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THE CHALLENGE OF GLOBALIZATION FOR LARGE CHINESE FIRMS

Peter Nolan and Jin Zhang

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THE CHALLENGE OF GLOBALIZATION FOR LARGE CHINESE FIRMS[1]

Peter Nolan and Jin Zhang

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Abstract

As China joins the World Trade Organization, the author questions whether China's large firms will be able to compete on the global level playing field. Over the past two decades, Chinese large enterprises have undertaken extensive evolutionary change but, at the same time, the world's leading firms have undergone a revolutionary transformation. Based on analysis of firms with the aerospace, oil and petrochemical industry, the authors conclude that China's leading firms face critical challenges, even in sectors in which China's policy makers have scored significant successes.

I. CHINA AND THE GLOBAL BUSINESS REVOLUTION

China's entry to the World Trade Organization (WTO) is a historic milestone in the process of China's integration with the world economy and business system. Among the many important possible effects is the impact on its large firms. In the course of two decades of struggle, China's large enterprises have undertaken large-scale *evolutionary* change. During the same period, the world's leading firms have undergone a *revolutionary* transformation. This poses a deep challenge for China's large firms at the point of entry to the WTO. During the global business revolution, in order to survive and prosper, the nature of the large firm based in high-income countries altered greatly. The inter-twining of China's internal business system change with the revolution in large global firms has been a protracted and complicated process.[2] It is far from over.

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[1] This paper was originally prepared for the Third United Kingdom-China Forum in October 2001. Professor Peter Nolan facilitated the discussions for the Industry Committee, Finance and Economy Committee of the Forum. Leaders of major firms from the United Kingdom and China participated in the discussion. Participants include BP, BAe System, Rolls-Royce, BOC, British Airways, Barclays, HSBC, Standard Chartered Bank, Prudential, Royal & Sun Alliance Insurance, Standard Life Assurance, Citigroup Europe, CGNU plc., Pricewaterhouse Coopers, Dresdner Kleinwort Wasserstein, Bank of England, China Petroleum & Chemical Corporation (Sinopec), China Ocean Shipping Corporation (COSCO), China Aviation Industry Corporation Group 1 (AVIC 1), China Aviation Industry Corporation Group 2 (AVIC 2), China International Trust and Investment Corporation (CITIC), China State Development Bank, and Ministry of Finance.

[2] Peter Nolan is Director of the China Big Business Programme, based in the Judge Institute of Management Studies in the University of Cambridge. Since 1994, he and Dr. Wang Xiaoqiang have been engaged in research on the transformation of the 'commanding heights' of China's industry, using in-depth case studies to attempt to analyze China's policy of building a powerful 'national team' of big businesses that can challenge the global giant corporations. They have combined their research in China with case study-based research inside the United Kingdom and US-based global corporations. This has attempted to provide a careful benchmarking of the progress and problems encountered in the course of China's industrial policy since the early 1980s. Their research has resulted in numerous books and articles written individually (Wang, 1999, Nolan, 1996, 1999, 2000, 2001a, 2001b, 2002a, 2002b), jointly by them (Nolan and Wang, 1997, 1998a, 1998b, 1999a, and 1999b), and jointly with other members of the research team (Nolan and Yeung, 2001a, 2001b). This paper is a part of that continuing research effort, and the general conclusions reached here draw heavily on these publications.

A. China's reforms

1. Lessons from other countries

A succession of 'late comer countries' developed powerful indigenous firms through different measures of industrial policy, including Britain during the Industrial Revolution, the United States and Continental Europe in the nineteenth century, the Republic of Korea, Taiwan Province of China and Singapore in the second half of the twentieth century. From the 1950s to the 1970s, Japan's industrial planners supported the growth of a series of oligopolistic companies that developed into globally powerful firms. After two decades of industrial policy in Japan, the country possessed a whole corps of globally competitive companies. Today, it still has over one hundred *Fortune 500* companies and 83 of the world's top 300 companies by R&D expenditure (DTI, 2000). In the light of these experiences, it seemed reasonable for China to follow similar policies to support the growth of its own indigenous large firms. The history of other fast-growing, late-industrializing countries suggested that it was realistic to hope that Chinese large enterprises would be able to 'catch-up' rapidly with the world's leading firms.

2. China's ambitions

China began liberalizing the post-Mao economy in the late 1970s. A consistently stated goal of China's industrial policy has been to construct globally powerful companies that can compete on the global level playing field:

> In our world today economic competition between nations is in fact between each nation's large enterprises and enterprise groups. A nation's economic might is concentrated and manifested in the economic power and international competitiveness of its large enterprises and groups… *Our nation's position in the international economic order will be to a large extent determined by the position of our nation's large enterprises and groups.* (Wu Banguo, Chinese State Council, August 1998.)

China's 'national team' of large industrial firms included: Aviation Industries of China (AVIC) in the aerospace industry; Sinopec and CNPC in oil and petrochemicals; Sanjiu, Dongbei, and Shandong Xinhua in pharmaceuticals; Harbin, Shanghai, and Dongfang in power equipment; Yiqi, Erqi, and Shanghai in automobiles; Shougang, Angang, and Baogang in steel; and Datong, Yanzhou and Shenhua in coal mining.

China's chosen global giant corporations were supported through industrial policies, which included: tariffs, which still were significant in many sectors at the end of the 1990s; non-tariff barriers, including limitations on access to domestic marketing channels, requirements for technology transfer and to sub-contract to selected domestic firms as the price for market access; government

procurement policy; government selection of the partners for major international joint ventures; preferential loans from state banks; and privileged access to listings on international stock markets.

As the reform process progressed, the Chinese government made it increasingly clear that the country intended also to be able to establish a group of globally competitive large firms in financial services and telecommunications. China Mobile and China Unicom, with massive international flotations, were at the forefront of this process. The Bank of China is scheduled to be the first major international flotation from the Chinese financial services sector. As China prepares to enter the WTO, the country's commitment to building globally competitive large firms remains undiminished:

> The state will encourage big state-owned businesses to become internationally competitive corporations by listing on domestic and overseas stock market, increasing research and development expenditure, and acquiring other businesses. *The country will develop thirty to fifty large state-owned enterprises in the next five years through public offerings, mergers and acquisitions, restructuring and co-operation.* (Bai Rongchun, Director General, Industrial Planning Department, State Economic and Trade Commission, July 2001.)

3. China's progress

China's industrial policies to support large firms were successful in the following senses. Large state-owned enterprises avoided the collapse that took place in the former USSR. Industrial output grew at around 13 per cent per annum from the early 1980s to the late 1990s, with sustained rapid growth for large firms. Major changes took place in the operational mechanism of large, state-owned enterprises. They absorbed a great deal of modern technology; learned how to compete in the marketplace; substantially upgraded the technical level of their employees; learned wide-ranging new managerial skills; and gained substantial understanding of international financial markets. China's large firms became sought-after partners for multinational companies. China attracted huge amounts of foreign direct investment. Increasingly, global corporations viewed China as a central element in their long-term strategy. A group of large mainland firms was listed successfully on international stock markets. By the year 2001, China had eleven firms listed in the *Fortune 500.*

4. China's difficulties

Achieving gradual reform of China's large state-owned enterprises and nurturing their transformation into globally competitive large firms was a daunting task. It was a very different challenge from that which faced the industrial planners in Japan, the Republic of Korea or Taiwan Province of China. The path taken by China was radically different from that followed in other planned economies, which abandoned industrial policy and attempted to achieve sweeping

privatization of the large-scale state sector, and allow the market to decide the outcome.[3] Unsurprisingly, China encountered many difficulties during this long evolutionary process.

a) Policy inconsistency

As we shall see, within the same industry, radically different reform policies were pursued at different times. For example, in oil and petrochemicals, for many years, the policy was to increase the autonomy of large production units. Then policy shifted totally towards centralized control over large production units. At the same time, completely different policies were pursued in different sectors. For example, while control was being centralized in the oil and petrochemical industry, AVIC was, incomprehensibly, being broken up into two separate entities, each of which was even less able than before to compete with the global giants.

b) Where is the firm?

The foundation of China's economic reform was to increase 'enterprise' autonomy. The core of most large 'enterprises' was a single large production unit. This had many benefits, including the development of a strong sense of corporate ambition at the enterprise level. However, it caused difficulties in the subsequent attempts to build multi-plant firms with unified central control over individual production units.

c) Impoverished economy

China is still a poor country, with a relatively tiny middle class. For example, the entire stock of saloon cars is only around five million. A large fraction of domestic demand is for low price, low value-added products for over one billion peasants, internal migrants and poor urban residents. Indigenous firms have to fight a battle on two fronts, on the one hand with global giants in high value-added products, and on the other hand, with domestic SMEs in low value-added products.

d) Local protectionism

China has a strong tradition of relatively autonomous local government. There has been persistent local resistance to cross-regional mergers, due to fears of downsizing and/or loss of control of a 'local asset'.

[3] In fact, as is now widely recognized, it did not prove as easy to privatize the large-scale state-owned sector as was originally visualized.

e) Inheritance from the planned economy

Unlike the other 'late-comer' countries, China's large enterprises inherited huge manning levels, which are extremely hard to reduce without causing social instability. This will remain a deep problem for many years.

f) Incentive to diversify

The inability of China's emerging large firms to compete in international markets, plus the fact that they each have a huge workforce, produced a high incentive for the individual enterprise to diversify. A single large enterprise could easily have hundreds of 'children' and grandchildren' subsidiaries and related companies. This gives the 'illusion of scale', but beneath an apparently large firm there are typically hundreds of uneconomically small firms and immense problems of corporate governance.

g) Problems for China's bureaucracy

China's bureaucracy lacked the intense nationalist incentive to build large firms successfully that drove Japanese (and the Republic of Korea) policy makers. Also, China's leaders are engaged in an intense drive to root out corruption from the country's huge bureaucracy. Corruption undermines the bureaucracy's ability to lead industrial policy effectively.

h) Ideological commitment to state ownership

China remained for most of the reform period committed to state ownership as a goal in its own right, rather than building powerful corporations by whatever means was suitable. It proved hard to achieve the separation of government and enterprise that has been advocated for many years.

5. The challenge for China

Case studies conducted in the late 1990s in a wide range of sectors (Nolan, 2001) show that after two decades of reform in most sectors the competitive capability of China's large firms is still weak in relation to the global giants. By the simplest of measures of sales revenue, profits and R&D, China's vanguard of leading firms that are intended to 'compete on the global level playing field', are still significantly behind the global leaders. This was found to be extremely marked in the ***high-technology sectors,*** such as IT hardware, complex equipment such as power plants, and pharmaceuticals, as well as in ***'mid-technology'*** sectors such as automobile assembly and automobile components. However, even in sectors with apparently ***less advanced technology,*** such as steel and coal, there was a significant gap with leading global companies in the high value-added segments of the market. In financial services, it is widely recognized that China's leading commercial banks, insurance companies and accountancy firms lag far behind the global leaders.

At the start of the 21st century, not one of China's leading enterprises has become a globally competitive giant corporation, with a global market, a global brand, and a global procurement system. The Chinese companies included in the *Fortune 500* all faced huge problems of downsizing. China had no less than five of the top ten companies in the *Fortune 500* in terms of numbers of employees (*Fortune Global 500*, 2001). China had just two companies in the *FT 500* which ranks firms by market capitalization (*FT*, 11 May 2001). These were China Mobile and China Unicom, both of which operate in a totally protected domestic environment. The vast bulk of their IT hardware equipment was purchased from the global giants.[4] China did not have one company in the world's *top 300 companies by R&D* expenditure (DTI, 2000). China did not have any representatives in *Morgan Stanley Dean Witter's* list of the world's top 250 'competitive edge' companies (MSDW, 2000). China did not have a single company in *Business Week's* list of the world's top 100 brands (*Business Week*, 6 August 2001).

B. The global business revolution

China's attempt to build large globally competitive firms coincided with the most revolutionary epoch in world business history, possibly even including the Industrial Revolution. The global business system was much more stable during the period during which Japan, the Republic of Korea and Taiwan Province of China were putting into place their industrial policy. China's effort to support the growth of competitive global corporations has taken place at a time of unprecedented change in the international business system, amounting to nothing less than a revolution. Moreover, the high-income countries were willing to tolerate extensive state intervention in these countries, because they were viewed as the front line in the fight against communism. China is regarded by the United States as a 'strategic competitor'.

There were a number of aspects to the *global business revolution*.

1. Liberalization of world trade and capital markets

The period since the late 1980s has witnessed for the first time the opening up of a *truly global market place* in goods, services, capital and skilled labour. The only market which still remains bound firmly by nationality is the vast sea of unskilled labour. The world's leading firms have massively increased their production capabilities in fast-growing parts of developing countries. Foreign direct investment (FDI) in developing countries grew from $24 billion in 1990 to $170 billion in 1998. China

[4] In 1999, total IT hardware sales in China reached $20 billion, including mobile infrastructure and handsets; traditional fixed line and broadband switching equipment; optical cable/optical cable fibre; SD and DWDM products. It is estimated that 90 per cent of the IT hardware by value was supplied by the global giants (including Nokia, Motorola, Ericsson, Cisco, Siemens, Alcatel, and Lucent) either through imports or their large production networks of within China.

was, by far, the main focus of attention, with FDI rising from $3.5 billion in 1990 to $44 billion in 1998 (World Bank, 2001: 315). The struggle among the world's leading firms has now deeply penetrated the most developed parts of the low and middle-income countries.

China is at the centre of this battle. The world's giant firms are struggling intensely with each other for a share of the China market: Boeing and Airbus in aerospace; Pfizer, GlaxoSmithKline, Merck, and Astra Zeneca in pharmaceuticals; Shell, BP and Exxon in oil and petrochemicals; IBM, Siemens, Nokia and Ericsson in IT hardware; Ford, GM, VW and Toyota in automobiles; Alstom, Siemens and GE in power equipment; Coca-Cola and Pepsico in soft drinks; Philip Morris, Japan Tobacco and BAT in tobacco; Nestlé and Unilever in FMCGs; Usinor, Posco and Nippon Steel in steel; Rio Tinto, Billiton and Anglo-American in mining; Morgan Stanley, Goldman Sachs and Merrill Lynch in investment banking; PwC, KPMG and De Loitte in accountancy; Axa, Allianz, AIG, Prudential and CGNU in insurance; Citigroup, Deutsche Bank, J.P.Morgan Chase, and Credit Suisse in banking; News Corps and AOL-Time Warner in the mass media.

2. Explosive M&A and concentration

The period since the 1980s witnessed by the world's most explosive period of *mergers and acquisitions*. Global M&A rose from $156 billion in 1992 to around $3,300 billion in 1999 (Nolan, 2001: 38). The size of the merger boom of the 1990s eclipses that of any previous epoch. It will leave a long-lasting imprint on the global business structure. In almost every sector a small number of focused global producers dominates the world market. Competitive capitalism's inbuilt tendency to concentration and oligopoly has finally flowered on a global scale.

Today, only two firms make large (over 100 seats) commercial aircraft.[5] In pharmaceuticals, the top ten firms account for 46 per cent of world sales. In oil and petrochemicals, a group of just three 'super majors' has emerged, occupying three of the top seven slots in the *Fortune 500* list of the world's largest companies ranked by sales revenue. In power equipment, the top three firms account for almost nine-tenths of the world total of gas turbines installed in the 1990s. In the automobile sector, the top six automobile firms account for over 75 per cent of the global market. In IT hardware, the top three firms account for 71 per cent of the global supply of servers, for two-fifths of the global sales of PCs and three-fifths of global sales of mobile phones. In fast-moving consumer goods, just two firms account for over 80 per cent of global sales of carbonated soft drinks; two firms account for around 70 per cent of global sales of camera film; three firms account for almost one-half of global sales of spirits; and four firms account for 60 per cent of global tobacco sales.

[5] For sources of data used in this and the following paragraph, see Nolan, 2001a: chapter 2, 'The challenge of the global business revolution'.

3. 'Cascade effect'

Not only have the core 'systems integrators' experienced an explosive process of concentration. The deepening interaction between core companies and supplier companies has created an explosive ***'cascade'*** effect that is rapidly leading to concentration and focus among the first-tier suppliers and spilling over even into second and third-tier suppliers. Concentration among leading aircraft assemblers has stimulated concentration among the main aerospace components suppliers: there are now just three makers of large aircraft engines across the world. Concentration among automobile assemblers has stimulated concentration among automobile components makers: the top three tyre makers account for almost two-thirds of global tyre sales; the top two manufacturers of automobile brake systems account for 56 per cent of global sales and the top two firms account for almost one-half of global sales of car air conditioning systems. Concentration among IT equipment makers has stimulated concentration among IT suppliers. One firm accounts for 85 per cent of global sales of micro-processors ('intel inside'), another accounts for 80 per cent of high end routers, another supplies around one half of all optical fibres and another accounts for over nine-tenths of computer operating systems.

In sector after sector, the 'first-tier' suppliers are themselves multi-billion dollar companies with 'global reach'. This makes the competitive landscape even more challenging for firms from developing countries.

4. The 'external firm'

If we define the firm not by the entity which is the legal owner, but, rather, by the sphere over which conscious co-ordination of resource allocation takes place, then, far from becoming 'hollowed out' and much smaller in scope, the large firm can be seen to have enormously increased in size during the global business revolution. In a wide range of business activities, the organization of the value chain has developed into a comprehensively planned and co-ordinated activity. At its centre is the core systems integrator. Through the hugely increased planning function undertaken by systems integrators, facilitated by recent developments in information technology, the boundaries of the large corporation have become blurred. In order to develop and maintain their competitive advantage, the systems integrators deeply penetrate the value chain both upstream and downstream. They are closely involved in business activities that range from long-term planning to meticulous control of day-to-day production and delivery schedules. Competitive advantage for the systems integrator requires that it must consider the interests of the whole value chain in order to minimize costs across the whole system. Far from becoming 'hollowed out' and much smaller in scope, the extent of control exercised by the large firm has enormously increased during the global business revolution (Nolan, 1999).

5. Dominance of firms based in advanced economies

Firms headquartered in regions containing a small fraction of the world's population have comprehensively dominated the global business revolution (table 1). The high-income economies

contain just 16 per cent of the world's total population. They account for 91 per cent of the world's total stock market capitalization, 95 per cent of Fortune 500 companies, 97 per cent of the FT 500 companies, 99 per cent of the world's top brands and 100 per cent of the world's top 300 companies by value of R&D spending.

North America is by far, the world leader in this process. North America has just over 5 per cent of the world's population, but it accounts for 40 per cent of the Fortune 500 firms, 46 per cent of the world's top 300 firms by R&D expenditure (74 per cent of the top 300 IT hardware and software firms, ranked by R&D spending), 50 per cent of the *FT 500* firms, 54 per cent of Morgan Stanley's list of the top 250 'global competitive edge' firms, and 61 per cent of the world's top 100 brands.

Developing countries are massively disadvantaged in the race to compete on the global level playing field of international big business. The starting points in the race to dominate global markets could not be more uneven. The whole of the developing world, containing 84 per cent of the world's population, contains just 26 Fortune 500 companies, 16 FT 500 companies, 15 of Morgan Stanley's list of the 250 leading 'competitive edge' companies, one of the world's top 100 brands and none of the world's top 300 companies by R&D expenditure.

C. Conclusion

China's rapid move towards 'close' integration with the world economy is occurring at a time of revolutionary change in the global business system. This presents an extreme challenge for China's industrial strategy. As China's enters the WTO, there is a series of critical questions that need to be answered both by Chinese and globally powerful firms seeking to penetrate the Chinese market. This raises numerous issues for China's industrial policy makers. Would privatization of China's large enterprises be sufficient to make them competitive on the 'global level playing field' within the WTO? At which level in the global value chain can any given large Chinese firm best compete: as a 'core systems integrator', 'first-tier supplier', or lower down the value chain? What role will be permitted for national industrial policy in China within the WTO? Does China's bureaucracy have the capability to administer industrial policy effectively? Does it matter whether China, or other developing countries, have 'national champions' that can compete on the 'global level playing field'? Does the global corporation, with production bases and markets throughout large parts of the world, any longer have a 'national' or a 'regional' identity?

Section II and III of this paper analyse the challenge of globalization in two very different industries, oil and petrochemicals and aerospace. The purpose of this detailed examination of these contrasting sectors is to investigate the nature of the challenge facing large Chinese firms in 'strategic' sectors that have formed, and still do form, an important focus of industrial policy in high income countries.

Table 1

Dominance of firms based in high-income countries of the global big business revolution

	Population		*GNP, 1977* [a]		*GNP, 1977* [b]		*Fortune 500 companies, 1988* [c]		*FT 500 companies, 1988* [d]		*Top 300 companies by R&D spending, 1977*		*Stock market capitalization, 1977*	
	$ billion	*Per cent*	*$ billion*	*Per cent*	*$ billion*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*$ billion*	*Per cent*
HIEs [e]	926	16	23,802	80	21,091	57	474	95	484	97	299	99	18,452	91
L/MIEs [f]	4,903	84	6,123	20	15,861	43	26 [g]	5	16 [h]	3	2	1	1,725	9

Sources: *FT*, 28 January 1999; The World Bank, 1998: 190–191, and 220–221; *Fortune*, 2 August 1999: DTO, 1998: 70–80.

Notes:

a At prevailing rate of exchange.

b At PPP dollars.

c Ranked by sales revenue.

d Ranked by market capitalization.

e High-income economies.

f Low/Middle-income economies.

g *Of which:* Republic of Korea = 9; China = 6; Brazil = 2; Taiwan Province of China= 2; Venezuela = 1; Russia = 1; India = 1; Mexico = 1; Malaysia = 1.

h *Of which*: Hong Kong (China) = 7; Brazil = 2; Taiwan Province of China= 2; Singapore = 1; Mexico = 1; India = 1; Republic of Korea = 1; Argentina = 1.

II. OIL AND PETROCHEMICALS

A. The global setting

1. World oil and gas in the 1990s

Crude oil and natural gas remain central to global political economy. The contribution of oil to the world primary energy consumption has remained stable at around 40 per cent. The share of natural gas in the world primary energy consumption rose from 20.3 per cent in 1990 to 24.7 per cent in 2000. The regional distribution of world oil and gas reserves, production and consumption are highly uneven (table 2). This is of special importance for global political economy. The Middle East and the former Soviet Union (FSU) account for 70 per cent of the world total oil reserves and 73 per cent of the world total natural gas reserves. The five countries of Saudi Arabia, Kuwait, the Islamic Republic of Iran, Iraq and United Arab Emirates between them account for over three-fifths of the world total oil reserves. Russia alone accounts for more than one-third of the world total gas reserves. The Middle East is the world's most important oil supplier, accounting for 31 per cent of global production. Seventy-five per cent of its output is exported. The FSU is the world's largest gas producer, accounting for 28 per cent of global production in 2000.

The United States is the world biggest oil and gas consumer (table 2). In 2000, the United States accounted for over one quarter of the world total oil imports and nearly half of the country's total consumption. The United States' share of the world gas production is 23 per cent, but still lags behind its share of gas consumption, accounting for 27 per cent of the global total. More than 60 per cent of Europe's oil consumption is met by imports from outside the region. Japan relies totally on imports for its oil and gas supplies (table 2).

China is poorly endowed with oil and gas. Its share of the world oil and gas reserves amount to only 2.3 per cent and 0.9 per cent respectively (table 2). In contrast, China's coal reserves are second only to those of the United States. China was the world's largest producer and consumer of coal in the 1990's. Coal accounted for 67 per cent of China's total primary energy consumption in 1999. It plans to raise the share of gas in total primary energy consumption from the current 3 per cent to 8 per cent in 2010, which will somewhat reduce the share of coal. Coal remains an abundant and cheap source of primary energy for China. During the 1990s, oil and gas consumption increased at a compound annual growth rate of 5.5 per cent and 5.7 per cent respectively. In 2000, China was the third largest oil consuming country after the United States and Japan. After 1993, China became a net crude oil importer. Oil imports reached 71 million tons in 2000 (BP, 2001), equivalent to 31 per cent of China's total oil consumption. It is predicted that by the year 2005, 40 per cent of China's demand for oil will be met by imports (China Petroleum, June 1999). The issue of oil supply security remains a major concern for China's policy makers.

Table 2

Geographical distribution of world oil and gas reserves, consumption and production, 2000

Regions & countries	*Proved reserves*		*Consumption*		*Production*		*Net imports [exports]*	
	Oil (bt)	*Gas (tcm)*	*Oil (mmt)*	*Gas (bcm)*	*Oil (mmt)*	*Gas (bcm)*	*Oil (mmt)*	*Gas[§] (bcm)*
World	142.1 (100%)	150.19 (100%)	3503.6 (100%)	2404.6 (100%)	3589.6 (100%)	2422.3 (100%)	-	-
United States	3.7 (2.8%)	4.74 (3.2%)	897.4 (25.6%)	654.4 (27.2%)	353.5 (9.8%)	555.6 (22.9%)	442.8	101.53
Europe	2.5 (1.9%)	5.22 (3.5%)	752.6 (21.4%)	458.8 (19.1%)	329.0 (9.2%)	287.9 (12%)	389.6	197.33
Mexico	4.0 (2.7%)	0.86 (0.6%)	84.3 (2.4%)	35.5 (1.5%)	172.1 (4.8%)	35.8 (1.5%)	[86.7]	0
S/C America*	13.6 (9.0%)	6.93 (4.6%)	218.7 (6.2%)	92.6 (3.8%)	348.2 (9.7%)	96.4 (3.9%)	[59.7]	[3.51]
of which:								
Venezuela	11.1 (7.3%)	4.16 (2.8%)	22.6 (0.6%)	27.2 (1.1%)	166.8 (4.6%)	27.2 (1.1%)	-	-
FSU**	9.0 (6.4%)	56.70 (37.8%)	173.1 (5.0%)	548.3 (22.8%)	394.4 (11%)	674.2 (27.8%)	[142.6]	[132.98]
of which:								
Russia	6.7 (4.6%)	48.14 (32.1%)	123.5 (3.5%)	377.2 (15.7%)	323.3 (9.0%)	545.0 (22.5%)	-	[130.33]
Middle East	92.5 (65.3%)	52.52 (35%)	209.0 (5.9%)	189.0 (7.9%)	1112.4 (31%)	209.7 (8.7%)	[831.7]	[23.44]
of which:								
Saudi Arabia	35.8 (25%)	23.00 (15.3%)	62.4 (1.8%)	47.0 (2.0%)	441.2 (12.3%)	47.0 (1.9%)	-	-
Iran (Islamic Rep.of)	12.3 (8.6%)	6.05 (4%)	56.9 (1.6%)	62.9 (2.6%)	186.6 (5.2%)	60.2 (2.5%)	-	2.65
Iraq	15.1 (10.8%)	3.11 (2.1%)	-	-	128.1 (3.6%)	-	-	-
Asia Pacific	6.0 (4.2%)	10.33 (6.8%)	968.9 (27.8%)	289.3 (12.1%)	380.5 (10.6%)	265.4 (11%)	557.9	22.41
of which:								
China***	3.3 (2.3%)	1.37 (0.9%)	226.9 (6.5%)	24.8 (1.0%)	162.3 (4.5%)	27.7 (1.2%)	59.9	-
Japan	-	-	253.5 (7.2%)	76.2 (3.2%)	-	-	214.9	72.46
Africa	10.0 (7.1%)	11.16 (7.4%)	116.7 (3.3%)	58.9 (2.4%)	373.2 (10.4%)	129.5 (5.3%)	[251.1]	[67.05]
of which:								
Nigeria	3.1 (2.2%)	3.51 (2.3%)	-	-	103.9 (2.9%)	11.0 (0.5%)	-	[5.61]

Source: *BP Statistical Review of World Energy, 2001*.

Notes: Figures in brackets ( ) are percentage share of world total; in square brackets [ ] are net exports.
* South and Central America. ** Former Soviet Union. *** Data exclude Hong Kong (China).
[§] Trade movement of gas transported by pipeline and LNG, excluding intra movement.
bt = billion tones; tcm = trillion cubic metres; bcm = billion cubic metres; mmt = million tones.

Table 3

Top 15 national oil companies, 1999

Company	*Reserves*		*Production*		*Refinery capacity (mmt/y)*	*Oil product sales (mmt)*	*Country*
	Oil (bt)	*Gas (bcm)*	*Oil (mmt)*	*Gas (bcm)*			
Saudi Aramco	35.50	6040.7	402.2	31.4	99.60	132.50	Saudi Arabia
PDVSA	10.50	4155.1	147.5	41.3	154.80	125.00	Venezuela
National Iranian Oil Company	12.10	23134.1	181.0	53.3	76.70	67.10	Iran (Islamic Republic of)
Pemex	3.89	849.7	167.2	49.5	76.40	82.50	Mexico
Indonesia National Oil Company	1.08	3361.6	48.7	65.1	52.50	59.50	Indonesia
Kuwait Petroleum Corporation	13.20	1492.5	101.3	9.7	53.75	58.25	Kuwait
Algeria National Oil Company	1.21	3860.1	74.0	78.4	24.25	37.50	Algeria
PetroChina	1.51	696.8	106.2	7.0	103.30	48.30	China
Petrobrás*	11.10	302.0	59.6	12.8	97.65	90.90	Brazil
Abu Dhabi National Oil Company	6.95	5553.8	62.0	32.9	11.70	22.75	United Arab Emirates
Iraq National Oil Company	15.40	3109.5	126.4	3.3	17.40	26.00	Iraq
Libya National Oil Company	3.23	1309.6	60.6	6.2	19.00	20.00	Libyan Arab Jamahiriya
Petronas	0.40	1825.8	31.8	52.7	14.50	21.25	Malaysia
Sinopec Group	0.82	307.9	31.5	2.2	118.65	68.80	China
Nigeria National Oil Company	1.85	2105.3	60.8	3.1	22.25	12.55	Nigeria
Total	**118.80**	**58104.5**	**1660.9**	**448.9**	**942.60**	**872.90**	

Sources: *Fortune Global 500*, 2001, *FT500*, 2001, company annual reports. *Petroleum Intelligence Weekly*, 18 December 2000. Authors' own research.
Notes: * 49% of Petrobrás is state-owned. bt = billion tonnes; bcm = billion cubic metres; mmt = million tonnes; mmt/y = million tonnes per year.

2. National oil companies

At the end of the 1990s, among the world top 25 oil companies ranked by operating performance, fourteen (fifteen if Petrobrás is included)[6] were state-owned national champions, all based in developing countries (table 3). These national oil companies (NOCs) own the majority of the world oil and gas reserves and are the world's largest oil producers. There have been no cross-border mergers among the NOCs. They are regarded as national assets by their governments. In 1999, the combined oil and gas reserves of these oil companies accounted for 77 per cent and 49 per cent of the total world oil and gas reserves respectively. They produced 48 per cent of total world oil production, compared with 18 per accounted for by the global oil majors (GOMs) based in the United States and Europe.[7] Gas production of the NOCs was 449 billion cubic metres in 1999, accounting for 19 per cent of total world gas production, compared with the 424 billion cubic metres produced by GOMs in the same year.

The NOCs are relatively weak in downstream refining and marketing. Their total annual refinery capacity in 1999 was 943 million tonnes per year (mmt/y), compared to the GOMs' capacity of 1064 mmt/y capacity. Refined product sales of the 15 NOCs were 873 mmt in 1999, less than the combined amount of 1063 mmt of refined products sold by Exxon Mobil, Royal Dutch/Shell and BP Amoco/Arco in the same period.

Among the NOCs, PetroChina and Sinopec Group are at the bottom of the league in terms of oil and gas reserves (table 3). Even their combined oil reserves were only 2.33 billion tons, just 6.6 per cent of those of Saudi Aramco and substantially behind the 3.89 billion tons of oil reserves held by Pemex. Their combined gas reserves of 1005 billion cubic metres were the smallest among the leading NOCs. Both PetroChina and Sinopec entirely rely on domestic reserves for production. In 1999, PetroChina was ranked the eighth largest oil producer in the world (Petroleum Intelligence Weekly, 18 December 2000). The combined oil production of PetroChina and Sinopec Group would rank China as the fifth largest producer in the world. In contrast, the combined gas production of PetroChina and the Sinopec Group was tiny, only 18 per cent of that of Petronas. Downstream, the annual refinery capacity of each of PetroChina and Sinopec Group was above 100 mmt/y, but their combined oil product sales were 117 mmt, at the level of Chevron alone.

[6] Petrobrás (Brazil) is partially privatized.
[7] They are Exxon Mobil, Royal Dutch/Shell, BP Amoco/Arco, TotalFinaElf, Chevron, Texaco, Eni, Repsol YPF, and Conoco.

3. Merger frenzy

In contrast to the NOCs, a frenzy of consolidation began to sweep through the global oil majors in the late-1990s. In just two years from 1998 to 2000, the number of major western oil companies was reduced from eleven to six. This fundamentally changed the competitive landscape in the industry.

a) BP/Amoco: August 1998

The consolidation process in the oil and petrochemical industry was initiated by BP's trans-Atlantic merger with Amoco in a $55 billion transaction in August 1998. The combined group placed itself close behind the world leader Royal Dutch/Shell and Exxon in terms of market capitalization, oil and gas reserves and production. The merger greatly strengthened BP's position in downstream marketing in the Mid-West and Eastern United States as well as in the petrochemicals production. The merger is highly significant in that it was one of a series of major transatlantic mergers and acquisitions initiated by European-based companies, including Daimler/Chrysler, Deutsche Bank/Bankers Trust, Siemens/Westinghouse (non-nuclear power division) and Deutsche Telecom/Voice Stream.

b) Exxon/Mobil: November 1998

Just three months after the BP Amoco merger, Exxon, then the second largest western oil company, announced that it was to merge with Mobil, the third largest, in an $86 billion transaction. The merged company overtook Royal Dutch/Shell as the number one western oil company in terms of revenue, profit, combined oil and gas reserves, oil and gas production, and refining capacity (tables 4 and 5). The new company Exxon Mobil has a much wider global spread of assets. It possesses a significant share in some of the world's most important emerging oil areas, including offshore in West Africa and in the Caspian Sea. It owns 60 per cent of the proved gas reserves in Europe and is exploring and developing gas fields in the Asia Pacific Area. Downstream, Exxon Mobil has 33,000 service stations world-wide. Both Exxon and Mobil have powerful global brand recognition. In the fast-growing and profitable lubricant market, Exxon is the world's top producer of lubricant base stocks while Mobil is the market leader in lubricants in both the United States and Europe. Exxon and Mobil also had complementary assets in major petrochemicals such as polyethylene and paraxylene. The merger enabled Exxon/Mobil to overtake Royal Dutch/Shell in financial performance and almost every aspect of operating strength.

Table 4

Operating data compared: global majors *vs* PetroChina and Sinopec, 2000

Company	*Reserves*		*Production*		*Refinery throughput (mmb/d)*	*Oil product sales (mmt/y)*	*Chemical production (mmt)*	*Service station number*
	Oil (bb)	*Gas (bcf)*	*Oil (mmboe/d)*	*Gas (bcf/d)*				
Exxon Mobil	11.56	55,866	2.55	10.34	5.64	400.0	25.60	45,000
Royal Dutch/Shell	8.67	50,842	2.27	8.22	2.92	278.5	20.29	46,000
BP	6.51	41,100	1.93	7.61	2.92	188.0	22.07	27,545
TotalFinaElf	6.96	20,705	1.43	3.76	2.41	185.0	15.40†	17,700
Chevron Texaco*	6.83	19,176	2.30	3.70	2.26	233.5	-	39,000‡
ENI	3.42	14,762	0.80	2.50	0.86	53.5	8.50	12,085
Repsol YPF	2.38	14,394	0.64	2.22	1.21	51.4	2.80	7,200
PetroChina	11.0	32,532	2.10	1.38	1.50	56.4	6.70	11,350
Sinopec Corp.	2.95	999	0.68	0.22	2.12	67.0	20.03	20,259

Sources: Compiled from company reports.
Notes: * Figures are combined estimates after announced merger in October 2000. † Capacity. ‡ Numbers include 8,000 service stations of Caltex. bb = billion barrels; bcf = billion cubic metres; mmboe/d = million barrels of oil equivalent per day; bcf/d = billion cubic feet per day; mmb/d = million barrels per day; mmt/y = million barrels per year; mmt = million tonnes.

Table 5

Financial indicators compared: global majors *vs* PetroChina and Sinopec, 2000

Company	*Revenue ($billion)*	*Net profit ($billion)*	*R&D spending ($million)*	*Market ** capitalization ($billion)*	*Employee numbers*	*Profit/ revenue (%)*	*Profit/ Employee ($)*
Exxon Mobil	210.4	17.70	936.0	286.4	99,600	8.4	177,711
Royal Dutch/Shell	149.2	12.70	1144.0	206.3	90,000	8.5	141,111
BP	148.1	11.90	599.0	178.0	107,200	8.0	111,007
TotalFinaElf	105.9	6.40	631.0	102.9	123,303	6.0	51,905
Chevron Texaco*	99.2	7.60	922.0	84.5	53,621	7.7	141,736
ENI	45.1	5.30	315.3	48.8	69,969	11.8	75,748
Repsol YPF	42.3	2.20	61.6 §	20.6	37,194	5.2	59,149
CNPC	41.7	5.80	-	-	1292558	13.9	4487,000
of which:							
PetroChina	29.2	6.70	212.0	3.5 †	441,000	22.9	15,193
Sinopec Group	45.4	0.72	-	-	1173901	1.6	613,000
of which:							
Sinopec	39.7	2.30	200.0	1.4 ‡	508,000	5.8	4,528

Sources: Compiled from company reports.
Notes: * Figures are combined estimates after announced merger in October 2000. ** Market capitalization on 4 January 2001. § 1999. † Flotation 10 per cent of company value, ‡ Flotation of 20 per cent of company value.

c) BP Amoco/Arco: March 1999

Following hard on the heels of the BP/Amoco merger, in March 1999, BP Amoco agreed on a $26.8 billion take-over of Atlantic Richfield Company (Arco). The acquisition of Arco significantly increased BP Amoco's oil and gas reserves. Through Arco, the new company has a much wider global reach with oil fields in Algeria, Venezuela, the Caspian and Russia as well as gas fields in the Gulf of Mexico, the United Kingdom North Sea, the South China Sea, Malaysia, Thailand and Qatar. Moreover, the new company has full operational control of the huge Prudhoe Bay oil and gas field in Alaska. Through Arco, the new company owns 40 per cent of the large Tangguh natural gas site in Indonesia. The acquisition of Arco also gave BP access to the large chain of service stations on the West Coast of the United States, thus effectively establishing a coast-to-coast network across the country. After the acquisition, BP's revenue, oil and gas reserves and production rival those of Shell. It became the world's third largest petrochemical producer after Shell and BASF, with leading technology and market share in acetic acid, polypropylene and PTA. The BP Amoco/Arco deal secured BP's position among the top 'big three' western oil companies.

d) TotalFina/Elf: September 1999

In late 1998, France's second biggest oil group, Total, acquired the Belgian PetroFina in a $7 billion transaction and renamed the new company 'TotalFina'. The acquisition enabled Total to strengthen its downstream businesses in Europe and enhance its international exploration capabilities. The transaction was highly significant in that it demonstrated the fading of national sensitivities associated with the former state-owned oil companies in Europe. Shortly afterwards, TotalFina launched a hostile $43 billion bid for Elf Aquitaine, France's biggest oil group. The take-over was vigorously resisted by Elf Aquitaine but was supported by the French government who owned a 'golden share' in Elf Aquitaine. After months of protracted negotiation, TotalFina and Elf Aquitaine finally agreed to a friendly merger in September 1999. The oil and gas reserves of TotalFinaElf are widely distributed across the world, with 28 per cent in Africa, 27 per cent in Europe, 25 per cent in the Middle East and 20 per cent across the rest of the world. TotalFinaElf's total oil and gas production is close to that of BP Amoco/Arco. The new company has a powerful downstream capability in integrating its petrochemicals with its refining activities around six main hubs. TotalFinaElf greatly strengthened its position as the fourth largest global oil company.

e) BP/ Burmah Castro: March 2000

In March 2000 BP Amoco announced that it had agreed to buy Burmah Castrol for $4.7 billion. Castrol is 'one of the great lubricants brands of the world', a name that 'stands for superbly engineered products of the highest quality, and research and development that has consistently kept those products

at the forefront of the marketplace' (BP Website). It has become BP Amoco's leading lubricants brand with its products made available through the group's 28,000 retail sites and to BP Amoco's massive worldwide customer base.

f) Chevron/Texaco: October 2000

In October 2000, Chevron and Texaco announced they were to merge in a $42 billion transaction. The new company became the world's fourth largest producer. The combined company has a strong position in most of the world's major and emerging exploration and producing areas. Chevron has low-cost international oil projects offshore Angola and Kazakstan and is a 50:50 equity partner with Petrobrás in the Campos and Cumuruxatiba areas of Brazil. Texaco has made deep-water discoveries offshore Nigeria and is an active explorer and developer in the Unites States Gulf of Mexico, Kazakhstan, deep-water Brazil, Venezuela and the Philippines. The new company became the third largest producer in the United States Gulf of Mexico next to BP and Exxon Mobil. Caltex, the refining joint venture between Chevron and Texaco since 1936, will be integrated into the new company, strengthening the new company's downstream businesses in Asia, Africa and the Middle East. Caltex runs 8,000 service stations. In the profitable lubricant business, the new company accounts for 20–30 per cent of the lubricant additive market and 5–10 per cent of finished lubricant sales in Europe.

g) Conoco/Phillips: November 2001

The consolidation process has been 'cascading' into the mid-sized integrated oil and petrochemical companies. In November 2001, Conoco and Phillips announced a $35 billion merger. Previous to this merger, each company has been making acquisitions fast. Conoco's acquisition of Gulf Canada Resources increased its natural gas reserves and production in North America by 50 per cent. Phillips' acquisition of Tosco increased its refining capacity in the United States by five times and the company becomes the second largest refiner in the United States next to Exxon Mobil. Conoco Phillips will become the world sixth largest energy company in terms of oil and gas reserves and production and the fifth largest global refiner. The merger to grow bigger comes from the pressure to compete with the industry's 'super-major' groups that have an edge in highly capital-intensive projects for the energy world in China, the Middle East and West Africa (*FT*, 20 November, 2001).

h) Repsol-YPF

During the period of large-scale mergers among the western major oil companies, Spain's Repsol launched a hostile, $13 billion all-cash bid for Argentina's YPF in 1999. The deal is highly significant in that it is the first time that a large privatized western oil company has taken over a major, formerly state-owned oil and petrochemical company from a developing country.

Before it was privatized by the government in 1991, YPF had exclusive rights for oil exploration and production in Argentina, though domestic and international private companies had long been allowed to participate in the oil sector. YPF had accounted for around half of domestic oil production. Following its privatization, YPF was restructured for international flotation. Separated from the non-core businesses, the core businesses from upstream exploration and development to downstream refining, marketing, and petrochemicals as well as electric power were grouped together and formed a joint stock company. In 1993, the new YPF listed in the stock exchanges in Buenos Aires and New York, the largest publicly-traded oil company in Latin America.

By 1998, YPF accounted for 51 per cent of Argentina's total oil production. Its three refineries accounted for 51 per cent of Argentina's refining capacity. Its 2,500 service stations across Argentina represented a 37 per cent market share. Under the strong leadership of its CEO, Roberto Monti, YPF had the ambition to build itself from a strong regional player, mainly based within Argentina, into a powerful international company. YPF pursued a series of international projects. In 1995, YPF purchased the United States independent exploration and production company Maxus Energy. It worked together with Petrobrás for a number of exploration blocks in Brazil and to develop gas business in southern Brazil. It also had a joint venture with Petrobrás to develop service station chains in Brazil. In addition, YPF had exploration interests in Bolivia, Ecuador and Venezuela. Through its affiliated companies, YPF also held stake in upstream operations in Russia and in downstream activities in Chile and Peru.

Repsol was the Spanish national champion in oil and petrochemicals. After its privatization in late 1990s, it followed a strategy of international expansion, mainly in Latin America. With 64 per cent of its assets in exploration and development, YPF is a strong upstream player and became an ideal target for Repsol's international expansion strategy, with a focus on Latin America. In January 1999, Repsol acquired a 14.99 per cent stake in YPF from the Argentine government, which still owned 20 per cent of YPF. In April 1999, Repsol launched a $13 billion all-cash bid for all the YPF's shares that it did not already own. Repsol's hostile bid was opposed by the board of YPF. However, the deal was supported by the Argentine government, which had 5.3 per cent of the shares in the company, three other provincial governments with smaller stakes and other private investors. Within only one week, the board of YPF conceded defeat. Chairman Roberto Monti commented, 'We have always maintained a business philosophy based on value creation, and it is the board's view, which I back, that Repsol's bid offers the best alternative for our shareholders in current market conditions' (quoted in the *FT,* 12 May 1999).

The new company Repsol YPF combined YPF's powerful upstream businesses with Repsol's strong downstream capabilities. It became the world's eighth largest publicly-traded oil company in terms of oil and gas reserves. Repsol YPF's reserves are close in size to those of ENI. Its assets are

spread across the world in Europe, North Africa, Latin America and the Unites States. It accounts for 59 per cent of refining capacity and 47 per cent of the retail market in Spain and 56 per cent of the refining capacity and 49 per cent of the retail market in Argentina. It is uncertain if even the new Repsol YPF will remain as an independent player in the new world of super-majors. Rumours have circulated about a possible 'southern European champion', which merged Repsol YPF with ENI, and a possible merger with Total Fina Elf.

4. Conclusion: Competitive obstacles for firms based in developing countries

The mergers in the world's oil and petrochemical industry during the global business revolution have created a group of new super-giants that stand in a position of greatly enhanced competitive advantage compared to potential competitors from developing countries. These new super-giants greatly increased their size and their assets base. They have constructed a portfolio of high quality oil and gas reserves distributed around the world. They are able to invest large amounts in R&D to sustain and extend their technical lead over other companies. They have the resources to invest in large-scale information technology systems that can better integrate their extended internal value chain, stretching from exploration to the petrol station. They have developed marketing systems with immensely powerful global brands. They have built massive multi-billion dollar central procurement capabilities with large consequent cost-savings. MSDW estimates that the super-majors, namely Exxon Mobil, Shell and BP, have a capability to sustain their competitive edge in the industry for at least fifteen years (MSDW, 1998).

On the global level playing field, even efficient, ambitious and well-run firms in this sector may be unable to survive as independent entities in the face of the intense competition from the super-majors. Not one integrated oil and petrochemical firm based in a developing country has been able to challenge the global giants in this sector. By far the most successful example was YPF. However, as that case vividly illustrated, privatization, liberalization and high quality management, are far from a guarantee of independent survival. Integrated oil and petrochemical firms based in developing countries face formidable obstacles in the ferocious competition with the global leaders. Indeed, in the pursuit of shareholder value, it may be highly rational for the most successful firms in developing countries to be acquired by the world leaders in the industry.

B. China's response

In the same period that the merger frenzy swept through the global major oil companies, China's oil and petrochemical industry underwent massive restructuring. After an intense debate on how to reform the oil and petrochemical industry, the Chinese government created two large integrated oil companies through administrative measures.

1. The 1998 reorganization of China's oil industry

In 1998, the State Council undertook a comprehensive restructuring program for China's oil and gas industry with the goal of creating internationally competitive large oil and petrochemical companies. Three objectives were achieved in this asset reorganization. First, through a huge assets swap, the new CNPC and Sinopec became two vertically integrated oil and petrochemical companies with assets across the whole value chain from upstream to downstream. The new CNPC, which had formerly been mainly concerned with the upstream side of the business, now accounted for 66 per cent of both China's oil and gas output, and 42 per cent of its refining capacity. The new Sinopec, which had formerly focused on the downstream part of the business, now accounted for 23 per cent of oil output, 11 per cent of gas output and 54 per cent of refining capacity. With sales revenue of $25–$30 billion each, both of the two groups would have been listed in the world's top 500 companies. Second, the administrative functions of CNPC and Sinopec were separated from their business management functions. As part of the major governmental restructuring programme in the same year, the State Petroleum and Chemical Industry Bureau under the State Economic and Trade Commission was formed to take over the administration functions from CNPC and Sinopec. Third, starting from June 1998, China's crude oil price was pegged to the Singapore FOB prices, which was a significant step in the integration of China with the global oil industry.[8]

2. The year 2000 flotation of PetroChina and Sinopec

Closely following the 1998 asset reorganization, CNPC and Sinopec each restructured the company in preparation for international flotation. The businesses and structure of the two companies were fundamentally changed. In each of the companies, core businesses covering oil and gas exploration and development, storage and transportation, refining and marketing, petrochemicals were separated from non-core businesses including enterprises that ran engineering, technical and infrastructure services to core businesses as well as social functions such as schools and hospitals. On 5 November 1999, CNPC grouped together its core businesses and created PetroChina as a joint stock company with limited liability. On 25 February 2000, China Petroleum and Chemical Corporation, known as Sinopec, was established on the core businesses from the old Sinopec, now known as Sinopec Group.

In April 2000, PetroChina listed in New York and Hong Kong (China) Stock Exchange. The initial public offering (IPO) accounted for 10 per cent of the company's total shares, and raised $2.89 billion. Among the shares issued, 32.1 per cent were bought by strategic and corporate investors

[8] Before that, the crude oil price in China was set by the government, which resulted in constant disputes between CNPC and Sinopec with each lobbying intensely for prices favourable to their own businesses. In line with the restructuring, the State Development and Planning Commission (SDPC) publishes monthly a benchmark crude oil price based on the average Singapore FOB prices. CNPC and Sinopec negotiate a premium relative to the benchmark price.

including BP Amoco, Sing Hung Kai, Hong Kong Cheung Kong Enterprises, and Hutchison Whampoa. After this global listing, CNPC held a 90 per cent of PetroChina's total equity. Six months later, in October 2000, Sinopec listed in the stock exchanges in New York, Hong Kong (China) and London. The IPO accounted for 21.21 per cent of the company's total shares, and raised $3.73 billion. After the global flotation, 56.06 per cent of Sinopec's equity was controlled by its parent company Sinopec Group, 22.73 per cent by the State Development Bank and three asset management companies, Cinda, Orient and Huarong, and 21.21 per cent by overseas investors including the three largest global oil companies Exxon Mobil, Shell and BP. Exxon Mobil, Shell and BP promised to purchase 20 per cent, 14 per cent and 13.5 per cent repectively of Sinopec's IPO, involving share purchases of up to $1 billion, $430 million and $400 million respectively. ABB Lummus also agreed to purchase $100 million worth of shares. Other overseas corporate investors include Henderson Investment Ltd., Hong Kong (China) and China Gas Company, Cheung Kong Enterprises and Hutchison Whampoa. Both Cheung Kong and Hutchison Whampoa are part of the group of companies owned by Li Ka-shing, whose business empire is based in Hong Kong (China).

3. Business capabilities

a) Reserves and output

Within China's total estimated oil reserves in the year 2000 of around 24 billion barrels (table 2), PetroChina owns 11.03 billion barrels, equivalent to those of Exxon Mobil and exceeding those of Shell and BP (table 4). PetroChina's natural gas reserves are 58 per cent those of Exxon Mobil and around 10,000 billion cubic feet more than that owned by TotalFinaElf and Chevron Texaco (table 4). In terms of oil output, PetroChina is already close to the level of the world's leading companies, with an oil output of around 2.1 million barrels per day, compared with 1.93 million at BP, 2.27 million at Shell and 2.55 million at Exxon Mobil. Sinopec is similar to Repsol YPF in terms of oil reserves and oil production but on a much smaller scale in natural gas reserves and production. However, in terms of natural gas output, even the combined production volume of PetroChina and Sinopec lags considerably behind the global giants (table 4).

There are, however, crucial differences between the reserves and output of the two leading Chinese oil companies and those of the global giants. First, the global distribution is strikingly different. PetroChina and Sinopec produce entirely within China. CNPC has international operations in Canada, Venezuela, Kazakhstan, Sudan, Thailand, Indonesia and Malaysia. In 2000, approximately 5.5 million tons of oil were obtained in 2000 from overseas operations, equivalent to just 7.8 per cent of China's total crude oil imports in the same year. CNPC itself retains ownership of these international projects. PetroChina, the floated company, does not have any operations in foreign countries. Sinopec has almost no overseas reserves and production. In the sharpest contrast, BP and

Exxon Mobil have production and exploration activities in 27 and 30 countries respectively. Second, the quality of the portfolio of oil and gas assets is very different. China's main onshore oil reserves are declining seriously. Fifty per cent of PetroChina's crude oil reserves are from the Daqing oil field, and one-third of the natural gas reserves are in the Tarim Basin. However, 89 per cent of PetroChina's proved crude oil reserves have already been developed. Daqing is in the secondary recovery stage and polymer flooding has been applied to about 14 per cent of its production. The Tarim Basin is in the remote western part of the country. It will require advanced technology and will involve high transportation costs to ship the gas to the main consuming areas in the eastern part of the country, which raises serious doubts about the commercial viability of the project.[9] Third, the global giants have attempted to construct a global portfolio of oil and gas assets that can make a profit at as low as $10 per barrel of oil. Less than five of PetroChina's oil fields can make a profit when the oil price is at $10–$15 per barrel due to costs induced by difficult nature of the reserves, technological problems and cumbersome management structure.

b) Refining

PetroChina and Sinopec between them have a total of 49 refineries, among which 21 have annual refining capacities greater than five million tonnes. None of PetroChina's refineries and only four of Sinopec's refineries have capacities greater than 10 million tons. The utilization rate of refineries owned by PetroChina and Sinopec rose from 61 per cent in 1998, the lowest in the 1990s, to 80 per cent in 2000. This is due to the increasing amount of crude oil available for the two companies' refineries and, to some extent, to the government's campaign to close down small refineries with annual capacity less than 1 million tonnes and refineries out of the state crude oil allocation plan. Since 1999, the State Economic and Trade Commission (SETC) has ordered the closure of 111 refineries over the country (SETC, 1999, 2000). However, the small refineries usually have the support from local government for tax revenue and employment. Closing them down has proved a complex task. Despite the government's campaign, an investigation by SETC shows that small refineries in Sha'anxi, Shangdong and Henan that should have been closed are still active (Zhang Zhigang, 2001).

China's total refining capacity was 280 million tonnes at the end of 2000, exceeding the country's total oil consumption by 53 million tons in the same year. However, the refining sector needs revamping, upgrading and expanding. First, most of China's refining facilities are equipped to process low-sulphur oil and unable to process high-sulphur crude oil from the Middle East except for a few refineries on the east coast such as Maoming and Zhenhai. With more than half of the oil imports from the Middle East, refineries need to add capabilities to use sour crude oil. The effort of PetroChina and Sinopec to increase the capabilities to process sour crude oil requires advanced technology and heavy. Second, more stringent environmental regulations for refined products calls for high-conversion refineries. Third, China's accession to the WTO will reduce the tariffs on refined products

[9] The project would involve the construction of a pipeline 4,200 kilometres long and an estimated total investment of RMB120 billion (approximately $14.5 billion).

from the current 6–12 per cent to a uniform rate of 6 per cent. Few of PetroChina's refineries can survive in near-open competition with imported refined products. For Sinopec, the tariff reduction for refined products will reduce its annual revenue by RMB3 billion (approximately US$360 million).

c) Marketing petroleum products

After 1999, both PetroChina and Sinopec aggressively expanded their network of service stations all over China. By 2000, PetroChina and Sinopec were reported to have over 11,000 and owns 20,000 service stations respectively. Each has almost doubled the number that it had in 1999. This has been strongly supported by the government, which granted the two companies exclusive licenses to operate new service stations in China. However, the two companies have engaged in a 'blind competitive dash' to acquire service stations, which led to 'less than stringent evaluations of, and inflated price paid for, the service stations' (Zhang Zhigang, Vice Minister of SETC, 2001). Around one quarter of each of the two companies' service stations are franchised retail outlets bearing the companies' brands, 'PetroChina' and 'Sinopec' respectively, are still run as separate entities. Neither refined products supplies or the price of refined products are centrally controlled, nor are accounts centrally consolidated, even for the network of service stations owned and operated by the two companies themselves. Between them, PetroChina and Sinopec have over 2,000 wholesale entities. These still have no effective co-ordination of supply, price or customers. Many of the storage facilities are obsolete. PetroChina and Sinopec still have a long way to go before they develop the logistics expertise of the global giants or posses a comparable brand based on the safe and low-cost operation of a huge logistics system. This is a crucial part of the development of the brand for globally competitive oil and petrochemical company.

d) Petrochemicals

Ethylene crackers

By the end of the year 2000, China had a total ethylene capacity of 4.3 million tons, ranking the eighth largest in the world and the third in Asia after Japan and the Republic of Korea (*Oil and Gas Journal*, 23 April 2001). Of the total of 18 ethylene crackers in China, only seven have an annual capacity above 400,000 tonnes (four owned by Sinopec and one by PetroChina) and the other eleven have a capacity of less than 200,000 tonnes. The annual capacity of the largest cracker is 480,000 tonnes, compared to the world's largest at 2.8 million tonnes. Compared with the integrated large sites of the global majors, the average capacity of each petrochemical complex is tiny (table 6). Instead of having a small number of giant, low-cost integrated sites situated in a few concentrated areas, as the global giants do, these 18 ethylene crackers are located at 16 sites in 15 cities.

Table 6
Top 10 ethylene producers* *vs* PetroChina and Sinopec Corp. **

Ranking	*Company*	*No. of sites*	*Capacity (Million tons per year)*		*Company interest (Per cent)*
			Entire complexes	*Company interests*	
1	Dow Chemical Co.	16	12.467	10.076	80.8
2	Exxon Mobil Chemical Co.	14	10.609	7.071	66.7
3	Equistar Chemicals	7	5.265	5.265	100
4	Shell Chemicals Ltd.	6	6.188	4.539	73.4
5	Chevron Phillips Chemical Co.	3	3.674	3.674	100
6	Saudi Basic Industries Corp.	4	5.65	3.95	69.9
7	BP	5	4.151	3.036	73.1
8	Nova Chemicals Corp.	2	3.54	2.968	83.8
9	Atofina	7	3.725	2.378	63.8
10	Enichem SPA	7	3.005	2.196	73.1
-	Sinopec Corp.	5	1.99	1.99	100
-	PetroChina	2 ‡	0.8	0.8	62 §

Sources: *Oil and Gas Journal*, 23 April 2001. Authors' own research.
Notes: * As of 1 April 2001. ** End of 2000. ‡ Sites of annual capacity over 350,000 tonnes.
§ Percentage of total capacity of company.

Product mix

A high proportion of China's petrochemical and refined products are low value-added products. High-value added petrochemical production only accounts for 30 per cent of total petrochemical production. Only 73 per cent of the diesel produced can be classified as the 'first class' and 70 per cent of the lubricants are of middle or high premium. By 1997, China could only produce 128 types of synthetic resins, compared to over 10,000 types produced by Japan (Chen Yongkai, 2001). The total petrochemical output and low value-added products has not kept up with the rapid growth of China's economy, which has led to large imports of petrochemicals. By 2000, imports of refined products and major petrochemicals accounted for up-to-half of the Chinese market (table 7). With further reductions in import tariffs after China's accession to WTO, even these low value-added petrochemical products will face intense competition not only from global majors but also from low-cost producers in the Middle East and the South-East Asia.

Table 7
Market share of imported oil products and petrochemicals in China, 2000
(Per cent)

Imported product	*Market share*
Refined products	20
Lubricants	25
LPG	50
Synthetic resins	48
Synthetic fibres	30
Synthetic rubbers	44

Source: Sinopec.

Technology

Both PetroChina and Sinopec have made many important technical advances. However, both companies are still far behind the global giants in their development of world-leading technologies. Whereas the world's leading oil and petrochemical companies each produce more than one thousand

patents annually, Sinopec produces only around 300. In the year 2000, PetroChina and Sinopec spent $212 million and $200 million respectively on research and development, about one-fifth to two-fifths of that spent by the 'big three' (table 5). The R&D spending/revenue ratio of Sinopec and PetroChina (0.5 and 0.7 per cent respectively) is no less than that of Shell and somewhat higher than that of Exxon Mobil and BP (0.4-0.5 per cent). However, the global majors are able to spend more on research and technological development in absolute terms due to the sheer size of their sales revenue. Moreover, they are able to purchase greater amounts of the R&D 'embedded' in the products of specialist suppliers to the oil and petrochemical industry.[10]

The technological capabilities of PetroChina and Sinopec both upstream and downstream are relatively backward. In exploration and production, their oilfield development equipment is at the world level of the late 1980s and in exploration equipment it is equivalent to the world level in the early 1990s. Oil extracting machinery and oil and gas treatment equipment are either imported complete or assembled in China. Key electronic instruments and software for exploration and production are imported. China's own industrial experts have pointed out that China's capability of technological innovation in upstream oil and gas industry is still at the level of a 'third world' country, which will be a great constraint on the industry's competitiveness and efficiency (*China Petroleum*, January 1999). The technological backwardness is reflected in the high level of energy consumption in petrochemical production. In ethylene production, PetroChina consumed an average of 872 kilograms of standard oil per ton in 2000 compared to the world average level of 500–690 kilograms. In addition, the percentage loss of ethylene is high. The average ethylene percentage loss in PetroChina's production was 1.3 per cent compared with the world average of 1.0 per cent. The high energy consumption level and high ethylene percentage loss contribute to the high cost of ethylene production. In China energy consumption accounts for 76 per cent of the total cost of production compared to the world average of 63 per cent. Moreover, only 55 per cent of the chemicals from the cracking process in China are further processed and utilized, which is significantly below the level achieved by the world's leading firms in the sector (Chen Huai, 1998: 29).

e) Financial performance

Revenue

Their sales revenue places PetroChina and Sinopec alongside the leading second tier of global oil and petrochemical companies, but far short of the industry leaders, Exxon Mobil, Shell and BP (table 5).

[10] For example, Schlumberger spends more on R&D than Shell (£324 million compared with £313 million), while Haliburton spends more than ENI (£160 million compared with £146 million) (DTI, 2000: 54).

Profit

In the year 2000 net profits at PetroChina and Sinopec dramatically improved to $6.67 billion and $2.30 billion, compared with $0.33 billion and $0.56 billion respectively in 1999. The gap in net profits with the global giants has narrowed considerably from being only a small fraction in 1999 to almost one-third and one-half that of the 'big three'. However, Ma Fucai, Chairman of PetroChina cautioned that 80 per cent of the company's increased operating profit in 2000 resulted from the rise in crude and refined oil prices (*FT*, 23 April 2001). Most of Sinopec's revenue increase came from the marketing and distribution of its oil products 'at a time of unusually robust prices' (*FT*, 17 April 2001). The year 2000 may not provide a good guide to the two companies net profits in the medium-term.

Profits per worker at PetroChina and Sinopec are minuscule compared to those at the world's leading companies in the sector. PetroChina and Sinopec each has a workforce four to five times as big as that of the top three global oil and petrochemicals giants (table 5). Downsizing these huge institutions is a complicated and difficult task

Market capitalization

PetroChina and Sinopec have market capitalizations that are only a small fraction of that at the leading global companies. If one assumed that the whole company was floated, then at the current share price, the market capitalization of PetroChina and Sinopec would be $35 billion and $14 billion respectively, compared with $286 billion for Exxon Mobil, $206 billion for Royal Dutch/Shell and $178 billion for BP (table 5). Analysts estimate that PetroChina's average annual revenue growth rate in the next five years will be 4.9 per cent, only one-half of that of Exxon Mobil and only one-third of that of the whole oil industry. Industry experts have voiced serious concerns about PetroChina's level of operational efficiency and about the high level of uncertainty in its performance after China's accession to the WTO. PetroChina's P/E/G (price/equity/growth rate) ratio is predicted to be less than 1.0, compared to 1.7 of Exxon Mobil. The shortfall is attributed to the element of 'institutional risk' involved in China (*Finance*, April 2001).

4. Organizational structure

The organizational structure of PetroChina and Sinopec is superficially similar to that of an international integrated oil company. They have established a board of directors, a senior management team and core businesses segments from upstream to downstream. The superficial similarity conceals important differences.

The global giants have a strong 'one company' corporate identity and culture. Within PetroChina and Sinopec there exist powerful entities that over the years developed strong independent corporate identities and ambitions. They struggled for autonomy in business management and aspired to become independent competitive companies. Daqing is China's largest oil field. It is now under PetroChina. Over a history of forty years, Daqing developed a strong corporate identity. Its employees took great pride in being 'Daqing people' (*Daqing ren*). Daqing was in many ways like a small country within China. Daqing had the corporate ambition to build itself into a leading oil company able to compete on the world stage. Daqing strongly believed that it should be an independently-floated firm. In the 1990s, four companies under Sinopec, including Zhenhai, Shanghai Petrochemicals (SPC), Yizheng and Yanhua listed separately in international stock markets. Zhenhai and SPC each had a history of more than thirty years and developed strong, distinctive corporate identities. Each devised plans and strategies for development through mergers and acquisitions. Both PetroChina and Sinopec took strong measures during the restructuring to integrate these powerful subordinate companies by centralizing control over planning, personnel, investment and finance. Nevertheless, establishing a unified corporate identity and culture remains a formidable challenge.

The relationship between the two listed companies and their parent companies remains ambiguous. As discussed above, CNPC controls 90 per cent of PetroChina and Sinopec Group controls 56 per cent of Sinopec. A principle part of the annual income of CNPC and Sinopec Group is from the dividend payment of the two listed companies. In 2000, CNPC received an approximate $3.1 billion dividend payment from PetroChina,[11] accounting for 53 per cent of its net profit. CNPC has retained the non-core businesses as well as social functions employing more than 800,000 people, a large fraction of whose activities are loss-making. The non-core businesses of Sinopec Group employ more than 600,000 people but none of the businesses in which they are employed made a profit in 1999. To what extent PetroChina and Sinopec have autonomy in decision-making with respect to business strategy, dividend payments and appointment of senior management remain unclear. Of the thirteen directors on the board of PetroChina (including three independent non-executive directors), five concurrently hold top positions with CNPC. Of the ten directors of the board of Sinopec (including three independent non-executive directors and one employee representative director), two also have top positions with Sinopec Group. Ma Fucai, Chairman of PetroChina, and Li Yizhong, Chairman of Sinopec, are each concurrently the president of the respective parent companies. Such a structure has caused concern to be expressed about the respective companies' commitment to creating shareholder value and protecting the rights of minority shareholders.[12]

[11] Based on PetroChina's dividend payment of $0.02 per share and the weighted average number of 171,630 million shares issued and outstanding in 2000.

[12] The issues of creating shareholder value and protecting minority shareholders are discussed in *China Petroleum*, April 2000, p. 18-29 and an article 'Oil industry: choices after flotation' in *Finance* (*Caijing*), November 2000. The paper comments: 'For the listed state-owned companies, this kind of structure involves risks that cannot be anticipated. It will affect the profits of a company and distort the behaviour of a company, which in fact jeopardizes the interest of shareholders. As a common problem, it will eventually damage the credibility of the Chinese concept shares (*zhong guo gai nian gu*).

5. The competitive landscape

The global giants are deeply interested to develop their business in China from upstream to downstream. In upstream exploration and development, there were 167 onshore blocks open to foreign companies for exploration and development. By 1999, total foreign investment reached $1.1 billion in onshore upstream and $6.45 billion in offshore upstream (SETC, 2001). There are altogether 70 oil companies from 18 countries participating in upstream activities (SETC, 2001), including the global giants Exxon Mobil, Shell, BP Amoco and other major players such as Texaco, and Phillips. In petrochemicals, six global majors will set up six joint ventures in petrochemical complexes by 2005 (table 8)**.** These projects each involve investment from $2.5 billion to $4.5 billion and all are located in the coastal regions, which have the highest average income level in China. Demand for ethylene was around 7.5 million tons in 2000 but total ethylene capacity in China was 4.3 million tons in the same year. It is projected that demand for ethylene will reach 10 million tons in 2005 (*Oil and Gas Journal,* 10 January 2000). If we assume all the joint venture projects start production in 2005, they would account for 42 per cent of total projected ethylene demand in China. In addition, the joint ventures (JVs) will have major associated production capabilities in related petrochemical products, in which the global giants are in most areas technologically far ahead of their Chinese counterparts. From the perspective of the foreign partner in the JV, they each form a part of the respective global business system, typically a single business unit. In this sense, they represent an important growth of the multinational giants within the indigenous Chinese firm.

Table 8
Proposed major Sino-foreign petrochemical joint ventures

Major partners	*Ethylene capacity (Thousand tons per year)*	*Investment ($ billion)*	*Location*	*Date of completion*
Sinopec SPC/BP*	900	2.7	Shanghai	2005
Sinopec Yangzi/BASF*	650	2.7	Nanjing	2005
Sinopec Fujian/Exxon Mobil/Saudi Aramco	600	2.5	Fujian	2005
Sinopec Tianjin/Dow Chemical	600	-	Tianjin	-
PetroChina Lanzhou/Phillips	600	-	Lanzhou	-
CNOOC/Royal Dutch/Shell*	800	4.5	Guangdong	2005

Sources: *Chemical Week*, 13 October 1999, *Oil and Gas Journal*, 23 April 2001. Authors' research.
Note: * Under construction.

The global majors have become strategic investors in PetroChina and Sinopec. Equity involvement by the global super-majors was crucial to their successful listing. Before its international listing, Sinopec signed an agreement with each of its strategic investors to develop businesses both upstream and downstream in China. In the upstream sector, Royal Dutch/Shell will partner Sinopec to develop natural gas resources in Inner Mongolia, the Ordos and Tarim Basins. In refining and marketing, Exxon Mobil will establish a joint venture with Sinopec for retail marketing in Guangdong Province, which will involve setting up 500 service stations within three years. Exxon Mobil will study the feasibility of doubling the current refining capacity of 150 thousand barrels per day at

Guangzhou Petrochemicals Company. Royal Dutch/Shell will have a joint venture with Sinopec involving 500 service stations in Jiangsu Province. BP will set up a joint venture with Sinopec to acquire, renovate or build 500 service stations in Zhejiang Province. These service stations will have the logos of both BP and Sinopec and will sell petrol supplied by Sinopec and other refined products supplied by both companies. For the three companies, this was *'but the beginning of their attempts to capture a share of the world's largest retail market'* (*Petroleum Economist*, October 2000). In April 2001, PetroChina established a retail marketing joint venture with its strategic investor, BP, in Guangdong Province, with PetroChina holding a 51 per cent equity share and BP holding the remainder. The joint venture will consolidate the 366 service stations owned by PetroChina and the 43 service stations owned by BP in Guangdong. A further 100 service stations will be acquired in 2001. The strategy of the global giants to expand their downstream, high-margin business, each in a different part of the China's high-income coastal markets, is clear.

6. Conclusion

In the evolutionary reform of large state-owned enterprises in China's 'pillar industries', the creation and international listing of PetroChina and Sinopec marked a crucial step in the attempt to create modern, internationally competitive firms. The process of restructuring and flotation was achieved through administrative measures within just one year.[13] This was an immense achievement.

Despite this achievement, substantial question marks remain. Across the whole value chain from upstream to downstream, PetroChina and Sinopec are at disadvantage in terms of the quantity of oil and gas reserves compared with the national oil companies, and in terms of global distribution and quality of reserves compared with the super-majors. They are at disadvantage in technology and financial strength compared with the global majors. There remains a deep internal battle to establish a cohesive corporate culture to integrate their powerful subordinate companies and establish a truly unified company. The relationship between the floated company and the parent remains unresolved. Across the value chain, PetroChina and Sinopec have been actively forming 'strategic alliances' and establishing joint ventures with global oil and petrochemical companies. How stable will these partnerships be, especially after China's accession to the WTO? Will PetroChina and Sinopec eventually emerge as the 'firm' that is to compete globally? The institutional structure of PetroChina and Sinopec remains in evolution.

The full extent of the challenges facing the Chinese oil and petrochemical industry on the verge of China's entry to the WTO was bluntly spelt out at a meeting convened by the State Planning Commission at the end of September 2001 (Xinhuanet, 2001). The reports to the meeting stressed that

[13] For a detailed description and analysis of the institutional evolution of CNPC and Sinopec prior to their international listing in 2000, see Nolan (2001), Chapter 7.

this is a 'pillar industry' for China's national economy. They emphasized that acceleration of the trend of globalization and consolidation means that China's petrochemical industry 'faces critical challenges from many aspects'. Experts at the meeting emphasized that China's petrochemical industry was a late-comer to the sector, and that it still had 'low technological and management standards'. The final verdict at the meeting on the state of the industry was blunt:

> The overall technological level of the petrochemical industry of our country lags behind the advanced countries about 10-15 years and has a fairly large gap compared with the world's advanced level. The energy and material consumption level of the majority of the refineries and ethylene crackers is higher than the average level in Asia. The capabilities of technological innovation are weak. Patented self-developed technologies are few. Development and introduction of high and new technologies and products is weak. Engineering capabilities are weak and lacking in potential for further development.

The institutional experiment in China's oil and petrochemical sector is being closely watched by all concerned to understand the future course of China's industrial strategy regarding large firms and their relationship with the global giants. This sector is held up as a beacon for other sectors to study in restructuring to face the challenge of globalization and consolidation. PetroChina and Sinopec have both successfully restructured and floated on international markets. However, everyone within the Chinese industry is fully aware of the deep challenges posed by globalization and China's deepening integration with the global economy and business system. It remains an open question whether PetroChina and Sinopec will succeed where YPF failed.

III. AEROSPACE

A. Global trends

1. Consolidation

The dramatic change in the demand side of the world's aerospace industry in the 1990s has been a powerful force to drive forward consolidation. After the Cold War, both the United States and Europe drastically reduced their defence spending. In the United States, total defence expenditure fell from a peak of $390 billion in 1986 to $253 billion in 1999, and in Europe (NATO) the total budget fell from a peak of $191 billion in 1990 to $135 billion in 1999 (IISS, 1999, p. 37). Procurement techniques rapidly moved towards those of the civil aerospace world as governments push contractors to lower costs. Alongside the decline in defence procurement, European and United States military aircraft manufacturers have been able to sell to markets that were inaccessible during the Cold War. The fastest growing market for Western arms sales was the Far East, to which arms deliveries increased by one-third in real terms from 1987 to 1998 (IISS, 1999, pp. 281–283). The countries

around China substantially increased their arms purchases from $9.1 billion in 1987 to $12.8 billion in 1998, compared with China's purchases of $0.9 billion and $0.5 billion in the same years (table 9).

Table 9
International arms deliveries within East Asia, 1987 and 1998
(Million of constant 1997 US dollars)

	Total	*China*	*Japan*	*Taiwan Province of China*	*Republic of Korea*	*Thailand*	*Malaysia*	*Singapore*	*Indonesia*
1987	9,926	877	1,512	1,408	1,012	581	95	418	351
1998	13,236	469	2,086	6,258	1,366	313	334	887	365

Source: IISS, 1999, p. 283.

Until the events of 11 September 2001, the civilian aircraft market had been predicted to grow substantially in the years ahead. Airbus had forecast that over the next two decades from 1997 to 2017, the world-wide airline fleet would increase from the 1998 level of 9,700 to 17,900. Airlines were predicted to buy 13,000–14,000 new and replacement aircraft over that period with a total value of around $1,200 billion. The predicted market for aero-engines (including original sales and sales of spare parts) was estimated to be around $500 billion in the next two decades (*FT*, 3 September 1998). These forecasts now need to be radically revised. However, even if they are substantially reduced, the market is still very large. Moreover, it is likely that a decline in commercial aircraft purchase will, to some extent, be partially compensated by increased purchase of military aircraft and other military equipment.

The nature of the market for civil aircraft has altered significantly since the 1980s. The privatization as well as international alliances among the world's airlines placed great pressure on aircraft suppliers to reduce cost. One major effect of the events of 11 September 2001 may well be to force national governments to end restrictions on foreign ownership of airlines. If so, the current parlous financial state of most of the world's airlines is likely to lead to large-scale global consolidation in the world airline industry, mimicking that among the equipment makers.

a) United States of America

Initiated by the Pentagon, over $62 billion-worth of mergers and acquisitions occurred between 1994 and 1998 in the United States (table 10). The most significant event in this process was the merger between Boeing and McDonnell-Douglas. The resulting extraordinarily high level of industrial concentration received 'strong support from the United States administration (*FT*, 23 September 1997). After the Boeing/McDonnell Douglas merger, Boeing and Lockheed Martin between them accounted for close to one-half of United States defence department contracts, and almost completely dominated military aircraft sales to the United States government (*FT*, 3 September 1998). The merger also resulted in Boeing being the only producer of jet airliners in the United States, the world's largest

airline market by far. Moreover, unlike Lockheed Martin, Boeing was now a colossus that spanned both the military and civilian spheres of aerospace production. Boeing accounted for no less than 84 per cent of the world's total commercial aircraft in service (*FT*, 23 September 1997). On 26 October 2001, the Pentagon made a 'winner-take-all' decision and awarded the $200 billion Joint Strike Fighter (JSF) programme, the biggest ever defence procurement, to Lockheed Martin. The procurement decision 'catapults Lockheed into an unassailable position as the world's top builder of fighter aircraft' (*FT*, 29 October 2001).

Table 10
Principal mergers and acquisitions in the United States defence industry, 1994-1998
(Deals of over $500 million only)

Acquirer	*Acquiree*	*Value ($ million)*	*Date*
Loral	IBM Federal Systems	1,575	March 1994
Northrop	Grumman	2,100	April 1994
Lockheed*	Martin Marietta*	>9,000	March 1995
Rolls-Royce	Allison Gas Turbine	525	March 1995
Loral	Unisys Defense Operation	862	May 1995
E-Systems*	Raytheon*	2,300	June 1995
Northrop Grumman	Westinghouse Electronic System	3,600	March 1996
Lockheed Martin	Loral	9,500	April 1996
Boeing	Rockwell Aerospace and Defence	3,025	Dec. 1996
Boeing*	McDonnell Douglas*	13,300	1997
Raytheon	Texas Instruments Defence Business	2,950	1997
GM Hughes Defence Business*	Raytheon*	9,500	1997
GEC	Tracor	1,400	1998

Source: *FT*, 3 September 1998.
Note: * For mergers, acquiring and acquired company are shown in alphabetical order.

b) Europe

By the late-1990s, the defence industry had become much more concentrated in the United States than in Europe. The level of government procurement in the United States is far above that in Europe. In 1999, the total defence budget of the United States was more than twice the size of that of the whole of NATO Europe (IISS, 1999, p. 37) and is certain to rise substantially in the wake of the events of 11 September 2001. Also a large fraction of Europe's procurement spending is still conducted by individual countries.

The European military aerospace industry realized that it must unify or perish before the United States challenge. In 1998, the 'national champions' of the United Kingdom, France and Germany, namely BAe, Aerospatiale and Dasa, declared their intention to unify into a single company, the European Aerospace and Defence Company (EADC), with a single management structure and quoted on the stock market. It was intended to incorporate all sectors of the European aerospace industry from military aircraft, guided weapons, space and defence electronics to large civil aircraft (including a restructured Airbus). However, the merger of BAe with GEC-Marconi in January 1999 posed a serious setback to the cause of European aerospace integration. Renamed BAe Systems, the new company

became the world's second largest in terms of military revenues (*FT,* 20 January 1999). Despite the serious setback to their plans, in October 1999, Dasa and Aerospatiale-Matra merged into a new giant company called the European Aircraft, Defence and Space Company ('EADS', as opposed to 'EADC'). However, EADS now has serious problems with its management structure leadership (*FT,* 16 November 2001). Moreover, BAe Systems, EADS's partner in Airbus, Eurofighter, now is a full partner with Lockheed Martin in the JSF programme. France is committed to its own Rafale fighter through Dassault and compete for export orders with EADS's Eurofighter. Italy has decided to quit the European programme to build a large military transport aircraft A400M.

In civilian aircraft production, the competition between Airbus and Boeing became more ferocious more than ever during the 1990s. Twice Airbus overtook Boeing in terms of new orders in 1994 and 1999. Moreover, in 2000, Airbus announced that it intended to proceed with plans to build a super-large aircraft, the A380 to directly challenge Boeing in the most lucrative segment of the market. The A380 is intended to carry more than 500 passengers. From 1996, Airbus began the prolonged attempt to transform itself from a 'Groupement d'intérêt économique' into a limited company floated on the stock market. EADS now holds 80 per cent of Airbus, compared with just 20 per cent for BAe Systems. This made it easier to turn Airbus into a single company. However, the events of 11 September will put severe pressure on Airbus, especially given the large outlays already undertaken on the A380, for which the market now looks much less optimistic than before 11 September. In sum, the final shape of the European aerospace industry is far from certain.

c) Transatlantic option

The United States has the world's largest arms market by far. Leading European aerospace companies are not only seeking to expand their roles as sub-contractors and risk-sharing partners for the United States giants, they are also considering merging with leading companies across the Atlantic. The possibilities for a 'transatlantic solution' seemed to be growing stronger in 1999. In an effort to prevent the emergence of a 'Fortress Europe' in the arms industry, the United States government moving towards relaxing its controls on foreign investment in the industry and greater technology sharing with European-based defence firms. Jacques Gansler (Head of Procurement, Pentagon) announced that the Pentagon was willing to allow European or Asian companies to 'buy major United States defence companies under certain conditions', one of which was that other countries must reciprocate, allowing similar access to their own markets (*IHT,* 8 July 1999). He believed that such mergers would create 'a huge new defense market' and would make it easier for allies who are likely to fight together in future wars to co-operate on developing common weapons (*IHT,* 8 July 1999). If realized, such mergers would radically change the nature of the Euro-US defence industry relationship and have a strong impact on the possible formation of the mooted EADC.

2. Systems integration

a) Integrating the supply chain

Modern aircraft and engines have become so complex, that a major aspect of competitive advantage has become the ability to integrate the whole system of supply to produce the final product. The surrounding system of suppliers today constitutes a veritable 'external firm', whose activities are closely co-ordinated and planned by the core systems integrators who design and assemble the civilian aircraft or are the prime contractors for defence industry contracts. For example, Rolls-Royce purchases around 70 per cent of the value of the final product from outside the company. Airbus has more than 1,500 suppliers in 27 countries. Its system of suppliers is truly global, including over 500 United States companies, and suppliers in Singapore, India, Australia, Indonesia, the Republic of Korea, Japan and China. The size of the 'external firm' can greatly exceed that of the core companies. Boeing's 'external firm' employs around three-quarters of a million people across the world, including sub-contractors in China. Rolls-Royce has around 20,000 people in its aerospace division in the United Kingdom, and estimates that around 40,000 people work full-time to supply the company with goods and services.

Organizing global supply networks has become an increasingly important part of the modern aerospace industry. The large scale components purchase that system integrators make from outsourced supply networks has necessitated large investments in IT systems to integrate the supplier networks tightly with the core design and assembly location, and involves increasingly detailed, instantaneous exchange of information. 'Lean production' techniques are essential to cost reduction and control. Rolls-Royce believes that intensified inter-actions between the core company and the network of over 1,500 first-tier suppliers are the main factors behind the sharp improvements in system performance.

b) Building internal systems integration capabilities

Alongside the trend towards concentration among component and sub-system suppliers, the leading systems integrators are themselves tending to become more vertically integrated. This enables them to perform the increasingly complicated tasks involved in integrating complex sub-systems with multiple interfaces (MSDW, 1999, p. 85). For example, Raytheon bought a succession of military businesses in the 1990s, including the military electronics company, E-Systems, the military systems and electronics business of Texas instruments, and the Hughes military electronics business from General Motors. Through the purchase of Hughes, it established a 'near monopoly in United States air combat weapons' (*FT*, 13 January 1997). By the late 1990s, Raytheon had become a huge company with a $20 billion annual turnover, and a wide range of systems integration capabilities in missiles and

torpedoes. In Europe, BAe acquired Siemens Plessey in 1997 in order to strengthen its in-house capability in information technology, central to electronics systems integration. BAe's 1999 merger with GEC-Marconi brought a major prime contractor in military equipment together with a major aerospace electronics company. The acquisition dramatically enhanced BAe's ability to develop its systems integration capabilities and compete as a prime contractor for the largest defence programmes, including aircraft carriers and combat aircraft.

3. The 'cascade' effect

The intense pressure from global systems integrators compelled the component supply industry to undergo rapid change. In order to meet the demands of the systems integrators, the major components suppliers themselves needed to invest heavily in R&D and to grow in order to benefit from cost reduction through economies of scale. A powerful merger movement is taking place among first-tier suppliers to the systems integrators: 'More mergers among the smaller sub-scale components and sub-systems manufacturers seem inevitable as the supplier base responds to the pressure being applied by the prime contractors such as BAe, or original equipment manufacturers, such as Boeing' (MSDW, 1999, p. 87). Indeed, leading first-tier systems integrators have themselves become 'systems integrators' of major sub-sections of aircraft.

In the crucial aircraft engine sector, there are now only three engine makers left that have the capability to produce large modern jet aircraft engines, namely Rolls-Royce, Pratt and Whitney of United Technology and GE Engine of GE. In 1997, the market share of civil aero-engine orders in terms of value between them was 34 per cent for Rolls-Royce, 53 per cent for GE and 13 per cent for Pratt and Whitney (*FT*, 6 March 1998).

In 1999, Allied Signal, one of the world's top five aerospace companies, strengthened its already powerful position as a first-tier supplier still further when it announced that it was to merge with Honeywell. The new company's largest single business is aerospace, with about $10.5 billion in annual revenues, 'bringing together Honeywell's focus on sophisticated avionics with Allied Signal's in-flight safety products and systems' (*FT*, 7 June 1999). The new Allied Signal/Honeywell company has 'a strong position in everything from manufacturing cockpit controls to handling aircraft service and maintenance' (*FT*, 8 June 1999). The combined R&D expenditure of the two companies is almost $800 million (DTI, 1998, pp. 60 and 63). Honeywell explicitly pointed to the consolidation of customers as a major reason for the merger (*FT,* 11 June 1999). Only through merger and cost-cutting can companies like Honeywell compete and establish long-run strategic partnerships with the giant customers like Boeing, Lockheed Martin and BAe Systems.

The trend towards concentration is affecting smaller companies within the industry also. In June 1999, Meggitt acquired Whittaker Corporation for $380 million. The company supplies valves, ground fuelling products and fire and smoke detectors to 'virtually every aircraft maker in the West' (*FT*, 10 June 1999). The merger was explicitly driven by the assemblers' push to reduce the number of parts suppliers. Without the necessary scale the two companies felt they would no longer be competitive. Mike Stacey, Meggitt's chief executive commented: 'We are very conscious that bigger suppliers is what it's all about' (quoted in *FT*, 10 June 1999).

4. Embraer

Alone among developing countries, Brazil may be on the verge of building a successful national aerospace industry, though it is still too early to record a final verdict on the endeavour. Embraer (Empresa Brasileira de Aeronautica) was established by the Brazilian government in 1969, as part of its import-substitution-based industrial policy. Early strategies concentrated on aircraft designing, assembling and fuselages production. Although strongly supported by procurement from the government, the company focused on export markets which brought it longer production runs, new ideas for technical change, and exacting performance standards (Goldstein, 2001). In 1994, the company made a loss of $30 million. In the same year, the company was privatized. It was bought by three domestic shareholders, who between them owned 89 per cent of the company's shares. The Brazilian state still retained a 7 per cent holding in the company.

Since then, Embraer has grown rapidly from a small regional manufacturer into a significant global player in regional jets. Embraer rapidly developed the systems integration skills necessary to assemble a modern airliner. It purchased all the key components from outside suppliers, including the avionics, flight controls, engines, wings, tail units and fuselage segments. By the end of April 1999, Embraer had achieved 373 firm orders for the ERJ-135 (37 seats) and ERJ-145 (30 seats), and 390 options for the planes. In 1999, the company delivered 97 regional jets, compared to 82 from Bombardier, its main rival; 23 from BAe and 15 from Fairchild Dornier (HBS Case). The company directly employs over 7,000 direct employees and has an estimate of further 3,000 employees working in supplier industries in Brazil alone. Furthermore, in July 1999, Embraer announced the launch of a new family of larger jets, the ERJ-170 (70 seats) and the ERJ-190-200 (90 seats). The launch order, the largest ever for regional jets, was placed by Crossair of Switzerland and had a total of 200 aircraft with a total value of $4.9 billion. In October 1999, Embraer announced that a consortium of French aerospace companies including Aerospatiale/Matra, Dassault, Thomson-CSF and SNECMA would acquire 20 per cent of its equity, which would reduce the Brazilian shareholder's total stake to 69 per cent. In July 2000, Embaer listed in the New York Stock Exchange.

5. Conclusion: Competitive obstacles for firms based in developing countries

The aerospace industry is a capital-intensive high-technology industry with high barriers to entry. The profound transformation of the leading aerospace companies based in the United States and Europe in the 1990s created even higher barriers to entry than existed before. Today, major aerospace companies in developing countries face greater obstacles than ever in their attempt to catch up with the world leaders. Aerospace companies based in Europe and the United States benefit from vast military procurement, which together account for around 60 per cent of the world total military procurement. They have massive economies of scale in assembly with long production runs for each aircraft type. They have huge R&D spending and large R&D support from their respective government (table 11), especially in the United States, which has enabled them to sustain their technological lead: 'The development of the United States aerospace industry was largely government-funded. As late as 1986, close to 80 per cent of all R&D in this industry was Federally-supported' (White House, 2000). They have huge financial strength and resources reflected in large market capitalization (table 12), access to export credit guarantees supported by the government and often have the benefit of co-finance of industrial development with the government. They have high capabilities in system integration in both the internal and external firms on a global scale. They have established globally recognized brands both for aircraft and for key sub-systems.

Table 11
Share of R&D spending financed by government for aerospace, 1970 and 1990
(Per cent)

Country	*Share of R&D financed by government*		*Share of R&D financed by government, excluding defence-related expenditures*	
	1970	*1990*	*1970*	*1990*
France	65	49	54	34
United States	58	46	40	26
Germany	45	33	38	30
Japan	28	19	28	18

Source: Fransman, 1995, p. 107.

Table 12

World leading aerospace and defence company, 2000

Company	*Assets ($ billion)*	*Revenue ($ billion)*	*Profit ($ million)*	*R&D spending ($ million)*	*Market capitalization ($ billion)*	*Employee*	*Country/Region*
Boeing	42.0	51.3	2,128	1,351	53.3	198,000	United States
United Technologies	25.4	26.6	1,808	1,220	34.6	153,800	United States
Lockheed Martin	30.4	25.3	-519	606	14.5	126,000	United States
Honeywell	25.2	25.0	1,659	767	38.7	125,200	United States
Raytheon	26.8	18.3	141	492	10.1	93,696	United States
EADS	38.9	18.0	-835	948	-	88,879	Europe
TRW		16.2		832		102,000	United States
BAE Systems	26.0	14.6	-20	1,382	16.8	85,000	United Kingdom
General Dynamics	8.0	10.4	901	-		43,300	United States
Northrop Grumman		8.3	608	203		39,300	United States

Sources: *Fortune 500*, 2001. *Fortune Global 500*, 2001. *FT* 500, May 2001. DTI (2000/2001).
Note: Market capitalization by January 2001.

Not one firm from a developing country has succeeded in challenging the aerospace giants of the developed countries either as a systems integrator or a major first-tier supplier. Embraer represents the highest achievements so far for developing countries in the field of commercial aerospace. However, it is far from certain that in the foreseeable future it will be able to compete successfully with the established giants in even the regional jet market, let alone in the market for larger aircraft. Embraer is tiny compared with either Boeing or Airbus, and significantly smaller than Bombardier (Canada), its main direct rival. Moreover, in each of these cases, the aerospace division of each of the companies is part of a much larger group. In November 1999, the WTO ruled against both Brazil and Canada for the subsidies they had given to Embraer and Bombardier. Embraer faces the serious risk of 'head-on competition with Boeing and Airbus in the bottom end of the full-size jet market' (Goldstein, 2001). To these risks are now added the projected general downturn in the civilian aircraft market, with many analysts believing that for short journeys within high income countries, especially in North America, which is Embraer's main market, there will now be a large-scale switch to railways away from regional jets.

B. China's response

1. Ambitions and successes

The restructuring of China's aerospace industry started at the same time when the world's leading aerospace companies entered a period of profound change. In 1993, Aviation Industries of China (AVIC) was established, assuming responsibility for the management of all the aviation industry assets formerly under the Ministry of Aviation Industry. It was formally turned into an experimental state holding company in 1996. AVIC is directly responsible to the State Council, to whom its senior managers report. It has the entire Chinese aviation industry under its control, with formal responsibility for managing the industry's assets, and formulating the industry's business strategy. The goal of the holding company was to transform the nationwide collection of enterprises into an internationally competitive aviation company:

AVIC is promoting itself to become a gigantic enterprise group with worldwide fame and influence… The aviation industry has itself become one of the key high-tech industries with intensive technology and vast infrastructure. AVIC will become an ultra-large industrial group, which combines military and civil aviation, is transnational in operation, high technology and export oriented (AVIC, 1998, pp. 2–4).

In the early 1980s, Deng Xiaoping gave powerful support to the attempt to build a large indigenous jet passenger plane: 'Henceforth, China's domestic airlines should use only domestically-produced airplanes' (Deng Xiaoping, December 1981). By 1985, AVIC had achieved the extraordinary success of building a large civilian airliner, the Y-10, based on reverse engineering of the Boeing 707. It was produced by the Shanghai Aircraft Manufacturing Plant. Two planes were built and underwent extensive flight testing. At this time, Airbus was still in its infancy. China also developed its own turbo-prop regional aircraft, the Y-7, produced by Xian Aircraft Corporation (XAC). The earlier, fifty-seat, version was developed in the 1960s. An upgraded sixty-seat version entered commercial service in 1986.

Based on the foundation of assistance from the USSR, China built a large-scale military aircraft industry. By the late 1990s, it had manufactured a total of several thousand military jet aircraft, including large numbers of fighters and bombers. It has continued to build and technically upgrade substantial numbers of military aircraft.

In the late 1980s, China and Pakistan jointly developed a relatively advanced jet trainer, the K-8 Karakorum. In 2000, China for the first time exported an entire aircraft assembly line. It signed a $345 million contract with Egypt to produce 80 K-8E (the export version of the K-8) jet trainers. China will provide Egypt with parts and materials, technical training and service support for the aircraft. In addition, China will help Egypt build five aircraft design and research institutes (*Economic Daily* (*Jingji Ri bao*), 4 January 2000). Myanmar has also ordered thirty of the K-8Es.

These were significant successes for a developing country. However, AVIC faces massive challenges.

2. AVIC's businesses and structure

a) Size

In terms of employment AVIC is, indeed, a global giant. It employs over 500,000 people, more than twice as many as Boeing and Lockheed Martin. However, if one looks at AVIC's total sales and profits, the company appears far from being a 'global giant'. The combined total sales of AVIC 1 and AVIC 2 are less than one-tenth of Boeing's and one-fifth of Lockheed Martin's. Moreover, the core aerospace business of AVIC is extremely small, on a par with a medium-sized company such as Vickers (United Kingdom). In 1997, sales of aviation businesses was just $650 million, only accounted for 23 per cent of the total sales revenue and less than one-half the sales value of Vickers (table 13). Even this small total aerospace revenue generated by AVIC was produced by over 100 production enterprises in all branches of aerospace activity (excluding extra-atmospheric rockets).

We may assume that the value of the aircraft manufacture, airborne equipment and engine divisions of AVIC in each case are no more than $250 million,[14] with the aircraft division somewhat larger than the other two. Seen in this perspective, AVIC becomes simply a minnow on the world stage. Its engine division produces no more than 2 per cent of the sales value of Rolls-Royce, and its aircraft design and assembly division generates no more than 0.5 per cent of the sales value of Boeing. If AVIC's entire engine division were a separate company, and adopted Rolls-Royce's manning levels, it would employ only around 1,200 people.

Table 13
Relative size of selected aerospace companies, 1997 and 2000

	1997				*2000*			
Company	*Assets ($ billion)*	*Revenue ($ billion)*	*Profit ($ million)*	*Employee ('000s)*	*Assets ($ billion)*	*Revenue ($ billion)*	*Profit ($ million)*	*Employee ('000s)*
Boeing	38.0	45.8	-178	239	42.0	51.3	2.1	198
Lockheed Martin	28.4	28.1	1,300	190	30.4	25.3	-519	126
Raytheon	28.1	13.7	523	75	26.8	18.3	141	94
Northrop Grumman	9.7	9.2	407	47	10.1	8.3	608	39
Bae	7.2	10.4	681	44	26.0	14.6	-20	85
Rolls-Royce	3.8	6.9	-45	43	3.9	5.9	83	43
Vickers*	0.5	1.2	83	10	-	-	-	-
AVIC**	7.1	3.1	72	560				
of which:					-	-	-	-
Aerospace	-	0.7	-	-				
AVIC 1	-	-	-	-	4.2	2.52	-	236
AVIC 2	-	-	-	-	3.8	2.35	-	210

Sources: *Fortune*, 27 April 1998, *FT*, 22 January 1998, *Fortune 500*, 2001, *Fortune Global 500*, 2001. Authors' research.
Notes: * Vickers was acquired by Rolls-Royce in 1999 for $576 million. ** AVIC was split into AVIC 1 and AVIC 2 in 1999.

b) Non-aviation production

In line with the policy of 'military to civilian conversion' and the strategy of 'civilian supports military', AVIC had been turned into a vast empire of diversified businesses. In 1979, the share of non-aerospace sales stood at just 7.5 per cent of total sales of the Ministry of Aviation Industry. By 1997, their share had risen to more than 80 per cent. In real terms, the sales of non-aerospace products rose by around 23 per cent per annum from 1979 to 1997. By 1997, AVIC manufactured more than 5,000 types of non-aviation products covering a wide range from automobiles and production machinery to white goods and household appliances. Automobiles, automobile components and motorcycles together are the most important sectors within AVIC's non-aviation sales, accounted for 62 per cent of the total value of AVIC's revenue in 1997 (AVIC, 2000, p. 9).

c) Sub-contract/sub-system joint ventures

Since the late 1970s, international sub-contracts and sub-system joint ventures have grown rapidly in China. By 1995, AVIC had signed contracts for a cumulative total of $1.5 billion worth of sub-contracting work. The principal contracts were with Boeing, for the manufacture of vertical fins,

[14] A rough guess, assuming approximately one-third of total sales revenue is generated by each of the branches.

horizontal stabilizers and rear fuselage and with McDonnell Douglas for the manufacture of the nose section and horizontal stabilizers, for the MD-82 and MD-90. In addition there was a wide array of smaller contracts, for aircraft doors, wing sections, turbine disks, blades, bores, rings, atmosphere instruments, meteorological radar, general radar instruments, pumps and valves. AVIC had progressed from purely compensation trade to becoming a competitive global supplier of components, including being the sole suppliers of some items (B-747 wing rear ribs, B-737 maintenance doors, BAe 146 doors, Dash-8 cargo doors and LM2500 turbine disks).

China's aero-engine companies have developed many sub-contracting and some joint venture arrangements with the global industry leaders. Each of the big three engine makers, Rolls-Royce, Pratt and Whitney and GE Engine, has become involved in the Chinese engine industry. However, the arrangements are all still relatively small scale. Chengdu Aero-engine Company (CEC) is China's largest and was a key supplier of engines for China's fighter force. Its largest contracts are with Pratt and Whitney, but the total value of the export earnings from this contract was only $8 million in 1998, amounting to just 2 per cent of the gross value of output at CEC. In 1997 it established sub-contracting arrangements with Rolls-Royce, and is negotiating with GE to sub-contract engine parts. However, neither of these promises to be as large even as the contract with Pratt and Whitney. Xian Aero-engine Company (XAEC) has probably the largest international aero-engine partnerships of any Chinese engine company. In the 1970s it was selected as the location for the manufacture of Spey engines under licence from Rolls-Royce. In 1997 it started a relatively large-scale joint venture to manufacture turbine blades for Rolls-Royce but total output value will be only around $30 million at full production in the early 21st century (*China Daily Business Weekly*, 11 October 1998).

Despite their substantial growth, China's sub-contracts with the global giants are small-scale. For example, in 1997 sub-contracts were still a less important source of revenue for Xian Aircraft Corporation than either the production of aluminum h-shapes for the construction industry or the manufacture of Volvo buses. AVIC doesn't participate in the decisions over aircraft purchase in China. This limits its ability to place leverage on the global aircraft makers to sub-contract within China. Moreover, the main Chinese aircraft manufacturers are competing with each other to obtain sub-contract work, which weakens the overall industry's bargaining power in obtaining sub-contracts, and in settling the terms for the sub-contracts. In the meantime, China's leading sub-contractors face intense international competition from Israel in military sub-contracting, and from Japan and the Republic of Korea in civil sub-contracting. Another key limitation for China's sub-contractors is their inability to co-finance on a large scale. China's sub-contractors are generally only able to contract for 'Level 3' contracts, compared to the sub-contract of Japan and the Republic of Korea usually at Levels 4 or 5. The latter usually involves co-financing and co-designing.

d) Structure

Children and grandchildren

The business structure of AVIC is extremely complex with very limited monitoring and control from the headquarters. Under the commercialization programme, AVIC's subordinate enterprises became substantially responsible for their own development, a dramatic transformation in their method of business operation compared to the 'planned economy' epoch. AVIC has 116 subordinate plants grouped under 56 'children' enterprises. They construct their own business plans, retain profit for reinvestment in state assets, control the way to distribute the wage fund and the size and nature of the bonus, subject only to quite limited supervision from the headquarters of AVIC. The establishment of new 'grandchildren' companies is formally approved by the AVIC headquarters, but the newly established 'grandchildren' report to the 'child' company, not to AVIC headquarters. AVIC has no rights over the income from the companies established by the 'grandchildren' companies. There is a cascade of businesses each with investments in subordinate companies, from 'children', through 'grandchildren', 'great grandchildren', 'great-great-grandchildren' and 'great-great-great-great grandchildren'. The result is a typical East Asian diversified conglomerate, investing in any activity that brings some short-term profit, but without a common focus. This structure raises deep problems for corporate governance and central control over the operations of subsidiaries and related companies.

Flotation

The institutional structure of AVIC has changed gradually since the mid-1990s through the flotation of different parts of the Company. By 1998, four subsidiaries of CATIC had floated, including CATIC Shenzhen in Hong Kong (China), and Shenzhen FIYTA Group, Nanguang Group and Shenzhen Tianma in Shenzhen. In addition, Liuyuan Hydraulic Company floated in Shanghai, Nanfang Motor Company in Shenzhen, and XAC International in Shenzhen. The typical flotation is of a minority share in the floated company, with the majority shareholding still held by AVIC through its subsidiary company. For example, in the case of XAC International, XAC held 64.71 per cent of XAC International.

3. Development setbacks

In military aircraft, it is likely that there was a real fall in the amount of resources allocated to modernization of China's indigenous industry during the economic reform period. The number of military aircraft produced is reported to have fallen significantly (Nolan, 2001). The main thrust of the indigenous military fighter production capability was reported to be the F-8II 'Finback'. However, international experts believe that this aircraft was 'not comparable to contemporary Western or Russian aircraft'. They concluded that 'the failure of the Finback programme forced the PLAAF to seek alternative aircraft', with Russia as the supplier (Sergounin and Subbotin, 1999, p. 74). At the

time of the resumption of miltary cooperation with Russia in the mid-1990s, China had ‘a fleet of 5000 obsolete combat aircraft, most of them based on old Soviet designs such as the MiG-21 and MiG-19 fighter aircraft, and the Tu-16 bomber’ (Sergounin and Subbotin, 1999: 74).

In civilian aircraft, the Y-7 turboprop was able to win only a limited number of domestic orders. In the year 2000, just 64 of the Y-7s were in service in thirteen domestic airlines. In addition, the People’s Liberation Army used the Y-7 as a transporter. Export orders were negligible. By the late 1990s, a total of only 130 Y-7s had been produced, and new orders had dried up completely. To compound matters, in the year 2000, a Y-7 exploded in mid-air. Following the conclusion of the crash investigation, all Y-7s were taken out of service in June 2001.

China’s attempt to build its own indigenous large passenger aircraft, the Y-10, ultimately failed. China’s domestic airlines refused to buy the plane. It was extremely heavy compared to the Boeing 707, with high fuel consumption and a very limited range. The test models were, reportedly, only able to fly for around half an hour at a time. Only two of the Y-10s were built. The plane never entered commercial production, and the Y-10 programme was halted in 1985.

After the conclusion of the Y-10 programme, the Ministry of Aviation devised a ‘three-step take-off plan’, with the goal of building a 180-seater plane by 2010. The plan was to start with the assembly of the McDonnell Douglas 80/90 series of planes, which would provide China with an understanding of the skills needed to assemble a large modern aircraft. The second phase involved the intention to co-operate with a leading manufacturer, in order to jointly design and manufacture a state-of-the-art 100 seater plane, to go into service around 2005. This was the 100-seater Air Express 100 (AE-100) joint venture between AVIC and Airbus. The final phase involved self-design and manufacture of 180-seater aircraft. One by one each of these objectives fell by the wayside.

By September 1998 China’s AE-100 programme was scrapped and the planned MD-90 programme was terminated. A year earlier, neither Airbus nor Boeing produced a 100-seater plane, and China had hoped to produce one by 2005. Now Boeing would have a 100-seater aircraft in service by 1999, and Airbus would have one in service by 2002. China would have nothing. The double blows of the termination of the MD-90 programme and the AE-100 programme were perceived outside China to ‘deal a severe blow to China’s nascent aviation industry’ and ‘throw into doubt its plans to become a substantial aircraft manufacturer’ (*FT*, 5 August 1998 and 6 October 1998). The double blow of the end of both the programmes left China’s aircraft industry reeling. Its development strategy of ‘three stage take-off’ was in tatters. The coincidence of the double blow was remarkable. Many people in the Chinese aircraft industry felt that it had been let down not only by Boeing and Airbus, but also by CAAC, which had refused to order either the MD-90 or the planned AE-100.

4. 1999 Restructuring: splitting into two

We have seen that the rapid expansion of AVIC's non-aviation business in the 1990s created a company which consists of a relatively small aircraft firm, by all measures other than size of workforce, within the shell of a vast diversified conglomerate. Moreover, the vast business structure consists of powerful autonomous entities competing with each other for funds, investment, and sub-contracting opportunities. The function of the headquarters in monitoring, control, co-ordination and unifying the whole company to utilize resources and maximize returns is extremely weak. No one within the industry believed this was a viable structure upon which to build either a successful aircraft manufacturing industry or to construct a successful non-aerospace business. The succession of development setbacks intensified the sense of crisis within AVIC. Debate over how to restructure it in the light of its own internal problems and the explosive changes going on in the world industry outside became increasingly intense by early 1999. China's debate over the institutional structure of its aircraft industry took place alongside the similarly intense debate within the European aerospace industry.

By autumn 1998, the strategy for China's aerospace industry was at a critical conjuncture. In early 1999, the Chinese government decided to split AVIC into two fully integrated parts, AVIC 1 and AVIC 2. Each group contains the full range of production and sales of military and civilian aircraft, airborne equipment as well as non-aeronautical products. The stated goal of the reform was the 'break up of monopoly and the fostering of fair market economy mechanism' (*China Daily Business Weekly*, 31 January 1999). Zhu Yuli, AVIC president said: 'The two groups will both compete and co-operate' (quoted in *FT*, 2 February 1999). While the world's leading aerospace corporations were in the midst of an unprecedented epoch of merger and acquisition, the Chinese aerospace industry was being divided into smaller segments. Compared to the global giants, each of China's 'competing aerospace companies' was now even more of a minnow than before the restructuring, each with aerospace revenues of no more than $400 million, and each surrounded by a sea of unrelated businesses in the non-aerospace industry sector.

Instead of one huge diversified conglomerate with no capability to compete with the multinationals, the 'reform' of AVIC in 1999 created two smaller, and even less internationally competitive conglomerates. The reform could have separated the vast civilian from the aerospace business, but was unable to do so because this would have provoked such opposition from the subordinate entities who stood to lose many of their most profitable activities. It could have separated engines and avionics from the airframe business, but it didn't. It could have separated military from civilian aerospace, but it didn't. If its main goal was to develop its capability as a sub-contractor, then it might have allowed strong subordinate production units such as Xian, Chengdu and Shenyang to become independent companies that could compete for business with the multinationals, but it didn't. In sum, the prospects for AVIC on the global level playing field were bleak.

Not only did the Chinese government decide to split AVIC into two, it simultaneously decided to split into two the other main branches of the national defence industries, under the State Defence Industries Commission (COSTIND). Thus, the China National Nuclear Industries General Company, the China National Aerospace Industries General Company, the China National Shipbuilding General Company, and the China National Armaments General Company, were each split into two segments in order to 'foster competition'. Instead of five aerospace and defence industry companies, China's 'restructuring' has established ten much smaller companies.

5. Development plans

a) Regional airliner

New regional jet programme

At the end of 2000, it was apparent that China had abandoned the ambition to build a medium-capacity, single-aisle airliner. Zhang Hongbiao, Vice Minister of the Committee of Scientific and Technological Industries for National Defence (COSTIND), announced in November 2000 that China would instead focus on development of a new regional jet. COSTIND will invest $600–$725 million in research and development for the new regional jet programme aiming to build a new 50–70-seater turbofan aircraft to international standards. It is expected to be delivered within six years and will target both domestic and international market. The primary goal of this programme is a successful business venture making full, 'self-reliant' use of all of China's aviation manufacturing technology while looking for international cooperation in investment, design, sub-contract production and technical consultancy on the principle of 'risk and benefit sharing'. It is argued that production of regional airliners is the country's 'best bet', frankly acknowledging that China cannot directly compete with the multinational giants: 'We cannot compete with aviation giants such as Boeing and Airbus in financial clout and market share' (Zhang Hongbiao, quoted in *China Daily*, 6 November 2000). CAAC also expressed its support for the programme. 'We specifically encourage the use of domestically made aircraft for short regional flights' (Bao Peide, Vice Minister of CAAC, quoted in *Air Transport World*, January 2001, p. 57).

AVIC 1 has formed a programme management company to oversee resources, production, certification and marketing of the new regional jet named ARJ21. Led by the President of Xian Aircraft Co. and the chief designer of Shanghai Aircraft Design Institute, the company will become a share-holding firm. 'We are willing to form *long-term* and *stable* relationships with *well-established* international companies to work jointly on the new regional jet programme' (Liu Gaozhuo, President of AVIC 1, quoted in *Air Transport World*, January 2001, p. 57, emphasis added).

The market prospect for regional jets in China is promising. Boeing has predicted that around 70 per cent of the total of the 1,800 new medium- and large-sized commercial aircraft purchased by

China over the next twenty years would be single-aisle regional jets, such as the Boeing 737 or 717 and the Airbus 319 or 320 (Keck, 2001). Although the prospects for the regional jet market in the high-income countries must now be radically downwardly revised, the prospects for the Chinese market are still bright, as China does not yet possess a high-speed train network that could readily substitute for air travel. The competition for selling regional jets to China is intense, with extensive substitution of regional jets for the fleet of turboprops. In December 1999, Shangdong Airlines placed a firm order with Bombardier Aerospace for five CRJ200s, which are the first CRJs scheduled for service in China. In 2000, the Xian-based Changan Airlines placed firm orders with Bombardier for three 78-seat Q400s that are to replace its turboprop aircraft. In late 1999, Embraer signed a letter of intent to supply ten 50-seat ERJ-145s to Sichuan Airlines (*Air Transport World*, February 2000, p. 23). Hainan Airlines has placed an order with Fairchild Dornier for 39 328-JETs, with 12 aircraft already delivered (*Aviation Week & Space Technology*, 13 November 2000, p. 35). Boeing and Airbus continue to actively market their smallest aircraft to Chinese airlines in an effort to capture the regional jet market. Price competition in all aircraft categories can be expected to intensify following the collapse in the world aircraft market after 11 September 2001. This is good news for Chinese airlines, but bad news for a potential regional jet produced in China. If China is, indeed, successful in designing and building its own regional jet, it will be far behind in the race for its own national market by the time that the first deliveries begin. This will be a huge disadvantage in an already intensely competitive segment of the world aircraft market.

MA-60 (Xinzhou 60)

In 2000, Xian Aircraft Company (XAC) launched the MA-60, known as the Xinzhou 60 in China. Developed from the Yun 7-200A, the MA-60 is a 56- to 60-seat turboprop with an extended fuselage, longer range and lighter airframe weight. It is powered by Pratt & Whitney's engines and equipped with Collins avionics. It costs one-third less than comparable Western turboprops. A total of 26 MA-60s have been ordered by Chinese airlines. In 2000, the newly formed Shenzhen Financial Leasing Co. signed an agreement with XAC for 60 MA-60s (*Aviation Week & Space Technology*, 13 November 2000, p. 36).

However, the market prospects for MA-60 are poor. First, there is already intense international competition in the 50–70 seat turboprop market. Strong global market positions are already held by the ATR 42 (produced by Aerospatiale and Alenia), the Dash 8 (produced by Bombardier), and the Saab 2000 as well as the Russian-built An-24 in former Soviet states. A powerful player in this market, Fokker, with the F-50 turbo-prop, went out of business. China has already imported ATR 42s, five of which were in operation by the late 1990s. Almost 600 ATR aircraft had been sold worldwide by 1998, enabling the company to benefit from economies of scale in a way that the Y-7 was unable to do, and the MA-60 is most unlikely to do. Second, the whole future of turbo-prop feeder planes is in

doubt. In the developed countries, competition for small, local feeder aircraft has grown from high-speed trains, a trend that will be accelerated by 11 September 2001. Moreover, there has been a marked shift in airline preference towards jet-engine feeder aircraft. Jet aircraft are preferred for safety, reliability and customer preference. Third, the history of the Y-7 in terms both of its lack of commercial success and question marks about its safety, makes the task of marketing the MA-60 to commercial airlines, that must respond to passenger perceptions and demands, extremely difficult, even within China, let alone internationally.

b) Sub-contracting

Following the collapse of the proposed joint production plans for the AE31X and the MD-90, Airbus and Boeing both responded with offers of considerably enhanced participation by AVIC in the production of sub-systems. Boeing is leading in that strategy with 74 per cent of all parts built in China going to Boeing (*Aviation Week & Space Technology*, 8 May 2000, p. 63). Boeing has offered to make China the second supplier of the wing for the B-717, alongside the current supplier, Hyundai. Airbus agreed that AVIC could participate in the development of its 107-seat A318 programme. In addition, Shenyang Aircraft Manufacturing Co. and XAC will gain work on A320 wing components. Shenyang will make the wing's leading and trailing edge components and build up production levels to four sub-assembly sets per month for all of the wing's leading and trailing edge components. Airbus has agreement with XAC for doors on the A300, A310, A330 and A340 and the fin fairing for the A320 and a variety of components for the A300 and A310 programmes. BAe has discussed with XAC its possible participation in wing manufacture for the A-320. Xian is also expected to become a source for raw material for various components for Airbus aircraft (*Aviation Week & Space Technology*, 5 July 1999, p. 40). These provide the possibility for a significant increase in sales from sub-contracting. However, in the foreseeable future this segment of the industry still seems likely to lag far behind the level of sales and technological sophistication achieved by the sub-contracting industry in Japan and the Republic of Korea.

6. Conclusion

Since the early 1990s, the world's leading aerospace companies have achieved massive competitive advantages through high-speed consolidation and through the development of systems integration capabilities, hugely strengthening their already very powerful competitive position. Moreover, this period witnessed the near-disintegration of the former Soviet Union's civilian aerospace industry and a serious weakening of its military aircraft industry. AVIC has failed to make any inroads on the dominant position of the world's leading corporations.

The institutional structure of AVIC is far removed from that of the global giants. Surrounding the core aircraft business is a vast sea of unrelated non-core business, which raises fundamental

difficulties for corporate governance. None of the non-core businesses has achieved sufficient scale to compete with globally successful firms in the respective sectors. In its core aerospace business AVIC is a minnow, without any commercially successful aircraft in either the civilian or military market. AVIC has painfully weak financial resources with which to support R&D and fund new aircraft development programmes. It must support a huge workforce, but many of those with the highest levels of skills in aerospace are leaving the company to work in relatively highly paid jobs outside the sector. It is decisively loosing the 'battle for talent'.

To meet its needs for advanced fighter planes, the Chinese military has been forced to rely heavily on imports and domestic production under licence of Russian planes. In 1996, China ordered 200 Russian Su-27 (Sukhoi) fighters. The government has contracted to buy a further 50 Su-30 strike aircraft from Russia (IISS, 1999: 175). China's Central Military Commission is becoming 'more and more reliant on outside sources for new technology and support' (*Aviation Week & Space Technology*, 29 November 1999, p. 33). Exports to China have been a crucial source of revenue for Sukhoi in extremely difficult times for the company.

The Chinese civilian aircraft market is one of the largest and fast-growing in the world. Due to the downturn in the global aircraft market after 11 September 2001, the relative importance of the Chinese market may be even greater. The predicted 1,800 additions to China's commercial aircraft fleet by 2019 will be worth an estimated $137 billion (*Aviation Week & Space Technology*, 13 November 2000, p. 35). China's capability to capture its own large domestic market for civilian aircraft, let alone to penetrate the world market, has proved negligible. China was unsuccessful in its attempt to build a commercially viable turboprop plane. China's large and fast-growing regional jet market is dominated by imports. China was unable to build a commercially successful large passenger jet. China's attempt to partner the multinationals in co-designing and building a large civilian aircraft came to nothing. China's entire civilian aircraft fleet of around 500 passenger aircraft is imported, consisting mainly of Boeings (70 per cent) and an increasing number of Airbuses.

There is no sign that China is in the process of building large, globally competitive first-tier suppliers to the world's aircraft industry in sub-systems such as engines, avionics, airframes, wings, lighting or landing gear.

Since the 1980s, in this, the most 'strategic' of all Chinese industries, the gap between China's 'national champions' and the global giant companies has widened drastically. The Chinese market for commercial aircraft and advanced military aircraft will be dominated by imported aircraft in the foreseeable future.

IV. CONCLUSION

The period since the 1980s has seen dramatic changes in the structure of large capitalist corporations. These changes have established the structure within which competition will take place on the 'global level playing field' in the early part of the 21st century. The period saw an unprecedented concentration of business power. Numerous firms in the high-income countries no longer exist, having merged with or been acquired by the 'winners' in the battle for the global marketplace. Numerous large 'national champions' have now been merged into even larger cross-border firms, either 'European champions',[15] 'transatlantic firms', or, even, European-Japanese or United States-Japanese firms. Almost all of these firms remained headquartered within the high-income countries, were owned mainly by shareholders from, and had senior management drawn mainly from, the high-income countries.

Globalization has dramatically changed the competitive terrain for which developing countries' governments must devise their industrial policies. Of all developing countries, China is the one with the greatest possibility to support the growth of globally powerful corporations that might be able to compete in this new environment. It has a potentially huge domestic market and a powerful and relatively effective state through which to implement industrial policy. However, as this paper has shown, even for China, the task has become far harder and more complex than could have been imagined fifteen or twenty years ago when the country began its industrial reforms.

In the oil and petrochemical industry, the period saw the creation of a new breed of 'super-major', with annual revenues of $150–$200 billion, and an unprecedented capability to integrate activities across an extended internal value chain. This in turn challenged the existing middle-ranking firms within the industry, provoking a cumulative process of merger and acquisition. These developments drastically altered the benchmark against which China's firms needed to evaluate their progress in system reform. China's planners responded to this revolution through an immense restructuring, which represents a significant triumph for industrial policy in developing countries. In 2000, PetroChina and Sinopec successfully listed in the international stock market and rose into the ranks of the top ten publicly-traded oil and petrochemical companies. Despite this success there remain deep challenges posed by the revolutionary change among the world industry leaders in this sector. For each of these firms growth within the Chinese market is a major strategic goal. They are already making substantial progress in this objective, and can be expected to accelerate this progress after China enters the WTO.

[15] This term was increasingly used to describe firms such as Alstom, which was formed from the power equipment divisions of Asea (Sweden), Brown Boveri (Switzerland), Alsthom (France), and GEC (United Kingdom).

In the aerospace industry, the 1990s saw an unprecedented process of high-speed global consolidation. The process still has a long way to go before some kind of institutional equilibrium is reached. It not only resulted in a new breed of immensely powerful ‘systems integrators’, but also unprecedented business capability at lower levels of the value chain. Alongside these changes in the world’s aerospace industry, China has had its own ‘restructuring’ in aerospace by splitting AVIC into two entities. Chinese policy-makers are still groping for a strategy that will enable the country’s aerospace industry to find its place within this business revolution.

As China is about to enter the WTO, it is crucial that global big businesses and government policy makers in the high-income countries appreciate the severity of the challenges that confront China’s policy makers and business leaders, even in key ‘strategic industries’. It is not enough to repeat comforting phrases about the beneficial impact of privatization and the free market. Privatization and liberalization are far from sufficient to enable China’s leading firms to compete on the ‘global level playing field’. The ‘global level playing field’ is not an abstract concept. In the end the marketplace involves a competitive struggle between firms, which, together with consumers, are the building blocks of the economic system. For the leading systems integrators and first-tier suppliers in each industrial sector, this is a competition between small numbers of identifiable large, often oligopolistic, firms. The struggle is not between the innumerable nameless small firms of textbook perfect competition.

The global business revolution has sharply changed the balance of power in market competition. The ‘players’ on the playing field occupy far more unequal positions than they did prior to the business revolution. China’s leading firms are in a highly vulnerable position, even in sectors in which China’s policy makers have scored significant successes. Moreover, large Chinese firms operate in a totally different political-economic environment from that of the world’s leading corporations. China’s political leaders have to consider the huge difficulties that stem from the existence of around one billion poor people within their boundaries, and the complexities involved in the reform of China’s political system. If China’s large firms were to experience widespread defeat, especially in key ‘strategic industries’, in the battle on the global level playing field of the WTO, that would raise deep issues not only for the Chinese government, but also for international relations, and, ultimately, for the large firms headquartered in the high-income countries.

Coping with failure is a massive challenge. Coping with success can also be a challenge.

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