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Final Report
For
Automotive Industry Case Study
On behalf of the UNIDO project
"Evaluation and adjustment of China's Sustainable Industrial Planning and Policies."

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CONTENTS

Summary

Backgrounds and Purposes

Since the term "sustainable development" was originally put forward in the report *Our Common Future* by the World Commission on Environment and Development in 1987, sustainable development has been universally acknowledged as a guiding principle for policymaking. There are several principles in the concept, such as lasting development, harmony, quality and fairness. However, there is no uniform interpretation of the concept and since the situation in different countries vary, their sustainable development policies is also different. This report below is based on an analysis of automotive industrial policies in China and other countries, and aims to evaluate the benefits and costs of China's previous industrial policies for the automotive industry. This study attempts to put forward some feasible policy suggestions in view of the sustainable development of China's automotive industry. Since China is a developing country and automotive industry plays an important role in national economy, this is a topic of great concern to the Chinese government.

Outline

This report is divided into five chapters.

Chapter 1 defines the implications of the sustainable development concept and its application in the automotive industry and what sustainable development policies have been adopted in China's automotive industry until now.

Chapter 2 firstly gives a brief review of China automotive industry development, and then use an Input-Output (IO) - model called MUDAN to analyze the important role of the automotive industry in the national economy, in order to explain the need for China formulate sustainable development policies focused on the automotive industry.

Chapter 3 evaluates current sustainable development policies related to China's automotive industry, which include the industrial policy for automotive industry, import policy, fuel tax policy, and environmental policy. It is the core of this report. The aim is to summarize what China may learn from the performance of and experiences with its own policies that influence the automotive industry.

Chapter 4 analyses and evaluates sustainable development policies for several selected automotive manufacturing countries. Detailed analysis is provided of the policies in the USA, Japan, Brazil, South Korea, while a more cursory analysis is provided of some of the European experiences. Then and more importantly, the report discusses what may be learned from the experiences of those countries.

Chapter 5 provides our policy suggestions for a sustainable development policy for China's automotive industry, based on the analysis in the previous chapters.

Main Points

1) Sustainable development is a relatively new development concept. There are different interpretations of the concept of sustainable development and different countries may adopt a different development type according to their own conditions.

2) China's interpretation of sustainable development belongs to the type of "weak sustainable development", alloding tradeoffs between economic growth and environmental quality. It has the following characteristics: (1) economic growth is the core of China's sustainable development. (2) population control and providing more job opportunities must be emphasized. (3) enduring resources utility, environmental protection and ecosystem balance are important parts of sustainable development. (4) To emphasize harmonious development; (5) to emphasize international cooperation and the construction of sustainable development capability

3) With regard to China's automotive industry, sustainable development includes the following aspects: (1) From the economic perspective, to increase the competitiveness of automotive industry. (2) From the social perspective, to stimulate employment and to increase people's income, and of course, to pay attention to its negative social impacts such as traffic accidents. (3) From the resource utilization and environmental protection perspective, to give priority to save energy and treat exhaust pollution. At present, the main point of environmental protection of automobiles is to manage and control emissions.

4) Since the foundation of the First Automotive Works in Changchun, Jilin province in 1956, China's automotive industry has made great progresses in production

capacity, product varieties and technology.

5) Automotive industry plays a very important role in China's economy. Although the value added of automotive industry accounted for only 2.8% of value added of manufacturing industry, and 0.6% of GDP in 1997, automotive industry has strong backward and forward linkages with upstream industries (such as metallurgy, machinery, and electronics) and downstream industries (such as transportation, fuel production, auto repairs and maintenance, and finance and insurance). If these linkages are taken into account, the automotive industry's direct and indirect contribution to GDP reached 9.81% in 1997. Also, automotive industry employed 1.814 million workers directly in 1997, while it employed 19.995 million employers indirectly in its related industries.

6) Since automotive industry plays such an important role in national economy, it is of the utmost importance to formulate relevant policies to promote the development of automotive industry.

7) The total lifetime impacts of a vehicle on environment & sustainability are various. In China, the pollution caused by automotive industry in both the production and discarding stage are not serious, but the pollution caused by the automotive industry in the use stage are very serious and will become the main source of pollution in the future, especially in urban areas.

8) *The Industrial Policy of Automotive industry*, the most complete set of regulations relevant to the automotive industry whose main purpose is to increase the competitiveness of China's automotive industry, has been effective in increasing production capacity and enlarging supply, realizing import-substitution and gain a certain competitiveness for China's automotive industry. On the other hand, the automotive industry has not become a pillar industry in China yet as the policy has expected and is still not competitive enough. The reason for this is the relatively small scale, low technology level, backward production mode, low management skills and small exports. Also this policy was intended to protect China's automotive industry, and many of its protective clauses will become invalid after China's accession into WTO.

9) *The Import Policy* features high tariffs, a quota policy and a permit policy on imported cars. Limiting imports has provided some space for the development of

China's automotive industry and prevents it from being impacted by foreign products. But over-protection also has some negative effects, in particular: (1) Excessive profits from protection has led to scattered investment in automotive industry and deteriorated the industrial organization of automotive industry. (2) Enterprises have lost their incentives to reform and innovate because of the excessive profits from over-protection.

10) *The Fuel Tax policy,* which is explicitly stipulated in the newly revised Highway Law, will encourage the production and use of fuel-efficient vehicles, and will reduce energy consumption and vehicle emissions. But since the imposition of fuel tax involves the adjustment of interests among different parties (for example, it will increase the farmers' burden) and needs stricter supervision to avoid Tax evasions, the policy has been postponed for a long time.

11) *Policy for Prevention Technology of Vehicle Emissions*, a policy with the greatest momentum, the widest scope and a greater feasibility until now, can enable the emission standard in China to coincide with the international criteria and consequently be instrumental in increasing the technical competitiveness of China's automotive industry products. However, it has some limitations: (1) It has a higher requirement for passenger cars and a lower requirement for motorcycles and trucks, but trucks are responsible for most of the pollution. (2) The policy mainly aims at common cars, and there are no limitations set for farming vehicles and tractors, while the pollution caused by these vehicles is several times larger than that of common cars.

12) *Criteria of Automobile Discard* is an important measure to ensure the safety, environmental protection, and fuel-efficiency of automobiles to implement the policy of discarding useless automobiles. Meanwhile it will accelerate the upgrading process, enlarge the demands of automobiles in market and boost the development of automobiles market. The policy has been obeyed fairly well, and 90% of the old useless automobiles are discarded each year. But there are some adverse impacts inherent is the discarding criteria: (1) To exercise uniform age and mileage limits on all cars, regardless of their quality and model, is harmful to the development of quality models. (2) From the perspective of sustainable development, compulsory discarding of well-performing automobiles is a waste of resources. (3) A stricter supervision and higher supervision cost are called for to implement the standards.

13) During the 10th five-year plan period, China's automotive industry will confront a more complicated set of conditions than before: (1) China's WTO accession will have large and broad impacts on the automotive industry and will force it to integrate with the world automotive industry. (2) The production capacity of China's automotive industry has increased rapidly, but some of the production capacity has been left idle. This implies that in the future, policy should focus on the market rather than on production. (3) The market will shift from a market dominated by institutional buyers (corporations, local government, and central government) to a market that is dominated by private individual. Hence, based on the evaluation of current policies and the situation during the 10th five-year plan period, China's policy should be improved in following aspects: (1) New policies should focus on how to create an atmosphere of fair competition. (2) New Policies should pay more attention to stimulate and support automotive enterprises in their effort to improve their technology level. (3) New policies should encourage individuals to buy and own a vehicle. (4) New policies should encourage enterprises to produce vehicles suitable to private use, such as small cars.

14) From the US' case, China has some important things to learn: (1) China should make its emission standard of vehicles suit its real conditions and amend them step by step. (2) Oil industries should make great efforts to improve oil quality for vehicle use. (3) Fuel efficiency should be paid more attention to. (4) Emission regulations should focus on the vehicles with big share of the total automobile parc. (5) Government could consider to launch a program as the US's PNGV to reach the environment goals and the industry interest. (6) Alternative fuels should be used and developed carefully.

15) The Japanese case has the following useful lessons for China: (1) China should learn from MITI's failure in guiding the rationalization of the Japanese automotive industry when formulating its future industrial policy. (2) China can encourage enterprises to develop and consumers to buy more fuel-efficient vehicles. (3) China can learn from Japan in emphasizing energy-saving in the production stage and recycling in disposal stage.

16) China can learn some lessons from practices of Brazil's automotive industry development. (1) To cooperate with or form joint ventures with multinational carmakers is a quick way to realize the catch-up strategy of automotive industry. (2) A stable macro-economic environment and stable policies targeted to the

automotive industry are essential for the automotive industry. (3) Developing certain products that have large demand in the domestic market, but are niche products in foreign markets is a way to improve the competitiveness of the industry. (4) The role of Brazil as a regional hub, but in some cases (e.g. Fiat Palio) becoming a global hub could be a model for China as vehicle manufacturers integrate the country into global production systems.

17) As for South Korea's case, China should note: (1) Government role in establishing the minicar segment for social equity and fuel efficiency. (2) The strategy of technology transfer via joint ventures with foreign firms, then gradual separation from foreign firms as in-house expertise develops. (3) The environmental implications of rapid motorization and slow infrastructure improvements. (4) The dangers of exposing a second-ranking car manufacturing sector to the rigours of global competition too soon – and the need for a robust financial sector to support car makers. (5) But possibilities of competing globally from a limited base with the right products at the right price and with the right marketing strategy.

18) From the current practice of the UK, China can learn from it to establish its own sustainability indicators system to evaluate the process of sustainable development of automotive industry.

19) The formulation of sustainable development strategy of China should also follow the rule of attaching foremost attention to development while taking into consideration both society and environment: (1) To reformulate the strategy and to set a pattern for long-term development based on the experiences of Brazil and South Korea and considering the WTO requirements. (2) To support load truck to make them more competitive by speeding up enterprise reorganization and opening up foreign market and building up the ability to innovate technology and equipment. (3) To encourage the production of clean and fuel-efficient vehicles. (4) To develop speed transportation system and make people less depend on automobiles. (5) To give rational adjustment of tax and expenses on automobiles and reduce the frequencies of car use. (6) To get engaged in study of sustainable development for automotive industry as soon as possible. (7) To set up and complete the service system centered on automobile utilization.

Chapter 1

Defining Sustainable Development

in Chinese Automotive industry

1.1 Definition of Sustainable Development

The concept "sustainable development" was originally put forward in the report *Our Common Future* by the World Commission on Environment and Development in 1987, referring to it as development "*that meets the need of the present without compromising the ability of future generations to meet their own needs*". Since the publication of Agenda 21 at the Earth Summit in Rio de Janeiro, Brazil, sustainable development has been universally acknowledged as a guiding principle for policymaking.

Sustainable development is an innovation in thinking on development issues. Compared with former development perspectives, sustainable development holds that development should adhere to the following four principles:

1) *Lasting development*. This emphasizes that development is the core of sustainable development, and emphasizes the need to improve people's welfare through development instead of suspending economic development to protect environment. And it emphasizes the long-term viewpoint of economic development, considering the needs of both current and future generations, and preventing the sacrifice of future capacity for development for high current economic growth.

2) *Harmony*. Economic and social development cannot surpass the carrying capacity of resources and environment. Human being must pay more attention to the protection and improvement of natural resources and enlarge the sustainability of resources and environment in order to accelerate the lasting economic and social development achieved through them.

3) *Quality*. This emphasizes the need to avoid increasing economic growth simply based on the expansion of resources consumption, to increase people's living quality at the most possibly low expense of resources, to stimulate

industrial competitiveness, and to improve economic efficiency.

4) *Fairness*. This development issue emphasizes to maintain fairness among present society and between the present and future people in resources utilization and development opportunities.

Sustainable development is a new development perspective that attaches importance to the influence of resources and environment on the welfare of future generations. It deals with such fields as economy, society, resources and environment. In the economic field, it argues to pay attention to the endurable increase of GDP, elimination of poverty and achieve moderate economic growth, to maximize the interests of capital input. In the social field, it argues to control population and develop human resources, meet the fundamental requirement of employment and life, build fair distribution principles and achieve social equality. As to the environment, it argues to reasonably develop and utilize natural resources, extend the provision period of resources, gradually develop new resources and other resources, as well as to protect environment and realize ecological equilibrium and endurable utilization of resources. To achieve sustainable development, we need to stimulate scientific progress and public participation to environmental protection and to establish relevant laws and regulations.

According to the level of importance attached to environment and resources, sustainable development can be divided into the following four types which are all characterized differently in the aspects of economic types, resources utility, objectives of economic policies, and viewpoints of moral (shown in table 1.1).

Table 1.1: Types of Sustainable Development and Their Characteristics

Type of Sustainable Development	No environmental concern	Weak sustainable development	Strong sustainable development	Super-strong sustainable development
Resources utility	Resource-exploiting; Simple economic growth	Resource-saving	Resource-protecting	Extremely protecting resources
Economy types	Market economy without restrictions; Against green economy	Green economy under economic-controlling	Deep Green economy regulated by the macro-environment standard	Super-deep Green economy□ Economic practices must meet the aim of minimum resources consumption
Objectives of economic policies	Maximization of economic growth (maximizing GNP)□ Considering technology progress can guarantee the boundless substitution of natural resource, which means technology progress can solve all the "scarcity" limitations (resources and environment capacity)	Adjusted economic growth, measuring GNP with revised green accounting□ Not approving the existence of boundless substitution between resources	zero economic growth rate, zero population growth rate□ Taking healthy development of the whole ecosystem as the main concern	Shrinking economic and population scales
Viewpoints of moral	Treasuring the rights and interests of the present generation, ignoring that of the future generations	Concerned with the others; and Concerned with the equality of present people and future generations	Individual interests are subordinate to the group interests, Treasuring the value of ecosystem	Accepting bio-morality, i.e. Morality, rights and interests suited to all the ecological species

1.2 Formation and Characteristics of Sustainable Development in China

China has thought of sustainable development for a long time before the concept was formalized. In the early period of 1980's, the Chinese government designated "controlling population growth" and "protecting the environment" as basic national policies. Since putting them at the strategic position of national economic and social development, the Chinese government exerted great efforts to promote economic growth, the society progressing corresponding with population increasing, natural resources consumption and environment protection. The government stipulated a series of strategic principles and measures to stimulate the transformation of economic system and economic growth model, improve the scientific progress, formulate a poverty eradication plan and control river pollution.

It was after the 1992 Earth Summit that China formally developed the comprehensive concept of sustainable development. In August 1992, the Chinese government put forward "Ten countermeasures of environment and development in China", clearly pointing out that sustainable development is China's necessary choice both at present and in the future. China formulated and publicized its sustainable development strategy----China's Agenda 21□*White Paper on China's Population, Environment, and Development in the 21 Century.* Considering China's national conditions and its current population, stage of economic development and environmental situation, China's Agenda 21 puts forward overall strategies and targets for accelerating sustained economic and social development in harmony with the rational use of natural resources and environmental protection, as follows.

- China's Agenda 21 urges to improve the quantity of development based on scientific progress and increasing laborers' quantity as well as maintain the rapid economic growth.

- China's Agenda 21 urges to build a stable social foundation for sustainable development by promoting social progress.

- China's Agenda 21 urges to control environmental pollution, improve ecological environment and protecting the resources foundation for sustainable utility. It will be necessary to establish comprehensive policies and a management system for promoting sustainable development, and to establish an economic and social system and maintain the relevant resources and environment foundation for

sustainability. Finally, China will realize economic booming, social justice and ecological security.

In *the National Economics and Social Development Strategy for the Ninth Five-year Plan and the 2010 Long-term plan* (approved in March 1996) sustainable development was mentioned as an important guiding principle.

China's recognition and understanding of sustainable development is closely related to the national conditions, with the following characteristics[1]:

1) Emphasis on *the utmost importance of development and regard economic development as the core of sustainable development.* Since China is a developing country with a comparatively low GNP per capita and with a lot of people living under the poverty line, China puts economic development at the primacy and center of all its projects. Rapid economic growth is not only necessary to eliminate poverty, to increase people's living standard and to strengthen comprehensive national power, but it is also necessary to provide a material basis for effectively utilizing resources and protecting environment and ecology. China will depart from the traditional development model and develop the intensive economic growth[2] model replacing the former extensive model in line with the national conditions The implementation of the strategy "rejuvenating China by science and technology" will promote the close combination of scientific and technological, educational, economical and social development.

2) *Strict control over the population growth, improve education and increase employment.* Since the enormous population exerts great pressures on China's economy, society, resources and environment, controlling population growth and improving education is important to realize sustainable development. Therefore family planning has become a basic national policy of China. Since China's urbanization is not adapted to its economic development, the social sustainability and low urbanization has become an obstacle hindering the employment of rural surplus labor. China should increase its urbanization rate and vigorously develop its tertiary industry. Furthermore, since the low education level is not adapted to the economic development, China will increase

[1] China's Agenda 21.

[2] In China, intensive economic growth and extensive economic growth are two important concepts, intensive economic growth refers to the economic growth by means of technology progress and improving economic growth quality, comparatively extensive economic growth refers to the economic growth by means of increasing capital, labor and land input.

investments in education in order to improve human resources quality.

3) *To consider the enduring resources utility and ecosystem protection as an important part of sustainable development.* At present and in the future, the comparative scarcity of resources per capita restricts China's economic development. So the sustainable development in China requires the continuity and optimistic trend of development, and economic and social construction in the light of environmental protection and enduring utility of resources. The sound use of resources and environmental protection include natural resources protection and endurable utility, such as water, and soil, also include the bio-diversity protection, prevention from desertification of land, prevention from and reduction of disasters, protection of atmospheric layer, such as control of atmospheric pollution and prevention from and controlling of acid rain; management of solid waste. Nowadays, environmental protection is another national policy of China. China will apply economic, legislative and administrative means to develop and exploit resources as well as to protect and increase value, vigorously and to exploit resources comprehensively, to increase gradually he utility of resources. The environmental problems in China stem from industrial pollution, ecological destruction during resource development and urbanization. The key is the coordination of industrial and environmental policies, scientific management and reasonable choices of technologies. The prevention from and controlling of industrial pollution are mainly to realize three transformations--from end control to control over all the processes; from concentration-based control to control entailing a combined focus on with concentration and total volume; from decentralization control to centralization control, and to carry out cleaner production. It is also necessary to prevent and control ecological destruction, mainly through comprehensive management projects of developing ecological agriculture, reconstructing ecological systems in forests, and conserving water and oil in the seven drainage areas. China will conduct a unified metropolitan management, and adopt preventative measures in the development of water resources, transport, energy and minerals etc. to prevent great destruction of ecological environment.

4) *To emphasize harmonious development*. To consider the development requirements of both currently and in the future, and avoiding to meet the needs and interests of the present while sacrificing the needs and interests of future generations, accelerate economic development in harmony with population,

resources and environment, link the present development with long-term development.

5) *To emphasize international cooperation*. China confronts some difficulties in the exercise of sustainable development strategy, which mainly include the comparatively low economic development level, and comparative lagging overall technological level, and the uncompleted transformation of economic growth model. The contradiction between the vast population and the resources shortage has existed over a long period. The contradiction between economic growth and capital, resources and environment are quite outstanding. The deteriorating trend of environmental pollution and ecological destruction has not been controlled effectively, and its solution is quite an arduous national task. Therefore, China's sustainable development policies pay sufficient attention to the harmony of China's environment and development strategy with that of the world. China put forward strategies, countermeasures and practice programs to deal with global climate change, prevent the lose of ozone in the stratosphere, protect bio-diversity and prevent from cross-border transfer of harmful waste and soil erosion and desertification. China's environmental problem is part of the global environmental problem. China knows well about its responsibility and role in the protection of global ecological system, and is willing to shoulder international duties corresponding to its development level and to further strengthen international cooperation in the problem of global environment and development.

6) *To emphasize the development of sustainable development capacity*. Including the establishment of a sound management system as well as price and capital allocation mechanisms, strengthening the information system focused on education and scientific technologies, and particularly, promote the participation by women, youngsters, minority nationalities, personnel and groups in scientific circles. China has put forward many important measures of capacity development constructions in mechanism, legislature, education, science and technologies and public participation, and thus has created an appropriate and healthy situation for international cooperation.

At present, China has exerted great efforts and made great achievements in many fields. China is trying to control population growth, improve the quality of population as well as to eradicate poverty by developing poverty alleviation projects. China is also comprehensively managing the city environments to accelerate the construction

of living settlements, strengthening the management of soil resources to achieve a stable increase of agricultural crop production, and to expand clearer production to prevent industrial pollution and transform the industrial growth model. Adhering to the principle of attaching equal importance to resources development and save, China reduces the consumption of energy and resources to prevent and control the environmental pollution. China continues its reforestation efforts continuous to cultivate forest resources, and to rationally develop, utilize and protect water resources, intensifying management of marine resources and protection of marine environment. China also rationally develops and utilizes its air based on better monitoring, evaluation and program, prevents and reduces natural disasters, prevents atmospheric pollution and protects bio-diversity, strictly fulfilling its obligations under international conventions such as *The convention on Biological Diversity.*

Referring to table 1.1, China's interpretation of sustainable development is mainly consistent with "weak sustainable development", involving tradeoffs between economic growth and environmental quality.

1.3 Implication of the sustainable Development in Automotive industry

The sustainable development of China's automotive industry is an important part of the national strategy of sustainable development. The development of the automotive industry has to submit to the national strategy, which is to practice the sustainable development strategy in the auto life cycle (production, consumption and discarding).

In the light of the national strategy of sustainable development and the development conditions of automotive industry, the sustainable development of China's automotive industry includes the following aspects:

1) The economic perspective. China tries to increase the production capacity of the automotive industry, its scale, local content rate, and to strengthen its competitiveness.

2) The social perspective. The automotive industry, as an important industry in China, can positively influence the development of related industries, providing additional employment opportunities and improving people's living standard. Meanwhile, products from the automotive industry still belong to luxury goods in

China. The automotive industry must expand to meet people's increasing demands of automobiles. Of course, development of the automotive industry has also negative social impacts in terms of traffic accidents, which should be paid attention to.

3) The environmental perspective. The environmental and resources problems caused by the increasing ownership of automobiles and other products from the automotive industry have to be paid more attention to. Along with the development of automotive industry, the emission pollution is more and more severe, related to the rapid growth in fuel consumption. All of these problems require the government to pay attention to the coordinated development of environment and economy. At present, the main point of environmental protection of automobiles is to manage and control emissions.

1.4 Review of the sustainable development policies of China's automotive industry

In the light of the national conditions and the development of automotive industry, the sustainable development policies of China's automotive industry is characterized as follows: 1) The central objective is to increase the competitiveness of automotive industry. On the one hand, China improves the overall quality of automotive industry by enlarging investment and introducing advanced technologies. On the other hand, since China's automotive industry is an immature industry, the government will adopt protection measures to gradually reduce custom duties and open the automobile market following the development of automotive industry. 2) During the development of China's automotive industry, China will pay continuous attention to energy saving and environment protection.

The Chinese government has issued a series of policies and regulations to lower the negative environmental impact of automobile emissions. For example, the development and production of energy-saving and economized automobiles have been strengthened.

1.4.1 The Industrial Policies for Automotive Industry--the comprehensive policies of China's automotive industry

1) *The Industrial Policy for automotive industry* (March 12, 1993, published by the State Council)(refer to section 3.2.1.1)

The policies are aimed at developing China's automotive industry into one of the pillars of the national economy by reversing the current situation -- which is marked for an over-scattered use of investment, small scale of production and obsolescence of products -- and revving up enterprises' development ability so as to raise product quality and technical level, while promoting the rationalization of its industrial structure to reach a profitable production scale. It is expected that the implementation of these policies will enable the automotive Industry to become a pillar of the national economy and give Further boost to the rapid development of other related industries. The main content includes goals of the policies and focus of product development, product certification, and policies on the industrial structure, the industrial technology, investment and fund-raising, policies for using foreign funds, on management of imports and exports, and policies on localization of production and consumption and pricing, and policies on related industries and social securities, and industrial policies planning and project management, as well as automotive security and environmental protection. This is the guiding regulation of China's automotive industry, which covers the most comprehensive policies issued by the Chinese government till now.

1.4.2 The economic policies related to China's automotive industry

Besides the industrial policy of automotive industry, the Chinese government also issued the following related economic policies

1) Management policies on automobile customs and quota (refer to section *3.2.1.2)*

The objective is to protect the development of domestic automotive industry through controlling imports.

2) Automobile consumption tax (*Provisional Regulations on Consumption Tax in People's republic of China,* approved on the 12th regular meeting of the State Council in November 26, 1993, implemented from January 1, 1994) and auto acquisition fee (*Notice on the Adjustment of Tax and Fee besides auto price,* issued by the State Council, implemented from January 1, 1994), etc., aimed at moderately controlling the automobile import and consumption.

The objective is to manage and control the manufacturing structure and demand structure of automotive industry.

3) Catalogue of nationally supported key industries, products and technologies (Auto part) issued by the State Planning Commission (ratified by the State Council in December 29, 1997, implemented from January 1, 1998). *Guiding Catalogue for the Foreign-funded Industries* issued by State Planning Commission, State Economic and Trade Commission, Ministry of Foreign Economic Trade and Cooperation (revised in December 1997, implemented from January 1 1998).

4) Law on Road in People's Republic of China (approved at the 26th session by the standing committee of the eighth National People's Congress in July 3, 1997, implemented from January 1, 1998) (refer to section 3.2.1.3).

As stipulated in the Article 36 of Charter 4 "Maintenance of Road", the maintenance fee of public highway is collected by the means of added fee on fuel. The objective is to control the fuel consumption through economic means and collect more fees from those who drive more.

1.4.3 Policies of environment protection related to China's automotive industry

1) *Criteria of Automobile Discard* (revised in 1997, approved by the State Council in July 15, 1997, issued by the State Economy and Trade Commission, State Planning Commission, Ministry of Domestic Trade, Ministry of Machine Industry, Ministry of Public Security, and State Bureau of Environmental Protection, SETC No. [1997] 456). *Notice on Adjustment of Discard Criteria of Light-duty Truck* (SETC NO. [1998] 407, issued in July 7, 1998)(refer to section 3.2.2.3).

This is the revised edition of the former *Criteria of Automobile Discard* formulated in 1986. It comprehensively regulated the automobile discard, including the accumulative driving mileage, accumulative usage period, auto situation, oil consumption, provision of spare parts to certain models, technologies of running security, emission pollutant, extended usage, etc.

2) Monitoring and Management regulations on Automobile Emission pollution

(SBEP No (90) 359) (Refer to section 3.2.2)

3) *Notice on Installing Automobile Pollution Controlled Products* (July 3, 1998, Environment Office of General Office of State Bureau on Environmental

Protection [1998] No.164) (refer to section 3.2.2)

4) *The ninth five-year plan on emission Pollutant of automobile products*, (issued by Ministry of Machinery Industry in Jan. 19, 1996), *Notice on Releasing Emission pollution Limitation of Light Automobile* (issued by Ministry of Machinery Industry in Jan. 30, 1996), and *Introduction on the Object and implementation Principles of Controlling Automobile emission* (by Machine-Building Bureau in July 1998).

These documents stipulated the controlling object by stages and automobile emission pollutant limitation.

5) Notice on halting Producing and Selling Leaded Gas by General Office of State Council, (approved by the State Council in September 2, 1998, issued by General Office of State Council, SC No. [1998] 129, implemented from January 1 2000) and Notice on Adjusting Consumption Tax Rate of Leaded Gas by Ministry of Finance and State General Tax Bureau (MF {1998} 163, November 30, 1998, implemented from January 1, 1999)(refer to section 3.2.2.2)

The notice stipulated leaded gas be halted to produce from January 1, 2000. From July 1, 1999, provincial capitals, economic zones, coastal open cities and key tourism cities should stop selling auto leaded gas, and all areas should stop the selling from July 1, 2000. From January 2000, the auto manufacturing enterprises should produce gas-fueled autos suited to use unleaded gas, and install emission purification apparatus and electronic spraying devices. Meanwhile, the consumption tax rate and price of leaded gas will be increased from January 1, 1999, ensuring the sales price of leaded gas not less than that of unleaded gas to guarantee the elimination of leaded gas.

6) *Automobile Emission Prevention Technology Policy.* (The State Technologies Monitoring Bureau, Ministry of Machinery Industry and State Bureau on Environmental Protection)(Refer to section 3.2.2.1)

7) *Current standards of auto emission pollution in China* (refer to section 3.2.2)

China has issued 66 mandatory auto standards till now, divided into three parts. The pollution controlling standards include 8 emission standards, 2 noise standards, and 1 radio jamming standards. And the Security standards include 37 initiative standards, 13 passive and 3 fireproof.

There are 7 standards related to auto emission pollution, all issued in 1993:

Emission standard for exhaust pollutant from light-duty vehicle (GB14761.1-93)

Emission standard for exhaust pollutant from gasoline engine of vehicle (GB14761.2-93)

Emission standard for fuel evaporation emissions from vehicle with petrol engine (GB14761.3-93)

Emission standard for pollutant from crankcase of vehicle engine (GB14761.4-93)

Emission standard for pollutant at idle speed from vehicle with petrol engine (GB14761.5-93)

Emission standard for smoke at free acceleration from vehicle with diesel engine (GB14761.6-93)

Emission standard for smoke at full load from diesel engine of vehicle (GB14761.7-93)

The following four national standards issued in 1999 has been implemented since January 1, 2000. The requirements to new automobiles' emission achieve the European level in the early period of 1990's, being stricter than the current national criteria by 80%:

Limits of emission from vehicle and its test methods (GB14761-1999)

Limits of pollutant emission from compressed-burning engine and vehicle with compressed-burning engine and its test methods (GB14761-1999)

Limits of visible pollutant emission from compressed-burning engine and vehicle with compressed-burning engine and its test methods (GB3847-1999)

Test methods on net power of vehicle-used engine (GMW692-1999)

1.4.4 Social policies related to China's automotive industry

1) *Technology Conditions of Motor Vehicles' Running Security* (GB7258-1997) (Issued in October 23, 1997, implemented from January 1, 1998), makes detailed provision in all aspects of security technologies of motor vehicles'

running.

2) *Requirements Related to 34 Mandatory Tests* (Issued by the Automobile Department of Ministry of Machinery Industry in March 10, 1998, implemented from October 1, 1998)

Chapter 2

Review of China's automotive Industry[3] development

This chapter attempts to summarize the highlights and policy thinking of China's automotive industry and its effects on China's economy by reviewing its development process and analyzing its importance in China's economy. The chapter has two aims: First, to find out what lessons China automotive industry can learn from its history, and what policies China should promote for the automotive industry in the future. Second, to find out how important for China to develop its own automotive industry by analyzing the contribution of China's automotive industry to the sustainable development of China.

2.1 The history of China's automotive industry

The development of China's automotive industry started as late as 1963, and has been advancing greatly during the previous several decades. Its development path can be roughly divided into 3 stages.

The first stage, initial development (1963-1980). In the planned economy, China's automotive industry developed slowly, and was characterized by the following aspects: 1) Small production scale. From the birth year of the first nationally produced automobile to 1980, China's automobile output merely rose to about 200,000. 2) Simple models. The domestic automobile industry concentrated on medium-sized trucks while there were very few passenger vehicles and sedans. In 1980, China's sedans production was 5418, only accounting for 2.4% of China's total automobile production. 3) Deconcentrated production. The output was scattered in nearly 100 enterprises, far from profitable production scale. 4) Low production

[3] Broadly, China automotive industry includes automobiles manufacturing, motorcycles manufacturing and their parts & components manufacturing industries but does not include the vehicles for farm-use manufacturing industry. But in the narrow way, it only refers to complete automobiles manufacturing industry.

technologies. Besides a few models of the medium-sized trucks, for example, the "Jiefang" of The First Automotive Work and the "Dongfeng" of The Second Automotive Work, most models lagged behind international standard for several decades.

The second stage, reconstructing modern automotive industry (1981-1993). Along with China's reform and opening up to the outside world, the automotive industry enters a period of rapid development which is characterized as follows: 1) rapid enlargement of production scale. During a dozen of years, the automotive output had been increased to 1,060,000 in 1992 from the 220,000 in 1980. 1992 was the first year in which production exceeded one million. 2) The basically formulated modern sedan industry began to develop rapidly. The proposal on foreign capital affiliated project of Shanghai sedan was ratified in 1981, and the first Santana sedan was successfully produced in April 1983, which signified the beginning of China's modern sedan industry. In 1987, the State Council defined three sedan bases at the First Automotive Work, the Second Automotive Work, and Shanghai Automotive Industry Corporation. Then with the joint-venture projects of the First Motor Automotive Work, the Second Automotive Work were put into production, China's sedans output reached 230.000 in 1993, accounting for 17.7% of China's total automobile output, and increased by 15.3% over 1980. 3) The technological level of the whole automotive industry was improved. During this period, besides the above-mentioned sedans industry, which greatly increased its technological capacities through international joint ventures or international cooperation, other automobile models also introduced comparatively advanced production technologies and models. Examples are the Sino-US joint-funded Cherokee Jeep (1985), the first domestically produced heavy truck Style in Jinan, the Iveco light passenger coach in 1991 in Nanjing, and the S10 pickup using GM technology, produced in 1992 by Jinbei Automobile Co. Ltd. This is a period of reconstructing modern automotive industry through international joint ventures.

The third stage, comprehensive development of automotive industry (1994 till now). This stage is a continuation of the second stage, with the biggest difference a clearer direction could be provided based on the development of the past period. The 14th

National Party's Congress (1992) determined that the automotive industry would be one of the pillars of the national economy. China issued its first industrial policies since the foundation of the PRC---- *Government Policies on the Automotive Industry*, which planned the development direction of China's automotive industry, considering twelve aspects: goals of the policies and focus of product development, product certification, policies on the industrial structure, policies on the industrial technology, investment and fund-raising, policies for using foreign funds, policies on management of imports, policies on management of exports, policies on localization of production, policies on consumption and pricing, policies on related industries and social securities, and industrial policies planning and project management (see 1.4.1 and 3.2). Publication of these policies marked that China's automotive industry came into orderly and comprehensive development. During this period, China's automotive industry experienced some optimistical changes: 1) The industry scale continued to increase gradually, the national automobile production increased to 1,830,000 in 1999 from 1,350,000 in 1994, with an average annual growth rate of 6.3% during the past five years. 2) The structure of automobile models is more rational. The production of sedans was 565,000 in 1999, accounting for 30.9% of the total output, an increase by 13.2 percentage point over the share in 1993. 3) The production concentration is obviously increased. At the end of 1999, the overall output of the biggest four enterprises, Shanghai Volkswagen Automobile Co. Ltd., the First Automotive Work, the Second Automotive Work and Tianjin Automotive Industry Group Co. Ltd, reached 714000, accounting for 39% of the national output. Though the degree of concentration is still comparatively low, this implies a great improvement compared to the former scattered and disorderly situation. 4) The production technologies have become more advanced. The manufacturers produced products of newer generation one after another. Santana 2000 was introduced into the market, replacing the former common models in 1995, Audi 200 in 1996, 20-stream-valve Jetta in 1997, Honda Accoda, General Buick and Audi A6 in 1999. These new products further reduced the gap between domestic and international technology levels, especially the last three models roughly achieved advanced international technologies at that time.

Figure 1 Output of automobile and its growth rate

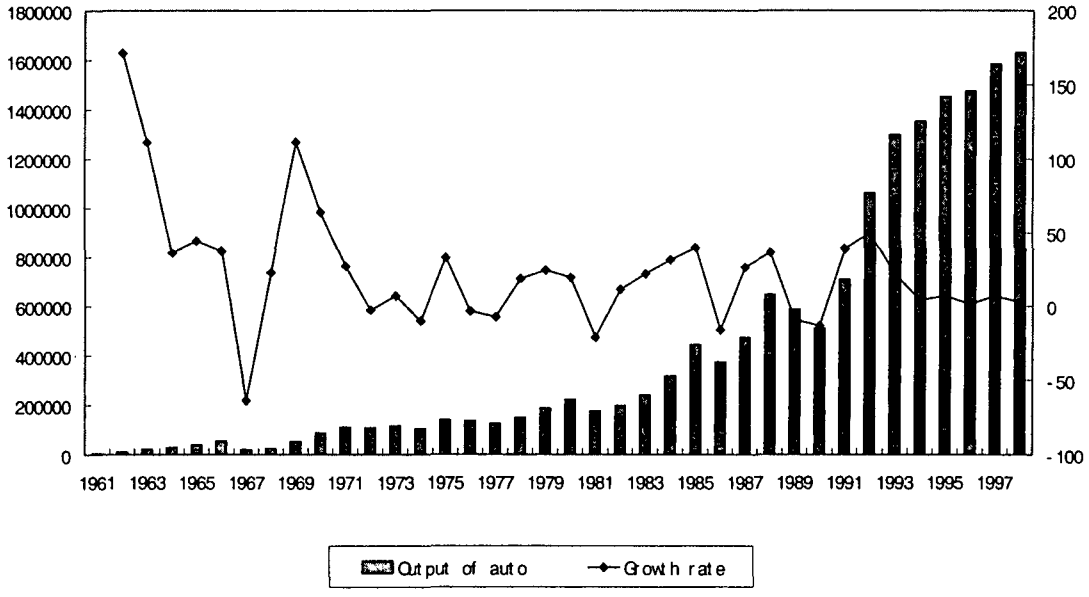


Table 2-1 Production and sales of top 20 enterprises (1999)

Rank	Enterprises	Location	Main Products	Volume of Production (units)	Volume of Sales (units)
1	Shanghai VW Automotive Ltd.	Shanhai	Car	230946	230699
2	The Second Automotive Work.	Hubei	Heavy/medium/ light truck, car	205469	205801
3	The First Automotive Work	Jilin	Heavy/medium/ light truck	191616	188417
4	Changan Automotive (Group) Ltd.	Chongqing	Mini-bus, mini-truck,car	171012	168197
5	Tianjin Automotive Industry (Group) Cooperation.	Tianjin	Car, Mini-bus, light truck	128786	140052
6	Chanhe Airpalne Industry Coperation	Jiangxi	Mini-bus, mini-truck	90079	92198
7	Haifei Automotive Manufacturing Ltd.	Heilongjian g	Mini-bus, mini-truck	86017	84318
8	FAW-VW Ltd.	Jilin	Car	82202	83620
9	Liuzhou Mini-automobiles Factory	Jiangxi	Mini-bus, mini-truck	80518	83399
10	Yunjin Automotive Group Coperation	Jiangsu	Light truck, light bus	71446	71409

11	BAIC Futian Vehicle Stock Ltd.	Beijing	Light/mini truck	64455	63646
12	Jinbei Automotive Stock Ltd.	Liaoning	Light truck, light bus	53463	51631
13	Qinlin Automotive (Group) Cooperation.	Chongqing	Light truck, light bus	40871	40002
14	Jianghui Automotive (Group) Cooperation.	Anhui	Light truck	34917	34696
15	Jianglin Automotive (Group) Cooperation.	Jiangxi	Light truck, light bus	25485	24070
16	Shanghai GM Automotive Ltd.	Shanghai	Car	23290	19820
17	Beijing Jeep Automotive Ltd.	Beijing	Light bus, car	21164	21006
18	Beijing Light Automotive Cooperation	Beijing	Light truck	19275	19208
19	Beijing Automotive&Motorcycle United Manufacturing Cooperation	Beijing	Light truck, light bus	15000	15015
20	Guanzhou Honda Automotive Ltd.	Guangzhou	Car	10008	10003
	Sum of top 20			1646019	1647207
	National total			1831596	1832976

2.2 Automotive Industry's Influences on China's economy

This section discusses the role of China's automotive industry on its national economy. The discussion includes the following aspects: its contribution to GDP, its influences on its upstream industries and downstream industries, its contribution to employment, its influence on imports and exports, its contribution to taxes and its influences on environment. The discussion aims to show the importance of the automotive industry in the national economy of China, and hence the importance of related policies to ensure the sustainable development of China automotive industry.

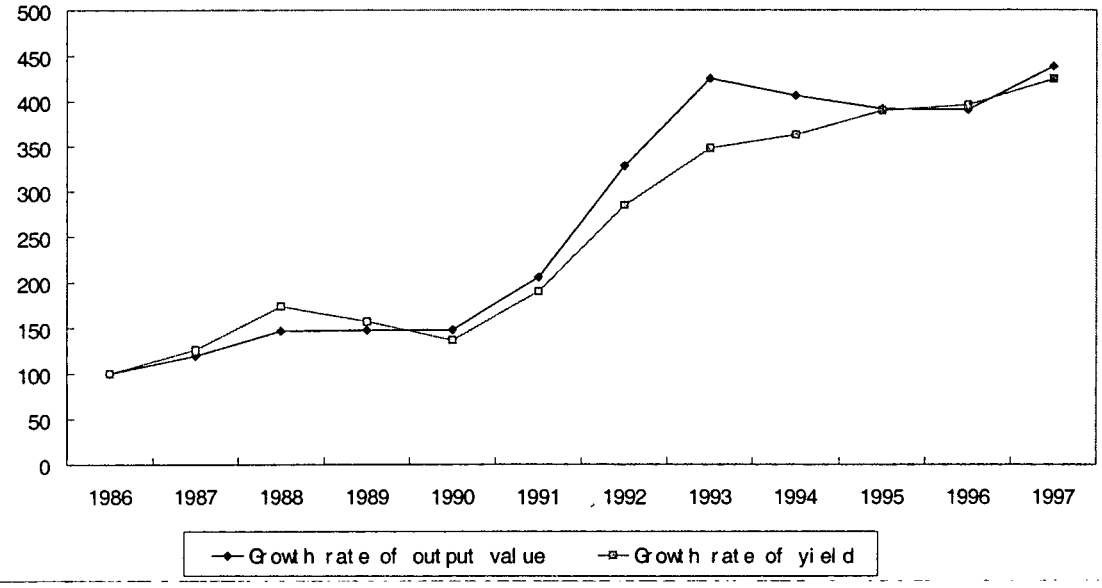
2.2.1 Influences on output value of manufacturing industry and GDP

2.2.1.1 The total output value and value added of automotive industry

From 1986 to 1997, the total real output value of China's automotive industry

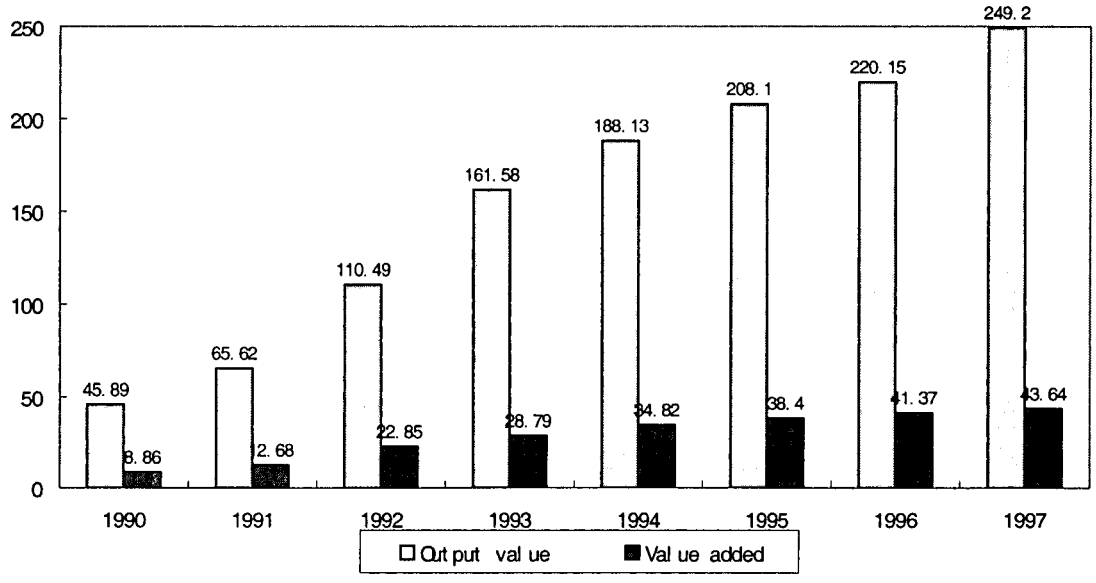
increased to RMB 88.86 billion from RMB 20.27 billion, growing at an average of 14.4% annually, while the average growth rate of automotive output is 14.3% annually. Figure 2 show that China's automotive industry has entered a stage of rapid growth since 1990, with great increases in both the total output value and total output. From 1990 to 1993, the average annual growth rate of total output value was 42.1%, that of the total output was 36.5%.

Figure 2 Growth rate of output value and yield of China's auto industry (1986=100)



The value added rate of automotive industry (industrial value added rate = industrial value added/ total industrial output value) reflects the intensity of processing in the automotive industry. During the period of 1990-1997, the value added of China's automotive industry mainly fluctuated between 18-20% (as shown in figure 3), and did not show an increase in processing intensity. This is related to the fact that technologies of spare parts and components are comparatively low. For example, the proportion of electronic parts and components is quite low and most of them need to be imported, so the value added is low, and products with high value added are few. This explains that the growth rate of value added is lower than the growth rate of the total output value of automotive industry.

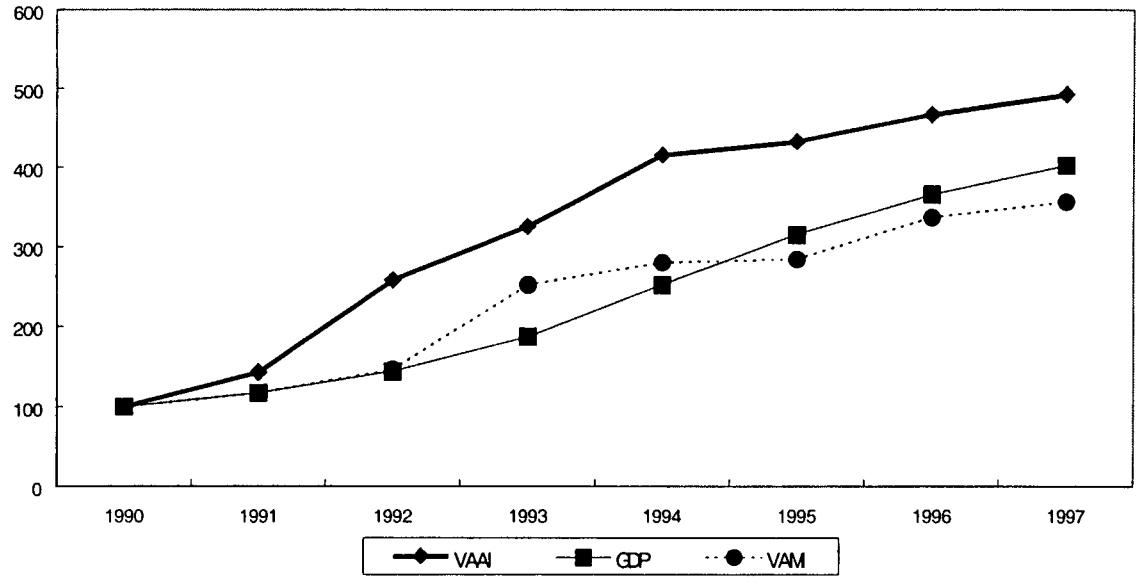
Figure 3 Output value and value added of China's auto Industry (in billion RMB)



2.2.1.2 Contribution of automotive industry to output value of manufacturing industry and GDP

The total output value of automotive industry in 1986 was RMB 20.27 billion, accounting for 2.5% of the manufacturing industry output, while the total output value of automotive industry in 1997 was RMB 249.2 billion, accounting for 4.2% of the manufacturing industry output. The value added of automotive industry was RMB 8.86 billion in 1990, corresponding to 2.1% of the manufacturing industry value added, and accounting for 0.5% of GDP. During the rapid development period of 1992 to 1994, the value added of automotive industry (VAAI) respectively accounted for 3.7%, 2.7%, 3.1% of the manufacturing industry, and 0.9%, 0.8%, 0.8% of GDP. Influenced by the lack of market demand, the ratio of value added of automotive industry in GDP went down, and reached RMB 43.63 billion in 1997, accounting for 2.8% of value added of manufacturing industry (VAMI), and 0.6% of GDP.

Figure 4 Index numbers of VAAI,VAMI,GDP
(1990=100)



Analyzing the direct and indirect contribution of the automotive industry's value added to the whole manufacturing industry's value added through the multi-dimensional dynamic analysis model (MUDAN, a dynamic Input-Output model), the contribution to the manufacturing industry are respectively 4.19% in 1990, 9.08% in 1995 and 9.81% in 1997, and the direct and indirect contribution to GDP are 2.29% in 1990, 5.35% in 1995, and5.95% in 1997. Figure 4 shows the growth of the value added in the automotive industry, which is faster than the value added of the manufacturing industry and GDP.

2.2.2 Influences on the upstream industries

2.2.2.1 influences on value of upstream industries

The automotive industry's development will increase the demand for the products of upstream industries, such as iron and steel industry, nonferrous metal industry, electric power industry, plastics industry, rubber manufacturing industry, textile industry, leather industry, chemicals industry, electronics industry, and electric equipment and machinery industry, and promote the development of those upstream industries. Using MUDAN, the

total demand for intermediate products of upstream industries (as shown in table 2-2) derived from the automotive industry can be calculated as RMB 96.2 billion in 1990, RMB 400.2 billion in 1995, and RMB 544.1 billion in 1997, accounting for respectively 1.70%, 3.86% and 4.31% of the total output values of those years. The output value of automotive industry and its proportion in the total output value are RMB 50.1 billion and 0.89% in 1990, RMB 251.8 billion and 2.43% in 1995, and RMB 329.5 billion and 2.61% in 1997. We can conclude that the automotive industry stimulates the demands of other industries considerably.

Table 2-2 Automotive industry demands for intermediate products from upstream industries

(in billion RMB)

Industry	1990	1995	1997
Forestry	1.49	5.74	7.82
Ferrous metals mining and dressing	0.43	1.95	2.63
Nonferrous metal mining and dressing	0.63	2.15	2.81
Textile industry	3.29	12.89	17.50
Leather, furs, down and related products	0.27	0.89	1.30
Petroleum processing and coking	1.92	6.04	8.60
Raw chemical material and chemical products	4.10	18.82	26.71
Rubber products	4.39	17.50	23.55
Plastics products	1.15	6.30	8.96
Smelting and processing of ferrous metals	11.75	42.88	54.15
Smelting and processing of nonferrous metals	3.46	9.17	11.28
Ordinary machinery	9.15	57.98	81.77
Electric equipment and machinery	3.63	18.16	25.14
Electronic and telecommunication equipment	0.71	5.32	6.99
Instrument, meters, cultural and office machinery	0.49	2.87	3.76
Electric power steam and hot water production and supply	2.61	8.69	12.37
Sum demand from above upstream industries	**49.47**	**217.35**	**295.34**

Table 2-3 shows the results of the value added changes of some upstream industries stimulated by automotive industry using the MUDAN model. The value added of the upstream industries stimulated by automotive industry is even larger then that of automotive industry itself, which shows automotive industry's importance to China's economy.

Table 2-3: Value added of some upstream industries caused by automotive industry

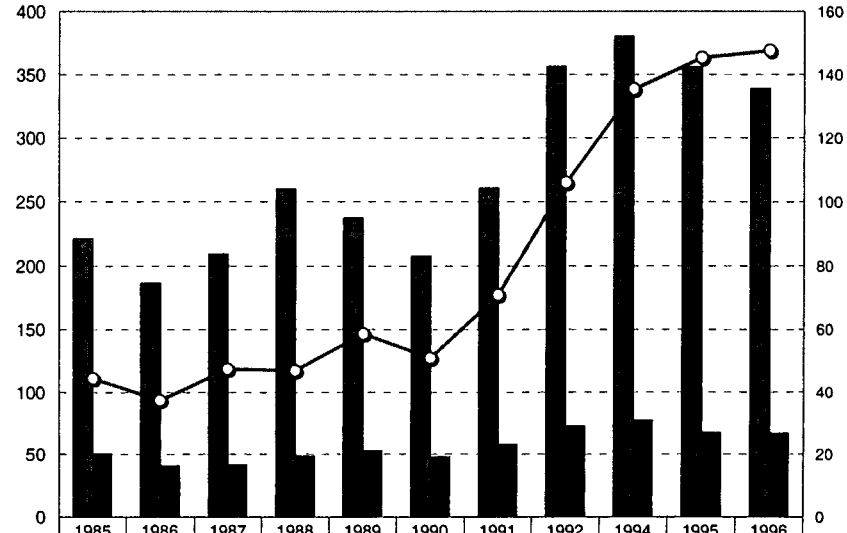
(in billion RMB)

Industry	1990	1995	1997
Forestry	1.07	6.80	9.25
Ferrous metals mining and dressing	0.12	1.00	1.43
Nonferrous metal mining and dressing	0.17	1.05	1.47
Textile industry	0.72	4.26	6.14
Leather, furs□ down and related products	0.05	0.27	0.42
Petroleum processing and coking	0.36	3.29	4.45
Raw chemical material and chemical products	1.05	5.92	9.07
Rubber products	1.13	5.72	8.22
Plastics products	0.26	1.85	2.82
Smelting and processing of ferrous metals	2.31	23.47	32.07
Smelting and processing of nonferrous metals	0.55	3.59	4.71
Ordinary machinery	2.72	21.82	32.53
Electric equipment and machinery	0.90	6.50	9.54
Electronic and telecommunication equipment	0.17	1.83	2.57
Instrument, meters, cultural and office machinery	0.16	1.28	1.77
Electric power steam and hot water production and supply	0.73	5.52	8.09
Sum of above upstream industries	**12.47**	**94.17**	**134.55**

2.2.2.2 Influences of on real material volume of the upstream industries

1) Automotive industry's influence on iron and steel industry. Figure 5 shows the consumption of steels and pig iron.

Figure 5 Consumption of steel and pig iron



	1985	1986	1987	1988	1989	1990	1991	1992	1994	1995	1996
Steel consumption(in 10000 tons)	221.4	186.1	209.2	259.8	237	207.9	260.7	355.9	380	355.4	339
Pig iron consumption(in 10000 tons)	50.7	40.78	41.9	48.2	53	47.8	58	72.3	77.1	67.5	66.7
Auto yield(in 10000)	44.3	37.3	47.3	46.9	58.7	50.9	70.9	106	135.3	145.3	147.5

2) Automotive industry's influence on other related industries. Nonmetal materials account for 17%--21% of the total sedan materials, including plastics (6%--9%), rubber (8%--10%), and glass (about 3%). The plastics used in automotive industry accounts for about 4% of the total consumption of plastics, rubber consumed in automotive industry accounts for 30% of its total consumption, and automotive industry accounts for 6% of the total consumption of petrochemical products.

2.2.3 Influences on the downstream industries

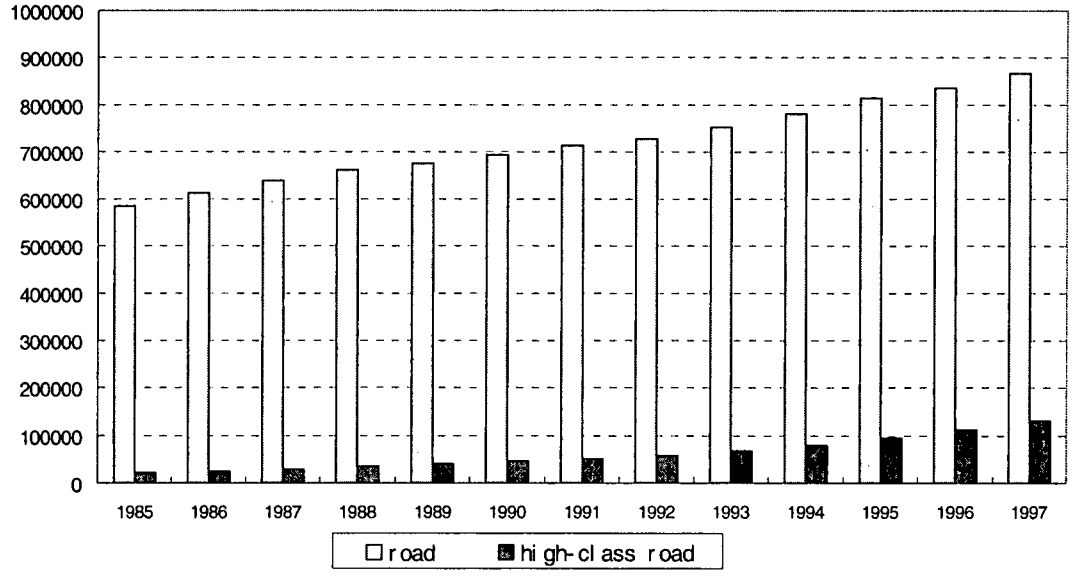
The sharp increase of the automobile parc also influences some downstream industries positively. Based on calculations with MUDAN, the automotive industry's influences on the downstream industries are as follows:

2.2.3.1 Influences on road construction

The rapid development of automotive industry promotes China's road construction,

especially the high-class road[4]. From 1985 to 1997, China's total road mileage has continuously increased (as shown in figure 6). Classified by the road classes, the increase rate of total road mileage is 4.2%, and that of Class I road and Class II road respectively are 37.6% and 14.8%. During the some period, the average increase rate of paved roads was 7.5%. Comparing the intensification of paved road mileage and road network between different regions, we get the result that the more developed a region, the more intensified its road network and the larger the share of high-quality road mileage.

Figure 6 Mileage of road and high-class road
(in km)



2.2.3.2 Influences on road transport

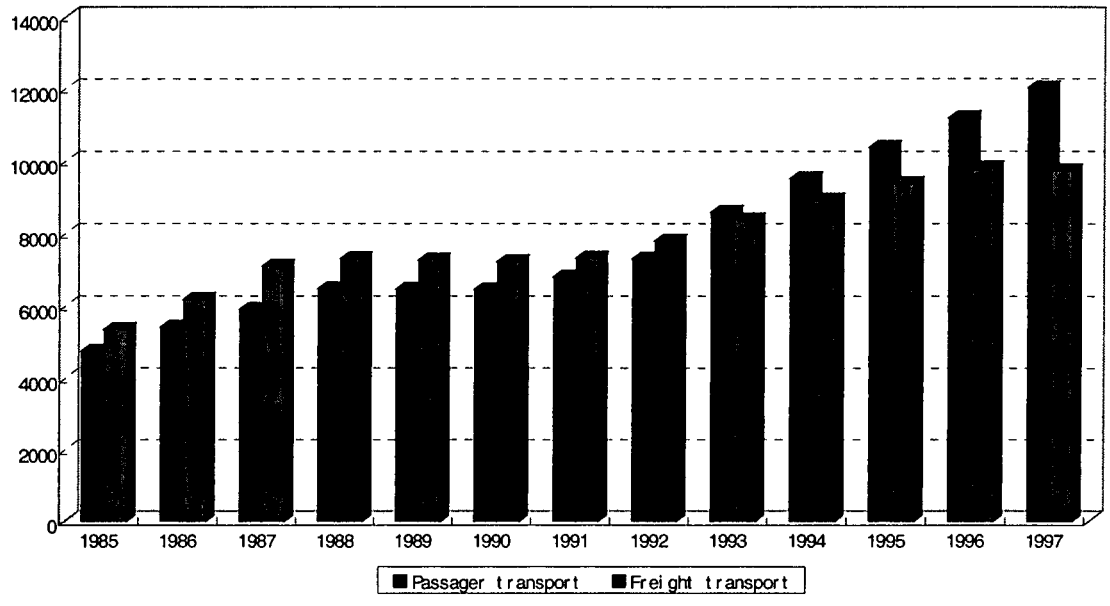
The road freight transport and passenger transport has been accounting for a comparatively high ratio in the total transport volume, characterized as the follows:

1) Total road freight transport in tons increased very rapidly, with an average growth rate of 6.8% from 1986 to 1997(shown in Figure 7-1). The road freight

[4] In China, classified by classes, road can be divided into express-way, Class I to IV road and road below Class IV, high-class road refers to express-way, Class I and Class II road. Classified by road paved or not , road can be divided into paved road and non-paved road.

transport in tons accounts for 75% or so of the total freight transport.

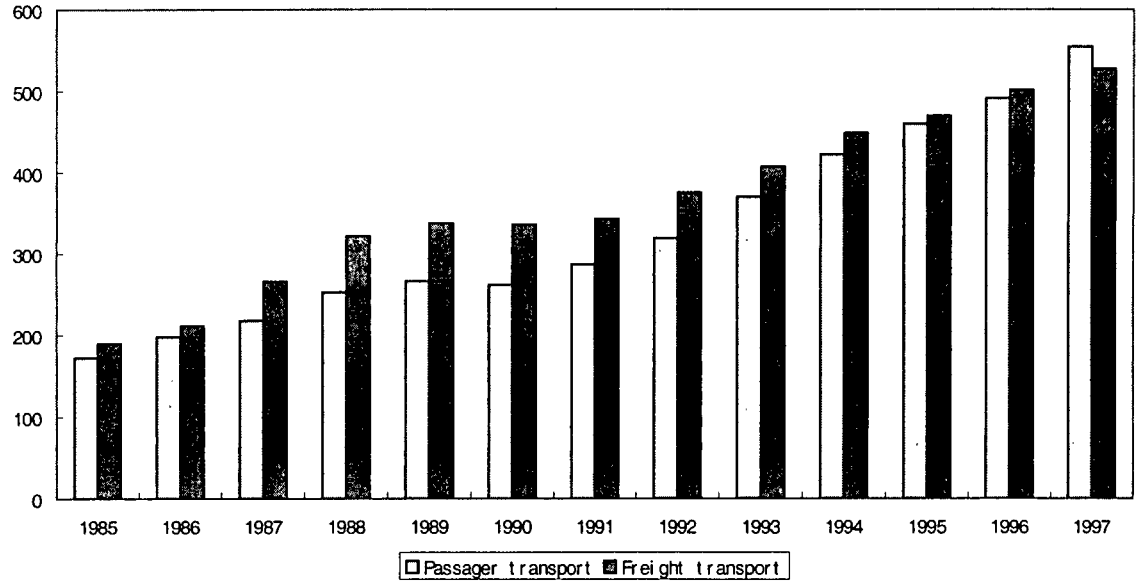
Figure 7-1 Passager traffic and freight traffic of road (in million persons/tons)



2) The increase rate of road freight transport in ton kilometer reaches 10%, accounting for 13.8% of the total in 1997, with great development potentials (shown in Figure 7-2)

3) The road passenger transport in person increased moderately rapid from 1986 to 1997, annually increasing by 5.6%(shown in Figure 7-1), accounting for 90% of total passenger traffic.

Figure 7-2 Passager transport and freight transport of road (in billion person-km/ton km)



4) Road passenger transport in persons kilometer increases comparatively smoothly (shown in Figure 7-2), accounting for 55.3% of the total in 1997.

2.2.3.3 influences on gas and diesel oil consumption

Since 1985, following the development of China's automotive industry and the rapid increase of automobile parc and automobile use, the production and consumption of gas and diesel oil increased significantly.

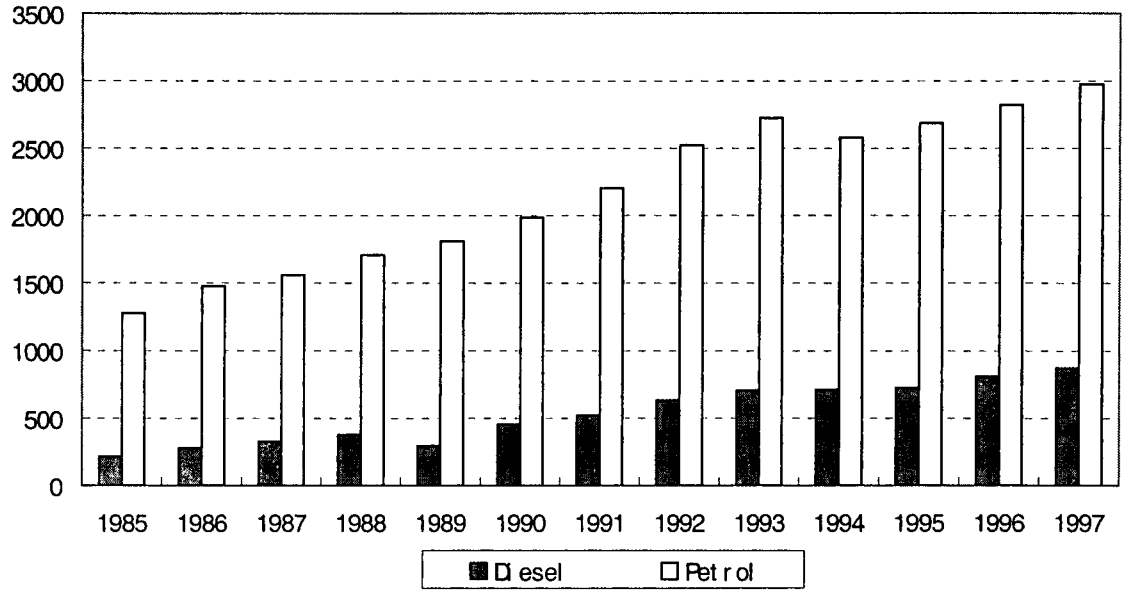
1) The total automobile oil consumption increased rapidly from 1986 to 1997, the average growth rate of gas consumption was 7.3%, and the diesel oil consumption annually increased 12.4%.

2) More than 85% of gas consumption was utilized by automobiles. Since the quality of oils used by automobiles is higher than that used by others, the increase of automobile parc will cause to the increase of high quality oil demand. 3) The share of diesel oil consumption in total oil consumption is comparatively low at

17.7% in 1997, while the consumption volume will grow with the improvement of manufacturing technology of the automotive industry.

Changes of gas and diesel oil consumption from 1985 to 1997 are shown in Figure 8.

Figure 8 Consumption of petrol and diesel (in 10,000 tons)

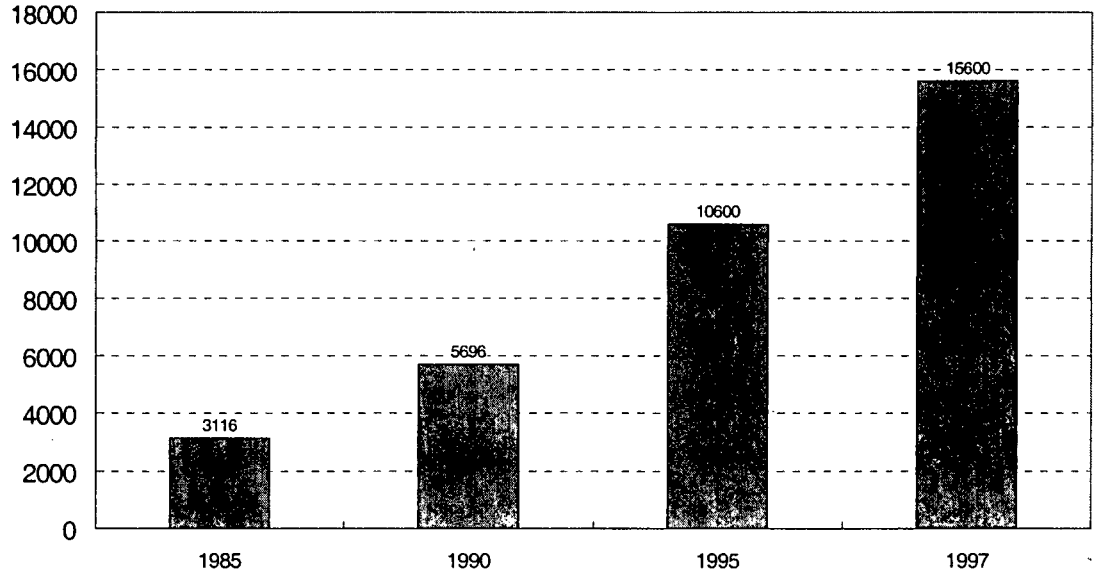


2.2.3.4 Influences on automobile maintenance, gas stations, and insurance

(1) Automobile maintenance. China opened the automobile maintenance market in 1983, allowing foreign and private companies to enter the maintenance industry. From 1983 to 1990, the automobile maintenance industry witnessed rapid development, with the number of enterprises in the automobile maintenance industry increasing to 100,000 from the former 20,000, an average increase of 26% annually. Since 1990, the growth rate of the number of enterprises has been maintained at 17%. In 1998, 310,000 maintenance enterprises existed (including 263 joint funded or operated maintenance enterprises), employing 2.4 million people, and creating an output value of RMB 30 billion.

(2) Gas stations. In line with the rapid increase of automobile parc, the number of gas stations has grown fast. In 1985, the General Corporation of Petrochemical Industry of China (CPCI) operated 3116 gas stations, increasing to 15600 in 1997, an average annual growth rate of 14.37%. The gas stations number of CPCI from 1985 to 1997 are shown in Figure 9.

Figure 9 Changes of gas station number in CPCI



(3) Automobile insurance. The development of automotive industry triggered a rapidly increasing demand for insurance. In 1987, there were 5 million insured automobiles with total insurance revenues of RMB 1.6 billion. The number of insured automobiles reached 13 million in 1997 and the insurance revenues increased to RMB 25.24 billion. From 1987 to 1997, the annual growth rate of insurance revenues was 31.76%. Based on revenues, automobile insurance has become the biggest insurance category of China's wealth insurance.

2.2.4 Employment

2.2.4.1 Employment in automotive industry

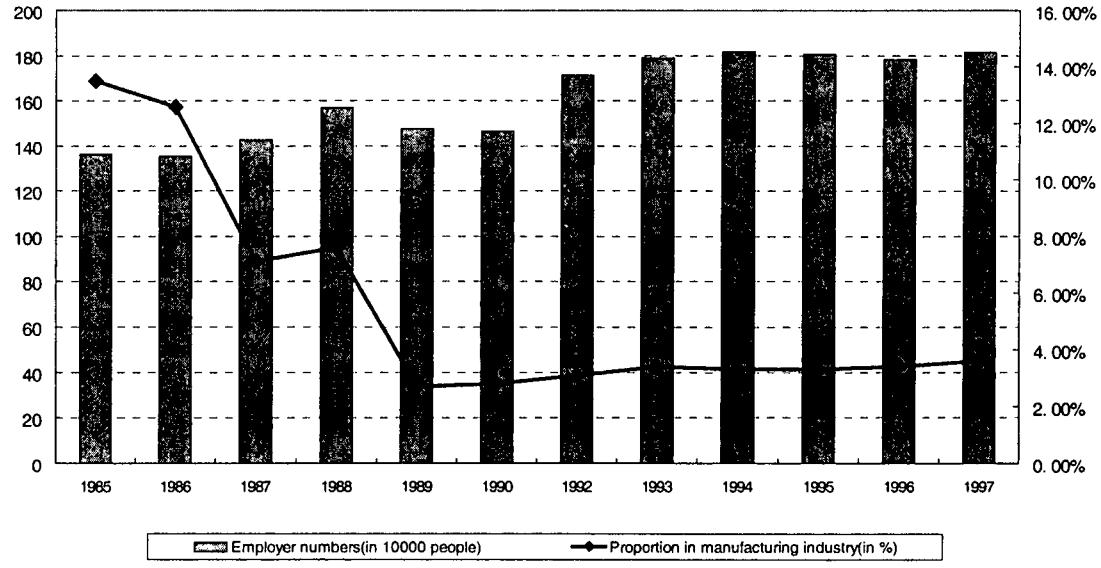
China's automotive industry has employed a rapidly increasing number of workers.

Total employment in the automotive industry was 720,000 in 1978, growing to 1.363 million in 1985, an average annual increase of 9.5%. During the 12 years from 1985 to 1997, though China's automotive industry developed comparatively rapid, the employer numbers increased only gradually to 1.814 million in 1997, an annual increase of 2.4%.

Actually, productivity per capita in automotive industry had greatly improved during the years from 1985 to 1997. In 1985, the total automobile production was 443,377 and the per capita production in the whole industry was only 0.33. By 1997, the total automobile production increased to 1,582,628, and the per capita production was 0.87. This improvement of productivity was largely attributed to the higher productivity of new factories. Although the complete statistics was absent, the gap can be seen by a comparison of the new factories and old ones. FAW-Volkswagen was a joint venture between the First Automobile Works in China and German Volkswagen. There were 3,845 workers in this factory in 1997 and the total production in that year was 46,405 automobiles. The per capita production was 12.7. By comparison, FAW, the automobile maker with the longest history in China, had 112,172 workers in the same year but only produced 164,093 automobiles. The per capita production was 1.46, only 11.5% of that of FAW- Volkswagen.

Changes of employer numbers and its proportion of manufacturing industry during 1985—1997 are shown in figure 10.

Figure 10 Employer numbers of auto industry and its proportion in manufacturing industry



2.2.4.2 Employment in the industries related to automotive industry

According to calculations with MUDAN and the employment numbers publicized by the State Statistics Bureau, it is possible to calculate the automotive industry's impact upon employment in some upstream industries (shown in table 2-4).

Table 2-4: Influences on employment of some upstream industries by automotive industry

(in 1000 people)

Industry	1990	1995	1997
Forestry	35.26	76.81	121.26
Ferrous metals mining and dressing	13.64	25.30	25.18
Nonferrous metal mining and dressing	28.47	50.10	48.01
Textile industry	77.48	167.58	168.07
Leather, furs, down and related products	5.77	6.34	6.55
Petroleum processing and coking	18.47	47.74	54.46
Raw chemical material and chemical products	79.87	190.76	206.98
Rubber products	87.98	190.34	184.58
Plastics products	19.30	47.09	49.39
Smelting and processing of ferrous metals	181.50	479.56	486.32
Smelting and processing of nonferrous metals	36.03	83.12	89.77
Ordinary machinery	272.83	845.13	939.68
Electric equipment and machinery	53.74	144.20	149.59
Electronic and telecommunication equipment	14.76	25.63	26.57
Instrument, meters, cultural and office machinery	14.74	36.81	37.60
Electric power steam and hot water production and supply	40.34	113.16	136.40
SUM of employers of above upstream industries	**980.18**	**2529.67**	**2730.41**

The development of China's automotive industry evidently promotes employment in upstream industries. In 1990, 980,000 people were employed in upstream industries, a number which increased to 2.73 million people in 1997, an annual increase of 20.9%.

Besides big positive influences on employment of its upstream industries, China automotive industry also had a marked positive influence on other related industries. The impact of the automotive industry on employment in other industries calculated by the Research Center of Automobile Technologies can be summarized in table 2-5.

Table 2-5: Employment numbers directly or indirectly related to automotive industry

(in 1000 people)

Year	1995	1997
Automotive industry	**1805**	**1814**
Full employment of some upstream industries	2530	2730
Automobile maintenance	2030	2199

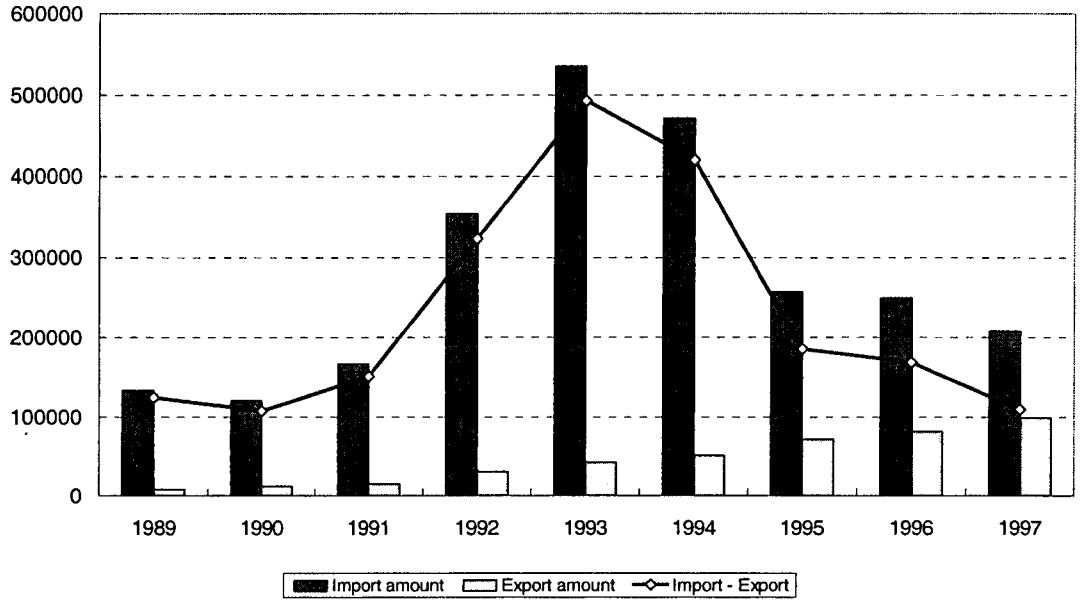
Transportation	4060	4224
Financial & insurance	180	200
Sales department	110	116
Management department	23	24
Research and information departments	24	27
Other departments	8550	10475
Sum of employers related to automobile except itself	**17507**	**199950**

In 1995 and 1997, the employment proportion of automotive industry and its related industries were 1:9.5 and 1:11. So it is evident that China's automotive industry and automobile consumption has promoted employment in other industries, and that its indirect impact on employment is increasing.

2.2.5 Import and export balance

China's automobile import and export trade has shown continuous deficits. In particular, the deficits sharply increased due to the increased volume and foreign technologies introduction from 1991 to 1993. After 1993, the import volume began to decrease rapidly and the trade deficit was gradually reduced. Since the export volume increased comparatively rapid in the past few years, the reduction of trade deficit in the automotive industry was relatively rapid. During the period from 1989 to 1997, the export volume increased to US$ 987.84 million from US$80.31million (as shown in figure 11), an average increase of 36.8% annually.

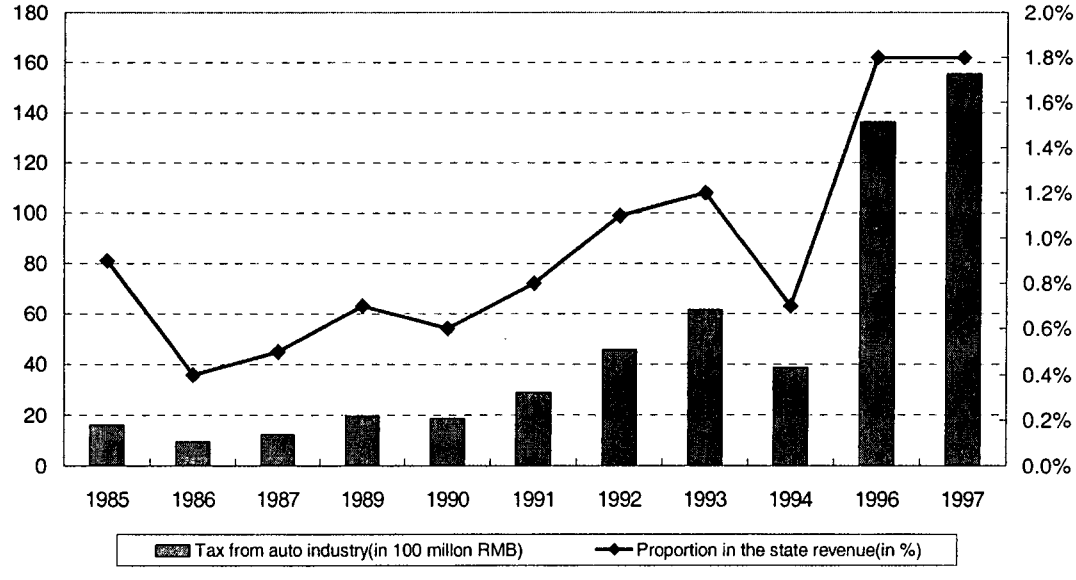
Figure 11 Import & Export amount of auto industry (in 10000 US$)



2.2.6 Tax revenue of automotive industry and related industries

The proportion of tax from automotive industry to state revenue is shown in figure 12.

Figure 12 Tax from auto industry and its proportion in the state revenue



The automotive industry's development not only results in increasing tax revenues in acquisition stage, but also provides comparatively high revenues for the state and local governments from automobile ownership and during the usage stage. According to related statistics, the state-ratified auto acquisition and road maintenance fee amounts to RMB 53 billion in 1997. The auto acquisition fee (a kind of sales tax), which is 10% of auto price, collected RMB 18.3 billion in 1997, and the road maintenance fee, which is 12%--15% of business income or monthly RMB 105--220 per ton, was collected RMB 34.7 billion in 1997. The additional fee to road passenger and freight transport (introduced by the provincial governments), the road and bridge pass fee imposed on all automobiles and the additional acquisition fee imposed of new autos amounted to RMB 36.8 billion. In addition, some locality, city and county governments collect road construction fees, city construction fees, an additional motor vehicle fee and road and bridge fee, etc. These different fees are not named in one unique fashion, and the charges bases and rates differ according to locality, making it difficult to assess how much is actually collected. The tax types and tax rates collected from automobiles are shown in table 2-6.

Table 2-6: Auto tax types and rates in acquisition, ownership and usage stages

Stage	Types of tax and fee		Objects taxed	Tax rate and standard
Acquisition stage	Consumption tax	for sedan	exhaust volume>2.2L	8% of sales price
			1.0L□exhaust volume□2.2L	5% of sales price
			exhaust volume□1.0L	3% of sales price
		for cross-country vehicle	exhaust volume□2.4L	5% of sales price
			exhaust volume□2.4L	3% of sales price
		for passenger vehicle	exhaust volume□2.0L	5% of sales price
			exhaust volume□2.0L	3% of sales price
	Tax on value added		All automobiles	17% of sales price
	Tariff		All imported automobiles	35%--230% of CIF
Ownership stage	Auto acquisition additional fee		All automobiles	10% of vehicle price
	New auto test fee		All automobiles	RMB 60--110
	Auto number plate fee		All automobiles	RMB 60--110
Usage stage	Usage fee of auto and ship		Passenger vehicle	RMB 60—320/year
			Truck	RMB 16—60/year
			Motor cycle	20--60/year
	Road maintenance fee		All automobiles	100--230/month
				12%--15% of business income
	Insurance fee	Non-business auto	Auto indemnity insurance	Basic insurance fee RMB 200—1450/year □insurance money ×1.2%
			Third party duty insurance	Fixed insurance fee RMB 800—2360/year
		Business auto	Auto indemnity insurance	Basic insurance fee RMB 200—1450/year □insurance money×1.2%
			Third party duty insurance	Fixed insurance fee RMB 800—2360/year

Because of the technological and economic relations among all the sectors of national economy, and the automotive industry's development has optimistically influence on other sectors' development and their tax revenue to some extent (See table 2-7). These data show that the proportion of tax revenue directly or indirectly linked to automotive industry respectively accounts for 3.66%, 7.61%, 8.19% of the total tax revenues in 1990, 1995 and 1997.

Table 2-7: Tax revenue brought by the complete demands of automotive industry to some industries' output

(in million RMB)

Industry	1990	1995	1997
Forestry	32	203	276
Ferrous metals mining and dressing	10	83	119
Nonferrous metal mining and dressing	10	64	89
Textile industry	95	561	808
Leather, furs, down and related products	5	28	43
Petroleum processing and coking	110	989	1338
Raw chemical material and chemical products	194	1096	1681
Rubber products	243	1230	1766
Plastics products	32	231	353
Smelting and processing of ferrous metals	372	3771	5152
Smelting and processing of nonferrous metals	84	546	716
Ordinary machinery	319	2562	3821
Electric equipment and machinery	138	1001	1470
Electronic and telecommunication equipment	21	231	325
Instrument, meters, cultural and office machinery	19	158	219
Electric power steam and hot water production and supply	114	865	1267
Sum of above industries	1798	13619	19443

2.2.7 Conclusion: Influence and Role of Automotive industry on China Economy

It can be seen from the discussion in this section that the development of automotive industry plays a great roles in China economy. Calculated by the statistics in 1997, the direct and indirect contribution of automotive industry's value added to GDP was 9.81%; its demands for upstream industries were 544.1 billion RMB, accounting for

4.31% in gross social output; it has greatly promoted the development of downstream industries, which include highway transportation, fuel production and marketing, automobile repairs and maintenance, and insurance. Automotive industry also made remarkable contribution to employment. The number of employed workers in the industry itself was 1.814 million, and in other related industries was 21.809 million. At the same time the development of automotive industry has greatly contributed to tax revenues. Direct and indirect revenues from automotive industry accounted for 8.19%. In view of the important role of automotive industry in national economy, China must pay great attention to the development of automotive industry and it is necessary to formulate sustainable development strategies for automotive industry.

2.3 Automotive Industry's Influences on China's environment

The concern about the impact of motorized vehicles center around four general issues: Emissions, Energy and resource consumption, Noise and Congestion and land use. But much of the focus is still on the emissions from vehicles.

The total lifetime impacts of a vehicle on environment & sustainability are various (see table 2-8).

Table 2-8: Car Life-Cycle Environmental Impact

Stages	*Environmental Impact*
1 Pre-assembly	• Mineral extraction for raw materials; transport of raw materials • Production of secondary materials (e.g. aluminium semis) • Transport of these materials to assemblers and suppliers • Production of components and subassemblies • Transport of components and subassemblies
2 Assembly	• Energy use in assembly plant • Pollution caused in assembly process (e.g. paintshop emissions) • Release of waste materials into ground and water and into recycling system • Transport of finished vehicles to dealer and customer
3 Use	• Energy used for driving • Pollution caused by emissions and waste materials from disposables (batteries, tyres, oil, etc.) • Land use requirements (roads, fuel stations, parking facilities, etc.) • Accident damage to people, animals and environment
4 Post-use	• Transport to dismantling site/scrapyard • Energy used in dismantling/scrapping process • Pollution caused by dismantling/scrapping process • Transport of recyclates

Source: Nieuwenhuis & Wells (1997*), The Death of Motoring?*

1). The production stage

In China, the pollutants of manufacturing industries include waste water, waste gas emissions, solids wastes and noises. But in the total pollution volume, the share caused by the sector machine building, electric machinery & electronic equipment manufacturing (in which automotive industry is included) is very low (shown in table 2-10), now in the manufacturing industry, the most polluted industries is production &

supply of electric power, gas & water industry, raw chemical materials and chemical products manufacturing industry, nonmetal mineral products manufacturing industry and smelting and pressing of ferrous metals industry. Because we lack separated data on pollution caused by production in the automotive industry, we cannot quantify how much this industry pollutes the environment, but its effects on the environment are smaller than for other industries.

Table2-9 Pollution caused by industry enterprises

Item	1995	1998	1999
Total Volume of Industrial Waste Water Discharged (10 000 tons)	2218943	1712355	1607678
Total Volume of Industrial Waste Gas Emission (100 million cu.m)	107478	110807	114721
Volume of Sulphur Dioxide Emission (10 000 tons)	1405	1210	1078
Volume of Soot Emission (10 000 tons)	838	680	557
Volume of Industrial Dust Emission (10 000 tons)	639	506	458
Volume of Industrial Solid Wastes Produced (10 000 tons)	64474	63648	64905

Table2-10 Pollution caused by sector of industry enterprises (1999)

Sector	Total Volume of Industrial Waste Water Discharged (000 tons)	Total Volume of Waste Gas Emission (billion cu.m)	Volume of Sulphur Dioxide Emission (000 tons)	Volume of Industrial Soot Emission (000 tons)	Volume of Industrial Solid Wastes Produced (000 tons)
Total	16076780	11472	10780	5570	649050
Mining and Quarrying	1224030	349	331	249	383063
Food, Beverage and Tobacco Industry	1745660	311	385	266	20073
Textile Industry	1212400	145	247	121	4257
Leather, Furs, Down and Related Products	138170	13	11	8	1053
Papermaking & Paper Products	2998470	223	308	259	8310
Printing & Record Medium Reproduction	18290	5	4	4	136
Petroleum Processing & Coking	626640	370	322	252	6668
Raw Chemical Materials and Chemical Products	3611850	869	832	434	49154
Medical and Pharmaceutical Products	323060	52	72	52	2129
Chemical Fiber	500370	296	127	58	2863
Rubber Products	93850	41	51	22	758
Plastic Products	30410	16	13	6	216
Nonmetal Mineral Products	468380	2369	2155	2501	15338
#Cement Manufacturing	268160	1859	884	490	8002
Smelting and Pressing of Ferrous Metals	2288470	1882	714	312	108543
Smelting and Pressing of Nonferrous Metals	310220	804	672	177	29709

Metal Products	105190	48	72	37	945
Machine Building, Electric Machinery, & Electronic Equipment Manufacturing	958620	345	202	131	9083
#Percentage in the total	5.96	3.00	1.88	2.35	1.40
Production & Supply of Electric Power, Gas & Water	2079550	4344	6374	3075	121075
Other Industries	475800	196	1366	1564	20920

In addition, since the automotive industry conducted many energy-saving measures, we find that energy consumption by the automotive industry increased much more slowly than Output of automobiles did (see table 2-11).

***Table2-11 Output* of automobiles and its Energy consumption**

	Energy consumption by automotive industry		Output of automobiles	
	Volume (equivalent coal, ton)	Annually increasing rate (%)	Output of automobiles (000 units)	Annually increasing rate (%)
1990	3958485		514.00	
1995	6938216	11.88	1452.70	23.10
1999	7689647	2.60	1832.00	5.97

2) In the use stage

Compared with the impacts on environment of pollution caused by automotive industry in the production stage, the impacts on environment of pollution caused by automotive industry in the use stage is much more serious and with automobiles parc increasing quickly, this type of pollution will become the main source of environmental pollution, especially in the urban area. In 1995 there were a little fewer than 1 million vehicles in use in Beijing, almost 10 percent of the national total. As a result, emissions of nitrogen oxides (NO_x) and monoxides (CO) reached 115,000 tons and 1.4 million tons respectively. In contrast, Tokyo in 1995 had some 4 million vehicles in use, four times as many as the number in Beijing, but corresponding figures were 50,000 tons for NOx and 100,000 tons for CO. This implies that emission rates per car are 9 resp. 56 times larger in Beijing than in Tokyo. Japan's spectacular performance in mitigating air pollution has been achieved through stringent environmental standards set by the government and incremental improvement in technology carried out by firms. After 1990s, government started to

reduce the pollution caused by automobiles use by tightening the emission standards, finding alternatives to fossil fuels (alcohols, electricity etc) and widening the fossil-fuels base used for automotive propulsion (LPG, CNG, LNG). But the current emission standards in China can only reach the early 1990s level in Europe, and due to poor oil quality, emission exhaust per vehicles is even larger.

3) The discarding stage

In China, those automobiles meet *Criteria of Automobile Discard* should be send to government-appointed automobiles recycling companies to be dismantled and its materials recycled. Because the volume of discarding automobiles are very tiny and its share in automobiles prac is only around 3% (see table 2-12), so its impacts on environment is small.

Table 2-12 Volume of Discarding Automobiles and its share in Automobiles Prac (1995-1999)

Year	Volume of Discarding Automobiles (units)	Volume of Automobiles Parc (units)	Share of Discarding Automobiles (%)
1995	253685	10400000	2.44
1996	339956	11000800	3.09
1997	347011	12190900	2.85
1998	403164	13193000	3.06
1999	405710	14529400	2.79

Chapter 3

Evaluation of Sustainable Development Policies

for China's automotive industry

3.1 Evaluation Methods

The evaluation mainly proceeds from the targets of formulated policies, the results of the policy implementation (whether it is successful, efficient, economical and fair, easy to carry out, acceptable, and any side effects), and evaluated them from three perspectives (competitiveness, employment and environmental protection) based on sustainable development for the automotive industry.

Table 3-1: Approaches of Evaluation

policy	targets of the policy	results of implementing the policy	evaluation of its role in sustainable development for the automotive industry
policy 1: Industrial Policy for Automobile Industry			• influence on competitiveness • influence on employment • influence on environmental protection
policy 2			
policy 3			
etc..			

3.2 Policy Evaluation

3.2.1 Evaluation of Economical policy

3.2.1.1 The Industrial Policy for Automobile Industry (IPAI)

The IPAI is the most complete regulation for the industry in China, and it is also the first industrial policy in China, which includes regulations on investment, manufacturing, marketing, and consumption. The purpose of the policy is to improve the situation characterized by scattered investment, small scale of manufacturing, and backward products, and to increase the capability of development of enterprises, to improve the quality and technology of the products, to enhance the optimization of industrial organization, to realize economies of scale economy, and to make the industry (including the motorcycle industry) a pillar industry[5] of the national economy as soon as possible, and to strengthen the competitiveness of China's automotive industry in the international market. The target was that by implementing the IPAI, China could lay a firm foundation for China's automotive industry by the end of 20th century, and could make it a pillar industry of national economy by 2010, and consequently to step up the development of other related industries.

1) Pillar Industry

The ultimate goal of the IPAI is to make automotive industry a pillar industry of the national economy.

[5] The concept of pillar industry was adapted from Japan & South Korea. It refers to an industry with strong forward and backward linkage with other industries and having big influence on the economy. It was adopted in China in The Framework of National Industrial Policy in the 1990s, in which machine building, electronics, automotive, petroleum and construction industries were selected as the pillar industries. For the automotive industry, targets were set that it should meet 5 indicators: its value added should be above 3% of GDP, both the indicator of sensitivity and the power of dispersion are above 1(that means when final demand of automotive industry increases 1%, the intermediate input from its related industries will increase above 1%; when intermediated input from automotive industry increases 1%, it will cause the final demand of its related industries increase above 1%), it employs around 5% of the labor force, the labor productivity is larger than the average of the whole manufacturing industry, and the market share of the three largest enterprises should be above 70%.

As a result of the policy, the ratio of output value of automotive industry in national economy has increased, but it is not enough to make the automotive industry yet a pillar industry in China at the moment.

First of all, the ratio of output value of automotive industry to gross output value of the national economy has increased. The output value of the automotive industry in 1986 was RMB 20.27 billion Yuan, accounting for 2.5% of gross output value of manufacturing industry. By 1997, the percentage has increased to 4.2% and the gross output value was RMB 249.2 billion Yuan. The value added of the automotive industry in 1990 was RMB 8.86 billion Yuan, accounting for 2.1% of the gross value added of manufacturing industry, and 0.5% of Gross Domestic Production (GDP). The value added grew relatively quickly in 1992, 1993 and 1994, which was respectively 3.7%, 2.7% and 3.1% of gross value added of the manufacturing industry, accounting for 0.9%, 0.8% and 0.8% of GDP. Due to the sluggish market demand since 1995, the value added of the automotive industry began to fall thereafter. By 1997 the value added reached a value of RMB 43.64 billion Yuan, accounting for 2.8% of the gross added value of manufacturing industry, and 0.6% of GDP.

Secondly, the contribution rate of the automotive industry to manufacturing industry has increased. The direct and indirect contribution of the automotive industry to the added value of manufacturing industry in 1990, 1995, and 1997 were respectively 4.19%, 9.08%, and 9.81%. The direct and indirect contribution of the automotive industry to GDP in 1990, 1995, and 1997 were respectively 2.29%, 5.35%, and 5.95%.

It is fair to say that a series of policies and measures have helped the automotive industry in China make great achievements, but the automotive industry has not yet become a qualified pillar industry in China, and it is far from competitive in international markets.

2) To Increase Supply

It is stipulated in the first clause of the first chapter of IPAI—Policy Objectives and Product Development Focus that "The country guides the auto enterprises to make full use of domestic and foreign funds to open up and expand the domestic and international markets and to produce in large scale and with variety." The total output of automobiles in 2000 should be able to meet more than 90% of domestic demand, and the number of cars should cover more than 50% of the total output and basically meet household demand.

It is fair to say the greatest success of our auto industrial policy lays in that it improves the supply capacity of automotive industry. From 1980 to 1999, the output and production structure of the automotive industry has greatly improved. First of all, there has been a steady increase in the automobile output. The annual output of automobiles exceeded 1,000,000 for the first time in 1992. By 1999 the number rose to 1,832,000, ranking the ninth in the world. The sales revenue from automobile products in 1998 was RMB 250 billion yuan, and total automotive industry output value (current price) was RMB 252,billion yuan. Secondly, the variety of products increased and the product mix became more rational. There were more than 120 varieties of 6 basic categories in the industry. There were also more than 750 kinds of transformed and special-purpose automobiles, and 1000 kinds of motorcycles with 15 types of engine power. The major enterprise groups allocated 1-2% of annual sales to research and development, and some enterprises used 3-5% of annual sales for this purpose. In 1998 the output proportion of light, middle, and heavy-duty business cars (trucks and buses) was 78.5: 17.8: 3.7. The output proportion of light, middle, and heavy-duty trucks was 67: 27.7: 5.3. The output proportion of trucks and passenger cars (cars and buses) was 40.6: 59.4. The number of cars owned by one thousand people increased from 5.2 in 1991 to 10.7 in 1998.

3) Local Content Rate Requirements

It is explicitly stated in the IPAI that "The enterprises of the automotive industry must promote the local content of automobiles when introducing technologies of product

manufacturing. The local content of current products is one of the conditions for getting the government's support for the development of the second model of automobiles." "The enterprises of automotive industry are not allowed to import by SKD (semi-knock down) pattern and CKD (completely knocked down) pattern. China will determine the preferential import tariff rates according to the local content of automobile products." The local content rate of automobile products should be above 40%□see table 3.2□.

Table 3.2 preferential import tariff rates according to the local content rate

Local Content Rate	Passenger car:	40-60%	60-80%	>80%
	Truck:	50-70%	70-90%	>90%
	Motorcycle	50-70%	70-90%	>90%
Derating Percentage of Import Tariff		25%	40%	60%

The policy is very effective. Guided by the IPAI, enterprises which produce introduced models from other countries have steadily increased their local content rate, which is over 80% in average. As one of the earliest introduced model, Shanghai Santana has reached a local content rate as high as 91%. The local content rate of Tianjin two-compartment Xiali in 1994 was 83%, and 93% by the end of 1998; the Audi model of The First Automobile Works (FAW) in 1993 was 40% and grew to 80% two years later. The Shenlong Automobile Company began to promote the local content rate of cars since it was established. After realizing local production of body and engine, it began to set up a manufacturing system of spare parts across regions and industries in China. In July 1998 the Citroen series of Shenlong Company at Wuhan passed the local content inspection, and got a mark of 94, which is the highest level in China. Last year the Buick model and the Accord model of Honda was introduced in Shanghai and Guangzhou respectively, both of which had a rate of local content more than 40% for the first batch of production.

It should be pointed out that local content is a concept that is also used in other countries; China is not the only country that demands a minimum amount of local content. Many other countries also have this requirement. The U.S. imposes a local content rate of 70%, and in Brazil, the rate is 90%. The actual implementations of these requirements in these two countries are quite different. The requirements in the U.S. can guarantee the final products with good quality and low cost because of the large scale and advanced technology in American automotive industry. In Brazil however, there is no such result because of the scattered layout of industries and weak capacity of development of automotive industry. The situation in China is similar to that in Brazil. Scattered layout, small scale of enterprises, and lack of development capability not only result in high cost of products under the condition of low labor force costs, but also cause low safety, low energy-efficiency and low comfort of products and low quality of after-sales service.

The main reasons for the local content requirement are as follows. First, the local content requirement can help China to increase the employment and value added of automobile manufacturing. The automotive industry has a high degree of comprehensiveness, involves a wide range of fields, and is suitable to manufacturing. Its development will stimulate the development of basic industries, such as steel, machinery, power, electronics, rubber, and glass. If spare parts are entirely imported then the local value added will be greatly reduced. The local content requirement of the automotive industry and the related industries will help to improve employment opportunities in China. Second, the local content requirement will help China to assimilate foreign advanced technology gradually. The process of local production of automobiles is also the process of assimilating advanced technology. In recent years, automobile manufacturing enterprises in China have trained a large number of human resources through localization, which also helps to improve the management levels of state enterprises in China. Third, it will help to save foreign currency used to import spare parts and reduce tariff payments greatly. In 1984, China only spent US$ 1.05 billion on importing cars, and in 1985 and 1992, the figure increased to US$ 2.95 billion and US$ 3.24 billion, accounting for 6.99% and 4.02% respectively in total expenditure of foreign currency, and automobile products become one of

biggest consumers of foreign currency. In view of this, China began to promote the development of automotive industry in 1984, and set requirements for local content of cars in the IPAI in 1994. Fourth, what is more important is that since the overall techniques of spare parts industry in China lags far behind the developed countries, local production will strengthen the protection of Chinese automotive industry, especially, the spare parts industry, and open up certain room for future development of automotive industry in China. The results are which development of spare parts has supported automotive industry more strongly. For examples, new products, whether it is the Honda Accord at Guangzhou or GM Buick at Shanghai, or Passat B5, Audi A6, and revised Buick model all reached a local content rate of 40% in the first year, and 60% in the second or the third year. That is to say, it only takes three years to finish the process of satisfying the local content requirements, while this took Shanghai Santana eight years to achieve. Foreign currency earned from export of spare parts in 1999 has increased to RMB 798 million yuan from RMB 84.35 million yuan in 1990.

But there are also some drawbacks of local production. First, the quality of products might be harmed. Since local production is carried out according to the specific situations in different countries, it might harm the quality of products. It may step up introduction of new technologies, but too much protection will reduce incentives for enterprises to improve product quality. Second, it may increase production cost. International practice is to manufacture cars on an international scale and purchase globally according to needs. However, in China most enterprises produce spare parts on a small scale, and consequently, the costs are much higher. Third, what makes an enterprise successful is not the high rate of local content, but strong competitiveness in international markets. So far, China's automotive industry has made some achievements in local production, but it remains in doubt whether it could survive if fully exposed to the international market. China's entry into WTO will definitely lead to lower prices of imported cars. If it becomes more profitable to export cars to China, who will come to invest in China's car manufacturing industry?

To sum up, the essence of requirements of local content rate on domestic automotive industry is actually a protective policy for domestic automotive industry, especially for

the spare parts industry. That policy opens up the possibility for the development of Chinese automotive industry, with the improvements of the comprehensive capability of the industry, and meanwhile helps to improve employment opportunities in China. However, the world's trend of spare parts production is global purchasing. Therefore a protective policy cannot improve the quality of Chinese products, and will not necessarily lower the cost. Viewed from the long run, it will also undermine the competitiveness of Chinese products in global markets.

4) Enterprise Group and Scale Production

The second clause of the IPAI rules that the state will enhance the centralization of investments in automotive industry and the reorganization of the industry to improve the scattered distribution and small scale of automotive industry. The focus will be on solving problems like reducing the number of factories and improving the scattered investment, and chaotic approval of projects; duplicated introduction of less advanced product; and slow building of selected factories and local production (scattered, messy, low and slow). The objectives for different stages are: to give special support to complete car and spare part projects approved by the state during the Eighth Five-Year period to create conditions for rapidly developing automotive industry; within this century, to help 2 to 3 auto manufacturers (enterprise groups) to grow into large enterprises in a short time, 6 to 7 auto manufacturers (enterprise groups) to grow into backbone enterprises, 8 to 10 motorcycle enterprises to become key enterprises with markets at home and abroad. An orderly and competitive market structure for a small number of large enterprises and the manufacturing system characterized with batch production and fewer factories should be established. Such market structure will enable the first three auto manufacturers with the same type of automobiles (categorized according to QC.T59-93[6]) to occupy 70% of the Chinese market. At the same time, cooperation between large enterprises and backbone enterprises should be encouraged in order to form 3 to 4 large automotive enterprise groups with international competitiveness and 3 to 4 large motorcycle enterprise

[6] This is the China's standard of automotive products categorization. In this standard, automotive products is categorized into 8 types, which are trucks, SUV/MPVs, self-load vehicles, draught vehicles, special-use vehicles, buses, sedans and hitchhike vehicles. In IPAI, one goal is that the market share of China's Big 3 will reach 70% or

group before 2010, and these enterprises will be responsible for their development, production, sales, and growth, and will take part in international competition. The ninth clause stipulates that "The state encourages auto enterprises to form cross-departmental and trans-regional enterprise groups by combining assets, merging, and shareholding, in accordance with property rights system reform of the state-owned enterprises, to step up reform of enterprise company system, and to build modern enterprise system". The tenth clause points out that "The state will render special support to auto and motorcycle and spare part enterprises or enterprise groups with independent products, technological development ability, and certain production scale and market occupation rate." They can take following preferential policies.

- The adjustment tax for fixed assets investment[7] in is tax-free
- Priority will be given to them for the issuing and listing of their shares and bonds.
- Banks should actively supply them with loans.
- Priority will be given to them in utilizing foreign capital.
- Loan programs guided by policies may be arranged for projects of economical automobiles, key spare part for passenger cars, models and foundry.
- Approved by the relevant departments of the State Council, financial companies inside the enterprise groups may expand their business scope.

Moreover, projects (including jointly funded cooperation projects involving Chinese and foreign partners) of complete car and engine approved by the relevant departments of the State Council should be constructed according to the following principles:

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more within each of the 8 types.

[7] A kind of investment tax. The tax rate for investments in different sectors is differentialized, in order to avoid all investment concentrating in high-return sectors.

- The annual production of cars whose engines have an exhaust emission volume below 1600 cc shall be no less than 150,000.
- The annual production of light duty trucks shall be no less than 100,000.
- The annual production of light passenger cars shall be no less than 50,000.
- The annual production of heavy-duty trucks shall be no less than 10,000.

Since the policy was issued, the concentration of production has increased, but the scattered situation of China's automotive industry has not been fundamentally changed. Policies of industry organization in Industrial Policy for Automotive industry are actively implemented, and during the Eighth Five-Year period, 80% of the RMB 58.8 billion yuan was invested into the 13 backbone enterprises. During the early stage of the Ninth Five-Year Plan, the concentration of investment was further enhanced, making the figure increase to 91% for the 13 backbone enterprises. Among them, several large groups have already realized certain scale economy, such as the FAW, Dongfeng, Shanghai, all have reached 300,000 or more. At the same time, the industry has changed the past practice of simple introduction of production technology to introduction of production and product development technology, or begun to cooperate with foreign partners to develop new products.

Table 3-3 Enterprises number of China automotive industry (1950-1999)

Year	Total	Car-maker	Refitting car-maker	Motor-cycle maker	Engine maker	Makers of parts & components for car / motorcycle
1950	22		7			15
1952	39		12			27
1956	104	1	16		1	86
1957	115	1	17		2	95
1958	217	8	20	2	6	181
1959	238	14	25	2	6	191
1960	269	16	28	2	7	216
1965	522	21	61	3	10	427
1970	1228	45	103	9	21	1050
1975	1852	52	158	19	26	1597

1980	2379	56	192	24	33	2074
1985	2904	114	314	47	63	2366
1990	2596	117	459	62	64	1894
1991	2643	120	486	59	65	1914
1992	2555	124	479	72	63	1817
1993	2462	124	552	75	61	1650
1994	2442	122	536	91	55	1638
1995	2479	122	516	109	61	1671
1996	2423	122	520	130	62	1589
1997	2474	119	540	143	54	1618
1998	2426	119	521	102	56	1628
1999	2362	118	546	107	51	1540

Source: China Automotive Industry Yearbook(various year)

However the problem for China's automotive industry is that their scale is still quite small and scattered. This problem has not been solved. There are currently 120 complete car producers (shown in table 3-3) with a production capacity of less than 3,000,000. Besides, the automakers are scattered everywhere, especially the passenger car industry. There are 13 production bases for passenger car and the concentration degree is steadily improving, but because of relative high profit, there are still numerous local investments, aggravating the already bad situation, which can be seen in that the number of passenger car producers in different places is increasing, and the trend will remain. By the early 21st century, the passenger car enterprises will increase to 25. Such a situation is not justifiable and is a result of errors by relevant departments. The deep reason is that "power outweighs law" and the impact of macro-regulation is not strong enough. Many countries apply macro-control to new industries to prevent huge waste of investments from rushing actions. A successful case is in Korea, were only three enterprises (Hyundai, Daewoo, and KIA) were allowed to manufacture passenger cars at the beginning of Korea's automotive industry. China also followed suit at the beginning but without much success. The background for this situation was very complicated. Simplified, the following reasons can be given for this: The first is that original policies were not firmly carried out. In the early stage of development of the passenger car industry, a meeting was held in Beidaihe in the summer of 1987 to solve the messy and scattered situation of the industry. The result of the meeting was the formulation of

the principles of establishing "three large and three small enterprises"[8] and the prohibition of new ones. But the principle lasted only for four years and was then turned into the establishment of "three large and three small plus two tiny enterprises[9]". The reason for this was that at that time the military enterprises were all in a difficult financial situation. To help them out, a number of military programs were turned into civil ones and consequently a number of enterprises got approval to produce minicars. With FAW car factory (the later FAW sedan Ltd.), the number of such enterprises rose to 12. Although this industry was taken to be a highly developing one, by the end of 1999, 13 catalogued passenger car enterprises (Shanghai General Motors was approved to open business in 1997) only had an average output of 40,000 automobiles. Such an average scale can only be regarded as quite small compared to foreign automotive industry. Mismanagement of catalogues[10] is another reason for the undue situation of car enterprises in China. Right now, a dozen of factories not included in the catalogue are producing and selling sedans because they have got catalogued in light buses. These factories are actually selling sedans in the name of light buses (the quasi-sedans whose license plate begin with 6). If these enterprises hadn't been catalogued, the situation would not have been so chaotic. Mismanagement of catalogues no doubt leads people to suspect there is corruption. The consequences are that catalogued large scale factories have come to the fore, for instance, Nanjing Yuejin Automobile Group, with an investment of RMB 1.4 billion yuan has concluded the first phase of a project which aims at an annual production of 150,000 quasi-sedans, through purchasing second-hand equipment. Calculated by the minimum production capacity, the factory would be able to have an annual output of 60,000. With another 500 million RMB, the whole project will be finished. The enterprises are all very optimistic of the prospect

[8] The three large enterprises are the First Automotive Work, the Second First Automotive Work and Shanghai Automotive Industry Corporation, the three small enterprises are Tianjin Automotive Industry Corporation , Beijing Automotive Industry Corporation and Guangzhou Automotive Industry Corporation.

[9] The two tiny enterprises are Chongqing Changan Automotive Industry Corporation and Guizhou Yunque Automotive Work.

[10] In China, there are 8 vehicle catalogues, which are trucks, SUV/MPVs, self-load vehicles, draught vehicles, special-use vehicles, buses, sedans and hitchhike vehicles. Among them, sedan's license plate begin with 7,while buses begin with 6. In China, what can be made by an enterprise was restricted by Catalogue Management, that means when enterprises wants to make a new product, it should apply to Ministry of Machinery Industry, after it is approved, the product is listed in the catalogue and the enterprises can make the products. Because the application for new sedan model is much more difficultly approved

and all mini-bus producers have begun to sell sedans. This means that the chaotic situation of China's sedan industry will remain for the next 10 years.

However, with the improvement of automotive industry structure, small enterprises will face the fate of being merged or closed. Unemployment caused by layoffs in the automotive industry will be a gradually serious problem. In particular, after China's accession to the WTO, some enterprises with small scale will face the competition from large carmakers in the international arena, and they are bound to get closed very quickly, making unemployment an issue with negative influence in the reorganization of automotive industry. Unemployment will also affect the income and living of enterprise staffers. It is indeed a critical issue in China and especially during the Tenth Five-Year period. The state will try to alleviate the negative effects of unemployment through creating new job opportunities and through the establishment of a social welfare system.

5) Technology Introduction

It is clearly pointed out in the Industrial Policy for Automobile Industry that "The state encourages automobile enterprises to develop our automotive industry by use of foreign investment", but foreign investors must satisfy the following conditions:

- They must have independent product patent rights and trademark rights.
- They must have product development technology and manufacturing technology, and its product technology index should be in accordance with the existing regulations of relevant countries (or regions).
- They must have independent global marketing channels (or networks).
- They must have sufficient financing capacity.

Joint venture automobile enterprises must meet the following conditions:

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than that for buses, enterprises apply for buses catalogue although the product is sedan in technology.

- The enterprise should have its own technology research and development department, which should have the main development capacity for upgraded products.
- It should be able to manufacture products with 1990s international technology.
- Joint ventures should mainly depend on the export of their products and find ways to balance foreign currencies.
- Joint ventures should give priority to domestic spare parts when selecting spare part suppliers.

Since reform and opening up, the automotive industry in China has been introducing foreign capital and technology to develop itself, which is known as basically a Latin American mode, i.e., to develop automotive industry through partnership with transnational companies and adoption of CKD production mode under the protection of high tariffs. Such mode has brought success to some countries (Brazil and Spain entered the ranks of Top Ten Automobile Makers in 1979 by using this mode of development), but it cannot help one to cultivate the ability to develop independently and there is no development of national brands. The whole industry is controlled by transnational companies. An independent and internationally competitive automotive industry will not be created. The characteristics of this mode are especially conspicuous in our country's automotive industry. There are currently 15 catalogued whole car manufacturers in China and 14 are Sino-foreign joint ventures. The foreign side includes all the main transnationals in the world. Except the Red Flag cars produced by the First Automobile Works which has its own independent brands (FAW produced 68,200 cars in 1997. Among them, 21,800 were Red Flags, accounting for 32% only), all other factories produced cars with foreign brands. Introduction from same transnational enterprise by different national enterprises is a serious problem. The automotive industry in China is controlled by transnational enterprises. In addition, there are three other fatal issues: the first is that the technology at introduction is not high. Among the cars with more than ten brands and dozens of models, the great majority embodied technology and design are from the

1970s to 1980s; only Buick, Accord and a few others are 1990s products. The second problem is that Chinese automotive industry doesn't form the ability to develop independently and even haven't the enthusiasm to develop new products, hence lacks international competitiveness. Such passive situation should be attributed to the strategic fault in automotive industry technology and in introduction of foreign capital. Or we can say that it is the interactive result from barriers among different departments and strategic fault in introduction of technology and foreign capital. The third problem is there are more and more joint ventures in China. And the Chinese national automobile enterprises are becoming less competitive. Although in most of the joint ventures the Chinese partners hold most of the shares, the joint ventures are not guided by the policies and orders of the state-owned automobile groups of China, because they are independent corporations. And the joint ventures certainly will not participate in the complete merging and partnership programs that are proposed by state-owned automobile groups of China and cannot bring financial benefits to them. On the contrary, these joint ventures are competing with state-owned automobile groups of China in China's market by taking advantage of their technology, capital, management and mechanism. Furthermore, with the increase of joint ventures, the number of complete car manufacturers in China is not reduced but become more dispersed.

Viewed as a whole, Chinese automotive industry has been relatively backward. Therefore, since 1980s, China has mainly relied on technology introduction to improve the overall level and to meet domestic demands. For more than 20 years, Chinese automotive industry has made full use of foreign capital to set up joint ventures: the total feign investment is $20,939,000,000, among which $10,579,000,000 is registered capital, accounting for 50.05%; agreed foreign investment is $5,286,000,000, accounting for 49.96% in registered capital; actual invested foreign capital is $4,543,000,000, accounting for 85.94% of agreed foreign capital. Since the reform and opening up of the early 80s, the Chinese automotive industry has established more than 600 foreign investment enterprises with more than 20 countries and regions. Large amounts of technology introduction and

cooperation have helped the Chinese automotive industry to make great achievements, which can be seen in the following developments:

(1) *Investment in automotive industry is enhanced.* Take the Eighth Five-Year Plan as an example. The actual investment was RMB 58,800,000,000 yuan, which was as much as the total investment over the past 40 years. Major products, especially the cars, can basically meet the domestic demands. Since mid 1990s, domestic cars have already occupied 90% of the domestic markets.

(2) *The technologies for automobile product were improved, and the product mix and industry structure have become more rational.* At present some of China's automobile products have reached advanced international standards of the 1990s. Cooperation and joint operation have also increased the self-development capability of Chinese automotive industry. The product structure in the past was featured of "lacking in heavy trucks, insufficient in light buses, almost no sedan". But now sedans, buses, and trucks each account for one third in the present structure. Viewed from industry organization, the production intensity has been greatly strengthened. Take cars as an example. The share of vehicle production by the five largest manufacturers has reached 95% of the gross vehicle production, and four of them are joint ventures.

(3) *Foreign advanced management methods and modes of marketing have also been introduced and popularized across the country, improving the overall managerial skill and enterprise performance by a large margin.*

However, foreign investors who made direct investment in automotive industry in China had their own aims. What attracted them was China's wide automobile market and cheap workforce. With their advantage in capital, technology, and products, and the high tariff protection and quantity restrictions by the Chinese government against foreign imports, they could have easy access to Chinese market and made great profits (see table 3-4). This certainly brought about some negative effects: (i). There were duplicated introduction of and investment in projects, although the country had tried hard to prohibit such practice, which made it very difficult to realize the local

production and batch production of whole car and spare part, the standardization, serialization, and generalization of spare part, and to research and develop new products; (ii). Too much attention was paid to assembling cars with spare parts, while the digest and assimilation of introduced technology and local production of spare part production were ignored; (iii). Joint ventures were often restricted by intellectual property rights, which put obstacles to Chinese automotive industry to form independent product development ability, jeopardizing related series of spare parts when new car models were introduced; (iv). Investments in whole cars outweighed those in spare parts; and (v). The scale of investment was not large enough, increasing the time enterprises spent on forming rational economic scale.

Table 3-4 Performance by type of enterprises of China automotive industry (1999)

Indicators	Total	Inter-fund enterprises	# SOE	Hongkong/Macao/Taiwan fund enterprises	Foreign fund enterprises
Output value(million Yuan)	312272	**215843**	111555	11389	85040
Sales value(million Yuan)	308984	214211	109663	109871	83486
Employer(000s)	1806.8	1630.2	996.9	40	136.5
Net Fixed assets(million Yuan)	155603	116876	72734	4407	34320
Profits (million Yuan)	10652	2868.2	-5771	603	7181
Profits/ Sales value(%)	3.45	1.34	-5.26	0.55	8.60
Profits/Net Fixed assets (%)	6.85	2.45	-7.93	13.68	20.92
Profits/ Employer (1000 Yuan/person)	5.90	1.76	-5.79	15.08	52.61

Source: China Automotive Industry Yearbook (2000)

3.2.1.2 Import Policy

In addition to the stipulations in Automobile Industry Policy, the import policy of restricting automobile imports exerts the greatest influence on our automotive industry. The import policy is based on (1) high customs duties on cars; (2) quotas and permits for the importation of cars; (3) minimum local content rates.

The third aspect has already been examined in detail in section 3.2.1.1, and the focus here therefore is on the influences of customs duties and import quota system.

Since its establishment in 1950s, Chinese automotive industry has been placed under the protection of excessive tariffs. The import customs duties of complete sedans even reached as high a level at 180-220% before Jan 1,1994. After several adjustments in recent years the average customs duties of automobile products have been kept at 38.3%, and the duty for complete sedans is about 80-100%. The average duty for spare parts is 27.1%. However, compared with other countries, the customs duties in China are still high. High customs duties give obvious competitive edge on the Chinese market to domestic car manufacturers in price. Besides, China has adopted other non-tariff measures, such as import permits, import quotas, import operation rights, and foreign currency control, to control the import and sales of automobiles.

Consequently, Limits of imports have played a positive role in developing China's automotive industry. Because the comprehensive capability and manufacturing technology of China's automotive industry were inferior to those in developed countries, and the manufacturing costs and prices were higher due to small scales, import limits opened up certain development room for the Chinese automotive industry and contributed to its initial growth, greatly improving the output value and amount of automotive industry, and the market share of imported cars was reduced to 2% in 1999 from 85% in 1985.

But since protection is the opposite of an open regime, protection will not make the industry competitive internationally. This is a negative effect of protection which should not be ignored. First, protection can make the industry more profitable than under competitive condition, and stimulated the development of automotive industries

at local levels. Furthermore, in order to make those local enterprises survive, those local governments must conduct some policies advantageous to their local enterprises. This is the main cause for the bad performance of automotive industry structure since the reform and opening up, and also caused the rampant practice of local protection and hindered the development of a uniform national market; second, excessive profit from protection weakened the motive of enterprises to reform and innovate, which was the main reason for backwardness in technology improvement, product development, and management; third, over-protection caused the wild spread of smuggling activities, since smuggled cars gained much higher profits than imported ones. Relevant departments estimate that the number of smuggled cars was twice as many as that of imported ones. Rampant smuggling not only reduced the national revenue, but also weakened the effect of import limits.

In conclusion, a certain degree of protection is conducive to the development of automotive industry. Since China is a large potential consumer of cars and there is no problem in finding a market, adequate protection, therefore, can help domestic cars to compete in price and to find a market. But over protection caused enterprises to lose the motive to improve on their present inferior status, and is harmful to improve the competitiveness of Chinese automotive industry in the international market.

3.2.1.3 Fuel Tax policy

It is explicitly stipulated in the newly revised Highway Law that if conditions allowed, road tolls may be changed to fuel tax. But since the imposition of fuel tax involves the adjustment of interests among different parties and increases or lessens the burden of different consumers, the policy has been postponed for a long time.

Viewed from the perspective of auto production, the collection of fuel tax can encourage enterprises to produce fuel-efficient cars, which will help to reduce energy consumption and air pollution by exhaust gases and therefore boost the sustainable development of economy. On the other hand, in order to pay less tax, consumers will either use less fuel or purchase fuel-economical automobiles. Old automobiles that

consume too much fuel will be gradually eliminated. However there are also some drawbacks of the fuel tax. First, it may increase the burden of certain departments and consumers, like the peasants. Currently sixty per cent of vehicles (including trucks, motorcycles, agricultural automobiles, and tractors) are used in the rural areas. The collection of fuel tax will inevitably increase the peasants' burdens, and the reality is that the income of peasants is so low that the policy will hardly be carried out. Therefore some departments must be exempted from such tax. Secondly, the imposition of fuel tax may lead to tax dodging and tax evasion. Since the fuel tax involves all parties that use petroleum and covers a wide range of departments, especially the public transportation and the agricultural departments, a uniform tax rate is not feasible. So some people may take advantage of loopholes in policy and obtain huge profits by evading the tax. Therefore the imposition of fuel tax calls for a high level of supervision.

3.2.1.4 Conclusion: Competitiveness

In general, 20 years of development and the implementation of relevant policies in IPAI have enabled our automotive industry to gain a certain competitiveness. Although the import tariffs were cut a lot, the volume of imported cars was reduced and domestic cars had gained a larger share in the market. The manufacturing capacity in 1998 was 3 million with an annual output of 1,630,000. However, compared with the developed countries, the automotive industry in China is still not competitive enough, for the following reasons:

1) Relatively Small Scale

The automotive industry is a typical manufacturing industry with very clear economies of scale. International experts[11] on the automotive industry believe that the minimum economic scale for a nation's automotive industry is 2,000,000; that for passenger car enterprises it is 250,000 to 300,000; that for light-duty truck enterprises is 100,000 to 120,000; and that for middle-duty truck enterprises is 60,000 to 80,000. A rational economic scale is the precondition for automakers to

[11] Auto Industry Research, 1998(6).

realize maximal margin and retain a competitive edge in the ever more fierce market competition. In 1996, automobiles produced by the three biggest auto makers in U.S. —General Motors, Daimler-Chrysler and Ford accounted for 35.1% of the world total output (the numbers were 8,381,000, 6,653,000, and 2,967,000 respectively). Automobile sales by the three biggest Japanese auto makers—Toyota, Nissan, and Honda in 1996 accounted for 28.2% of the world's total, numbering 9,655,000 (4,751,000, 2,798,000, and 2,106,000 respectively). But in 1998, the first three auto makers in China—FAW, SAW, and Shanghai Automobile Industry Company (SAIC) only produced 289,000, 236,000, and 191,000 thousand automobiles respectively, the total of which accounted only for 7.4% of the output by the Japanese auto makers, and the sales revenue was also far less than that of the world's larger car makers. Take SAIC, the enterprise with the highest sales in China, as an example. Its sales turnover in 1998 was RMB 39,500,000,000 yuan ($4,760,000,000), which is only 3% of GM sales, which was $161,300,000,000.

Since most carmakers could not reach the minimum economic scale, the degree of production concentration for the Chinese automotive industry was generally very low. In 1998, the degree of production concentration of the first three of automotive industry was 42.81%. The total output of more than 200 carmakers was only 1,600,000, the same as that of a middle-sized factory in the developed countries (the output of Renault company in France, ranked 11th in the world, already reached 1,851,000 in 1996). The only two Chinese companies with an output exceeding 200,000 were FAW and Shanghai Automobile Group, all lagging far behind the world's largest automakers.

2) Low Labor Productivity

The whole car output per worker in 1996 and 1997 was 2.4/person/year and 2.5/person/year. But in Japan and Europe and America, the figure was 40-60/person/year and 20-40/person/year.

Viewed from added value per capita, the added value per worker in the Chinese automotive industry was $3623/person/year (current prices in 1997), created pre-tax

profits per worker of $707, accounting for respectively 5.9% of US added value per capita and 4.6% of pretax revenue in 1994. The overall productivity of Shanghai Automobile (Group) Corporation in 1997 was only $19,300/person/year.

3) Low Technology Level

Although the automotive industry in China has been developing for more than 40 years, it is still in its "infancy". While auto industries in developed countries have long passed the stages of batch production and promotional competition, and entered the stage of taking product design as the center, our automotive industry is still in the elementary stages of introducing technology, localization of spare parts. The use of labor is still high. In major developed countries, automotive industry has become a pillar industry, while in China, the automotive industry has not yet started to play its role as a pillar industry in the national economy.

Our auto technology has always lagged behind world advanced levels, and domestic enterprises have not acquired the independent ability to develop. For many years, our emphasis is put on the formation of an independent technology development and production system in order to adopt the independent export-oriented strategy. But because China's technology is always lagging behind the world advanced level, the automotive industry in China is trapped into the vicious circle of "introduction, lagging behind, and reintroduction". Partial exclusion of foreign capital into domestic backbone enterprise and automotive industry by the administration has led to a wider gap between China and the world. Compared with top international levels, our automotive industry is very weak in such aspects as product design and development ability, trial production means, manufacturing capacity, technical equipment, the manufacturing capacity of non-metal materials and spare parts. Besides, our technical methods, instruments, and equipment are also relatively backward. At present automotive industry in China only has the independent ability to develop middle-sized automobiles and to imitate heavy and light-duty automobiles, but lacks the ability to develop and design cars and passenger automobiles. However, the gaps in technology in producing cars will be gradually narrowed. Jointly produced cars will catch up their foreign counterparts in technology. With the improvement of

self-development ability and assimilation and introduction of new technology, the gaps are sure to narrow. For trucks, the gaps in interior decoration are expected to gradually narrow, but the disparity in whole-car design and engine facility will remain.

This can be seen in the following aspects: It is estimated by relevant experts that compared with foreign cars of the same design, our cars weigh about 10-20% more; burn 10-30% more fuel; the initial trouble mileage is about 3000 kilometers, only one fifth of foreign cars; guaranteed trouble-free period is half a year, about one sixth of foreign cars; the life-span is generally 100,000 to 150,000 kilometers, half of foreign cars. The emission of carbon monoxide and hydrocarbon of domestic petrol cars is 10 to 20 times higher than the standards in developed countries. Relevant index of domestic diesel car is up to 3 to 5 times higher.

4) Backward Production Mode and Low Management Skill

With economic globalization, the transnational automobile makers can now dispose the resources within the range of the whole world, and there are some new changes to their production modes. The first change is that to gain ever more economies of scale and competitiveness, top carmakers are stepping up the process of merger. The second change is that top transnational carmakers are enhancing cooperation to optimize resource disposition and share common benefits. Another change is that they all start to localize in order to make the products satisfy the needs of local markets and to take full advantage of workforce and technological resources. The fourth change is that in order to pursue specialized interests, the transnational corporations all have streamlined departments producing spare parts, and increased the proportion of outsourcing. The purchasing of spare parts is experiencing the obvious process of globalization. Accordingly, the concentration degree of spare parts suppliers has been markedly improved. Professional management of production is the fifth change. In 1970s, Japan improved the productivity by introducing the "Just in Time" production paradigm; upon entering 1990s, the U.S. laid more emphasis on high flexibility of management by adopting "quick and flexible production technology" to meet the demand of variety in the market. In one word, the

purpose of all such efforts is to improve competitiveness by reducing cost and adapting to market changes.

Because of barriers between different departments it is difficult to dispose resources throughout the country and to maximize the utilization of resources. The automotive industry still has the shortcomings of being "scattered, messy, and bad". Structural adjustment is hindered by an inferior capital market and differences in focus of the local governments and departments. Since whole car manufacturing enterprises only pay attention to their own production system, there are various standard systems and supporting systems in the spare part industry, and the professional technology of production and supporting ability is limited. This has on the one hand caused a high self-supply rate of whole car enterprises. On the other hand, the production of spare parts is featured of small economic scale and low product technique, and there is a general lack of technological development ability. The management is featured of extensive and low level, lacking advanced management notions and means.

5) Small Export

Import and export can, to a certain extent, reflect the international competitiveness of a country's automotive industry. The annual export of automobiles only accounts for a small proportion in gross national production. Domestic enterprises don't have international competitiveness at all. Although our auto output ranks the tenth in the world, our gap can be seen from the small scale of annual production and the extremely low ratio of exported autos in total output. During the 19 years from 1980 to 1998, China exported only 126,500 automobiles of different kinds, among which 9,206 were cars, equivalent to one tenth of the imported automobiles in the same period by China, and one third only of the annual exports by Sweden, which ranked the eleventh in the world in 1997 (Sweden exported 378,000 automobiles in 1997). In the same period, our exports of spare parts amounted to RMB 2.523 billion *yuan*, while the annual sales of the spare part industry in the world is now as high as more than $400 billion.

The export market of the auto products of China is mainly in the developing countries. Take 1997 as an example. Among the 14,800 cars that were exported in 1997, only 295 were exported to the developed countries, valued at $ 3.19 million, accounting respectively 2.0% and 1.7%. Even if exports to Hong Kong and Singapore were counted in, the portion was no more than 21.8%.

3.2.2 Evaluation of Environmental Policy

The protection of environment is a main part of the sustainable development. In the international arena, the concept of auto environmental protection refers to low material consumption and pollution during the whole life cycle of production, use, and discard. The current auto environmental protection policy in China mainly focuses on safety, fuel-efficiency, and low pollution, especially during the stage of car use, which emphasizes the reduction of pollution emission and maximization of the efficiency of fuel use. The actual measures include: to actively promote the use of lead-free fuels and raise the limits of car emission to get integrated with the international standards.

On September 5th, 1987, China published The Air Pollution Law of The People's Republic of China, the thirtieth clause of which stipulates that "The emission of pollutants into the air by vehicles and vessels shall not exceed the discharge limits. Any vehicle or vessel that discharges excessive air pollutants shall be treated. Vehicles that violate the national emission control regulation must not be manufactured, sold or exported." On May 29, 1995, the Air Pollution Law was amended, and it was stipulated that "The country encourages and supports the production and use of quality lead-free petrol, and limits the production and use of leaded petrol. The relevant department under the State Council shall make plans to gradually reduce the output of leaded petrol, until the production and use of leaded petrol is completely stopped." In promoting the use of lead-free petrol by automobiles, China has been actively engaged in making plans to eliminate the use of leaded petrol in a progressive way. Starting from July 1, 1997, Beijing took the lead to use lead-free petrol. So far there are already a dozen of cities that use lead-free petrol. By 2000, the whole country will be using lead-free petrol. The utilization of lead-free petrol created a good condition for installment of catalytic converter. It is a

key step for China to reduce emission of pollutants by vehicles, and also a concrete act to enforce the Air Pollution Law.

With regard to the exhaust emission, China has formulated the pollution control regulations in 1989 and standardized the regulations in 1993. In 1999 amendments were made to the original emission regulations. Standards in new regulations were 80% lower than in the original ones, which played a positive role in controlling the air pollution.

There are 17 existing emission standards and testing measures in China. Those standards regulate the limitation and testing measures of CO, CO_2, HC, NO_x and other hazardous materials exhausted from motor vehicles.

1) *Emission standard for exhaust pollutant from light-duty vehicle*

2) *Emission standard for exhaust pollutant from gasoline engine of vehicle*

3) *Emission standard for fuel evaporation emissions from vehicle with petrol engine*

4) *Emission standard for pollutant from crankcase of vehicle engine*

5) *Emission standard for pollutant at idle speed from vehicle with petrol engine*

6) *Emission standard for smoke at free acceleration from vehicle with diesel engine*

7) *Emission standard for smoke* with peak load *from vehicle with diesel engine*

8) *Testing method of pollutant emission by light-duty vehicle*

9) *Testing method of pollutant emission by petrol engine*

10) *Measuring of petrol vehicle pollutant from fuel consumption and evaporation—collection method*

11) *Testing method and pollutant emission limits for petrol crank case*

12) Testing method for petrol vehicle—idling method

13) Testing smoke method of free acceleration —filter paper smoke method

14) Testing smoke method for diesel engine with peak load

15) Pollutant emission limits for motorcycles

16) Pollutant emission limits for motorcycles—idling mode

17) Pollutant emission limits for motorcycles—operating mode

There are also other local standards, like the double idling standard in Beijing.

Besides, Beijing has made standards stricter than national stipulations, equivalent to emission limits used in Europe in 1990s, effective from January 1999. The State Environmental Protection Administration has published "The Pollutant Emission Limits for Light Duty Automobiles" in July 1999 (GWPB1-1999), effective from January 1, 1999.

In addition, to protect the environment and to improve the air quality, the State Bureau of Quality and Technical Supervision has recently published 4 new emission standards, which are 80% lower than existing ones. They are: GB 14761-1999 "Automobile Emission Limits and Testing Modes", GB 17691-1999 "Pollution Emission Limits and Testing Modes for Automobiles with Compression Ignition Engine and Installed Compression Ignition Engine", GB 3847-1999 "Visible Pollutant Emission Limits and Testing Modes for Automobiles with Compression Ignition Engine and Installed Compression Ignition Engine", and GB /T17692-1999 "Testing Modes for Net Power of Auto Engine". The first three standards are compulsory, while the fourth is recommended by the state. These new standards adopted the legal system of auto emission by UN European Commission, raising the emission standards for new cars to 1990 level in Europe. They will be put into effect on January 1, 2000. Newly produced cars must conform to the policy.

3.2.2.1 Automobile Emission Prevention Technology Policy

Rapid development of economy in China has led to a marked increase of vehicles, which are amassed in the urban areas. The annual average growth rate of vehicles in the last decade was 14%, and the number of vehicles in use was 58,000,000. With the increase of urban construction, population density and traffic, the vehicle pollution is continually affecting the air quality in cities. A reason for this is that there is a relatively relaxed standard for vehicle emissions and the technology to control vehicle emissions is not advanced enough, equivalent to that of 1960s or 1970s in developed countries. Environmental monitoring statistics by State Environmental Protection Administration (SEPA) indicate that the urban pollutants are changing from smoke to a combination of smoke and vehicle pollution or total vehicle pollution. Experts of (SEPA)estimate that, if effective measures are not adopted, by the year 2010, the emission of carbon monoxide and nitrogen oxide in Beijing will be three times higher than in 1995. Most cities in China will face the same difficulty as Beijing and the urban air pollution will become unbearable.

In accordance with such serious reality of backwardness in vehicle emission control technology, the State Environmental Protection Administration, the State Commission of Science and Technology, and the State Administration of Machinery Industry formulated the Policy for Prevention Technology of Vehicle Emissions and Guide to Prevention Technology of Vehicle Emissions, to strictly control the emission standards for vehicles and to control the total emission by vehicles.

The technology policy is formulated in accordance with The Air Pollution Law of The People's Republic of China to protect the air environment and to prevent vehicle emissions. What needs to be taken into consideration is that the levels of carbon monoxide, carbon hydride, and nitrogen oxide and diesel particles should be lowered; and freon (an ozone-depleting substance) used in vehicle air conditioners must be replaced. Automobiles, motorcycles, and automobile engines with low pollution and low energy consumption should be developed. Since most vehicles are in urban areas, the focus of pollution control should be in the cities.

The Technology Policy defines the objectives of vehicle emission control: clear technical criteria are given for the different links of product development, quality

control and after-sale service of newly produced automobiles, motorcycles, and engine products; strict technical requirements are put forward for automobiles and motorcycles in use; concrete requirements are given in the production, sales, and use of auto fuels; explicit requirements are also stipulated for emission control equipment and testing equipment, technological introduction and technological support.

The explicit control objectives in the Technology Policy are: emission of sedans should reach the first stage of Europe by 2000 (91/441/EEC and 93.59/EEC); other light-duty trucks (including diesel automobiles) with a maximum weight of 3.5t should reach the ratified emission level of the first stage of Europe in 2000; the emission level of all light-duty trucks (including sedans) should reach the second stage of Europe around 2004 (94/12/EC and 96/69/EC), by 2010; the emission level should be uniform with the international levels; the emission level of heavy-duty trucks (with a maximum weight of 3.5t) and motorcycles should reach the first stage of Europe by 2001 (91/542/EEC), the second stage of Europe by 2005 (91/542/EEC), and get integrated with the international level by 2010.

It is fair to say that Policy for Prevention Technology of Vehicle Emissions is a policy with the greatest momentum, the widest scope and a great feasibility. The implementation of the policy will inevitably raise the technical requirements for automakers and increase the cost, hence raise the price of the automobiles and reduce their price competitiveness. It will also increase the burden of car users. But since the standards in it are 80% stricter than the original ones, it will enable the emission standard in China to coincide with the international criteria and consequently increase the technical competitiveness of Chinese auto products.

Nevertheless the implementation of the existing emission policy is restricted in some aspects. First the main purpose of the present emission policy is to reduce air pollution from automobiles. Therefore the focus of prevention is light-duty automobiles, especially passenger cars. But the requirement for motorcycles and trucks is not so strict, which actually produce the greatest pollution, and the number of trucks in China is very large. Secondly, the emission limits should be applicable to

all vehicles. But the policy places its stress on automobiles only without any limits for tractors and agricultural vehicles, whose emissions are several times higher than automobiles and whose number also outweighs the automobiles. The current annual output of agricultural vehicles is 3,000,000, while that of automobiles has just reached 2,000,000 in 2000. Thirdly, foreign practice of limiting car emissions is to encourage the production of fuel-efficient automobiles, but in China, there is no such supporting policy to reduce car pollution through the encouragement of fuel-efficient automobiles.

3.2.2.2 Notice on halting Producing and Selling Leaded Gas

Automobile emission can be reduced by means of improving car manufacturing technology and upgrading technology. Another important link to achieve that end is to raise the quality of fuel. On September 12, 1998 the State Council approved the Notice on halting Producing and Selling Leaded Gas in Given Time, demanding that the production and sales of leaded petroleum shall be stopped from January 1, 2000, and this must be completed by July 1, 2000. By then the standards GB 484-93 and SH 0112-92 shall be put to an end.

Rapid development of automotive industry in recent years in China brings about such problems as increasing car emission and fast consumption of oil. In 1998 petroleum and diesel used by automobiles were respectively 32,000,000 tons and 45,500,000 tons, accounting respectively for 85% and 50% of the total consumption. It is estimated that by 2000 total consumption of petroleum and diesel will reach 40,000,000 and 60,000,000 tons. Pollutants like Pb, Nox, CO, HC, SOx and PM will account for 40-60% in urban pollutants, greatly harming the health of people. How to adapt to the requirements for automotive industry development and environmental rules and regulations is a serious challenge posed to the oil refinery industry.

In recent years the upgrading and improvement of automobile petroleum has made great progress. This can be seen: (i.) High standard automobile fuel is increasing, while low standard automobile fuel keeps decreasing. In 1993 petroleum numbered 90 and above accounted for 43% in automobile fuels, and the figure increased to

79.8% in 1998. In 1999 petroleum output will reach 16,269,000 tons, among which petroleum numbered 90[12] and above accounts for 98.6%. (ii.) The introduction of unleaded automobile petroleum is accelerating. In 1993 China formulated the industrial standard for lead-free automobile petroleum (SH 0041-93). By 1998 the proportion of lead-free petroleum numbered 90 and above reached 95.2%. The average concentration of lead in petroleum has been decreasing for years, and in 1997 the figure was 0.019g/L. China Petroleum and Chemical Group stopped the production of leaded petroleum on July 1, 1999. (iii.) The mixing and components of petroleum have experienced structural changes. Achieving a reasonable composition of different components in petroleum is key to the upgrading of petroleum quality. In 1997, the share of direct distillation petroleum in total vehicle-use petroleumdropped 9.4 percentage point, compared with that in 1994, while the share of catalytic cracking petroleum increased 13.8 percentage point, compared with that in 1994. The production capacity of equipment producing high-octane value petroleum is enhanced. (iv.) Petroleum with purificant[13] is extended. China has developed a series of petroleum purificants. Driving experiment shows that the purification rates of CO and HC of automobile emissions are 15-50%, and the fuel consumption is decreased at 3-10%. Such petroleum purificants are similar to the third generation purificants (spray nozzle and intake valve) in other countries.

Although the overall quality of automobile petroleum has been significantly improved and the state stipulated to use lead-free petroleum by 2000, but leaded petroleum will still be in wide use for some time. Even in places where lead-free petroleum is in wide use, the quality of petroleum is not as good as that used in other countries. The quality of petroleum directly influences the performance of catalyst. Lead and sulphur remaining in the petrol poison the catalyst. There is a high content of alkene whose polymers will reduce the combustion efficiency of engine or even directly cover the surface of catalyst and undermine its effect. Experts in this field predict that it will take China at least 10 years to promote automobile petroleum that measures up to

[12] It refers to the quality of petroleum. The bigger the number is, the highter the quality of petroleum is. Current number of pertroleum for automobile use are above 90.

[13] A kind of chemical materials. Emission pollution can be reduced at some extent when purificants were added in petrollum.

European No. 1 Standard. China's technology to lower the content of sulphur and lead is not advanced enough. The low quality of petroleum should be held partly responsible for the high emission of exhaust gases in China.

3.2.2.3 Criteria of Automobile Discard

It is an important measure to ensure the safety, environmental protection, and fuel-efficiency of automobiles to implement the policy of discarding useless automobiles. China has issued and revised the standards for discarding useless automobiles for many times. The present standards stipulate that any automobiles used by civilians and registered in the territory of China should be reported as worthless if one of the following conditions apply:

- Light trucks and minicars (including cross-country cars), and special vehicles for mining use that have an accumulated mileage of 300,000 kilometers; middle-duty trucks (including cross-country trucks) with an accumulated mileage of 400,000 kilometers; extra heavy, heavy, middle, light and mini passenger automobiles (including cross-country cars), and sedans that have an accumulated mileage of 500,000 kilometers; other automobiles with an accumulated mileage of 450,000.

- Light trucks and minicars (including cross-country cars), trucks with trailers, special vehicles for mining use and all kinds of taxis that have been in use for 8 years; and other automobiles that have been in use for 10 years.

- Automobiles that are severely damaged or with irreparable technical problems for different reasons.

- Eliminated automobiles that have no source of spare parts.

- Automobiles that have been in use for a long time and the energy consumption exceed state standards 15%.

- Automobiles that cannot meet the technical requirements for safety after repairs and adjustments.

- Automobiles that have a higher content of pollutants than state limits in exhaust gases after repairs and adjustments.

Any passenger automobiles and trucks that have reached the year limits listed above, with the exception of taxis of less than 19 seats and light trucks and minicars (including cross-country cars), must be inspected strictly by the administrative department of the Public Security Ministry in accordance with the safety emission limits given by the state. If their performance can meet the requirements, their time limits may be extended, but the extension shall not exceed half of the time limits listed in the second item above. For cranes, fire trucks, driller trucks, and other automobiles for special purposes, the time limits may be extended according to the actual time they are in use. Owners of automobiles with extended time limits must accept additional inspections by the Ministry of Public Security, and those fail to meet the requirements for safe exhaust emission shall be forced to discard their automobiles.

Those automobiles that meet the *Criteria of Automobile Discard* should be send to government-appointed automobiles recycling companies to be discarded and recycled.

The purpose of the discard policy of automobiles is to ensure the safe driving of automobiles and to meet the requirements for environmental protection and energy saving. Meanwhile the discard policy will accelerate the upgrading process, enlarge the demands of automobiles in market and boost the development of automobiles market.

The Leading Group of National Automobile Upgrading (affiliated to the Internal Trade Bureau) publishes the models and number of the discarded automobiles every year, and can ensure that 90% of the old automobiles are discarded. Such achievement is in no doubt very encouraging. But there are also certain limitations of the standards. First, uniform year limits and mileage limits are imposed on all automobiles, disregarding the various quality and models. This poses an obstacle to the development of markets of high quality models. In the past automobiles owned by

organizations and taxis are the major demanding groups. Because of high frequency of car use and the sufficient capital owned by the organizations, people do not care so much about earlier discard. But nowadays, the private user becomes the major group in automobile markets. Low frequency of use and limited capital seriously hinders the development of private markets if the above year limits and mileage limits remain the same. Moreover, with the development of automotive industry in China, the quality and performance of automobiles will be greatly improved. Comparatively low year limits and mileage limits are harmful to technical innovation. In regard of sustainable development, if the automobiles are discarded earlier than the designed year limit while its performance is still good, its discard will result in a waste of resources. Therefore, some experts suggest the current standard of discard should be revised. According to the proposed revision, the automobiles can continue to drive on road, so long as the specifications of the automobiles can meet the national standard, which doesn't make any compulsory regulations on the mileage and time limit of discard. This standard also needs a high level of supervision. In towns and cities the standard can be carried out strictly because there are strict registration and examination of automobiles. In small towns and rural areas strict regulations of registration of automobiles are absent, hence there are cases in which people alter the mileage and date of production of automobiles illegally. In some places automobiles even can be used without any restriction at all. Besides, these areas lack regular examination of automobiles, which permits unqualified automobiles to be driven on road. Generally speaking, in most of the small towns and rural areas, the policy of discard is not strictly carried out at all.

3.3 An analysis of the Chinese situation during the 10th five-year plan

During the 10th five-year plan, China's automotive industry will confront a more complicated condition:

1) China's WTO accession will have great and broad impacts on automotive industry and will make it integrate with the world automotive industry.

The accession of China to the WTO will have a strong impact on the automotive industry, which is not yet competitive in world market terms, as shown in section 3.2.1.4.

The most prominent concessions on China's side will be:

- The gradual decrease of tariffs on cars from currently 80-100% to 25% by 2006
- The gradual decrease of tariffs on components from currently ~ 50% to 10% by 2006
- Immediate increase of import quotas to US$ 6 billion and their gradual phasing out by 2005
- Abolishment of special taxes, investment restrictions and the license system for imported cars
- Abolishment of the „index" system which currently gives the government the power to decide which car models are offered in China
- Abolishment of local content restrictions
- Introduction of new financing alternatives for customers, including leasing, operated by foreign bank or non-bank institutions under Chinese regulations
- Abolishment of any restrictions for foreign investors on operating their own trading and maintenance networks.
- Abolishment of foreign equity share restrictions.

The WTO aims to reduce tariffs, quota & license limitations and other obstacles that hinder trade and investment, creating a competitive and equal business environment for domestic as well as foreign companies. Therefore, with accession to the WTO, China will have to open up its automotive market to foreign investment and products. The consumer will notice that prices have come down and there will be a wider variety of cars available at a reasonable price. Importers will face a more open market and will be able to expand their sales significantly, and local manufacturers will face fierce competition. With only 6 years left to become competitive enough to face competition from Japan, Europe and the US, Chinese car manufacturers should take steps immediately so as not to lose market share to foreign imports.

2) The production capacity of China's automotive industry has increased a lot and some of them are idle, so the future policy should focus on market rather than on production.

As analyzed in previous, now the production capacity of China's automotive industry has reached 3 millions which can meet current demand. In contrast, the demand has not increased very quickly; hence some capacity remains idle. So during the 10th five-year plan, the main task of future policy should focus on how to enlarge demand and how adjust production structure to meet demand of different segments.

3) The buyer of automobiles will shift from non-individuals dominated to individuals dominated.

An analysis of automobile purchases shows the proportion of automobiles purchased by individuals increased very fast and this trend will last a long time. As forecasted by us, during the 10th Five-year Plan period the market for passenger cars will become dominated by individuals, with the share of demand coming from individuals exceeding 50%. Therefore, it is essential to make the production structure meet the needs of individuals.

3.4 Conclusions: improvements of current policies

Since during the 10th five-year plan, the main tasks of China's automotive industry are how to survive in competition, how to improve its competitiveness and enlarge the demand of automobiles. Based on the evaluation of current policies, China's policy should be improved in following aspects,

!) Policy should focus on how to create an atmosphere of fair competition. Firstly, to abolish the restrictions on who can make vehicles and what type of products can be made, especially to allow national private funds and foreign funds to invest in automotive industry. Second, to abolish local protectionism of province level. Thirdly, to focus the regulations more on safety, energy-saving, environmental protection rather than focus on who can make vehicles and what type of products can be made.

2) Policy should pay more attention to support automotive enterprise to improve their technology level. The government can cooperate with enterprises on research focused on improving automobiles manufacturing technology. Government can develop a strategy of technology transfer with foreign firms, and then gradually separate from foreign firms.

3) Policy should encourage individuals to buy and own a vehicle[14]. The most important thing is to reduce all irrational fees and irrational restrictions to individuals.

4) Policy should encourage enterprises to produce vehicles suited to individual use, such as the small car segment.

[14] In most countries, government discourage individual to own a vehicle dueto air pollution, safety, crowding of streets, infrastructure development costs etc. There are two reasons why Chinese government should conduct the policy to encourage individuals to buy and own a vehicle: first, compared with other countries, in the past, Chinese automotive market is a non-individual dominated one rather individual dominated one, secondly, in China, there are many irrational fees and irrational restrictions to individuals until now.

Chapter 4[15]

Lessons from selected countries

in SD policies of automotive industry

We selected the four countries, that is Japan, US, Brazil, South Korea. The former two are the most developed auto-make countries in the world; the later two are new auto-make countries, which have similar situation with China. We consider its case study is useful for the Chinese case. We will review these one by one below.

4.1 Lessons from US

US is the pioneer of both automobile production and environmental protection related to automobile use. From its practice and performance, China can learn what it needs to do and how to do it.

4.1.1 History of Emissions Legislation:

Environmental legislation of the motor car originated in California and until the mid 1990s, California remained the leader in this field. Initiatives and regulations started in this state have usually spread from here to other states and thence formed the basis for Federal legislation and subsequently regulations in other countries. For this reason, consideration of the US in this context is essential.

By the middle of the 1950s a consensus among the scientific and engineering community attributed most of the California air pollution problems to crankcase blow-by. Armed with this knowledge the Californian State legislators set to work and came up with the world's oldest environmental regulation of the motor car. From the 1964 model year all new cars sold in the state had to be fitted with a positive crankcase ventilation (PCV) system of some sort.

[15] This Chapter is originally from the paper written by the international exports of the project, Paul Nieuwenhuis & Peter Wells(CAIR). We would like to express our sincerely acknowledgment to them.

The situation in California prompted a series of studies of the impact of vehicle exhaust emissions on air quality and the results of these allowed the Federal legislators to follow the Californian mandate with the Federal Clean Air Act. The Federal Government's Surgeon General compiled a report of all known information on the dangers of vehicle emissions, which was presented to Congress in 1963. This led very quickly to the Clean Air Act. This in turn led to the Clean Air Act amendment of 1965, which for the first time enabled the Federal Department of Health, Education and Welfare to set and enforce national standards limiting gaseous emissions from vehicles. The Environmental Protection Agency (EPA) was created as part of the Clean Air Act Amendments of 1970.

Table4.1: Brief history of emissions legislation in the USA 1963-2004.

Date	Action
1963	State of California enacts compulsory fitment of PCV systems
	Federal Clean Air Act
1965	Clean Air Act amended to enable setting and enforcement of standards
1966	Federal standards adopted for 1968 model year, covering crankcase emissions and exhaust emissions of CO and HC
1970	Clean Air Act Amendments: setting up of EPA, which sets national standards for CO, HC, NOx, PM and SO_2 in ambient air and at source.
1975	EPA deadline for first round of emissions limits, later delayed until: 1978 and subsequently delayed until 1980, with some limits not implemented until 1981, hence...
1981	Final introduction of Federal emissions standards for cars and first particulate limits for truck diesels from:
1983	Baseline for truck emissions standards
1987	Deadline for limits on HC and CO for trucks, which combined with the car standards are now known as US87
1991	Truck emissions standards tightened up further
1994	Car and truck emissions standards tightened up gradually between now and 2004
	Californian TLEV, LEV, ULEV AND ZEV, legislation planned to come into force by 2003, but adjusted several times by the California Air Resources Board (CARB) during the 1990s

Source: Nieuwenhuis & Wells, *The Death of Motoring?*, 1997

The last phase of legislation outlined in table 4.1 is also the most significant. It involves the introduction of four new classes of vehicle categorized by their

emissions levels as Transitional Low Emissions Vehicle (TLEV), Low Emissions Vehicle (LEV), Ultra-Low Emissions Vehicle (ULEV) and Zero Emissions Vehicle (ZEV). It rapidly became apparent that only battery electric vehicles would qualify under the last category. An additional requirement setting minimum targets for the percentage of new registrations for each category caused widespread concern in the industry. Few manufacturers expected to be able to make, let alone sell, the required 2% ZEVs in 1998 and 10% ZEVs in 2003.

Under its new chairman, John D Dunlap III, CARB began to adopt a more pragmatic approach to its dealings with the industry. Gradually some of the requirements were eased. The 2% sales requirement for 1998 was dropped, although General Motors, for one had a suitable product available in time in the shape of its EV-1. Although the 10% requirement for 2003 remained, CARB now recognized the fact that the emissions from electricity generating plants needed to be taken into account when assessing a vehicle's zero emissions status. This opened the way for a new category the SULEV or Super Ultra-Low Emissions Vehicle. Under this heading a non-ZEV that has emissions equivalent to those produced by a given mix of generating facilities to power a ZEV is allowed. Several of the new generation of hybrid electric vehicles – such as the Toyota Prius and Honda Insight - qualify and can be sold to make up the required 10% for 2003. Credits can also be gained by alternative fuelled vehicles.

Under Dunlap, the initial eager adoption of several alternative fuels in California was also tempered as the new dangers these brought were recognized. Methanol experiments had virtually ceased by the end of the 1990s and oxygenated gasolines produced by adding MTBE were also phased out after a series of disastrous leaks of this additive into scarce ground water reserves. Ozone – a secondary pollutant - came to be seen as the substance most harmful to health and most in need of regulation. While the initial focus was on HC's role in low level ozone formation, the focus now shifted to the role of NOx.

Table 4.2: Percent Reductions of Emissions from Passenger Cars in the United States from 1960 Baselines

	by 1993	by 2006*
Hydrocarbons	95	98
Carbon monoxide	68	84
Oxides of nitrogen	76	95

*Projected; based on proposed standards
Source: Copyright 1994-1998 Encyclopaedia Britannica

4.1.2 Oil quality

By the late 1980s it was realized that any further improvements in automotive emissions would require the cooperation of both the car and oil industries. This approach was first developed in North America, however the EU followed soon after, in the early 1990s. These so-called Auto-Oil Programmes for the first time brought the car makers and oil companies around the same table and a number of changes in fuel were suggested to support the powertrain changes forced on the vehicle makers. The reduction of sulphur in fuel is the principal change required.

4.1.3 Fuel economy

In most countries, fuel economy has traditionally been achieved through high fuel excise duty, but in the US, the government has sought to legislate for improved fuel efficiency. Corporate Average Fuel Economy (CAFE) was introduced in 1978 in response to the 1973/4 energy crisis and it sets a maximum average fuel economy figure for all the cars sold by a manufacturer during a given year. If the manufacturer does not reach this figure, a fine has to be paid, although it can buy credits from a manufacturer that performs better than the standard. The main flaw seems to be that a manufacturer is penalised for the behaviour of its customers. CAFE limits were tightened up regularly until 1990, but did not change during most of the 1990s. Only in 1999 were new forthcoming standards proposed. The penalty has become a way of life for companies such as Jaguar and Rolls-Royce. However, the customer does pay a once off 'gas-guzzler' tax on buying a car that does not reach the standard.

Table 4.3: Car Corporate Average Fuel Economy, 1978-94 (miles/US gallon).

Year	Standard	Domestic average	Imported average

1978	18.0	18.7	27.3
1979	19.0	19.3	26.1
1980	20.0	22.6	29.6
1981	22.0	24.2	31.5
1982	24.0	25.0	31.1
1983	26.0	24.4	32.4
1984	27.0	25.5	32.0
1985	27.5	26.3	31.5
1986	26.0	26.9	31.6
1987	26.0	27.0	31.2
1988	26.0	27.4	31.5
1989	26.5	27.2	30.8
1990	27.5	26.9	29.8
1991	27.5	27.4	30.0
1992	27.5	27.4	30.0
1993	27.5	27.7	29.5
1994	27.5	26.3	29.4

Source: Ward's, 1994

The position of the overall standard to be met has changed only 1.5 miles per US gallon since 1983. In the time since 1978, US producers have shifted from slightly over-performing against the standard, to slightly under-performing. In contrast, imports started the period with a higher fuel economy performance than that which US cars finished with in 1994. In recent years the CAFE performance of imported cars has fallen towards that of the standard, a reflection of the proportional increase in sales of larger and higher performance cars.

In addition, US buyers have increasingly opted for light trucks, which now make up around half the market. These vehicles, which include pick ups, 4x4 sport utility vehicles and people carriers, MPVs or minivans are much heavier than cars and have much worse fuel consumption figures. One concern for the vehicle manufacturers over CAFE in the US was that the standard for light trucks may be raised. During the 1990s the standard increased only slightly from 20.2 miles per gallon to 20.7 miles per US gallon. At the same time, the large shift in purchases towards light trucks has continued, which reinforces the attention given to truck CAFE standards. These developments have prompted the suggestions from the

NHTSA for new measures, which would require both cars and light trucks to meet the same standards. The current penalty is $5 for every 0.1mpg below the standards, multiplied by the number of cars sold by that manufacturer for that year. Between 1983 and 1995, over $400 million in penalties were collected, which in terms of the total value of the market suggests a very weak signal.

Table4.4: Rise of Light Truck Sales in the US (000s)

Sales	1975	1980	1985	1990	1995
Car	8,500	8,961	10,982	9,295	8,636
Light Truck	2,248	2,227	4,481	4,591	6,130
Total	10,749	11,188	15,401	13,886	14,766

source: Automotive News

In November 1998 CARB decided to reclassify SUVs as passenger cars and thus make them subject to the same emissions standards, although this does not immediately affect their CAFE status.

4.1.4 PNGV program

By the early 1990s there was a general feeling, that regulation had not delivered the hoped-for environmental benefits. Similarly, the mandated market share approach such as that embodied in California's ZEV regulations, and CAFE was also seen to be flawed. A new approach was sought. This was found in a new type of government-industry cooperation to develop more environmentally benign vehicle technologies. Probably the most influential of all government R&D programmes is the Partnership for a New Generation of Vehicles (PNGV). The PNGV was launched on the White House lawn in 1994. Tim Adams, PNGV Director for Chrysler commented: *'PNGV represents the opportunity to more efficiently address fundamental national objectives than the regulatory mandate approach that we have taken before.'*

The PNGV has three central goals:

- Significantly improve national manufacturing competitiveness in the US

- Implement commercially viable innovation from ongoing research on conventional vehicles

- Develop a vehicle to achieve up to three times the fuel efficiency of today's comparable vehicle, i.e. 80 mpg (US)

This PNGV vehicle is still a theoretical concept, however its specification is to some extent outlined already .The "Big3" has invested to develop it in some key part, such as the hybrid-electric vehicle (HEV), and some concept cars of a number of PNGV vehicles was developed in recent years are likely to see production from 2004 onwards.

4.1.4 Conclusions: Implications for China:

As a new-comer, China should learn a lot from the practice of US in environmental protection.

1) *China should make its emission standard of vehicles suit to its real conditions and amendment them step by step.* In environmental protection field, the US is the pioneer, its regulation is visionary and tight because the US society cares relatively much about the environment very much and environmental protection is an important part of automotive industry competitiveness[16]. For China, market of its automobile products is domestic with lower income and its society cares about environment less than the US society does, the more important thing than environmental protection for automotive industry is to produce cheaper products, hence China can make a lower emission standard of vehicles than the US and then improve them step by step with economy develops.

2) *Oil industries should make great efforts to improve oil quality for vehicle use.* The US's case tells us that in order to reduce emissions from vehicles, not only needs the car-maker's manufacturing technology be improved, but also and more importantly high quality oil for vehicle use is needs be developed by the oil

[16] Tighter environmental regulation can reduce imports from the countries with low environmental standards and enlarge exports to the countries with tight environmental standards.

refinery industry side. So further improvements in automotive emissions would require the cooperation of both the car and oil industries. As a newcomer, China can improve emission exhaust of most vehicles especially light passenger cars by introducing mature technologies from advanced auto-make countries. This is what has been done in recent years, so improving technology is not a big problem. However, the poor oil quality is really a bottleneck that the Chinese government should pay attention to, even though China has recently ceased to produce leaded oil.

3) *Fuel efficiency should be paid more attention to*. With the increase of vehicle population, oil consumption will increase quickly, China need to import more oil and it will cause oil price rise. Hence China should pay more attention to improve fuel efficiency.

4) *Emission regulation should focus on the vehicles with big share of the total automobile parc*. The US's popularizing SUVs shows SUVs effected the environment more than before, which has make CARB tightened its regulation. For China, only the emission regulation for light passenger cars is strict, the regulations for various kinds of other vehicles (such as motorcycle, trucks, buses, vehicles for farmer uses etc) are much less stringent, but those vehicles are more polluting. Hence, China should make and tighten their emission regulations.

5) *Government can launch a program as the US's PNGV to reach the environment goals and the industry interest*. The US's case shows that a command and control approach, such as the market share approach that embodied in California's ZEV regulations, had not delivered the hoped-for environmental benefits. The main reason is enterprises cannot benefit from those regulations. Therefore, policies should also provide a reward. Through the partnership with industry (PNGV) of interest, the PNGV cannot only improve the performance of vehicle emission, but also can increase automotive industry competitiveness. China's government can learn from this experience in developing close cooperation with automotive enterprises.

6) *Alternative fuels should be use carefully*. Form the US's case, although alternative fuels can reduce the pollution caused in vehicle uses, it can cause pollution in production such as leaks of this additive into scarce ground water reserves and emissions from electricity generating plants needed to be taken into account when assessing a vehicle's zero emissions status.

4.2 Lessons from Japan

4.2.1 Industry development and Export increase

The social and economic impact of the automotive industry in Japan is indeed large. In the mid-1990s the estimated direct and indirect employment generated by the industry was 7.2 million jobs, or about 11% of the total working population of 66.15 million (JAMA, 1995).

The Japanese motor industry has a long tradition with many years of development. The first all-Japanese petrol-powered car was created in 1907. But the time Japanese motor industry achieved the big progresses was from post-war. At that time, Japanese motor industry was able to achieve the transition from technological dependence and reliance on a (relatively small) domestic market, to self-reliance and export-led growth. The Japanese industry had an unprecedented and unrepeatable opportunity afforded by the overall level of technology development in the industry and by an increasingly free-trade environment that provided the space for Japanese companies to enter.

Since the early years of the automotive industry in Japan there has been a distinct category of very small cars, variously called kei class, mini-cars, midget cars or micro-cars. These have been defined primarily on the basis of engine size, but the definition also includes maximum dimensions. Over time the definition (for taxation purposes) of the kei class has changed, in essence the class has allowed larger vehicles. The result is that Japan has a significant parc of small, fuel-efficient cars.

Before 1960, production volumes overall were low, but it grew very fast from 1965 onward (shown in Table 4.5). One main reason is the increase of exports. Japan was a major exporter of vehicles. Japanese companies were major beneficiaries of the 'oil shocks' of the 1970s. In the crucial US market, the big domestic manufacturers (Ford, GM, Chrysler) were still producing the classic 'gas guzzlers' while consumers were suddenly confronted with the need to acquire more fuel-efficient vehicles. Japanese vehicle manufacturers had developed product with the requirements of their domestic market in mind where, because of the need to import all the petroleum the country needed, fuel efficiency had been a central concern to government for strategic as much as economic reasons. These smaller, more fuel-efficient vehicles were also, as American consumers discovered, often better built than their US counterparts.

Table 4.5: Japanese vehicle production and exports, 1961-1999 (000s)

Year	*production*		*exports*	
	Cars	All vehicles	Cars	All vehicles
1961	249	813	7	38
1965	696	1,875	100	194
1970	3,178	5,289	725	1,086
1975	4,567	6,941	1,827	2,677
1980	7,038	11,042	3,947	5,966
1985	7,646	12,271	4,426	6,730
1990	9,947	13,486	4,482	5,831
1995	7,610	10,195	2,896	3,790
1999	7,934	9,064	n.a.	4,408

However, in the long-run Japanese vehicle manufacturers have not been able to avoid global integration. As a result of economic prosperity the Japanese Yen soared in value compared with the US Dollar, placing increasing strain on export-led growth and contributing to the surge in FDI by Japanese vehicle manufacturers. When the domestic market stagnated in the early 1990s and the Asian recession developed in the latter 1990s the Japanese vehicle manufacturers had to do what was previously unthinkable: close plants, lay off workers, break up the keiretsu system, accept

capital participation and management from US companies and abandon the life-time employment model.

4.2.2 MITI's role

Since 1945, the Ministry for International Trade and Industry (MITI) had sought rationalization in the industry to attain international competitiveness. In this sense MITI pursued (albeit without success) a 'national champion' strategy. In any event, the importance of Japanese ownership and control was critical to government policy and public sentiment. It is only in the latter 1990s that these attitudes have changed, most notably with the rescue of Nissan by Renault.

MITI has played a crucial role throughout post-war Japanese industrial history. MITI was crucial in negotiating trade agreements, VERs and quotas on behalf of the industry. Here it was able to build a rapid consensus among the automakers, which gave it a powerful negotiating position internationally. However its attempts at internal industrial policy have at times been misguided and often unsuccessful. Most crucially its attempts at rationalization of the Japanese car industry – aimed ultimately at mirroring the US 'Big3' or at the time 'Big4' (Ford, GM, Chysler, American Motors) situation – were largely misguided and unsuccessful.

Seven mergers were suggested by MITI between 1966 and 1968, of which three were actually implemented. The rationalization of Hino (> Toyota 1966) and Daihatsu (joined Toyota keiretsu 1967, became Toyota company in 1999) and Prince (> Nissan in 1966 with Gloria and Skyline names) might have come about anyway. Attempts to prevent Honda from making cars were clearly misguided in view of Honda's subsequent success as a car maker. Similarly, Mazda invested considerable resources in Wankel rotary engine technology primarily to set itself up as a technology leader in order to avoid being rationalized out of existence. Such misguided policies could have been avoided had MITI followed a policy reliant more on an understanding of the car industry and markets, rather than simplistic economic models.

4.2.3 Sustainability and policy

Policy-making in Japan with respect to sustainability has combined legislation (formal regulation) with voluntary agreements with the automotive industry. As with other countries, over the 1990s the automotive industry in Japan became increasingly aware of environmental issues. In particular the following issues were regarded as important:

- Improved fuel economy
- Reduced exhaust emissions, pollution other than exhaust emissions and noise
- Improved recyclability
- Improved materials utilisation

Table 4.6 summarises the key sustainability policies in Japan, together with their objectives, results and impacts.

Table 4.6: The key sustainability policies in Japan

Policy	Objectives	Results	Impact on E/S/Ev
Kei class created by defining small car dimensions. Policy later relaxed slightly to allow exportable cars.	Reduce congestion and pollution by encouraging smaller vehicles through taxation and regulation.	Growth in Kei segment, but largely in rural areas. Effectively consumers presented with low-cost motoring.	Created unique (therefore protected) market in Japan. Not an exportable product for EU / US. Reduced profits for manufacturers (sales substitution from larger segments). Some environmental and social benefits
Car parking permits in urban areas.			
Emissions and fuel quality legislation enacted.			
Periodic testing regime (Shaken) including the	Assure vehicle safety and performance.	Fleet of vehicles in use relatively young and in good order.	Helps sustain replacement demand for new cars in Japan

mandatory replacement of key components.		Older vehicles exported to other markets.	
Telematics R&D programmes.			
Safety legislation eg seatbelts? Airbags?			
Phase out use of CFCs in production and product.	Reduce global warming impact and ozone depletion by replacing CFCs with other materials.	Largely unproblematic and in line with developments in the global industry. Environmental benefits at little extra economic cost.	No impact on competitiveness as this was happening to the automotive industry across the world.
Establish Association for Cooperation in Abandoned Car Disposal	Create a mechanism to ensure abandoned vehicles are collected and disposed of.	Increase to almost 100% the capture of ELVs. Approximately 100,000 cases per annum	Reduction in pollution; increase in materials recycled; support of employment in ELV sector.
Establishment of the Association for the Promotion of Industrial Waste Treatment	Promotion of markets and technologies for recyclate.	Not documented	

1) In Production Stage: reducing energy consumption

The vehicle manufacturers in Japan committed themselves in the early 1990s to reduce energy consumption in production by 1% per annum to the year 2000. In 1993 the automotive industry in Japan consumed about 3,800,000 kilo litres crude oil equivalent in vehicle manufacturing plants. The Japanese vehicle manufacturers agreed in 1990 to reduce the level of manufacturing waste destined for landfill by 50% over the decade to 2000. However, this includes the use of 'thermal' recycling whereby waste is incinerated and the energy recovered.

2) In Using Stage: reducing emissions, noises and using telematics

Following the 1992 Rio Conference, the Japanese automotive industry and the Ministry of Transport published agreed targets for per-vehicle fuel economy. These are shown in Table 4.7.

Table 4.7: Fuel economy targets in Japan

Vehicle type	1990 (km/l)	2000 (km/l)	% improvement
Standard (>2000cc)	8.3	9.1	9.6
Small (<2000cc)	12.1	13.0	7.4
Mini (<660cc)	17.8	19.0	6.7

(Source: JAMA. Note: also Standard = 1515.5 kg or more; Small -= 827.5 kg to 1515.5 kg; Mini = less than 827.5 kg)

As with other countries with large vehicle populations, Japan has enacted a series of regulatory measures to control per-vehicle toxic emissions. Table 4.8 shows the extent of emissions reduction compared with an unregulated car.

Table 4.8: Emissions reduction for gasoline cars in Japan from 1965 (% reduction compared with unregulated car).

Year	**CO**	**HC**	**NOx**
1965	100	100	100
1967	60	100	100
1970	50	75	100
1973	50	75	70
1974	45	48	70
1975	5	4	39
1976	5	4	20
1978	5	4	8

Noise pollution is a particular problem in the tightly-packed urban areas of Japan. The vehicle manufacturers accept only partial responsibility, taking the view that noise pollution is also a function of road structure, traffic flow rates, building design, the physical environment including trees, etc. and human factors including driving style. The government instituted a collaborative programme in the latter 1980s. Average noise from vehicles has reduced over time as a result of technical improvements in passenger cars:

Table 4.9: Noise from passenger cars

Pre-1975	84 dB(A)
1976	82 dB(A)
1977	81 dB(A)
1978	78 dB(A)
1979	76 dB(A)

The benefits of the use of telematics to improve traffic flow are somewhat hypothetical, but in Japan some attempt has been made to calculate those benefits. Table 4.10 shows the impact of improved traffic flow in terms of CO2 emissions (for the average 2 litre gasoline car) and NOx emissions (for the average 2 ton diesel truck.

Table 4.10: Impact of improved traffic flows on emissions

Average vehicle speed (km/h)	**CO2 index**	**NOx index**
10	100	100
20	63	62
30	50	52

3) In Disposal Stage: recycling

As in other industrialized countries, most ELVs are captured by the recycling system and about 75% by weight of each vehicle is recycled. In Japan the resulting shredder residue, amounting to about 800,000 tons per annum, goes to landfill. The main route chosen to reduce this volume is incineration whereby the energy so released is used to extract the metallic content of the vehicle. The industry has cooperated on research into technical alternatives for the re-use of shredder residue such as plastics pyrolysis.

4.2.4 Implications for China

The Japanese case has the following useful lessons for China:

1) *China should learn from MITI's failure in guiding rationalization of the Japanese automotive industry to inform future industrial policy*. In the past, China's policy-maker overevaluated the impact of MITI on the Japanese automotive industry and set down its own industrial policy for automotive industry referring to what MITI did in Japan. However, although MITI had played a very important role in trade, its rationalization policy was unsuccessful. Hence China should develop a rationalization and concentration through market forces rather than by administrative degree.

2) *China can encourage enterprises to develop and consumers to buy more fuel-efficient vehicles*. The success of Japan-made automobiles export during the 'oil shocks' of the 1970s can be ascribed to its focus on fuel-efficient cars. For the long future, domestic market is main destination of China's automobile products, with energy consumption increasing quickly, China's oil will not meet the demand, China should encourage enterprises to develop fuel-efficient vehicles and encourage consumers to use them by vehicle taxation system.

3) *China can learn from Japan in emphasizing on energy-saving in production stage and recycling in disposal stage*. Japan has done well in the areas of energy-saving and recycling, China can learn from it.

4.3 Lessons from *Brazil*

4.3.1 Industrial development

The Brazilian motor industry was created by the government in the 1950s. The strategy involved attracting inward investment by assemblers, whilst developing and retaining a supply sector in Brazilian hands. In order to accomplish these aims, the government was able to build on the existing aftermarket sector, developed to service the existing parc.

By the early 1960s, the strategy was beginning to bear fruit and a number of assemblers had set up facilities in Brazil: Volkswagen, DKW-Vemag, Willys-Overland, Simca, Ford, GM and Alfa Romeo-FNM. Half of these involved joint

ventures with local firms. The primary motive was import substitution, although by the mid 1960s, the government became interested in the export potential of the industry for helping relieve Brazil's foreign debt. Although limited exports have taken place at various times, the industry primarily served its home market during most of its history.

Several of the early assemblers either pulled out or disappeared. However, today Brazil is a significant production base for Volkswagen, GM, Ford, Fiat and truck makers Mercedes-Benz, Volvo and Scania, with other firms having smaller facilities. Brazil is increasingly being integrated into the global networks of car makers, particularly those of VW and Fiat. VW for example, has exported car designs and components from Brazil to China.

The history of the Brazilian automotive industry is perhaps more typical of a developing country than that of Korea in that Brazil has long relied on the active presence of foreign vehicle manufacturers.

Production and markets in Brazil have been strongly influenced by changes in government policy over the years, particularly with respect to macro-economic management, from the 1960s, development of Brazil automotive industry had gone through 3 growth phases and 3 phases. The mix of vehicles has also reflected these policies and the particular needs of the market. A characteristic of production in Brazil has been the relatively small proportion accounted for by passenger cars (58% in 1965, 13% in 1996) compared with station wagons, pickups and various commercial vehicles. This is indicative of its level of automotive development (see table 4.11). Another characteristic, however is that despite often making obsolete models designed for developed markets Brazil has also built many unique local designs based on these, some of which have been exported. Examples are the VW Brasilia and SP1/2 sportscar, and the Fiat Weekend derivatives, while Brazilian designed and built Puma sportscars have also been exported to European markets such as Switzerland.

Table 4.11: Production by vehicle type, selected years (units)

Year	Passeng	Station	Vans	Jeeps	Pickups	Heavy	Buses	Total

	er cars	wagons				trucks		
1961	54,978	5,227	24,439	17,621	12,826	26,891	3,602	145,584
1965	108,573	5,199	24,323	9,496	12,637	21,828	3,131	185,187
1970	249,913	57,002	35,518	4,723	26,487	38,388	4,058	416,089
1980	470,266	462,886	34,360	5,631	75,549	102,017	14,465	1,165,174
1990	267,482	395,602	17,258	1,775	165,721	51,597	15,031	914,466
1996	245,166	1,213,410	67,740	244	211,713	48,712	17,343	1,804,328

Car production in Brazil has been dominated by non-domestic vehicle manufacturers such as Fiat, VW, Ford and GM, whose production was 1.755 million in 1996, accounting for 97.3. The growth in the share of the 'Popular Car' segment has been dramatic: 11.3% of the market in 1991 rising to 67% in 1999. European small-car producers such as Fiat and VW have been beneficiaries of this policy.

For many years Brazil was an insignificant exporter of cars or commercial vehicles. Table 4.12 shows exports before the Fiat Palio came into production. Increasingly, Brazil is integrated into global production structures and will import and export more vehicles over time. South America, and particularly Argentina, is the vital exports market of Brazil-made vehicles. In 1996 Argentina accounted for just over 66% of all exports, while South America as a whole accounted for 86% of all exports. Since the formation of Mercosur in particular, Brazil and Argentina have been regarded by many manufacturers as an integrated production system. Models produced in either country are combined in both countries to make a model range, while both supply key components and subassemblies to the other. This is a clear illustration of the part played by Brazil-Argentina as a regional hub in the global production systems of large vehicle manufacturers. This also provides a good basis for the expansion of exports to other markets, and expansion illustrated by the more recent Fiat Palio model.

Table 4.12 Exports from Brazil by vehicle type, selected years (units)

Year	Passenger cars	Vans	Jeeps	Pickups	Heavy trucks	Buses	Total
1961	0	0	0	0	0	380	380

1965	0	0	0	0	9	120	129
1970	52	57	75	69	122	34	409
1980	115,482	8,407	1,568	10,260	18,977	2,391	157,085
1990	120,377	394	5	53,180	8,371	4,984	187,311
1996	211,656	3,407	1	67,543	8,545	5,212	296,373

Brazil has made frequent adjustments to key aspects of trade policy such as import tariffs on complete cars and components, import quotas, vehicle purchase tax, etc. and this has created a turbulent environment within which companies have to operate.

Brazil has a number of advantages that, despite the economic turmoil, have contributed to further development of the automotive industry. These are: the significant domestic market, the expansion of that market by the relationship with Argentina and other Mercosur countries, the strong supply base, the flexibility of the workforce. The latter two points have been crucial to recent investments, notably the VW Resende plant and the Fiat Betim plant. In both cases local networks of physically proximate suppliers are vital to the functioning of the just in time system, a practice likely to be extended with the new Ford plant. In the late 1990s, Brazil became the principal base for Fiat's Palio world car project, Project 178. This means that for the first time, Brazil became the hub for a global platform. This represents a major elevation for the Brazilian automotive sector which has now become genuinely part of the global automotive industry.

4.3.2 Environment

In terms of environmental policy, Brazil has been largely separate from many developments elsewhere. Although it is now moving closer to world standards, there are some unique aspects of Brazil's environmental policies that deserve some discussion, most notably the Proalcool programme.

Brazil has limited domestic reserves of oil. However it is not of the most suitable grade for automotive use and after the oil crisis of 1973/4 it was felt exports of oil could help in debt repayments. For this reason the government encouraged the use of ethanol as an automotive fuel under its 'Proalcool' programme.

Alcohol-based fuels have been used in automotive applications for a long time, particularly as high-octane fuels for racing cars. They burn more completely and thus produce lower emissions, although they are still hydrocarbon fuels. In the mid 1970s the Brazilian government launched the 'Proalcool' programme as an import substitution project. In the wake of the oil crisis of 1973/4 Brazil felt it spent too much on importing oil to run its cars and a means was devised to substitute this with ethanol produced from sugar cane. The programme was introduced from 1979.

Sugar cane production was increased to produce the ethanol. Initially 20% alcohol was added to petrol and this proportion was gradually increased to supply pure alcohol. Under the programme, the Brazilian car makers were encouraged to produce engines to use the fuel and their cooperation was obviously vital for success. In the process, Brazil developed considerable technical expertise in alcohol fuel and engine technology. However, by 1987 the programme had already cost the country $20bn in various subsidies. As a side effect, more rainforest was destroyed in order to grow additional sugar cane crops. Another problem was that in the 1980s, demand abroad for alcohol-powered cars was limited, although by the early 1990s there was some interest from California. This prevented Brazil from recovering some of the development costs with foreign currency. By the 1990s, the low price of oil had virtually eliminated any demand for alcohol-powered cars in Brazil.

Although the heyday of the programme was in the 1980s, cars capable of running on alcohol are still built in Brazil. In practical terms there are limitations to this approach as vast areas of dedicated crop cultivation are required to run a significant proportion of cars on this fuel. Even in Brazil the programme was criticised by those – most notably specialist car maker Gurgel - who felt crops should be grown to feed Brazil's urban poor, rather than the cars of the rich.

4.3.3 Conclusion: implications for China

Brazil is a country with less competitiveness of automotive industry, but it still achieve some progress, for example its success in light commercial vehicles and alcohol-fuelled cars. China can learn some lessons from practices of Brazil automotive

development.

1) *To cooperate with or make joint venture with multinational carmakers is a quick way to realize the catch-up strategy of automotive industry*. The success of the Brazil automotive industry is partly due to the policies allowing multinational carmakers to invest directly in the industry. Following this example, China can loosen the restrictions on multinational carmakers investing directly in the industry in order to improve the competitiveness and technology level of domestic industry.

2) *Stable macro-economic environment and policies of automotive industry are essential for the industry.* The most significant threat to the industry in Brazil has been the macro-economic environment and the tendency of the government to use the industry as a tool of economic management. For my own opinion, one reason is probably which Brazil's automotive industry is dominated by transnational carmakers rather than by national carmakers. Because the government pays less attention to the interests of transnational carmakers than to that of national carmakers, the government prefers to use the industry as a tool of economic management.

3) *Developing certain products with high-volume in the domestic market, but relative niche products in other markets is a way to improve the competitiveness of the industry*. The importance of the station wagon, van and pickup truck segments in the market in Brazil has given rise to a production pattern that might be viable for China. In this pattern certain products are high-volume in the domestic market, but relative niche products in other markets. These other markets can become export destinations. In effect, Brazil has a comparative economic advantage in light commercial vehicles of certain types, similar specialisation might be possible in China (in mini buses, light trucks for example).

4) *The role of Brazil as a regional hub, but in some cases (e.g. Fiat Palio) becoming a global hub could be a model for China as vehicle manufacturers integrate the*

country into global production systems. In this case, mainstream product in Brazil can be a low-cost entry-level model in established markets.

4.4 Lessons from Republic of Korea

4.4.1 Industry development

South Korea (Republic of Korea) started in the 1950s and boomed in the 1960s (shown in table 13 and table 14).

Table 13. ROK Vehicle Industry Historical Highlights

Year	Events
1954	Ssangyong began vehicle production in small numbers
1962	Saenara Motors starts assembling Nissan cars from CKD
1965	Saenara absorbed by Shinjin Motors, building Toyota cars, later Jeeps
1967	Hyundai Motor Co set up to assemble Ford Granada and Cortina models under technical agreement with Ford UK
1972-	Shinjin forms JV with GM -GM Korea
1974	government puts up protective barriers
1975	Giugiaro-designed Hyundai Pony launched (1st Korean-developed car) with Mitsubishi technology

Table 4.14: Car Production in South Korea 1965-2001

Year	Car Production (units)
1965	106
1970	12000
1979	113564
1980	57225
1983	121,987
1987	793,125

1990	987,000
1995	2,003,146
1996	2,264,709
1997	2,308,476
1998	1,625,125
1999	2,362,000
2000	2,400,000 (forecast)
2001	2,450,000 (forecast)

Source: various

Now, the vehicle industry has become a major exporter. By the middle of the 1990s, it came 5th in the ranking of exporting industry sectors, after electronics, textiles, machinery and iron and steel, with 5.7% of exports by value. In 1998, ROK ranked 8th in terms of world car producing countries, although in 1994 it ranked fifth.

From an early stage the automotive industry enjoyed government support. Initially this support was motivated by the desire for import substitution. Only in the 3rd Five Year Plan (1972-76) was the automotive sector specifically incorporated as it was rationalised with a view to cars spearheading an export drive in order to bring in foreign exchange to pay off the growing foreign debt incurred through industrial development. The 4th Five Year Plan (1977-81) was more biased towards heavy and chemical industry. The murder of president Park in 1979 caused some political instability. The real export push came with the 5th (1982-86) and the 6th Five Year Plan (1987-91) despite some setbacks in North America.

Korean governments have considerably more power and influence than those of Japan and play a key role in guiding the car industry and the wider economy. At various stages, the government has determined who could make vehicles and what type of vehicle. Currently the Kim administration is pursuing a free market agenda and a policy involving a break up of the chaebols. Some aspects of this policy may have done more harm than good to the industry, although the overall aims are perhaps laudable.

The success of Kia's Pride – the first small car in Korea - suggested there was considerable untapped demand. The government introduced a scheme whereby

manufacturers were encouraged to start building minicars. This was initially resisted by the car makers who expected small profits, however by the late 1990s, Daewoo's minicars in particular enjoyed worldwide success, thus vindicating to some extent the government's policy.

In 1997, South Korea was itself hit by the 'Asian crisis', causing a collapse of the won and triggering a general collapse of the financial system. As in Japan, the Korean financial sector had failed to develop in line with the manufacturing sector. Banking regulations in Japan and Korea have traditionally been less restrictive than in the West, where a series of financial crises – such as that of 1929 – have prompted ever tighter regulation. This crisis has also affected the car industry in that borrowing became tighter at a time when they were in an expansionary investment phase. Also, as in Japan, the auto sector has been engineering and manufacturing-led, while in the West, many firms have been more finance-led (which has caused a different set of problems). This has prompted the rationalization we have seen in Korea in recent years.

However it is also noteworthy that Korea recovered quickly from the Asian crisis and that car production actually reached a record high in 1999, So far this year also looks promising, although some days have been lost to industrial action. The struggles for ownership at the top also hide the fact that there has been considerable rationalisation in the supply sector. Forty new foreign joint ventures have been formed over the past 2-3 years, while some big local players, such as Halla Mando – have been broken up. Daewoo Auto Components is now owned by Delphi of the US.

Korean car makers adopted a technology transfer strategy, which has a number of distinct phases:

1) Build entirely foreign designs under license for local market (Ford-Hyundai; GM-Daewoo) – late 1960s onwards

2) Build own-design car on foreign platform with foreign core technologies (Hyundai Pony-Mitsubshi based, Stellar – Ford based) and start exporting – 1970s and early 1980s

3) Gradually localise core components: engine, transmission – and reduce reliance on foreign partners – late 1980s and early 1990s

4) Develop and build own car with in-house designed components and sever or marginalise relationship with foreign partner – 1990s

In the next phase, the ROK firms would develop unique differentiating technologies that would give a technological advantage in certain key areas. This has not yet fully happened and we have seen that the industry is running out of time as it is going through a period of severe consolidation. The hope is that one strong domestic car maker will emerge centred around Hyundai-Kia-Asia, which is able to move into this next phase, possibly with a foreign link of some sort, such as the recent link with Daimler-Chrysler/Mitsubishi.

4.4.3 Environmental

South Korea was relatively quick to adopt emissions legislation and from the early 1990s, US standards were adopted. This was partly due to the fact that much of Kia and Daewoo's exports at this time involved 'captive' exports with their respective partners Ford and GM to the US. Thus standardizing regulation with the US made sense. Clearly local air quality in Korea has also benefited.

The standards are enforced on vehicles in use via the 80,000km Emission Durability Test and the 6,400km Emission Approval, which is a type approval test covering emissions, noise and fuel economy. Imported cars are exempt from these tests if they are type approved to equivalent standards in their country of origin – in practice US or EU and more recently also Japanese standards. Domestic cars are subjected to a monthly emissions test and imported cars of which more than 500 have been sold in Korea are also subject to this.

ROK is currently working on a sustainability strategy which also incorporates a motor industry element. Although we are in contact with some of the parties involved in devising this strategy it is as yet too early to report on the details.

4.4.4 Implications for China

In a sense, the Republic of Korea can be said to be one step ahead of China in terms of automotive development. However in practice its situation is quite different. The ROK is a small country by regional standards and still a second ranking player as a carmaker. China is one of the world's most powerful countries with the largest population. This gives China potentially a much greater influence on how the world motor industry is shaped. Nevertheless, there are a number of features of Korea's experience that are worth noting:

1) *Government role in establishing the minicar segment for social equity and fuel efficiency.*

2) *Strategy of technology transfer via joint ventures with foreign firms, then gradual separation from foreign firms as in-house expertise develops has been partly successful and without the 1997 crisis might have succeeded by now.*

3) *Environmental implications of rapid motorization and slow infrastructure improvements.*

4) *Dangers of exposing second ranking car manufacturing sector to the rigours of global competition too soon – and need for robust financial sector to support car makers.*

5) *But possibilities of competing globally from a limited base with the right products at the right price and with the right marketing strategy.*

4.5 Lessons from Other Countries

If we spread our review wider to other countries, recent developments in the UK may be of some interest. In 1999, the UK government presented a plan for sustainable development (DETR May 1999). In this it challenged individual sectors of industry to map out their own strategies for sustainable development in the UK. The first sector to respond was the car industry which through its trade body, the SMMT (Society of

Motor Manufacturers and Traders) launched a sustainable development strategy in April, 2000. The document was supported by BMW, Dunlop, Ford, GKN, Nissan, Rolls Royce and Bentley, Tennex, Toyota, Unipart, Vauxhall and Volex. SMMT is hoping to get more on board over time and will provide regular updates tracking the industry's performance via a number of indicators.

The UK government itself published a series of around 150 sustainability indicators (DETR, December 1999) late last year and these are to form the baseline figures on which to base future assessments of the UK's moves towards sustainable development. Out of the 150 or so indicators, the government has selected a number of headline indicators, as follows.

Table 4.15: UK Sustainablity Headline Indicators

Themes, issues and objectives	**Headline indicators**
Maintaining high and stable levels of economic growth and employment	Total output of the economy (GDP and GDP per head; total and social investment as a percentage of GDP; proportion of people of working age who are in work
Social progress which recognises the needs of everyone	Indicators of success in tackling poverty and social exclusion (children in low income households, adults without qualifications and in workless households, elederly in fuel poverty); qualifications at age 19; expected years of healthy life; homes judged unfit to live in; level of crime
Effective protection of the environment	Emissions of greenhouse gasses; days when air pollution is moderate or higher; road traffic; rivers of good and fair quality; populations of wild birds; new homes built on previously developed land
Prudent use of natural resources	Waste arisings and management

Source: DETR December 1999

The SMMT document published in April 2000 primarily focuses on past achievements by the automotive sector (SMMT 2000). It also highlights ongoing research in alternative fuels and alternative powertrain. However the key to the SMMT response to the government challenge is going to be the indicators on which the future improvements of the sector are measured.

From the current practice of the UK, China can learn from it to establish its own

sustainability indicators system to evaluate the process of sustainable development of automotive industry.

Chapter 5

Future policy guidelines and suggestions

The concept of sustainable development has many different meanings, which mainly refer to economic development, social development, and environmental protection. Owing to different real conditions of the economic and social development, different countries may place stress on different aspects of sustainable development. Economy and society in developed countries in Europe and America have reached a very advanced level, the material needs of people have also been sufficiently satisfied, therefore the focus of sustainable development in these countries is put on the quality of life and the living environment. Another reason is that these countries have enough economic strength and technical input to be used on environment protection.

China is still a developing country. Its level social and economic development is lagging far behind the developed countries. The top priority for China is to develop economy and shorten the gap with the developed countries. Meanwhile, since China is undergoing economic transformation, a large number of surplus workforces from state owned enterprises and the rural areas need to be reemployed; employment is an issue that calls for special attention in our economic development. But this is not to say that the protection of environment may be ignored. Actually because of limitations of economic development stage and economic strength, the environmental protection in China is bound to subject to economic growth with focus on main issues.

When it comes to our automotive industry, the formulation of sustainable development strategy should also follow the rule that attaching foremost attention to development while taking into consideration both society and environment.

5.1 To formulate a strategy and to set a pattern for long-term development

At present, the international automotive industry is actually shared by the several transnational companies in the developed countries. The few successful patterns in developing countries may be summarized as two. One is the Brazilian pattern. It completely gives up the national automotive industry, and makes the country a production base and distribution center for the transnationals. Another is the Korean pattern, whose characteristic is to implement the strategy of import substitution by introducing foreign technology to develop national auto production and development capability.

China first formulated its strategy for long-term development for automotive industry in Industrial Polices for Automotive Industry published in 1994, which is similar to the Korean strategy, hoping to cultivate its own automotive industry and realize import substitution by introducing technology, capital, and management, based on its market advantages. This can be clearly seen from the stipulation of localization and that cooperated enterprises must set up technological R&D center.

However, this strategy is not easy to be carried out in actual practice. Guided by their own interests, enterprises turned out to introduce the modular assemblies and did not have the ability to research and develop products independently, and therefore did not have their own brand products. With China's imminent accession into the WTO, the polices of localization and co-funding will all be restricted in their applicability. The actual situation of Chinese auto enterprises demonstrates that the chances to attain the objectives set in Industrial Polices for Automotive industry are very slim, if practical and enforceable polices are absent, and automotive industry in China will deviate from its original road, and end up with the Brazilian pattern.

The discussion here is not meant to compare the weakness and strength of different patterns. Even the Korean pattern, which we deemed to be very successful, showed its weakness of enormous bad debts resulting from large-scale investment after experiencing the Asian Financial Crises. What we emphasize here is that at the critical point of China's automotive industry, the development strategy and pattern

must be determined: to carry out the original strategy and develop the national industry through cultivation of the local production and research ability, or to adjust the objectives and become a production and distribution center for transnationals in the far east. No matter which strategy is adopted, a series of policy adjustments is needed and must be resolutely implemented to ensure the goals will be realized.

5.2 To support load truck to make them more competitive

China's load trucks are the most competitive of its various automobiles models. Several decades of growth has enabled truck enterprises to have independent development ability, and the price/performance rate for current models is very competitive. However, because the market scale and profitability of load trucks are not as big as those of passenger cars, the state and auto enterprises pay much more attention to the latter, and ignored the development of the load truck.

After China's accession to WTO, the national passenger car industry will face more embarrassing situation, and will probably become a production center for transnational enterprises. But load truck production in China will be very competitive. The state must adopt relevant measures to redress the problems in the production field of load truck, increase its competitiveness, and open up the international market for load trucks in the low end. The detailed suggestions are as follows:

1) *To speed up enterprise reorganization* There are currently quite a number of enterprises producing load trucks, but only those produced by FAC, Dongfeng, Nanqi and a few others have a sufficient production scale. The scale of the remaining enterprises is all too small, and some enterprises have been impedimented in very difficulty situation. The state encourages the advantageous enterprises to merge the middle and small ones, and form 2 or 3 globally competitive enterprise groups in a short time, which can produce 200,000 load trucks.

2) *To build up the ability to innovate technology and equipment of the enterprises with good performance.* The major load truck enterprises in China have had

the ability to research and develop independently, but there is still a wide gap between China and the advanced international levels. We must adopt strong supportive measures to strengthen the ability of technological innovation and raise the technology level of our load truck in a short time. At present our load truck already has the advantage of price. Once the technology is reinforced, it will become very competitive.

3) *To speed the pace of opening up foreign market for load trucks.* Although our load truck has obvious advantages in price in international market especially in the low-class load truck market, the exported number is still very small due to inefficient work in opening to foreign market. From now on, we should work harder to open up more market, especially in Africa, Latin America, and part of Asia, and consolidate its position in international market.

5.3 To encourage the production of clean and fuel-efficient vehicles

Environmental protection has become an important standard for automotive industry in developed countries. It is necessary to raise the standard of environmental protection and encourage the production of clean and fuel-efficient automobiles to ensure the sustainable development for our automotive industry. The need for this is based on the following arguments.

1) From the perspective of energy

In recent years, international oil prices have registered a dramatic increase, and this trend will not change in the long run. Oil will be in short supply. China is a country with scanty oil, and has to import large amounts of crude oil and refined oil each year. Meanwhile, Chinese households will increasingly purchase passenger automobiles, and will consequently consume a large amount of energy. To develop fuel-efficient automobiles is a must.

2) From the prospective of environmental protection

Our country is facing serious pollution and the pollution in large and mid-sized cities is especially alarming. Some large and mid-sized cities are ranked the most polluted cities in the world. It is high time to handle this serious situation. Emission of cars is a main source of pollution. To develop clean cars is the most efficient means to control pollution.

3) From the perspective of stimulating demands and open up market

Fuel expenses are markedly increased because of the surging oil price and fuel tax reform. This is an important factor limiting the purchase of automobiles, especially private cars. Fuel-efficient automobiles will reduce the expenses of utilizing a car, opening up greater room for the development of automotive industry in China.

5.4 To develop speed transportation system and make people less dependent on automobiles

There is an inherent contradiction between automobiles and environmental protection and between automobiles and urban construction. It is impossible to inconvenience the daily transportation of people by restricting the use of automobiles for the sake of environmental protection. -The best solution would be to develop effective, clean, and fuel-efficient vehicles in place of automobiles. Urban speed transportation system is a good alternative and perhaps the best available one. Only a few large Chinese cities, like Beijing, Shanghai, Tiajin and Guangzhou, have subway transportation, and the total mileage is rather limited. The main problem that limits the construction of subway is funds. Take Beijing as an example. The cost for each kilometer of subway is over 500 million RMB. The sources of funding are none other than: (1) finding more sources; (2) saving expenses. Finding more sources means to find more channels of funding. To depend solely on financial input by the state is far from enough. Currently two sources of funding are worth of attention. One is social funds. We may learn from foreign countries to combine the construction of subway with the land utilization along the subway. By selling or letting the land we may raise some money. The other source is foreign capital. Preferential policies may attract and encourage foreign investors to contribute to the subway construction in China.

Saving expenses means to lower the construction cost. The cost of light track system is much lower than subway, but it occupies more land and produces greater noise. It is impractical to build light track in downtown areas. But with the expansion of cities, emphasis can be put on the light track construction in areas far from the city center, like the third ring and beyond in Beijing, which can greatly reduce the construction costs and speed up the construction of fast track system. This will efficiently reduce the use of automobiles and hence reduce pollution from automobiles.

5.5 To give rational adjustment of tax and expenses on automobiles and reduce the frequencies of car use

There has long been a dilemma in the development strategy for China's automotive industry. On the one hand, it was hoped that the automotive industry would give impetus to economic growth and would help to solve employment. On the other hand, out of consideration for environmental protection, transportation, and energy consumption, China does not want the car parc to increase too quickly. As a developing country, China is bound to lay more stress on economic growth and employment when making sustainable development strategy. China has published the Industrial Polices for the Automobile Industry and will be publishing the Automobile Consumption Policy, which means to encourage the development of automotive industry. But it has started to limit auto entry out of consideration for environmental protection and transportation.

One solution to this problem is "to encourage purchasing of cars while limiting its use", i.e., to reduce the price of cars and its fixed expenses (like purchasing tax and license fee), so that people can afford to buy cars. But at the same time, the expenses of using cars must be increased to reduce the frequencies of car use.

What calls attention here is that in implementing the policy, two conditions must be there: one is that the price of cars is low enough for people to afford, otherwise nobody will spend a large sum of money on a car just to lay it idle; another condition is that there must be a well-developed public transportation system at people's choice, otherwise the frequencies of car use will not be reduced.

5.6 To get engaged in study of sustainable development for automotive industry as soon as possible

Sustainable development has become a trend on which the developed countries have conducted in-depth research, and have passed laws and regulations of market accession. China's research has just begun and the depth and scope of research is at an elementary level. For the long-term development and short-term interest for automotive industry, we must strengthen the study of sustainable development for automotive industry.

5.7 To set up and complete the social service system centered on car use

China is a developing country and its top priorities are economic growth and employment. Automotive industry will certainly provide more opportunities for employment. This should not be limited only the manufacturing industry. The service sector centered on the different links of car use is labor-intensive, like car repairs and maintenance. The development of this sector is still at the early stage and has great market demands. Policies should try to encourage the rapid development of this sector, which will provide large number of employment opportunities.

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