INSTITUTO
UNIVERSITÁRIO
DE LISBOA

Impacts of Institutional Change on Industrial Economy: A China's automobile industry perspective

LI Gang

Doctor of Management

Supervisors:
PhD Nelson Antonio, Professor,
ISCTE University Institute of Lisbon

PhD XIAO Wen, Professor,
University of Electronic Science and Technology of China

May, 2020

BUSINESS
SCHOOL

Marketing, Operations and General Management Department

Impacts of Institutional Change on Industrial Economy: A China's automobile industry perspective

LI Gang

Doctor of Management

Supervisors:
PhD Nelson Antonio, Professor,
ISCTE University Institute of Lisbon

PhD XIAO Wen, Professor,
University of Electronic Science and Technology of China

May, 2020

BUSINESS
SCHOOL

Marketing, Operations and General Management Department

Impacts of Institutional Change on Industrial Economy: A China's automobile industry perspective

Li Gang

Doctor of Management

Jury:

PhD Maria João Major, Full Professor,
ISCTE University Institute of Lisbon
PhD Nelson Antonio, Professor,
ISCTE University Institute of Lisbon
PhD Fernando Ferreira, Associate Professor,
ISCTE University Institute of Lisbon
PhD Fernando Teixeira, Assistant Professor,
Instituto Politécnico de Beja
PhD FANG Jiaming, Professor,
University of Electronic Science and Technology of China
PhD WANG Guofeng, Associate Professor,
University of Electronic Science and Technology of China

May, 2020

Statement of honor

Submission of master's dissertation or project work or doctoral thesis

I the undersigned state on my honor that:

- The work submitted herewith is original and of my exclusive authorship and that I have indicated all the sources used.
- I give my permission for my work to be put through Safe Assign plagiarism detection tool.
- I am familiar with the ISCTE-IUL Student Disciplinary Regulations and the ISCTE-IUL Code of Academic Conduct.
- I am aware that plagiarism, self-plagiarism or copying constitutes an academic violation.

Full name Li Gang

Course Doctor of Management

Student number 74744

Email address Li_Gang@iscte-iul.pt

Personal email address li.gang@xcar.com.cn

Telephone number _____

ISCTE-IUL, 05/06/2020

Signed 

_____

Abstract

China's automobile industry is a perfect example of institutional change – it went through a series of development stages including the shaping-up of industrial system, rapid expansion, and competitiveness improvement, as the industry's policy system and the implementation effects improve. Our main studies and conclusions include: (1) Review and analysis of institutional change and the development of China's automobile industry. The continuous improvement of the policy system of China's automobile industry, as represented by the above-mentioned policies, as well as their implementation effects are the main drivers behind China's ever-improving independent R&D capability and global competitiveness. (2) Quantitative analysis of the characteristics of the impacts of institutional change on China's automobile industry. As the research shows, the growth process of China's automobile industry and its key influencing factors can be described with the Cobb-Douglas production function model containing institutional variables. The intensity of the impact of institutional change variables on the automobile industry changes significantly over time. (3) Case study on the impacts of institutional change on China's automobile industry. As shown in the study, the automobile industry policy plays a significant role in driving the development of Chinese automobile companies who should therefore take such opportunities to enhance technological innovation, resource integration and other abilities.

Keywords: Institutional change, Industrial economy, Automobile industry, Industrial policy, China

JEL: L16, O25

Resumo

A indústria automobilística da China é um exemplo perfeito de mudança institucional - passou por uma série de estágios de desenvolvimento, incluindo a formação do sistema industrial, a expansão rápida e a melhoria da competitividade, à medida que o sistema de políticas industriais e os efeitos da sua implementação melhoraram. Esta tese analisou as mudanças institucionais e o desenvolvimento da indústria automobilística chinesa. Em nossa opinião as mudanças institucionais que se consubstanciaram em políticas industriais para o setor automobilístico contribuíram para a crescente capacidade independente de pesquisa e desenvolvimento da indústria e da sua competitividade global. Procedemos também a uma análise quantitativa sobre as características do impacto das mudanças institucionais na indústria automobilística chinesa. Como mostra a nossa pesquisa, o processo de crescimento da indústria automobilística chinesa e seus principais fatores de influência podem ser descritos com o modelo de função de produção Cobb-Douglas, introduzindo variáveis institucionais. A intensidade do impacto das variáveis de mudança institucional na indústria automobilística muda significativamente ao longo do tempo. Procedemos também a um estudo de caso sobre os impactos das mudanças institucionais na indústria automobilística chinesa. Como mostra o estudo, as políticas industriais referentes à indústria automobilística desempenham um papel importante no desenvolvimento das empresas automobilísticas chinesas. As empresas devem estar atentas a estas políticas e aproveitar as oportunidades para aprimorar a inovação tecnológica, a integração de recursos e outras competências.

Palavras-chave: Mudança institucional, Economia industrial, Indústria automobilística, Política industrial, China

JEL: L16, O25

摘 要

中国汽车市场正处于市场需求潜力巨大的增长期，但汽车产业核心技术缺失等矛盾与问题仍然在未来一段时间内可能存在。因此，迫切需求深入推进制度层面改革，继续释放汽车产业的“制度红利”。在理论层面，制度变迁理论为分析世界和中国汽车产业发展问题提供了新途径，但相关领域研究仍然相对缺乏。鉴于此，本文系统研究制度变迁对中国汽车产业发展影响的规律与特征，识别中国汽车产业发展制度层面的差距与问题，并提出相应的对策建议。

我们的主要研究和结论包括：（1）制度变迁与中国汽车产业发展的回顾与分析。通过对三个阶段的代表性政策的背景、目标和效果等进行系统梳理与比较分析。研究结果表明，以三大政策为代表的中国汽车产业政策体系的不断完善、政策实施效果的不断提升，是中国汽车产业的自主研发能力和国际竞争力不断加强的重要驱动力。（2）制度变迁对中国汽车产业影响特征的计量分析。研究表明，中国汽车工业的增长过程及其主要影响因素可以用包含制度变量的 Cobb-Douglas 生产函数模型来描述。汽车产业变量对制度变迁变量的脉冲反应具有持续性。（3）制度变迁对中国汽车产业影响特征的案例分析。研究结果表明，汽车产业政策对中国汽车企业发展具有显著的促进作用。因此，汽车企业需要把握产业政策所带来的发展机遇，不断提升技术创新、资源整合等方面的发展能力。

本文着眼于中国汽车产业转型发展的实际需求，将探索学术前沿与服务于国家产业战略与政策制定相结合，研究成果既有助于强化制度经济与产业经济理论与方法的探索，又可以为决策部门与相关企业在世界和中国经济变化新形势下，正确把握国内外汽车产业发展趋势，提升政策制定的有效性与前瞻性提供科学参考。

关键词：制度变迁，工业经济，汽车工业，产业政策，中国

JEL: L16, O25

Acknowledgements

Time passed very slowly and quickly, from 2015 to now has been 5 years. Near graduation, there is a lot of memories and thanks in my mind. The doctor's study gave me a lot of new perspectives and new knowledge on thinking.

The moment I enrolled in this program in order to learn, I told myself to insist on and to finish it, and to work hard. From strange to stable to familiar, I gratefully acknowledge the help and company of teachers and friends during this time.

First of all, I want to express my greatest gratitude to Professor Nelson Antonio who is a warm-hearted gentleman with indifferent appearance He offered me a lot of valuable suggestions in my thesis, opened up my field of knowledge and taught me many new ways to think about problems. His kindness and openness were the biggest motivation for me to insist on my research.

Secondly, I want to send sincere thanks to Professor Xiao Wen. It was always inspirational and cheerful to have a discussion with her about thesis and research during these years. Thanks for her guidance and encouragement.

Thirdly, I want to show my sincerest gratitude to Professor Virginia Trígo. She has helped me through all the stages of the writing of this thesis.

Finally, I would like to thanks my family members who gave me much support during the process of this study. Without theirs support, I cannot complete my studies.

致 谢

时间飞逝，从 2015 年到现在已经有 5 年了。临近毕业，我的脑海里充满了回忆和感谢。博士的学习和研究带给了我很多新观点和新知识。

从注册博士项目开始学习的那一刻，我告诉自己要努力工作，并坚持去完成它。从一切陌生到渐渐稳定，再到慢慢熟悉，我在此感谢所有老师和朋友的帮助和陪伴。

首先，我要向纳尔逊·安东尼奥教授表示最大的感谢，他是一位严肃而又热情洋溢的绅士。他在论文的写作过程中为我提供了许多宝贵的建议，为我开辟了新的知识领域，并教会了我许多新的学习方法，和考虑问题的新视角。他的友善和开放是我坚持研究的最大动力。

其次，我要对肖文教授表示诚挚的感谢。这些年来与她讨论论文和课题研究总是很鼓舞人心，也很愉快。十分感谢她的指导和鼓励。

第三，我要对弗吉尼亚·特里戈教授表示最诚挚的感谢。在我完成本文写作的全程，她都给予了很大的帮助和支持。

最后，我要感谢我的家人。在博士论文研究过程中，他们给予我大力支持。没有他们的支持，我无法顺利完成学业。

Contents

List of Tables

List of Figures

Chapter 1: Introduction

This chapter mainly introduces the background, issues, goals, values, and the general framework of the research.

1.1 Background

As an important indicator of a country's industrialization level, economic strength and technological innovation capacity, automobile industry plays a critical role in global economy. The global automobile industry is growing steadily. Global automotive production has increased from 70.52 million units in 2008 to 90.78 million units in 2015, at a compound growth rate of 3.67%; total sales increased from 68.34 million units to 89.68 million units, at a compound growth rate of 3.96%. According to the World Bank, the compound annual growth rate of global GDP from 2008 to 2014 was 3.60%, meaning that both the growth rate of global car production and sales have surpassed the global GDP growth over the same period. With the expansion of demand on cars in emerging markets and the upgrade of manufacturing driven by the global revolution of intelligent manufacturing, the global automobile industry still has a promising future (Figure 1-1).

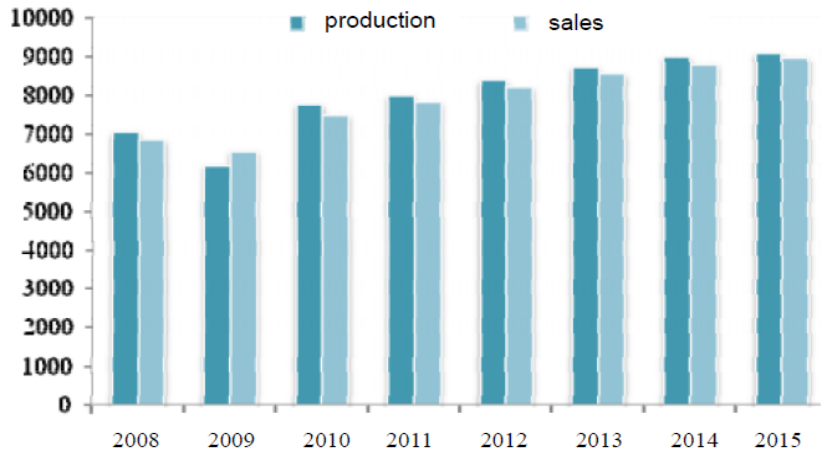


Figure 1-1 Global automobile production and sales 2008-2015

Source: www.chyxx.com

The global automobile industry is experiencing accelerated structural transformation, with the proportion of production from the four traditional strong players (U.S., Japan, Germany and France) gradually shrinking, while emerging markets represented by BRIC (Brazil, Russia, India and China) countries are taking over at a fast pace as shown in Table 1-1. In 2009, exceeding Japan in car production for the first time, China became the world's largest producer of automobiles. Emerging markets in China, Brazil and India has maintained fast growth. The center of global automobile production has shifted from developed countries such as the western countries to developing countries represented by China. With fast economic globalization, automobile market in developed countries is hitting saturation, and developing countries have become a major contributor to the fast growth of global automobile industry. This is due to the fact that developing countries are experiencing a fast growth in national economy and the upgrade of consumption structure. Across the global automobile industry, both international automobile giants and local OEMs are increasing investment in capacity of markets in developing countries, which will lead to the rise in the status of developing countries in the global automobile industry. According to PWC, the global automobile production will reach 108 million units in 2018, growing by 5.6% annually on average. Developing countries will become the main driver, contributing 83% of the growth in production, in which China contributes 40.4%, India 12.3%, Brazil 6.8% and Russia 4.5%. Traditional automobile giants such as U.S., Japan, Germany and France experienced significant fluctuation in the industry resulted from economic crisis. As economy slowly recovers, the overall development of automobile industry of these countries will become more stable. But in general, the center of global automobile industry will continue to shift to new emerging countries.

Table 1-1 Growth of automobile production in major countries 2014-2016 (million units)

Country	2016		2015		2014	
	Production	Growth rate	Production	Growth rate	Production	Growth rate
U.S.	12.2	0.80%	12.1	3.77%	11.66	5.40%
Japan	9.2	-8.80%	9.28	-5.02%	9.77	1.50%
Germany	6.06	0.50%	6.03	2.03%	5.91	3.30%
France	2.08	5.60%	1.97	8.24%	1.82	4.40%
China	28.12	14.50%	24.5	3.29%	23.72	7.26%
India	4.49	7.90%	4.13	7.55%	3.84	-1.50%
Brazil	2.16	-11.20%	2.43	-22.86%	3.15	-15.30%

Source: www.chyxx.com

Since the implementation of reform and opening-up policy, especially after 2000, China’s automobile industry has made remarkable progress. In 2009, China became the world's largest car producer and seller. From 2013 to 2016, China maintained its car sales exceeding 20 million units every year. From 2006 to 2016, China’s automobile production increased from 7,278,900 units to 28,188,800 units, and automobile sales from 7,328,000 to 28,802,800units, at average annual growth rate of 15.30% and 14.99% respectively. In the first half of 2017, China’s automobile production and sales continued to grow steadily, achieving automobile production and sales of 13.525 million and 13.335 million units respectively, up by 4.6% and 3.8% over the same period of the previous year. In recent years, as shown in Figure 1-2, the growth rate of China’s passenger car production and sales remains higher than the overall growth rate of the industry, acting as the main force driving the growth of the automotive industry. The level of economic development determines the level of private consumption of automobiles as well as the prospect of the market. In 2012, with GDP per capita reaching US$6,100, China entered a new stage of residential consumption upgrade represented by improved living conditions and automobile consumption. This led to a typical popularization period of cars. Thanks to the rise of private car consumption, China’s passenger car market has shown great vitality since 2001. The production of passenger cars has grown from 700,000 in 2001 to 19.92 million units in 2014, at a compound annual growth

of 29.33%.

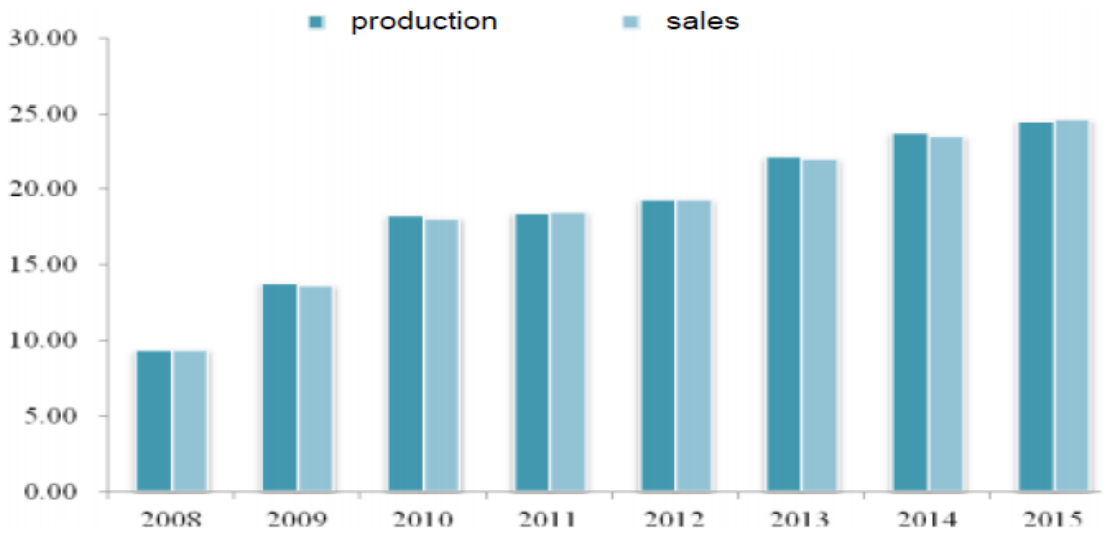


Figure 1-2 2008-2015 national car sales

Source: www.chyxx.com

The development of China's automobile industry went hand in hand with institutional change. The institution includes various policies, laws, rules and behavioral norms formulated by the government. Institutional change is a process of institutional innovation, which refers to the revolution of existing institutions aimed to give innovators additional and potential benefits. Industrial policy is a key approach of national macro-control. Policies of the automobile industry generally refer to laws, regulations and policy systems formulated by government sectors to support the development of the industry. Adjustment in automobile industry policies is an important indicator of institutional change in the industry. In different historical periods, China also made related policies of the industry. In general, evolution of the automobile industry policy can be divided into three stages.

Policy on Automotive Industry published in 1994 established the development course of encouraging joint venture to "exchange market for technology", contributing to the rapid development of automobile joint ventures in China. *Policy on Automotive Industry* made specific requirements in various areas of domestic industry development including policy goals, development priorities, industrial organization, industrial technology, investment and financing, consumption and prices, and utilization of foreign capital. The main goal of this

policy is to develop the automobile industry into a pillar industry of national economy as fast as possible. *Policy on Automotive Industry* kicked off the continuous improvement of China's auto industry policy system, followed by the introduction of related industrial policies and regulations.

Policy on Development of Automotive Industry published in 2004 proposed the strategy to develop large automobile groups and the exclusive sales model of automobile brands, which substantially promoted the competitiveness of China's automobile industry. In 2004, the National Development and Reform Commission issued the *Policy on Development of Automotive Industry.* Compared with the *Policy on Automotive Industry* published in 1994, new chapters were added in *Policy on Development of Automotive Industry* to address product development, trademark and brand, marketing network and access management, and provisions on investment management and import management were largely amended. *Policy on Automotive Industry* (1994) and *Policy on Development of Automotive Industry* (2004) are by far the most authoritative, long-lasting and influential automotive industry policies in China.

Since 2009, China has issued industrial policies and regulations such as *Plan on Adjusting and Revitalizing the Auto Industry* and *Notice on Adjusting the Structure of Automobile Industry*. According to the data released by the National Bureau of Statistics, the total mileage of highways in China increased from 3.73 million kilometers to 4.57 million kilometers, and the urbanization rate increased from 45.68% to 56.10% from 2008 to 2015. The introduction and implementation of policies and regulations, the development of supporting infrastructure and the growth of urbanization rate have effectively promoted the rapid development of China's automobile industry. The 2015 "Made in China 2025" strategic plan prioritized the transformation and development of China's automobile industry. The arrival of the Industry 4.0 era has brought new opportunities for the development of the global automotive industry.

China's automobile market is in a period of growth with strong potential in market demand. The production and sales of the automobile industry is steadily increasing, industrial structure is continuously improving, and the overall development is satisfying. Its influence

on national economy has been growing. At present, China's average car ownership is still lower than world average. According to National Bureau of Statistics, at the end of 2015, the domestic car parc per 1,000 people was only 118.4 units. The continuous improvement of transportation infrastructure, the growing potential in purchasing power and the relatively low penetration rate are the driving forces of the rapid development in China's automobile industry. Meanwhile, as domestic macro economy slows down, the growth rate of China's automobile production and sales has slackened significantly since 2014. Affected by contributing factors such as the preferential purchase tax policy, the growth rate of China's automobile production and sales rebounded in 2016. However, conflicts and issues such as the lack of core technology, severe imbalance in industrial operations, failure of exerting scale effects, and challenges in establishing brands are unlikely to be resolved soon. Therefore, it is urgent to deepen reform on institutional level and explore the "institutional benefits" to support the sustainable and healthy development of China's automobile industry.

1.2 Research problem

Our research problem: the development of China's automobile industry is closely connected to institutional change. Since Reform and Opening-up, China has released several typical and comprehensive industrial policies such as *Policy on Automobile Industry* with the purpose of developing this industry as a pillar of national economy. As the industry's policy system and implementation effects improve, China's auto industry has also gone through a series of development stages including the shaping-up of industrial system, rapid expansion, and competitiveness improvement, making China one of the top countries in terms of automotive manufacturing and sales. To address new economic challenges in China and the world, it's imperative to explore the mechanism of how institutional change impacts China's automobile industry so as to support the industry better.

Research questions：

RQ1: Which landmark industrial policies were developed during the institutional change of China's automobile industry? How effective were they?

RQ2: How to describe the growth of China’s automobile industry in the context of institutional change? What characteristics can we draw from the mechanism of institutional change?

RQ3: How did Chinese auto companies develop in the context of institutional change? What implications did they provide?

1.3 Purposes and values of research

The research is conducted to find out the rules and characteristics of the impact of institutional change on the development of China's automotive industry, identify the gaps and problems in the system level of China's automotive industry, and put forward solutions and suggestions. The research results can provide scientific references for decision-making departments and relevant companies to get a correct understanding of industrial trends home and abroad while improving the effectiveness and proactivity of policy making under new economic circumstances of China and the world.

This research focuses on the practical needs for the transformation and development of China's automotive industry, combining academic explorations with practical implications for national industrial strategy and policy formulation. The research results are not only conducive to the exploration of theories and methods of institutional economy and industrial economy, but also have great significance for policy making.

In terms of research concept and design, this research studied the development of automotive industry from the perspective of institutional change, which is quite different from previous studies on automotive industry. It adopts a systematic approach, which combines theories, empirical evidence and cases, to study the mechanism, effects and factors of institutional change on industrial development, and it also emphasizes the applicability of the research logic, quantitative model and typical case analysis in the "Chinese context".

The research includes effect evaluation of China’s automotive industry policies, the building and application of production function model of automotive industry with system-related variables, and case analysis from multiple dimensions. Combining the

practices of China’s automotive industry and Institutional Economic theory with case analysis method, econometric method and other research methods, this research aims to provide new approaches and evidence for analyzing the system innovation and competitiveness improvement of China's automotive industry, and to provide new reference for promoting the development of China's automotive industry driven by system innovation.

1.4 Research framework

The structure of this thesis:

Chapter 1 is an introduction which summarizes the research background, research questions, research objectives and significance, as well as the overall framework of the research.

Chapter 2 systematically reviews the development of theories and empirical studies on Institutional Change Theory, industrial economy and industrial development theory, institutional change and China's economic reform, as well as the development of China's automotive industry and other aspects, and points out the development direction and main problems of related research in the field.

Chapter 3 introduces the research methods and applications, data collection and processing, and technical route.

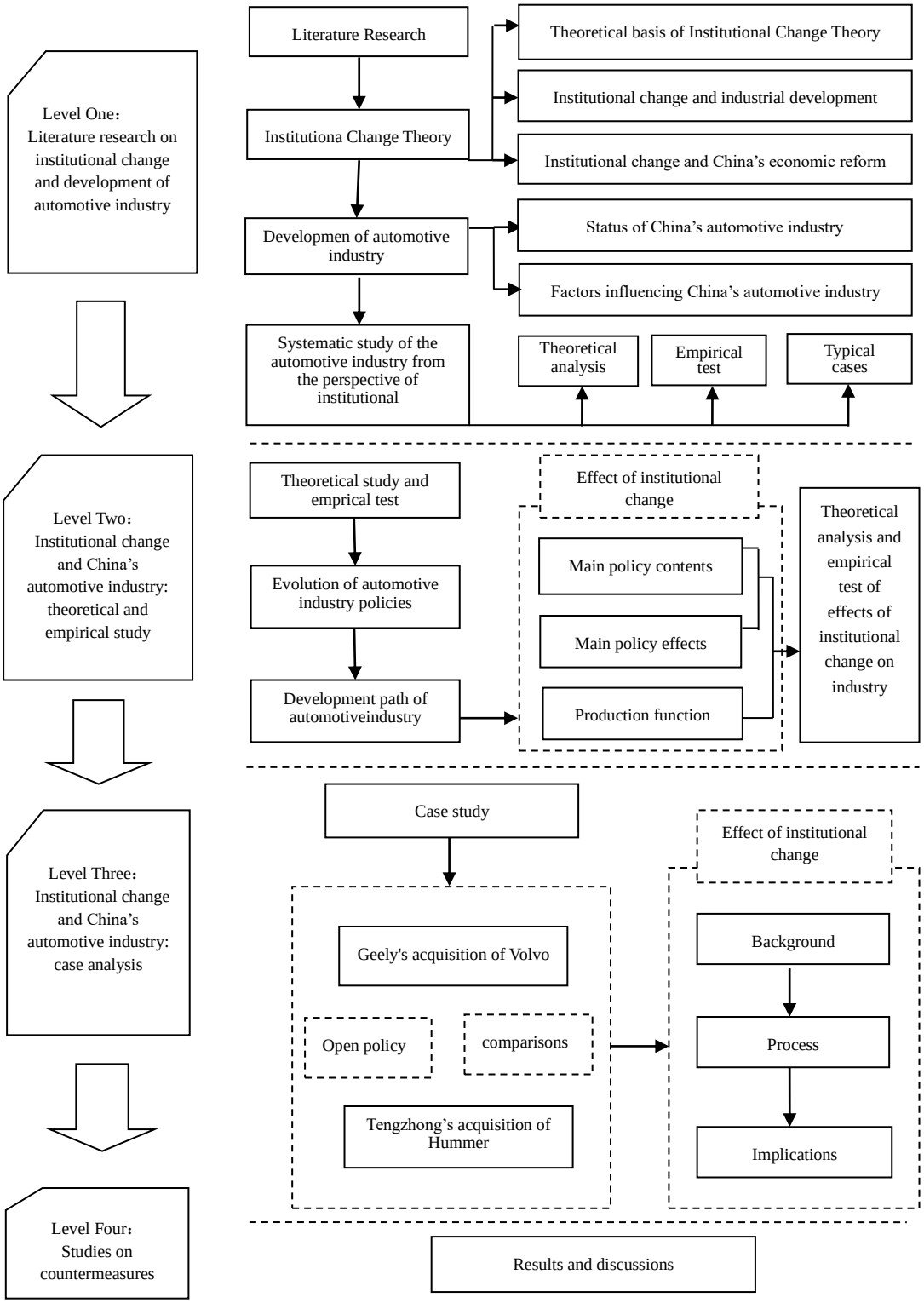
Chapter 4 reviews and analyzes the three stages of the evolution of China's automotive industry policies, and compares and analyzes the background, objectives and effects of the representative policies in the three stages such as Policy on Automotive Industry, Policy on Development of Automotive Industry and Plan on Adjusting and Revitalizing the Auto Industry.

Chapter 5 conducts an empirical analysis of the impact of institutional change on China's automotive industry based on the framework of production function model, using the co-integration method, vector error correction model, state space model and other econometric methods.

Chapter 6 analyzes the situation of and implications for China’s automotive enterprises

in the process of institutional change from the micro level, by combining a case study of Geely, Tengzhong and other typical companies.

Chapter 7 is a summary of research conclusions, implications for management, as well as limitations and prospects of the research.


Level One：
Literature research on institutional change and development of automotive industry
Literature Research
Theoretical basis of Institutional Change Theory
Institutional change and industrial development
Institutiona Change Theory
Institutional change and China’s economic reform
Developmen of automotive industry
Status of China’s automotive industry
Factors influencing China’s automotive industry
Systematic study of the automotive industry from the perspective of institutional
Theoretical analysis
Empirical test
Typical cases
Level Two：
Institutional change and China’s automotive industry: theoretical and empirical study
Theoretical study and emprical test
Effect of institutional change
Evolution of automotive industry policies
Main policy contents
Main policy effects
Development path of automotiveindustry
Production function
Theoretical analysis and empirical test of effects of institutional change on industry
Level Three：
Institutional change and China’s automotive industry: case analysis
Case study
Effect of institutional change
Geely's acquisition of Volvo
Background
Open policy
comparisons
Process
Tengzhong’s acquisition of Hummer
Implications
Level Four：
Studies on countermeasures
Results and discussions

Chapter 2: Literature Review

This chapter is the literature review of the study, an overview of theories on institutional change, industrial economy and industrial development, institutional change and China's economic reform, as well as the theoretical and empirical research on areas such as the development of China's automobile industry. The development trends and main issues of study on related fields are also clarified in this chapter.

2.1 Theory of institutional change

2.1.1 Definition of basic concepts

(1) Institution

Institutional economists have made systematic analysis and definition of the concept "institution". Nobel Prize winner in economic sciences Ronald H. Coase proposed the famous "Coase Theorem". In 1937 and 1960, he published two theses: *The Nature of the Firm* and *The Problem of Social Cost*. His argument in these two theses was named "Coase Theorem", which is the basis of property-rights economics with the main viewpoint established around transaction cost. According to Coase (1937, 1960, 1974, 2014), institution is a set of rules based on which property rights are arranged and adjusted.

North and Thomas (1970) made the most systematic analysis and definition on the concept "institution". North and Thomas (1973) defined institution as a series of rules devised by human to constrain the interests from utility maximization of economic entities. North (1990, 1994) suggested that institutions "are the rules of the game in a society", "the humanly devised constraints that shape human interaction". Institutions are the rules of the game in a society and the players of the game are organizations. Institutions are made up of informal constraints, formal rules and their implementation characteristics (North, 1994) . Other scholars also explained the characteristics of "institution" from different perspectives. For

example, Schultz (1968) supposed that institution is a behavioral rule closely related to social, political and economic behaviors, stressing that the main function of institutions is to serve the economy; According to Ruttan (1978) and Ruttan and Hayami (1984), institutions are the dominance over specific behavioral models and their interrelations, and are formulated by the coordination in social relations during social interactions-.

(2) Transaction cost

Coase (1937) proposed the concept of "transaction cost" for the first time, and elaborated on the existence, nature, scale and boundary of firms with this concept, establishing the modern Theory of the Firm. Coase (1960) explained external issues with transaction cost and property right, leading to the well-recognized "Coase Theorem" . The essence of Coase Theorem is the discovery of the relationship between transaction cost and property right arrangement, putting forward the influence of transaction cost on institutional arrangement. This provides people with an effective approach of decision-making in property right arrangements. According to the transaction cost theory, there is cost for the operation of market institutions, the use of institutions, the arrangement, and changes in the arrangement of institutions. Transaction cost affects the formulation and transformation of any institutional arrangement.

Following Coase, economists like Williamson further developed and improved the theory of transaction cost. Williamson (1975) divides transaction cost into costs generated before and after the trade. In his opinion, due to the uncertainties of the future, the rights, responsibilities and obligations of each side of the trade need to be stipulated in advance, and costs and prices will be generated in the process of clarifying these rights, responsibilities and obligations. These costs and prices are related to the transparency of the property right structure of each side; post-trade transaction cost refers to cost generated after the trade.

Williamson (1979) analyzed factors influencing transaction costs. According to him, factors influencing transaction costs mainly include environmental uncertainties, small number condition, opportunism in organizations or among people, as well as information asymmetry. These factors make up the conversion relation between the market and firms.

The Mechanism of Governance by Williamson (1996) covered all the research results of

Williamson from 1983 to 1996 on governance under the framework of transaction cost economics. In this book, Williamson constructed main cases and explained the effect of governance institution on mitigating risks through economics, law and histology, from a cross-disciplinary perspective. The concept of "main case" is a key contribution of Williamson to transaction economics in this book. The core of this concept to saving transaction cost.

In *Institutions and economic theory: The contribution of the new institutional economics*, Furubotn and Richter (1997) took new institutional economics as a mixture of transaction cost economics, property right analysis and contract theory, and discussed related explanations on these fields. Furubotn and Richter (1997) suppose that two sides of a trade need to find suitable subjects for each other. Activities such as communication and information exchange will result in transaction cost, which can be divided into fixed cost and variable cost, the latter related to volume.

(3) Property rights

Modern property rights theory is a branch of new institution economics. In reality, market economy is always faced with "external issues" and it has flaws in its mechanism. Modern property rights theory holds the opinion that externalities arise because private costs and social costs are not equal, that is, social costs are greater than private costs, leading to the loss or inefficiency of social welfare. Therefore, in the operation of a market, property right definition and proper allocation take up an important role.

In "The Problem of Social Cost", Coase (1960) systematically discussed the economic effect of property right, analyzed its functions and pay special attention to the key role of property right structure to social cost reduction, overcoming externality and other market failures. In this way, property right institution becomes a necessary condition to guarantee the effectiveness of resource allocation.

In the evolution of property rights theory, Cheung (1975) first raised the two major propositions of property rights control: when the income claim right of one party to the contract is completely or partially deprived, unless the right is fully granted to another person, the transferred income will tend to dissipate; second, due to the existence of given

non-proprietary income and its dissipation trend, all parties involved will strive to minimize the dissipation of rents under constraint conditions. Moss and Demsetz (1989) made a formal definition on the core scope of property rights control: When property rights are regulated and cannot be bought out, emphasis should be placed on non-price competition rather than price mechanism. Barzel (1989) supposed that if property rights are regulated, people will use various alternative ways to adjust their own behavior and protect their own interests. Eggertsson, Eggertsson and Eggertsson (1990) held the view that regulating people's ability to exercise the specific rights of property rights will change the pattern of product distribution and wealth distribution behind it. Barzel (1997) pointed out in *Economic Analysis of Property Rights* that property rights are personal rights to assets. It consists of the income of consuming these assets or gained from these assets, and the right or power to transfer the assets. Property rights is not absolute, but can be changed through personal actions.

(4) Institutional Entrepreneur

Throughout history and from incidental observations, it is acknowledged that thinking and leadership are the two most important forces driving institutional change (Zhang, 2015). In Zhang's (2015) opinion, the theoretical point of view in traditional economics that "institutional change is simulated as a game of interest between different groups" has its limitations. In order to fully understand an institutional revolution, two factors have to be taken into consideration: thinking on the direction of institutional change and the leadership of the institution where change happens.

In the field of institutional economics, entrepreneurs are seen as a key role driving institutional change. Actually, the understanding of institutional entrepreneurs can date back to North and Thomas (1970), who regarded businessmen and entrepreneurs as promoters of institutional innovation pursuing self-interests. Institutional economists also started to focus on the role of agents who pursue self-interests in driving institutional change (Coase, 1974). Eisenstadt (1980) introduced "institutional entrepreneur" as the role contributing to resource revolution, institution establishment and interest agents, thus expanding the fields of research in institutional theory. Institutional economists also introduced different terms, such as "institutional entrepreneur" and "property rights entrepreneur", to conceptualize agents who

start institutional change for personal interests in the pursuit of economic interests (Anderson & Hill, 2002).

In recent literature, Anderson and Hill (2002) used the term "institutional entrepreneur" to describe those who seek to establish and restructure property rights and other institutional structures to take advantage of economic opportunities. They believe that traditional entrepreneurs are those who produce new products by adopting new methods, while institutional entrepreneurs should design new institutional arrangements and influence institutional changes to obtain economic value.

2.1.2 Institutional change and institutional innovation

(1) Environment and condition of institutional change

Institutional Change Theory brings institutional factors into the theoretical framework of economic growth. *The Rise of Western World,* the *economic* history book published by North and Thomas (1973), changed previous practice of exploring reasons for economic growth from technological innovations and pioneered the use of institutional change to explain economic growth. Institutional change determines the way of social evolution in human history and is the key to understand historical change. The so-called "institutional change" refers to the innovation of the new institutional arrangement, or the change or replacement of the existing institutional arrangement.

North and Thomas (1970) first tried to introduce the perspective of dynamic analysis into the study of institutional change and the theoretical framework transformed from static state to dynamic state, providing a new opportunity for the development of the Institutional Change Theory (Huang, 2008). North (1990) revised the framework of Institutional Change Theory for the first time, subdividing the system into three aspects: formal rules, informal constraints and implementation characteristics. North (1994) revised the framework of Institutional Change Theory for the second time, explaining initially the indirect impact of informal constraints on economic individuals to revise institutions through influencing their ideology (Stone, Levy, & Paredes, 1992). The role of informal constraints is increasingly valued. Informal constraints form the basis of a large number of formal organizations, and affect

fundamentally political and economic life (Knight, 2009). Scholars from various countries including Lin (1989), Sun (2006) and Harmon, Green and Goodnight (2015) have further studied informal constraints from the perspectives of ideology, values and rhetoric.

The purpose of institutional change is to save transaction costs relatively, that is, to reduce institutional costs and improve institutional benefits. Therefore, institutional change can be understood as the substitution of one system with higher returns for another system with lower returns. Therefore, the reasons for institutional change include three aspects: The first is the effectiveness of the organization. In the environment of scarcity economy and competition, the continuous interaction between institutions and organizations is the key to institutional change. The second is the adaptive efficiency. According to the Institutional Change Theory, the effectiveness of system must provide adaptive efficiency for organizations. The third is the system defect. The so-called system defect refers to the deficiency caused by the imperfect system and institutional structure itself. According to Coase's Institutional Economics, the change of relative price and preference is the external condition of institutional change. Since the change of relative price will change people's incentive mode, and the change of people's preference will change contract structure, all of which may lead to the institutional change.

(2) Driving force of institutional change

Coase (2014) pointed out that there are two main forces driving institutional change, namely "the first action group" and "the second action group", both of which are decision-making bodies. The general process of institutional change can be divided into the following five steps：

1) Form the first action group to promote institutional change, that is, the group plays a major role in institutional change;

2) Put forward the main scheme of institutional change;

3) Evaluate and select the scheme according to the principle of institutional change;

4) Form the second action group to promote institutional change, or the group that plays a secondary role;

5) The two groups work together to achieve institutional change.

According to the different economic entities who act as the first action group, institutional change can be divided into "bottom-up" institutional change and "top-down" institutional change. The so-called "bottom-up" institutional change refers to the institutional change initiated, organized and realized spontaneously by individuals or a group of people who are lured by the profit of the new system, which is also known as induced institutional change. The so-called "top-down" institutional change refers to the institutional change introduced and implemented by the government as the first action group in the form of government orders and laws, which is also called mandatory institutional change.

(3) Supply, demand and cost of institutional innovation

Coase (1960) pointed out in *Property Rights and Institutional Change* that the system can be regarded as a public good, produced by individuals or organizations, which is the supply of the system. Due to the limited rationality of people and the scarcity of resources, the supply of system is limited and scarce. With the change of the external environment or the improvement of their own rationality, people will constantly put forward the demand for new system to achieve the expected increase in revenue. When the supply and demand of the system are basically balanced, the system is stable; when the existing system cannot meet people's needs, institutional change will occur. The ratio of cost to benefit of institutional change plays a key role in promoting or postponing institutional change. Only when the expected benefit is greater than the expected cost, will the behavior subject push the institutional change until it is finally realized, and vice versa.

Coase (1960) pointed out in *The Problem of Social Cost* that people only pursue behaviors that lead to greater gains than losses. However, under the premise of improving decision-making, when selecting from various social patterns, we must remember that changes in the existing institution that will lead to improvements in some decisions will also lead to the ineffectiveness of others. Moreover, we must consider the operating costs of various social patterns, whether market or government, and the costs of switching to a new system.

According to North (1994), the reason why the economic system changes is that

individuals or groups in the society expect to obtain the maximum "potential profits", that is, innovators believe that they can obtain some profits that are impossible under the old system arrangement. According to North (2013), whether institutional change can take place depends largely on the cost of institutional change in addition to the expected benefits of it. Only when the expected benefit of institutional change is greater than the cost, the original institutional equilibrium will be broken and institutional change may occur. Yin (2003) found through the constructing of the Classical Game Model that the supply shortage of current system became the starting point of system innovation, and the decision makers of the organization actually dominated the process and direction of system innovation.

There is no innovation in a zero-profit economy (Wang, 1992). Economies in cycles turn behavior into habits, and habits are the least costly institutional arrangements, unless there is uncertainty. When uncertainty arises, innovation becomes necessary, and profit is at least the result of innovation at god's first push. There are obvious similarities between institutional evolution and technological progress (Wang, 1995). In Schumpeter's Theory of Innovation, "implementing new combinations" or "using existing labor and land services in different ways" is the innovation process. When the link between profit and innovation becomes the information shared by the society, profit is no longer just the possible result of innovation, but becomes the incentive of innovation. This is the traditional theory of institutional innovation, which is a general process of social evolution (Yin, 2003).

2.1.3 Types of institutional change

(1) Induced institutional change

In reality, when the efforts to change the status quo get a breakthrough, such efforts will spread within the organization, and slowly form a mechanism that triggers institutional change (Smets, Morris, & Greenwood, 2012). Individuals in small groups achieve little with their efforts to expand new knowledge or build new capabilities (Edwards & Molz, 2014), but the collection of innovation efforts made by countless small groups in the society ultimately drives the process of institutional change. Lin (1989) called this process Induced Change, refering to the change or replacement of the existing system and the formulation of the new

system are prompted by the efforts of individuals or groups of individuals to improve the current situation. Induced Change is a bottom-up mechanism based on spontaneous efforts of individual. However, it takes a long time to integrate the efforts of different individuals, making the supplied system hard to meet the society's needs for system innovation.

(2) Imposed institutional change

In terms of system supply, the introduction of transitional policies can provide adaptive efficiency for the social system and solution to the short-term lack of motivation for reform caused by insufficient system supply (Zhou, 2014). Lin (1989) called such supplementary system supply through state intervention as Imposed Change, referring to the introduction and implementation of the new system by the government by mandatory means such as command or law. Although the adaptive adjustment of the market to the policy can mitigate the negative effects of the policy (Cheung, 1975), the achievements of Imposed Change cannot sustain for long due to the lack of cognition by each individual in the society and the potential impact of informal constraints.

2.2 Industrial economics and industrial development theory

2.2.1 Industrial economics

Generally speaking, "Industrial Economics" refers to people's understanding, views, ideological and policy propositions of industrial development issues and resulting industrial economic theories. Systematic industrial economy theory is the core of the entire industrial economics.

Japanese scholar Kenichi Miyazawa believes that industrial economics is the sum of industrial organization theory, industrial correlation theory and industrial structure theory. Industrial organization theory studies the patterns of interaction between enterprises within the industry. Industrial correlation theory studies the patterns of technological and economic relations between industries which are connected by various inputs and outputs. Industrial structure theory studies the quantitative relation & structure and technological economy relation between industries. “Industrial organization is an economic discipline that helps

explain why markets are organized in the way they are and how they affect the way they work," said Clarkson and Miller. There are also opinions that the industrial economics theory is a broad theory in microeconomics that focuses on enterprise behavior, the close relationship between enterprise behavior and market structure and market evolution, as well as relevant public policies (Dong, 2005).

The mainstream viewpoints of Chinese scholars come from two perspectives. First, industrial economics reveals the economic patters specific to the industry such as development and change of the industry, the interaction between enterprises within an industry, and the interconnections between industries from an industrial perspective. Second, as a derivative of microeconomics, the theory of industrial organization analyzes the relationship between manufacturers, the market and their mutual relationship with microeconomic theories. It is an emerging branch of applied economics that studies the structure and behavior of enterprises, market structure and organization, and the interaction and influence between market and enterprises (Dong, 2005).

Generally speaking, European and U.S. economists think the industrial economics theory is the same thing as the industrial organization theory, both of which study the economic patterns of the interaction between enterprises in the industry. Chinese and Japanese economists believe that industrial economic theory includes not only the theory of industrial organization, but also the theory of industrial correlation, the theory of industrial structure, the theory of industrial layout and industrial policy. At present, there is a consensus in international academic circles that industrial economy theory (industrial organization theory) originated in the United States in the 1930s with a history of more than 70 years as a theoretical system. It was not until 1996 that China listed "industrial economics" as a second-level discipline under the first-level discipline of "applied economics" in the category of "economics" to be in line with international conventions (Dai, 2006).

Schools of industrial economics and representatives:

(1) Harvard School

After 1930s, the modern industrial economics system was formed with Harvard University as the center and Mason and Bain as the main representatives, also called Harvard School. The

main contribution of the Harvard School is to establish a complete theoretical paradigm of SCP. The initial form of SCP paradigm is Bain's (1956) syllogism paradigm of market structure and market performance. The formation of SCP paradigm marked the initial maturity of industrial economics system, and industrial organization theory became a relatively independent economic discipline. Harvard School thinks that the focus of analyzing industrial organization is market structure, and the criterion of the improvement of market relative efficiency is the number of enterprises in the market, so the theory of Harvard School is also called "structuralist" theory. At the policy level, Harvard School thinks that promoting and maintaining the market structure of effective competition should be the foothold of industrial organization policy. Monopoly and oligopoly in the market need to be regulated, and anti-monopoly policy needs to be advocated.

(2) Chicago School

After the 1960s, economists at the University of Chicago including Stigler, Demsetz and Posner harshly criticized the SCP analytical paradigm and established the so-called Chicago School, which was also called “efficientist” by the theoretical circle for paying attention to the relationship between market structure and efficiency. The publication of Stigler's Industrial Organization in 1966 marked the maturity of the Chicago School. Different from Harvard School, Chicago school does not think that monopoly power is the core factor of enterprise scale expansion. Chicago school thinks that the high efficiency factor of enterprises in the industry is likely to promote the industry to have a high profit margin, and a market structure with a large scale of enterprises and a highly concentrated market. At the policy level, the Chicago school should adopt policies such as segmentation and merger to deal with large-scale enterprises with excessive concentration, and the focus of antitrust policy is to intervene in the behavior of enterprises.

(3) New Austrian School of Economics

New Austrian School of Economics is an industrial economics school that emerged in America and Britain in the 1970s and 1980s.The theory of this school developed towards two directions. The first was "new institutional economics", also known as "post-SCP school". Scholars including Coase, North, Williamson and Alchian introduced the theory of transaction

cost, completely changing the traditional method of examining enterprises only from the perspective of technology and examining the market only from monopoly and competition, which provided a new theoretical angle for the study of enterprise behavior. The second was the "new industrial organization" which was an extension of the SCP paradigm. Around the 1980s, economists represented by Taylor and Cripps reformed the theoretical system of industrial organization with the analysis method of game theory, and gradually formed the theoretical system of "new industrial organization".

The new Austrian School of economics is different from Harvard School and Chicago School in basic theory. According to the basic axiom of "human behavior is a reasonable behavior to achieve its purpose", the new Austrian School of economics believes that it is necessary to analyze economic phenomena with the theory and method of human behavior science. Personal utility and behavior, non-linear causal transfer of price are the main research issues. At the policy level, the Neo Austrian School of economics advocates laissez faire policy and opposes structuralist policies such as enterprise division and merger prohibition.

2.2.2 Institutional change, industrial policy and industrial development

Nelson (2002) combined evolutionary economics with new institutional economics and proposed that institution should be regarded as a "social technology" and be included into the industrial evolution model as an endogenous variable. System is not only an incentive or constraint mechanism related to economic interests, but also an endogenous technological variable that plays a role in the process of economic growth and industrial evolution (Nelson, 2002). Institutional innovation should be understood as the innovation that achieves the reform and sustainable development of the economic system by establishing a new and more effective standard system of behavioral incentive or constraint (Li & Lv, 2011).

Industrial development is the process of generation, growth and evolution of an industry. The evolutionary process includes not only the quantitative changes in the number of enterprises, product or service output, but also the changes in quality such as the adjustment, change, replacement and dominance of the industry structure. The evolution also takes place around the core of structural changes and develops towards structural optimization (Dong,

2005). Industrial policy is the sum of all policies that a government has made to intervene industrial development in order to achieve certain economic and social goals, namely, to promote the development of domestic industries and economic growth (Dong, 2005) With the development of economy, industrial policy will play an increasingly big role by extending its intervention coverage and have a stronger voice in worldwide economy.

Policies on the development of industrial system and environment as well as industrial governance are an important embodiment of industrial transition and an important way to propel industrial development. For example, Paraskevopoulou (2011) proposed that it was not a one-way relationship between industrial regulation policy and industrial development, but rather they influenced each other, which made institutional innovation register characteristics of dynamic evolution, and such evolution process is similar to that of technological innovation. Ruan, Shi, and Zhang (2014) believed that in the process of industrial upgrading, whether local governments can provide appropriate public goods is a decisive factor for an industry to maintain its competitiveness. Range and Sandberg (2016) believed that the Swedish government promoted the development of Swedish economy and the upgrading of industrial structure by introducing policies to encourage active ecological innovation among enterprises. At the same time, institutional innovation on micro level can also promote industrial development. For example, Te, Song, and Xu (2015) believed that many Chinese enterprises did not value the property right system, which led to lack of IP protection for their innovation achievements and the resulting economic losses . Yildizoglu (2002) used the simplified V-W model to reveal the driving effect of enterprise innovation strategy in the process of industrial evolution based on the change of industrial performance and enterprise competitive advantage . Li (2009), Lu and Li (2011) and Xiang, Yu and Chi (2012) thought that the innovation of entrepreneur system could improve the efficiency of enterprise operation and management by adjusting the internal property right system and function management system.

2.3 Institutional change and China’s economic reform

After the Third Plenary Session of the 11th Central Committee of the Chinese Communist Party, China has gone through four major economic reforms: the stage opened by rural economic reform (1978-1984), the stage of an overall economic institutional reform with a focus on urban areas (1984-1992), the initial stage of the establishment of socialist market economy (1992-2002), and the refinement stage of socialist market economy (Liu, 2008).

In nature, China’s reform and opening up and the process of economic institutional reform is a process of institutional innovation and institutional structural change. The government progressively loses its administrative intervention, gradually enhancing the role of market mechanism (Li & Deng, 2013) . According to scholars like Yang (1993, 1998, 2000) and Wang et al. (2005) , a reform approach combining multiple methods that is conducted gradually is beneficial to cost reduction. Scholars like Yang (1993, 1998, 2000) and Wang et al (2005) supposed that the co-existence of multiple reform approaches and a gradual reform can reduce the cost. The rate of non-state-owned economy, market allocation and the level of opening up are the main dimensions evaluating the process of China’s institutional change (Liu, 2008; Wang, Zou, & Shi 2013).

From the perspective of institutional economy, China's market-oriented economic reform is a process of systematic and huge institutional change. In the early 1990s, new institutional economics prevailed in China. The academia explained the model of China’s economic growth with the theory of institutional change, approving that “a reform is an institutional transformation” (Miao, 1992; Hong, 1996). The academia reached consensus on the influence of institutional change on economic growth, which is that the two sides can promote each other (Xiao, 2017). China’s institutional transformation can significantly promote economic growth, and the effect will gradually increase (Li & Chen, 2015).

From the perspective of property right institutional change, transaction fee and power allocation between the government and the market, scholars like Hong (2002) and Pan and Yang (2006) systematically discussed the role of institutional change in promoting capital, labor and technology productivity in China’s “economic miracle”. In emprical studies,

according to the quantatitive calculation by Lu and Hu (1993) , Wang (2011) , China's institutional changes had great contribution to its economic growth; Lin (2013) , Li and Wei (2015) depicted the nonlinear effect of the quality of China's economic growth. Therefore, to sustain economic growth, it is necessary to maintain the impetus for reform and carry out steady and regularized institutional changes (Wang, Zou, & Shi, 2013).

2.4 Studies on China's automotive industry

To evaluate the development of China's automotive industry, Qiu and Li (2004) constructed an evaluation index system considering 7 aspects, including status of the industry, trade competitiveness index, market share, economies of scale, market concentration, technological level, domestic market capacity; Wang, Huang and Shi (2005) developed a multi-level evaluation index system, and adopted methods of comprehensive index and single index evaluation for quantitative research; Wang, Zou, and Shi (2013) assessed the international competitiveness of China's automotive industry using indicators such as revealed comparative advantage, competitive advantage index and market share. Yang (2010) established a comprehensive competitiveness index system based on technology innovative power, enterprise scale, profitability, operation capacity and development ability.

In terms of the decisive factors affecting the development of the automotive industry, Rui (2006) conducted studies based on Michael Porter Diamond Model, holding the view that factors like knowledge assimilation, innovative power, and engagement to the international labor division have great impact on the development of China's automotive industry; based on the studies of consumption theory and economic growth theory. Dong (2005) concluded that the development of the automotive industry is affected by factors such as economic policy, international environment, and consumer income. Wang and Zhang (2008) suppose that the competitiveness of automotive industry is affected by the subject and the object. Li (2010) believe that the competitiveness of the automotive industry consists of three factors, brand competitiveness asset, brand environment and brand competitiveness. Meanwhile, Ma and Zhu (2002), Wu (2006), and Wu and Guo (2007) conducted empirical studies on factors affecting the development of the automotive industry, applying the methods of

trans-department cross-section analysis, vector autoregression model, and unrestricted error correction model respectively. Gu and Wang (2019) combined relevant research results to build a Cobb Douglas production function Poter Dunning model of the automobile industry, and found that the degree of vertical specialization and R & D investment have a positive impact on the international competitiveness of the automobile industry, while the labor cost and foreign direct investment have a negative impact.

Institutional factors are important factors affecting the development of China's automobile industry (Yang, 2005). Sheng (1998) argued that the industrial policies at that time promoted the development of the automobile industry at the expense of consumers' interests, among which parts manufacturers were the main beneficiaries under the domestic requirements and trade protection policies. Gao (2017) believed that China's automobile industry management system has gone through the evolution from "industrial trust", "three-level management system" to "separation of government and enterprise", and the gap between the specific goal and the actual development of the government management system can be used as a standard to measure the performance of the automobile industry management system. Zhao and Hua (2001) hold that the failure of China's automobile industry regulation is due to the limited authority of regulatory subjects and industry authorities, and the strong preference of local governments as regulatory objects. Dong (2008) believed that industrial policies were ineffective on the whole by analyzing the automobile industrial structure, industrial organization and industrial technology. Through the comparison between China and India, Shen (2017) believed that the main reason for the failure of exchanging market for technology in China's automobile industry lies in the failure of automobile industry policies. Liu, Luan and Wang (2019) believe that the ups and downs of the automobile industry in the 70 years since the founding of new China are closely related to the automobile industry policies. The evolution of automobile industry policies can be divided into four periods: the initial period of 30 years before the founding of new China, the preliminary establishment of China's automobile industry foundation; the exploration period of the 1980s, the automobile industry policies focus on promoting and regulating the rapid development of the industry; From the 1990s to the period of policy introduction before and after China's accession to the

WTO, the systematic policies represented by the two versions of automobile industry policies promote the technological progress and rapid development of the automobile industry; in the transition period since the international financial crisis in 2008, new energy vehicles and intelligent Internet connected vehicles have become the focus of industrial policies.

2.5 Comment and reference

Institutional Economic Theory opens a new chapter for the development of Economics. In the World Economic History, the economy of European and American countries rose because of the institutional efficiency unleashed by the incentive mechanism brought by the clarity of Property Rights System (North & Thomas, 1973). According to the theory of New Institutional Economics, when transaction costs exist, clarity of Property Rights System can internalize externalities to a greater extent, and help guide various incentive mechanisms and allocate resources effectively (Coase, 1960). New Institutional Economics provides a new theoretical explanation for "economic growth mystery". Especially for developing countries and countries in transition, institutional change and a series of institutional arrangements and innovations brought are regarded as the key to the revitalization of a country. (Lin, 2012).

The Institutional Change Theory also provides a new approach to analyze the development of the world and China's automobile industry. There are two research perspectives. One is the process of institutional change of automobile industry. In the short term, the process of institutional change means the replacement of one more effective institutional arrangement by another. In the long-term, the process of institutional change is from institutional innovation to institutional balance, and then to institutional innovation. On this basis, the impact mechanism and path of macroeconomic environment change, interest pattern adjustment, technology promotion and institutional self-cycle accumulation on the process of institutional change is further explored. Second is the effect of the institutional change of automobile industry. Based on the Economic Growth Theory of the New Institutional School, which takes the system as its explanatory variable, this thesis analyzes the industrial economic effects of the institutional factor changes in the automobile industry through other production factors, resource flows, transaction costs, incentive effects and

behavior patterns. The industrial economic effect on the institutional change of automobile industry can be divided into two dimensions: "time and space" and "quantity and quality". The dimension of "time and space" involves the temporal evolution of industrial life cycle replacement, as well as the spatial evolution of industrial region extension, exit and transfer. The dimension of "quantity and quality" involves the quantitative expansion of the industry in terms of the increase in the number of enterprises and the expansion of production scale, as well as the quality improvement of the industry in terms of core technology progress, industrial structure optimization and the improvement of industrial organization efficiency.

Generally speaking, there are relatively few researches analyzing the development of automobile industry from the perspective of institution. As for the current research, domestic scholars tend to focus on the analysis of specific problems in a specific period, while there lacks systematic studies on the system change process of China's automobile industry and the evaluation of system change performance from multiple dimensions and perspectives. With the change of economic development, China will also face new opportunities and challenges to improve the development of automobile industry. Under the new development stage and conditions, to comprehensively grasp the influence pattern of institutional change on automobile industry, discuss the conduction mechanism and function mechanism of the institutional impact in depth, and to evaluate the system’s contribution to the industry development, can expand and deepen the theory and application research of the auto industry, and also provide decision-making reference to promote transformation and upgrading of the auto industry.

Chapter 3: Research Method and Design

This chapter introduces the study methods and their application in the research, data collection and processing, and technical route.

3.1 Research methods

3.1.1 Methodology

Since the subject of research is institutional change and the development of industrial economy, we used the methodology proposed by Institutional Change Theory which emphasizes the combination of historical event analysis, case study, descriptive qualitative analysis and quantitative analysis.

North, the founder of Institutional Change Theory, carried out research on institutional change under the analytical paradigm which pursues the "maximization" of rational man advocated by neoclassical economics. The generality and characteristics of the system are inferred through case analysis; empirical system analysis is carried out from a historical perspective to examine the generation, development and transition of system, in which the dynamic and historical nature of the system is given full consideration. Following the methods of neoclassical economics about the economic man hypothesis, equilibrium analysis, marginal analysis and cost-benefit analysis, the methodology of Institutional Change Theory integrates system and institutional change into the analysis framework of equilibrium and non-equilibrium to analyze the supply and demand of system and the opportunity of institutional innovation. (Sun & Xu, 2008).

Following this research methodology, this research comprehensively adopted historical analysis, case analysis, mathematical model evidence analysis, and econometric analysis to study institutional change and the development of China's automotive industry.

3.1.2 Application of specific research methods

(1) Historical research method

Historical research is a method of studying past events in the order of historical development using historical data. It is also called longitudinal research method, a form of comparative research method. It studies the history of political system, finds causal clues from the relationship between various events, deduces the causes for the current situation of the system, and speculates the future changes of the system. In Chapter 4, the transition of China's automobile policies and their impacts are studied with the historical research method.

(2) Case study method

Case study method refers to the whole process of investigating a certain individual, a certain group or an organization for a long time to study the development and change of their behaviors, which is conducted through a series of steps including collecting, processing and analyzing case materials. In chapter 6, case study method is adopted to study Geely and other automotive enterprises, and analyze the impact of institutional change on the automotive industry on multiple levels and dimensions.

(3) Comparative research method

Comparative research is a method to investigate two or more related items based on certain standards to find their similarities and differences and explore more general or specific patterns. In chapter 4, we studied the characteristics and trends of policy evolution and the development path of China’s automotive industry in different stages using the comparative research method. Chapter 6 compares the development of different automotive enterprises in the process of institutional change.

(4) Statistical analysis method

Two kinds of statistical analysis methods are mainly applied. The first is correlation analysis method. In chapter 1, 4, 5 and 6, the quantitative relationship between institutional variables and variables such as the growth and structure of the automotive industry is analyzed through statistical diagrams, correlation coefficients and other analytical methods.

The second is time series analysis method. In chapter 5, this method is adopted to analyze the long-term trend elements and cycle elements of the institutional change indicators and automotive industry development indicators, and to explore the inherent timeliness rules of relevant data.

(5) Econometric research method

In chapter 5, econometric model is used to study the development of automotive industry. Based on the Cobb-Douglas production function model, a multivariate linear regression model of the automotive industry development and institutional variables was constructed. The overall effect of the model was evaluated through parameter estimation and hypothesis testing, and the influence mechanism and characteristics of institutional variables on the automobile industry were described. On this basis, multiple non-stationary time series long-term equilibrium constraints are imposed on the vector autoregressive (VAR) models with the development variables and institutional variables of the automobile industry, to construct the vector error correction model (VEC model). The impact of institutional change on the development of the automotive industry is simulated through impulse response analysis.

3.2 Data collection

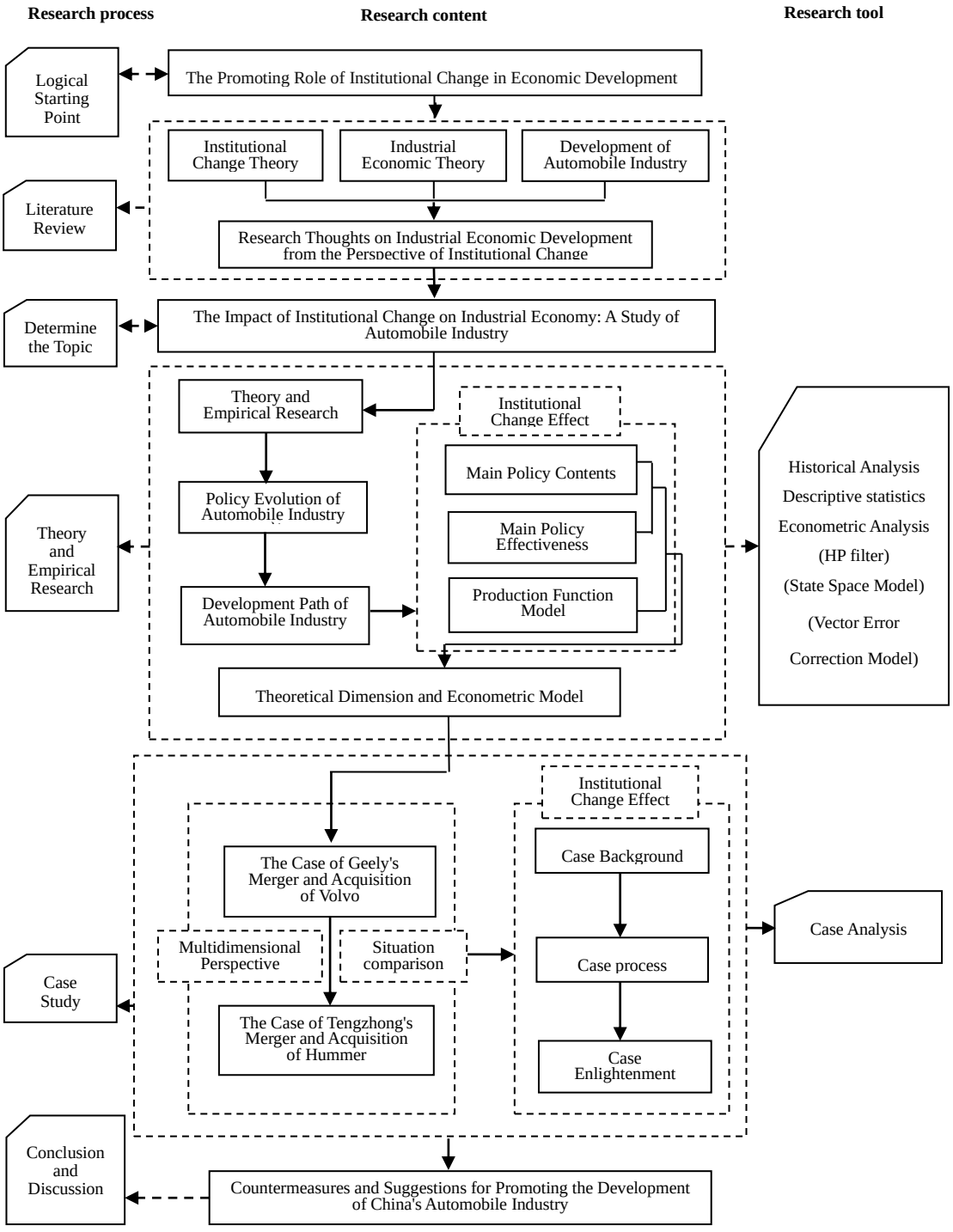
Data in this research mainly comes from: China Automotive Industry Yearbook, website of China Association of Automobile Manufacturers (www.caam.org.cn), statistical information website of China Association of Automobile Manufacturers (www.auto-stats.org.cn) and website of China industry information (www.chyxx.com).

3.3 Data processing

In this research, the data collected is broken down into long-term trend and short-term fluctuation, to identify the basic characteristics of the change trend. Unit root test, co-integration test and other analysis were conducted on the data to identify the stability of the

data and the long-term cooperative change relationship among variables. Based on the analysis of data properties, the econometric model of data estimation is used for empirical analysis. The inspection and analysis of data were conducted through the econometrics software Eviews.

3.4 Technical route


Research process
Research content
Research tool
Logical Starting Point
The Promoting Role of Institutional Change in Economic Development
Institutional Change Theory
Industrial Economic Theory
Development of Automobile Industry
Literature Review
Research Thoughts on Industrial Economic Development from the Perspective of Institutional Change
Determine the Topic
The Impact of Institutional Change on Industrial Economy: A Study of Automobile Industry
Theory and Empirical Research
Institutional Change Effect
Main Policy Contents
Policy Evolution of Automobile Industry
Main Policy Effectiveness
Theory and Empirical Research
Development Path of Automobile Industry
Production Function Model
Historical Analysis
Descriptive statistics
Econometric Analysis
(HP filter)
(State Space Model)
(Vector Error Correction Model)
Theoretical Dimension and Econometric Model
Institutional Change Effect
The Case of Geely's Merger and Acquisition of Volvo
Case Background
Case Analysis
Multidimensional Perspective
Situation comparison
Case process
Case Study
The Case of Tengzhong's Merger and Acquisition of Hummer
Case Enlightenment
Conclusion and Discussion
Countermeasures and Suggestions for Promoting the Development of China's Automobile Industry

Chapter 4: Historical Review and Analysis of Institutional Evolution and Development of China's Automobile Industry

This chapter mainly reviews and analyzes the three stages of China's auto industry policy evolution; it also compares and analyzes the background of the representative policies, goals and results of the three stages of *Policy on Automotive Industry*, *Policy on Development of Automotive Industry* and *Plan on Adjusting and Revitalizing the Auto Industry*.

4.1 Set out in dawn: 1994 Policy on Automotive Industry

The institutional scope in the evolution includes various policies, laws, rules and behavioral norms formulated by the government. The institutional evolution is a process of institutional innovation, which refers to the existing institutional changes that enable innovators to obtain additional and potential benefits. Industrial policy is an important means of national macro-control. The automobile industry policy is a general term for the government's laws, regulations and policy systems for the development of the automobile industry. The adjustment of automobile industry policy is an important manifestation of the institutional evolution in the automobile industry.

4.1.1 1994 *Policy on Automotive Industry*: Background

On July 13, 1956, the first Jiefang truck was off the assembly line, marking the beginning of a new era of China's automobile industry. After 1976, the automobile industry re-entered the normal development track. During the period of the First Five-year Plan to Fifth Five-year Plan, the state's support for the automobile industry continued to increase, laying a solid foundation for the subsequent rapid development (Table 4-1). In the planned economy period, China's policies on automobile enterprises are mainly protective. The main features of automobile industry policies are high tariffs, high localization and high protection,

referred to as the “Sangao” policy.

Table 4-1 The total amount and classification of fixed assets investment completed by the automobile industry during the First Five-year Plan to the Fifth Five-year Plan

(unit: 100 million yuan)

Period	Total	Vehicle	Modified Vehicle	Motorbike	Vehicle Engine	Parts
“The First Five-Year Plan” (1953-1957)	5.5	5.1	0	0	0	0.4
“The Second Five-Year Plan” (1958-1962)	2.0	0.7	0.2	0	0.1	1.0
Adjustment Period (1963-1965)	1.8	0.7	0.2	0	0.2	0.7
“The Third Five-Year Plan” (1966-1970)	10.2	5.0	0.6	0	0.6	4.0
“The Forth Five-Year Plan” (1971-1975)	22.6	-	-	-	-	-
“The Fifth Five-Year Plan” (1976-1980)	18.3	-	-	-	-	-

Source: China Automotive Industry Yearbook (1953-1980)

In the early 1980s, there were many auto manufacturers, but the scale was small, with imported cars increasing significantly. In this context, the government attached great importance to the automobile industry, especially sedan production, and introduced a series of policies.

In 1980, the National Machinery Industry Committee issued *Outline of National Automobile Model Development Plan from 1981 to 1990* and *Automobile Industry Adjustment and Reorganization Plan*. FAW, Dongfeng and other key automobile manufacturers began to build an industry complex, and established China Automotive Industry Corporation, responsible for the management of the automotive industry.

In 1986, “The Seventh Five-Year Plan” clearly identified the automobile manufacturing industry as an important pillar industry for the first time. In 1987, the national government clarified the "Three Big and Three Small" strategy of sedan production layout.

In 1994, *Outline of the National Industrial Policy of the 1990s* clarified the protection policies for pillar industries such as automobiles, to promote their revitalization and development.

In 1994, *Policy on Automotive Industry* clearly defined the development of China's automobile industry in terms of policy objectives, development priorities, industrial organization, industrial technology, investment financing, consumption and prices, and utilization of foreign capital. The main policy goal is to build the automobile industry into a pillar industry of the national economy as soon as possible. *Policy on Automotive Industry* kicked off the continuous improvement of China's automobile industry policy system, and relevant industrial policies and regulations continued to be introduced.

In 1995, “The Ninth Five-Year Plan" made economy cars and heavy-duty vehicles as well as their parts industry the focus of the automobile industry development. It also established a national technology development system, achieved scale operations and improved product quality.

4.1.2 1994 Policy on Automotive Industry: Purpose

The *Policy on Automotive Industry* in 1994 aimed to change the situation of scattered investment, small scale of production and out of date products, enhance the development capability of enterprises, improve the level of technical equipment and products, promote the rationalization of industrial organizations, and realize economies of scale. Via the implementation of this automotive industry policy, it laid a solid foundation for China’s automotive industry.

The main objectives of *Policy on Automotive Industry* have the following features: First, it focused on promoting the scale and grouping of the automobile industry. The state has vigorously cultivated several key automobile industry groups with demonstration effects, and mainly used direct intervention and investment as policy tools. Second, it focused on

improving the technical capabilities of the automotive industry, while encouraging the establishment of Sino-foreign joint ventures and foreign auto giants to set up R&D institutions in China. Finally, it began to notice the development trend of the international automobile industry and encouraged the development of energy-saving and low-pollution vehicles.

4.1.3 1994 Policy on Automotive Industry: Effects

With the implementation of *Policy on Automotive Industry* in 1994, the automobile production and sales volume was greatly improved, the automobile production technology and management level underwent a qualitative leap, and the automobile market and the consumer service environment was greatly improved (Figure 4-1). 2004 was the last year in which this industrial policy played a leading role. At that time, the automobile production was 5.07 million, and the total number of household vehicles was 14.8466 million, accounting for 55.1% of all civilian vehicles. The main effects of the *Policy on Automotive Industry* are as follows:

First, the production of automobiles grew rapidly. From 1985 to 2000, China's automobile production in mainland increased from 473,200 to 1,068,100, an increase of 4.73 times.

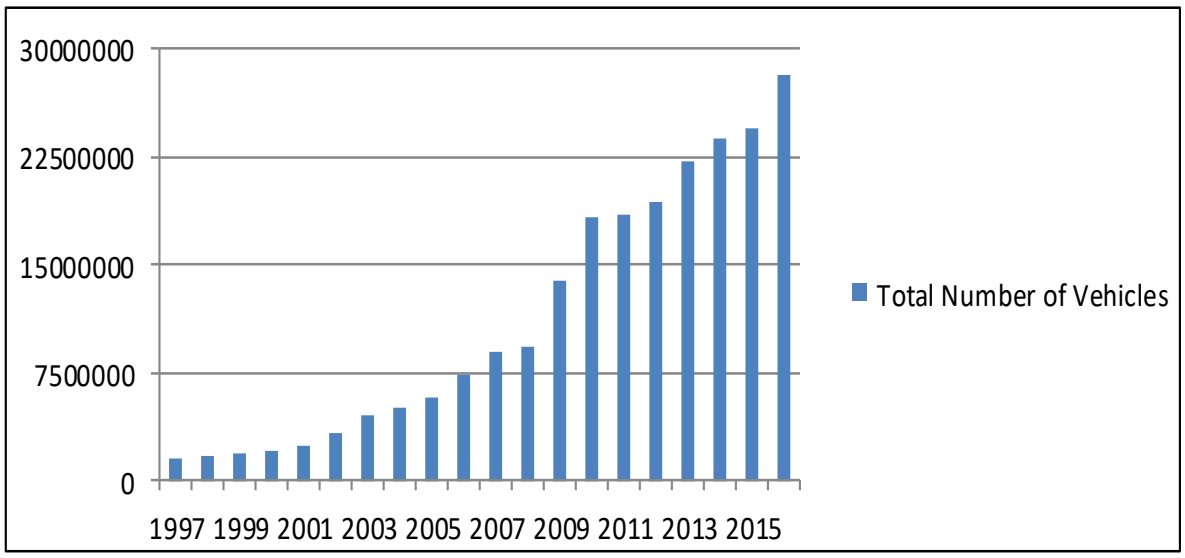


Figure 4-1 China's Automobile Production Statistics for the Years 1997-2016

Source: China Automotive Industry Yearbook (1997-2016)

Second, the organizational structure of the automobile industry tended to be reasonable, and production concentration was improved (Table 4-2). The state's support policy for the automobile industry was focused on the key enterprises. More than 80% of the investment was concentrated in 13 key enterprises, which promoted their production to or close to the economic scale. In 2000, the production concentration of the top 13 key automobile enterprises in China exceeded 90%, among which the automobile production concentration of FAW, Dongfeng, and SAIC reached 44%. The production concentration of sedan manufacturers generally showed a downward trend, but the overall level was high. The concentration of sedan production of the top three manufacturers before 2000 was 69.15% (Table 4-2).

Table 4-2 Changes in Concentration of the Automobile Industry

Year	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
CR3	80.8	84.5	82.6	87.3	81.8	83.0	78.8	69.4	61.3

Source: China Association of Automobile Manufactures (1993-2001)

The third is to introduce foreign capital, technology and management in the form of cooperation and joint ventures, to achieve rapid development in the automobile industry. From 1981 to 1995, 313 foreign advanced technologies were introduced and more than 350 joint ventures were established. The investment in research and development of China's automobile industry had increased year by year (Table 4-3). By 2003, the research and development cost of the automobile industry rose to 10.73 billion yuan. Although there was still a gap compared with the international average, it showed a good trend.

Fourth, the product structure began to be reasonable and the technical level was improved. The enterprises accelerated the pace of product upgrading, and some mid-range products initially formed independent development capability. The introduction of technology changed from introducing only the production skills to both production and development technology.

From 1990 to 1998, the total production of sedan increased from 42,000 to 508,000, with an average annual increase of 36.6%. The annual output of heavy-duty vehicles increased

from 18,000 to 35,000, with an average annual increase of 8.7%. The unreasonable structural problems such as imbalanced output of light and heavy vehicles were basically solved.

Table 4-3 Percentage of Sales and Research Cost of the Automotive Industry from 1998 to 2003

(amount: 100 million yuan)

Year	R&D Cost（A）	Sales Income（B）	A/B（%）
1998	38.2	2742.5	1.39
1999	57.4	3114.7	1.84
2000	67.7	3560.7	1.90
2001	58.6	4253.7	1.38
2002	86.2	5947.7	1.45
2003	107.3	8144.1	1.32

Source: China Automotive Industry Yearbook.

Fifth, the general situation of the auto parts industry were improved. Under the support of national policies, a number of key enterprises begun to take shape and were matched to a variety of models while entering the international market. From 1990 to 2000, the annual foreign exchange earning of parts increased by 30.2%.

Sixth, the automobile market was undergoing a fundamental change. The consumption structure was mainly from public funds purchase to private purchase. In 1999, the number of private car ownership in China increased from 816,000 in 1990 to 5.34 million, an annual growth rate of 23.2%. Since 1998, more than 50% of cars have been purchased by individuals.

4.2 Commitment to the world: 2004 policy on development of automotive industry

4.2.1 2004 policy on development of automotive industry: background

Judging from the international market situation, after joining the WTO, China promised to gradually open up the automobile market, reduce automobile import tariffs year by year,

increase import quotas, and cancel quotas in 2005. The automobile industry was facing a more severe test. The trend of global large-scale mergers and acquisitions had been remarkable (Table 4-4).

Table 4-4 Market Concentration of Major Automobile Producing Countries in the World in 2003

Country	US	Germany	Japan	Korea
CR	CR3（98.9%）	CR4（92%）	CR3（63%）	CR3（97.1）

Source: China Association of Automobile Manufactures (2003)

The scale of automobile industry enterprises had further expanded and market concentration had increased significantly, while the concentration of China's automobile industry had been declining. The pace of technological innovation had accelerated, the proportion of electronic information technology products had become higher and higher, and new low-emission, new-fuel vehicles had been put into production (Table 4-5).

Table 4-5 Overall Changes in China's Automobile Market (2000-2003)

Year	Number of Enterprises		Number of Brands		Scale (10,000 units)		Production Concentration	
	Total	JV	Total	JV	Production	Sales	CR4	CR8
2000	16	7	33	26	60.47	61.27	77.29%	98.01%
2001	16	9	45	37	70.35	72.15	67.72%	92.63%
2002	23	11	64	44	109.08	112.6	61.62%	85.60%
2003	38	12	88	53	218.93	215.41	47.12%	65.27%

Source: China Automotive Industry Yearbook (2000-2003)

Judging from the domestic situation, the constraints on resources and environment had been strengthened. In the case of a rapid increase in car ownership, if no effective measures were taken, the automotive energy supply would become a bottleneck for development. Whether it could meet the requirements of resources and environment had become the key to the long-term, sustainable and healthy development of China's automobile industry. The process of product legalization management was accelerating, and the automobile industry’s development policy played a connecting role. It guided the relevant government departments

to formulate necessary rules and regulations to carry out legalized management. The organizational structure and product structure adjustment requirements were strengthened. “To manage the overheating of investment and repeated construction” was one of the important backgrounds for the 2004 edition of the automobile industry policy.

In accordance with the terms promised by China upon joining the WTO, since 2002, the General Administration of Customs promulgated the *Adjustment of the Provisional Tax Rate from January 1, 2001*, and lowered the import tariffs on automobiles seven times, resulting in a substantial increase in imported automobiles.

In 2004, the National Development and Reform Commission issued the Policy on Development of Automotive Industry. In addition, there were other supporting policies on automobile access, automobile quality, automobile recall, automobile consumption tax, automobile finance. The number of relevant policy texts had reached a record high, which also enriched China's automobile industry policy system.

In 2007, the State Council formulated the Outline of the 11th Five-Year Development Plan for the Automobile Industry. The "Outline" included the realization of independent innovation in the automotive industry and the construction of a strong automobile industry in the policy objectives. On the quantitative standard, it purposed to achieve the sales target of 9 million vehicles, and regulated the fuel consumption.

The total investment in fixed assets of the automobile industry increased from 4.44 billion yuan during the "Sixth Five-Year Plan" period to 462.11 billion yuan during the "Eleventh Five-Year Plan" period (Table 4-6). The investment scale of automobiles, modified automobiles, motorcycles, vehicle engines, and parts was expanded significantly.

Table 4-6 Total Investment and Classification of Fixed Assets in the Automobile Industry during the Period from the Sixth Five-Year Plan to the Eleventh Five-Year Plan

(Unit: 100 million yuan)

Period	Total	Automobile	Modified Automobile	Motorcycle	Vehicle Engine	Parts
"Sixth Five-Year Plan" (1981-1985)	44.4	-	-	-	-	-
"Seventh Five-Year Plan" (1986-1990)	172.4	89.1	22.6	7.6	13.5	39.6
"Eighth Five-Year Plan" (1991-1995)	756.1	364.3	69.9	54.3	57.1	210.4
"Ninth Five-Year Plan" (1996-2000)	967.7	491.0	73.1	94.7	44.3	264.5
"Tenth Five-Year Plan" (2001-2005)	2351.6	1430.7	143.7	90.4	89.2	597.7
"Eleventh Five-Year Plan" (2006-2010)	4621.1	2560.3	260.7	151.4	217.7	1431.0

Source: China Automotive Industry Yearbook (1981-2006)

4.2.2 2004 policy on development of automotive industry: purpose

On May 21, 2004, *Policy on Development of Automotive Industry* was issued to adapt to the requirements of continuously improving the socialist market economic system and the new situation of the domestic and international automobile industry development after joining the WTO. It aimed to promote the structural adjustment and upgrading of the automobile industry, improve the international competitiveness of the automotive industry, meet the growing consumer demand for automotive products, and promote the healthy development of the automotive industry. The policy covered the automotive industry's technology policy, structural adjustment, access management, trademark branding, product development, parts and related industries, marketing networks, investment management, import management, and automobile consumption.

The new *Policy on Development of Automotive Industry* in 2004 clearly put forward four specific targets:

First, adhere to the principle of combining the basic role of market allocation resources with the government's macroeconomic regulation and control, to create fair competition and a unified market environment, and improve the legalized management system of the automobile industry. According to the mandatory requirements of administrative regulations and technical specifications, government functional departments should implement management of automobiles, agricultural transport vehicles (low-speed trucks and three-wheeled vehicles, similarly hereinafter), motorcycles and parts manufacturers as well as their products, and regulate the market behavior of various economic entities in the automotive industry.

Second, promote the coordinated development of the automotive industry and related industries, urban transportation infrastructure and environmental protection. Create a good environment for the usage of vehicles, foster a healthy vehicle consumer market, protect consumer rights and promote private vehicle consumption. By 2010, China would become the world's major automobile manufacturing country, and automotive products would meet most of the domestic market demand and enter the international market in batches.

Third, encourage automobile manufacturers to improve their research and development capabilities and technological innovation capabilities, to actively develop products with independent intellectual property rights, and implement brand management strategies. In 2010, automobile manufacturers should form a number of well-known brands of automobiles, motorcycles and parts. This goal clearly aimed to improve enterprises' research and development capabilities and innovation capabilities, to form products with independent intellectual property rights, and to cultivate their own brands.

Fourth, promote the adjustment and restructuring of the automobile industry, expand the scale efficiency of enterprises, increase the concentration of industries, and avoid repeated, chaotic, and low-level redundant construction. Via market competition, several large-scale automobile enterprise groups with international competitiveness should be formed, which should strive to enter the top 500 enterprises in the world by 2010. Encourage automobile production enterprises to form enterprise alliances according to market rules, achieve

complementary advantages and resource sharing, and expand business scale. Cultivate a group of parts enterprises with comparative advantages to achieve scale production and enter the international auto parts procurement system, to actively participate in international competition.

4.2.3 2004 policy on development of automotive industry: characteristics

Policy on Automotive Industry in 1994 and *Policy on Development of Automotive Industry* in 2004 are the most authoritative and influential comprehensive automotive industry policies in China so far. From the publication of *Policy on Automotive Industry* in 1994 to the promulgation of *Policy on Development of Automotive Industry* in 2004, China's automobile industry had made considerable progress. The production scale, automobile production and sales, product variety, technology level and market concentration had all been developed significantly.

From the perspective of policy orientation, there were some differences between *Policy on Automotive Industry* in 1994 and *Policy on Development of Automotive Industry* in 2004. The *Policy on Automotive Industry* in 1994 conformed to the trend of joint venture and regarded the automobile industry as the pioneering industry for opening up and international cooperation.

The *Policy on Development of Automotive Industry* in 2004 further strengthened the structural adjustment of the automobile industry. Via improving the corresponding tax measures, it encouraged the development of the automobile manufacturing industry, promoted the localization of products, created a favorable market environment for the development of China's automobile industry, and worked hard to make the management system open and transparent.

In particular, one of the important reasons for the promulgation of *Policy on Development of Automotive Industry* in 2004 was that China must fulfill its commitment to join the WTO in terms of tariff reductions year by year, opening of automobile import quotas, and opening of engine companies' shares. Part of *Policy on Automotive Industry* promulgated in 1994 was not in accordance with certain rules of the WTO. It could not adapt to the needs

of the changing situation.

Compared with *Policy on Automotive Industry* in 1994, *Policy on Development of Automotive Industry* added chapters on product development, trademark brand, marketing network, and access management, which greatly enriched and modified investment management and import management (Table 4-7).

Table 4-7 Comparison of the 1994 edition of Policy on Automotive Industry and the 2004 edition of Policy on Development of Automotive Industry

2004 edition of Policy on Development of Automotive Industry		1994 edition of Policy on Automotive Industry	
Chapter 1	Policy Objectives	Chapter 1	Policy Objectives & Product Development Priorities
Chapter 2	Development Plan	Chapter 2	Product Homologation
Chapter 3	Technology Policy	Chapter 3	Industrial Organization Policy
Chapter 4	Structural Adjustment	Chapter 4	Industrial Technology Policy
Chapter 5	Access Management	Chapter 5	Investment & Financing Policy
Chapter 6	Trademark Brand	Chapter 6	Foreign Investment Policy
Chapter 7	Product Development	Chapter 7	Import Management Policy
Chapter 8	Parts & Related Businesses	Chapter 8	Export Management Policy
Chapter 9	Marketing Network	Chapter 9	Domestication Policy
Chapter 10	Investment Management	Chapter 10	Consumption & Price Policy
Chapter 11	Import Management	Chapter 11	Related Industrial & Social Security Policies
Chapter 12	Vehicle Consumption	Chapter 12	Industrial Policy, Planning & Project Management
Chapter 13	Others	Chapter 13	Others
Total Number	78	Total Number	61

Overall, compared with the 1994 Policy on Automotive Industry, the newly promulgated Policy on Development of Automotive Industry has 7 features: it eliminated the inconsistency with WTO rules and China's WTO commitments; reduced administrative approval, and relied on regulations and technical standards; proposed brand strategy and encouraged the development of products with independent intellectual property rights; guided existing automobile production enterprises to merge and reorganize; required automobile manufacturers to attach importance to establishing sales and service system of the brand; guided and encouraged the development of energy-saving and environmentally-friendly vehicles and new-fuel vehicles; and provided guidance on creating a better consumer environment.

4.2.4 2004 policy on development of automotive industry: effects

After the implementation of the new 2004 edition of *Policy on Development of Automotive Industry*, China had successively introduced many industrial policies related to the automobile industry. The effects of the policy are mainly reflected in the following aspects:

(1) Coordinated Development of Related Industries & Improved Transportation Infrastructure

Since the implementation of *Policy on Development of Automotive Industry*, the parts industry has developed rapidly and the total indicators have increased rapidly. High-tech products and some self-owned brand products have been put into the market. The number of parts exported increased rapidly; with the export volume greater than the import value, the production cluster effect was first seen. The investment in China by multinational auto parts companies has increased year by year, and localization has made certain progress.

Synchronous with the development of automobile-related industries is the transportation infrastructure, and the nationwide road construction as well as highway network are gradually improved. In 2004, China's national road mileage was 1,870,700 kilometers, including 34,300 kilometers of highway. In 2005, the national road mileage reached 3,345,200 kilometers, including 4,100,000 kilometers of highway, which ranked second in the world; by the end of

2006, China's total mileage of road reached 3,577,000 kilometers and the highway reached 45,400 kilometers. by the end of 2007, the total mileage of road reached 3.5537 million kilometers and the highway reached 53,600 kilometers. At the end of 2008, the total mileage of road in China reached 3,730,200 kilometers, among which the highway mileage reached 60,300 kilometers; in 2009, the newly added road mileage in the country was 98,000 kilometers, reaching 3,882,200 kilometers, and the newly added highway was 4,719 kilometers. The total mileage of China's highway reached 65,000 kilometers (Figure 4-2).

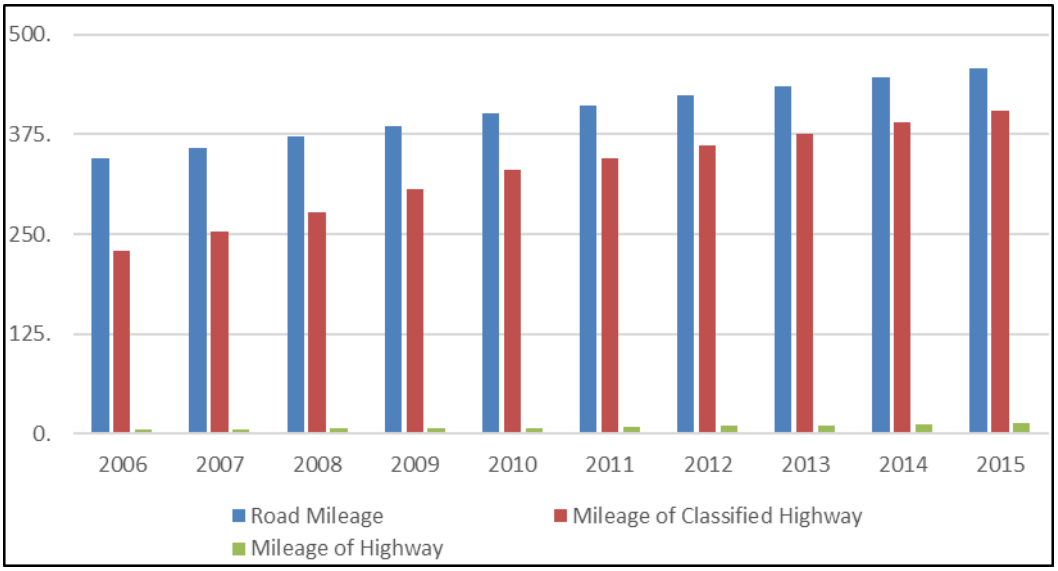


Figure 4-2 China's Road Mileage, Classified Highway Mileage, and Highway Mileage

Source: Statistical Bulletin of Development of Transportation Industry (2006 to 2015)

(2) Production and sales grew steadily, and private consumption became mainstream

From 2004 to 2008, China's automobile industry output growth was 14.11%, 12.57%, 27.54%, 22.02% and 5.21%, respectively; sales growth was 15.49%, 13.55%, 25.32%, 21.83% and 6.70% (Figure 4-3). With production and sales growing steadily, the overall situation is gratifying.

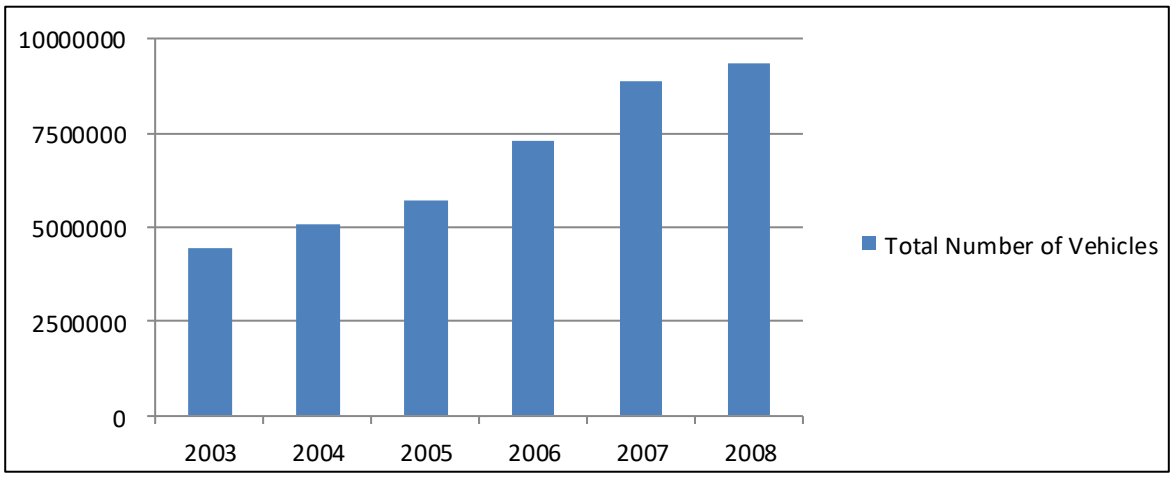


Figure 4-3 China Automotive Industry Output from 2003-2008

Source: China Automotive Industry Yearbook (2003-2008)

From 2004 to 2008, the proportion of private vehicles in civilian automobile was 55.12%, 58.49%, 63.11%, 65.99% and 68.66%, respectively, gradually occupying a dominant position (Table 4-8).

Table 4-8 Civilian Automobile Ownership and Private Automobile Ownership in China 2004 - 2008

Year	Civilian Automobile	Private Vehicles	Proportion of Private Vehicles
2004	2693	1184	55.12%
2005	3159	1848	58.49%
2006	3697	2333	63.11%
2007	4358	2876	65.99%
2008	5099	3501	68.66

Source: China Automotive Industry Yearbook.

(3) New breakthroughs were made in production and sales, and the status in the international market was gradually improved

From the perspective of production and sales, as of 2008, the production and sales of Chinese domestically produced vehicles were 9,345,100 and 9,363,300, respectively. China had become the second largest producer and seller in the world, ranking top three in the world in automobile production and consumption. While meeting the needs of domestic markets, China’s automotive products have gradually “gone abroad”.

From 2004 to 2008, China's automobile exports in each year were 76,000, 164,300, 343,400, 614,400, and 681,000. The growth rates of exports in each year were 65.94%, 116.18%, 109.01%, 78.92%, and 10.84% respectively; the proportion of export volume to total sales in each year was 1.50%, 2.85%, 4.76%, 6.99%, and 7.26% (Figure 4-4).

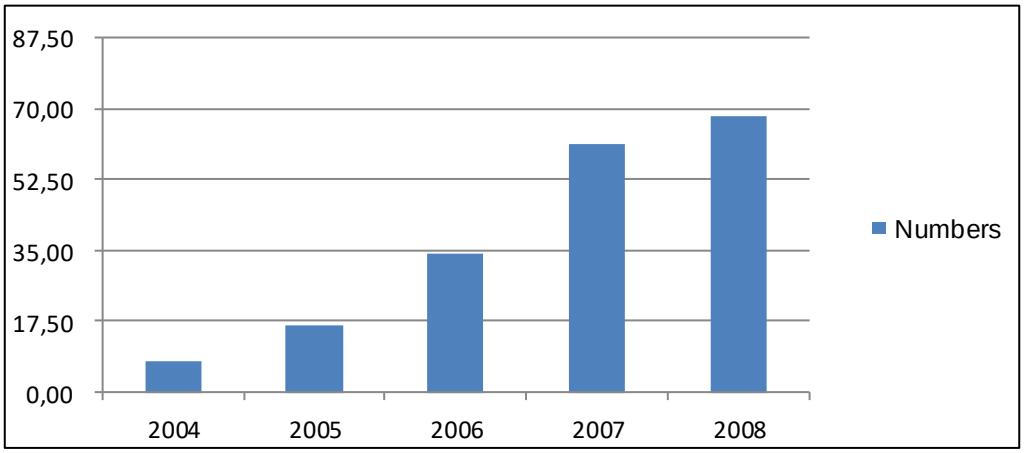


Figure 4-4 Statistics on China's Automobile Export Volume from 2004 to 2008

Source: China Automotive Industry Yearbook

(2) Both the innovation ability of enterprises and the competitiveness of independent brands were improved continuously.

From 2004 to 2006, the cooperation in technology between Chinese and foreign enterprises grew steadily, and the establishment of R&D centers made the technical cooperation between the two sides a high position. According to the statistics of China Association of Automobile Manufactures in 2006, the cumulative sales of self-owned brand passenger vehicles totaled 2,146,700, accounting for 41.47% of the total sales of passenger vehicles. Among them, the cumulative sales of self-owned brand sedans was 982,800, accounting for 25.67% of the total sales of sedans.

After opening the market, new varieties of the independent brands gradually increased, while entering the middle and high-end market. Externally, the total export volume of self-owned brands accounted for nearly 60% of all sedan exports, which was the absolute main force of sedan exports with a dominant position in China's automobile exports. In 2009, China's self-owned brand passenger vehicles sold a total of 4,577,000 units, accounting for

44% of the total sales of passenger vehicles. Among them, self-owned brands sold a total of 2,273,300 units, accounting for 30% of total car sales.

(3) Industrial structure adjustment accelerated and industry scale benefits continued to expand

On June 14, 2002, FAW Group and Tianjin Automobile Industry Group signed a joint restructuring agreement, which was called “the largest reorganization case of China's automotive industry” and broke the “three bigs and three smalls” pattern of the automotive industry. On May 29, 2005, Changan Auto and Jiangling Motors Group each invested 500 million yuan to establish Jiangling Holdings Co., Ltd., each of the two parties holds 50% of the shares, complement ing each other’s advantages.

On July 30, 2007, GAC Group and Hino Motor Co., Ltd. established a joint venture and reorganized the projects of Guangzhou Yangcheng Automobile Co., Ltd. and Shenyang Shenfei Hino Automobile Manufacturing Co., Ltd. GAC Group further rationalized its commercial vehicle segment. On December 26, 2007, SAIC and Yuejin Group, which is the parent company of Nanjing Auto Group, signed a comprehensive cooperation agreement officially. The auto business of Yuejin Group was fully integrated into SAIC. SAIC Group became the largest auto group in China, hence improving the previously scattered, chaotic and low-end structure of China's auto motive industry.

At the macro level, in 2008, according to the statistics of the number of enterprises divided by the total labor productivity (value added) of the automobile industry, the number of enterprises with a total labor productivity (value added) of the automobile industry in the range of “100,000 yuan/(person·year) and above” was 1056, accounting for 40.17% of the national auto industry enterprises. and the benefits of most of the Chinese auto industry have improved (Table 4-9). The performances of most companies in the Chinese automotive industry had been improved.

Table 4-9 Number of Enterprises Classified by Total Labor Productivity (Value Added) of the Automobile Industry in 2008

Labor Productivity	Below 5000 yuan/(person·year)	Below 5000-10000 yuan/(person·year)	Below 10000-20000 yuan/(person·year)
Numbers	95	52	147
Proportions	3.61%	1.98%	5.59%
Labor Productivity	Below 20000-50000 yuan/(person·year)	Below 50000-100000 yuan/(person·year)	Above 100000 yuan/(person·year)
Numbers	568	711	1056
Proportions	21.61%	27.04%	40.17%

Source: China Automotive Industry Yearbook (2008)

4.3 Rebirth in crisis: 2009 plan on adjusting and revitalizing the auto industry

4.3.1 2009 plan on adjusting and revitalizing the auto industry: background

Since the 21st century, China's automobile industry had developed at a high speed, forming a vehicle and parts production and supporting system with multi-variety and all models. The industrial concentration had been continuously improved, and the product technology level had been significantly improved. China had became a major automobile production country in the world.

Since the second half of 2008, with the spread of the international financial crisis, deepening and the severe shrinkage of the international auto market, the domestic auto market was severely affected. The industry's production and sales declined, and China's auto sales growth rate dropped from 22.02% in 2007 to 5.21% in 2008. In the second half of 2008, there was even a 5.2% negative growth, with a negative growth of 8.20% in the fourth quarter. The impact of the problems such as the decline in the economic performances of key enterprises, the weak development of self-owned brands, and the increasingly prominent structural contradictions were highlighted.

In the face of the impact of the international financial crisis on the automobile industry, major automobile production and sales countries including the United States, Canada, Japan, the United Kingdom, Germany, India and Korea introduced measures to assist the automobile industry or stimulate automobile consumption.

On November 26, 2008, the 37th executive meeting of the State Council decided to formulate and organize the adjustment and revitalization of key industries such as the automobile. In January 2009, the State Council executive meeting reviewed and approved in principle the adjustment and revitalization plan for the automobile industry and the steel industry.

In March 2009, the State Council promulgated *Plan on Adjusting and Revitalizing the Auto Industry* to provide clear opinions on the development of the automobile industry in the post-financial crisis era. The *Plan* took the cultivation of the automobile consumer market as the primary task of revitalizing the automobile industry. The government promoted the development of the automobile consumer market by reducing automobile purchase tax, trade-in, and regularly cleaning up scrapped cars.

In December 2011, the Ministry of Commerce issued *Guiding Opinions on Promoting the Development of the 12th Five-Year Plan for the Automobile Circulation Industry,* to improve the automobile marketing and service system, cultivate the used car market, regulate the circulation of auto parts, create a good automobile circulation environment, enhance the modernization level of vehicle circulation and encourage the vehicle circulation industry to combine “bringing in” and “going abroad”.

In particular, the development of new energy vehicles became the focus of policy support. In November 2007, the state promulgated the *Management Rules for the Production of New Energy Vehicles*, and proposed the concept of new energy vehicles for the first time. In January 2009, the Ministry of Finance and other departments launched the “Ten Cities and Thousand Vehicles” Energy Saving and New Energy Vehicle Demonstration and Application Project, and formulated the *Interim Management Measures for Financial Subsidy Funds for Energy Saving and New Energy Vehicle Demonstration and Promotion*. In October 2010, the State Council confirmed new energy vehicles as strategic emerging industries in *Decision on*

Accelerating the Cultivation and Development of Strategic Emerging Industries. In May 2015, the State Council further emphasized in the "Made in China 2025" that it would continue to support the development of electric vehicles and fuel cell vehicles, form a complete industrial innovation system from key parts to vehicles, and promote energy-saving and new energy vehicles of independent brands to go in line with the international advanced level.

4.3.2 2009 plan on adjusting and revitalizing the auto industry: purpose

The planning period for *Plan on Adjusting and Revitalizing the Auto Industry* was from 2009 to 2011, and eight goals were to be achieved in three years:

First, to achieve steady growth in automobile production and sales. In 2009, the production and sales volume of automobiles should strive to exceed 10 million units, with an average growth rate of 10% for three years.

Second, the automobile consumption environment should be significantly improved. Establish a complete automobile consumption policy and regulation framework system, a scientific and reasonable automobile tax and fee system, a modern automobile service system and an intelligent traffic management system, and establish an electric vehicle infrastructure supporting system to provide foundation for the stable development of the automobile market.

Third, the market demand structure should be optimized. It was necessary to achieve a market share of more than 40% for passenger cars with a displacement of less than 1.5 liters, of which the market share of small-displacement vehicles below 1.0 liters should reach more than 15%. Heavy trucks accounted for more than 25% of all trucks.

Fourth, significant progress should be made in mergers and acquisitions. Via mergers and acquisitions, 2-3 large automobile enterprise groups with a production and sales scale of more than 2 million vehicles as well as 4-5 automobile enterprise groups with a production and sales scale of more than 1 million vehicles should be formed. In addition, the number of automobile enterprise groups with a production and sales volume accounting for more than 90% of the market share should be reduced from 14 to less than 10.

Fifth, the proportion of self-owned brand auto market should be expanded. Make the domestic market share of self-owned brand passenger cars exceed 40%, of which sedans

should exceed 300io, and the proportion of self-owned brand automobile exports to production and sales should be close to 10%.

Sixth, the production and sales of electric vehicles should form scale. Renovation of existing production capacity would result in the production capacity of 500,000 new energy vehicles such as pure electric, plug-in hybrid and ordinary hybrid vehicles. The sales of new energy vehicles should account for about 5% of the total sales of passenger vehicles.

Seventh, the R&D level of vehicle should be increased significantly. The self-developed vehicle products, especially the energy-saving, environmental protection and safety indicators of small-displacement sedans, should be strived to reach the international advanced level. The main sedan products should meet the requirements of the developed countries, while the safety and comfort of heavy-duty trucks and large passenger cars should be close to the international level, and the overall technology of new energy vehicles should reach the international advanced level.

Eighth, the key parts technology should be independent. The key parts technology in the engine, transmission, steering system, braking system, transmission system, suspension system and automobile bus control system should be independent while new energy vehicles' special parts technology should reach the international advanced level.

Focusing on the above objectives, the main tasks of the automobile industry adjustment and revitalization were:

First, cultivate the automobile consumer market. Take effective measures to curb the decline in automobile production and sales to ensure steady growth in 2009. In the areas of automobile purchase, use, and scrappage, adjust and introduce policies and measures to encourage automobile consumption and restore market confidence. Clean up and eliminate various regulations that were not conducive to the development of small-displacement vehicles, and guide the increase of small-displacement automobile consumption via economic means such as taxation.

Second, promote the restructuring of the automotive industry. Encourage large auto companies such as FAW, Dongfeng, SAIC and Changan to implement mergers and acquisitions across the country. Support automobile companies such as BAIC, GAC, Chery

and CNHTC to implement regional mergers and acquisitions. Support key enterprises of auto parts to expand their scale via mergers and acquisitions, and increase the market share of auto parts at home and abroad.

Third, support independent innovation of enterprises. Take the enterprise as the main body and strengthen their product development capability. First is to establish the vehicle design and development process, master the body and chassis development technology and the matching technology as well as exhaust purification technology of vehicle, engine and transmission; break through the key technologies such as collision safety, NVH (vibration, noise, smoothness); control the cost of designing and manufacturing of new energy vehicles. The second is to improve the energy-saving, environmental protection and safety technology level of traditional passenger vehicles. The third is to establish a strategic alliance for the automobile industry and form a long-term cooperation mechanism for production, education and scientific research.

Fourth, implement special projects for technological transformation. Formulate *Technology Progress and Technical Transformation Project and Product Catalogue of the Automobile Industry,* to support the technological progress and structural adjustment of the automobile industry and increase the intensity of technological transformation.

Fifth, implement the new energy vehicle strategy. Promote the industrialization of pure electric vehicles, plug-in hybrid vehicles and their key parts.

Sixth, implement self-owned brand strategy. Formulate corresponding policies in technology development, government procurement, financing channels, to guide automobile production enterprises to develop their own brands as their strategic focus, and support automobile manufacturers to develop their own brands via independent development, joint development, domestic and foreign mergers and acquisitions.

Seventh, implement the export strategy of automotive products. Accelerate the construction of the national automobile and parts export base. Set up public service platforms in the field of automobile export information, homologation, common technology research and development, testing and training.

Eighth, develop the modern automotive service industry. Accelerate the development of

automotive R&D, production logistics, auto retail and after-sales services, car rental services, used car trading, auto insurance, consumer credit, parking services, scrap recycling and other services, and improve relevant regulations and management systems. Support key automobile manufacturers to accelerate the establishment of auto finance companies and carry out automobile consumer credit and other businesses.

4.3.3 2009 plan on adjusting and revitalizing the auto industry: effects

The financial crisis was an external impact on the structural adjustment process of China's automotive industry. After years of rapid growth, China's auto industry must make a major adjustment to resolve the many contradictions between the internal structure and the external environment. The international financial crisis became the trigger for that. However, the Chinese auto market was in a period of growth, and the potential demand of the urban and rural market was huge, and the fundamentals of the auto industry development were not changed. The 2009 edition of *Plan on Adjusting and Revitalizing the Auto Industry* played an important role in promoting the development of China's automobile industry.

(1) The status of the pillar industry became increasingly prominent.

After 2000, in the face of the new economic environment, the automobile industry achieved rapid development, which not only in terms of output, but also greatly increased the degree of independent production (Table 4-10).

Table 4-10 Statistics on the Total Output Value of China’s Automobile Industry over the Years and the Proportion of the Total Industrial Output Value of the Country (1995-2015)

Unit: 100 million yuan

Year	Auto Industry (A)	Total Output Value of the Automobile Industry of that year					National Industrial Output Value (that year) (B)	A/B%
		Vehicle	Modified Vehicle	Motorbike	Vehicle Engine	Car and Motorcycle Parts		
1995	2216.5	1133.1	179.8	401.1	104.3	398.2	98520	2.3
1996	2399.1	1197.6	214.1	468.0	94.2	425.2	99595.4	2.4

1997	2668.7	1347.3	239.2	482.7	87.1	512.4	113733.7	2.4
1998	2787.3	1392.5	272.7	466.4	98.1	557.6	67737.1	4.1
1999	3122.7	1595.6	283.8	526.1	108.5	608.7	72707	4.3
2000	3612.6	1985.8	352.7	549.6	108.8	615.7	85673.7	4.2
2001	4433.2	2524.4	389.1	561.6	99.0	859.1	95449	4.6
2002	6224.6	3576.8	611.0	549.4	171.0	1316.4	110776.5	5.6
2003	8357.2	5274.4	634.8	579.0	245.0	1624	142271.2	5.9
2004	9463.2	5762.7	680.1	714.9	291.7	2013.8	201722.2	4.7
2005	10223.3	5640.4	640.3	779.9	508.7	2653.9	251619.5	4.1
2006	13937.5	7429.8	813.2	903.2	623.7	4167.7	316589	4.4
2007	17242	9338.1	1033	1084.3	840.6	4946.1	386747	4.5
2008	18780.5	10375.4	1204.5	1130.9	898.5	5171.3	507448	3.7
2009	23437.8	14243.7	1469.1	882.6	1044.1	5798.3	548311	4.3
2010	30248.6	18937.8	1378.1	962.2	1409.1	7561.5	698591	4.3
2011	33155.2	21041.1	1433.8	833.1	1874.3	7973	844269	3.9
2012	35774.4	22703.3	1547	890.6	2013	8620.5	869909.5	4.1
2013	39225.4	25109.3	1965.1	886.5	1909.6	9355	897638.3	4.4
2014	42324.2	27093	2120.3	956.5	2060.5	10094	-	-
2015	45014.6	28427.4	1567.8	411.9	1199.5	13407.9	903900	5.0

Note: Since 1998, the total industrial output value of the country has been state-owned, and the total output value of state-owned and non-state-owned industrial enterprises above designated size is incomparable. Non-state-owned industrial enterprises above designated size refer to enterprises with an operating income of more than 20 million yuan.

Source: China Automotive Industry Yearbook (1995-2015)

The efficiency of the automotive industry increased significantly. In 2015, the total assets of China's automobile industry reached 583.924 billion yuan, the sales revenue was 716.172 billion yuan, the profit was 576.234 billion yuan, and the total asset contribution rate reached 19.74% (Table 4-11).

Table 4-11 Economic Scale of China's Automobile Manufacturing Industry

Unit: 100 million yuan

Year	Total Assets	Sales Income	Total Profits
2011	34751.55	47419.37	4053.18
2012	39447.74	50531.55	4065.28
2013	46788.28	60540.00	5107.74
2014	52144.41	66677.01	5990.97
2015	58390.24	71631.72	5762.34
January to June, 2016	61125.15	36322.05	3120.58

Source: China Association of Automobile Manufactures (2011-2016)

Overall, China's auto industry's output value and total profit maintained rapid growth for more than 10 consecutive years. The overall efficiency of the industry was greatly improved, which effectively promoted the development of industries such as steel, rubber, glass, electronics, instrumentation, refrigeration, logistics, transportation, and finance.

According to the statistics of the Association of Automobile Industries, the share of Chinese vehicles in the international market further increased. In 2000, China exported only 170,000 vehicles with an amount of US$133.0 million. In 2014, it exported 900,000 vehicles with an amount of RMB 77 billion and total exports of auto parts totaled RMB 302.2 billion. From January to November 2015, China's total vehicle exports totaled 699,400 units, with a decline of 18.3% year-on-year; the total import and export volume of national automobile products was US$142.149 billion, down 13.9% year-on-year. The global economic situation was turbulent in 2016, especially in the emerging economies that were China's major auto exporters. As of August 2016, China's total vehicle exports totaled 504,600 units, and the total vehicle imports totaled 671,400 units, declined 5.3% year-on-year.

(2) The scale of the consumer market further expanded.

Plan on Adjusting and Revitalizing the Auto Industry proposed that the target of the automobile market growth in 2009-2011 (Appendix 1) should be: In 2009, the production and sales volume of automobiles should strive for more than 10 million, and the average growth

rate for three years should reach 10%. To this end, *Plan on Adjusting and Revitalizing the Auto Industry* also introduced support policies from various aspects such as taxation and finance, encouraged the expansion of automobile consumption, and brought significant benefits to the domestic auto market, indicating that the government's clear attitude on guiding automobile consumption, enhancing consumer confidence, and revitalizing the automobile industry, which played a significant role in the stable growth of the automotive market.

According to the statistics of China Association of Automobile Manufacturers, in 2009, China's automobile production and sales reached 13.79 million and 13.64 million respectively, with an increase of 48% and 46%. Among them, the sales of passenger cars exceeded 10 million for the first time, and the sales volume of the whole year was 10.83 million, with a year-on-year increase of 54%; the sales volume of commercial vehicles was 3,407,200, with a year-on-year increase of 33%. The outstanding point was that, affected by the country's tax reduction policy of passenger cars with 1.6 liters displacement and below introduced in *Plan on Adjusting and Revitalizing the Auto Industry*, the sales volume of this type of vehicle in 2009 was as high as 7,195,500 units, with a year-on-year increase of 71%. It contributed 70% to the growth of car sales throughout the year.

The explosive power of the Chinese auto market, driven by China's auto industry-related policies, impressed domestic and foreign auto companies again. In 2010, China's auto production and sales rebounded, and a new round of strong growth trend appeared. China's auto sales surpassed that of the US, and entered the 10 million "car club". In 2015, China's auto market showed a steady growth trend, with production and sales exceeding 1.5 million vehicles per month, and the average monthly production and sales exceeded 2 million. In the whole year, production totaled 24,503,300 vehicles, a year-on-year increase of 3.25%, and sales of automobiles reached 2,459,760 vehicles, an increase of 4.68% year-on-year. The year-on-year growth rate of production and sales decreased by 4.05 and 1.92 percentage points respectively compared with 2014. Since then, the annual production and sales volume ranked first in global production and sales (Table 4-12 and Table 4-13).

Table 4-12 Statistics of Car Sales of the Top 25 Countries in the World in 2015 (unit: car)

No.	Country/Region	2015	2014	Year-on-year Growth.%
1	China	24564649	23488603	4.6
2	US	17830265	16844660	5.9
3	Japan	5046511	5562886	-9.3
4	Germany	3564922	3358125	6.2
5	India	3423698	3182211	7.6
6	UK	3036896	2846979	6.7
7	Brazil	2568979	3498012	-26.6
8	France	2355028	2210925	6.5
9	Canada	1938310	1886957	2.7
10	Korea	1921720	1736670	10.71

Source: China Association of Automobile Manufactures.

Table 4-13 Statistics of Car Production of the Top 20 Countries in the World in 2015 (unit: car)

No.	**Country**	**2014**	**2015**	**Year-on-year Growth.%**
1	China	23731600	24503326	3.3
2	US	11660702	12100095	3.8
3	Japan	9774665	9278238	-5.1
4	Germany	5907548	6033164	2.1
5	Korea	4524932	4555957	0.7
6	India	3844857	4125744	7.3
7	Mexico	3368010	3565469	5.9
8	Spain	2402978	2733201	13.7
9	Brazil	3146386	2429463	-22.8
10	Canada	2394154	2283474	-4.6

Source: China Association of Automobile Manufactures.

With the continuous improvement of Chinese residents' income level, the growth of

personal car ownership was strong. In 1990, China’s personal car ownership was 816,000. Since 1998, more than 50% of cars were purchased by individuals. By the end of 2015, civil car parc in China had reached 16.27 million, an increase of 11.47% over the previous year. Overall, the scale of Chinese civilian vehicles was still growing rapidly (Appendix 2).

(3) Product and industrial structure were further optimized.

Under the guidance of *Plan on Adjusting and Revitalizing the Auto Industry*, China’s automobile product and industrial structure adjustment achieved remarkable results in 2009. The market share of safe, environmentally friendly and energy-saving small-displacement vehicles increased significantly. Mergers and acquisitions went on steadily, and the concentration of the automobile industry was further increased.

First, China's automobile consumption structure improved significantly. Statistics showed that in 2009, the proportion of domestic passenger car sales reached 76%, an increase of 4 percentage points over the previous year. In terms of passenger car, the market share of low-displacement car varieties increased rapidly. In 2009, the sales volume of passenger cars with a displacement of 1.6 liters and below reached 7,195,500, and the market share was 70%, which was a new record high and was 8 percentage points higher than in 2008.

New energy vehicles developed rapidly. In 2015, a total of 379,000 new energy vehicles were produced, a four times increase over the same period last year. Among them, the production of pure electric passenger vehicles was 142,800 units, a three time increase over the same period of last year. The production of plug-in hybrid passenger vehicles was 63,600 units, a three time increase over the same period of last year. The production of pure electric commercial vehicles was 147,900 units, which was an eight times increase. The production of electric hybrid commercial vehicles was 24,600 units, a year-on-year increase of 79%.

Secondly, the mergers and acquisitions of enterprises were carried out steadily, and the concentration of the automobile industry was further improved. In 2009, the competition in the Chinese auto market became increasingly fierce, with corporate mergers and acquisitions steadily carried out. GAC became a shareholder of Changfeng while Changan Automobile reorganized AVIC, and the effect of cooperation between SAIC and Nanjing Auto Group

became increasingly apparent.

According to the statistics of CAAM, the top ten auto manufacturer groups in sales in 2009 were: SAIC, FAW, Dongfeng, Changan, BAIC, GAC, Chery, BYD, Brilliance and Geely. These 10 enterprises sold a total of 11.8933 million vehicles, accounting for 87% of the total sales of domestically produced vehicles, an increase of 4 percentage points over the previous year, and only 3 percentage points lower than the target of more than 90% proposed in *Plan on Adjusting and Revitalizing the Auto Industry*.

At the end of 2009, there were five enterprise groups with annual sales of more than one million vehicles in China, namely SAIC, FAW, Dongfeng, Changan and BAIC, with an increase of two compared with the previous year. The five enterprise groups sold a total of 9,660,500 vehicles in 2009, which accounted for 71% of total vehicle sales, and an increase of 9 percentage points over the previous year. The concentration of China's auto industry was further increased.

In 2003, the top three enterprises in China's automobile production concentrated about 46.7%. In 2015, the production and sales volume of 6 automobile production enterprises (groups) exceeded 1 million, of which SAIC’s sales exceeded 5 million units, reaching 586.35 million units. The sales volume of Dongfeng, FAW, Changan, BAIC and GAC reached 3.872 million, 2.0384 million, 2.7765 million, 2.489 million and 1.3031 million respectively. The top five enterprises (groups) sold a total of 17.8453 million vehicles in 2015, accounting for 72.6% of total vehicle sales.

In terms of the sales proportion of the top ten enterprises, in 2016, the top ten enterprise groups sold a total of 22,069,000 vehicles, accounting for 89.5% of the total vehicle sales; in 2016, the top ten enterprise groups sold a total of 24,759,900 vehicles. Vehicles accounted for 88.34% of total vehicle sales (Table 4-14).

Table 4-14 Sales Ranking of the Top Ten Manufacturers in 2016 in terms of Models (unit: 10,000)

	Vehicle (by group)		Passenger Car		Commercial Car	
Rank	Name	Sales	Name	Sales	Name	Sales
1	SAIC	647.16	SAIC Volkswagen	200.02	Beiqi Foton	48.09
2	Dongfeng	427.67	SAIC GM	188.00	Dongfeng	44.37
3	FAW	310.57	SGMW	187.82	Jianghuai	27.08
4	Changan	306.34	FAW-Volkswagen	187.24	SGMW	26.28
5	BAIC	284.67	Changan Auto	121.96	FAW	23.95
6	GAC	164.92	Beijing Hyundai	114.20	Jiangling	23.49
7	Changcheng	107.45	Dongfeng Nissan Passenger Vehicle Company	111.79	CNHTC	19.99
8	Geely	79.92	Changcheng Auto	96.89	Chongqing Lifan	17.89
9	Brilliance	77.44	Changan Ford	94.38	Changan Auto	16.02
10	Chery	69.85	Geely Holding Group	79.92	Jinbei Auto	12.26
Total		2476	1382.22		259.42	
Proportion		88.34	56.70		70.15	

Note: The above enterprises' vehicle data are based on the group's standards; the data of passenger cars and commercial vehicles are based on the subsidiaries' standards.

Source: China Association of Automobile Manufactures.

(3) The competitiveness of independent brands was further improved.

The share of independent brands was greatly improved. In 2009, the sales volume of China's self-owned brand passenger vehicles reached a total of 4.57 million, accounting for 44% of the total sales of passenger vehicles, an increase of 4 percentage points over the previous year. This also showed that independent brands were increasingly recognized by consumers. Judging from the rankings, FAW-Volkswagen not only lost the first place in 2009, but also fell behind SAIC GM. Independent brands were occupying more and more places. In 2008, only Chery entered the top ten, while in 2009 there were three. Among them, Chery and BYD beat FAW and Toyota, ranking sixth and seventh. Geely Automobile also ranked 10th

with sales of 330,000 vehicles.

According to the data of China Automobile Industry Association, 2015's the sales of self-owned brand passenger cars reached 8.737 million, with a year-on-year increase of 15.3%, accounting for 41.3% of the passenger car sales market, and the market share increased by 2.9 percentage points compared with previous year. From January to August 2016, the sales of self-owned brand passenger cars totaled 6.099 million, an increase of 16.0% year-on-year, accounting for 42.4% of the total sales of passenger cars with an increase of 1.4 percentage points over the same period of the previous year. The growth rate of self-owned brands was higher than that of joint venture brands and the overall level of the market, and had became an important driving force for the growth of the automobile market. From the market share in the past five years, changing from 41.8% in 2012 to 38.4% in 2014 and 42.2% in 2016 (January to August), independent brands were gradually "taking over" lost ground, which could be seen to all.

Chapter 5: Institutional Changes and China's Automobile Industry: Quantitative Inspection

This chapter is mainly based on the production function model framework, using the cointegration method, the vector error correction mo del, the state space model and other econometric methods to conduct empirical analysis on the impact of institutional changes on the Chinese automotive industry.

5.1 Developing a production function model for automobile industry

In Western economics, the production function refers to the technical relationship between input and output. Production functions can be represented by a mathematical model, chart, or graph. In other words, it is the relationship between input and output under certain technical conditions. When dealing with actual economic problems, the production function is not only the correspondence between the input and output, but also the constraint of production technology. The production function has differences in terms of micro and macro. In the aspect of economic growth research, the production function is the macro production function, also known as the total production function, which refers to the production function of the whole national economy. It refers to the relationship between the total input and the total output.

This topic draws on the basic idea of production function, constructs the economic growth model of China's automobile industry including institutional factors, introduces the institution as a growth factor into the production function equation of the automobile industry, and uses the econometric analysis method for empirical analysis. Assuming that under a given level of technology, an economic society uses two elements of labor and capital in the sense of total quantity for production, the macro production function can be expressed as:

$$y = f(L,K) \tag{5-1}$$

In this equation, y represents the total output, L refers to the employment level or employment for the entire society, K is the capital stock of society as a whole. The formula (5-1) shows that the output of the economic society depends on the employment volume or employment level of the entire society.

Currently, the Cobb-Dauglas production function is the most widely used production function in empirical research. The classic Cobb-Douglas production function was jointly proposed by mathematics scientist Cobb and economist Douglas in the early 1930s. The general form is:

$$y = AL^{\alpha}K^{\beta} \qquad (5\text{-}2)$$

In this equation, A, α and β are the three parameters, $0 < \alpha, \beta < 1$.

According to the theory of economic growth and the research results at home and abroad, based on the Cobb-Douglas production function model, we introduced an institutional variable to construct an econometric model, in order to empirically test and analyze the impact mechanism and effect of institutional changes on the development of the automobile industry. According to the Cobb-Douglas production function, if the automobile industry development is assumed to be influenced by technological progress, capital factors, labor factors and institutional factors, the production function model of the automobile industry development can be constructed in the following forms:

$$Y = AK^{\alpha}L^{\beta}I^{\gamma} \qquad (5\text{-}3)$$

In this model, *Y* refers to the variable of automobile industry development; *A* is the variable of technological progress; *K* is the variable of capital input; *L* is the variable of labor; *I* is the institutional variable. In order to realize the quantitative estimation of the parameters in the model, the logarithm of both sides of the production function model can be taken at the same time, then the model can be transformed into a linear regression model for processing (Gong, 2007) Taking the logarithm of both sides of (5-3) and the result is:

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \lambda \ln I \qquad (5\text{-}4)$$

The tremendous achievements of the Chinese economy since the reform and opening up

have been based on industrial growth and progress. Among the many factors affecting the growth of the industry, the decisive one is the formation of a competitive market environment (Liu, 2008). After the reform and opening up, the pressure of technology gap with developed countries forced China's auto industry to quickly move toward the stage of technology introduction with joint venture model (Lu & You, 2010). Especially after China joining the WTO, the automobile industry has made rapid progress in terms of quantity and scale, quality, service, new product development, technology and organizational innovation. It reflected the topic of “Open market and competition promote industrial progress” (Liu, 2008). Shen (2017)'s substantive research on the automobile industry shows that opening up is one of the important factors affecting the impact of foreign direct investment on the quality of economic growth.

The state organizes fiscal revenue via taxation and regulates the national economy to operate in an orderly manner. Taxation can also guide the industry development and regulate the consumption structure. The automotive industry is one of the pillar industries for China's future development. The macroeconomic regulation and control of a country is usually reflected in taxation policies, especially in the automotive industry. Therefore, the current tax policy of the automobile industry will directly affect its industrial development, even China's future economic growth. Domestic economic system reform and policy changes are closely linked to the development of China's automobile tax and fee (Luo, 2011). As part of the government’s general policy, fiscal and taxation policies can penetrate all aspects of the industrial system (Cheng, 2009). Guided by fiscal and taxation support policies, combined with the auto industry’s high correlation and strong capital accumulation ability, it is necessary to accelerate the optimization and upgrading of China's auto industry structure, enhance its international competitiveness, and continuously promote the overall development of China's economy (Mu, 2010). Research on the taxation system of the automobile industry has gradually become a hot issue in the academic and political circles (Wang & Liu, 2014). Yu and Fang (2010) proposed the optimization proposal of China's automobile tax and fee policy on the basis of analyzing the automobile taxation system of developed countries.

Therefore, this thesisthesis mainly studies the impact of China's auto industry institutional

changes from the perspective of opening up and industrial policies represented by taxation. According to the formula (5-4), assuming the technical conditions are unchanged, we construct the following multiple regression model to empirically analyze the impact of China's institutional changes on the automobile industry development.

$$y_t = c + \sum_{f_1=0}^{n} \alpha_{f_1} k_{t-f_1} + \sum_{f_2=0}^{n} \alpha_{f_2} l_{t-f_2} + \sum_{f_3=0}^{n} \alpha_{f_3} i_{1t-f_3} + \sum_{f_4=0}^{n} a_{f_4} i_{2t-f_4} + \varepsilon_t \quad (5\text{-}5)$$

Among them, y_t is the industrial development variable, measured by the logarithm of the added value of the automobile industry. k_t is the capital variable and is measured by the logarithm of the fixed assets investment in the automobile industry. l_t is the labor variable and is measured by the logarithm of the number of employees in the automobile industry. i_{1t} is the variable of the degree of opening up. People used to use export dependence (export value/total output value of the automobile industry that year) to reflect the degree of economic extroversion (Wen & Hu, 2003). The research of Wang (2011) shows that the contribution of export trade to the upgrading of the automobile industry is greater than the introduction of foreign capital, that is, the industrial upgrading effect of “going abroad” is obviously better than “bringing in”. Therefore, the export value of the automobile industry is measured by the proportion of the added value of the automobile industry. i_{2t} is the variable of industrial policy. The state organizes fiscal revenue via taxation, and taxation indicators are important manifestation of policy regulation. In terms of empirical research, Meng and Yin (2011) used monthly data empirical analysis to find that China's consumption tax policy changes’ impact on automobile consumption; Gao (2017) applied the econometric co-integration theory analysis method to test the long-term stable relationship between financial and taxation financial support and the automotive industry's technological innovation capability, and establish a quantitative analysis model of the two. Via research, it is found that the financial tax incentives of the automobile industry are the reasons for the technological innovation capability improvement of the automobile industry. Referring to the existing research results, it can be measured by the proportion of automobile industry’s tax revenue in the total tax revenue of the machinery industry.

5.2 Estimation of production function model

5.2.1 Dynamic correlation analysis of variables

We first use HP filter to decompose the data series of variables in the production function model of automobile industry, and then analyze the driving forces of automobile industry development from the perspective of long-term trend and short-term fluctuation via comparison. HP Filtering is a commonly used macroeconomic trend analysis method, which is essentially a linear filtering method and does not change the basic characteristics of data series. Compared with the time series decomposition methods such as band pass filtering, HP Filtering is relatively suitable for trend analysis of less data (Liu & Fan, 2001).

The HP filter is designed by Hodrick and Prescott (1980, 1997), using a symmetric data moving average method to design a filter. The HP filter considers that economic variables are neither permanent nor random, and the trend is slowly changing. The time series consists of trend components and periodic fluctuation components. The HP filter is a commonly used time series decomposition method which can be used to decompose the time series into trend components and wave components, and then analyze the overall variation characteristics of the time series. The basic principle of HP filter is: provided the economic time series is $Y=\{y_1,y_2,...,y_n\}$, the composition of its trend is $T=\{t_1,t_2,...,t_n\}$, and n is the length of the sample. Usually, the unseen trend t_i in the time series y_i is defined as the minimized result of the following formula:

$$\min\left\{\sum_{i-1}^{n}(y_i-t_i)^2+\lambda\sum_{i-1}^{n}\left[(t_{i+1}-t_i)-(t_i-t_{i-1})\right]^2\right\} \quad (5\text{-}6)$$

Among them, the arithmetic number λ indicates the weight of the long-term trend and cyclical fluctuations in the decomposition. The best choice of λ is: $\lambda=\sigma_1^2/\sigma_2^2$, in which σ_1 and σ_2 are the standard deviation of the trend component and the fluctuation component in the time series. If the economic variable is above its trend level, the economic variable can be considered to be at a higher level and vice versa.

This thesis uses the time series of HP filter economic variables for analysis. Figure 5-1 to Figure 5-6 show the HP filter decomposition results of the variable sequence in the production function model of the automobile industry.

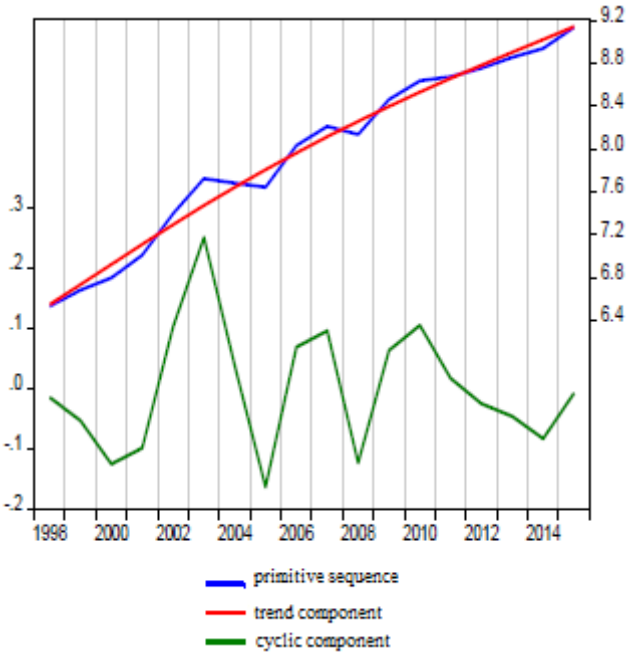


Figure 5-1 Industrial Added Value of the Automobile Industry

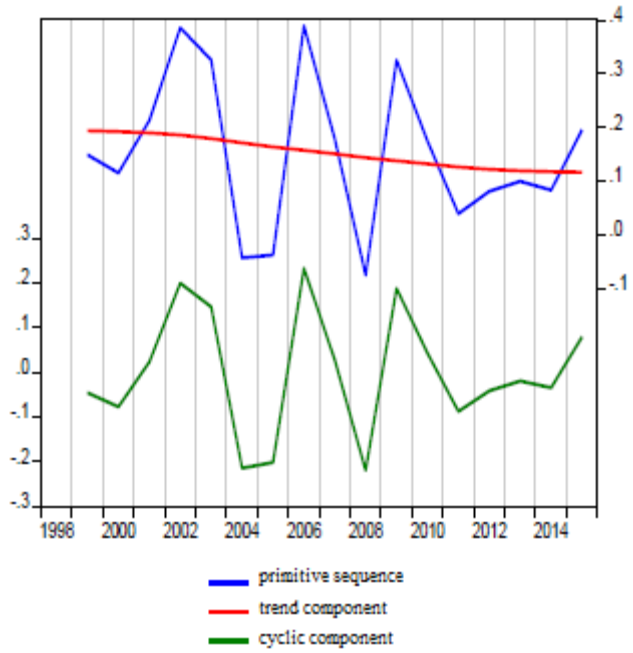


Figure 5-2 Growth Rate of the Added Value of the Automobile Industry

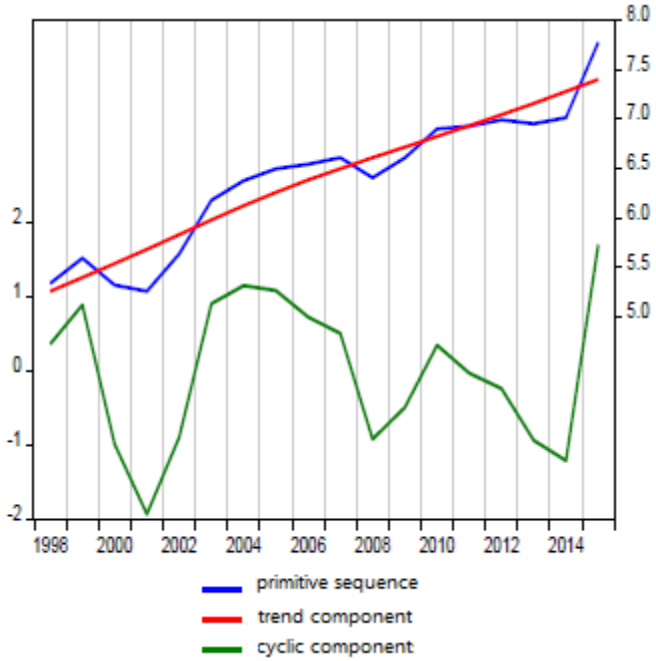


Figure 5-3 Investment in Fixed Assets of the Automobile Industry

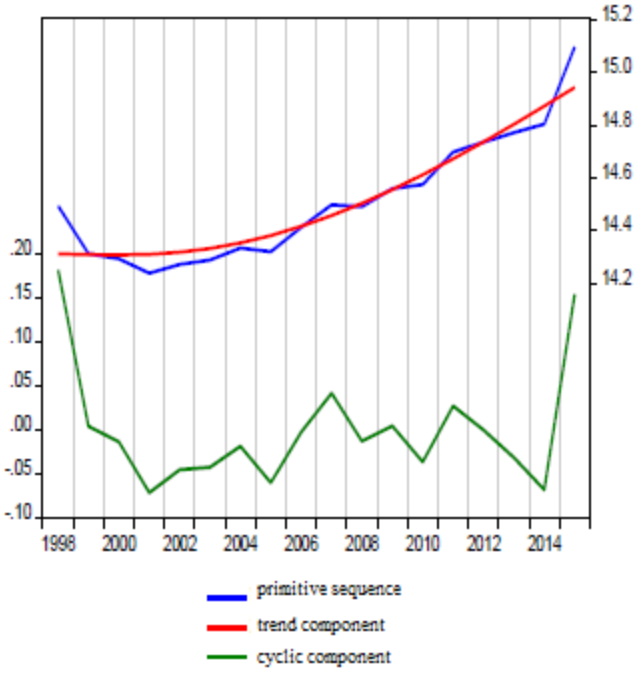


Figure 5-4 Number of Employees in the Automobile Industry

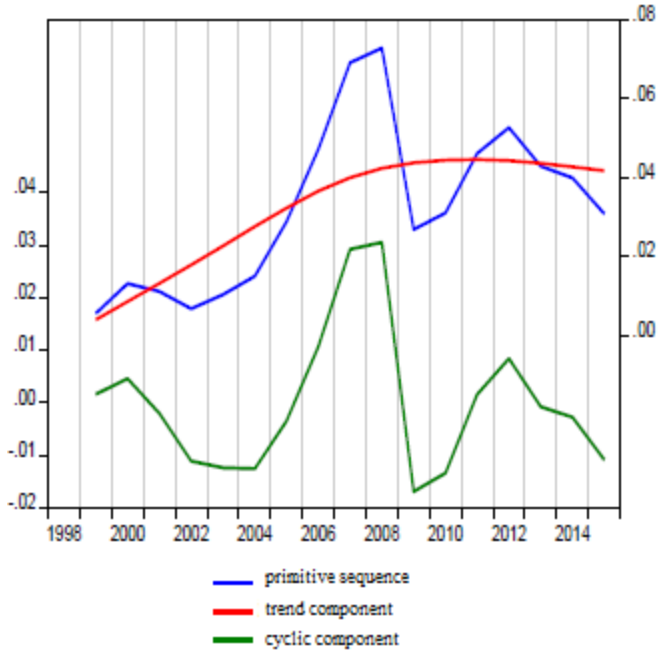


Figure 5-5 Variables of the Opening up Degree of Automotive Industry

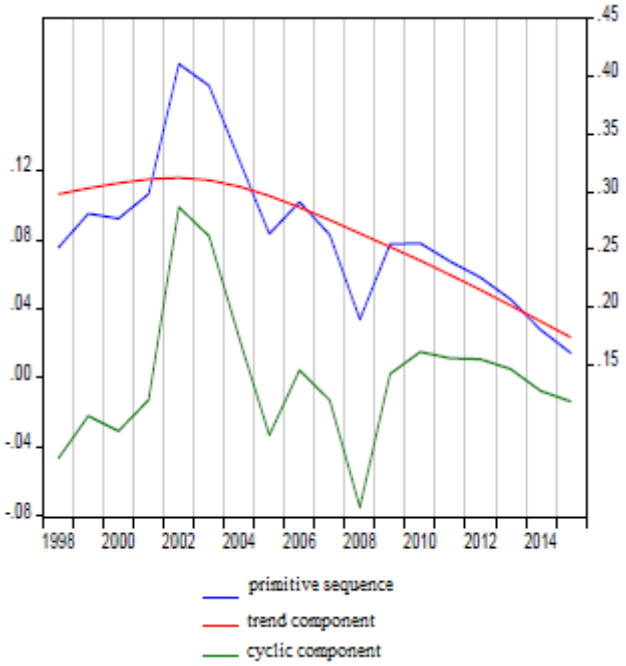


Figure 5-6 Policy Variables of Automotive Industry

The decomposition of the time series shows that in the sample, the variable sequence in the automobile industry production function model can decompose the trend component and the wave component significantly. From the perspective of trend components, the variable trends of the automobile industry's fixed asset investment, the number of employees, and the degree of opening up, as well as the trend component of industrial added value have the same

direction of change, while the trend component of industrial policy variables and the trend component of industrial added value show a reverse relationship. From the perspective of the volatility component, there is a certain coupling between the fluctuation components of each variable. Therefore, on the whole, the change of time series indicates that the cumulative growth of the added value of China's auto mobile industry is sustainable, and each driving factor may have a greater impact on this process, which is the reason for the volatility of the added value.

On this basis, the correlation coefficient is further calculated and the correlation between the variables is measured. Table 5-1 shows the calculation results of the correlation coefficients between variables.

Table 5-1 Calculation Results of Correlation Coefficient of Variables

	y_t	k_t	l_t	i_{1t}	i_{2t}
y_t	1	0.95	0.89	0.61	-0.64
k_t	0.95	1	0.89	0.5	-0.65
l_t	0.89	0.89	1	0.47	-0.79
i_{1t}	0.61	0.56	0.479	1	-0.61
i_{2t}	-0.64	-0.65	-0.79	-0.61	1

The calculation results of correlation coefficient in Table 5-1 show that capital variables, labor variables and institutional variables have strong correlation with the development variables of the automobile industry. The correlation coefficient is a statistical index to reflect the close relationship between the variables, which can be used to quantitatively measure the linear correlation strength between the variables. The judgment of the correlation between variables is the basis for further establishing the model for empirical analysis. According to the calculation of the related coefficient, specifically, there is a positive correlation between k_t, l_t, i_{1t} and y_t; while there is a negative correlation between i_{2t} and y_t. Therefore, not only the capital and labor are important factors in promoting the development of the automobile industry, but the degree of opening up and industrial policy variables also have a significant impact on the development of the automobile industry. At the same time, according to the relevant analysis results, the regression model can be further established for empirical

analysis.

5.2.2 Model estimation based on Engle-Granger co-integration theory

The economic and financial data encountered in practice are mostly non-stationary sequences, and the numerical features of non-stationary sequences vary with time, which means the random laws of non-stationary time series at different time points are different. It is difficult to grasp the randomness of the time series as a whole via the given information. Before estimating the regression model, it is necessary to test and judge the stationarity of the variable data sequence. If the data sequence containing the variables in the model is a non-stationary sequence, then the "pseudo-regression" problem can be avoided only when there is a cointegration relationship between the sequences, so that the constructed model is effective.

Whether the data sequence is stationary or not can be tested by the unit root test method. The unit root test mainly refers to whether there is a unit root in the test sequence. If there is, the tested data sequence is a non-stationary time series. It can be proved that the existence of the unit root process in the sequence is not stationary, which will lead to the phenomenon of "pseudo-regression" in the regression analysis.

There are two ways of using unit root test method to test the stationarity of the sequence: ADF test and PP test. The most commonly used is ADF test. For the time series model:

$$y_t = \sum_{i=1}^{p} \phi_i Y_{t-i} + \mu_t, \quad \mu_t \sim IN(0,\sigma^2) \tag{5-7}$$

It can also be written as a form of a lag operator polynomial (L is a lag operator):

$$\phi(L) y_t = \mu_t \tag{5-8}$$

Among them: $$\phi(L) = 1 - \phi_1 L - \phi_2 L^2 - \cdots - \phi_p L^p$$

To verify that the time series is stationary, it is often necessary to check whether the sum of the roots of the characteristic equation $\phi(L) = 0$ is 1, which is also called the unit root. If there is a unit root, then the time series is not stationary, and the established model may have

"pseudo-regression". The above time series model can also be written as:

$$\Delta y_t = (\beta - 1) y_{t-1} + \sum_{j=1}^{p-1} \phi_j^* \Delta y_{t-i} + \mu_t \quad (5\text{-}9)$$

Among them, $\beta = \sum_{i=1}^{p} \phi_i$, $\phi_j^* = -\sum_{i=j+1}^{p} \phi_i$, $j = 1, 2, \cdots p-1$,

Provided $\rho = \beta - 1$, the above equation can be written as:

$$\Delta y_t = \rho y_{t-1} + \sum_{j=1}^{p-1} \phi_j^* \Delta y_{t-i} + \mu_t \quad (5\text{-}10)$$

To test this model, H_0 provided: $\rho = 0$ is accepted, which means the time series is not stationary, H_1: $\rho = 0$ is rejected, which means the time series is stationary. Dickey and Fuller obtained the distribution of statistical tests using the Monte Carlo method in 1979. This test method is called DF or extended DF test (ADF test). It is a one-sided test, if DF or ADF value is greater than the critical value, then the original hypothesis is accepted, that is, the time series is non-stationary, and the established time series model is untrustworthy; conversely, if the DF or ADF value is less than the critical value, the original hypothesis is rejected, that is, the time series is stationary, and the established time series model is trustworthy.

This topic selects the ADF test method to run the unit roots test on the variables y_t, k_t, l_t, i_{1t} and i_{2t} in the model to check its stationarity. The testing results are shown in Table 5-2.

Table 5-2 Testing Results of the Unit Root

Sequence	Level		1st Difference			
	T-statistic	Threshold	T-statistic	Threshold	T-statistic	Threshold
y_t	-2.599978	-3.081002	0.1145	-5.020772	-3.081002	0.0014
k_t	-0.880317	-3.040391	0.7703	-4.006734	-3.065585	0.0085
l_t	1.599074	-3.052169	0.9988	-2.014058	-1.964418	0.0452
i_{1t}	-0.584384	-1.964418	0.4482	-3.168884	-1.966270	0.0038
i_{2t}	-0.756834	-1.961409	0.3743	-3.957591	-1.961409	0.0005

According to the unit root testing results listed in Table 5-2, at the 5% significance level, all variables accept the original hypothesis which is “at least one unit root exists”, while their first-order difference sequence rejects the original hypothesis of unit roots at the same level of significance. Therefore, we infer that the data sequences of variables y_t, k_t, l_t, i_{1t} and i_{2t} are non-stationary and are subject to the integrated process.

The unit root test shows that the data sequences required for the estimation model are non-stationary sequences, and the co-integration test needs to be performed on the relationship between the sequences. Assuming that some economic indicators are linked by a certain economic system, in the long run, these variables should have an equilibrium relationship, which is the basic starting point for establishing and testing models. In the short term, these variables may deviate from the average due to seasonal effects or random disturbances. If this deviation is temporary, then it will return to equilibrium over time; if this deviation is permanent, it cannot be said that there is an equilibrium relationship between these variables. Cointegration can be seen as a statistical representation of the nature of this equilibrium relationship.

The cointegration test can be divided into two types in terms of the test objects: one is the cointegration test based on regression coefficient (Johansen cointegration test). the other is the cointegration test based on regression residuals (Engle-Granger cointegration test). We use the Engle-Granger cointegration test method to estimate the production function model of the automotive industry. The main steps of the Engle-Granger cointegration test are as follows:

① If k sequences y_{1t} and y_{2t}, y_{3t}, …, y_{kt} are all integrated of order, establish a regression equation:

$$y_{1t} = \beta_1 + \beta_2 y_{2t} + \beta_3 y_{3t} + \cdots + \beta_k y_{kt} + u_t \qquad (5\text{-}11)$$

The residual value estimated by the model is

$$\hat{u}_t = y_{1t} - \hat{\beta}_1 - \hat{\beta}_2 y_{2t} - \hat{\beta}_3 y_{3t} - \cdots - \hat{\beta}_k y_{kt} \qquad (5\text{-}12)$$

② Test whether the residual sequence $\hat{u}_t$ is stationary, that is, to determine whether the sequence $\hat{u}_t$ contains a unit root.

③If the residual sequence is stationary, then it can be confirmed that there is a co-integration relationship in k variables $(y_{1t}, y_{2t}, y_{3t}, \cdots, y_{kt})$ in the regression equation, with a cointegrated vector of $(\hat{\beta}_1, \hat{\beta}_2, \cdots, \hat{\beta}_k)'$; otherwise, there is no co-integration relationship between $(y_{1t}, y_{2t}, y_{3t}, \cdots, y_{kt})$.

According to the above illustration, the OLS method is used to estimate the multiple linear regression model of the automotive industry development. The estimated results are shown in Table 5-3.

Table 5-3 Estimation Results of Production Function Model

Variable	Coefficient	Standard Deviation	T Value	P Value
k_t	0.81	0.11	7.22	0.00
l_t	0.22	0.05	4.02	0.00
i_{1t}	5.78	2.85	2.03	0.08
i_{2t-1}	-2.19	0.67	-3.23	0.01
R^2	0.98			
Adjusted R2	0.97			
D.W Statistic	2.02			

Table 5-3 shows that all the estimated values of the model parameters are significant. Capital variables, labor variables and institutional variables have a significant impact on the development of the automotive industry, as an explanatory factor for it. The overall fit of the model is good. According to the estimation results of the model, the residual sequence of the model $\hat{u}_t$ can be obtained (Figure 5-7). The ADF unit root testing results of the residual data sequence are shown in Table 5-4.

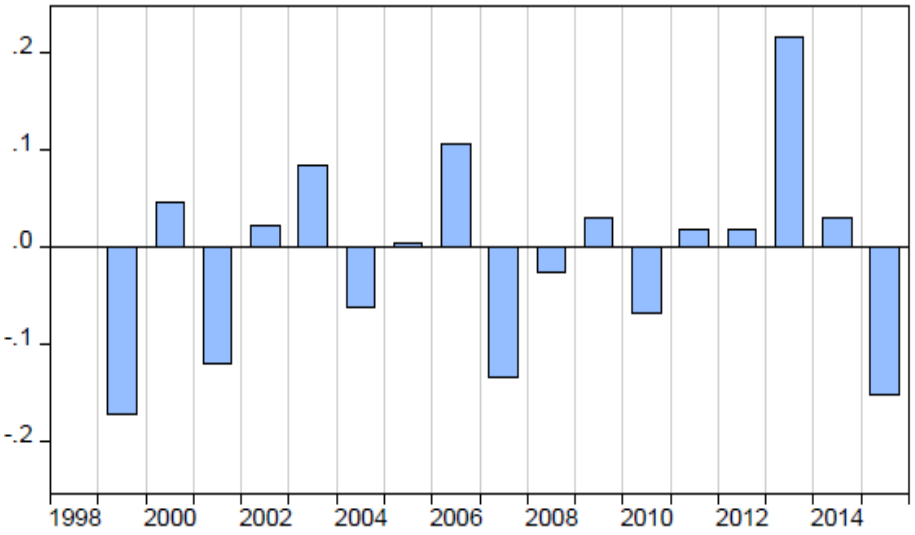


Figure 5-7 Residual Sequence Path of the Production Function Model

Table 5-4 Unit Root Testing Results of the Residual Sequence

Sequence	Level		
	T-statistic	Threshold	p Value
$\hat{u}_t$	-3.498153	-1.966270	0.0018

The unit root testing results in Table 5-4 show that the data sequence of residual $\hat{u}_t$ rejects the original hypothesis of the unit root at the 5% significance level, accepting the conclusion that there is no unit root. Therefore, it can be determined that the residual sequence is a stationary sequence. This shows that there is a cointegration relationship between the variables tested. The results of cointegration test show that under the condition of containing institutional variables, the relationship between the variables described by the production function model is long-term and stable, which can simulate the development process and trend of China's automobile industry better.

5.3 Dynamic change in the effect of institutional change on automobile industry

5.3.1 Variable parameter model of institutional change effects

Over time, the original economic structure has undergone great changes due to factors such as economic reforms, various external impact, and policy changes, and such changes cannot be expressed using traditional fixed-parameter models. Therefore, it is necessary to consider applying a variable parameter model. Hence, we applied a variable parameter model to characterize the process of institutional variables affecting the intensity of the automotive industry.

The variable parameter model can be written as the following forms:

Measurement equation: $y_t = \mathbf{z}_t'\boldsymbol{\alpha} + \mathbf{x}_t'\boldsymbol{\beta}_t + u_t$ （5-13）

State equation: $\boldsymbol{\beta}_t = \psi\boldsymbol{\beta}_{t-1} + \boldsymbol{\eta}_t$ （5-14）

$$\left(\varepsilon_t, \boldsymbol{\eta}_t\right)' \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}\sigma^2 & 0\\0 & \mathbf{R}\end{pmatrix}\right), t = 1, \cdots, T \quad \text{（5-15）}$$

In the measurement equation shown in (5-13), $\mathbf{z}_t$ is a set of explanatory variables with a fixed coefficient $\boldsymbol{\alpha}$, $\mathbf{x}_t$ is a set of explanatory variables with random coefficients, and the random coefficient vector $\boldsymbol{\beta}_t$ is a state vector, which is called a variable parameter. Since $\boldsymbol{\beta}_t$ is an unobservable coefficient vector, it must be estimated using the observable variables y_t and $\mathbf{x}_t$, and it is assumed that the variation of the coefficient vector $\boldsymbol{\beta}_t$ obeys the AR(1) model shown in (5-14) (which can also be easily extended to the AR(p) model). ε_t and $\boldsymbol{\eta}_t$ are the disturbance terms of the measurement equation and the state equation, respectively.

The estimation of the above model can be realized by Kalman filter. Kalman filter can be described as the most ideal recursive process for computing state vectors based on all available information at t. The main function of Kalman filter is to calculate the likelihood

function by predictive error decomposition when the disturbance term and the initial state vector obey the normal distribution, so that all unknown parameters in the model can be estimated, and once the new observations are obtained, Kalman filter can be used to continuously correct the estimate of the state vector.

5.3.2 Model estimation and result analysis

Based on the estimation results of the automobile industry production function model in Table 5-2, this project simulates the change process of the open system variables and the intensity of the industrial policy variables. In other words, it is assumed that the coefficients of the two institutional variables are respectively set as variable parameters and they are estimated under the same conditions.

It can be seen from Figure 5-8 and Figure 5-9 that the intensity of the opening up degree and industrial policy variables on the automotive industry has dynamic features over time.

The variable coefficient of the opening up degree variable is positive, and the coefficient is gradually increasing, which indicates that the opening up degree variable has a positive impact on the overall growth of the automobile industry. The increase of opening up degree will promote the growth of the automobile industry. The intensity of the impact of the opening up degree variable on the automotive industry has gradually increased. Before 2002, the intensity of the opening up degree variable showed a steady increase, and the speed of increase was relatively slow. Between 2002 and 2007, the intensity of the opening up degree was relatively stable. The intensity of the opening up degree variable increased rapidly from 2007 to 2013, peaking around 2013, and the impact intensity declined slightly thereafter.

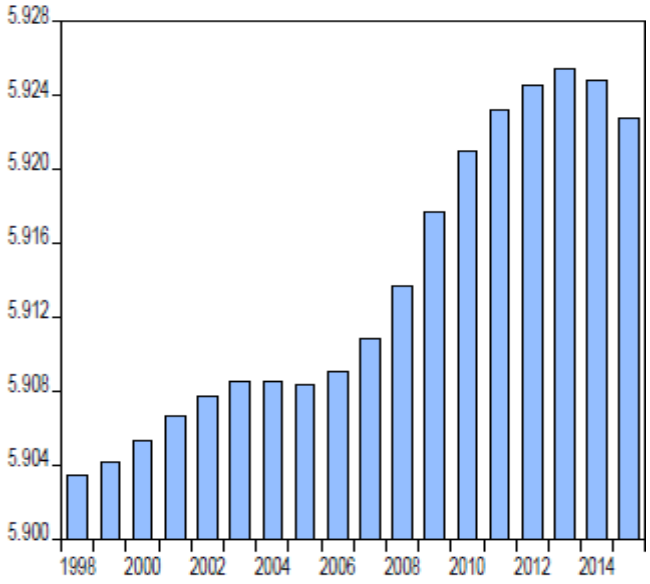


Figure 5-8 Impact Intensity Change of Opening up Degree Variable

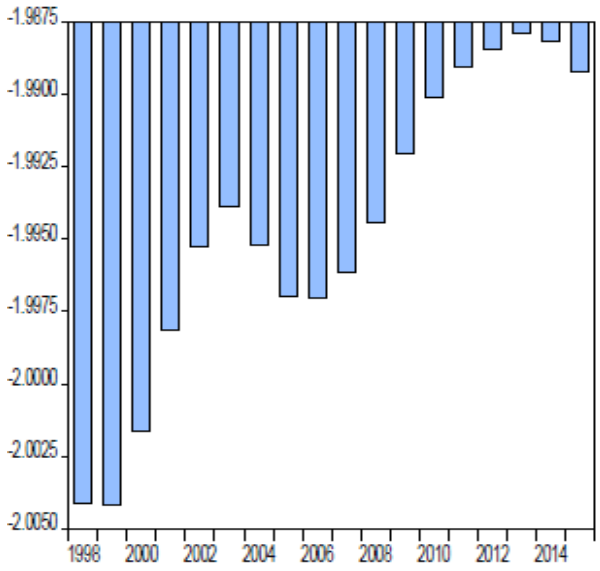


Figure 5-9 Impact Intensity Change of Industrial Policy Variable

The variable coefficient of the industrial policy variable is negative, and the absolute value of the coefficient is gradually reduced. It indicates that the industrial policy variable has a negative impact on the overall growth of the automobile industry, and the intensity of the influence is gradually weakened. The overall tax burden of China's auto industry is relatively heavy, while the tax structure is unreasonable, with the purchase process highlighted and the process of retaining and using neglected. This is not conducive to the further development of the automobile industry, and it is also difficult to give play to the wealth distribution

function and environmental protection function of the automobile industry tax. Structural tax reduction with “both increasing and decreasing, while reducing the overall burden” is one of the possible tax adjustment directions (Wang & Liu, 2014). Empirical studies have shown that reduction of tax may promote the growth of the automotive industry. The intensity of the impact of industrial policy variables on the automobile industry has gradually weakened. Before 2003, the intensity of the impact of industrial policy variables showed a steady weakening trend, and the speed of decline was relatively fast. Between 2002 and 2006, the intensity of the impact of industrial policy variables showed a steady increase, and the speed of increase was relatively slow. From 2007 to 2013, the intensity of the impact of industrial policy variables weakened rapidly, reaching the bottom near 2013, and the intensity of the impact increased slightly thereafter.

5.4 Dynamic equilibrium adjustment of automobile industry brought by institutional change

5.4.1 Johansen Cointegration Test

The Johansen cointegration test is another method of cointegration test and a very common method. The Johansen cointegration test can be used to determine the long-term equilibrium relationship between two time series (Johansen, 1990). Below we present the basic cointegration theory model.

Provided that $X_t = (Y_t, Z_t)'$, its p-order autoregressive model is:

$$X_t = A_0 + \sum_{i=1}^{p} A_i X_{t-i} + Bu_t + \varepsilon_t, \quad t = p+1, \cdots, T \tag{5-16}$$

Among them, u_t is an exogenous variable that may exist, ε_t is a sequence-independent residual sequence, and T is the sample size. The above model can be expressed as:

$$\Delta X_t = A_0 + \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + Bu_t + \varepsilon_t \tag{5-17}$$

Here: $\Pi = \sum_{i=1}^{p} A_i - I$, $\Gamma_i = -\sum_{j=i+1}^{p} A_j$

If the matrix Π in the above model is downranked, which means $0 < rank(\Pi) = r < 2$, then the components of the vector X_t are cointegrated. At this time there are column vectors α and β, which makes $\Pi = \alpha\beta'$. Here β is called cointegrated vector which can be standardized (take the first component as unit 1). With the cointegrated vector as coefficient, $\beta' X_t$ is a stationary sequence. In general, we use Johansen's characteristic root test to determine the cointegration between random sequences and obtain the most significant cointegration combination. Cointegration combinations of economic time series generally contain obvious economic implications, which represent the relationship between the common trends of these economic variables, or the long-term equilibrium relationship between them.

The unit root testing results showed that the original sequence of each variable accepted the original hypothesis of “the existence of at least one unit root” at a 5% significant level. Therefore, it can be inferred that each variable obeys the integrated process at a significant level of 5%, while the vector error correction model (VEC model) can be further used to test the long-term and short-term effects of the automotive industry development and institutional changes. This project uses Johansen Maximum Likelihood Estimation to test the cointegration relationship between the development variables of the automotive industry and institutional variables. The testing results are shown in Table 5-5 and Table 5-6.

From Table 5-5 and Table 5-6, it can be seen that there is a significant cointegration relationship between vehicle development variables and variables of opening up degree, as well as between vehicle development variables and industrial policy variables, which indicates that there is a long-term, stable synergistic change relationship between China's automobile industry development and institutional changes. The effective improvement of institutional factors can promote the development of the automotive industry.

Table 5-5 The Johansen Cointegration Testing Results Between yt and i1t

	Trace Test		Maximum Eigenvalue Test	
Original Hypothesis	r=0	r<=1	r=0	r<=1
Alternative Hypothesis	r>=1	r>=2	r>=1	r>=2
Eigenvalue	0.976807	0.944064	0.976807	0.944064
Statistic	86.41686	37.48616	48.93071	37.48616
5% Threshold	25.87211	12.51798	19.38704	12.51798
Probability Value	0.0000	0.0000	0.0000	0.0000

Table 5-6 The Johansen Cointegration Testing Results Between yt and i2t

	Trace Test		Maximum Eigenvalue Test	
Original Hypothesis	r=0	r<=1	r=0	r<=1
Alternative Hypothesis	r>=1	r>=2	r>=1	r>=2
Eigenvalue	0.945835	0.318966	0.945835	0.318966
Statistic	46.19800	5.378007	40.81999	5.378007
5% Threshold	15.49471	3.841466	14.26460	3.841466
Probability Value	0.0000	0.0204	0.0000	0.0204

The cointegration equation between the vehicle development variable and the variable of opening up degree is:

$$y_t - 4.1277 i_{1t} - 0.1160 trend_t - 6.5802 = e_{1t} \quad (5\text{-}18)$$

The cointegration equation between the vehicle development variable and the industrial policy variables is:

$$y_t + 9.8445 i_{2t} - 10.8258 = e_{2t} \quad (5\text{-}19)$$

Among them, e_{1t} and e_{2t} are cointegration errors. From (5-18) and (5-19), it can be

seen that from the perspective of the long-term level change of each variable, the variable of China’s opening up degree has a positive influence on the development of the automobile industry. In the cointegration equation including the trend term, the long-term impact coefficient is 4.13; China's industrial policy variables have a negative impact on the development of the automotive industry. In the cointegration equation, the long-term impact coefficient is -9.84. Figure 5-10 and Figure 5-11 show the variation path of the cointegration error.

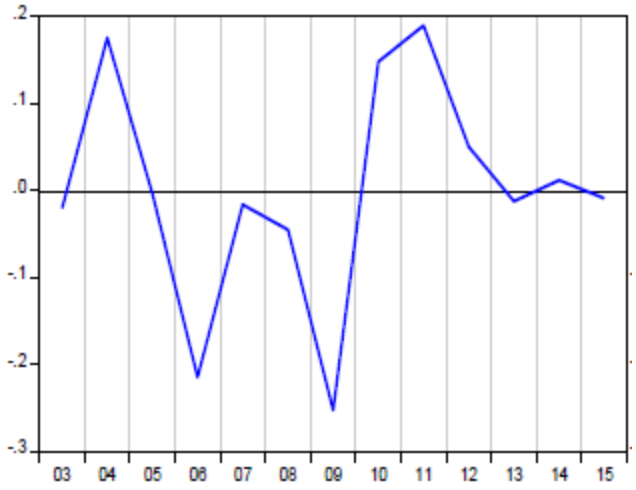


Figure 5-10 Dynamic Path of Cointegration Error e_{1t}

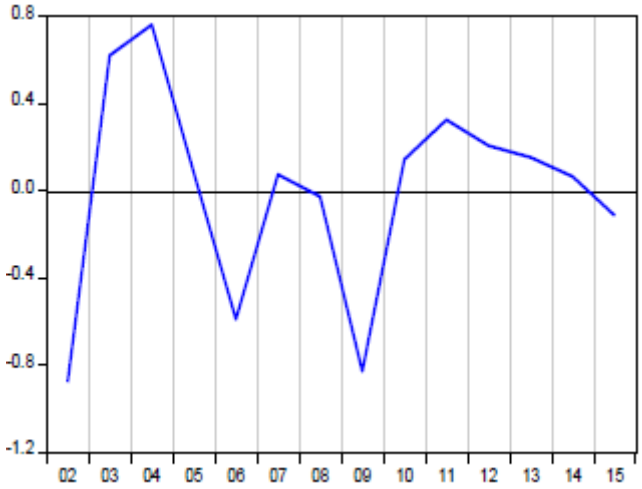


Figure 5-11 Dynamic Path of Cointegration Error e_{2t}

From Figure 5-10 and Figure 5-11, it can be seen that the cointegration errors of the two cointegrating equations basically show a state of stable fluctuation around the zero line, with

no significant deviation. The cointegration error can reflect the dynamic deviation of the equilibrium relationship between variables in the cointegration equation to a certain extent. Therefore, the stable fluctuation of the cointegration error also shows that the institutional changes have a positive effect on the development of the automobile industry, which is the guarantee for the sustainable development of the automobile industry. There is a long-term equilibrium cointegration relationship between the level of various economic variables. Therefore, we can further study the impact of Chinese institutional changes on the development of the automobile industry under the framework of the VEC model.

In the VEC model, the difference term reflects the impact of short-term fluctuations. The size of the error correction term factor reflects the strength of the adjustment to the deviation from the long-term equilibrium. According to the estimation results of the VEC model, the error correction coefficients in the opening up degree model and the industrial policy model are significant, and they are -1.755 and -0.267 respectively. When the short-term state of the automobile industry deviates from equilibrium, the relationship between opening up degree, industrial policy and the automotive industry will be pulled back from the unbalanced state to equilibrium with adjustments of 1.655 and 0.267 respectively.

5.4.2 Granger causality test

In economic analysis, it is often necessary to make judgments about the causal relationship between economic variables. Although people can make preliminary judgments based on the causal relationship between variables according to economic theory. However, since the assumptions based on different economic theories are inconsistent, it is difficult to make reasonable judgments based on economic theory alone, and may even lead to the opposite judgment regarding the casual relationship between the same combination of variables. Therefore, using the statistical inference method to obtain the empirical judgment of the causal relationship between variables from the actual observation data may be an effective method for causality test.

Granger Causality Test was initiated in 1969 by the famous American econometrician Granger, and was further developed by Hendry and Richard. In the case of a time series, the

causal relationship between two economic variables can be defined as: if the past information includes variables *X* and *Y*, the prediction effect on *Y* is better than that on *Y* with only its past information alone, which means variable *X* helps in explaining the changes regarding *Y* in the future. In this way, variable *X* Granger has an impact on variable *Y*, which means there is a casual relationship between the two. To consider whether this kind of relationship exists, we can build the following two models:

$$Y_t = \alpha + \sum_{i=1}^{m} \alpha_i Y_i + \sum_{j=1}^{k} \beta_j X_j + \mu_t \qquad (5\text{-}20)$$

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i Y_i + \mu_t \qquad (5\text{-}21)$$

If $\beta_j = 0$ exists to all $j = 1,2,\cdots,k$, then X will not lead to Y, and there is no causal relationship between the two. The choice of the lag period can be arbitrary.

In this way, we can assume that:

$$H_0 : \beta_j = 0, \quad j = 1,2,\cdots\cdots k$$

Then we go back to the regression of formula (5-20) and (5-21), to get the residual sum of square of EES_1 and EES_2, as well as the residual sum of square of RSS_1, and to construct the following statistic:

$$F = \frac{(EES_1 - EES_2)/m_1}{RSS_1/[T-(k-m+1)]} \qquad (5\text{-}22)$$

The *F* statistic obeys the first degree of freedom of m, and the second degree of freedom is the distribution of $T-(k-m+1)$, with a given level of significance α, then the relative critical value is F_α. If $F > F_\alpha$, then the assumption of H_0 is rejected by the confidence of $(1-\alpha)$. In the meaning of Granger, X is the cause of Y, otherwise H_0 hypothesis is accepted, and the change of Y cannot be imputed to the chance of X.

According to the estimation result of the vector error correction model, the Granger Causality Test between the vehicle development variable and the opening up degree variable,

as well as between the vehicle development variable and the industrial policy variable can be performed. The testing results are shown in Table 5-7.

Table 5-7 Grange Causality Test Results Between yt and i1t as well as Between yt and i2t

Original Hypothesis	χ^2 Statistic	Degree of Freedom	P Value
y_t has no Granger impact on i_{1t}	1.912103	3	0.5908
i_{1t} has no Granger impact on y_t	52.42069	3	0.0000
y_t has no Granger impact on i_{2t}	17.60884	3	0.0005
i_{2t} has no Granger impact on y_t	7.220790	3	0.0652

From Table 5-7, it can be seen that under the 10% significance level, there is a one-way Granger impact relationship between China's automobile development variables and variables of the opening up degree. The changes in the opening up degree is the Granger cause for the development of the automobile industry, therefore, changes on the degree of opening up have a significant effect on the automotive industry’s development. There is a two-way Granger impact relationship between China's automobile development variables and industrial policy variables. Therefore, on the one hand, industrial policy changes have an effective and adjustable effect on the changes of the automobile industry. On the other hand, industrial policies respond to changes in the automobile industry.

5.4.3 Impulse response function

Since the VAR model is a non-theoretical model, it does not need to make any apriority constraints on the variables. Therefore, when analyzing the VAR model, how the change of one variable affects the other variable is often not analyzed, but rather the dynamic effect on the system when the error term changes, or when the model is subjected to a certain impact, is analyzed. And this analysis method is called the impulse response function method.

The impulse response function is used to measure the impact of a standard deviation shock from a random disturbance term on the current and future values of endogenous variables. The basic idea of the impulse response function is explained below based on the VAR model of two variables.

$$\begin{cases} x_t = a_1 x_{t-1} + a_2 x_{t-2} + b_1 z_{t-1} + b_2 z_{t-2} + \varepsilon_{1t} \\ z_t = c_1 x_{t-1} + c_2 x_{t-2} + d_1 z_{t-1} + d_2 z_{t-2} + \varepsilon_{2t} \end{cases} \quad t = 1, 2, ..., T \tag{5-23}$$

Among them, a_i, b_i, c_i, d_i are parameters, $v_t = (\varepsilon_{1t}, \varepsilon_{2t})'$ is the disturbance term, and provided that it is the white noise vector with the following properties:

$$\begin{cases} E(v_t) = 0 \quad , \forall t \\ Var(v_t) = E(v_t v_t') = \begin{pmatrix} \sigma_1^2 & 0 \\ 0 & \sigma_1^2 \end{pmatrix}, \quad \forall_t \\ E(v_t v_t') = 0 \quad \forall_t \neq s \end{cases}$$

Provided that the above system starts from stage 0, with $x_{-1} = x_{-2} = z_{-1} = z_{-2} = 0$, and provided that the above system starts from stage 0, with $x_{-1} = x_{-2} = z_{-1} = z_{-2} = 0$ again. Then assume that stage 0 defines the disturbance term of $\varepsilon_{10} = 1, \varepsilon_{20} = 0$, and all the followings are 0, which means $\varepsilon_{1t} = \varepsilon_{2t} = 0 (t = 1, 2, ...)$. Hence, stage 0 gives x an impulse, and the response between x_t and z_t is discussed below: when on stage 0, put $x_0 = 1$ and $z_0 = 0$ into formula (3-3); when on stage 1, with $x_1 = a_1$ and $z_1 = c_1$, and take this result into formula (3-3); when on stage 2: $x_2 = a_1^2 + a_2 + b_1 c_1$, $z_2 = c_1 a_1 + c_2 + d_1 c_1$, and continue the calculation, provided the result is: $x_0, x_1, x_2, x_3, x_4, \cdots$ which is called the influence function of x caused by the impulse of x. Similarly, calculate $z_0, z_1, z_2, z_3, z_4, \cdots$ and call it the response function of z caused by the impulse of x.

The impulse response function describes the impact effect trajectory of a certain endogenous variable on other variables in the VAR.

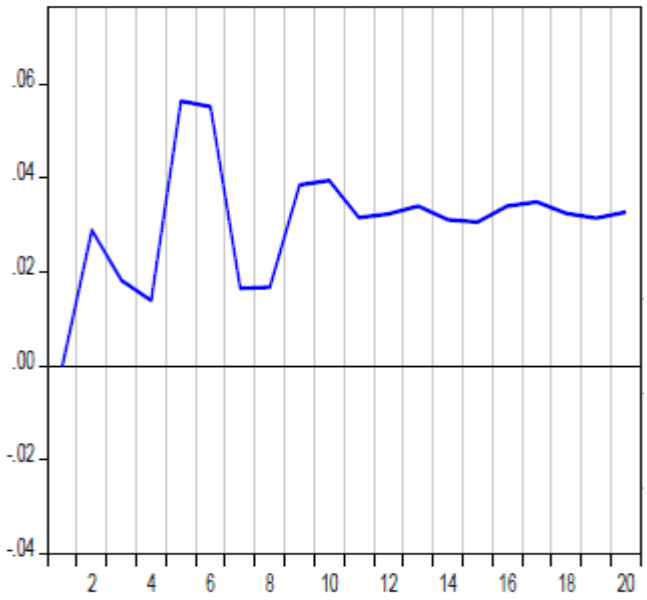


Figure 5-12 Impact Effect of Variables of Opening up Degree

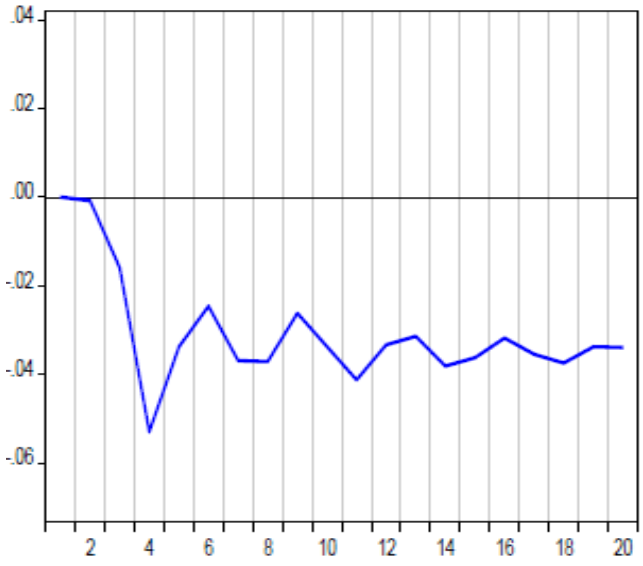


Figure 5-13 Impact Effect of Industrial Policy Variables

From Figure 5-12, it can be seen that the opening up degree variable has a positive impact on the development of the automotive industry. And it continues to increase during the stage of 0~3. During the stage of 4~8, the impact intensity generally increases, with large fluctuations. After the 9th stage, the impact intensity is relatively stable. As can be seen from Figure 5-13, the impact of industrial policy variables is positive on the development of the automotive industry. And it continues to increase during the stage from 0 to 4. During stage 5 to 11, the impact intensity generally increases, with large fluctuations. After stage 12, the

impact intensity is relatively stable.

The research methods in this chapter are summarized as follows:

Table 5-8 Summary of the Main Research Methods Applied in this Chapter

Method	Purpose	Software Applied	Testing Results
HP Filter	Identify long-term trend components of time series	Eviews	The key variables of the analysis have obvious trend components, and it is possible that there is some correlation between the variables.
Correlation Coefficient	Measure the size of the correlation between variables	Eviews	The correlation coefficient between key variables is above 0.6, and the econometric model can be further established to feature the relationship between variables.
Cointegration	Feature long-term, stable relationships among variables	Eviews	There is a significant cointegration relationship between key variables, and there is a long-term and stable correlation between institutional changes and the development of the automobile industry.
Vector Error Correction Model (VEC Model)	Feature the relationship between long-term and short-term changes of the system variables under the constraint of cointegration	Eviews	The dynamic relationship between key variables can be simulated and predicted via the VEC model. The long-term correlation between institutional changes and the automotive industry will affect the short-term features of the automotive industry.
Granger Causality Test	Identify the relationship between short-term changes in variables under the frame of VEC model	Eviews	Granger causality exists between short-term changes in key variables, and institutional change is the Granger cause for the short-term changes in the automotive industry.
Impulse Response Analysis	Simulate the effect of the change of one variable on others under the frame of VEC model	Eviews	Sudden changes in institutional variables have a significant impact on the automotive industry, and this kind of impact is sustainable.

Variable Parameter Model	Describe the change in the intensity of the explanatory variable's influence on the other variables over time	Eviews	The influence relationship between key variables has obvious time-varying features, and institutional changes will not only affect the development of the automobile industry, but the intensity of impact will also change in different periods.

Chapter 6: Institutional change and China's automobile industry: case study

6.1 Geely: the first private automobile enterprise in China

6.1.1 1996: acquisition of production and operation rights

(1) Basic situation

At the beginning of his career, Li Shufu once spent 60,000 yuan to buy a Zhonghua sedan. "What is a car? Isn’t it four wheels, one steering wheel, one engine, one body shell, two sofas inside?" With this fearless power, Li Shufu turned his attention to a new field.

In the 1990s, the automobile industry has not been open to private enterprises. Li Shufu did not give up because of it. He decided to take a devour and start the motorcycle factory first. Li Shufu created the first pedal motorcycle in China, and the demand of this product has been exceeded the supply since its launch in the market. However, Li Shufu has never forgotten to build an automobile factory in the future and he has actively planned the construction of “Geely Haoqing Automobile Industrial Park”.

In 1996, Li Shufu learned that an automobile factory under the Deyang Prison in Sichuan had the right to manufacture and operate, so together they established a joint venture Sichuan Geely Boeing Automobile Co., Ltd., and it is later renamed Geely Automobile Manufacturing Co., Ltd.

On 1998 August 8, the first car of Geely was off the assembly. Since it is included in the national-approved production directory, only one deputy governor was shown in the unveiling ceremony although there were more than 700 invitations. "I really wanted to cry. I have a 100-table banquet, but I do nothave a guest. What is that like?"

In 1999, Zeng Peiyan, then director of the State Planning Commission, inspected Geely Group, Li Shufu said to him: "Please allow private entrepreneurs to dream of automobiles. If

it fails, please give me a chance to fail."

In November 2001, before joining WTO, Geely Haoqing was listed on the automobile manufacture product directory, and Geely Group became China's first private enterprises qualified to produce automobiles. In order to break the myth that small private enterprises can't make cars, he deliberately said, "What's mysterious about making a car? Isn't it four wheels, two couches, plus an iron shell!" Some people say that Geely's manufacture of automobile is tantamount to suicide, and he replied, "Then give us a chance to commit suicide!"

In the early days of the venture, Li Shufu opened the domestic market with cheap cars. The ultra-low price has triggered a wave of price cuts for peer car enterprises in this kind, and cars are no longer exclusive to the rich. However, while enjoying the price advantage, Geely has become the synonym of low cost and low end. It has even been joked that "There is no fear of death and no fear of suffering to drive a Geely."

(2) Policy background and effects

The Policy on Automotive Industry in 1994 provided a window of opportunity for the entry of Geely Automobile and a broad market development potential. Policy on Automotive Industry is the first policy on automobile industry since the founding of the People's Republic of China and is a programmatic industrial document that specifically implements the spirit of the "14th National Congress". The policy makers believe that only by formulating a comprehensive and stable policy based on the objective laws of the development of the automobile industry and by creating a good market environment suitable for the development of the automobile industry, can we fundamentally change the passive situation of the development of China's automobile industry, and then realize the goal of constructing this industry as a pillar of the national economy.

Under the guidance of the Policy on Automotive Industry, most of the new projects are funded in a shareholding system. At the same time, in order to alleviate the burden on large key enterprises, the state implemented "debt-to-equity swaps" for some enterprises, approved some enterprises to go public, and established financial companies and raised capitals from private companies and individuals, which has broadened financing channels and optimized

capital structure. At the same time, the policy clarified the direction of sedan-oriented automobile development, first proposed to encourage car consumption, allow private car purchases, and have a clear localization requirement for joint venture products.

In October 2000, the 4th plenary session of the 15th central committee approved the Proposal of 10th Five-Year Plan of CPC Central Committee on National Economic and Social Development which put forward to develop public transport and promote cars and computers to enter Chinese families. For the first time, the Proposal stated that it was necessary to vigorously revitalize the automobile manufacturing industry and it encouraged families to purchase sedans. From then on, "letting cars enter the homes of ordinary people" directly promoted the expansion of the automobile consumption market, and the varieties of cars for private consumption have sprung up in the market.

Li Shufu sharply grasped the policy opportunities and strode into the auto industry. In 1999, the total assets of Geely Group exceeded 2 billion; in 2003, it exceeded 200 billion; in 2005, Geely went listing in Hong Kong. And Geely's sales performance is equally impressive, as well as Li Shufu's "crazy remarks": "To sell cars like selling cabbage", "Let China's cars go to the world, rather than let the foreign cars run all over China." It is these remarks that made Li Shufu the title of "Car Madman".

At the same time, in the early days of the company's establishment, in the face of fierce competition from other domestic auto companies, Geely chose to target low-end models that have long been ignored by foreign auto companies, thereby controlling costs and using the cost advantage to occupy the market and achieve small profits but quick turnover. Geely's business mode is to enter the auto market with "low price". Compared with international advanced technology, China's auto industry is still in its infancy and not able to compete with international high-end models. Therefore, Geely chose "low-end models" as the main product of market operation. However, the investment in mid-level and high-end cars continues. At this stage, Geely’s strategy is to “build good cars that ordinary people can afford”. The strategy of focusing on low-end models has granted Geely a place among many domestic auto companies, but it also left consumers with the impression as a low-end brand.

6.1.2 2010: “small” Geely acquired “big” Volvo

(1) Basic situation

In 2002, Li Shufu once planned to acquire the British Rover Automobile, but due to lack of experience, he eventually fell one step behind and lost to Nanjing Automobile Company. Four years later, he stared at Mercedes-Benz's fancy model Smart, but the other party put forward harsh conditions that made it unacceptable.

After two failures, Li Shufu finally got an opportunity. In 2006, Geely Group won the favour of the British century-old automobile company Manganese Bronze Holding Co., Ltd., and the two parties jointly established the Shanghai Yinglun Dihua Joint Venture to produce the famous London black minibus in Shanghai and realized the “British brand made in China”. In 2008, Li Shufu took advantage of the opportunity brought about by the financial crisis to win the second-ranked Australian DSI automatic transmission company.

Due to the financial crisis of 2008, the Ford Company of the United States has turned its strategic direction and has no spare capacity to take care of many brands under it. It must focus its resources on the Ford brand and turn to the “One Ford” strategy through resource integration, maximizing the use of innovative technologies and resources, developing the models that users really need, and using modularization of components to improve economies of scale. Ford is eager to get rid of its other brands to reduce losses.

Li Shufu has long admired the Volvo brand and has the successful experience of acquiring the British Manganese Bronze Company and the Australian DSI Company. To take the Geely brand to global arena, he embarked on the acquisition of Volvo.

In early 2009, Li Shufu received a guest from afar - John Thornton, an independent member of board of Ford. Thornton’s visit to the Geely Group has only one purpose: to examine the strength and sincerity of buyers interested in acquiring Volvo. As a result, he concluded that Ford should seriously consider the Geely Group's offer. On October 31, 2009, Ford finally made choice between two bidders - French automobile company Renault and China Geely Group: Geely Group is the preferred bidder.

In December 2009, Geely and Ford have announced a framework agreement. On March

28, 2010, after several rounds of negotiation on the price, Geely Automobile signed a formal agreement to acquire Volvo of Ford Motor Company in Gothenburg, Sweden, and the $ 1.8-billion purchase price also created by far the largest amount of overseas car acquisition case for a Chinese private enterprise. Geely was gorgeously staged a "Common Man Marrying to a Princess" show.

Regarding the development direction of Volvo, Li Shufu said in the speech at the signing ceremony: "Geely does not produce Volvo, Volvo does not produce Geely." He said that Volvo is a tiger which "should return to the forest," to free this "Tiger" needs to restore Volvo's own value.

(2) Policy background and effects

Since the 5th Plenary Session of the 15th CPC Central Committee, China has begun to fully implement the "going out" strategy. In 2004, the Policy on Development of Automobile Industry proposed to explicitly support large-scale automobile enterprise groups and foreign automobile groups to jointly reorganize domestic and foreign automobile production enterprises, expand the market operation scope, and adapt to the globalization trend of automobile production.

In 2005, the State Council issued the Suggestions on Encouraging, Supporting and Guidance for the Development of Individual and Private Sectors and other Non-public Economy. The document clearly states that the government supports private enterprises to participate in international competition, and will gradually increase support in fiscal, tax and financial aspects for the non-public sector of the economy, and encourage qualified enterprises to conduct foreign investment and transnational operations. In May 2007, the Ministry of Commerce jointly issued Suggestions on Encouraging, Supporting and Guiding Non-public Enterprises in Foreign Investment and Cooperation, to encourage, support and guide non-public enterprises to actively participate in international competition and cooperation.

In 2009, the State Council issued the Plan on Adjusting and Revitalizing the Auto Industry as an action plan for the comprehensive response measures of the automobile industry. The main tasks of the Policy include cultivating the automobile consumption market,

promoting the restructuring of the automobile industry, supporting independent innovation of enterprises, implementing new energy strategies and independent brand strategies, and developing modern automobile service industries. In May 2010, the State Council issued Suggestions on Encouraging and Guiding Private Investment in Healthy Development, clearly proposed to promote private enterprises to strengthen independent innovation, transformation and upgrading.

In this context, Volvo can almost meet all of Li Shufu's requirements for an automobile brand: first, he needs to use Volvo, an international brand with more than 80 years of history, to take Geely to the high-end level. Geely Group's financial consultant said in a report: "Volvo is a company with the ability to revitalize and develop sustainably, with 4,000 high-quality R&D talents, low-carbon engine production technology and over 2,400 dealers in more than 100 countries around the world..." Secondly, he always wanted to be the leader of the Chinese automotive industry in terms of the concept of "energy saving, environmental protection and safety car", and Volvo is known worldwide for its energy saving, environmental protection and safety. Li Shufu said: "Ford and Volvo have spent tens of billions of dollars studying new energy technologies in the past 10 years. I think it is very cost-effective to buy them with $ 1.8 billion." Geely's acquisition of Volvo also embodies the theoretical logic of knowledge transfer. From a theoretical point of view, the larger the scale of the invested (acquired) European enterprises, the higher the expected performance of reverse knowledge transfer. Large enterprises with a long business history are generally rich in knowledge sources and innovation capabilities. Therefore, the reverse knowledge outflow of such enterprises is expected to be higher. The foreign investment behavior of Chinese multinational enterprises aiming at knowledge learning is often aimed at large European enterprises.

Therefore, Geely's acquisition of Volvo includes the following outcomes:

The first is to achieve strategic transformation of the enterprise. In 2007, Geely promoted the transformation plan and changed the original strategy of "making a good car that can be afforded by ordinary people" into "making the safest, most energy-efficient and environmentally-friendly car", thus making an overall change in technology, quality and

various concepts. Through the implementation of this strategic transformation, Geely plans to gradually transform its core competitiveness from the previous cost advantage to technology and research and development advantages. At this time, Geely was only established for 20 years, and its independent research and development capabilities and technical reserves are seriously insufficient. If Geely wants to achieve strategic transformation quickly, it must acquire advanced production technology and other resources through external mergers and acquisitions. Before the acquisition, Volvo's three best-selling models XC60, V50, and V70 have not yet been introduced to the Chinese market. The introduction of these models will better meet the quality requirements of consumers. The acquisition of Volvo Cars will increase the overall quality of Geely, which was originally only a low-priced car, to gain the trust and choice of higher-end consumers.

The second is to obtain technical support. After Geely acquired Volvo, its R&D capabilities in both safety technology and new energy technology have been greatly improved. Geely chose to acquire Volvo, in large part because Geely took a fancy to the advanced technology and patents owned by Volvo. Volvo has been a global leader in automotive safety technology, and the cars produced by it are considered to be the safest cars in the world. At the same time, Volvo also has considerable R&D capabilities in terms of low carbon environmental protection. Volvo's self-developed engine can meet the European V and European VI vehicle exhaust emission standards.

The third is to obtain the brand effect. As a Nordic car company with a history of nearly 100 years, Volvo has established a high-end luxury image in the eyes of consumers all over the world. Volvo's S- series, XC and other car systems are synonymous with luxury cars. The acquisition of Volvo will allow Geely to enter the high-end model market directly, filling its gap in the high-end market, therefore Geely will have a complete product line covering high, medium and low-end models. At the same time, the case of small and medium-sized enterprises to reversely merging and acquiring large enterprises can also play a very good publicity effect, and also help to enhance Geely's brand image.

The fourth is to gain market share. Volvo has nearly 2,400 dealers in more than 100 countries and regions, 90% of which are located in Europe and North America. Such a

complete dealer network is not only Volvo's asset, but also allows Geely to obtain Volvo's overseas sales network and quickly open up overseas markets. The acquisition of Volvo can also allow Geely to directly enter the mid- to high-end market and expand its market share.

6.1.3 2018: wonder continued - Geely acquired daimler

(1) Basic situation

In 2018, the car madman Li Shufu acquired a 9.69% stake in Daimler for $ 9 billion and became the largest shareholder of the Mercedes-Benz parent company, causing industry tremors. Headquartered in Stuttgart, Germany, Daimler's business units include Mercedes - Benz passenger cars, Daimler trucks, Mercedes - Benz light commercial vehicles, Daimler buses and Daimler financial services. Upon completion of the acquisition, Geely Group will become the largest shareholder of Daimler and promise to hold its equity for a long time.

Li Shufu said: "The global automotive industry in the 21st century faces tremendous opportunities for innovation and challenges from non-automotive companies. It is difficult for individual auto companies to win this war alone. In order to seize the opportunity, we must refresh our thinking pattern and cooperate with friends and partners to capture the technical commanding heights through collaboration and sharing. The investment in Daimler is based on this strategic thinking." At the same time, Daimler is a global automotive leader in the field of electrification, intelligence, driverless and sharing travel. From the perspective of strategic coordination, Daimler, Geely and Volvo will have synergies together.

(2) Policy background and outlook

Cultivating and developing new energy vehicles has become a strategic measure to alleviate energy and environmental pressures, promote the transformation and upgrading of the automobile industry and realize the sustainable development of the automobile industry. Policy protection plays an important role in the development of new energy vehicles. In 2009, the *Plan on Adjusting and Revitalizing the Auto Industry* first proposed the new energy vehicle strategy and arranged 10 billion yuan to support the industrialization of new energy vehicles and key components. It is proposed that during the period of 2009-2011, the industry will reach the capacity of 500,000 units of new energy vehicles including BEV, PHEV and

ordinary hybrids, and the sales of new energy vehicles should account for about 5% of the total sales of passenger vehicles.

In 2012, the State Council issued the *Energy-saving and NEV Industry Development Plan (2012-2020)*, further defined the goal, tasks and measures of the development of energy saving and China's NEV industry. In July 2014, the State Council issued *Guiding Opinions on Accelerating the Promotion of the Use of New Energy Vehicles*, putting forward 30 specific policy measures from 8 aspects including the general requirements, charging facility construction. In 2015, *Made in China 2025* proposed “energy-saving and new energy vehicles” as a key development area.

Geely faces the pressure to introduce electric vehicles, which must meet strict new standards. By 2025, sales of new energy vehicles will account for at least one-fifth of local sales, and an interlaced quota system will be implemented from 2018. As early as 2015, Geely Automobile set a target for new energy vehicles, and by the end of the century, its sales will account for 90%. Most of them are hybrid and plug-in hybrids.

In the field of new energy vehicles, Daimler has always been more radical in the three luxury brands. The company plans to invest more than $ 10 billion in the future of electric vehicles. In addition to investing in electric vehicle manufacturing, an additional $1 billion will be invested in the production of battery products. A large part of this $1 billion will be used in battery plant construction. The plant will be used to produce electric SUVs and other models. Daimler has also actively deployed in the Chinese new energy vehicles market. The company's shareholding in BAIC New Energy was approved by the National Development and Reform Commission. Daimler also established a joint venture with BYD to jointly launch the Tengshi pure electric vehicle. The cooperation between Daimler and Geely has also become one of the focuses of the industry.

6.2 Tengzhong: China’s failed auto dream to go international

6.2.1 Tengzhong's acquisition of hummer

On June 2, 2009, General Motors and Tengzhong Heavy Industrial Machinery Co., Ltd

signed the Memorandum of Understanding on the merging and acquisition of Hummer, and Tengzhong will get all the equities as well as executives and operation teams of the latter. However, the final realization of this merger still needed to be approved by the Ministry of Commerce, the National Development and Reform Commission and other departments.

On July 15, 2009, Tengzhong said it had submitted an application to the NDRC, marking the acquisition of Hummer entering the official approval stage. The approval of the two steps of the acquisition of Hummer and Hummer localization was carried out respectively by the Ministry of Commerce and the National Development and Reform Commission.

On August 14, 2009, the signing was repeatedly postponed due to the disagreement between GM and Tengzhong on the specific asset prices of Hummer.

On August 21, 2009, in order to prepare to take over Hummer, Tengzhong is actively deploying related work, and hired Huang Zhiqiang, the vice executive president of Chery Sales Company and deputy general manager of Chery Automobile International Co., Ltd, in preparation for the establishment of Hummer China operations team in Shanghai, which will mainly be responsible for the sales of imported Hummer in China.

On August 24, 2009, Tengzhong executives flew to Detroit and prepared to start the final negotiations with GM. The official sale agreement of Hummer would also be signed and announced to the public. However, the approval of the regulatory authorities of China and the United States was required before the transaction taking effect.

On September 29, 2009, the National Development and Reform Commission has completely rejected the application for the acquisition because the acquisition report only registered the intention to acquire the Hummer brand, which did not belong to projects that needed NDRC approval.

On October 10, 2009, Tengzhong and GM announced the signing of a definitive agreement for the sale of GM's Hummer brand of high-end all-terrain business. Tengzhong will acquire the ownership of the Hummer brand, trademark and trade name for around US$ 170 million, and will have the right to use the specific patents necessary for the production of Hummer.

On February 1, 2010, Tengzhong Heavy Industrial Machinery Co., Ltd. and General Motors reached agreement on the one-month extension of the deadline for Hummer deal (from January 31 to the end of February). At the same time, they had to wait for the approval of Chinese regulators.

On February 25, 2010, General Motors headquarters in Detroit announced that Tengzhong could not complete on schedule the acquisition of Hummer, therefore the acquisition transaction failed, and GM will gradually shut down Hummer operations.

6.2.2 Comparison between Geely and Tengzhong

(1) Target selection

Before Geely acquired Volvo, Zhejiang Geely Holding Group Co., Ltd. was one of the top ten enterprises in China's auto industry. Since entering the sedan field in 1997, it has been one of the top 500 Chinese enterprises for five consecutive years and entered the top ten in auto industry in China for three consecutive years. Geely's acquisition target — Volvo Car Corporation is the largest auto company in Northern Europe and the largest industrial group in Sweden and one of the top 20 auto companies in the world. Geely has more than ten years of experience in automobile production in China and has a good foundation for acquiring Volvo.

In the Tengzhong & Hummer case, Tengzhong was the Sichuan Tengzhong Machinery Manufacturing Co., Ltd. which was incorporated in 2005, and changed its name to Sichuan Tengzhong Heavy Industrial Machinery Co., Ltd. It was a modern heavy industry enterprise focusing on construction machinery, new energy, petrochemicals equipment and others. From the perspective of the industry, Tengzhong did not have the experience of producing passenger cars. The acquisition of Hummer, the famous automobile brand under GM, was difficult to control in many details. It was also difficult to get the industry’s recognition in terms of its ability to operate in the automobile industry and integrate the industry chain.

(2) Financing channel

Geely's rapid development and good performance in recent years have enhanced the confidence of financial institutions and private funds in the success of their mergers and

acquisitions. At the same time, because its mergers and acquisitions meet the requirements of the development of national industrial policies, it was easier to get receive government support. This makes Geely's acquisition of Volvo supported by not only funds from domestic financial institutions, local development funds and other semi-private funds, but also financial support from foreign financial institutions. Therefore, its financing channels are more stable.

In contrast, domestic financial institutions suspected of Tengzhong in the acquisition because of the high risk and synergy effect, which made them hesitate in this "gamble", so the acquisition of Tengzhong to Hummer was mainly funded by foreign financial institutions. Therefore, its capital resource channels were narrow and the risk was relatively greater.

(3) Core Technology

Geely's wholly owned acquisition of Volvo gives it not only the full shareholding of Volvo, but also all of Volvo's key technologies (including ownership of core technologies and intellectual property which was unique in automotive safety and energy conservation). The acquisition was conducive in realizing synergies in brand and technology, which would not only enhance the product brand image, but also the core competitiveness in the international market.

Tengzhong acquired only the brand of Hummer under GM, and its main purpose is to obtain Hummer’s corresponding management experience, market, which did not involve the core technology of the automobile manufacturing industry.

(4) Product demand

At present, “green, energy saving and environmental protection” has become the theme advocated globally. In the case of Geely's mergers and acquisitions, Volvo was a well-known brand in the world. The cars it produced were recognized as environmentally friendly cars in the world and in line with the future development trend of the automotive industry. In addition, Geely's mergers and acquisitions were overseas mergers and acquisitions supported by the national macro policy, so it was easier to obtain support and approval from relevant government departments.

The Hummer that Tengzhong intended to acquire was a high-displacement, high-volume,

high-consumption car. In today's automotive industry where energy efficiency and environment protection has become the mainstream, Hummer models were inconsistent with the trend of low-carbon environment protection and did not meet the development needs of China’s energy conservation.

6. 3 Main implications

The case of Geely Automobile showed that the rise of Chinese auto companies could not be separated from the support of the auto industry policy. It was precisely in the context of the support of automobile industry policy that Geely Automobile seized the opportunity of strategy, enhanced its core development capability, created one “miracle” after another in the world automobile field, and became an outstanding representative of China's own brand.

The development of Geely Automobile reflected that China's auto companies needed to upgrade the key capabilities in an open and developing way. The first was the ability to innovate in technology. At the beginning of the establishment of Geely Automobile, the cost was reduced through low-end imitation, and the market was rapidly expanded with a low-price strategy. However, compared with the famous brands such as Mercedes-Benz, there was still a big gap. The important achievement of Geely's acquisition of Volvo was to obtain some of Volvo's core technologies, and Tengzhong did not acquire the core technology of Hummer, but only the external brand value. Lack of core technology and self-developed intellectual property rights were the bottleneck that restricted the development of Chinese automobile enterprises. The second was the ability to integrate resources. Geely Automobile's “going out” strategy has opened the prelude to its global resource integration and provided valuable experience for other domestic auto companies to “go out”. Looking at Toyota, GM, Volkswagen and other multinational auto giants, all of them are highly capable of global resource integration, which can be reflected in their improvement of efficiency and core competitiveness. The key is to integrate and utilize the market, technology and other advantages of resources around the world. The world is in the post-financial crisis period and the world's major auto groups have encountered difficulties, but this also opened a strategic opportunity window for Chinese auto companies to "go global." At the same time, the failure

of Tengzhong and other enterprises also showed that for the Chinese automobile enterprises, the integration of global resources is still long way to go.

China's auto industry policy has an important role in promoting the development of auto companies.

The automotive industry policy helps auto companies improve their technological innovation capabilities. For example, the *Policy on Automotive Industry* in 1994 and the *Policy on Development of Automotive Industry* in 2004 actively encouraged auto companies to increase their investment in independent R&D and technological innovation and accelerate the development of products with independent intellectual property rights and certain competitiveness to bring products to the international market. In the context of the implementation of industrial policies, Geely experienced a journey from imitation to self-made vehicles. Geely Research Institute has gathered a variety of senior talents such as academicians, doctors and masters. It has established the positive self-development capability of key technologies such as automobile, engine, transmission and new energy. Based on this, Geely has streamlined the product sequence through scientific planning of product platforms and continuous deepening of generalization, and in the past two years, it has continuously introduced new cars that are more in line with consumer concepts.

The automotive industry policy helps auto companies improve their resource integration capabilities. For example, the 2008 US financial crisis threw the global economy into trouble, and it also brought many negative effects to the development of China's automobile industry. *Plan on Adjusting and Revitalizing the Auto Industry* once again clarified the core development strategy of independent innovation and encouraged the acquisition of multinational auto companies as an opportunity to learn and absorb advanced foreign technology, comply with the trend of globalization, and actively explore the market. Geely Automobile complies with the policy, seizes the opportunity and continuously expands its domestic and international marketing network. Through the implementation of B2B and B2C network marketing, it has created a new channel for car sales. Especially after the successful acquisition of Volvo, Geely has entered the high-end brand and stood out among the competitors in the industry. Geely not only acquired Volvo's safest technology, but also

possessed a Swiss production base and a well-established foreign marketing network.

Therefore, policy is an important driving force for the development of automobile enterprises, and automobile enterprises are the carriers of the automobile industry policy. The automobile industry policy, as a set of various policies formulated by the central or local government of a country to actively intervene in the economic activities of the automobile industry, has important functions of making up for market failure, regulating and allocating resources, and promoting fair competition. The formulation of the automobile industry policy needs to be adapted to the stage of economic development of the country. The scientific and rational automobile industry policy has far-reaching impact on the healthy development of the country's automobile industry. The automobile industry policy realized the purpose of adjusting the organization and structure of the automobile industry by acting on the behaviour and capabilities of automobile enterprises. The implementation of the automobile industry policy will promote the changes in the internal production environment and the external competitive environment of automobile companies, thus guiding the development direction of the entire automobile industry. The sensitivity, responsiveness and cooperation of auto companies to policies not only determine the degree of achievement of policy objectives, but also the opportunities for the survival and development of auto companies. The combination of automobile industry policies and the intrinsic conditions of automobile companies has prompted a series of changes in the behaviour and capabilities of automobile companies.

At the same time, as the government plays an important role in the formulation, implementation and improvement of the automobile industry policy, it is necessary to properly handle the relationship between the government, the market and the enterprise, and to properly position the automobile industry policy. At the government level, the formulation of the automobile industry policy should avoid short-sighted market behaviour, carefully maintain market rules, protect the fairness and effectiveness of market competition, give full play to the positive role of the market, and foster a sound environment for the development of the automobile industry. From the perspective of development trends, China's macro economy will still be in a relatively stable growth period. As an important pillar industry of the national economy, the automobile industry policy will continue to play a significant role. Auto

companies need to grasp the development opportunities brought about by industrial policies and continuously improve their technological innovation and resource integration.

Chapter 7: Conclusions and Discussions

This chapter provides research conclusions, implications for management, research limitations and prospects.

7. 1 Main research conclusions

Institutional economic theory has opened a new chapter in the development of economics. In the history of the world economy, the economic rise of European and American countries has benefited from the high efficiency of the system released by the incentive mechanism brought about by the clarification of the property rights system. The institutional economic theory brings the key to the study of the development of China's automobile industry.

The development of China's automobile industry is accompanied by the process of institutional change. The adjustment of automobile industry policy is an important manifestation of the institutional changes in the automobile industry. China has formulated relevant policies for the development of the automobile industry in different historical periods. The evolution of the automotive industry policy can be roughly divided into three phases: the 1994 Policy on Automotive Industry, the 2004 Policy on Development of Automotive Industry and the 2009 Plan on Adjusting and Revitalizing the Auto Industry. With the continuous improvement of the automobile industry policy system represented by the three major policies and the continuous improvement of the policy implementation effect, China has become a major automobile production and sales country in the world, and the independent research and development capability and international competitiveness of the automobile industry have been greatly improved. The role of auto industry as a pillar industry has become increasingly prominent, the industrial concentration has been gradually improved, the product structure has become more reasonable, and the independent research and development capabilities have been continuously enhanced. The automobile industry has

better met the changes in domestic and international market demand.

Assuming that the development of the automobile industry is influenced by technological progress, capital factors, labour factors and institutional factors, the growth process of China's automobile industry and its key influencing factors can be characterized by using the Cobb - Douglas production function model containing institutional variables. The variable sequence in the production function model can significantly decompose the trend component and the wave component, and the changes of the corresponding components of each variable are synergistic. The estimation parameters of the production function model are significant, and the overall fitting effect of the model is good. The capital variables, labour variables and institutional variables will have a significant impact on the development of the automobile industry as an explanatory factor for the development of the automobile industry. In general, the cumulative growth of the added value of China's auto industry is sustainable, and the driving factors have a significant impact in this process, which is the reason for the volatility of the added value.

Further empirical research shows that the intensity of the openness variables and industrial policy variables that reflect institutional changes have a dynamic change over time. Openness variable has overall positive impact on the growth of the automotive industry and the influence gradually increases; industrial policy variables have a negative impact on the overall growth of the automotive industry and the impact gradually wanes. There is a significant co-integration relationship between automobile development variables and openness variables, automobile development variables and industrial policy variables. When the short-term status of the development of the automobile industry deviates from the equilibrium state, the equilibrium relationship between the openness degree, industrial policy and the automobile industry will bring the unbalanced state back to the equilibrium state with the adjustment strength of 1.655 and 0.267 respectively. There is a one-way Granger influence relationship between automobile development variables and openness variables. The change of openness is the Granger cause of automobile industry development; there is a two-way Granger influence relationship between automobile development variables and industrial policy variables.

In the process of the change of open system, the development of Geely Automobile Enterprise is typical. Under the influence of relevant automobile industry policies such as Policy on Development of Automotive Industry and Plan on Adjusting and Revitalizing the Auto Industry, Geely Automobile Group acquired Volvo from Ford for US$ 1.8 billion and acquired the entire equity and related assets of Volvo, well playing the "Common Man Marring to Princess" show. But at the same time, not all companies can grasp the policy opportunities, and Tengzhong's acquisition of Hummer ended in failure. The case of Geely and Tengzhong shows that the automobile industry policy is an important driving force for the development of automobile enterprises, and automobile enterprises are the carriers of the automobile industry policy. The formulation of the automobile industry policy needs to be adapted to the stage of economic development of the country. Scientific and rational automobile industry policies will have far-reaching impact on the healthy development of the country's automobile industry. Auto companies need to grasp the development opportunities brought about by industrial policies and continuously improve their technological innovation and resource integration.

7. 2 Implications for management

(1) Reasonable judgment of the development trend of the automobile industry

The Chinese auto market is in a period of growth with huge market demand potential. Currently China's per capita car parc is still lower than the world average. The production and sales volume of the automobile industry has increased steadily, and the scale of the industry has gradually expanded. From small-scale production to large-scale operation to joint ventures, it has continuously strengthened the national economy. The industrial structure continued to be optimized, the development was gradual, and the variety was continuously enriched. From the truck that is the only product kind to the current tripolar market segments with bus, sedan and truck, the overall development trend was good.

China's auto industry is entering an important stage of transformation and upgrading. With the rapid development of the national economy, its household consumption structure is

in the process of upgrading. Although the scale of industrial production is already large, with the advancement of urbanization, the automobile consumption market will expand to third- and fourth-tier cities and rural markets. The demand for automobiles will increase in the future, and the automobile industry will shift from a high-speed growth period to the period of stable development, and there is still much room for development.

China's market status in the global automotive industry continues to increase. Global automobile production centre has gradually shifted from Europe and the United States and other developed countries to developing countries represented by China. With the rapid development of economic globalization, the automobile market in developed countries is becoming increasingly saturated, driving the sustained growth of the global automotive industry. In the global auto industry landscape, international auto giants and local automakers are paying more attention to capacity investment in developing countries.

(2) Accurately identify the development of the automotive industry

However, it should be clearly seen that there is still a big gap between the Chinese auto industry and the developed countries in terms of product variety, quality, scientific and technological content, market concentration, and corporate profits. And there is still a long way to go. Bottleneck constraining vehicle development are mainly reflected in five aspects: first, auto companies' technological innovation capability is improving slowly, self-brand has insufficient market compatibility, and there is a big gap in core competitiveness between local enterprise and multinational companies; the second is that a standardized, open market environment has not been formed in supporting parts system, and cooperation of the major domestic auto companies and parts companies needs to be strengthened; Third, energy and environmental issues is prominent, and energy-saving and emission reduction pressure is increasing, as cars have become the main source of pollution in main cities; Fourth, energy-saving and new energy vehicles need to be vigorously promoted. Core technologies are not yet fully grasped, and key components and equipment still rely on imports, and policies and regulations need to be further improved; fifth, comprehensive quality and strength need to be improved, local auto companies lag behind in product development, and the market share of small-displacement energy-saving vehicles is still low.

(3) Scientific design on industry development policy

In the near future, although it is still needed to focus on capacity expansion and general consumption satisfaction, China's auto industry policy orientation should focus more on improving the technical innovation capability, adjusting product structure, creating and cultivating their own brands and other aspects. The following should be included:

First, support the improvement of domestic innovation capabilities. China has become a major automobile production and sales country, and expanding its scale is not the main problem facing the Chinese auto industry. Strengthening the ability of independent development, cultivating independent domestic brands, improving the level of automobile technology, and improving international competitiveness should become the direction of the development of China's automobile industry. Policy design needs to provide strong support and encouragement for independent domestic brands and self-developed auto companies from the aspects of fund investment, financing preferences, import tariffs, export tax rebates, and consumption policies.

Second, improve the policy of developing new energy vehicles. First, policy design focuses on the integration of policy, production, academic, region and consumer forces, forming a coordinated work mechanism with clear division of work to jointly promote the development of the automobile industry; second, further improving the scientific and technology support policy and increasing investment in research and development of new energy vehicles. Comprehensively improve the industrial production capacity of key technologies and parts of new energy vehicles; third, the procurement of vehicles in the official sector such as government departments and public institutions should be inclined to new energy vehicles.

Third, improve the environmental policy of the automobile market. At present, China's economic growth is increasingly dependent on the consumption demand of residents. To promote the sustainable development of the automobile industry, the government should focus on cultivating good market demand and improving the market environment. Policy design may increase investment in infrastructure construction, improve auto consumption financial support policies, rationally formulate taxes and fees paid by residents for purchasing cars, and

accelerate the construction of urban parking facilities to further release the potential of residents' automobile consumption.

7. 3 Limitations and prospects of research

Limited by factors such as knowledge reserve and ability, this thesis still has obvious deficiencies on some issues, which is mainly reflected as follows:

(1) The phased research on the impact of institutional changes still needs to be deepened. This thesis uses the econometric method to focus on the main characteristics of institutional factors affecting the development of China's auto industry. One of the important research conclusions in this thesis is that by constructing a variable parameter model, it is found that the influence of institutional variables such as openness and industrial policy on the development of the automobile industry will change with the passage of time. Drawing on the theoretical results and typical facts such as the mechanism and effect of economic policy has nonlinearity and asymmetry features, the time-varying effect of this institutional change effect may be more in line with the general law of economic system operation. Although the corresponding empirical evidence is provided in the thesis, the research of this problem needs more theoretical analysis and empirical test from different perspectives. The research results have positive significance for identifying the impact of institutional changes on the automobile industry and identifying the development trend of the automobile industry.

(2) Because of the limited information and data sources, this thesis has some limitations on the selection and measurement of indicators in the Chinese institutional change. Institutional change may be a multi-dimensional, multi-level dynamic process. The process of assessing institutional changes from a quantitative perspective may involve the analysis, selection and processing of data indicators in all aspects. The selection of institutional change variables is based on the research results of the existing automobile industry analysis, trying to reflect the main aspects of the impact of institutional changes on the automobile industry, but there are still some indicators with obvious institutional changes are not included in the empirical research framework of this thesis for various reasons (such as the indicators

themselves are not complete or the data is incomplete.). At the same time, the planned economy period is the main stage of China's economic system, but due to the difficulty in obtaining relevant data, the focus of research is more on the period after reform and opening up.

Future research in this field is expected to have breakthroughs in the following areas:

(1) Given complete data, it is expected that there will be an improvement in the selection of empirical research methods and the selection of institutional change indicators. In research methods, non-linear model should be introduced into the study to more accurately portray phase characteristics of the impact of institutional change on the automotive industry, and in-depth research should be conducted on the causes that shape the phase characteristics. The selection of indicators should try to be more comprehensive, and in order to avoid the problem of too few data for some indicators at the time sequence level, we should strive to extend the research to economic climate analysis, panel measurement model research to have better observation in the different dimensions and different levels of institutional change impact on of China's auto industry.

(2) It is expected to pay more attention to the impact of the formation and changes of the informal institution on the Chinese automobile industry. The informal institution is the basis for the formation of the formal institution and the necessary condition for ensuring the role of the formal institution. The institutional changes of a country are often carried out and realized under the joint action of the formal and informal institution. As China's gradual reforms may be more generally reflected in government-led manner which is mainly reflected as man-made changes in formal institutions rather than the coordinated evolution of formal and informal institutions, the impact of informal institutions such as culture and customs also needs to be further researched in depth.

Bibliography

Anderson, T. L. & Hill, P. J. (2002). Cowboys and Contracts. *Journal of Legal Studies*, 31(S2), S489-S514.

Bain, J. S. (1956). *Barriers to New Competition.* Harvard University Press. Cambridge, MA.

Barzel, Y. (1989). *Economic Analysis of Property Rights*, Cambridge University Press.

Barzel, Y. (1997). *Economic Analysis of Property Rights*. translated by Fangyu F. Yicai D., Shanghai People's Publishing House.

Cheung, S. N. S. (1975). Roofs or Stars: the Stated Intents and Actual Effects of a Rents Ordinance. *Economic Inquiry*, 13(1):1-21.

Cheng, X. S. (2009). Using Tax Policy to Promote China's Automobile Industry Development. *Tax Research*, (9): 45-48.

Coase, R. H. (1937). The Nature of the Firm. *Economica*, 4(16): 386-405.

Coase, R. H. (1960). The Problem of Social Cost. *Journal of Law and Economics*, 3:1-44.

Coase, R. H. (1974). *Lighthouse in Economics*. J.l. & Econ.

Coase, R. H. (2014). *Property Rights and Institutional Change*. Shanghai People's Publishing House.

Dai, Z. H. (2006). Theories and Schools of Industrial Economics and Their Development in China. *China Economist*, (1):27-28. (in Chinese)

Dong, S. (2005). *Industrial Economics (2nd Edition).* Higher Education Press. (in Chinese)

Dong, H. (2008). Analysis and Evaluation of the Performance of China's Automobile Industry Policy. *Market Weekly*, (5):51-53. (in Chinese)

Edwards, G. & Molz, R. (2014). MNE Practice Transfer as a Process of Institutional Change. *Canadian Journal of Administrative Sciences / Revue Canadienne des Sciences de l\"Administration*, 31(2) :116-127.

Eggertsson, T., Eggertsson, Þ., & Eggertsson, T. (1990). *Economic behavior and institutions: Principles of Neoinstitutional Economics*. Cambridge University Press.

Eisenstadt, S. N. (1980). Cultural Orientations, Institutional Entrepreneurs, and Social Change: Comparative Analysis of Traditional Civilizations. *American Journal of Sociology*, 85(4), 840-869.

Furubotn, E. & Richter, R. (1997). *Institutions and economic analysis*. Ann Arbor: Michigan University Press.

Gao, R. (2017). Thoughts on promoting the healthy development of the financial leasing industry. *Modern Auditing and Accounting*, (002), 39-42.

Gong, S. M. (2007). *Applied Statistics (Second Revision).* Beijing Jiaotong University Press. (in Chinese)

Gu, L. L. & Wang, C. (2019). Analysis of the Factors Influencing the International

Competitiveness of China's Automobile Industry. *Journal of Hubei University of Economics*, (9): 61-64. (in Chinese)

Harmon, D.J., Green, S. E., & Goodnight, G T. (2015). A Model of Rhetorical Legitimation: The Structure of Communication and Cognition Underlying Institutional Maintenance and Change. *Academy of Management Review*, 40(1):76-95.

Hong, S. (1996). Study on the Transitional Process of China's Reform toward Market Economy. *Economic Research Journal*, (1):69-80.

Hong, S. (2002). *Seeking for a Stable Way of the Reform*. Shanghai University of Finance and Economics Press. (in Chinese)

Huang, S.A. (2008). *Property Rights Theory and Institutional Economics*. Xiangtan: Xiangtan People's Publishing House. (in Chinese)

Knight, C. (2009). *System and Social Conflict*, Translated by Weilin Z. Shanghai: Shanghai People's Publishing House. (in Chinese)

Li, B. H. & Lv, Y. J. (2011). ICT Standardization and IPR Exploration Based on Interaction between Technological Innovation and Institutional Innovation. *Journal of Beijing University of Posts and Telecommunications (Social Science Edition)*, 13(5):96-100. (in Chinese)

Li, H. & Deng, T. (2013). Innovation of the Subject Theory of Institutional Change and Study on Its Correlated Response. *Economist*, (9): 34-42. (in Chinese)

Li, G. (2010). Theoretical Analysis of the Competitiveness of Auto Brands. *Guide to Business*, (8):112-113. (in Chinese)

Li, Q. & Wei, W. (2015). Nonlinear Effect of Institutional Change on the Quality of China's Economic Growth. *Research on Economics and Management*, (12):3-10. (in Chinese)

Li, Z. Q. (2009). Institutional Configuration of Entrepreneurial Innovation Behavior: Characteristics of Evolution. *Management World*, (7):180-181. (in Chinese)

Li, Z. Q. & Chen, Z. K. (2015). Influence of Institutional Change and Technological Advancement on China's Economic Growth. *Research on Economics and Management*, (12):11-18. (in Chinese)

Lin, J. Y. (1989). An Economy Theory of Institutional Change: Induced End Imposed Change. *Cato Journal*, 9 (1): 1-33.

Lin, Y. (2013). *An Empirical Study Based on the Impact of Institution Changes on Chinese Economic Growth*. Doctoral Thesis, Southwest Jiaotong University. (in Chinese)

Lin, Y. A. (2012). Review of the Empirical Literature on the Influence of Political System Changes on Economic Growth. *Review of Economic Research*, (6):35-44. (in Chinese)

Liu, J. J. & Fan, J. Q. (2001). Research on Asymmetry and Correlation of China's Economic Cycle. *Economic research*, (5): 28-37. (in Chinese)

Liu, S. J. (2008). Open Market, Competition and Industrial Progress-Disputes and Important Experiences in the Development of China's Automobile Industry for 30 Years. *Management World*, (12):1-9. (in Chinese)

Liu, W. Q., Luan, Q., & Wang, X. (2019). From Zero to Intelligent Internet Connection: Review and Prospect of 70 Years' Automobile Industry Policy in New China. *Economic Horizon*, (10): 43-54. (in Chinese)

Lu, R. & You, J. X. (2010). Research on Open Market, Technology Learning and Innovation

Ability of China's Automobile Industry. *Journal of Southeast University (Philosophy and Social Sciences)*, 12(2). (in Chinese)

Lu, X. X. & Li, X. M. (2011). On System and Entrepreneurial Activities. *Economist*, (5):42-49. (in Chinese)

Lu, Z. Y. & Hu, A. G. (1993). The Influence of Market-Oriented Reform on China's Economic Operation. *Economic Research Journal*, (12). (in Chinese)

Luo, R. H. (2011). *Analysis of Tax Policy for China's Automobile Industry Development*. Doctoral Thesis, Southwestern University of Finance and Economics. (in Chinese)

Ma, J. F. & Zhu, H. L. (2002). An Empirical study on Determinants of Intra-Industry Trade in China. *The Journal of World Economy*, (9):22-26. (in Chinese)

Meng, Y. Y. & Yin, Y. P. (2011). Research on Consumption Effect of Automobile Consumption Tax-Based on Analysis of Monthly Macro Data. *Journal of Tongling College*, 10(5): 37-40. (in Chinese)

Miao, Z. (1992). Issues in Selecting Reform Strategy in Institutional Change. *Economic Research Journal*, (10): 72-80. (in Chinese)

Moss, S. & Demsetz, H. (1989). The Organization of Economic Activity. Vol. I: Ownership, Control and the Firm. *Economic Journal*, 99(396):499.

Mu, X. Y. (2010). *Research on Fiscal and Taxation Policies to Encourage China's Automobile Industry Development.* Doctoral Thesis, Dongbei University of Finance and Economics. (in Chinese)

Nelson, R. R. (2002). Bringing institutions into evolutionary growth theory. *Journal of Evolutionary Economics*, 12(1-2):17-28.

North, D. C. & Thomas, R.P. (1970). An Economic Theory of the Growth of the Western World. *The Economic History Review*, 23(1):1.

North, D. C. & Thomas, R. P. (1973). *The Rise of Western World: A New Economic History*. Cambridge: Cambridge University Press.

North, D. C. (1990). *Institutions, Institutional Change and Economic Performance.* Cambridge University Press, Cambridge, UK.

North, D. C. (1994). Economic Performance Through Time, *The American Economic Review*, Vol. 84, No. 3, June: 359-368.

North, D. C. (2013). *Understanding the Process Economic Change.* Translated by Zhengsheng Z. and Hua X., Beijing: Renmin University of China.

Pan, H. F. & Yang, L. Y. (2006). Institutional Change and Endogenous Growth. *Nankai Economic Studies*, (2):74-83. (in Chinese)

Paraskevopoulou, E. (2011). *The co-evolution of sectoral regulation and technological innovation: the case of detergents industry in Europe* (No. 2011/10). LEM Working Paper Series.

Qiu, G. D. & L, Z. K. (2004). Analysis of International Competence of China's Automobile Industry and the Countermeasures. *Journal of Dongbei University of Finance and Economics*, (1):64-69. (in Chinese)

Range, M. & Sandberg, M. (2016). Windfall Gains or Eco-innovation? 'Green' Evolution in the Swedish Innovation System. *Environmental Economics and Policy Studies*,

18(2):229-246.

Ruan, J. Q., Shi, Q., & Zhang, X. B. (2014). Rules of dynamic evolution of industrial clusters and local government policies. *Management World,* (12):79-91. (in Chinese)

Rui, M. J. (2006). New Diamond Model" of Industry Competitiveness. *Journal of Social Sciences*, (4):68-73. (in Chinese)

Ruttan, V. W. (1978). *Induced Innovation: Technology, Institutions and Development.* Baltimore: Johns Hopkins University Press.

Ruttan, V.W. & Hayami, Y. (1984). Toward a Theory of Induced Institutional Innovation. *Journal of Development Studies*, 20(4): 203-223.

Schultz, T. W. (1968). Institutions and the Rising Economic Value of Man. *American Journal of Agricultural Economics*, 50(5): 1113-1122.

Shen, G. Y. (2017). Direct Foreign Investment, Opening up and Quality of Economic Growth——Based on Empirical Experience of China's Automobile Industry. *Economic Issues Research*, (10): 118-127. (in Chinese)

Sheng, B. (1998). Economic Analysis of China's Pillar Industries: A Case Study of Automobile Industry. *Nankai Economic Research*, (5):3-9. (in Chinese)

Smets, M., Morris, T. & Greenwood R. (2012). From practice to field: A multilevel model of practice-driven institutional change. *Academy of Management Journal*, 55(4):877-904.

Stone, A., Levy, B., & Paredes, R. (1992). *Public institutions and private transactions: The legal and regulatory environment for business transactions in Brazil and Chile*. World Bank Publications.

Sun, S. M. (2006). Theoretical Analysis of Ideology from the Perspective of Institutional Change. *Economic Review*, (6), 59-67. (in Chinese)

Sun, S. M. & Xu, X. M. (2008). Comparative Analysis of Three Paradigms of Institutional Change Research in Economic History. *Literature, History and Philosophy*, (5):151-158. (in Chinese)

Te, R. K., Song, B., & Xu, F. (2015). Research on the Evolutionary Mechanism of Strategic Emerging Industries in Collaborative Innovation of Technology and System. *Scientific Management Research*, (4):50-53. (in Chinese)

Wang, D. D. (1992). General Theory of Institutional Innovation. *Economic Research*, (5):71-82. (in Chinese)

Wang, D. D. (1995). *Economic Development and Institutional Innovation*. Shanghai People's Publishing House. (in Chinese)

Wang, J. (2011). *Opening up and Industrial Upgrading*. Doctoral Thesis, Zhejiang University. (in Chinese)

Wang, J., Huang, Y. H., Shi, J., & Wu, S. Q. (2005). Evaluation Analysis of the International Competiveness of China's Automotive Industry. *Auto Industry Research*, (2). (in Chinese)

Wang, J., Zou, G. P., & Shi, X. J. (2013). The Influence of Institutional Change on China's Economic Growth: An Empirical Study Based on VAR Model. *China Industrial Economics*, (6):70-82. (in Chinese)

Wang, L. F. & Zhang, S. J. (2008). Formation Mechanism of the Competitiveness of Automotive Industry. *Economic Herald*, (1):63-65. (in Chinese)

Wang, Y. J. & Liu, H. (2014). Research on Tax System of China's Automobile Industry. *Journal of Finance and Economics*, (3):99-103. (in Chinese)

Wen, Q. X. & Hu, H. L. (2003). An Empirical Analysis of the Contribution of Institutional Change to the Growth of China's Automobile Industry. *Economic Latitude and Longitude*, (6), 8-11. (in Chinese)

Williamson, O. E. (1975). Markets and Hierarchies, Analysis and Antitrust Implications: A Study in the Economics of Internal Organization. *Social Science Electronic Publishing*, 86(343):619.

Williamson, O. E. (1979). Transaction-Cost Economics: The Governance of Contractual Relations. *The Journal of Law and Economics*, 22(2):29.

Williamson, O. E. (1996). *The mechanisms of governance*. Oxford University Press.

Wu, W. H. (2006). An Emprical Analysis of the Factors Influencing the International Competitiveness of China's Automobile Industry. *Journal of Huaihua University*, 25(11):50-54. (in Chinese)

Wu, X. H. & Guo, J. (2007). Impact of Determinants on the Competitiveness of China's Auto Industry: A UESM Model. *System Engineering Theory and Practice*, 27(3):155-160. (in Chinese)

Xiao, X. (2017). Institutional Change Theory and Chinese Institutional Reform. *Journal of Capital University of Economics and Business*, 19(4):96-104. (in Chinese)

Xiang, G. P., Yu, Z. B., & Chi, K. X. (2012). The Mechanism of Entrepreneurial Institutional Capacity on the Growth of Private Enterprises in Transitional Economy -- Case Study of Geely Group and Hengdian Group. *Scientific and Technological Progress and Countermeasures*, 29(15):76-81. (in Chinese)

Yang, D. J. (2005). On the Development Policy of Automobile Industry - A brief analysis of the New Automobile Industry Policy from the Perspective of New Institutional Economics. *Enterprise Economy*, (4):117-118. (in Chinese)

Yang, R. L. (1993). On System Supply. *Economic Research Journal*, (8):45-52. (in Chinese)

Yang, R. L. (1998). The Three-Stage Theory of China's Institutional Change. *Economic Research Journal*, (1). (in Chinese)

Yang, R. L. (2000). A Step-By-Step Model of Gradual Institutional Change: Another Discussion of Local Government's role in China's Institutional Change. *Economic Research Journal*, (3):24-31. (in Chinese)

Yang, Z. Q. (2010). An Empirical Analysis of the Automotive Manufacturing Industry Basedon Entropy-weighting TOPSIS Method. *Economic Forum*, (7):110-113. (in Chinese)

Yildizoglu, M. (2002). Competing R&D strategies in an evolutionary industry model. *Computational Economics*, 19(1), 51-65.

Yin, D. S. (2003). General theory of Institutional Innovation: Logic, Model and Expansion. *Economic Review*, (6):33-36. (in Chinese)

Yu, W. & Fang, Z. (2010). Referring to Foreign Automobile Tax System to Optimize China's Automobile Tax and Fee Policies. *Contemporary Economic Management*, 32(2): 85-93. (in Chinese)

Zhang, W. (2015). The power of ideas and leadership in China's transition to a liberal society. *Cato J.*, 35, 1. (in Chinese)

Zhao, B. & Hua, D.Y. (2001). Reflections on the Failure of Entry Control in China's Automobile Industry. *Journal of Capital University of Economics and Business*, 3(6):30-34. (in Chinese)

Zhou, B. (2014). Adaptive Efficiency of Transitional Institutional Arrangements. *Economist*, 12(12):14-20. (in Chinese)

Webliography

China Industry Information Network. (2013-2016). *China Automotive Production and Sales*. from http://www.chyxx.com

China Industry Information Network. (2017). *Development and Trends of China's Automobile Industry*. from http://www.chyxx.com

China Industry Information Network. (2017). *Outlook on China's Automobile Market Consumption*. from http://www.chyxx.com

China Industry Information Network. (2017). *Development and Trends of China's Automobile Industry*. from http://www.chyxx.com

China Auto News. (2015). *"Industrial 4.0": Direction and Path of Automobile Industrial Upgrade in China*, from http://auto.people.com.cn

Other References

Chinese People's Political Consultative Conference. (2016). *The Five-Year Outline Plan for National Economic and Social Development of the People's Republic of China* (No.13). China.

National People's Representative Meeting. (2001). *The Tenth Five Year Plan of China's Automobile Industry* (No.10). China.

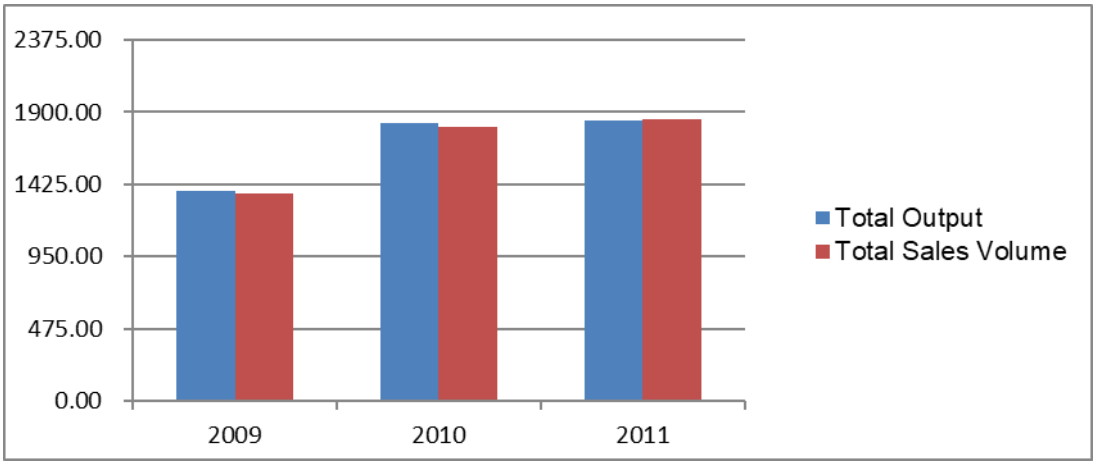
China Automobile Industry Association. (2006). *Work report of 2006 annual meeting of China auto parts industry* (No. 1). China.

Geely. (2016). *Geely 's development report* (No.1). China.

Tengzhong Heavy Industry Machinery Co., Ltd. (2009). *Report on Tengzhong's acquisition of Hummer* (No.1). China.

Appendix

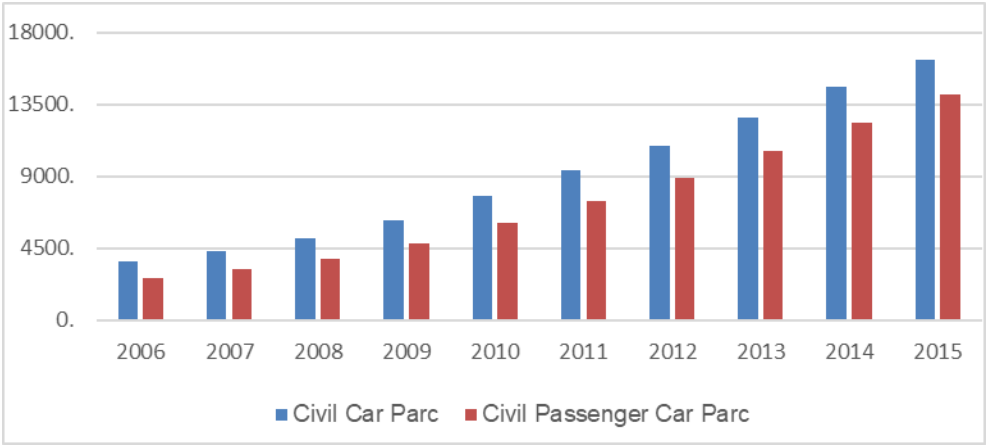
Appendix 1 Statistics of China's Automobile Production and Sales in 2009-2011



Unit: 10,000 vehicles

Data from China Automotive Industry Yearbook

Appendix 2 Civil Car Parc and Passenger Car Parc in China in 2006-2015 (unit: 10,000)



Data from China Automotive Industry Yearbook