As stated in the National Basic Research Development Programme (973 Programme), the following 7 basic research areas were selected for additional support, including agriculture, energy, information, resource and environment, population and health, materials, as well as synthesis and frontier sciences.

#### 2.4.2 Sectoral policies

Unlike other countries, the private sector in China is not synonymous with the industrial sector, as only a proportion of business enterprises are privately owned. Numerous privately-owned enterprises (POEs) have been transformed from state-owned enterprises (SOEs) through privatisation since the 1990s. The number of POEs was three times the number of SOEs in 2003. Although governmental policies and funds are available to promote R&D activities in enterprises, it is still hard for POEs to receive government direct appropriations compared with SOEs. Nevertheless, the linkage between private enterprises and public research units has strengthened over the years. More than 5000 POEs established partner relationships with universities and research institutes to get technological support for enterprise innovation by 2003. Lack of financial support and weak IPR enforcement are the main barriers for enterprises developing new technologies and products. According to the

---

26 Source: China Statistical Yearbook on Science and Technology 2008.
27 The data was calculated by the author based on information from China Statistical Yearbook on Science and Technology 2008. The electronic version is available at http://www.sts.org.cn/sjkl/kjtjdt/data2009/2009-1.htm
national guideline MLP, a set of policy instruments to encourage enterprise-centred indigenous innovation are given to innovative POEs, such as preferential tax policies, regional special funds for research and development in local POEs, and the like.

Sources:
Kanamori, Toshiki and Zhao, Zhijun (2004), Private Sector Development in People's Republic of China, Asian Development Bank Institute

3 REGIONAL RESEARCH POLICIES

3.1 Overview
In spite of its pronounced growth in R&D investment, China's research policies are facing some important challenges including targeting national policy to address regional disparities; balancing of R&D investment between government, industry and other institutions; and encouraging R&D investment among enterprises. Given the history of a highly centralised management system, Chinese policy making typically takes a top-down approach, which leads to limits on bottom-up initiatives. Its research policies possess the same characteristics. Regional disparities in China are rather wide due to the large and diversified territorial units which differ significantly in industrial composition, culture, natural, financial and human resources. Policies initiated by the central government often fail to recognise regional and local attributes. Regional governments are expected to play a more active role in developing research policies that are more relevant to local R&D activities.

Region 1
Guangdong Province has served as the frontier of China’s economic reform since the 1970s. Just over 94.49 million people live in Guangdong (2007), equivalent to some 7.1% of China’s population. Due to its geographical and cultural proximity to Hong Kong, Macau, and Taiwan, Guangdong attracted more than 20% of China’s total FDI in recent years. Not only is Guangdong province the biggest GDP contributor, it is also among the leading regions in terms of R&D expenditure, next only to Beijing and Jiangsu Province. In 2009, the R&D expenditure of Guangdong province was 65.3 billion Chinese Yuan (6.5 billion Euro), 11% of the national total.

Compared with other developed regions in China, Guangdong province does not have many top universities. Instead, in a region known as “the world manufacturing factory”, R&D activities in Guangdong province are mainly market driven and carried out in industry, especially large- and medium- sized enterprises (LMEs). In 2007, enterprises contributed about three fourths of S&T funds, and over two thirds of regional R&D was performed by LMEs. Correspondingly, research policy in Guangdong province is very much focused on encouraging technology upgrading and enhancing industrial R&D capabilities.

Source: China Statistical Yearbook on Science &Technology 2009

Region 2
As the political, economical, and cultural centre of China, Beijing is at the top in terms of its share of national R&D investment. The metropolitan population of Beijing is about 16.33 million people (2007), or 1.2% of the total population of China yet this region accounted for 12% of national R&D expenditure in 2009. Beijing is richly endowed in research resources and technical talents. Beijing hosts the Chinese Academy of Sciences and 172 universities. It is the most scientific and engineering intensive area in China. With the inflow of

multinational enterprises over these years, Beijing is becoming an international R&D centre in addition to being the domestic R&D hub. Consistent with national trends, research policy in Beijing is evolving from the funding of public research institutions to encouraging university-industry collaboration. Zhong-guan-cun Science Park (ZGC), the “Silicon Valley in China”, was initiated in 1988 to facilitate the commercialisation of knowledge developed in universities and research institutes to enterprises. ZGC hosts 39 key universities, the Chinese Academy of Sciences and over 4500 high tech enterprises.

Region 3
The western region of China comprises seven provinces (Chongqing, Gansu, Guizhou, Qinghai, Shaanxi, Sichuan, and Yunnan) and what are known as the autonomous regions (Guangxi, Inner Mongolia, Ningxia, Tibet and Xinjiang). Covering more than one-half of China's land area, the western region contains nearly 387 million people, or about 29% of the overall population of China. China’s western region has historically lagged in regional development, for a variety of reasons. Moreover, since the recent open door policies, western regions have been left further behind as China’s preferential policies favour eastern coastal areas. Unlike the coastal areas, the western regions lack rich knowledge assets, a competitive market and industrial agglomerations or clusters. But on the other hand, most western provinces possess rich natural resources, distinctive cultural heritages, and enjoy more flexible governance. With the launch of the Great Western Exploration Strategy in 2000, the western regions have recognised that the lack of human capital is a bottleneck for development, especially in the process of absorbing technology diffused from the coastal provinces and foreign countries. S&T development and education have been the priority on the agendas of western regions in order to construct local scientific capacity to absorb new technology and promote economic development.

<table>
<thead>
<tr>
<th></th>
<th>Region 1 (Guangdong Province)</th>
<th>Region 2 (Beijing)</th>
<th>Region 3 (Western provinces and autonomous regions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional GERD as a percentage of Regional GDP</td>
<td>1.65</td>
<td>5.5</td>
<td>1.08</td>
</tr>
<tr>
<td>Regional BERD as a percentage of Regional GDP</td>
<td>1.4</td>
<td>0.94</td>
<td>0.52</td>
</tr>
<tr>
<td>Total R&amp;D personnel (FTE) in the region</td>
<td>448946</td>
<td>401595</td>
<td>759834</td>
</tr>
</tbody>
</table>

3.2 Regional research policies and programmes

Since the economic reform and open-door policy, regional governments (provinces, municipalities) have been granted more fiscal power and are thus playing more important roles in regional research policies as well as regional development. One of the most important features of China's present regional research situation is its spatial disparity. The national government has pursued a strategy of “let a few people and a few regions get rich first.” Hence, many preferential policies favour coastal areas which possess better physical and human capital resources than other parts of the country. The result is the “four worlds” in China (One China Four Worlds). The “first world” in the eastern seaboard region has reached a level similar to some developed countries in terms of economic performance; however, only 2.2% of the Chinese population lives in this region. The further westward one goes, the less economically developed the provinces are. Around half of the population lives in the “fourth world”, with a per capita income below that of average developing countries. A similar profile can be found in the distribution of R&D resources. Most scientific centres are located in coastal provinces and special development zones in southern and eastern China, while only a few are in inland areas. This unequal distribution of research institutions
contributes to the disproportionate distribution of national research projects, which reinforces the investment of resources in richer areas. This huge disparity has been recognised by both national and regional government, and is regarded as a major challenge for China's sustainable development.

The second feature of China's regional research policy is the coexistence of horizontal competition and vertical cooperation. Due to China's special personnel mechanism - the central government plays a key role in deciding who will occupy important positions at a local level - officials in regional governments have to maintain good relationship with the central government. This is especially true for coastal provinces and metropolitan areas. National-regional cooperation involves coordinating major national S&T projects, implementing S&T plans and catalysing S&T development. At the same time, due to the scarcity of resources, different regions compete strongly against each other to attract national preferential policies, central governmental research programmes and foreign direct investment.

Regional policy making in China is led by regional governments and is consistent with national policies. National policies are replicated in each region and customised towards regional needs. For example, after the Five-year National Plan for S&T Development is published, each region is responsible for developing a Five-year Regional Plan for S&T Development. Regional plans generally follow national plans but are allowed to have their own policy measures. While research policies at the national level emphasise research investment, research policies at the regional level are more focused on developing research infrastructure, promoting technology commercialisation and attracting high quality human capital.

China has four municipalities, twenty-three provinces, five autonomous regions and two special administrative regions. All regions are under the leadership of the central government and have similar governance systems. Each region has a regional government that manages local innovation and economic development and a set of departments, such as S&T, education, taxation and finance that administer governmental functions and report to the governor. Regional research policies are mainly formulated and implemented by regional Science and Technology Commissions and Education Commissions. Regions compete for national funding and resources. Developed regions have more local resources and are more independent while less developed regions are more reliant on appropriation from the central government.

The central government plays an important role in supporting regional S&T development by coordinating and mobilising national resources. National research programmes with a regional focus generally target less developed regions. For example, the National Development and Reform Commission and the Steering Group of Western Region Development in the State Council jointly issued the 11th Five-year Plan on Western Region Development on March 1st 2007. The plan supports investment in research infrastructure, encourages research collaborations between R&D institutions in eastern and western regions, and attracts university graduates and experts to work in the western region. The Spark Programme administered by the Ministry of Science and Technology particularly targets rural areas in China. The programme was initiated in early 1986 and aims at developing agricultural technologies and promoting their application in rural area. Regional governments are responsible for developing regional research policies and programmes. They often cooperate with each other and form alliances to share resources. For instance, six provinces and cities in the Bohai Sea Area (i.e. Beijing, Tianjin, Hebei, Inner Mongolia, Shandong and Shanxi) set up Regional S&T Infrastructure Sharing Service Platform in June 2006 to integrate S&T resources and reduce duplicate investment. In the underdeveloped regions,
Chongqing, Chengdu, Sichuan, Guizhou, Yunnan and Tibet jointly initiated the University Industry Alliance in South-western China in November 2007 to facilitate university-industry collaboration. The alliance has the goal to set up research infrastructure and develop key technologies by coordinating resources in the south-western region.

Research activities in China are highly concentrated in the eastern region. In 2005, the eastern region performed 72.4% of R&D, the mid region 14.9%, and the western region 12.7%. In particular, Beijing performed 15% of total R&D and Shanghai performed 8.5% of R&D, comparable with the total R&D activities in mid and western regions. R&D intensity (GERD as a percentage of GDP) was 5.25% in Beijing, 2.59% in Shanghai, while the national average was 1.54% (2008). In 2009, Beijing was home to 0.19 million person-years total R&D personnel (FTE), accounting for 0.8% of total population (22 million). Shanghai had 0.13 million total R&D personnel (FTE), accounting for 0.6% of total population (19.21 million). Both are much higher than the national average of 0.1%. The number of total SCI publications per thousand inhabitants was 0.75 in Beijing and 0.32 in Shanghai, more than ten times higher than the national average of 0.03. The number of total invention patents per thousand inhabitants was 0.23 in Beijing and 0.11 in Shanghai while the national average was 0.02.

National research policies with a regional focus:

Regional research policies:
The Five-Year Regional Plan on Science and Technology Development (by each region)
Decision on Sharing S&T Resources in Beijing (Beijing Municipal S&T Commission, 2007)

4 POLICY MIX

4.1 Fiscal Policies

China's tax policy plays an important role in encouraging R&D investment. Around 25% of S&T related policies and laws issued since 1980s use tax instruments. Tax policy is implemented through the R&D tax credit. Following the Medium and Long Term National Plan for S&T Development, Ministry of Finance (MOF) is working on 13 tax regulations to encourage R&D and innovation. Some regulations were released. In the new regulations, the allowable tax credit is 150% of qualified R&D expenditure for enterprises. If the amount is more than the total tax, the credit could be carried forward to the next year. Investment on R&D equipment can be excluded from income tax for equipment with a value of less than 300,000 Yuan. Accelerated depreciation is applied to R&D equipment with a value of more than 300,000 Yuan.

Encouraging industrial R&D activities by providing fiscal incentives and promoting academic-industry partnership

29 Source: Development of S&T Policy in China.

4.2 **Human Resource Policies**

High quality human resources are regarded as the basis of S&T development in China. The share of scientific and technical personnel as a percentage of the population is expected to increase significantly. According to the National Medium- and Long-term Development Plan for Human Resources (2006-2020) released in June 2006, the number of R&D personnel per 10,000 employees will reach 33 person-years in 2015 and 43 person-years in 2020. China also aims to develop top level universities, research institutes, leading scientists, and research teams.

Universities are major players in the S&T system in China, not only through producing S&T personnel but also through participating in R&D activities. Several programmes are implemented by the Ministry of Education to encourage universities to improve R&D and the training of high quality research personnel.

The major human resources programme is the 211 Programme, which is named after the plan to make 100 universities competitive internationally in the 21st century through building research capabilities. Significant research funding goes to selected universities to build their research capabilities;

The Yangtze Scholars Programme was established in 1998 to attract outstanding researchers from China and abroad to work in the universities and contribute to the development of science in China; The Education Revitalisation Plan towards 21st Century was officially announced in 1999. The plan encourages R&D activities in universities and collaboration among universities, research institutes and industry. Around 200 National Youth Centres of S&T Education have been set up since 1999 to improve scientific knowledge of young people. In order to boost China scientific and technology development, the Chinese government launched a nationwide "One Thousand Talents" Programme to attract global elites with top salaries and start-up funding.

4.3 **Interaction between Knowledge Triangle Policies**

Innovation policy is closely associated with research policy. In order to encourage R&D activities and promote technology transfer and commercialisation, incubators and high-tech zones have been established in many parts of China. This initiative, inspired by the Silicon Valley model in the US, was started at the end of 1980s. By 2010 there were 83 high-tech zones, hosting more than 90% of high-tech firms and incubators. These firms enjoy preferential tax treatment for doing R&D.

Universities and research institutes create spin-off companies, through which they commercialise technology and the R&D products developed in their research labs. Spin-offs not only provide a channel for technology spillover, but also help to stimulate further R&D by generating revenue. Spin-off companies only account for a small proportion of total Chinese industry, but they create advanced technologies and are valuable in the development of the high-tech industries.
4.4 Other Policies

Public procurement of technology is a rather new policy learned from the US and Korea. In the Implementing Policies for the Medium- and Long-term National Plan for S&T Development promulgated in 2006, it is specified that indigenous innovative products are the priority in public procurement and should be given a price advantage; and no less than 60% of the cost of technology and equipment purchase should be spent on domestic firms. This policy encourages firms to engage in R&D and innovation by reducing market uncertainty.

Foreign direct investment (FDI) has been an important contributing factor to the recent economic growth of China. China is the biggest recipient of FDI among developing countries, which is the product of preferential policies in the country to encourage FDI inflow. The business tax rate for FDI corporations in Special Economic Zones is 15%, whereas the rate for domestic enterprises is 33%. In addition, 40% of the taxes paid by FDI corporations are refundable on the condition that the funds are reinvested in China over a five-year period. (Source: Business Tax Law for Foreign Enterprises in China) While the contribution of FDI to the economic growth of China is widely acknowledged, its impact on the innovation capacity of domestic companies is still a matter of debate. Positive technology spill-over effects are found in some sectors, such as ICT, but sluggish growth of domestic firms is found in other sectors, such as the automobile industry. While maintaining a desire to attract FDI to China, a discussion is ongoing calling for equal tax treatment for foreign and domestic firms, and promoting the idea of favourable FDI policies to target selected industries and selected regions.

Source: Liu, Xielin (2006), Chinese R&D and Innovation Performance, Graduate University of Chinese Academy of Sciences.

5 GOVERNANCE STRUCTURES

5.1 Government policy making and coordination

The Ministry of Science and Technology (MOST) is the leading ministry in terms of formulating S&T policies. Other ministries also have the right to formulate and implement S&T policies relevant to them. Policies can be proposed by an individual ministry independently, or by several ministries jointly. Policies implemented jointly by ministries are more influential than those implemented by single departments. For instance, MOST can promulgate policies independently under its own jurisdiction, but if MOST wants to have fiscal policies to promote industrial R&D such as taxation treatments or discount loans, it has to work together with Ministry of Finance, Bank of China or other related departments. Policies and programmes can be promulgated at the ministry level, the State Council level, or the National People's Congress level, and are more influential and significant if they are approved at the latter two levels.

Source: IPTS (2005), Report on Research Investment Policies in China, prepared by SPRU.

5.2 Science Policy Advice

Policy making in China is basically a top-down process. The government, either through the Ministry of Science and Technology or the State Council, starts the process when policy problems arise. Typically, a special group of experts with relevant knowledge is set up. Most
of the experts come from the Chinese Academy of Sciences, universities, and other research institutes under relevant ministries. Industry does not participate actively in this stage. The group reports to the government with policy recommendations. The policy is then promulgated by the ministry or the State Council.

5.3 Tools for policy advice

In 2003, the Chinese Academy of Sciences (CAS) initiated a project on "Technology Foresight of Next 20 Years in China", led by the Institute of Policy and Management. CAS organised a project team with 4 technology groups: information and communication technology, biotechnology, material, energy, and 32 subfield groups. This project used Delphi analysis and surveyed 1800 and 2000 experts with relevant knowledge in 2003 and 2004 respectively. Around 40 research priorities in the next 20 years were suggested. The first output of the project – Technology Foresight Report 2005 - was published in 2005. The result was used in making the Medium- and Long-Term National Plan for S&T Development.

5.4 Actors in policy implementation

The Ministry of Science and Technology is the leading ministry in S&T policy design and is also the main implementation unit. It operates S&T programmes and provides funds to R&D activities. The National Natural Science Foundation of China has a similar function in managing programmes and research funds. The Chinese Academy of Sciences is another important executive agency, which manages 97 research institutes and is the main research performer in China. The ministries or agencies in charge of policies and programmes are responsible for communication and increasing public awareness.

6 RESEARCH FUNDERS

6.1 Funding flows

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>EU average (the latest available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GERD (€ million)</td>
<td>30025.0</td>
<td>37098.0</td>
<td>46158.0</td>
<td>54330.0</td>
<td>237,001.0</td>
</tr>
<tr>
<td>GERD per capita (€)</td>
<td>22.8</td>
<td>28.1</td>
<td>34.7</td>
<td>40</td>
<td>476.2</td>
</tr>
<tr>
<td>R&amp;D intensity (GERD as % of GDP)</td>
<td>1.4</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.9</td>
</tr>
<tr>
<td>BERD (€ million)</td>
<td>21337.4</td>
<td>25768.9</td>
<td>33237.8</td>
<td>39449</td>
<td>151,448.7</td>
</tr>
<tr>
<td>GERD financed by business enterprise as % of total GERD</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>55.0%</td>
</tr>
<tr>
<td>GERD financed by abroad as % of total GERD</td>
<td>1.61%</td>
<td>1.35%</td>
<td>1.24%</td>
<td>1.43</td>
<td>8.9%</td>
</tr>
<tr>
<td>GBAORD (€ million)</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>88,884.8</td>
</tr>
<tr>
<td>GBAORD as % of general government expenditure</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>1.52</td>
</tr>
</tbody>
</table>
The total amount of China R&D expenditure in 2010 was ~€69.8 billion. More than 70% of R&D funds came from the business sector and one quarter from the government. In terms of R&D expenditure, research institutes and universities were the main target (85%) of government funds, while around 13% of government funds went to the business sector.

1 Euro = 10 Yuan
Source: China Statistical Year Book on Science and Technology 2009

6.2 Government and regional authorities

6.2.1 Overview

The Chinese government's S&T appropriation has more than quadrupled over eight years from €7033 million in 2001 to €32249 million in 2009. Its share in total government expenditure also rose from 3.7% in 2001 to 4.23% in 2009. This growth is considerable given

30 Note: The debt is not included in the total government expenditure.
that China’s total government expenditure has simultaneously expanded impressively. Both national and local governments keep this rising trend of R&D investment with the lead of central government. In terms of regional variation, Shanghai, Zhejiang Province and Beijing dominated the overall R&D investment at sub-national level.

Source:
China Statistical Yearbook on Science &Technology 2010
China S&T Indicators 2008

6.2.2 Institutional Funding

Institutional funds play an important role in China's R&D investment. Realizing the lag of research performance between Chinese domestic universities and their international counterparts, the P.R.C government concentrates its investment on some key research fields among 100 selected Chinese universities, namely the 211 Project. In addition, under the national strategy of "Invigorating China through Science and Education", China strives to construct several world-class universities. About forty selected universities receive block funds of millions of Euros directly from national government each year. A large part of the funding goes to academic exchange.

6.2.3 Competitive funding

Competitive funding, or project-based funding, particularly in the format of research programmes, is the key element of China's R&D investment. According to the released figures from Chinese Ministry of Science and Technology (MOST), in 2009, the central government appropriated a total of 21.791 billion Yuan to the S&T programmes – 12.715 billion Yuan for the National High Tech R&D Programme (863 programme), S&T Support Programme and National Basic Research Programme (973 programme), 3.191 billion Yuan for the National S&T Infrastructure programme, and 5.885 billion Yuan for the policy orientation programmes and special programmes.

The main R&D programmes receiving central government appropriations in 2009 were:
National High Tech R&D Program (863 Programme) 5.115 billion Yuan in total, 57.7% of the total project funds:  ICT (23.5%), manufacturing (15.5%), materials (14.7%), agriculture and biotechnology (9.9%), resources and environment (9.4%).

S&T Support Programme – 5 billion Yuan: agriculture (19.3%), transportation (14.3%), materials (10.7%), population and health (9.4%), resources (8.6%), information industry and modern services (8.2%), urbanisation and urban development (7.9%), environment (7.5%), manufacturing (5.7%), public security and other social affairs (5.2%), energy (3.2%).

National Basic Research Program (973 Programme) – 2.6 billion Yuan in total – population and health (12.3%), energy (9.2%), nano (9.2%), resources and environment (9.1%), interdisciplinary (9.1%), agriculture (8.8%), cutting-edge (8.6%), materials (8.2%), information (7.8%), growth and regeneration (7.0%), protein (5.9%), quantum (4.8%).

Source: National S&T Programmes Year Book 2010

6.2.4 Other modes of funding

Direct funding to outstanding individuals is the most common non-mainstream format in China’s research funding system. In China, the level of Chinese government support of
business R&D is low, with only 4.5% of GERD coming from government sources. Nevertheless, following other advanced economies, the R&D expenditure tax credit has been adopted in China to spur innovation in “resident enterprise” according to China's New Enterprise Income Tax Law (EITL). Effective from January 2008, instead of the 25% corporate income tax rate, high-Tech and New-Tech enterprise in China can enjoy a 15% reduced tax rate, a tax holiday of "2-year tax exemption and 3-year 50% deduction" if located in the prescribed areas. In addition, indirect tax incentives include business tax exemption and duty-free importation of equipment and spare parts, etc.

Source:
New Enterprise Income Tax Law
China Statistical Yearbook on S&T 2006

6.3 Business enterprise sector

6.3.1 Intramural
The majority of private funding in China goes to industry. In 2008, 94.8% of R&D funded by business enterprises was performed in-house, comprising about 93% of private sector R&D.

6.3.2 Extramural
By contrast, €1631 million of industrial R&D funds went to public research institutions and higher education and represented 14% of public research R&D, mainly through contract based projects. Of the €1631 million, €1349 million were received by universities, accounting for 34.6% of university R&D, and €282 million were received by governmental research institutions (GRIs), accounting for 3.5% of GRIs R&D. Only a very small portion of private R&D was allocated to other types of recipients mainly private non-profit institutions. The share was 0.34% in 2008, representing €112 million.

Source: China Statistical Yearbook on Science & Technology 2009

6.4 Funding from abroad

International funding, including European funding increased dramatically in 2008. Although its share of national R&D expenditure (3.4%) is rather small, the total foreign funding of R&D in China in 2008 was increased from € 484 million in 2007 to €1584 million in 2008. About half of foreign funds (50.1%) went to public research organizations, 32.1% was received by business sectors, and another 15.7% by universities.
### 6.5 Private non profit sector

Charitable foundations or non-profit organisations do not play any significant role in the China's research system.

### 6.6 Important Research Programmes

The selected key research programmes in China and their links are listed below.

<table>
<thead>
<tr>
<th>R&amp;D PROGRAMME</th>
<th>KMI LINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Innovation Programme</td>
<td><a href="http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=610">http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=610</a></td>
</tr>
<tr>
<td>Hundred Talents Programme</td>
<td><a href="http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=589">http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=589</a></td>
</tr>
<tr>
<td>National Basic Research Development Programme (973 Programme)</td>
<td><a href="http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=586">http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=586</a></td>
</tr>
</tbody>
</table>
National High Technology R&D Programme (863 Programme)  
http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=588

R&D Infrastructure and Facility Development  
http://kmi.erawatch-network.eu/KMI/overview_support_measure.cfm?id=948

See complete list of Chinese national and regional S&T funding programmes:  

7 RESEARCH PERFORMERS

7.1 Higher Education Institutions

In the planned economy era, the functions of Chinese universities were generally limited to education. Only a few leading research universities participated in R&D, such as Tsinghua University and Peking University. In accordance with China’s economic reform, China’s higher education system also went through dramatic changes after the 10-year Cultural Revolution. China resumed the national college entrance tests in 1978. The Third Plenary Session of the 11th Communist Party of China Central Committee was the watershed event for China’s higher education development. But the real transition from elite higher education to mass higher education started in 1999, manifested by the absolute number of universities, the proportion of enrolment growth, and extent of recruitment autonomy of students and faculties. In addition, more universities started to carry out R&D, and the university system conducted around 10% of national R&D in the last decade. R&D expenditure in universities increased from 3.9 billion Yuan in 1994 to 46.82 billion Yuan in 2009. Out of the R&D funds total of 48.82 billion Yuan in 2009, 56% came from government funds, 36.7% from industry, and 7.3% from other sources including foreign funds (1%). A recent (2010) Chinese ranking of the academic quality of universities places 34 Chinese universities amongst the top 500 universities worldwide, which is more than doubled of that in 2004 (16), with National Taiwan University, Peking, Tsinghua, and Chinese University of Hong Kong ranked among top 200. The relative weakness of the majority of Chinese universities in global comparison is likely to be a growing area of policy concern in China.

Unlike the western countries, the State is responsible for the overall planning of higher education in China. The Ministry of Education is in charge of establishing higher education institutions with the active participation of society. By the end of 2009, China harboured 2,305 universities / higher education institutes, among which, 1,354 universities (58.7%) are engaged in R&D activities. Independently, these universities can be classified as key universities, regular universities, and two- or three-year colleges. Key universities and some regular universities offer graduate programmes and they are also the major performers of R&D. They in total are accommodating over 20.2 million undergraduates and 1.3 million postgraduates according to the figures released by the Ministry of Education of the People’s Republic of China. The number of postdocs in China has increased as well. There were 45,000 postdocs in China by the beginning of 2007, with 40% in engineering, 20% in science and 10% in medicine (Zeng, 2008). Although the researcher mobility is still low, changes are happening inspired by various programmes encouraging mobility of researchers as well as university-industry collaboration and regional collaboration.

31 http://www.shanghairanking.com/
32 http://www.moe.edu.cn/
The stipend of academic positions in China is notoriously low, especially considering the fact that the majority of top Chinese universities are located in national and provincial capitals where living cost is rather high. To attract and retain researchers, two open secrets of stimulating research activity is a certain level of discretion of allocating research fund and direct monetary rewards for research output.

In sharp contrast with other advanced economies, Chinese universities and research institutes are the main driver of China’s explosive patenting phenomena. The Amended Chinese Patent Law states that “the entity shall be the patentee”. For a patent application associated a Chinese university or research institute, when it is approved, the entity, i.e. the research institution or university will be the patentee of that patent. In another words, Chinese research institutions or universities will own the patent for their employees (Wang & Ma, 2007). In reality, however, the management mechanism of intellectual property rights at Chinese universities is rather ineffective. The faculty patent is often treated the same as publication in research evaluation, both of which are rewarded monetarily, either in terms of increased salary or stipend or both. There are no national wide regulation about the compatibility between the regular activities as a university employee and research activities performed outside the university.

Sources:
Communique on the Key Statistics of Scientific Research and Experimental Development Resources in China 2010
China Statistical Yearbook on Science and Technology 2008
China S&T Indicators 2007
Ministry of Education of the People's Republic of China

7.2 Public research organisations

There are three types of government research institutions (GRIs). The most important type includes GRIs that belong to the Chinese Academy of Sciences (CAS), which is the main research organisation in China. CAS was founded in 1949 together with the establishment of PRC. It manages 97 research institutes, one university, one graduate school and one documentation and information centre. GRIs in CAS focus primarily on basic research. In 2010, expenditure for basic research, applied research and experimental development accounted for 36.1%, 56.8% and 7.1% respectively. A second type includes GRIs affiliated with ministries. There have been hundreds of GRI under different industrial ministries, with a focus on applied and developmental tasks related to the theme of their own ministries. A third type is composed of GRIs at the regional level. They often carry out research and development relevant to the needs of their regions.

In 2009, there were 3,707 GRIs nationwide, 82.4% of them regional GRIs. In terms of the R&D expenditure of GRIs in 2009, 11.1% was spent on basic research, 35.2% on applied research, and 53.7% on experimental development. Compared with regional GRIs, GRIs at the national level are much more research oriented. While on average 71% of S&T expenditure was for R&D in national GRIs during 1998-2003, the figure for regional GRIs was only 17%.

Governmental research institutions (GRIs) have been major actors in China's research system. They were the leading R&D performer until the late 1990s when they were surpassed by enterprises. Since then, with increased industrial R&D and many GRIs transformed into enterprises, the business sector has replaced GRIs as the top contributor to R&D.
7.3 Business enterprise sector

The business sector has been the largest performer of R&D since the end of the 1990s, although most R&D activities in enterprises are focused on minor technological changes and incremental innovation due to limited capabilities. Possessing the majority of S&T resources, large- and medium-sized enterprises (LMEs) are the backbone of industrial R&D, contributing 85% of all industrial R&D expenditure in 2009 12,434, or 30.5% of LMEs in 2009 had R&D activities. In 2008, scientists and engineers represented 5.19% of total employees and R&D expenditure accounted for 0.84% of total revenue. Most S&T activities are self-financed (90.1%).

A lion share of industrial R&D was contributed by state-owned enterprises (SOEs), state funded enterprises and domestically-funded enterprises (72.6%), and 12.9% by foreign-funded enterprises. Private research performers only accounted for a small share of industrial R&D. Private businesses were not allowed to operate until the 1980s. The legal rights and interests of the private sector were guaranteed in the constitution in 1999 and property rights were granted in 2004. SOEs limit their focus to core industries, such as electricity, petroleum, steel, telecommunication, etc. In other industries, SOEs are encouraged to transform into private enterprises or share-holding firms. By 2009, 16,153, or 6.4% of private firms conducted R&D activities. The rest of the firms conducting R&D activities in terms of percentage among their kinds were: SOEs 14.1%, collective enterprises 2.9%, foreign enterprises 11.6%. The majority of private firms are small in size and mostly distributed in the low technology manufacturing, retail and service sectors.

According to the 2009 EU Industrial R&D Investment Scoreboard, only 0.6% of the top 1,350 R&D intensive companies are located in China. Table 7.3.1 below lists the top 10 Chinese companies by level of R&D investment.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>ICB Sector</th>
<th>2008 R&amp;D Investment (€m)</th>
<th>change 08/07 (%)</th>
<th>2008 Net Sales (€m)</th>
<th>2008 R&amp;D/Net Sales ratio (%)</th>
<th>2008 Operating Profit (% of Net Sales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>PetroChina</td>
<td>Oil &amp; gas producers (53)</td>
<td>818.26</td>
<td>46</td>
<td>112,948</td>
<td>0.7</td>
<td>13.5</td>
</tr>
<tr>
<td>133</td>
<td>ZTE</td>
<td>Telecommunications equipment (9578)</td>
<td>450.52</td>
<td>33.1</td>
<td>4,671</td>
<td>9.6</td>
<td>7.6</td>
</tr>
<tr>
<td>152</td>
<td>China Petroleum &amp; Chemical</td>
<td>Oil &amp; gas producers (53)</td>
<td>361.36</td>
<td>0.2</td>
<td>153,118</td>
<td>0.2</td>
<td>-0.9</td>
</tr>
<tr>
<td>259</td>
<td>China Railway Construction</td>
<td>Construction &amp; materials (235)</td>
<td>185.15</td>
<td>516.3</td>
<td>23,136</td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>283</td>
<td>Lenovo</td>
<td>Computer hardware (9572)</td>
<td>158.28</td>
<td>-15.8</td>
<td>10,721</td>
<td>1.5</td>
<td>-1.4</td>
</tr>
<tr>
<td>295</td>
<td>Dongfeng Motor</td>
<td>Automobiles &amp; parts (335)</td>
<td>152.9</td>
<td>33.2</td>
<td>7,441</td>
<td>2.1</td>
<td>6.4</td>
</tr>
</tbody>
</table>

Note: Companies headquartered in Hong Kong are also included in the above China list. The electronic version is available at http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=2859
<table>
<thead>
<tr>
<th></th>
<th>Company</th>
<th>Sector</th>
<th>Employees</th>
<th>Revenue (¥)</th>
<th>Profit (¥)</th>
<th>ROE</th>
</tr>
</thead>
<tbody>
<tr>
<td>372</td>
<td>China Coal Energy</td>
<td>Mining (177)</td>
<td>115.99</td>
<td>5,377</td>
<td>2.2</td>
<td>19.3</td>
</tr>
<tr>
<td>378</td>
<td>China Communications Construction</td>
<td>Construction &amp; materials (235)</td>
<td>114.62</td>
<td>289.6</td>
<td>18,863</td>
<td>0.6</td>
</tr>
<tr>
<td>402</td>
<td>BYD</td>
<td>Electronic equipment (2737)</td>
<td>106.31</td>
<td>13.2</td>
<td>2,825</td>
<td>3.8</td>
</tr>
<tr>
<td>403</td>
<td>China South Locomotive</td>
<td>Commercial vehicles &amp; trucks (2753)</td>
<td>105.99</td>
<td>105.5</td>
<td>3,700</td>
<td>2.9</td>
</tr>
</tbody>
</table>


**Public- private Research and Technology Organisations**

Public research institutes used to be entirely supported by the state. Since 1999, China has started to restructure some development-oriented governmental research institutes (GRIs). By the end of 2003, 1149 GRIs (20% of national total) had been transformed, with 1050 of them being converted into enterprises, and the rest merged with universities or converted to other public service units. Most of them are still partly funded by the state. In 2004, the Chinese Academy of Sciences promulgated the Decision on Accelerating the Socialisation of CAS-affiliated Enterprises, which specified that the CAS and its institutes are not allowed to own over 35% of each enterprise.

Source: China S&T Indicators 2008

**8 NATIONAL POLICY DEVELOPMENTS AND EUROPEAN RESEARCH AREA**

**8.1 Labour market for researchers**

Accompanied by rapid economic development, China’s human capital is also growing rapidly evidenced by the expanding activities of higher education institutions (HEIs), the increased research performance of Chinese universities, and the absolute size of the number of science and technology (S&T) personnel. According to figures released by the Ministry of Education of China, in June 2009, China harboured over 2,700 institutions of higher education, accommodating over 20.2 million undergraduates and 1.3 million postgraduates. According to the S&T Statistics 2009, China had about 3.18 million R&D staff, among which, the number of researchers was 1.152 million person-years, 18% of the world total, and second only to the US. The number of post docs in China increased, too. At the beginning of 2009, China has produced 45,000 post docs with 40% in engineering, 20% in science, and 10% in medicine. These statistics provide solid research base for China’s R&D attainment.

China Education Association for International Exchange (CEAIE), China Scholarship Council (CSC), and Chinese Service Centre for Scholarly Exchange (CSCSE) are three non-governmental organizations affiliated to the Ministry of Education that play key roles in charge of international educational exchanges.
8.2 Research Infrastructures

The supportive role of Chinese government policy relating to scientific advancement has been generally accepted. Echoing Deng Xiaoping’s slogan that “Science and Technology are the Chief Productive Forces,” the Chinese elites have embarked on a significant push to improve the China’s research infrastructure via a series of national research programmes. Take the Knowledge Innovation Program (KIP) for example. The KIP was inaugurated by the Chinese Academy of Sciences (CAS) in 1998 to allocate additional resources to the most promising institutes and research fields of the Chinese Academy of Sciences. From its inception in 1998, KIP aims to improve the scientific performance of CAS and build it into China's pre-eminent S&T centre for R&D capability. The targeted research themes of the Knowledge Innovation Program (KIP) include information, biology, advanced materials and manufacturing, new energy sources, space and oceanography, the environment and ecology, and cutting-edge research in some strategic areas of basic science. In the field of environmental, health and safety in nanotechnology (hereinafter Nano EHS), the National Laboratory for Biological Effects of Nanomaterials and Nanosafety (hereinafter Bio-Lab) was established in 2006. Unsurprisingly, given the Bio-Lab’s mission to promote research investigating the properties and health and safety effects of nanotechnology, rapid growth is manifested by the China’s research outputs in Nano EHS. The close connection between China’s topical evolution and state-led programs, and its dynamic changes in research focus, suggests that China’s Nano EHS research is increasingly driven by its own evolving research infrastructure.

In 2010, CAS launched Innovation 2020, an extension of the Knowledge Innovation Programme (KIP), which lays special emphasis on four key areas, namely space science, information technology, energy and health. Under the initial projects of the programme, the academy will set up a series of research centres (space science centre, centre for clean and efficient use of coal, and a research centre for geo-science devices) and three science parks in Beijing, Shanghai and Guangdong.

8.3 Research Organisations

Similar to other countries, China’s evaluation on academic/research quality are output-oriented. The main indicators they use include conventional bibliometric indicators, such as the number of articles published in international journals, the number of patents filed in the State Intellectual Property Office of China and other patenting offices, amount of domestic and international research grants, etc. Recently, quality measures such as citation counts, the share of licensed patents are also taking into consideration.

There is no information available on GBAORD in China. The linkage between research output and block funding, which was hard to trace, can be identified to some extent based on acknowledgement in the Web of Science database.

8.4 Knowledge transfer

Responding to government policies, Chinese universities and research institutions have implemented specific measures to stimulate research exchange and knowledge transfer both domestically and internationally. These efforts include hosting international conferences, establishing formal collaboration with foreign institutions, recruiting outstanding overseas scientists, and bestowing monetary rewards and promotions based on scientific publications. All of these interact and reinforce each other, catalyzing the accumulation of individual
knowledge attained through both individual and collaborative learning. This further contributes to the overall development of research at aggregated level in China. As a result, China publishes more academic papers than any other country with the exception of the US.

One good example of policy facilitating knowledge transfer is the "Thousand Talents Programme", or "one-thousand-talents scheme". This program was initiated in 2008 by the Organization Department of the Chinese Communist Party Central Committee. The objectives of this party-run programme are to connect Chinese domestic scientists with the global first class researchers through overseas Expatriates, and to change the academic atmosphere by the groups of top-notch Chinese returnees. This programme provides rather generous stipend and funding opportunities for selected candidates. At national level, the government will offer a relocation package of 1 million CNY (approximately €100,000) per person with salaries and research funding left to the recipient organizations. Since its implementation, the “Thousand Talents Programme” has brought back several world renowned scientists such as Xiaodong Wang, a Howard Hughes Medical Institute investigator, Yigong Shi, a chaired professor of structural biology at Princeton University, and to just name a few. These leading scientists are expected to bring breakthroughs in key technologies, develop high-tech industries to enable China stay globally competitive.

Source:

8.5 Cooperation, coordination and opening up of national research programmes

Efforts are underway to intensify scientific collaboration activities between China and European countries, and accumulated evidences suggest that Chinese policy makers value EU-China bilateral cooperation and view this as an opportunity to strengthen scientific, economic, and political relationship with European countries. One example was opening up the EU Framework Programme to China in 1998. China is now the third largest non-European partner of the EU in FP7, with projects focusing in the themes of transport, ICT, environment, health and food, agriculture and biotechnology. Target areas of interests to both China and the EU include information technology, biotechnology, nanotechnology, food safety, energy, environment, and health. These topics are also the priority research fields in the Medium- and Long Term National Plan for S&T Development.

In the 9th Joint Steering Committee of EU-China S&T Cooperation Agreement in March 2011, both sides agreed to address areas of common interest and mutual benefits for S&T collaboration through setting up thematic task forces, in particular in the field of food, agriculture and biotechnologies.
Source: China-EU Dialogues.

8.6 International S&T cooperation

As a major partner in previous Framework Programmes, China quickens its collaboration steps with the European countries. In addition to the renewal of the 1998 Agreement on
Scientific and Technological Cooperation in 2004 and 2009, the Science and Technology Partnership Scheme was set up in 2009. Meantime, China signed various bi-lateral and multilateral agreements with individual European countries to promote international research cooperation. These efforts include the Sino-Germany Research Centre, UK-China Collaborating Program in sustainable energy, China-France Joint Research Centre in Computer Science, Automation and Applied Mathematics, and Sino-Switzerland Joint Research Agreement, just to name a few.

9 INTERNATIONALISATION OF S&T COOPERATION

9.1 Orientation

Research collaboration between China and the EU can be traced back to the 1980s, and it has become increasingly active in the past two decades. The EU opened all projects in the Framework Programme to China in 1998. China opened in principle two major programmes - the National High Tech R&D Programme (863 Program) and the National Basic Research Development Program (973 Program) – in 2002 to EU participants. In 2005, CO-REACH (Co-ordination of Research between Europe and China) was launched. This European Commission funded initiative now completed aimed to facilitate the EU-China research cooperation through joint activities and new European programmes. As an ERA-NET Co-ordination Action, CO-REACH covered a wide range of collaborations fields, which include life sciences, physics, engineering, environmental sciences, and humanities and social sciences.


9.2 Instruments

In addition, a variety of bilateral and multilateral cooperation agreements and programs with scientifically advanced economies have been set up to stimulate knowledge transfer across national borders, such as the Sino-US S&T Agreement, the China-U.S. Physics Examination and Application (CUSPEA) program, the Joint Fund on Major Scientific Equipment Research, to name just a few, have been established in the past several decades. Under these programs, China has strengthened formal collaboration with western economies in many aspects, as evidenced by the rapid expansion of institutional collaborations. For instance, at the institutional level, the establishment of the Sino-Germany Joint Research Centre, the Sino-U.S. Joint Centres for Soil and Water Conservation and Environmental Protection, and the Society of Chinese Bioscientists in America (SCBA) demonstrate active research collaboration between Chinese research institutes with their counterparts in other advanced economies. The Chinese government has become actively engaged in fostering international research collaboration, particularly with the U.S., in deciding which fields, researchers, and areas should be given priority for postgraduate and scholar exchange programs. The 12th Five-year plan for S&T Development underlined that internationalisation of scientific research activities will be further enhanced and China will actively participate in international S&T organisations and large international science programmes.
9.3 Solving the Grand Challenges through Transnational R&D Cooperation

China started to participate in S&T cooperation activities with the EU in the 1980s. Since the 2nd EU Framework Programme (FP), China has been participating in the international collaboration programme of the FPs. After the EU-China Science and Technology Agreement was signed in 1998, an increasing number of Chinese researchers and research institutions have participated in many projects in the EU Framework Programmes with European partners. In the EU's 7th Framework Programme FP7, latest statistics showed that 243 Chinese participations have been selected in the Cooperation specific programme covering all FP7 themes, in particular transport, ICT, environment, health and food, agriculture and biotechnology. In addition Marie-Curie fellowships to research projects were also provided by the EU to support the exchange of scientists between EU and China. In parallel, according to the EU-China S&T Agreement, Chinese national basic and high-tech research programmes -the 973 National Basic Research Program and the 863 National High-Tech Research Program, are in principle open to EU partners. The EU-China Science and Technology Agreement was renewed in 2004 following a positive review.

List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>BERD</td>
<td>Business Enterprise Research and Development</td>
</tr>
<tr>
<td>CAE</td>
<td>Chinese Academy of Engineering</td>
</tr>
<tr>
<td>CAS</td>
<td>Chinese Academy of Sciences</td>
</tr>
<tr>
<td>CSTIND</td>
<td>Commission of Science Technology and Industry for National Defense</td>
</tr>
<tr>
<td>ESF</td>
<td>European Social Funds</td>
</tr>
<tr>
<td>ERDF</td>
<td>European regional development fund</td>
</tr>
<tr>
<td>FP</td>
<td>European Framework Programme for Research and Technology Development</td>
</tr>
<tr>
<td>GERD</td>
<td>Gross Expenditure on Research and Development</td>
</tr>
<tr>
<td>HEI</td>
<td>Higher education institutions</td>
</tr>
<tr>
<td>HES</td>
<td>Higher education sector</td>
</tr>
<tr>
<td>MLP</td>
<td>Medium- and Long-term National Plan for Science and Technology Development 2006-2020</td>
</tr>
<tr>
<td>MOA</td>
<td>Ministry of Agriculture</td>
</tr>
<tr>
<td>MOE</td>
<td>Ministry of Education</td>
</tr>
<tr>
<td>MOF</td>
<td>Ministry of Finance of China</td>
</tr>
<tr>
<td>MOST</td>
<td>Ministry of Science and Technology of China</td>
</tr>
<tr>
<td>NDRC</td>
<td>National Development and Reform Commission</td>
</tr>
<tr>
<td>NSFC</td>
<td>National Natural Science Foundation of China</td>
</tr>
<tr>
<td>PRO</td>
<td>Public Research Organisations</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development</td>
</tr>
<tr>
<td>SF</td>
<td>Structural Funds</td>
</tr>
<tr>
<td>S&amp;T</td>
<td>Science and technology</td>
</tr>
</tbody>
</table>