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The past, present and future of China's automotive industry: a value chain perspective

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Abstract: The economic growth and industrial development in China over the last decade has been of considerable interest to industry and policy-makers alike, and also been subject of many academic studies. Considerable research on the macro-economic growth and process of industrialisation, as well as the subsequent increase in the domestic demand has been reported. In case of the automotive industry, previous studies have analysed the rather complex industry structure, still dominated by a range of joint ventures between domestic and foreign manufacturers, and specifically commented on the potential and sustainability of domestic demand. In this study we aim to extend the focus by analysing the key features and challenges not only at the manufacturer, but also at the supplier and distribution tiers in the automotive supply chain in China. Reviewing the governmental policies that led the auto industry's development since 1950, we analyse the current capabilities and challenges at the different tiers in the automotive value chain, before concluding with an outlook on the factors impacting on the future development of the automotive industry in China.

[AQ2]: Please provide the keywords (not more than 10) for this paper.

Keywords: [AQ2]

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1 Introduction

With near-stagnant main markets in the USA, Western Europe and Japan, the attention of the global automotive industry has turned towards China, where the fast growing economy – coupled with considerable potential in domestic and export markets – is attracting much attention. This paper focuses on the automotive industry in China, and assesses the factors that have shaped its development historically and the development policies currently being pursued by the Chinese state. Until about 1975, there was virtually no passenger car production in China. Cars were the prerogative of a relatively small number of high-ranking officials, and most vehicle production comprised trucks, and to a lesser extent, motorcycles. Yet by 2004, China, with domestic passenger car sales of 2.3 million units, rivalled Germany for the position of third-largest market in the world, only superseded by the size of the US and Japanese markets. The recent growth in China follows a long-term trend in the motor industry, whereby industrialising countries increasingly feature local production capabilities, as opposed to importing vehicles from the developed world (Hong and Holweg, 2005). As in many other sectors, China, India and Latin America are seen as major market opportunities in an otherwise stagnant industry. With growing domestic demand, the establishment of manufacturing facilities in these countries is part of the global presence of the vehicle manufacturers. Some manufacturers have had operations in China for many years. Volkswagen, for example has been present in China since 1985 and has topped the rankings as one of the leading 50 foreign firms in China in terms of revenue for 19 consecutive years. Volkswagen plans to invest a further US$1.7 billion in the Asia-Pacific region by 2010, the majority of which will be in China (Zhang, 2001).

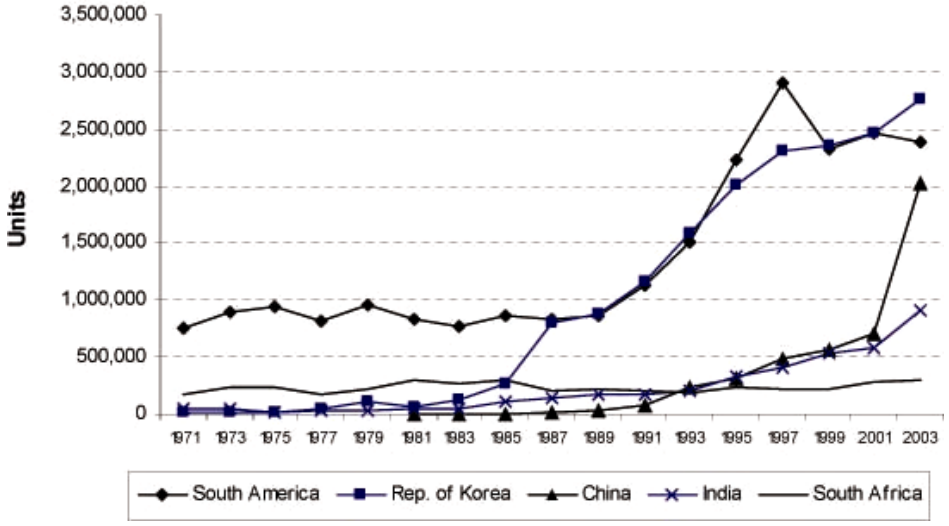
Figure 1 shows the development of auto-production in selected newly industrialising countries and regions. This shows a stark contrast to the stagnant or declining markets in the established regions of North America, Europe and Japan. The figure clearly shows the distinct phases of manufacturing capacity expansion in the Republic of Korea from 1985 onwards, in South America, and to a lesser extent, in India from 1990 onwards, and in China from 2000 onwards.

The trend towards globally distributed manufacturing is a long-term trend in the auto industry. The majority of vehicles produced in NIEs serve local rather than export demand,[1] a conclusion also supported by Sturgeon and Florida (2000).

Clearly, the growth experienced in China (albeit from a very low base) raises many questions. What factors are fuelling it? How are indigenous enterprises responding to the challenges posed by rapidly increasing volumes? What problems and opportunities await

both Chinese and non-Chinese enterprises attempting to take advantage of the developing automotive market? How sustainable is this growth, and what are the implications of such rapid growth?

Figure 1 Evolution of car production in selected newly industrialised economies and regions, 1971–2003 (see online version for colours)



Source: World Motor Vehicle Data (1980–2005)

This paper falls into three parts. First, the history of Chinese industrial organisation since 1949 is briefly reviewed. Second, the current state of the automotive value chain in China is analysed and key issues at the levels of vehicle assembly; component production and distribution in the automotive value chain in China are explored. Taking the perspective of the whole value chain is crucial, as much analysis to date has focused on industrial policy or concentrated on vehicle assembly operations only; vehicle assembly is only one part of a much larger and complex set of operations in the production and distribution of autos. Some future trajectories for the Chinese auto industry are then outlined, focusing in particular on the factors that determine its future development and sustainability, and the policy options to address the energy and environmental issues raised by mass motorisation in China.

2 The past – an overview of the development of China's auto industry

The development of China's automotive industry has clearly been shaped by the circumstances of China's wider political economy. To understand (and appreciate) its growth, it is important to understand its evolution in the wider context of China's industrialisation, which, unsurprisingly, has been centrally driven and shaped under very distinct industrial policies, which are reviewed in this section. The history of the automotive industry is considered in terms of four key phases of development: the central control and planning era of 1949–1979, the proliferation phase (1979–1994), the phase of concentration (1994–2004) and the most recent phase, since 2004.

2.1 The central control and planning era (1949–1979)

Before the Communist Party came to power in 1949 there had been 8 years of war against Japan and 3 years of civil war between the Communists and the Guomindang. There was virtually no automotive industry to speak of at that time. In the early years of Communist control China's main alliance was with the USSR, which provided assistance with many large projects during 1950–1960. One such project was the First Automobile Works (FAW).

The FAW was founded in 1953, in the northern city of Changchun, Jilin Province. Production of Jiefang (Liberation) trucks began in 1956, when 1600 units were assembled. This product was unchanged for about 30 years. In 1958, the Hongqi (Red Flag) limousine began production at the FAW. This was a high specification vehicle, used by senior Chinese officials. In 1991, the FAW entered into a Joint Venture (JV) with Volkswagen, initially to produce the Santana (a sedan version of the Passat Mk II) and later the Audi 100, the Jetta and the Golf.

When he visited the plant in the 1980s, Lee Iaccoca (ex-CEO of Chrysler) described it as following the "Rouge Pattern", due to its high degree of vertical integration, with most of the production of components taking place within the assembly plant itself. This is not surprising, as engineers from the former Soviet Union had visited Ford's Rouge Plant in Detroit during the 1930s, and transferred the Rouge model to the former Soviet Union. This model was subsequently transferred to China when the USSR helped China set up the FAW.

In 1958 there was the 'Great Leap Forward'. The economy had developed quite successfully between 1950 and 1957, and China aspired to catch up with Western economies in key industrial products such as steel, metallurgy equipment, power generators and machine tools within a period of 15 years. One of the criteria used to assess progress towards this goal was the output of iron and steel. In 1957, the output of steel in China stood at 5,350,000 tons. The Central Committee aimed to double the output of steel to 10,700,000 tons in 1958 (Xie and Oliver, 1996). Many units – even schools – joined the process of iron and steel and steel production, and some technical schools were actually turned into factories.

During the 1960s, international circumstances changed. The relationship between China and the Soviet Union deteriorated and in August 1960 the USSR withdrew 1390 experts, terminated 3343 contracts, ended its assistance and asked China to pay back all debts. At the Second People's Representative Conference in 1963, the Chinese government decided to pay back all the USSR's debt before 1965, and to pursue a policy of self-development. Over 30 years later, these ambitions were still reflected in the Automotive Industry Policy of 1994 in the form of ambitious local content and product development targets.[2]

There were frequent border conflicts between China and the USSR during the 1960s, and a border war between India and China in 1962. In 1965, China became involved in the Vietnam War, supporting North Vietnam against the United States. As part of the war effort, China set up a series of heavy and medium truck plants. The new plants were located in the mountain areas (away from the borders) and included the Second Automobile Works (more commonly known as Dongfeng[3]), the Sichuan Auto Works and the Shaanxi Auto Works.

As the relationship between China and the USSR worsened, China had to rely on its own resources for these developments. Consequently, all new automotive plants were designed, constructed and operated by personnel from existing auto plants. For example,

personnel from the FAW were involved in setting up the Second Automobile Works (Dongfeng). Ironically, Dongfeng became a competitor of the FAW in the early 1980s, and now has JVs with Peugeot-Citroen, Nissan, Honda and Kia.

Dongfeng was located in the mountain area, Hubei Province, and about 500 machine tool suppliers (many of them non-Chinese) supplied equipment to the FAW. However, because of distrust of outsiders, the Chinese themselves installed all equipment from foreign suppliers. Indeed, foreign suppliers did not even know where their equipment was located until China opened its doors in 1978.

2.2 The proliferation phase in the reform era (1978–1994)

In the 1970s, international circumstances changed again. President Nixon visited China in 1972, and China–US relations were normalised in 1978. China re-joined the United Nations in 1971 and the fear of war began to subside. Chairman Mao died in 1976, and at the Third Plenum of the 11th Chinese Communist Central Committee in 1978 Deng Xiaoping was endorsed as de facto leader. China began to open up to the rest of the world, and as it did so the focus moved from political to economic issues. 'Developing Productive Power' rather than 'Class Struggle' became the predominant concern.

Most crucially, at this point the transition from a planned economy to the market economy began. Provincial and municipal governments and ministries had more autonomy to make decisions without the fear of being accused of going down the capitalist road. Many chose the auto industry as a means of developing their regions or departments, and the automotive industry entered what might be termed a 'proliferation' stage. This proliferation occurred in two ways: an increase in the *volume* of output, and an increase in the *range* of products.

During the central planning stage (1949–1978), volumes and variety were centrally planned, rather than controlled by the market. Most vehicles were trucks and the production of passenger cars was very limited. Saloons were only available for senior officials and there were strict regulations concerning which officials could use which vehicles. With the relaxation of planning, there were many more customers and the market for saloons and other vehicles increased greatly. For example, there were no taxis at all during the central planning period, so as restrictions were relaxed, saloons and mini vans were produced to supply the taxi market.

Existing facilities offered neither the quality nor the diversity of products to satisfy the growing market. The FAW and Dongfeng, controlled directly by the central government, had the advantage of size but lacked flexibility. Small automotive factories began to develop under the direction of both provincial and municipal governments. Some machinery factories under the control of the Ministries of the Weapons Industry and the Aviation Industry also began production of vehicles such as light trucks, mini vans and large passenger cars. The number of automobile factories increased from 55 in 1979 to 114 in 1985.

[AQ3]: Table 1 was given but its citation was not provided and citation of Table 2 was given but the table was not provided; and Tables 8–10 were missing. Therefore, all the tables have been renumbered. Please check their renumbering as well as their citations.

2.3 The concentration phase (1994–2004)

The Chinese market for automobiles was protected by high tariffs – a situation that was only eased by China's accession to the World Trade Organization (WTO) in 2002. Table 1[AQ3] gives an overview of the tariffs pre- and post-WTO accession. A legacy of central planning was that the government decided the price of automobiles; this absence

of a market mechanism to mediate between demand and supply enabled small-scale auto factories to survive. However, these small-scale, scattered, manufacturing operations spread capital and other resources thinly, thereby hindering the development of large-scale automobile plants capable of competing with foreign automakers.

Table 1 Tariffs, pre- and post-WTO membership

	Before entry into WTO	*After entry in WTO*
Tariffs	200% in the 1980s 80%–100% in 1990s	25% by 2006
Import quotas	30,000 vehicles a year allowed from foreign carmakers	Quota increased by 20% a year, phased out by 2006
Local content requirements	40% in first year of production, increasing to 60% and 80% in second and third years, respectively	No local content ratio requirement after 2002
Auto financing for Chinese domestic costumers	Foreign, non-bank financial institutions prohibited from providing financing	Foreign, non-bank financing permitted in selected cities before gradual national rollout after 2002
Foreign participation in sales and distribution	Limited to wholesaling through JVs; prohibited from consolidating sales organisations of imports, JVs	By 2006 be allowed to own vehicle wholesale, retail organisations, integrated sales organisations

Source: Gao (2002)

Although the ministries and local governments have considerable autonomy, the central government continues to be influential with local governments, and by the 1990s two powerful forces were at work. On the one hand, the rapidly developing market and the growing presence of foreign companies put pressure on China to develop several large-scale, competitive automobile plants. After China started negotiations to join the WTO, there was only a limited period of tariff protection before Chinese enterprises were to be exposed to foreign competitors (see Table 1). On the other hand, local governments were supporting the development of local manufacturers to boost industrialisation in their respective regions, which led to the emergence of a range of smaller vehicle manufacturers owned by municipal governments, such as Nanjing Automotive. Nanjiing was originally a small-scale truck manufacturer, yet under pressure from the provincial government entered car production and later became Fiat's JV partner in China.

In 1994, the Chinese government designated a number of industries as 'Pillar Industries' intended to drive the national economy; the automotive industry was chosen as one of these industries. The reasons for this are not difficult to see – an automobile is composed of more than 10,000 parts and components; the automotive industry is related to many other industries such as metallurgy, petroleum, chemistry, coal, light industry, electronics and textiles, and it was reasoned that the development of an automotive industry would encourage Chinese enterprises in many sectors to specialise and coordinate their efforts better.

These conditions provided the background for the Chinese government's Automotive Industry Policy. The State Planning Commission, State Economy, Trade Commission and the Ministry of Machinery Industry submitted the policy proposal in February 1994; the

State Council approved it in March that year and published it in July 1994. The policy proposal had four key objectives: (1) to establish large-scale groups of saloon and light truck producers (to replace the small-scale, scattered manufacturers); (2) to improve the components industry; (3) to create automotive product development capabilities and (4) to encourage individual car ownership.

As well as the four objectives listed above, the policy addressed issues of local content requirements, pollution and environmental considerations, conditions for the approval of foreign investment and others. The policy contained an aggressive schedule for the development of the Chinese automotive industry, as outlined in Table 2, and was further amended in 2004.

Table 2 Stages of the automotive industry policy

Stage	*Description*
1994–1996	'Foundation' stage: Approved projects of light weight vehicles and saloons to commence production; the development of the components industry; vehicles to have a local content of 60%–80%
1997–2000	'Attacking Difficulties' stage: The target output for 2000 was 2.7 million vehicles, of which 1.35 million were saloons. The intention was that there would be two or three large-scale automobile groups and six or seven 'backbone' automobile enterprises. Basic R&D capabilities were to be established
2000–2010	'Rapidly Developing' Stage: The target output for 2010 was 6 million vehicles per year, of which 4 million were to be saloons. The industry was to be self sufficient for product development and competitive by international standards

Source: Table is authors' synthesis of the government policy documents cited before

2.4 Analysis of current automotive policy (since 2004)

China joined the WTO in 2002 and from this followed a number of steps to open up the market, including tariff reductions and eliminating local content requirements. These actions rapidly advanced the growth of China's automotive market. The government continues to look to the automotive industry to drive growth throughout the entire economy, including a variety of basic and service-related sectors such as machinery, rubber, petrochemicals, electronics, textiles, auto financing, aftermarket distribution channels and automotive repair services.

After China's entrance into the WTO the automotive industry began to grow faster than ever. Overall production increased by 38.8% and 36.7% in 2002 and 2003, respectively, making China the fourth largest auto producer and third largest auto market in the world.

The growth in the automotive industry, in particular in 2002 and 2003, attracted considerable foreign investment. This included those manufacturers that already had operations in China and were seeking to expand their capacity and production, and also those that had not previously established operations there. A secondary effect of this was that the capacity installed exceeded demand, this overcapacity increased competition considerably. To address this, from the beginning of 2004 the government started to implement selected economic cooling-down policies, including discouraging bank lending and slowing approval for investments. In addition to these macro-adjustments,

consequent lower lending from the banks and frequent price cuts reduced demand, with many price-sensitive Chinese consumers delaying buying cars as prices continued to fall. Despite these conditions, total auto output still climbed by 14.1% year-on-year in 2004 to 5.07 million units.

In 2004, to adapt to changes in the Chinese automotive industry, to China's economic boom since the late 1990s, and to face the challenges emerging in the automotive industry after China's entry to WTO, the National Development and Reform Commission released the New Automotive Industry Policy. The new policy had several objectives above and beyond the 1994 policy. These included: (1) to promote the harmonious development of the automotive and associated industries; (2) to drive industrial structural adjustment; (3) to encourage self-reliant product development and local brand development, with a view to building up a few famous brands and globally competitive (top 500) automotive groups by 2010; (4) to encourage independent research and development and production on a large scale for key components and parts, and to foster the local suppliers and their international operations and (5) to promote light duty vehicles and new energy-efficient vehicles.

The industry policy from 2004 differed from the one of 1994: it offered encouragement and strategic direction, rather than regulation. This indicates a significant change in the role of the government in economic matters, as it is now committed to using *market* forces to influence the industry's future, rather than *government-prescriptive* policies. For example, instead of previous regulations about local content rates imposed on suppliers and vehicle manufacturers, the new policy encourages global platforms, with the expectation that global components would be produced in China not only for the domestic market, but also for export to North America, Europe and Japan.

Historically, the government imposed high tariffs to protect local firms. Now, in line with the WTO agreements, the historical auto import quota has been cancelled, and the tariff rate for imported complete cars decreased to 30% on 1 January 2005 and dropped to 25% by 1 July 2006. The tariff for imported auto parts has been lowered to 10%. The key changes that took place in 2004 are summarised as follows.

First, the government reformed the automotive industry policy and loosened its control over the industry. Second, the government encouraged and supported private auto consumption, which helped to expand the passenger car market. Third, the increase in foreign investment and the entrance of more private capital into the industry has meant that overall production capacity (and economies of scale) have been growing fast. With falls in vehicle prices, private car ownership has grown (despite some would-be buyers delaying their purchases in anticipation of further price reductions), and private buyers are now the major market; the parts industry has grown along with automobile-related services such as auto finance, repair, maintenance and insurance. In addition, the state is speeding up the construction of transportation infrastructure to support the growth of automobile ownership.

In 2005, after the substantial growth of 2002–2004, the Chinese auto industry temporarily 'cooled down' in the first quarter, but recovered again.[4] It is expected that demand will be more stable in the future, as discussed below. However, although productive capacity has moved ahead of demand the Chinese auto market is far from being saturated in relation to its ultimate economic size. There is, however, significant uncertainty with currency issues, with increasing congestion and pollution in the urban areas, and China's long-term energy supply.

3 The present – key issues in the value chain

3.1 The automotive value chain in context

The automotive value chain in China is in transition. The Chinese auto industry has grown from a closed market before 1980, to a market with selected JVs (such as Volkswagen–FAW) that brought some mainstream passenger car production, to one of the largest global markets, with all major players including Volkswagen, BMW, Mercedes-Benz, Mazda, Nissan, Honda, Ford, General Motors, Hyundai, Toyota, Suzuki present in a market that also features a large number of domestic car manufacturers. Entire designs as well as key components used to be imported, but with growing local production, imports of finished vehicles have fallen sharply. Although designs are still largely imported, the amount of locally sourced content has risen, with a range of contracts awarded to Chinese, or JVs between foreign and Chinese, suppliers. Similarly to the Original Equipment Manufacturer (OEMs)[AQ4], all of the top ten global first-tier[5] suppliers have set up operations in China, and are engaged in multiple JVs with local suppliers.

[AQ4]: Please check the spell-out forms of 'OEM', 'IPR' and 'AVL'.

Yet challenges remain: while suppliers have gained competitiveness in terms of unit costs, largely derived from low wages, they still lack product development capabilities. Equally, at the vehicle manufacturer level, product development capabilities are bought-in, and even those Chinese firms that do not have foreign JV partners are buying (often outdated) designs from abroad. The pressure to acquire product designs is considerable, as is illustrated in the case of the UK's MG Rover. Rover had initially contemplated a JV with Brilliance in 2002, and then sold the intellectual property of two models and several engines to Shanghai Automotive Industry Corporation (SAIC) in 2004 in the hope of a full merger that did not happen. The remaining assets were sold to Nanjing after Rover's financial collapse in April 2005. While 'full mergers' and 'continued car production in the UK' were part of the rhetoric in each of these cases, it seems doubtful that any of the bidders had any interest in Rover other than for its technology and manufacturing equipment. Honda, Rover's technological partner from 1979 to 1994, subsequently withdrew design pauses and equipment in 2005, in fear of losing its Intellectual Property Right (IPR)[AQ4] embedded in the joint Rover–Honda products (Civic Mk I and Mk II, Concerto, Ballade, Accord Mk I, Legend Mk I).

Furthermore, along with developments in the component supply and vehicle assembly tiers, the distribution channels have changed drastically. Although private ownership of passenger cars was never forbidden in China, the cost was prohibitive. As Tables 3 and 4 show, the number of private cars before 1990 was negligible. Today, an estimated 30% of all households in Beijing own a vehicle. The distribution channels had to be built from scratch, and are largely based on private entrepreneurs selling and servicing vehicles.

This distribution, however, is not uniform. Car ownership is concentrated in the areas of highest economic growth. Table 4 shows car ownership by region in 2003, set in the context of the respective economic power of each region. Nationally, the total passenger car park grew from 9.42 million vehicles (of which 2.05 million were privately owned) in 1994, to 16.08 million (6.25 million private cars) in 2000, to 27.42 million (13.65 million private cars) in 2004 (World Motor Vehicle Data, 2005).

Table 3 Vehicle production, registrations, imports and ownership in China, 1960–2001

	Production		*Registrations*		*Imports*		*Vehicle park*	
	Passenger cars	*Commercial vehicles*	*Passenger cars*	*Commercial vehicles*	*Passenger cars*	*Commercial vehicles*	*Passenger cars*	*Commercial vehicles*
1960	98	22,476	-	-	76	22	-	-
1970	196	86,970	-	-	-	-	133,000	480,000
1980	5148	216,870	60,000	238,131	1459	25,087	60,000	900,000
1992	161,745	904,997	160,000	837,000	106,000	30,700	1,839,303	5,177,378
1993	229,745	1,081,800	223,000	948,000	199,765	111,944	2,859,800	5,316,000
1994	247,631	1,090,000	248,000	1,073,000	178,210	102,865	N/A	N/A
1997	481,611	1,096,287	481,611	1,096,287	33,305	15,162	5,319,074	6,871,828
1998	465,139	1,142,572	418,917	1,064,863	24,331	14,933	6,548,324	6,644,710
1999	570,000	1,234,500	570,410	1,181,184	19,953	15,239	7,402,307	7,127,106
2000	604,677	1,464,392	721,463	1,476,205	N/A	N/A	N/A	11,817,900
2001	717,790	1,641,352	701,602	1,629,581	N/A	N/A	N/A	N/A

Source: Shimokawa (2004)

[AQ9]: Link 'a' is provided in the Table, but no footnote is given. Please provide the footnote or else delete the link 'a' from the Table.

Table 4 Private car ownership in 11 major cities in China, 2003

	Private car ownership (millions)	*Population (millions)*	*Cars per 1000 population*	*GDP (billion Rmb)*	*GDP per capita (Rmb)*	*Disposable income per capita*	*Cars per disposable income*
National	**6.698[a] [AQ9]**	**1284**	**8**				
11 Cities, average	**3.58**	**71.04**	**50**	**2180**	**30,570**	**10,157**	**4.96**
1. Beijing	1.07	10.67	100	312	29,283	12,464	8.05
2. Guangzhou	0.29	5.84	50	273	47,053	13,380	3.71
3. Chengdu	0.28	4.40	64	101	23,477	8232	7.73
4. Tianjin	0.27	7.52	36	182	24,260	9338	3.84
5. Shenzhen	0.22	1.39	158	226	46,388	21,914	7.20
6. Shanghai	0.15	12.70	12	535	42,089	13,250	0.89
7. Nanjing	0.15	4.80	31	120	24,706	9157	3.41
8. Chongqing	0.10	9.99	10	105	10,550	7238	1.38
9. Shenyang	0.85	4.89	174	120	24,545	7050	24.67
10. Hangzhou	0.11	3.87	28	137	35,664	11,778	2.41
11. Xi'an	0.09	4.97	18	75	15,155	1784	10.14

Source: Schipper and Ng (2004)

The following sections will analyse issues facing vehicle manufacturers, component suppliers and the vehicle distribution chain in detail. The majority of previous studies have focused on the evolution of the vehicle manufacturer tier in the value chain; this study extends to the entire value chain and highlights key issues and trends at component supply and distribution/retail level, adopting a holistic, value-chain perspective.

4 Vehicle manufacturers

4.1 Production

As outlined in Table 3, vehicle production in China has risen considerably over the past 25 years. Initially, the rise in production was driven by commercial and military needs. From the 1950s to the 1980s, automobile production in China was largely craft based; the mass, and later lean, production techniques that emerged in Japan during this period and became prevalent in the Western world would have been less applicable in China because of the low volumes – even if the Chinese auto industry had had easy access to these techniques, which it did not. Only with the economic reforms under Deng Xiaoping and the subsequent entry of the first wave of international automakers – initially Volkswagen and then Chrysler and Peugeot-Citroen – was advanced automotive production knowledge applied. In the 1990s, the development of the industry started to accelerate in parallel with overall economic trends, the increase in disposable income in the metropolitan areas and the establishment of an affluent middle class. In general, China's auto production and sales grew on average by about 15% every year from 1994 to 2002, and increased further and dramatically with China's entry to WTO. In 2002 and

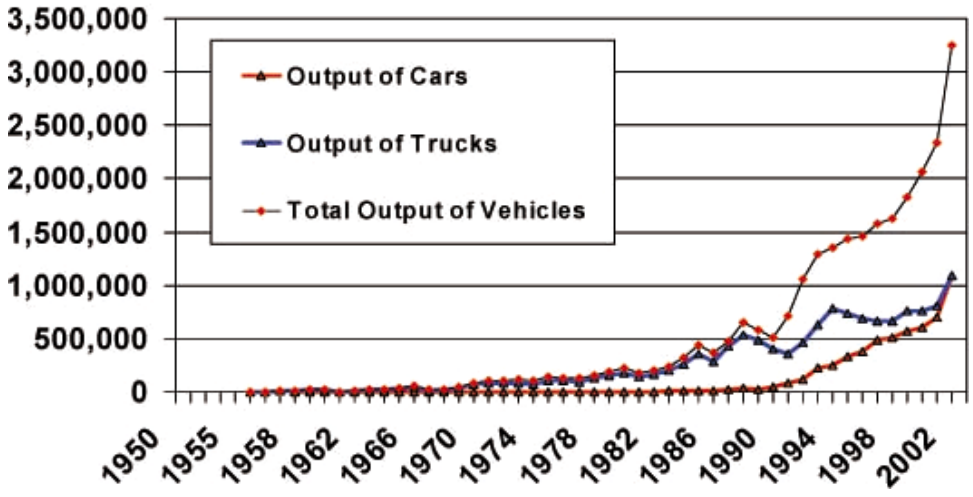
2003, overall production climbed by 38.8% and 36.7%, respectively, and passenger car production grew by 55% and 85%, respectively. The cooling-down policies of 2004 resulted in a slowing of this trend, yet total auto output in 2004 still climbed by 14.1% to 5.07 million units, including 2.32 million cars, 1.51 million trucks and 1.24 million buses.[6] The domestic auto market is expected to exceed 10 million units annually by 2010, and 16 million units by 2020 (according to the China Automotive Engineering Association), which roughly equals the current size of the US market, globally the largest.

4.2 The vehicle manufacturer landscape

In 2005, despite dynamic new entrants (commonly labelled 'young tigers' in the press), the vehicle manufacturers were still dominated by three types of manufacturer: first, JVs between local Chinese vehicle manufacturers and multi-national foreign companies, which in 2004 accounted for about 90% of total sales of passenger vehicles. Second, there were five large domestic groups that, either in addition to their JVs with foreign firms or independently, manufacture and sell cars (e.g. FAW and Chang'an). Third, there was also a substantial base of small manufacturers (e.g. Chery and Geely), which largely produce economy vehicles for the low-end market. Figure 3 shows the evolution of the number of vehicle manufacturing companies in China from 1955 to 1995.

[AQ5]: Please provide the citation of Figure 2 in the text.

Figure 2 Production volumes of cars, trucks and vehicles in China (1950–2002) (see online version for colours) [AQ5]



Source: Updated from Xie and Oliver (1996)

To some extent the evolution of the automotive industry in China mirrors the development of the industry in the West in the 1920s. From a large base of craft manufacturers at the turn of the century, the United States auto industry comprised 120 independent manufacturers by 1920. In 1950, the industry had consolidated and there were ten players, with 86% of the production volume attributed to the Big Three (General

Motors (GM), Ford and Chrysler). By 1970, the industry had consolidated into these three large players only, with independent manufacturers like American Motors, Packard, Kaiser and Studebaker either being absorbed or exiting vehicle manufacturing altogether. Given this pattern, a major consolidation of the Chinese manufacturing base could also be expected. Nonetheless, whereas market forces largely formed the US manufacturer landscape via consolidation and economies of scale, a key difference in China is the active intervention by central and local government.

Figure 3 Growth of vehicle assemblers in China, 1955–1995 (see online version for colours)

Source: Xie and Oliver (1996)

The growth in the number of manufacturers in China is closely linked to the stages in the history of its automotive industry, which were outlined in Section 2. From 1953 onwards, when FAW was established, the first 5-year plan period saw a few municipal government-supported auto plants, such as Shanghai Auto Works and Beijing Auto Works. Increased military demand led to the emergence of a second wave of state-owned auto plants, including Dongfeng, Sichuan Auto Works, Shanxi Auto Works and so on. These plants were created mainly to produce trucks, and were located in the mountains of central China for security. The third step came in the mid-1980s with economic reform. The government officially set the automotive industry as one of the pillar industries in 1986, but as capital and technology were extremely scarce in all industries, and the Chinese automakers lacked experience beyond truck production, there was almost no knowledge of car development and production. The very few indigenous car brands reliant on craft production, including Red Flag, Shanghai and Jingangshan, could not meet the government objective of developing the passenger car industry as 'High Jumping-off Point, Mass Capacity and Professionalism' (China National Development and Reform Commission, 2004). Thus, a policy to support JVs and use these as a means of technology transfer was implemented. With the 1994 auto industry policy, entry to the

industry was limited in order to foster economies of scale and to centralise resources. The government prohibited passenger car projects other than in the supported State-Owned Enterprises (SOEs), which included the so-called 'Big Three, Small Three and Mini Two'[7] policy that clearly set out which manufacturers were to be sustained. By the end of 1990s, government regulation gradually relaxed with the process of China's marketisation, and the industry attracted more international automakers aiming to capture the fast growing domestic demand.

While international JVs became the backbone of the Chinese auto industry, as discussed in the following section, the large auto enterprises have in parallel formed trans-departmental and trans-regional enterprise groups via merger, acquisition and cross share holdings. FAW, for example, acquired Tianjin Automotive Industry Company (TAIC) in 2002 (and thus strengthened the cooperation with Toyota through this acquisition, as TAIC was the largest partner of Toyota in China). SAIC in turn controls local companies in Yantan and Qingdao (Shangdong) and Liuzhou (Guangxi). SAIC has also actively pursued a strategy of acquiring shares in foreign assemblers. It holds a 10% share in Daewoo and 49% in Ssangyong in the Republic of Korea, and was involved in bidding for MG Rover and bought some of Rover's IPR in 2004 – a contentious point with Nanjing, which bought the remaining assets of MG Rover in July 2005. Chang'an (also known as Chana), based in Chongqing (the economic centre of western China), became the third largest manufacturer in China in 2004 through acquiring local companies, as well as expanding through collaboration with Ford and Suzuki.

Despite similar consolidation trends, a key difference between the auto industries of China and the US is that the Chinese central government sought to regulate auto production in big auto groups from 1953, although this has only been partially successful due to the ambitions of strong local governments, many of which have sought to develop their own local champions. As regulation has gradually given way to marketisation, the forces of the market are shaping the automotive industry, with enterprises regrouping and consolidating in order to establish viable economies of scale.

4.3 Joint ventures

Joint ventures were a favoured government instrument for achieving technology transfer and rapid growth and their establishment was initially a strict central government requirement if foreign companies wished to operate in China, forcing vehicle manufacturers to establish their operations as JVs with state-owned enterprises. The major JVs are summarised in Table 5.

The JVs are concentrated in the passenger car segment, partly due to the strategic significance of the sector and partly because knowledge of truck production was already relatively advanced.

The first JV was Beijing Jeep Co. of Beijing Automotive Industry Co. (BAIC) and American Motors Co. (which was subsequently taken over by Chrysler), which was established in 1983. In September 2000 Chrysler (by then DaimlerChrysler) and BAIC extended and expanded their cooperation for another 30 years. The second JV was Shanghai Volkswagen, involving Shanghai Automotive Industry Company and Volkswagen AG, which was established in 1985. It is still the largest international JV in China with an annual capacity of 450,000 units, comparable to Volkswagen's main plant in Wolfsburg, Germany. Volkswagen based its long time market dominance in China on

this early-mover advantage, and in 2005 still produced the Santana model (albeit a face-lifted version). This dominance was only lost in 2005, when Shanghai GM took first place in the league table of production volumes.

Table 5 JVs in the Chinese passenger car market

Enterprise	*Chinese partner*	*Western partner*	*2004 capacity*	*2004 production*	*2004 sales*
Shanghai Volkswagen	Shanghai Automotive Industry Corp.	Volkswagen	450,000	346,338	353,649
FAW–Volkswagen	FAW	Volkswagen	400,000	287,117	300,117
Shanghai GM	Shanghai Automotive Industry Corp.	General Motors	200,000	253,000	252,000
Guangzhou Honda	Guangzhou Automotive Industry Group	Honda	240,000	202,312	202,066
Beijing Hyundai	Beijing Automotive Industry Corp.	Hyundai	150,000	150,158	144,090
Chang'an-Suzuki	Chang'an Automobile Group	Suzuki (Japan)	100,000	107,337	110,052
Shenglong (Dongfeng-PSA)	Dongfeng Motor Corp.	PSA	150,000	88,034	89,129
FAW–Toyota	FAW	Toyota	120,000	83,437	77,739
Dongfeng Yueda Kia	Dongfeng Motor Corp.	Kia	100,000	63,267	62,506
Fengshen (Dongfeng-Nissan)	Dongfeng Motor Corp.	Nissan	150,000	64,197	60,784
Chang'an-Ford	Chang'an Automobile Group	Ford	150,000	50,000	47,119

Source: Automotive News (2005)

Another early JV was Guangzhou Peugeot, established in 1985 with PSA (more commonly known as Peugeot-Citroen). The JV company went bankrupt in 1997 because of the conflicts between the partners and Guangzhou's lack of manufacturing experience and access to qualified suppliers at that time. A further issue was Peugeot's reluctance to build modern (technologically advanced) vehicles in China, which angered the government, and led to the closure of the operation. PSA's issue with the JV, the loss of IPR, is still a major concern for foreign automakers in China.

In the late 1980s, the state-owned FAW and Dongfeng also embarked on a series of JVs. FAW's first JV was FAW–Volkswagen in 1992, which had started with an earlier technology tie-up with Audi. Besides Volkswagen, FAW now has JVs with Toyota, and licence agreements for several models from Mazda. Dongfeng set up its first JV with Peugeot in 1992. For decades, three car models dominated the Chinese auto market – the Santana manufactured by Shanghai Volkswagen, the Jetta manufactured by FAW–Volkswagen and the Fukang manufactured by Dongfeng–Peugeot, highlighting the dominance of the Chinese Big Three and Volkswagen during those (still heavily regulated) years.

Furthermore, in the small car segment, a range of local enterprises was engaged in licence agreement and technology tie-ups with international automakers. In the late 1980s, Suzuki mini car technologies were brought in and shared by a few small local

companies, including Chang'an, Changhe, Hafei and Liuzhou Wuling. Tianjin Automotive Industry Co. licensed the Xiali (Charade) from Daihatsu and Toyota, which was also a popular model and regained the status of best-selling car in the first half of 2005. Changan set up a JV with Suzuki in 1993 to produce the Alto and then the Gazelle and Swift. It also produced several Chang'an-badged minivans, with licensed technologies from Suzuki. The other of the Mini Two, Guizhou Aviation, licensed Subaru mini car models in 1994, and established a small JV with Subaru in 1998.

In conclusion, in analysing the evolution of JVs during the 1980s and 1990s, two key features can be identified. First, the government has promoted JVs, but prohibited auto plants from being fully owned by foreign carmakers in order to achieve the desired technology transfer. Second, almost all international partnerships that were centrally supported were with the Big Three, Small Three and Mini Two companies, while some locally or regionally supported small enterprises also engaged in licence agreements with international automakers. Small enterprises generally rely on international automakers, as they lack know-how for product development and sophisticated production management, and commonly produce outdated Western and Japanese designs under their own brands. These account for an increasingly small proportion of the market though.

After China's entry into the WTO in 2002, almost all the remaining global automakers entered China, and although no longer a requirement, teamed up with a local partner. A key difference post-2002 is the free choice of partner. BMW, for example, did not choose the state-owned enterprise suggested by the government, but instead teamed up with Brilliance, as it did not yet have a foreign partner, reducing BMW's fear that its technology might be leaked to its international competitors via a shared JV partner.

As a result, a complex partnership structure between locals and internationals has developed, as shown in Figure 4. This is not without its problems. While this structure helped the transfer of manufacturing know-how and experience to Chinese manufacturers, drove the initial development of local state-owned enterprises and fostered the growth of local suppliers, the transfer of product development capabilities to the local firms did not occur – largely because there was almost no product development activity within these JVs. Furthermore, the complexity of the cross-holding partnerships also results in considerable difficulty in managing operations. One problem is that some companies have several JV partners, and have started JVs with foreign companies, which are direct competitors. Honda, for example, has two JV partners, one in Guangzhou (Guangzhou Automobile Industry Group), and one in Wuhan (Dongfeng). Both JV partners are competing for new products, but Honda has a limited product range for the Chinese market, and thus there is potentially unhealthy competition between the two Chinese operations. Also, manufacturers like FAW and Dongfeng have independent operations that are in direct competition with their own joint-venture operations.

4.4 Industry clusters

The automotive industry in China is grouped in several distinct clusters around the key regional industrial centres – Shanghai, Beijing, Changchun, Hubei, Chongqing and Guangzhou (Figure 5). The consolidated location layout brings not only advantages in terms of logistics (of both components and finished vehicles, as the industrial areas are where demand is strong), but also problems such as labour shortages. Volkswagen, for example, has complained in the trade press that wage levels in Shanghai are reaching European levels for qualified managers due to the shortage of candidates.

Figure 4 Structure of JVs in the Chinese auto industry

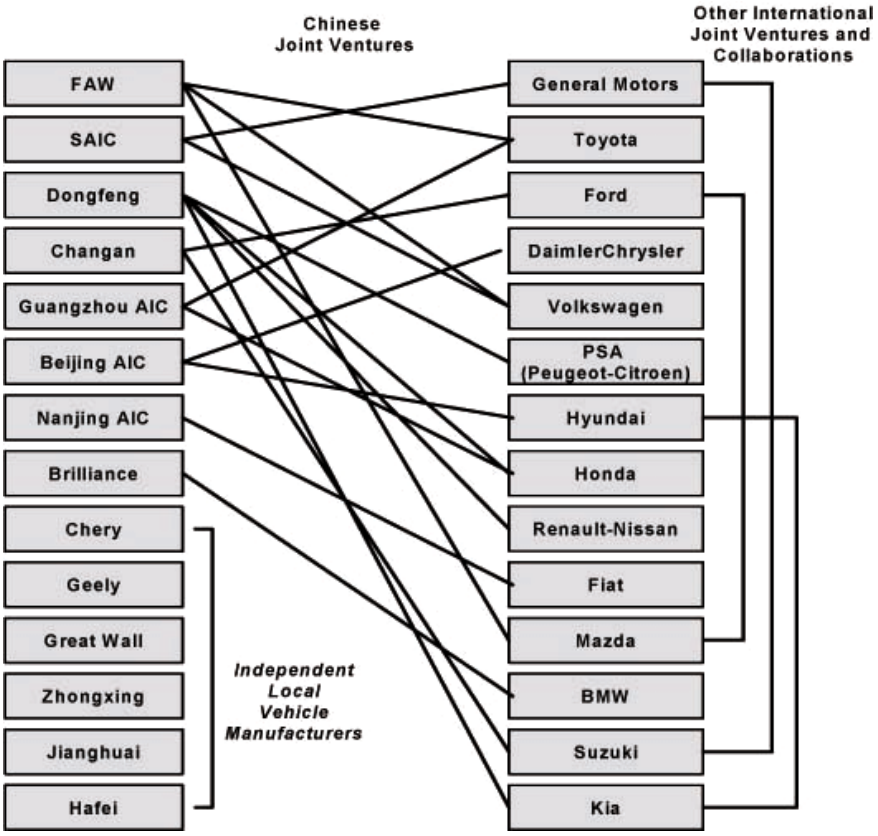
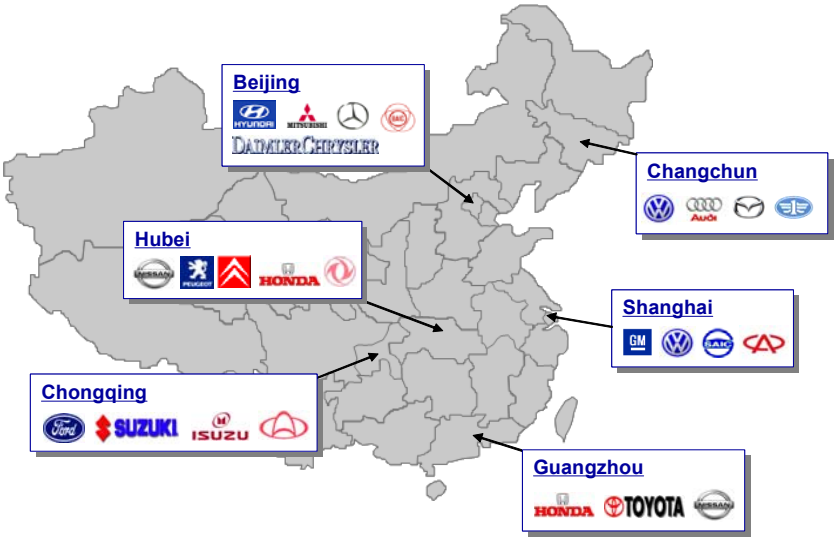


Figure 5 Location of vehicle manufacturers in China (see online version for colours)



The Changchun region was chosen for FAW in 1950 because it was close to the Soviet Union, from where assistance was initially drawn, and historically the northeast of China was also a industrial base. Shanghai has become one of the automotive production centres because of its long industrial history. Shanghai Auto Works was established in the 1950s in the first round of state-owned automotive plant construction. Volkswagen then chose Shanghai Auto Works as a partner because of its convenient geographical position, which allowed for efficient deep-sea logistics for imports to and, more recently exports from China. Since then, entrepreneurial young local independent automakers (e.g. Geely and Chery) have set up plants in the same area.

Beijing, as the capital, was also chosen as one of the first four cities to develop local automotive plants, and remains still one of the largest regional personal car markets in China (Shanghai is the largest city in China in economic terms, but personal car purchasing is choked in Shanghai by a local policy of control on the number of vehicle registrations, which aims to mitigate traffic congestion). Mercedes Benz's new JV will build C- and E-Class sedans in Beijing to feed the demand.

Hubei province is listed as one of the centres because Dongfeng (Second Auto Works) is located there. Dongfeng was founded in Shiyan in the central mountains of Hubei in the Cold War era for security and military reasons, in order to serve as a backup for FAW, which was near the border with the Soviet Union. From a logistics perspective, Hubei has considerable disadvantages, and this is one of the reasons for the relatively slow development of Dongfeng.

Guangzhou's automotive industry started to develop after the economic reforms of the mid-1980s. Peugeot's venture in Guangzhou, which started in 1985, was among the first JVs, but closed in 1997. The arrival of Honda, Toyota and Nissan put Guangzhou at the forefront of China's auto industry, and Dongfeng is increasingly moving its business to sites around Guangzhou. The development of Guangzhou's auto industry has been accelerated by its proximity to southern China's economic centres, important international trading ports and especially Hong Kong.

Chongqing was the fourth city to achieve the status of municipality (after Beijing, Tianjin and Shanghai) and is the economic and industrial centre of western China. Relatively few automotive manufacturers and suppliers are based in Chongqing, such as Chang'an Automotive Group (also called Chang'an Motors and Chang'an auto, or simply Chang'an) with its partners Ford and Suzuki, Chongqing Isuzu, Hongyan Heavy Truck Co. and Sichuan Heavy Truck Co. Chang'an. In 2005, Chang'an was the fourth largest producer of automobiles in China as a result of its multiple JVs. These include Chang'an Suzuki (established in 1992) and Chang'an Ford (2001). The Chang'an Ford Mazda Engine Co (2005), produces engines while the Jiangling Landwind Sports Utility Vehicle (SUV) is produced with Jiangling Motors. The company also launched its own branded vehicle, the Chang'an CM8 in 2005. Approximately one-third of all motorcycles made in China are produced in Chongqing Co. Chang'an. In 2005, Chang'an was the fourth largest producer of automobiles in China as a result of its multiple JVs. These include Chang'an Suzuki (established in 1992) and Chang'an Ford (2001). The Chang'an Ford Mazda Engine Co (2005), produces engines while the Jiangling Landwind SUV is produced with Jiangling Motors. The company also launched also its own branded vehicle, the Chang'an CM8 in 2005.[8] Approximately one-third of all motorcycles made in China are produced in Chongqing.

4.5 Capacity utilisation

The auto industry is a highly capital-intensive industry; the utilisation of production capacity is a vital performance measure (Holweg and Pil, 2004). The present low profitability of the global auto industry can be partly attributed to global overcapacity of 20 million units (compared with a global annual production of 58 millionunits), which roughly equals installed capacity in western Europe (Holweg and Pil, 2004). The average capacity utilisation of vehicle assembly plants in the Western world is around 80%, and companies' financial results are very sensitive to under-utilisation; an illustrative example is Ford, which announced plant closures in the USA in early 2005, as overall capacity utilisation had fallen below 75%.

In China, the capacity utilisation situation is much worse than in the West. This is largely a consequence of the investment after the boom years since 2000, which yielded considerable profits for foreign vehicle manufacturers. For example, in 2004, China accounted for around 6% of GM's sales, but for around 11% of GM's global profits. Overall, China has become the second largest market for GM, after the USA. Because of the strong earnings in China, almost all the international automakers, including GM, Ford, Volkswagen, Toyota, Daimler Chrysler, etc. have been expanding their capacity there. Volkswagen plans to add an investment of €6 billion and to double its annual production capacity to 1.6 million cars by 2008. GM also planned to spend over US$3 billion to more than double its annual production capacity to 1.3 million vehicles by 2007. Overcapacity in China is frequently discussed in the trade press, although it seems surprising in the most dynamically expanding market in the world.

Table 6 shows the capacity utilisation of the assembly plants in China, calculated for the main groups, for the years 2003 and 2004. The results clearly show that only five plants (Beijing Hyundai, Chang'an Suzuki, Guangzhou Honda, Shanghai GM and GM Wuling) among the sample of 39 achieved a capacity utilisation of 80% or more in 2004, which would be comparable to the Western standard. In general, capacity utilisation is around 50%–60%, far below that of the Western auto industry. While this can be explained by the fact that China is still an emerging and expanding market, and assemblers need to prepare extra capacity for predicted increases in demand, this development nonetheless gives rise to considerable concern. Not only will it accelerate the exit of independent domestic makers, with all the negative regional economic consequences, but it may also start a spiral of overproduction and sales discounts. This push-based mass production approach may have been appropriate in the early days of the industry, but in the current market, with increasing emphasis on customisation and model variety, it is a very short-sighted route. It could be argued that the Chinese market has managed to replicate the ills from which the Western automotive industry is currently suffering (Holweg and Pil, 2004).

Another factor that caused falling capacity utilisation from 2003 to 2004 was overoptimistic forecasts as passenger car sales jumped 87% from 2002 to 2003; so most plants expanded their capacity in order to capture their share of the cake. By 2004 the market had cooled down as a result of government intervention, and most of the plants were operating way below capacity.

Another interesting phenomenon is that the global JVs are faring better than the domestic plants, and that big state-owned enterprises' independent divisions are doing better than independent small domestic assemblers in terms of capacity utilisation. Nonetheless, even the global JV companies are far below Western levels of capacity utilisation – a situation that is likely to persist for the foreseeable future.

Table 6 Installed capacity and capacity utilisation, 2003 and 2004

	Automaker	*Production 2004 (units)*	*Production 2003 (units)*	*Capacity 2004 (units)*	*Capacity 2003 (units)*	*Utilisation 2004 (units) (%)*	*Utilisation 2003 (units) (%)*
	Brilliance China Automotive Holdings Ltd.						
D	Shengyang Brilliance Jinbei Automotive Co.	11,806	26,841	120,000	100,000	9.8	26.8
G	BMW Brilliance Automotive Co.	15,138	7500	30,000	30,000	50.5	25.0
	Beijing Automotive Industry Holdings Co.						
G	Beijing Hyundai Motor Co.	150,158	55,113	150,000	50,000	100.1	110.2
G	Beijing Benz-DaimlerChrysler Automotive Ltd.	33,679	19,441	100,000	80,000	33.7	24.3
	Chang'an Automotive Co.						
G	Chongqing Chang'an Suzuki Automobile Co.	107,337	102,083	100,000	100,000	107.3	102.1
G	Chang'an Ford Automobile Co.	50,000	18,535	150,000	50,000	33.3	37.1
	Dongfeng Motor Corp.						
G	Dongfeng Peugeot Citroen Automobile Co.	88,034	105,475	150,000	150,000	58.7	70.3
G	Dongfeng Yueda Kia Automobile Co.	63,267	52,017	100,000	100,000	63.3	52.0
G	Dongfeng Motor Co. (Nissan)	64,197	66,134	150,000	100,000	42.8	66.1
D	Dongfeng Liuzhou Motor Co.	16,486	10,302	50,000	50,000	33.0	20.6
	FAW Group						
G	FAW–Volkswagen Automotive Co.	287,117	302,346	400,000	300,000	71.8	100.8
D	Tianjin FAW Xiali Automobile Co.	130,506	117,186	180,000	180,000	72.5	65.1

Table 6 Installed capacity and capacity utilisation, 2003 and 2004 (continued)

	Automaker	*Production 2004 (units)*	*Production 2003 (units)*	*Capacity 2004 (units)*	*Capacity 2003 (units)*	*Utilisation 2004 (units) (%)*	*Utilisation 2003 (units) (%)*
G	Tianjin FAW Toyota Motor Co.	83,437	49,535	120,000	50,000	69.5	99.1
D	FAW Haima Automotive Co.	66,954	54,824	150,000	75,000	44.6	73.1
D	FAW Car Co.	50,066	48,219	100,000	90,000	50.1	53.6
D	FAW Huali (Tianjin) Motor Co.	9127	742	60,000	50,000	15.2	1.5
D	Changchun FAW Fengyue Auto Co.	4207	666	10,000	10,000	42.1	6.7
G	Sichuan Toyota Motor Co.	3110	397	10,000	10,000	31.1	4.0
	Guangzhou Automotive Group						
G	Guangzhou Honda Automobile Co.	202,312	117,178	240,000	120,000	84.3	97.6
	SAIC						
G	Shanghai Volkswagen Automotive Co.	346,338	405,252	450,000	450,000	77.0	90.1
G	Shanghai General Motors Corp.	253,000	206,964	200,000	200,000	126.5	103.5
G	SAIC GM Wuling Automobile Co.	228,839	180,188[a]	200,000	180,000	114.4	100.1
G	Shanghai GM Norsom Motors Co.	737	3559	50,000	30,000	1.5	11.9
D	Anhui Jianghuai Automobile Co.	17,245	14,746	40,000	40,000[a]	43.1	36.9
D	BYD Auto Co.	17,245	20,100	60,000	50,000	28.7	40.2
D	Chery Automobile Co.	79,565	91,223	350,000	120,000[a]	22.7	76.0
D	Geely Automobile Holding Co.	91,744	81,285	360,000	300,000	25.5	27.1
D	Great Wall Automobile Holding Co.	27,540	28,067	170,000	45,000	16.2	62.4
D	Guizhou Skylark Automobile Co.	165	1180	50,000	50,000	0.3	2.4

Table 6 Installed capacity and capacity utilisation, 2003 and 2004 (continued)

	Automaker	*Production 2004 (units)*	*Production 2003 (units)*	*Capacity 2004 (units)*	*Capacity 2003 (units)*	*Utilisation 2004 (units) (%)*	*Utilisation 2003 (units) (%)*
D	Hafei Motor Co.	28,599	32,387	300,000	150,000	9.5	21.6
D	Hebei Zhongxing Automobile Co.	16,192	28,500	100,000	100,000	16.2	28.5
G	Hunan Changfeng Motor Co.	24,986	29,230	80,000	50,000	31.2	58.5
G	Jiangling Motor Corp.	74,715[a]	60,276	100,000	100,000	74.7	60.3
G	Jiangxi Changhe Suzuki Co.	19,354	37,333	100,000	100,000	19.4	37.3
D	Jiangxi Changhe Automobile Co.	7402	2711	60,000	60,000	12.3	4.5
G	Nanjing Fiat Co.	26,598	37,418	100,000	100,000	26.6	37.4
D	Rongcheng Huatai Automobile Co.	11,000	4787[a]	30,000	30,000	36.7	16.0
D	Soueast (Fujian) Motor Corp.	41,468	83,535	150,000	120,000	27.6	69.6
G	Zhengzhou Nissan Automobile Co.	9383	10,056	60,000	60,000	15.6	16.8
G	Global JV plants	2,131,736	1,866,030	3,040,000	2,410,000	70.1	77.4
D	Domestic plants	627,317	647,301	2,340,000	1,620,000	26.8	40.0
D	Plants of independent domestic OEMs	327,504	395,507	1,620,000	985,000	20.2	40.2
	Independent plants of top 5 SOEs	277,346	231,939	550,000	455,000	50.4	51.0
	TOTAL	2,759,053	2,513,331	5,380,000	4,030,000	51.3	62.4

Note: The subtotals in bold do not add up to the total given, but exceed it because the categories overlap.

Source: Authors' calculations based on Automotive News (2005). Several plants with incomplete data are excluded. D = domestic automaker; G = global JV

[a]Other sources.

However, in spite of the current low utilisation, prospects for both domestic demand and exports are still seen as promising by industry analysts, so vehicle manufacturers are increasing their capacity. Ford, for example, which arrived late and had little presence in China but has successfully caught up. Ford assembles the Fiesta subcompact and Mondeo full-sized sedan in at its JV with Chang'an. The plant in Chongqing is boosting capacity to 200,000 units. Ford, with Chang'an and Mazda, is constructing a second assembly plant of 160,000 units annually, to make Ford- and Mazda-badged cars, and another Ford engine plant with a capacity of 350,000 engines is also under construction in Nanjing, to start production by the end of 2007.

GM planned to invest US$3 billion to more than double its annual production to 1.3 million vehicles by 2007. In the first half of 2005, GM's sales reached 308,722 units; an 18.9% increase over the same period of 2004, and for the first time overtook Volkswagen's sales. GM is continuing its expansion in China. With its new plant in Shanghai Jinqiao and its acquisition of Qingdao Auto Industry Park (via SAIC–GM Wuling), GM now has a total capacity of 850,000 autos per annum in China.

Volkswagen, which posted losses in China from the beginning of 2005, has constructed a second FAW–Volkswagen plant in Changchun, giving FAW–Volkswagen a capacity of 660,000 units per year. Another FAW–Volkswagen JV plant is to be constructed in Sichuan province in western China, which will bring Volkswagen's annual production capacity to 1.6 million cars in China by 2008, if Shanghai-Volkswagen's capacity of 450,000 units is included.

Thus, despite the obvious overcapacity that already exists in the Chinese market, which expresses itself in (costly) low utilisation, most manufacturers are still increasing their presence there. It seems that in their view, the prospect of continued growth is outweighing the short-term adverse financial implications of overcapacity. But the growth projections may not be realistic – a point which is elaborated later in the Section on the future determinants of sustainable growth.

5 Component suppliers

Purchased components and materials account for around 50% of the total value chain and between 66% and 75% of the vehicle value-added that is bought by the vehicle manufacturers from their suppliers (Holweg and Pil, 2004). Furthermore, increasing vehicle complexity has resulted in specialised suppliers that design and provide entire vehicle systems such as fuel injection systems, break systems and other modules. The China Automotive and Technical Research Centre reported that the overall turnover of the automotive component industry reached Rmb440 billion (US$54 billion) in 2004, and many of the major international automotive component manufacturers have already established manufacturing operations in China, both to supply domestic vehicle manufacturers and to benefit from low labour costs for exports. In 2005, more than 70% of the global top 100 suppliers were operating in China. With labour costs at about 1/30 of those in the developed countries, the export of components is increasing fast, as discussed in Section 3.

5.1 Supplier landscape

In 2003, approximately 1700 automotive component suppliers were registered in China, of which around 450 were of partial or full foreign owners, primarily owned by German, Japanese, US and other European suppliers (KPMG, 2004). Although the number of

suppliers in China seems comparatively large in relation to the manufacturing base, the scale of most operations is small. In comparison with the vehicle manufacturer landscape, the supply industry is highly fragmented, illustrated by the fact that the top 10 component suppliers account for only around 20% of the total sales revenue in the sector (China Markets Yearbook, 2004).

Automotive suppliers in China can be categorised in four groups. First, there are the leading independent parts and component groups, which include the Wanxiang Group and Torch Automobile Group, for example. These large local groups insist on self-reliant strategies for technologies and management, possess economies of scale and are relatively competitive internationally. Both Wanxiang and Torch have established factories in the USA. The second group are suppliers affiliated with local big SOEs, for example Fawer Automotive Parts Co. Ltd or the Shanghai Parts Industry Group. These parts and component manufacturing groups were established through separating and integrating the previous parts divisions of the big SOEs; similar to the evolution of the Ford and GM parts divisions that became the independent suppliers of Visteon and Delphi in the late 1990s. The second group is, in the view of this chapter, less competitive, yet their affiliation to large national vehicle manufacturers is a key advantage in securing business. The third group are small parts manufacturers (there are around 3000 according to KPMG's (2004) *Component Industry Report 2004*). These small suppliers have neither economies of scales nor R&D capabilities, and have largely focused on supplying the aftermarket. Finally, the fourth group are JVs of international suppliers, or their wholly controlled subsidiaries. This group possesses advanced production technology and R&D capabilities (mostly abroad). These international suppliers have often engaged in JVs with local suppliers (e.g. Delphi and Visteon), yet some are independent (e.g. Bosch and Valeo). These suppliers serve the domestic vehicle manufacturers in China, and are exporting a significant proportion of their production, contributing to the increasing exports discussed earlier.

5.2 Content of sourcing

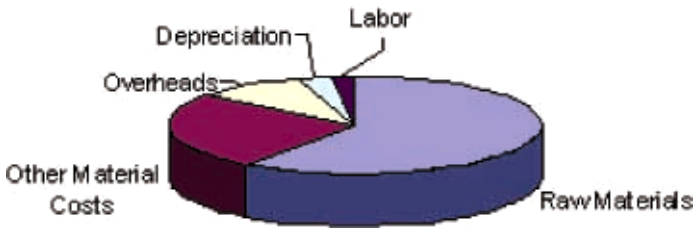
A central question when analysing automotive value chains in emerging markets is to what extent components are still imported, if (and to what extent) the content of local sourcing content is increasing, and what trends can be observed for the future. A truly independent industry obviously requires a component supply base that not only is capable of supplying all key systems and components today, but also one that is capable of designing and manufacturing components for future vehicle generations.

During the planning era of the 1980s, the government strictly stipulated a local content rate. Most international JVs started with Complete KD[9] (CKD) kit operations, but soon had to invest in a local supply base to meet the criteria. The SOEs have largely sourced from their indigenous suppliers since then, most of which are affiliated with their respective groups. Thus, it was a natural migration for these affiliated suppliers to supply the international JVs.

As regulation was loosened in the late 1990s, a large fraction of China's auto production still relied on assembling imported parts and components, as well as purchasing from the foreign suppliers' operations in China. Knowledge-intensive parts in particular, which local suppliers could not provide, were imported. Approximately 40% of the components used in GM's Chinese assembly plants are still imported from North America, including engines, axles and exhaust systems. For local suppliers it is a major

challenge to break into the circle of accredited suppliers to the major international vehicle manufacturers. Although China is seen as a low-cost centre, the cost of producing components in China is not significantly lower than in Western countries. Wages in China are as low as US$0.50/hour, compared with US$31.67 in the USA and US$5.04 in Mexico (Ward's Automotive Yearbook, 2005; data for 2002). As a recent study shows, however, that labour is only a small fraction of the total costs as seen in Figure 6. The major cost component for many suppliers is raw materials (in particular steel), prices of which are appreciating as much in China as elsewhere. Furthermore, some domestic raw materials cannot meet the quality requirement for the automotive industry, so it is necessary to import raw materials or subcomponents, which further increases the costs, damaging the cost structure further.

Figure 6 Estimates of supplier cost structure in China (see online version for colours)



Source: KPMG (2004)

Ford sourced approximately US$1 billion worth of parts and components from China in 2004, most for its production in China itself. GM's vice president of worldwide purchasing has estimated that by 2009, GM will buy US$4 billion worth of Chinese parts annually for GM assembly plants outside China, up from US$200 million in 2003, and an additional US$6 billion in Chinese parts for its operations in China, which is more than twice the value for 2003. DaimlerChrysler is also looking for suppliers in China to make low cost parts for its operations worldwide, as well as local suppliers for the Chrysler Jeep and Mercedes-Benz sedan plants in Beijing. Delphi sourced US$247 million of parts from China in 2003, and plans to quadruple this to US$1 billion by 2007. Japanese and European suppliers are also increasing their investments. In early 2004, Volkswagen announced plans to reduce imports of European auto parts to China by half over the next 5 years in order to offset the rise of the Euro against the Chinese currency. Because the exchange rate of the Euro against the US dollar had increased by 40% since 2002 (while the Renminbi was fixed against the US dollar), transporting European parts to China cost Volkswagen an extra €1.2 billion in the first 9 months of 2003. In 2005, Volkswagen announced plans to invest a further €6 billion in establishing and expanding factories at its JVs in China, with a large portion of this going to parts and component plants.

In general, the vehicle manufacturers still import key components and knowledge-intensive parts and components, or source from international suppliers with operations in China. The parts sourced from the local suppliers tend to be labour-intensive or low-value added ones. In total in 2004, China imported parts and components worth US$7.237 billion, with key components worth US$3.689 billion, with Germany being the largest provider, followed by Japan. In line with China's commitment to the WTO, the tariffs on

auto parts and components were to be reduced from the 2001 average levels of 23.4%, to an average of 10% by 2006. These reductions will further increase the attractiveness of imported parts, unless remedial action is taken. A new policy in this area already levies the same tariff on subassemblies as for entire vehicles, aiming to drive vehicle manufacturers to increase the localisation of key assemblies and parts. Inevitably, the arrival and expansion of international suppliers will result in a further shrinking share of local suppliers. On the positive side, there are signs that the fragmented supplier industry is developing economies of scale through restructuring and consolidation, and the international part and component manufacturing JVs will help in the technology transfer so critically lacking at present.

5.3 The competitiveness of Chinese suppliers

The competitiveness of the Chinese automotive industry is not only determined by productivity at the vehicle manufacturer level, but – driven by the high degree of value sourced from suppliers – by the component suppliers as well. Few studies have benchmarked the competitiveness of the component supplier industry, but Oliver et al. (1998) have applied a benchmarking methodology to Chinese suppliers that was previously used to compare the Western suppliers' competitiveness with Japan (Oliver et al., 1994). The methodology is a development of the performance benchmarking approach pioneered by the MIT International Motor Vehicle Program (IMVP) (Womack et al., 1990; Holweg and Pil, 2004), and had previously been applied to comparative global studies in Europe, the USA and Japan. The performance statistics in this study are based on seven automotive component plants in China from which complete data were obtained. All were suppliers to carmakers ranked among the top eight in China. These statistics are shown alongside the Japanese, US and European benchmarks from the global study on automotive component industry of 1994, and the key findings are summarised in Table 7. The major performance measures analysed in this study were labour productivity and quality: labour productivity refers to the output of finished units (e.g. seat sets, exhaust systems or brake callipers) divided by labour hours. Productivity was adjusted for vertical integration and, where necessary, product complexity. Quality was measured by the number of units claimed by the carmakers to be defective and is represented in parts per million.

Table 7 Comparative supplier performance in key regions

	Japan	*USA*	*Europe*	*China*
Indexed productivity (best plant = 100)	65.1	54.8	47.9	17.6
Consumer-reported defects (parts per million)	193	263	1373	3447
Indexed unit labour costs	47	50	50	31
Capacity utilisation (%)	89.7	92.9	85.1	80.2
Age of equipment (age in years)	7.6	5.2	7.0	2.7
Product variety – live part numbers (number of live part numbers)	241	90	374	8
Level of inventory (hours of inventory)	18.2	73.1	69.3	91.9
Stock turnover ratios (ratio of stocks to sales)	80.8	68.7	44.6	13.9

Source: Oliver et al. (1998)

In summary, the Chinese plants produced only one-fourth of units per labour hour of the Japanese plants, and about one-third of the US and European competitors – yet in terms of indexed labour cost per unit still outperformed the other regions. Thus, although far less productive, the low labour cost per hour compensates for this deficiency. The performance differences are even larger for the delivered quality: the Chinese plants delivered 13 times as many defects to their consumers compared with the US plants, and 18 times the level of the Japanese plants. A key reason for this was the lack of modern manufacturing methods such as total quality management and lean production, whose proliferation was found to be very low, as a mixture of early mass and craft production was still widely used in the Chinese plants. The high levels of inventory, which stood at five times the levels in Japan, and the low stock turnover ratios, also demonstrated the less sophisticated production management capabilities. In conclusion, although limited empirical evidence is available, the above study clearly shows the then prevailing lack of manufacturing capability in the supplier sector. While the drastically lower costs somewhat compensate for the low labour productivity, the output still shows much higher levels of defects, as would be expected from a fragmented, craft-based industry. Coupled with the limited involvement of suppliers in research and development, the overall competitiveness of the Chinese supplier industry in the late 1990s was poor, and certainly far from the standards of productivity, quality and production management needed to compete on an international level. How much improvement has occurred since then is clearly a key question.

5.4 Suppliers – geographical distribution

The geographical distribution of suppliers in China is one the most crucial characteristics of the automotive part and component industry from a supply chain viewpoint. Provinces and municipalities around the Yangtze River Delta accounted for around 17% of total component production by revenue in 2002, while Shanghai remained the largest components manufacturing centre with around 10% of total production. Zhejiang and Jiangsu, the provinces south and north of Shanghai, together account for another 8% of total production, while other key areas of production include the provinces of Guangdong, Liaoning, Shanxi, Jilin and Hubei, with a combined share of 32%. The distribution of parts production in China is illustrated in Figure 7, and to a large degree maps on to the distribution of vehicle assembly plants.

Dispersal of supplies is limited by the cost and time of transportation. Due to limited freight transportation via railway, and the developing, yet still poor, highway system, suppliers must be close to the carmakers. Regional protectionism (exercised by local governments) is another reason forcing suppliers into colocating near the vehicle manufacturers. Historically, the state-owned automotive companies purchased components regionally around their major assembly plants to serve the economic development interests of the municipal governments, and to a certain extent this pressure still persists, even though transportation costs have reduced with the improving infrastructure.

Figure 7 Distribution of automotive component production (see online version for colours)

Source: China Markets Yearbook (2004)

6 Technological capabilities of the Chinese auto industry

6.1 Historical shortage of R&D capabilities

In addition to *manufacturing* capabilities, *research and design* capabilities are of crucial importance. During interviews conducted by the authors in China in 2005, it transpired that the deficiency of research and design capabilities was seen a critical inhibitor by senior Chinese auto executives. This applies equally to vehicle manufacturers, as it does to component suppliers. Both local vehicle manufacturers and suppliers are notoriously short of technology. Government policies, by encouraging JVs and prescribing a local content rate, were designed to foster technology transfer from international automotive makers, and to develop domestic R&D capabilities.

For the Chinese vehicle manufacturers, this general lack of R&D capability manifests itself in a persistent reliance on foreign manufacturers, usually their joint-venture partners or licence providers, which deliver product designs, and often also tooling, manufacturing equipment and production expertise. For the suppliers, a lack of R&D expertise means that local suppliers are often excluded from the bidding processes for new vehicles, as they cannot provide the necessary capabilities to develop a component from the concept stage to the final manufactured item. For Chinese groups that operate with foreign JV partners this means that Chinese suppliers, which in many cases belong to the same group as the JV company, are de facto excluded from the bidding process; a senior purchasing executive at a Chinese–Japanese JV described this issue as “a great embarrassment”. Chinese suppliers are therefore relegated to contract manufacturer status, as opposed to being full service suppliers like their European, US or Japanese competitors operating in China.

The problem of inadequate R&D capability is well-known and acknowledged, and the government has issued policies to address it. R&D is seen as a second step after establishing a local manufacturing presence, which by now has largely happened – thanks to the numerous JVs with Western (and lately also Eastern) firms. While China no longer relies on vehicle imports, it still relies on foreign design, and the challenge now is to create an independent Chinese automotive industry. To this effect, several SOEs have started to establish their own R&D centres, although so far the large groups have not yet independently developed any significant products. Interviews with Bejing Motors and Dongfeng showed some interest in increasing R&D work in China, yet concerns were also raised over the competitiveness of such products, and whether the models provided for the Chinese domestic market would meet the standards for the European, US, Japanese and Korean markets. Since the Chinese-designed products were manufactured under the same cost structure as the non-Chinese products, design inferiority is implied. Interviewees did not perceive a need for cars customised to Chinese tastes.

The reasons for limited R&D capability are historic. In the 1980s and 1990s, due to the government policy of focusing on them, JVs were the major players in the Chinese passenger car industry. Combined with entry limit and trade barriers, this gave JVs a new monopoly position, especially Shanghai-Volkswagen, FAW–Volkswagen, Dongfeng-Citroen and Tianjin-Daihatsu. By taking advantage of their oligopolistic position the JV partners were able to operate with large profits by holding high prices. In the meantime, the foreign partners of the JVs also adopted a strategy of postponing the update of products in favour of producing aged models such as the VW Santana. In 1999, there were only 10 brands and 20 models available in China, and Shanghai-Volkswagen earned profits of US$723 million by selling only 230,000 Santana sedans in 1998 and 1999 (Luo, 2005a).

As a result, R&D technology transfer did not happen to any significant extent during these years. Even worse for the indigenous industry, since domestic products faced stiff competition from the Volkswagen, GM and Peugeot models, local firms, mostly the Big Three and Small Three, gave up R&D and production of their own cars, and merged their plants into JVs. Thus, although R&D departments were established in the JVs according to government requirements, they normally had no significant input into vehicle development. Thus, the JVs failed to transfer advanced product technologies and R&D capabilities to local firms, and were used as production bases by their foreign partners. The large SOEs have not yet engaged in any significant R&D activities, although the government has 'encouraged' them to establish R&D centres. Most have complied, or are in the process of doing so, but visits in 2005 suggested that there was very limited product development activity in these centres. It seems that the function of most of these R&D centres is to act as showcases of compliance with government policy.

Development activities so far are thus largely limited to minor models, badged under local brands. At FAW for example, the Red Flag model has been developed independently, which is based on a licensed Audi 100 platform. Most other SOEs rely entirely on their JV partners for design, like Dongfeng or SAIC, and are actively developing their own capabilities by acquiring foreign second-tier automakers, like Ssangyong and Rover. The R&D activities at the small independent automakers are more practical and profit-driven, and historically were mostly based on reverse engineering of existing models and components. More recently, even small manufacturers like Chery have engaged in international development collaboration with companies like Pininfarina and Bertone (Luo, 2005a).

Interviews conducted by the authors have allowed them to identify four different strategies for how Chinese vehicle manufacturers seek to gain technological capabilities, and thus loosen their reliance on foreign designs. First, 'learning-by-doing' is a strategy commonly found at small manufacturers like Chery and Geely, whereby manufacturers have started from reverse engineered components and are now gradually expanding their R&D activities. Second, some large companies have a dual strategy of having large JVs as well as their own independent operations. FAW and Chang'an are examples of this type. They produce foreign models in JVs, license foreign models to be produced in their independent plants and also further develop the licensed models. While gaining experience, they also are engaged in JVs, producing foreign designs. Third, companies like Dongfeng and Guangdong Automotive rely entirely on foreign designs. This type of collaboration seems, more than anything, to be born out of the need for a strong partner. Dongfeng, for example, is in financial difficulties that limit development, while Guangdong Automotive Industry Group has historic roots in car production and lacks both R&D and manufacturing knowledge. In these relationships, the function of the Chinese partner seems to cover financial management, while the foreign partners manage JV. Finally, some companies like SAIC have sought to buy in capabilities. SAIC took over 48.92% share holdings of Ssangyong Motors, the Republic of Korea's fourth largest auto firm in 2003. SAIC aims to use Ssangyong technology to develop Shanghai-badged cars, and a similar motive lay behind the move to acquire MG Rover in 2004.

6.2 Intellectual property issues

The protection of intellectual property has been a major concern for foreign companies engaging in operations in China. Volkswagen soon found that its components were finding their way into domestic manufacturers' cars; Toyota lost a case against a local manufacturer about the use of its logo; and GM battled with Chery over the design of the QQ minicar. Historically, the government openly sanctioned these IPR violations, and copycat designs were even available in official component catalogues (Ge and Takahiro, 2003). While open violations are now rare, in particular since WTO accession, it is still difficult for foreign companies to sustain their IPR in Chinese courts (Zhi, 2004).

There are several types of intellectual property issues facing the international automakers. First, through the complex JV structure, foreign companies find themselves sharing the same Chinese partner with global competitors. For example, Nissan and Honda both have JVs with Dongfeng; Volkswagen, Mazda and Toyota build cars with FAW; while Volkswagen AG and General Motors share SAIC as a partner. Given this convoluted network of partnerships, intellectual property is hard to trace and protect. Technologies and manufacturing processes are exposed to competitors, and this risk was a major part in BMW's decision (against government wishes) to team up with the comparatively minor Brilliance Group, as Brilliance did not have existing JVs.

Second, supplier networks are shared, and suppliers commonly sell the same components to other manufacturers. For example, Chery used components that bore the Volkswagen logo in its Feng Yun sedans. The parts were purchased from a supplier of Shanghai Volkswagen, which was geographically close to Chery's plants. In 2001, Chery compensated Volkswagen for this, but the unofficial transfer of knowledge is unquantifiable. A number of Chery managers originally worked at the FAW–Volkswagen JV plants, so they were familiar with the product platform and the local part supply system of Volkswagen.

Third, in addition to open violations, the majority of intellectual property disputes are related to the reverse engineering of completed cars. Over recent years, a number of young tigers, including Geely, Chery, Shuanghuan, Great Wall, etc., have been accused of copyright infringement, patent infringement or unfair competition. The first case was related to the Shuanghuan Automobile Company in Hebei province. In November 2003, Honda filed a lawsuit with the Beijing People's Senior Court against Shuanghuan, alleging the Laibao SRV[10] of Shuanghuan was a copy of its CR-V SUV, and asking for compensation of Rmb100 million (US$12 million). No court hearing was ever held. Nissan also claimed that the Sing SUV of Great Wall Motor Company copied the design of its Frontier SUV sold in the USA. Of all the cases that have been raised, only one legal judgment has been reached: in November 2003, Geely won the case put forward by Toyota against Geely for trademark infringement and unfair competition, which was the first ever foreign-related motor lawsuit after China's entry to the WTO. Toyota had claimed that the emblem of Geely is similar to that of Toyota, resulting in trademark infringement and unfair competition.

The most openly discussed design dispute, however, took place between Chery, China's leading young tiger and General Motors. In May 2003, Chery released the QQ minicar, which bears a remarkable resemblance to GM Chevrolet Spark (also called Daewoo Matiz in other countries) at a base price of Rmb 49,800 (US$6000). Figure 8 shows both models in their 2003 configuration.

Figure 8 Chery QQ Minicar (left) and GM Chevrolet Spark/Daewoo Matiz (right) (see online version for colours)

The GM Spark was released 6 months later than the Chery QQ, at a higher base price of Rmb61,800 (US$7446). The Spark is more expensive since it is assembled from Knock-Down (KD) kits, the kits being sent to China from Daewoo in the Republic of Korea. As a result, the Spark failed to take any real market share from the QQ model due to its later launch and higher price, and the QQ has been outselling the Spark by 6 to 1. This incident was particularly intricate, as GM's joint-venture partner in China, SAIC, also held a 20% stake in Chery.

In 2004, GM openly accused Chery of copying the Daewoo Matiz without paying any royalties, and even claimed that Chery had accelerated the safety approval of the QQ by using a Matiz in the crash testing. Chery denied GM's accusation and claimed that it developed QQ independently 'with a little inspiration from the Daewoo Matiz'. Chery had also filed a design patent for the QQ on 28 January 2002, which was granted on 15 January 2003, while GM had no design application filed for the Spark in China. GM then exerted pressure on its JV partner SAIC, which sold its stake in Chery in September 2004, and broke all ties with Chery. Meanwhile, the Ministry of Commerce (MOC) and

the National Office for Protection of Intellectual Property Rights (NOPIPR) investigated the case at the request of GM. In September 2004, the NOPIPR declared that, according to the evidence provided by GM, Chery could not be identified as infringing the copyright of GM, nor carrying out illegal competition activity under Chinese law. The NOPIPR encouraged the companies to solve the dispute through mediation or legal means. GM finally filed a lawsuit at the Shanghai No.2 Intermediate Court against Chery for alleged piracy of GM Daewoo Matiz in December 2004. The case was settled out of court in November 2005. According to the authors' interviews with Chinese legal experts, a key difficulty for GM to win this lawsuit was that Chery had been granted the design patent of QQ while GM had no design patent for Spark in China.

The latter case vividly illustrates the persisting difficulties foreign companies experience when operating in China. It is difficult to say whether the situation will significantly improve in the short term. A sign of increasing local R&D capability is the cooperation of international automotive technology suppliers from Italy, Germany, Japan and Austria with Chinese vehicle manufacturers. For example, Chery is designing cars with the help of Pininfarina, and is producing the first Chery-badged engines, developed collaboratively with Automatic Vehicle Location (AVL[AQ4]), an Austrian powertrain engineering consultancy (Luo, 2005a).

7 Sales and distribution networks

7.1 Market structure

In 2006, around 4.3 million passenger vehicles were sold in China, compared with 3.1 million the previous year. When both personal and commercial vehicles are taken into account this figure reaches 7.3 million, which makes China the third-largest auto market in the world after the USA and Japan. Moreover, for the first 3 months of 2007, overall vehicle sales in China further rose by 22% relative to the same period in 2006, suggesting that total industry sales of 9 million units in 2007 might be achieved – a tremendous growth rate considering that only about 2.3 million vehicles were sold in 2000.[11]

Demand is fuelled by the rapidly expanding passenger car market, in which over 50% of sales are private purchases (70% in urban areas). In the passenger car market, as shown in Table 8, the JVs are the leading players while only two independent domestic carmakers – Geely (8th) and Chery (10th) – are present in the top ten. Beijing Hyundai's sales showed the greatest expansion, with the launch of the Elantra sedan in 2003. Similarly, Chang'an-Ford, FAW–Toyota and Guangzhou Honda also significantly increased their sales, and Honda advanced to third behind Volkswagen and GM. This gain mainly relied on the Accord model, which was the best selling vehicle in the mid-size sedan segment. In terms of model mix, small cars dominate the Chinese market. According to Fourin (2005), in 2004 the Chinese market comprised 41% small cars, 27% basic cars, 21% mid-size sedans and only 6% MPVs[12] and 5% SUVs. This structure is comparable to other emerging markets such as Latin America, and a gradual expansion of the larger segments, as well as a fragmentation into different segments as the market matures, could be expected.

Table 8 Passenger car sales by manufacturer

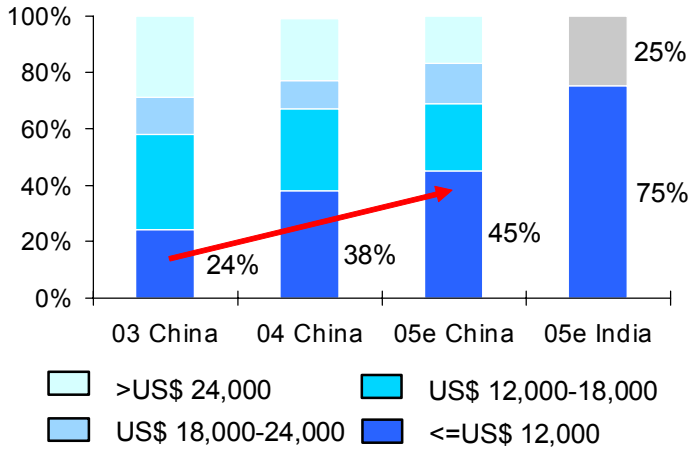
Companies	*2004*			*2003*			*% Growth rate*	*% Share change*
	Sales	*Rank*	*% Share*	*Sales*	*Rank*	*% Share*		
Shanghai Volkswagen	355,006	1	15.3	396,023	1	17.0	–10.36	–1.8
FAW–Volkswagen	300,118	2	12.9	298,006	2	12.8	0.71	0.1
Shanghai GM	252,109	3	10.8	201,282	3	8.7	25.25	2.2
Guangzhou Honda	202,066	4	8.7	117,130	5	5.0	72.51	3.7
Beijing Hyundai	144,090	5	6.2	52,128	11	2.2	176.42	4.0
Tianjing FAW	130,031	6	5.6	117,335	4	5.0	10.82	0.5
Chang'an–Suzuki	110,052	7	4.7	100,018	7	4.3	10.03	0.4
Geely	105,879	8	4.6	81,252	9	3.5	30.31	1.1
Shenglong (PSA–Dongfeng)	89,129	9	3.8	103,126	6	4.4	–13.57	–0.6
Chery	86,568	10	3.7	90,367	8	3.9	–4.20	–0.2
FAW–Toyota	81,879	11	3.5	47,287	14	2.0	73.15	1.5
Dongfeng Yueda Kia	62,506	12	2.7	51,008	13	2.2	22.54	0.5
Fengshen (Dongfeng–Nissan)	60,784	13	2.6	65,108	10	2.8	–6.64	–0.2
FAW Hainan Mazda	53,205	14	2.3	43,046	15	1.9	23.60	0.4
FAW Car	50,798	15	2.2	51,314	12	2.2	–1.01	0.0
Chang'an–Ford	47,119	16	2.0	17,301	18	0.7	172.35	1.3
Beijing Jeep	29,834	17	1.3	18,326	17	0.8	62.80	0.5
Southeast Car	28,693	18	1.2	33,557	16	1.4	–14.49	–0.2

Source: Fourin (2005)

7.2 The purchasing power of Chinese consumers

A key determinant of the sustainable growth of the Chinese auto industry is the ability of the population to purchase vehicles. This ability is driven by two factors: the vehicle price in relation to household disposable income, and the ability to finance or lease vehicles through financial service providers. The growing disposable income of the Chinese people has served as the main driving force in sedan (limousine) demand, especially with the growing number of urban middle-class customers. Furthermore, it should be remembered that for most of the 1990s only a very limited number of models were available (such as the VW Santana and Jetta). With more car companies entering the market after the WTO accession, the available model range diversified considerably, a further stimulus for the car market. In parallel, the passenger car market shifted from a primarily company car market of institutional buyers to a market which also featured a strong private customer segment. This shift also meant that the most popular segments became the small-car and mid-size sedan segments, rather than the large limousines previously sold to company executives or officials. This trend is illustrated in Figure 9, which shows the increase of the budget segments in the market, compared with forecast demand in India, which is dominated primarily by private customers.

Figure 9 Sales price of motor vehicles in China (see online version for colours)



Source: Nakamura (2005). Actual figures for 2003 and 2004, estimates for 2005

A key determinant of sustained growth in the future is not only an affluent middle class, but also the economic situation of the wider population. Here a different picture emerges. Income per capita in China did not exceed US$1000 until 2003, and data from 2001 show that even the average income of the top deciles of urban Chinese (48 million in total) had not exceeded US$1834 (Nolan, 2003). If statistical evidence from the development of Japan and the Republic of Korea serves as an accurate example, demand for cars will grow when the ratio of the average auto price to average GDP per head approaches 3:1. Moreover, finance, taxation, fuel and running costs might further deter consumers, and limit demand. It is very difficult to predict the overall market size of a country given the uncertainties involved. Nonetheless, if historic analogies from other (now developed) nations in Asia are right, a *total* market size of 16 million cars per annum (note: market sizes are given in units per annum) should be expected, assuming current levels and distribution of GDP per capita – a figure that suggests that many predictions aired in the press are optimistic.

7.3 Auto financing and leasing

Vehicle financing and leasing have been a long-established sales instruments in the Western auto markets, in the USA, for example one in four cars are sold through financed deals. In China, the auto demands boom after 2000 was mainly driven by the fast growth of personal car buying, which was stimulated by the increased availability of personal loans, post-1998. From 2000 to 2002, private car ownership increased by about 25% year-on-year, and by 2003 personal buyers accounted for over 70% of total car purchases. The official statistics show that in 1998 the total value of auto loans granted was Rmb400 million, but this increased to Rmb2.5 billion in 1999, Rmb71.6 billion in 2002 and over Rmb180 billion in 2004 (Anbound Information Corporation, 2005).

However, the absence of a personal credit system in China meant that about Rmb100 billion of bad debts had accumulated by 2004 (Luo, 2005b). The government intervened

and restricted access to personal credit, to reduce the risk of further bad loans and to protect the banking system, as well as to slow down demand to avoid overheating the economy. As of 2004, all banks tightened their credit regulation, while some even stopped their loan business altogether. In 2004 purchases based on loans accounted for only 5% of total auto sales, compared with more than 30% in 2002. The availability of vehicle financing is a very sensitive measure to control domestic demand. With the new credit restrictions in place, market growth slowed to a 12% year-on-year increase in 2004, and sales actually dropped by 8% in March 2005, after growth rates of 55% in 2002 and 75% in 2003.

The 2004 automotive industry policy document encouraged the development of auto finance businesses, and foreign automakers have been allowed to run auto finance businesses in China since then. Thus, while some domestic banks withdrew from the auto finance business because of bad debts, or because of the government as above, foreign automotive groups' finance companies are very positive. GM's Auto Finance Company (GMAC) predicted in 2005 that auto loans would reach 15 million units (total market value of Rmb1.5 trillion), with an average car price of Rmb100,000 (US$12,500) by 2008. Ford's Motor Finance Company was the first to receive approval to finance vehicles in China in May 2004, and supports the sales of vehicles manufactured in China, as well as sales of imported cars. GM, Volkswagen, Toyota and DaimlerChrysler have all received approval from the Chinese Banking Regulatory Commission to operate auto finance businesses in China, and some domestic automakers like FAW, SAIC and Dongfeng also started credit businesses in 2004.

Thus, further growth of the auto finance sector seems likely, even though it is widely acknowledged that at present these activities are unprofitable. Although a reliable personal credit system is developing in China, financing motor vehicles is still a risky undertaking. Given that the demand for motor vehicles is very sensitive to the availability of loans, however, it seems likely that manufacturers will maintain their financing activities regardless of the risks, in order to maintain and expand their market shares.

7.4 The dealer and service networks

Traditional sales channels were very hierarchical, as vehicle manufacturers sold to national general sales agents, who in turn supplied regional sales agents, then to provincial sales agents, who supplied the retailers that served the consumers. Such a multi-stage distribution chain had obvious disadvantages in high distribution costs, slow customer feedback and inflexibility, and has largely been replaced except for some luxury brands in China. For the volume segment, several different distribution and sales channels exist. The most popular are specialist stores, which sell only one brand of cars. Here, the auto producers supply their customers directly. These specialised stores generally provide integrated pre-sales and after-sales services in-house, and are commonly also '4S stores' (Sales, Spare parts, Service and Survey). Another channel is the auto supermarket, which is gaining popularity. These can be of many different types such as '1S' (Sales only), '4S' and '3S' (without Survey). Auto supermarkets are generally large-scale operations close to metropolitan areas and feature different brands.

The government also encourages brand-specific sales structures, similar to the franchised dealer system in Europe, Japan and the USA. The 2004 automotive industry policy introduced a new brand sales management measure with effect from 1 April 2005. It requires all sales of passenger cars in China to be executed under the legal umbrella of

a brand. The objective is to reorganise scattered sales networks, and to encourage manufacturers to take partial responsibility for the sales process, thus providing a certain protection to the end consumer.

For international vehicle manufacturers, which often used the sales outlets of the other brands of their JV partners, this represented a welcome separation from local brands. The overall distribution network is still developing, and Table 9 gives an overview of the sales network structure in 2004.

Table 9 Distribution network and sales outlets, major vehicle manufacturers

Vehicle maker	*Models/brands sold*	*4S store*	*Non-4S store*	*After-sale service shop*
FAW saloon car	Hingqi (Red Flag);	51	51	199
	M6	110		
FAW–Volkswagen	Jetta, Bora, Golf	350		130
	Audi	106	16	
FAW–Hainan	Mazda	N/A	N/A	N/A
FAW–Tianjin Xiali	Xiali, Vela, Vizi	182	86	180
FAW–Huali	Xingfu Shizhe	59	34	173
FAW–Toyota	Corolla, Vios	135	0	17
	FAW Total	**993**	**187**	**699**
SAIC–Volkswagen	Polo, Santana, Passat, Gol	383	173	180
SAIC–GM	Sail, Excel, Regal, Royaum	311	10	321
SAIC–Chery	Cheery, QQ	146	114	46
SAIC–MW	Chevrolet, Spark	97	0	0
	Total SAIC	**937**	**297**	**547**
Dongfeng–PSA	Citroen	200	130	
	Peugeot	76		
Dongfeng–Nissan	Bluebird, Sunny, Teana	152	N/A	N/A
Dongfeng–YK	Kia	97	14	6
Dongfeng–Honda	CR-V DH Dealers	10	0	0
	CR-V Gh Outlets	43	0	0
	Total Dongfeng	**578**	**144**	**6**
Chang'an Suzuki	Alto, Ling Yang, Swift	95	237	505
Chang'an Ford	Fiesta, Mondeo, Focus	60		
	Total Chang'an	**155**	**237**	**505**
Guangzhou Honda	Fit, Accord	220	0	0
BAIC–Hyundai	Elantra, Sonata	186	N/A	N/A

Source: Vehicle manufacturer, internal document

7.5 Export of motor vehicles and components

The analysis so far has focused on the domestic automotive market, yet given the comparative advantage in labour costs, the prospect of vehicle and components exports from China has clearly been a further inducement for manufacturers and suppliers to set up operations in China, particularly as the sector is one of the country's 'pillar' industries and the government has offered a number of incentives.

Vehicle exports from China have been growing fast in recent years. Although the data from different sources vary, they all point to the rapid growth of the sector. According to national statistics, China exported vehicles and components worth US$8.2 billion in 2004, an increase of 73% over 2003, while imports rose by 13% to US$16.3 billion, giving a trade deficit of US$8.1 billion. Statistics from the General Administration of Customs show that total exports of vehicles and parts were worth US$28.1 billion in 2006, an increase of 42.7% over 2005. Official industry estimates value China's vehicle exports in 2006 at about US$3.2 billion compared with US$1.58 billion in 2005.

According to the MOC, vehicle exports rose from 78,000 units in 2004 to 173,000 units in 2005, and in 2006 this figure more than doubled to 340,000 units, 70% of which were commercial vehicles sold in the regional Asian market. Exports of passenger cars rose from 32,000 in 2005 to more than 100,000 in 2006 and are expected to reach over 200,000 in 2007. In the first 3 months of 2007, exports of Chery were over 10,000 units and the company expected them to reach 100,000 by the end of the year.[13]

Various vehicle manufacturers have announced their intention to export cars in the near future. In 2005, Honda started to export its Jazz subcompact to Europe, while DaimlerChrysler is contemplating building a minivan jointly with Chery for export to the USA – an announcement in 2005 that was met with criticism by the US auto unions. Of the domestic manufacturers, Chery is working with the US entrepreneur Malcolm Bricklin to build cars for export to the USA, and sales were due to begin in 2007.

It seems that a considerable share of the current assembly capacity being installed in China (some industry analysts estimate a total vehicle assembly capacity of 7 million units by 2008) will serve for export purposes. In terms of components, the prospects are equally ambitious. China's vice minister of commerce said in April 2004 that China aimed to export between US$15 billion and US$20 billion worth of automobiles and components in 2005, which was not unrealistic (total exports of automotive components alone were estimated at over US$14 billion in 2006 while motor vehicle sales were over 7 million units),[14] and even US$70–100 billion by 2010 (Department of Commerce, 2003[AQ6]).

[AQ6]: 'Department of Commerce (2003)' is not included in the reference list. Please provide the reference details to be included in the reference list, or else delete the citation.

Chinese suppliers still lag behind in terms of production technology, R&D capability and domestic innovation, yet have a major advantage in labour intensive parts. Given the extensive JVs with international suppliers, an increasing global presence of Chinese suppliers can be expected for low-value, labour-intensive parts and commodities. However, structural adjustment of the sector needs to be accelerated to be able to confront challenges of energy efficiency, and transport and environmental management.

The potential for currency fluctuation casts some uncertainty over export prospects. China adopted current account convertibility in 1996, and the renminbi traded in a narrow band of about Rmb8.28 per US dollar until, under intense international pressure, the central bank 'de-pegged' it in July 2005, and revalued it at Rmb8.11 per US dollar. It is not clear when or whether the Chinese currency will be revalued again against the weak US dollar, or when the currency will be permitted to float more freely. As and when China adopts full capital account convertibility there will be pressure on the current peg. To what extent currency fluctuations will affect future exports of vehicles and components are impossible to predict. If the respective industrial declines following the currency devaluations in Brazil and Argentina in 2000/2001 serve as an example, however, currency realignment could exert a major influence on the automotive industry. So far, the central bank in China has only gradually adjusted the currency in comparison to the drastic adjustments that were made to the rates of the Brazilian real in 1999, and

the Argentinean peso in 2002, respectively, which was prudent in light of the South American perspective. Nonetheless, the exchange rate could be a major influence on the future development of the Chinese auto industry, both in terms of domestic demand and exports.

8 The future – determinants of sustainable growth

Over the last decade, the Chinese automotive industry has undergone dramatic growth. With negligible vehicle production until 1975, the government implemented drastic growth policies in the 1980s, which were reiterated in the Industry Policy of 1994 and refined in 2004. Notoriously short on technology after abandoning the initial collaboration with the Soviet Union, China has relied on foreign auto manufacturers to partner with SOEs to establish a modern car industry. Volkswagen, as one of the pioneers, was the main beneficiary of this policy by gaining long-term market leadership with its Santana and Jetta models. With continuing growth and further economic reform, the Chinese market showed increasing domestic demand and political stability, and thus became very attractive to foreign vehicle manufacturers, which has led to a drastic increase in installed capacity, with plans to install more.

This chapter has reviewed the evolution of the Chinese motor industry in relation to the economic policies that have been the drivers of this rapid growth since the late 1980s, and discussed the key features and continuing challenges at manufacturer, supplier and retail level in the automotive value chain. This section reviews the key conclusions identified and provides an outlook on the future development of the Chinese vehicle market. In a dynamic market such as China, there are multiple uncertainties ranging from micro-economic factors such as the accessibility of personal loans for vehicle purchases, macro-economic factors such as currency fluctuations and global economic factors such as oil prices and energy supply. The predictions below are restricted to a qualitative description of potential future trajectories and factor sensitivities, rather than quantifying potential future sales and production figures. Consultants and researchers alike are continuously attempting the latter, but as the unforeseen sales recession in early 2005 showed, these predictions portray a certainty that is not warranted in such a dynamic setting.

There are four main conclusions from this study. First, the market growth rates of 55% and 72% experienced in 2002 and 2003, respectively, are not likely to return, despite some predictions. This result not only is of government intervention in personal loans (which cooled down demand in 2004, and reduced the year-on-year sales growth to 12%), but is also of the skewed income distribution and increasing urban traffic congestion that will slow down the rate of growth of vehicle sales to below the levels that statistics on vehicle ownership per capita suggests. China has one of the lowest rates of vehicle ownership in global comparisons, in particular in terms of passenger cars as shown in Table 10. However, it should not be forgotten that personal vehicle ownership is not – and will not be for the foreseeable future – economically feasible for a large proportion of the rural population. In the urban areas, vehicle ownership has already increased considerably, and space, traffic system capacity, emissions and parking restrictions are in place, suggesting increasing saturation in urban areas. Shanghai is a case in point, as government restrictions keep vehicle ownership at a much lower level than the income per capita would suggest possible. Future predictions of demand must consider the impact of government intervention, taxation, income distribution and municipal traffic restrictions. A mere extrapolation of past sales is not sufficient.

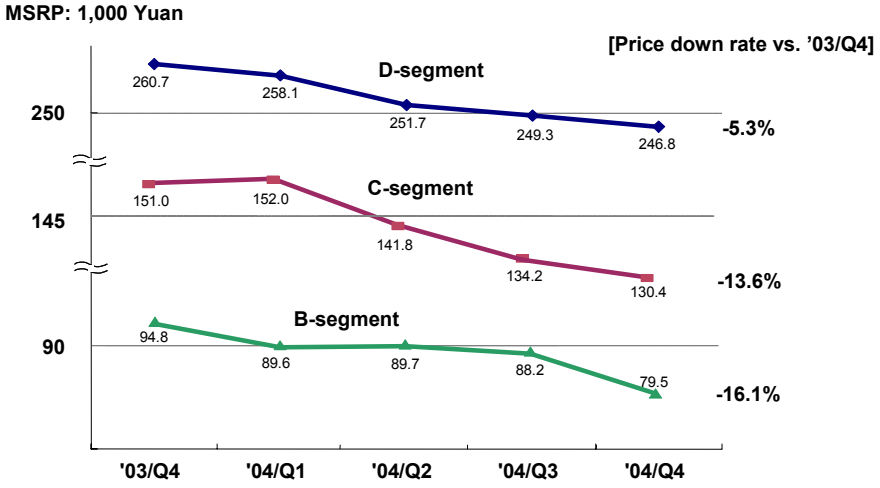
Table 10 Vehicle ownership in selected developing countries, 2002

	Persons per vehicle	*Number of vehicles in use (passenger cars only) (m)*	*Number of vehicles in use (total) (m)*	*Passenger cars as percentage of total vehicle park*
Argentina	5.4	5.4	7.0	77
Brazil	8.8	15.8	19.8	80
Mexico	8.4	12.2	17.8	69
China	87.6	4.3	14.5	30

Source: Various

Second, current assembly capacity is considerably above levels of domestic demand, and as a result capacity utilisation is very low throughout China. Until the situation eases, this will limit the profitability of the Chinese market, and may speed up the rate of consolidation of smaller, independent Chinese vehicle manufacturers. Overall, with an estimated overcapacity of 1.5–2 million units, the Chinese auto industry is likely to enter a cycle of overproduction, high inventories, price reductions and sales incentives. This development is positive for the customer, as it has driven price reductions across all segments (see Figure 10). For the auto industry as a whole, this situation is dangerous, as low profitability may result in reduced R&D activity, and thus prolong the reliance on imported design.

Figure 10 Price trends by segment[17] (see online version for colours)



Source: Nakamura (2005). Manufacturer Recommended Retail Price (MSRP). "Price down rate" is Nakamura's description of the decrease in list price per segment

Third, while manufacturing capabilities in large JV plants are comparable to other newly industrialised countries, Chinese manufacturing capabilities are not yet up to global standards, and any competitive advantage is based on labour cost advantages. While the best international JVs operate to international quality standards with a comparable labour productivity, the majority of plants are not employing any advanced manufacturing techniques, and are not competitive in global terms. A further key constraint on the future

development of the Chinese automotive industry is the lack of technological and R&D capabilities. While the government policy of 1994 succeeded in establishing a large and modern vehicle-manufacturing base in China, these so far are mostly contract manufacturers. Almost all vehicles sold in China are foreign designs, either through JVs or licences. Although most SOEs have established or are about to establish R&D centres, so far these have not undertaken any significant product development activities. Suppliers suffer particularly from the lack of R&D capabilities, by being de facto excluded from bidding for contracts on new vehicles. The technology shortage is not going to abate in the near future, and thus continued IPR infringements will most likely be the consequence. The JVs at manufacturer and supplier level, as well as other international collaborations do have a positive impact, but not in the near term. Thus, in terms of international competitiveness, China's key asset is still low labour costs; it is this that enables manufacturers such as Geely to offer vehicles at prices starting at US$4000. In terms of exports, these budget cars will surely find a market in the developed world in the entry segments, as have those of Kia, Daewoo, Hyundai, Perodua and Proton in the past. For higher segments, the actual labour cost in the vehicle is less critical, as the high-value components are still imported from abroad, and raw materials are no less expensive in China than elsewhere. Thus, coupled with a low capacity utilisation, it is hard to see how the export of high-value added cars will be cost competitive in the near to medium-term future.

Fourth, the key determinant of growth of the Chinese car market is not only economic growth (in terms of disposable income per capita), but also the distribution of this income. So far, there has been major growth of vehicle sales in urban areas, yet increasing market saturation, as well as traffic congestion and traffic restrictions, which will limit this market. Furthermore, to the majority of Chinese, vehicle ownership is still economically unfeasible. Thus, with limits to growth in urban areas and still low-income levels in rural areas, future demand will not grow as quickly as in the recent past. Further mitigating factors are government policies, in particular in relation to vehicle financing, as the sales recession after the tightening of credit in 2004 has demonstrated. Second, the currency exchange rate is an uncertainty, both for the domestic and the export market. The experiences of motor industries in Argentina and Brazil have shown that currency devaluation can have disastrous effects on local industries. Vehicle output in Argentina, for example, fell by 32% from 2001 to 2002 (after devaluation of the peso in January 2002), and only recovered to 2001 levels in 2004. Third, taxation is another area where the government could intervene. In 2005, the fuel price in China was half the price in the USA. The government is considering introducing a series of tax policies to promote energy conservation development and environmentally friendly vehicles, which will most likely mean higher fuel prices, in line with the high crude oil price.[15]

9 Outlook

In respect of rapid growth and expansion, the government policy aiming to establish a modern motor industry in China has been very successful, yet challenges remain. Most crucially, the lack of technological and R&D capabilities will persist, at least in the short term, and largely relegate Chinese operations to contract manufacturing outfits that produce designs brought in from abroad. While some independent R&D efforts can be observed, largely based on 'reverse engineered' designs of competitors, true R&D independence is still a distant goal for the Chinese auto industry.

Furthermore, although China's economic growth will undoubtedly continue in the short and medium term, it is not clear that the growth in the domestic automotive market will follow suit, as is commonly predicted. Changes related to loan restrictions, traffic congestion, taxation and currency fluctuations all pose uncertainties for the future development of domestic demand. Furthermore, the vehicle manufacturers continue to build production capacity in China that will – according to their projections (and hopes) – serve long-term export demand from China to the rest of the world. China's export volumes of 78,000 units in 2004, 340,000 in 2006 and expected 700,000 units by the end of 2007 stand against a projected overcapacity of 2,000,000 units by 2008.[16] In the short term, this overcapacity will result in further price reductions in the Chinese market, and most likely, in the overproduction and sales incentive battles so common in most Western markets. It could even be argued that China is replicating many of the problems that afflict the USA and European markets at present.

In the long-term, the growing energy consumption and vehicle emissions will become of increasing importance. While this is already being recognised at government level, the alternative powertrain development and pilot projects currently undertaken do not have any real potential to counter this trend, and the world will have to brace itself for a country that – assuming the ratio of vehicle sales per population of the USA – could potentially put another 73 million vehicles on the road per annum.

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Notes

1 The only noticeable exceptions to date are Mexico, which largely produces vehicles for export to the USA and to some extent for Europe (VW Puebla), and South Africa, which produces right-hand drive versions of the Mercedes C-Class, BMW 3-series and VW Golf for export to the UK, Japan and Australasia. From Brazil, the Volkswagen Fox has been exported to Europe since 2005, alongside engines for the BMW Mini. From India, Tata had exported the City Rover to Europe, and Honda is exporting the Jazz model from China to Europe. In comparison with exports from Japan, Republic of Korea, and to a lesser extent, Malaysia (Proton and Perodua), exports from Asia and South America to Europe and the USA are insignificant.

2 The Industrial Policies of 1994 and 2004 are summarised in Appendices A and B[AQ8], respectively.

3 The name Dongfeng literally translates as 'east wind', which alludes to Mao's famous saying about the "east wind overwhelming the west wind", which he made in Moscow in 1957. The name also has a mythological meaning, as during the Han Dynasty, when China was divided into countries that were frequently at war, an easterly wind helped the Han defeat an invading army, and has been considered to bring good fortune ever since.

4 In 2005 China's motor vehicle production and sales increased by around 27% and 25%, respectively, and in 2006 sales were over 7 million units. (RNCOS report *China Automobile Industry Forecast (2006–2010)*), http://www.rncos.com/Report/IM050.htm

5 First-tier refers to those suppliers that directly supply parts and components into vehicle assembly plants. Second-tier are those that supply the subcomponents and materials into the first-tier suppliers, and so on. A typical automotive supply chain consists of three to four tiers, whereby the third- and fourth-tier suppliers are generally the raw material suppliers such as steel or glass works.

6 Total motor vehicle output rose from 5.7 million units in 2005 to 7.3 million units in 2006 while that of cars rose from 2.8 million units to 3.9 million units (Chinese National Bureau of Statistics, CNBS).

7 The Big Three were First Automotive Works, Shanghai Automotive Industrial Corporation and Dongfeng Motor Company, the Small Three were Beijing Automotive Industrial Corporation, Tianjin Automotive Industrial Corporation and Guangzhou Automotive Industrial Corporation and the Mini Two were Changan and Ghizou Aviation (see Xia et al., 2002).

8 http://www.chinacarforums.com/changan_automobile.html

9 Knock-Down (KD) assembly operations refer to the approach of assembling and shipping unassembled kits of vehicles to be assembled in foreign markets. In many cases this approach was used to circumvent high taxes imposed on imports of finished vehicles, or to avoid the investments for a full vehicle assembly facility where volumes did not justify this. KD operations can take various forms, from Complete KD kits (CKD) to Semi-KD (SKD) operations, where pressing, welding and painting operations are done locally, whereas the parts are imported in sets (as kits) from abroad.

10 Sport Recreational Vehicle (SRV); Sports Utility Vehicle (SUV).

11 http://www.jdpower.com/corporate/china/download/TDunne_BWArticle_June2007.pd 'Future Chinese Vehicle Exports', by Tim Dunne, Director Asia-Pacific Market Intelligence, J.D. Power and Associates, 2007.

12 Multi Purpose Vehicle (MPV); Sports Utility Vehicle (SUV).

13 http://www.chinadaily.com.cn/china/2007-01/01/content_772955.htm

14 According to the 'China Automobile Industry Forecast (2006–2010)' by RNCOS, May 2007 and http://www.buyusa.gov/asianow/cauto.html

15 http://www.china.org.cn/english/government/224365.htm

16 http://www.businessweek.com/globalbiz/content/jun2007/gb20070604_816866.htm

17 The segments refer to vehicle classes (largely determined by size): the B-segment refers to small cars (e.g. VW Polo, Ford Fiesta), the C-segment refers to compact cars (e.g. VW Golf, Ford Focus), the D-segment refers to mid-size cars (e.g. VW Passat, Ford Mondeo).

[AQ8]: Appendices 'A and B' are cited in the text, but are not provided. Please provide the appendices if required.