

**Chinese Multinational Companies in Global R&D and Innovation Rankings:
An Explorative Study**

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Abstract

Internationalisation of Chinese firms is a salient feature of the contemporary world economy. They evolve from local producers to multinational companies, strengthening their presence in a variety of economies – from neighbouring developing countries to sophisticated western markets. Their competitive advantage is often found in access to low costs labour, and in many cases, state support. Innovation is becoming an important variable of the international business strategies of emerging Chinese multinationals. The question is whether innovation will be a new competitive advantage of emerging Chinese multinationals. While this is a very relevant subject, due to its novelty, it is not yet sufficiently addressed. Therefore the aim of this paper is to contribute to the nascent literature stream on this topic. We examine performance of Chinese companies in the global R&D and innovation rankings, both quantitatively and qualitatively. This can be considered as a first step in a study of the interplay of innovation and internationalisation of Chinese firms.

Key words: innovation, China, multinationals, ranking

1. Introduction

The beginning of the 21st century has been marked by a spectacular rise of China that has shown a sustained two-digit economic growth for several years. China represents an attractive multi-million market for western multinationals. Many of whom establish R&D centres in China in order to adjust their products for the Chinese market as well as to develop new ideas and concepts for application globally. Emergence of Chinese multinational companies is an inherent characteristic of the rise of China's economy. They expand their international presence, driven by a variety of motives – such as resource-seeking (mostly in Africa) and market-seeking (in neighbouring markets and even in advanced markets).

China's "National Medium- and Long-Term Plan for the Development of Science and Technology (2006-2020)" states that China is to build its dominance by "enhancing original innovation through co-innovation and re-innovation based on the assimilation of imported technologies". For this purpose, Chinese government seeks to employing the fast-growing domestic market and powerful regulatory regime. China's innovation campaign aims to decrease reliance on foreign technology and promote indigenous technologies that will enable it to solve its environmental, infrastructural and social problems. Innovation starts playing a more pronounced role in the business strategies of Chinese multinational companies. For example, China's Huawei Technologies specialising in designing and manufacturing of telecommunication equipment and routers begins to challenge the US multinational Cisco, the global leader in this market. The fundamental question in this respect is whether emerging Chinese multinationals would be able to compete with traditional multinationals using innovation as a competitive advantage. It is observed that many Chinese companies are overgrowing the stage of OEMs (original equipment manufacturers) of western multinationals and seeking to enter markets offering own innovative products under their own brands.

The phenomenon of innovation and technology in the emerging markets (and China in particular) has attracted a growing interest from the part of scholars, practitioners and policy-makers (e.g. Fu and Soete 2010). Specifically, The Economist devoted a special report on innovation in emerging markets in its issue in April 2010. One of its predictions is that the emerging markets are good not only for incremental innovation and "the emerging world will undoubtedly make a growing contribution to breakthrough innovations". Despite this growing interest, the topic remains under-researched due to its novelty. A growing body of literature has examined innovation and R&D of Chinese firms on their domestic market, in China (Hu et al 2005, Li 2010, Hou and Mohnen 2011). However, the interplay between innovation and internationalisation, i.e. innovation as a competitive advantage of emerging Chinese multinationals is yet to be thoroughly studied despite the presence of several publications on this topic (e.g. Zeng and Williamson 2007, Li 2008).

Specifically, academic research should address innovation strategies of emerging Chinese multinationals and their contribution to the international expansion of these companies. The initial stage of such research is an inventory of the current stage of innovative activity of Chinese multinational companies. This is the main focus of this paper. It aims to critically examine and analyse the evolution and current positions of Chinese multinational companies in the global R&D and innovation rankings.

Methodologically, we rely on a number of both quantitative and qualitative data sources, authoritative international rankings, to achieve our objective. Additionally, we provide data on other BRIC economies as reference points. Positions of individual companies in various rankings are then compared and analysed. Further, we reflect on further research on the interplay of innovation and internationalisation of Chinese companies, and their innovation strategies.

The paper is structured as follows. Section 2 provides a theoretical background of our study. Section 3 provides an in-depth examination of the position of Chinese companies in global R&D and innovation rankings. Section 4 concludes.

2. Theoretical Background

The eclectic paradigm, also known as the OLI model, is a well-known academic contribution of John H. Dunning, used to explain internationalisation of the firm. According to the paradigm, the multinational company should possess “Ownership” advantages (specific tangible and/or intangible assets – trademark, production technique, entrepreneurial skills, returns to scale), “Locational” advantages (advantages of being present in a specific locations outside its home base – existence of raw materials, low wages, special taxes or tariffs) and “Internationalisation” advantages (advantages of having own foreign production rather than producing through a partnership arrangement) (Dunning 1981). Originally developed to explain internationalisation of western firms, the OLI model came under question whether it is applicable to describe the internationalisation of emerging multinationals.

The key question is about “O”, i.e. what kind of ownership advantages the emerging multinationals possess, or even whether they possess them at all. It may be seen that firms from the emerging economies internationalise to compensate in fact for the lack of “O” as they possess ownership *disadvantages*. It is argued that these companies internationalise to augment their assets, to learn and catch up with global multinationals; and that would not be possible if these companies operated only in their home market. Dunning (2006) suggests that the emerging multinational companies may start their internationalisation with advanced economies in order to improve their ownership advantages, such as technology base and innovativeness. In fact, it may be argued that the emerging multinationals still have certain unique advantages. In the case of China, these could include the ability to generate funds to acquire foreign companies and access to the huge home market (Dunning 2006).

An alternative, related, concept is the CSA/FSA (country-specific advantages vs. firm-specific advantages) framework (Rugman 1981). A company’s FSAs and the type of CSAs it faces will determine whether a production activity will be located in a foreign country, thus whether internationalisation will take place. The emerging multinationals might not have FSAs but rely mostly on CSAs to compete globally (Rugman, 2009). For example, these CSAs include a large pool of low-cost, low-skilled labour that can be used to keep manufacturing costs low.

To sum up, scholars acknowledge the lack of competitive advantage of late comers, emerging multinationals, in one form or another. The late comer perspective views internationalisation as “the process of the firm’s becoming integrated in international economic activities” (Mathews 2006). It presents the global economy as pre-existing, and internationalisation is seen as strategic involvement with it.

Internationalisation of Chinese firms, late comers in the global economies has generated considerable scholarly interest, in terms of the need to rethink the current theory (Child and Rodrigues 2005, Li 2007), determinants of Chinese outward FDI (Wu and Chen 2001, Buckley et al 2007, Liu et al 2005), expansion strategies (Taylor 2002, Luo et al 2007, Rui and Yip 2008) and a number of case studies of successful internationalisation (Liu and Li 2002, Liu 2007, Duysters et al 2009). Bonaglia et al (2007) investigate how three emerging multinationals, including China’s Haier, pursued global growth through accelerated internationalisation combined with strategic and organisational innovation. Success of these firms seems to lie in their ability to treat global competition as an opportunity to build capabilities, move into more profitable industry segments, and adopt strategies that turn latecomer status into a source of competitive advantage.

More and more evidence suggest that Chinese companies continue boosting their domestic innovative capabilities (necessarily for successful internationalisation). INSEAD’s The Global Innovation Index 2011 (Dutta 2011) places China on the 29th position, an improvement compared to the previous years – the 47th in 2010, and the 37th in 2009. According to this methodology, China is ahead its direct competitors, other BRIC economies ranked in the 2011 Report – Brazil is

47th, Russia is 56th and India is 62th. China's special administrative region of Hong Kong occupies the top of the rating – the 4th position. The Index relies on several metrics and approaches to better capture the richness of innovation in society. These individual sub-indices show that China scores very well on 'innovation output' side (14), and less so – on 'innovation input' (43). The 'innovation input' is formed by sub-indexes such as institutions (98), human capital & research (56) and infrastructure (33), market sophistication (26) and business sophistication (29). In its turn, 'innovation output' is made of creative output (35), scientific output (9). The last component, in its turn, consists of elements of knowledge creation, knowledge impact, knowledge diffusion. It means that while enabling conditions such as institutions, business environment, etc are still emerging, the actual innovation output is very promising.

Yin and Williamson (2011) identify several most common types of innovation that Chinese firms are pursuing. First is "cost innovation" aimed at reengineering the cost structure to offer customers adequate quality and similar or higher value for less cost. It is driven by cost-oriented innovation mind-set and flexibility competency. Second is "application innovation", meaning finding innovative applications for already existing technologies or products. Third is "business model innovation", and idea of changing one of the four core components of the business model (customer value proposition, profit formula, key resources or knew processes), so that this adjustment can be done quickly and at minimum cost. Fourth is "process innovation", i.e. reconfiguration of the traditional value chain to achieve extreme flexibility and agility. It is driven by "good enough" mentality and aimed at simplification. The last one, fifth, is "genuine innovation", essentially the model that western (multinational) companies have been implementing, yet with a different philosophy and value focus.

As it can be seen, the key variable emphasised in Yin and Williamson's (2011) classification is cost. Competitive cost is an imperative of any innovation, and "cost innovation" is in fact a key innovation model. Other three models (apart from "genuine innovation") may be viewed as dimensions in combination with "cost innovation" (Zeng and Williamson, 2007). Another observation is that "genuine innovation", inherent to most western multinationals, is only one of many innovation models, and even then the focus lays on value.

3. Chinese Companies in Global Innovation and R&D Rankings

In this Section we endeavour to have a closer look at the positioning of Chinese companies in global innovation and R&D rankings. We analyse different sources – two quantitative scorings of investments in industrial R&D, one quantitative assessment of innovation potential and three qualitative rankings, and seek to determine the position and role of Chinese (multinational) companies in them.

3.1. EU Industrial R&D Investment Scoreboard

The EU Industrial R&D Investment Scoreboard is published annually since 2004. It collects information on the top 1000 EU companies and 1000 non-EU companies investing the largest sums in R&D in the last reporting year. The Scoreboard includes data on R&D investment along with other economic and financial data from the last four financial years.

The Scoreboard appeared for the first time in 2004 (with data for the year 2003), and it then included 500 EU and 500 non-EU companies. The following year, the number of companies increased to 700 (both for EU and non-EU companies). Since 2006, it includes the top 1000 EU and 1000 non-EU companies. According to the 2011 edition, the top 1000 non-EU companies jointly invested in R&D some €324 billion. R&D threshold was set at €32.73 million. Unsurprisingly, the lion's share of non-EU top R&D investors are companies headquartered in the USA and Japan, as well as Switzerland, South Korea, Taiwan.

Table 1 and Figure 1 present an evolution of the position of companies from BRIC economies in the Scoreboard, since 2004. While our focus is Chinese companies, we provide data on companies from Brazil, India and Russia to show China's development in the context of other emerging economies. Hong Kong Special Administrative Region of the People's Republic of China is often treated in separation from (mainland) China for a variety of reasons. In our analysis, we explicitly include Hong Kong. The reason is that several companies, originating from (mainland) China are presently registered (headquartered) in Hong Kong. For example, CNOOC appeared in the Scoreboard in 2006 and 2007 as a Chinese company, and since 2008 till present, it is a Hong Kong company. Shanghai Electric is a similar example.

Table 1 BRIC companies in the EU Industrial R&D Investment Scoreboard

Publication		2004	2005	2006	2007	2008	2009	2010	2011
Reporting period		2003	2004	2005	2006	2007	2008	2009	2010
Non-EU companies	N	500	700	1 000	1 000	1 000	1 000	1 000	1 000
	€m	195 637	212 785	257 700	250 455	252 984	300 414	279 323	323 929
China	N	2	3	6	8	10	15	21	19
	€m	375.20	591.18	913.58	1 163.74	1 374.75	2 617.84	5 371.26	7 631.75
Hong Kong	N	1	2	4	3	4	6	8	8
	€m	66.75	101.58	334.40	267.27	323.94	591.02	727.47	1 023.72
Brazil	N	2	2	3	4	5	3	8	9
	€m	296.68	304.34	652.05	1 027.50	1 339.01	1 599.30	1 500.42	1 819.73
India	N	-	1	4	10	15	15	17	18
	€m	-	68.7	252.83	477.03	1 023.78	1 066.39	1 366.81	1 856.20
Russia	N	-	2	1	1	3	2	3	2
	€m	-	116.06	193.02	378.03	500.79	538.45	768.90	679.37

Source: compiled from respective annual editions of the EU Industrial R&D Investment Scoreboard. N stands for number, €m – for millions of euros. 'China' stands for mainland China, without Hong Kong and Macau

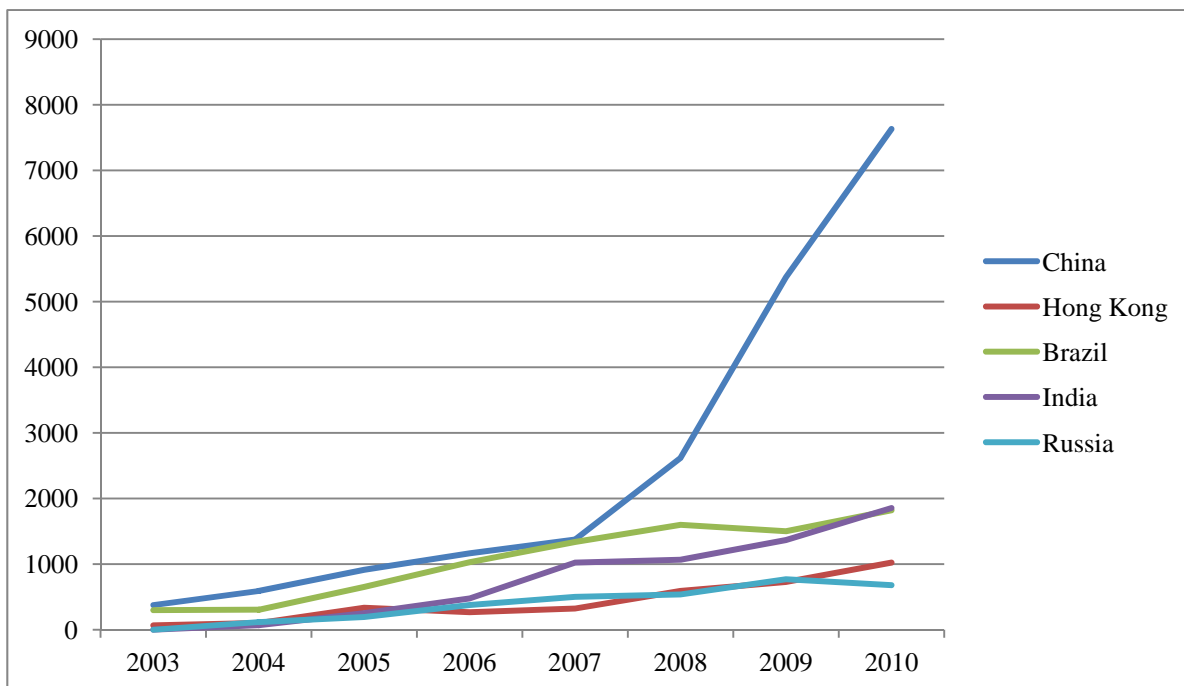


Figure 1 Cumulative investments in R&D by BRIC companies ranked in the EU Industrial R&D Investment Scoreboard (the vertical axis is in €million; the horizontal axis presents the reporting period).

Originally, companies from BRIC economies were very scarce in the ranking. In 2004, China was represented by only two companies, both are state-owned oil and gas producers – PetroChina and China Petroleum & Chemicals. Yue Yuen Industrial, a personal goods producer, was the only Hong Kong company. Jointly, their R&D investments represented a mere 0.23% of the cumulative R&D investments of top 500 non-EU companies. Still, that was a good result in comparison to other BRIC economies. Brazil had two companies (but smaller cumulative R&D investment), and no Russian or Indian companies were present at all.

Since then, the share of BRIC companies started to grow. More companies joined the rating, and hence the amount of the cumulative R&D investment grew too. Presently, among other emerging economies, China has the highest number of companies in the Scoreboard – 19 (and 8 companies from Hong Kong). Together, these 19 companies invested €7.6 billion in R&D, and 8 companies from Hong Kong – €1 billion. China enjoys an undisputed leadership position among BRIC countries. Brazil has 9 companies on the list, and India – 18, but the amount of cumulative R&D investment is relatively the same – around €1.8 billion. Russia lags behind with only 2 companies and R&D investment of €679 million.

Table 2 presents more detailed information on all Chinese and Hong Kong companies appearing in the Scoreboard.

The story of Huawei Technologies Co. Ltd, the Chinese multinational networking and telecommunications equipment and services company, and the largest R&D spender among Chinese companies, is illustrative. Established in 1988, presently Huawei is the largest China-based networking and telecommunications equipment supplier and the second-largest supplier of mobile telecommunications infrastructure equipment in the world. It made its debut in the Scoreboard in 2010 with an annual R&D investment of €1.3 billion (45th rank among 1000 non-EU companies), and next year it recorded an annual investment of €1.8 billion (39th place).

PetroChina Company Limited, a Chinese oil company and is the listed arm of state-owned China National Petroleum Corporation (CNPC), is second R&D investor among Chinese companies. It has been on the list of top R&D investing companies since 2004. It appeared in 2004 on the 147th rank, and in 2011 it recorded R&D investment of €1.3 billion, on the 51st place in the global list of top 1000 R&D investors.

It can be observed that some companies (PetroChina, ZTE, China Petroleum & Chemicals, China Telecom, Lenovo, VTech, CNOOC) have been on the list for quite a long period of time, consistently improving their positions. Other companies (CSR China Guangzhou Automobile) are only newcomers to this league, and it is yet to be seen whether their investments in industrial R&D will remain on a consistently substantial levels. At the same time, certain companies (AviChina Industry & Technology, TCL Communication Technologies, Yue Yuen Industrial) did appear on the list in specific years, and they following R&D investments were not high enough to get to the list in the following years. These R&D investments can be seen as a reflection of the dynamic growth process of Chinese companies.

In terms of R&D intensity, which is a more relevant indicator enabling to make cross-sectoral comparisons, in most cases, Chinese companies have had a relatively stable level. Further, the R&D intensity is consistent with the average levels for respective industries (e.g. up to 1% for oil and gas industry, 2-3% for automobiles and machinery).

Table 2 Investment in R&D by Chinese companies in the EU Industrial R&D Scoreboard, investments in millions of euros and R&D intensity in percentages

Company	ICB Sector	2004	2005	2006	2007	2008	2009	2010	2011
Reporting period		2003	2004	2005	2006	2007	2008	2009	2010
CHINA									
Huawei Technologies	Telecommunication s equipment (9578)							1334.0	1805.8
								8.8	8.6
PetroChina	Oil & gas producers (53)	230.47	260.99	335.63	413.90	497.70	818.26	1009.4	1339.4
		0.8	0.8	0.6	0.6	0.6	0.7	1.0	0.8
China Railway Construction	Construction & materials (235)						185.15	527.02	1062.5
							0.8	1.5	2.1
ZTE	Telecommunication s equipment (9578)		195.25	205.85	275.23	300.63	450.52	624.56	896.90
			10.4	9.1	12.3	9.2	9.6	10.2	11.3
China Petroleum & Chemicals	Oil & gas producers (53)	144.73	134.94	235.63	281.96	320.16	361.36	389.58	546.95
		0.5	0.3	0.3	0.3	0.3	0.2	0.3	0.3
CSR China	Commercial vehicles & trucks (2753)								276.44
									3.8
China Railway	Construction & materials (235)						33.32	66.36	236.20
							0.1	0.2	0.5
Metallurgical Corporation of China	General industrials (272)							148.03	202.94
								0.9	0.9
BYD	Electronic equipment (2737)						106.31	115.41	198.48
							3.8	2.9	3.8
China Communications Construction	Construction & materials (235)						114.62	177.33	178.17
							0.6	0.8	0.6
China Coal Energy	Mining (177)						115.99	129.65	169.68
							2.2	2.4	2.1
SAIC Motor	Automobiles & parts (335)							145.78	161.54
								1.0	1.0
Guangzhou Automobile	Automobiles & parts (335)								116.85
									1.7
Dongfang Electric	Industrial machinery (2757)						51.95	65.03	110.56
							1.8	1.9	2.6
Weichai Power	Automobiles & parts (335)					30.27	40.02	45.96	100.41
						1.2	1.2	1.3	1.4
Harbin Power Equipment	Industrial machinery (2757)						49.79	47.33	73.56
							1.6	1.6	2.3
China Telecom	Fixed line telecommunications (653)			27.42	28.37	49.07	51.67	55.64	61.09
				0.2	0.2	0.3	0.3	0.3	0.2
China National Materials	Construction & materials (235)							46.47	57.06
								1.5	1.1
TravelSky Technology	Telecommunication s equipment (9578)					24.72		29.83	37.34
						13.2		11.2	10.8
China South Locomotive	Commercial vehicles & trucks (2753)						105.99	173.18	
							2.9	3.7	
Semiconductor Manufacturing	Semiconductors (9576)			66.86	71.41	66.37	73.56	112.04	
				6.7	6.4	6.3	7.6	15.0	
Tencent	Internet (9535)				28.89	35.22	59.33	99.64	
					10.6	9.8	7.9	7.8	
First Tractor	Commercial vehicles & trucks (2753)							29.05	
								3.2	
AviChina Industry & Technology	Automobiles & parts (335)				27.34	26.35			
					1.6	1.6			

Shanghai Electric ¹	Industrial machinery (2757)					24.26			
						0.6			
CNOOC ²	Oil & gas producers (53)	42.19	36.64						
		0.6	0.4						
HONG KONG									
CNOOC	Oil & gas producers (53)					45.16	53.47	55.05	93.15
						0.5	0.4	0.5	0.4
Dongfeng Motor	Automobiles & parts (335)					152.90	213.06	296.38	
						2.1	2.3	2.1	
Geely Automobile	Automobiles & parts (335)						42.48	58.41	
							3.0	2.6	
Great Wall Motor	Automobiles & parts (335)						34.22	50.61	
							2.7	2.0	
Lenovo	Computer hardware (9572)	35.88	162.91	172.41	178.76	158.28	149.39	226.17	
		1.7	1.4	1.6	1.6	1.5	1.3	1.4	
Shanghai Electric	Industrial machinery (2757)					102.23	110.70	169.77	
						1.6	1.9	2.4	
TCL Communication Technology	Telecommunication s equipment (9578)		37.92						
			6.1						
Marel Food Systems	Industrial machinery (2757)					37.04			
						6.9			
Techtronic Industries	Electrical components & equipment (2733)	53.82	60.57	64.96	83.20	82.99	86.90		
		2.2	2.8	3.0	3.4	3.8	3.4		
VTech	Telecommunication s equipment (9578)		34.28	35.09	40.94	39.59	42.34		
			3.1	3.3	3.9	3.7	3.3		
Yue Yuen Industrial	Personal goods (376)	66.75	65.7	79.75					
		3.4	3.3	3.0					

Source: compiled from respective annual editions of the EU Industrial R&D Investment Scoreboard

The first line indicates an absolute amount in millions of euros, and the second one – R&D intensity (ratio of absolute investment to sales, in percentages) ¹ In Hong Kong rating since 2009; ² In Hong Kong rating since 2008

3.2. UK R&D Scoreboard

Another world-class publication of R&D investments of global companies is the R&D Scoreboard, the top 1000 UK and 1000 global companies by R&D investment, published annually by the UK's Department for Business Innovation & Skills. In light of the purpose of the study, the key difference with the EU Scoreboard is that in the former, Chinese companies are positioned in the list of top 1000 non-EU companies. In contrast, in the UK R&D Scoreboard provides a list of the top 1000 global companies (from all across the world). The ranking of Chinese companies can be seen on a global scale (and not only on a non-EU scale, as the EU Scoreboard treats them).

Similar to the previous section, Table 3 presents an evolutionary overview of the companies from the BRIC economies in the Scoreboard. For the first time, Chinese companies appeared in this authoritative listing in 2002. China was represented by only one company China Petroleum & Chemical, with an annual R&D investment of £108m. Similarly, Hong Kong appeared in the list in 2003, represented by Yue Yuen Industrial £38m. We include Hong Kong in our analysis as certain Chinese companies with high potential are registered (headquartered) in Hong Kong.

By now, several years later, China has strongly established itself in the rating, with 16 companies in 2010 that jointly invested £4.6bn in R&D. Hong Kong followed suit, with 5 companies in 2010 that jointly invested £543m. This development may seem impressive, but on a global scale, investments of these 16+5 companies in R&D represent only 1.5% of the cumulative R&D investments of the 1000 global R&D-intensive companies. However, if compared with other BRIC economies, this development is indeed impressive – in 2010, India has 12 companies, Brazil – 6, and Russia – only 3.

Table 3 BRIC companies in the UK R&D Scoreboard

		2002	2003	2004	2005	2006	2007	2008	2009	2010
Period		2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010
Global companies	N £m	600 206466	700 206719	700 204579	1 000 219723	1 250 249355	1 250 243943	1 400 273851	1 000 395806	1 000 344017
China	N £m	1 108	1 114	2 264	3 419	5 609	7 766	9 992	12 2 412	16 4 596
Hong Kong	N £m	- -	1 38	1 47	3 95	4 230	3 180	4 238	5 532	5 543
Brazil	N £m	1 91	1 91	2 209	3 239	3 448	3 675	5 983	3 1 546	6 1 264
India	N £m	- -	1 238	- -	1 49	3 155	7 268	15 752	7 722	12 1 066
Russia	N £m	1 97	- -	- -	2 82	1 133	1 255	3 368	2 521	3 683

Source: compiled from respective annual editions of the R&D Scoreboard published by the UK's Department for Business Innovation & Skills

N stands for number, £m – for millions of British Pounds. 'China' stands for mainland China, without Hong Kong and Macau

Further, we look at R&D investments per company for a 5-year period, from 2006 to 2010 (Table 4). The table presents both absolute values of R&D investments (£m) and R&D intensity (as percentage of R&D to sales). The companies on the list represent a variety of industrial sectors, from mining and oil & gas producers, to electronic & electrical equipment, automobiles & parts, industrial engineering, technology hardware & equipment, and software & computer services.

Out of the 2010 list of 16 companies, 6 companies have consistently been present for the past four years. Two oil and gas producers – CNOOC and PetroChina (initially as a Chinese company, and later as that of Hong Kong), two technology hardware & equipment producers – Semiconductor Manufacturing and ZTE, one Software & computer services provider – Tencent, and one fixed line telecommunications provider – China Telecom. Their investments in R&D have been on a steady rise.

Likewise, in Hong Kong, out of 5 companies of the 2010 list, 2 have been consistently present for 4 years – Lenovo, a technology hardware & equipment manufacturer, and Techtronic Industries, electronic & electrical equipment producer.

Table 4 Investment in R&D by Chinese companies in the UK R&D Scoreboard, investments in millions of British pounds and R&D intensity in percentages (sorted by the amount of investment in the latest available year)

Company	Sector	2006	2007	2008	2009	2010
CHINA						
Huawei Technologies	Technology hardware & equipment					1185.26 8.8
PetroChina	Oil & gas producers	230.61 0.6	278.87 0.6	365.55 0.6	791.05 0.7	896.81 1.0
ZTE	Technology hardware & equipment	141.44 9.1	185.44 12.3	220.81 9.2	435.54 9.6	554.92 10.2
China Railway Construction	Construction & materials				178.99 0.8	468.25 1.5
China Petroleum & Chemical	Oil & gas producers	161.90	189.97	235.15	349.35	346.14

Chemicals		0.3	0.3	0.3	0.2	0.3
China Communications Construction	Construction & materials				110.81	157.56
					0.6	0.8
China South Locomotive	Industrial engineering				102.46	153.87
					2.9	3.7
Metallurgical Corporation of China	General industrials					131.52
						0.9
SAIC Motor	Automobiles & parts					129.53
						1.0
China Coal Energy	Mining				112.13	115.20
					2.2	2.4
BYD	Electronic & electrical equipment				102.77	102.54
					3.8	2.9
Semiconductor Manufacturing	Technology hardware & equipment	45.94	48.12	48.75	71.11	99.54
		6.7	6.4	6.3	7.6	15.0
Tencent	Software & computer services		19.46	25.87	57.36	88.53
			10.6	9.8	7.9	7.8
China Telecom	Fixed line telecommunications		19.12	36.04	49.95	59.44
			0.2	0.3	0.3	0.3
China Railway	Construction & materials					58.96
						0.2
Dongfang Electric	Industrial engineering				50.22	57.78
					1.8	1.9
Weichai Power	Automobiles & parts			22.23		
				1.2		
AviChina Industry & Technology	Automobiles & parts			19.35		
				1.6		
TravelSky Technology	Technology hardware & equipment			18.16		
				13.2		
CNOOC ¹	Oil & gas producers	28.99	24.69			
		0.6	0.4			
HONG KONG						
Dongfeng Motor	Automobiles & parts				147.81	189.30
					2.1	2.3
Lenovo	Technology hardware & equipment		116.17	131.29	153.02	132.73
			1.6	1.6	1.5	1.3
Shanghai Electric	Industrial engineering				98.83	98.36
					1.6	1.9
Techtronic Industries	Electronic & electrical equipment	36.98	40.81	47.69	80.43	73.73
		2.2	2.8	3.0	3.4	3.8
CNOOC ¹	Oil & gas producers			33.17	51.69	48.91
				0.5	0.4	0.5
VTech	Technology hardware & equipment		23.09	25.77		
			3.1	3.3		
Yue Yuen Industrial	Personal Care	54.79				
		3.0				
TCL Communication Technology	Technology hardware & equipment	26.05				
		6.1				

Source: compiled from respective annual editions of the R&D Scoreboard published by the UK's Department for Business Innovation & Skills

¹ Before 2008, CNOOC was registered in China, since then – in Hong Kong

Absolute number of R&D investments can hardly be compared among companies and among countries (e.g. differences in the cost of R&D in different countries). R&D intensity, calculated as a percentage of R&D investments to sales, is a more appropriate indicator in this respect. However, a

generalised R&D intensity for all national companies may be misleading too due to its sectoral specificities. As some of industries (e.g. biotechnology) are naturally more R&D intensive than the others (e.g. mining). And the average value of 3.6% of R&D intensity for 1000 most R&D spenders in the world becomes meaningless. Table 5 presents a comparison in terms of sectoral R&D intensity between all companies presented in R&D scoreboard and Chinese and Hong Kong companies belonging to the same sector. It can be concluded that while R&D intensity of Chinese and Hong Kong companies are on a similar scale as the global values, still they somewhat smaller.

Table 5 Sectoral R&D intensity, 2010

Sector	Global, all companies	China	Hong Kong
Automobiles & parts	4.7	1.0	2.3
Construction & materials	1.1	0.8	-
Electronic & electrical equipment	4.4	2.9	3.8
Fixed line telecommunications	1.8	0.3	-
General industrials	2.7	0.9	-
Industrial engineering	3.3	2.8	1.9
Mining	1.2	2.4	-
Oil & gas producers	0.4	0.7	0.5
Software & computer services	10.3	7.8	-
Technology hardware & equipment	8.7	11.3	1.3

Source: compiled from respective annual editions of the R&D Scoreboard published by the UK's Department for Business Innovation & Skills

3.3. Top 100 Most Innovative Companies by Forbes

Forbes, an American business magazine, publishes annually the list of top 100 most innovative companies. It is a ranking based on objective financial indicators such as sales and income growth. Members of the list must have \$10 billion in market capitalisation and spend at least 1% of their asset base on R&D and have seven years of public data. The core of this ranking is the so-called Innovation Premium, a measure of how much investors have bid up the stock price of a company above the value of its existing business based on expectations of future innovative results (new products, services and markets).

Table 6 BRIC companies in Forbes' Top 100 Most Innovative Companies

Rank	Company	Innovation Premium	Country	Industry
4	Tencent Holdings	52.3	China	Computer Services
40	China Oilfield Services	30.0	China	Oil Services & Equipment
72	Sany Heavy Industry	21.2	China	Heavy Equipment
75	Zoomlion Heavy Industry	20.9	China	Heavy Equipment
8	Natura Cosméticos	44.5	Brazil	Household/Personal Care
9	Bharat Heavy Electricals	43.6	India	Electrical Equipment
15	Infosys	37.1	India	Computer Services

Source: Forbes Top 100 Most Innovative Companies (using data of HOLT, a division of Credit Suisse, in collaboration with Innovator's DNA LLC; Bloomberg; Thomson Reuters Fundamentals and Worldscope via FactSet Research Systems)

The Innovation Premium index ranges from 75 for the top first company up to 16 for the 100th company. The list is dominated by traditional leaders from the Triadic economy. However, it does feature companies headquartered in China, India and Brazil (Table 6). China's Tencet Holdings, an investment holding company whose subsidiaries provide Internet and mobile phone value-added services and operate online advertising services in China, occupies the 4th position in the ranking.

China Oilfield Services, a subsidiary of China National Offshore Oil Corporation (CNOOC) is in the middle of the ranking. And two companies operating the heavy equipment sector – Sany Heavy Industry and Zoomlion Heavy Industry – are positioned at the bottom of the ranking.

3.4. The 50 Most Innovative Companies 2010 by Bloomberg Business Week

Sections 3.1 and 3.2 outlined the position of Chinese companies in the global rankings of top R&D investors, judged by the actual amounts invested in formal (in-house) R&D processes. Section 3.3 presented position of Chinese firms in a global ranking judged by a formal index of innovation premium.

Another way to look at the innovativeness of Chinese companies is to focus not the amount of R&D investments, but at innovation in a more global qualitative sense. This approach has its pro's and con's. While it may be lacking scientific rigour, it may well offset the very same rigidity of empirical data. R&D investments represent a good formal measure, but it represent only 'an input' in the innovation process in a company; a company might have high R&D investments but may not necessarily be innovative. On the other hand, perceptions of senior executives seem to reflect the innovativeness of a company as such, its corporate culture, organisational innovation, pro-activeness, attitude to innovation. In other words, while quantitative rankings are good measures of 'input' into innovation, qualitative rankings may serve as a proxy for the 'process' and/or 'output'.

Annual list of 50 most innovation companies by Bloomberg BusinessWeek is built based on the perceptions of senior executives surveyed by the Boston Consulting Group (BCG) (Andrew et al, 2010). The list 50 is made of 22 US companies, with Apple, Google and Microsoft in the top three respectively. Traditional leaders, Japan and the UK have five and four companies respectively in the list. South Korea and Germany are represented by three companies each. Other countries – Canada, Finland, Switzerland, Spain, Italy, Taiwan – have one company each.

China is represented by four companies, on par with the UK. More impressive is that three of these companies are newcomers to the 2010 ranking, as they were not ranked among top 50 companies in the 2009 survey. And Lenovo, that occupied the 46th place in 2009, moved to the 30th place. India has two companies in the list, and Brazil – one. Russian companies do not appear in the ranking (Table 7).

Table 7 Chinese companies in Bloomberg's The 50 Most Innovative Companies 2010

2010 Rank	2009 Rank	Company	Country	Industrial Sector
8	NR	BYD	China	Electronic & electrical equipment
28	NR	Haier Electronics	China	Consumer electronics
30	46	Lenovo	China	Technology hardware & equipment
44	NR	China Mobile	China	Telecommunications provider
17	13	Tata Group	India	Diversified
33	15	Reliance Industries	India	Oil & gas producers
41	NR	PetroBras	Brazil	Oil & gas producers

NR: Not ranked in 2009 survey.

n/a – Scoreboard provides ranks of specific divisions of Tata Group, no cumulative rank.

Source: Bloomberg BusinessWeek (2011). The 50 Most Innovative Companies 2010.

http://www.businessweek.com/interactive_reports/innovative_companies_2010.html

If compared with position of the same companies in the EU and UK R&D Scoreboards (Sections 3.1 and 3.2), specific differences become visible. Due to differences of sample definition (non-EU vs. global companies) specific ranks differ. What is notable is that top innovative companies Haier Electronics and China Mobile are not represented in R&D Scoreboards at all, meaning that their formal R&D investments are below the cut-off point. BYD, which stands in the top 10 of BusinessWeek, ranks only the 519th in the UK R&D Scoreboard of global R&D investors, and the 272nd in the EU R&D Scoreboard of non-EU R&D-intensive companies.

3.5. The 50 Most Innovative Companies in 2012 by Technology Review (published by MIT)

Another qualitative assessment of innovativeness of companies is published by Technology Review, an outlet by the Massachusetts Institute of Technology (MIT). This list includes 50 companies in an alphabetical order without any ranking.

A TR50 company (a company in the list of the 50 most innovative companies) is defined as a business whose innovations force other businesses to alter their strategic course. TR50 members are nominated by Technology Review's editors, who look for companies that over the last year have demonstrated original and valuable technology, are bringing that technology to market at a significant scale, and are clearly influencing their competitors. The list is heavily influenced by US technological companies, mainly from California. It also includes 2 Chinese companies and 1 Indian company (Table 8).

Table 8 Chinese companies in Forbes' Top 100 Most Innovative Companies

Company	Reasoning	Key innovation
Goldwind Science and Technology	It is optimizing wind farms for conditions in China.	Wind turbines are specially adapted for the high altitudes and low wind speeds that characterize Chinese wind resources.
Suntech Power	It has developed a low-cost way of making better silicon solar cells.	Its new panels are more efficient because they reflect less light and use thinner electrodes that block less light.
Healthpoint Services (India)	It is using telemedicine techniques to deliver health care to rural India.	Its network of eight centres brings advanced telemedicine systems to patients.

Source: compiled by author, from <http://www.technologyreview.com/tr50/2012/>

As it can be seen, both Chinese companies are awarded the 'innovative' status for their achievements in the field of renewable resources. Established in 1998, Goldwind Science and Technology Company is a Chinese state-owned wind turbine manufacturer based in Urumqi, Xinjiang. The company is one of the largest turbine manufacturers in China, with international operations and offices abroad. Founded in 2001, Suntech Power is the world's largest producer of solar panels. It is headquartered in Wuxi, China; and is present on many global markets as it delivers its products to customers in many countries worldwide.

3.6. The 50 Most Innovative Companies 2011 by Fast Company

Another qualitative ranking is annually composed by Fast Company (fastcompany.com), a leading business media brand, with an editorial focus on innovation in technology, ethical economics, leadership, and design. Based on the expert judgment, it annually compiles a list of the 50 most innovative companies. In most cases, this award is granted for a specific innovative achievement (or innovation in process), not for a general innovative performance. Unsurprisingly, the ranking is

dominated by US and UK technological start-ups and established multinationals. Three companies – Dawning Information Industry, Huawei and Changchun Dacheng Industrial Group – are Chinese. It is interesting to note that Huawei (18) is right above the US chip producer Intel (19). There are also 2 Russian IT companies, 1 Indian and 1 Brazilian. In the year before, China was also represented by three companies – BYD (16), Alibaba (29) and Huayi Brothers (42).

Table 9 BRIC companies in FastCompany’s The 50 Most Innovative Companies 2011

	Company	HQ	Award
7	Dawning Information Industry	Beijing, China	For building the world’s fastest supercomputer
18	Huawei	Shenzhen, China	For building the future of telecoms
46	Changchun Dacheng Industrial Group	Changchun, China	For turning corn husks into chemical building blocks
26	Yandex	Russia	For its prowess in search
32	Kaspersky Lab	Russia	For turning hackers into an army of virus fighters
39	Shaadi.com	India	For proving that marriage, Indian-style, works online as well as off
47	AZUL	Brazil	For converting bus riders into frequent fliers

Source: compiled by author, from <http://www.fastcompany.com/most-innovative-companies/2011/>

Dawning Information Industry is a state-owned supercomputer manufacturer in China, located at China’s National Supercomputing Centre. FastCompany reports that in October 2011, a supercomputer performed 2.57 petaflops, i.e. 2.57 quadrillion calculations per second, making it the fastest computer in the world. Originally Dawning computers were built with a support from American technology. However, Dawning is using that technology as a springboard. It is working on its own processors, the Loongson family, in the hopes of constructing an all-Chinese-made supercomputer in the near future.

Huawei is a Chinese multinational networking and telecommunications equipment and services company headquartered in Shenzhen, Guangdong, China. It is the largest China-based networking and telecommunications equipment supplier and the second-largest supplier of mobile telecommunications infrastructure equipment in the world. According to FastCompany, Huawei leads the market in LTE (long-term evolution), the newest mobile-network standard, and it’s working on what it calls “100G” technology to wirelessly transmit massive amounts of data at ultra-high speeds. Huawei is present at other emerging markets, and more than 75% of revenue comes from India, China and Latin America.

Changchun Dacheng Industrial Group is involved in the manufacture, research and development of corn-based biochemical products in China. As FastCompany notes, Changchun Dacheng Industrial Group is working to turn agro-waste into lip gloss and liquid detergent. The company already makes a range of products from cornstarch, including glycols, key ingredients in cosmetics and cleansers that are usually made with petroleum. It has now pioneered a method to turn cornfield debris into glycols.

3.7. Comparing BCG ranking, and innovation and R&D rankings

R&D and innovation rankings presented in Sections 3.1-3.6 consider purely R&D/innovative performance. The fact whether a company is rapidly internationalising (physically present in at least one country outside the home base) is not so much of relevance of innovation ranking. An

authoritative annual publication by the Boston Consulting Group (BCG) presents a list of top 100 emerging multinationals, or “Global Challengers” by BCG terminology (Verma et al 2011). The ranking includes 100 companies from 14 emerging economies, specifically, 36 Chinese, 20 Indian, 13 Brazilian and 6 Russian companies. We identify 38 companies that feature in at least one innovation ranking (UK R&D Scoreboard, EU R&D Scoreboard, Bloomberg 50). Further, we cross check whether a company is present in the BCG list and at least in one of these innovation lists. This would certify that a company is international / internationalising and it is innovative / R&D-intensive. It should be noted that if a company is not present in the BCG list, it does not entail that the company does not have any international activities / presence. The BCG list merely says that the company is promising in its internationalisation path.

This analysis shows that only 4 companies – BYD Group, China National Offshore Oil Corporation (CNOOC)¹, Huawei Technologies and Lenovo – are present in three different innovation rankings and in the BCG internationalisation ranking. They can be characterised as true innovative (R&D-intensive) multinationals. Several 8 companies appear in the BCG list and at least in one of the innovation rankings – China Communications Construction Company (CCCC), China Mobile, Geely International, Haier, Shanghai Electric Group, Suntech Power, Zoomlion and ZTE, meaning that these multinational companies possess promising innovation potential. 21 companies are present in the BCG internationalisation list, they are ‘global challengers’ – emerging multinationals but not in any global innovation rankings; and vice versa, 26 companies are listed in at least one of the global innovation rankings but not defined as ‘global challengers’.

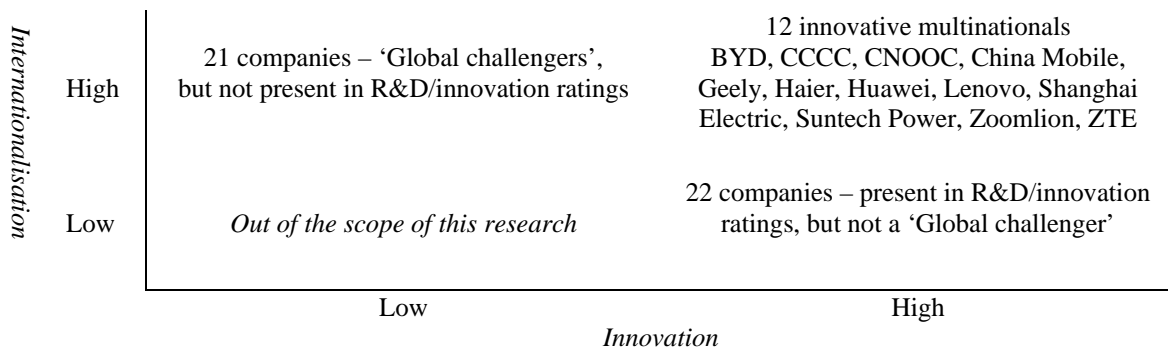


Figure 2 Chinese companies: Innovation vs. Internationalisation

¹ In Forbes Top 100 it is represented by its subsidiary China Oilfield Services

Table 10 Chinese companies in several rankings

	BCG 100	UK R&D	EU R&D	Bloom berg50	Forbes 100	MIT 100	FC 50
Aluminium Corporation of China (Chalco)	+						
Anshan Iron and Steel Group	+						
Baosteel Group	+						
BYD Group	+	+	+	+			
Changchun Dacheng							+
Chery Automobile	+						
China Coal Energy		+	+				
China Communications Construction Company (CCCC)	+	+	+				
China International Marine Containers Group (CIMC)	+						
China Minmetals	+						
China Mobile	+			+			
China National Chemical Corporation (ChemChina)	+						
China National Materials			+				
China National Offshore Oil Corporation (CNOOC)	+	+	+		+		
China Petroleum & Chemical Corporation (Sinopec)		+	+				
China Railway		+	+				
China Railway Construction		+	+				
China South Locomotive		+					
China Shipbuilding Industry Corporation (CSIC)	+						
China Shipping Group	+						
China State Construction Engineering Corporation	+						
China Telecom		+	+				
Chint Group	+						
Cosco Group	+						
CSR China			+				
Dawning Information Industry							+
Dongfang Electric		+	+				
Dongfeng Motor		+	+				
Galanz Group	+						
Geely International	+		+				
Goldwind Science and Technology						+	
Great Wall Motor			+				
Guangzhou Automobile			+				
Haier	+			+			
Harbin Power Equipment			+				
Huawei Technologies	+	+	+				+
Johnson Electric	+						
LDK Solar	+						
Lenovo Group	+	+	+	+			
Li & Fung Group	+						
Metallurgical Corporation of China		+	+				
PetroChina		+	+				
Sany Heavy Industry					+		
Shanghai Automotive Industry Corporation (SAIC)		+	+				
Shanghai Electric Group	+	+	+				
Semiconductor Manufacturing		+					
Sinochem	+						
Sinohydro	+						
Sinomach	+						
Sinosteel	+						
Suntech Power	+					+	
Techtronic Industries (TTI)		+	+				
Tencent		+			+		
Travel Sky Technology			+				
VTech			+				
Wanxiang Group	+						
Weichai Power			+				
Yanzhou Coal Mining Company	+						
Zoomlion	+				+		
ZTE	+	+	+				

4. Conclusions

Many Chinese companies seek to boost their innovative capabilities, internationalise and enter competitive western markets. Many of these firms have passed the stage of low-cost manufacturers or OEMs. As these companies had gained experience in China's domestic market, accumulated managerial skills and enhanced financial position, they built beneficial conditions to move into international market. Chinese market itself can be considered as an international market, due to a growing number of affluent consumers (a rising class of multi-millionaires whose tastes and demands are very high) and the largest consumer market (and corresponding market varieties). Therefore, sustained growth and development on the Chinese domestic market leads to accumulation of capabilities necessary for entering the global market.

Regarding the OLI model and CSA/FSA framework, Chinese firms benefit from CSA (large market, pool of low-cost labour, etc). These advantages help Chinese firms locally acquire basic skills and technology locally by co-working with western multinationals. By doing so, many Chinese firms boost their CSA. Combined, CSA and FSA translate into an ownership advantage of OLI model.

The question is whether innovation starts playing a more distinctive role in this internationalisation and become a competitive advantage of emerging Chinese multinationals. We do find that Chinese companies are progressing in international rankings of global innovative companies. Their investments in R&D in absolute amounts are rising and R&D intensity is catching up with global standards. It seems that Chinese multinationals are willing to invest in R&D as part of a strategy to improve their competitive advantage. Moreover, we find that Chinese companies appear in global innovation rankings for specific scientific achievements and innovative products.

Acquisition of foreign technology-intensive companies is a common mechanism of international expansion for Chinese emerging multinationals. However, many Chinese companies lack M&A capabilities and therefore post-acquisition performance often suffers. Chinese companies should strengthen their absorptive capacities to benefit from the foreign expertise.

A growing number of Chinese firms internationalise under their own brands and locate production facilities overseas. As latecomers entering sophisticated western markets, emerging Chinese multinationals are facing major challenges, such as weak brands, lack of proprietary technologies, a limited pool of managers with international experiences, and inexperience to tailor local consumer tastes and adjust to market environments in specific economies around the world. These factors should be taken into consideration in the global expansion strategy.

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