



**Faculty of Economics and Business**

**Efficiency Performance of Industrial Innovation System of China Brand  
Automobile**

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Efficiency Performance of Industrial Innovation System of China Brand  
Automobile

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## DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## ABSTRACT

In 2009, China has become the largest automobile production and sales country in the world. However, China automobile industry presents a large but not strong situation, that is the market share of own brand automobile is not high, and the situation of relying on foreign brands and technology is still serious. Based on the innovation system of automobile industry, this study analyzes the problem of “large but not strong” of China automobile industry. The aim of this study is to investigate the efficiency performance of the innovation system of China automobile industry from 2001 to 2021. The DEA-VRS, DEA-CRS method and DEA-Malmquist index model were used to evaluate the innovation efficiency of China brand automobile industry. The technical efficiency, pure technical efficiency, scale efficiency, total factor productivity, comprehensive technical efficiency, and technological progress index are calculated, respectively. It also explores the determinants of innovation system’s efficiency. The conclusion of this study is that, from the perspective of 24 regions, there are obvious spatial imbalances in the efficiency development of China own brand automobile industry’s innovation system. From a national perspective, there is no significant upward or downward trend in the efficiency of the innovation system in the own brand automobile industry. The total factor productivity and comprehensive technical efficiency show no significant trend and do not exceed 1.0, while the technology progress index shows a fluctuating upward trend, with values higher than 1.0 throughout the entire sample period. In terms of influencing factors, there are several identical ones that have different impacts on efficiency and productivity, respectively. The policy recommendations of this study are that own brand automobile enterprises should strengthen technological research and development, choose the optimal

development model. The government should increase investment in the research and development of own brand automobile enterprises, establish scientific systems, promote the effective combination of industry, academia, and research, carry out top-level design to enhance the independent innovation drive of state-owned automobile groups.

**Keywords:** Automobile industry, China brand, Innovation system, Efficiency performance

## ***Prestasi Kecekapan Sistem Inovasi Industri Automobil Jenama China***

### ***ABSTRAK***

*China telah menjadi negara pengeluaran dan pemasaran kereta terbesar di dunia pada tahun 2009. Walau bagaimanapun, industri automobil di China adalah industri yang besar tetapi ia tidak kukuh, iaitu syer pasaran kereta jenama nasional adalah tidak tinggi, dan kebergantungan kepada jenama dan teknologi asing adalah masih serius. Tiada jenama terkenal antarabangsa dan tiada syarikat multinasional automobil bertaraf dunia. Berdasarkan sistem inovasi industri automobil, kajian ini menganalisis masalah "besar tetapi tidak kuat" industri automobil di China. Matlamat kajian ini adalah untuk mengkaji prestasi kecekapan sistem inovasi industri automobil China dari tahun 2001 hingga 2021. Kaedah DEA-VRS, DEA-CRS dan model indeks DEA-Malmquist digunakan untuk menilai kecekapan inovasi industri automobil jenama China. Kecekapan teknikal, kecekapan teknikal tulen, kecekapan skala, jumlah faktor produktiviti, kecekapan teknikal komprehensif, dan indeks kemajuan teknologi dikira masing-masing. Ia juga meneroka pembolehubah penentu kecekapan sistem inovasi. Kesimpulan kajian ini adalah terdapat ketidakseimbangan spatial yang jelas dalam pembangunan kecekapan sistem inovasi industri automobil jenama China sendiri berdasarkan perspektif dari 24 wilayah. Dari perspektif negara, tiada trend menaik atau menurun yang ketara dalam kecekapan sistem inovasi dalam industri automobil jenama sendiri. Jumlah produktiviti faktor dan kecekapan teknikal yang komprehensif tidak menunjukkan trend fluktuasi yang jelas, dan nilai kecekapan tidak melebihi 1.0, manakala indeks kemajuan teknologi menunjukkan arah aliran menaik yang turun naik, dengan nilai yang lebih tinggi daripada 1.0 sepanjang keseluruhan tempoh sampel. Dari segi faktor yang mempengaruhi, terdapat beberapa*

*faktor yang serupa yang masing-masing mempunyai kesan berbeza terhadap kecekapan dan produktiviti. Cadangan dasar kajian ini ialah syarikat kereta jenama tempatan harus mengukuhkan penyelidikan dan pembangunan teknologi, memilih model pembangunan yang optimum. Kerajaan harus meningkatkan pelaburan dalam penyelidikan dan pembangunan perusahaan automobil jenama tempatan bagi mewujudkan sistem saintifik, menggalakkan gabungan industri, akademik dan penyelidikan yang berkesan, melaksanakan reka bentuk peringkat atasan untuk meningkatkan pemacu inovasi bebas kumpulan automobil milik kerajaan.*

**Kata kunci:** *Industri automobil, Jenama China, Sistem inovasi, Prestasi kecekapan*



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## LIST OF ABBREVIATIONS

BYD	Build Your Dreams
DEA	Data Envelopment Analysis
EV	Electric Vehicle
FAW	First Automobile Work
GAC	Guangzhou Automobile Group Co., Ltd
JAC	JiangHuai Automobile Co.Ltd
PTE	Pure Technical Efficiency
R&D	Research and Development
SAIC	Shanghai-Automotive-Industry-Corp
SE	Scale Efficiency
SFA	Stochastic Frontier Analysis
TE	Technical Efficiency
TFP	Total Factor Productivity
VIF	Variance Inflation Factor

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

The automobile industry is an essential pillar of the national economy in many countries, which plays a significant role in social development with a long industrial chain, high correlation, comprehensive employment and large consumption. The share of automobile industry accounted for 20%, 13.1%, 9% and 10% of the gross domestic product (GDP) in Japan, India, Germany and China, respectively, in 2020 (Sabeti, 2020). Additionally, the number of workers in the automobile industry reached 36 million in 2022. The automobile industry creates not only direct jobs, but also employs additional jobs in other sectors. It was found that for each job completed in the automobile industry, four different jobs were created in another sector (International Labour Organisation, 2020).

Innovation refers to transforming production factors and conditions into a new mode through permutation and combination to reduce production costs and improve production efficiency. Schumpeter was the first to put forward five forms of innovation: product, technological, market, resource allocation and enterprise organisation innovation (Wang & Cao, 2012). Innovation is the soul of enterprise development; it is the eternal vitality of the development of the automobile industry; innovation, the development of the automobile industry will be complex. Enterprise innovation not only brings enormous benefits to enterprises, but also provides better products for consumers. At the same time, it can drive the development of relevant enterprises and jointly promote social prosperity and progress.

The development level and innovation ability of the automobile industry reflect a country's industrialisation level, comprehensive innovation ability and industrialisation complementation. The operation performance of the innovation system of the automobile industry directly affects the innovation performance and the international status of China's automobile industry. The essence of the industrial innovation system is a connection, which is to connect the innovation activities of enterprises and other secondary participants. Furthermore, it takes technological innovation as the core, forms integrated innovation ability, reduces the innovation cost of individual innovation activities and maximises the benefits. This is to promote the generation, flow, renewal and transformation of new technologies, or new knowledge in the industry and promote the formation of enterprise innovation ability and the improvement of industrial competitiveness. System efficiency evaluation is an essential content of industrial innovation system research, which helps to grasp the evolution process of industrial innovation ability and provides the basis for making related innovation policies.

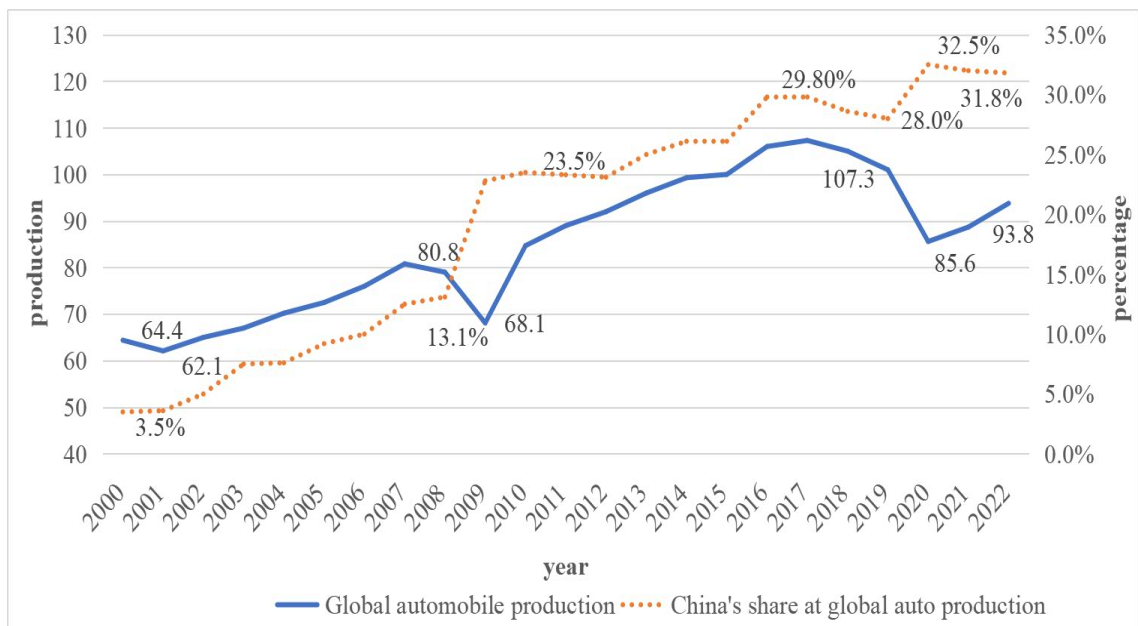
## **1.2 Background of the China Automobile Industry**

Since 2009, China has been the world's largest automobile manufacturer and automobile market. China's annual auto production accounts for more than 30% of the global automobile production (Statista Research Department, 2021). The market share of the top ten global automakers was at the same level as that of China's top ten automakers for the first time in 2017. Nearly 20% of the top ten global automakers' entire product is manufactured in China, as shown in Figure 1.1.



**Figure 1.1:** Market Share of the Automobile Production in China (2010 to 2017)

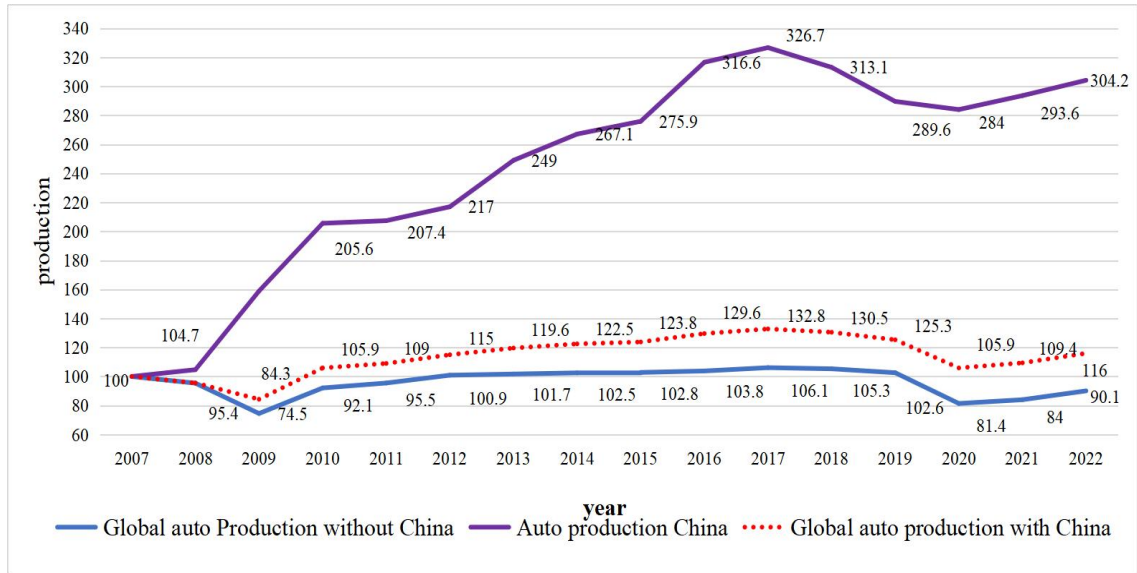
Source: Quest Trend Magazine (2019)



**Figure 1.2:** World Automobile Production (2000 to 2022) (Unit: '00,000)

Source: Organization Internationale des Constructeurs d'Automobiles (OICA, 2023)

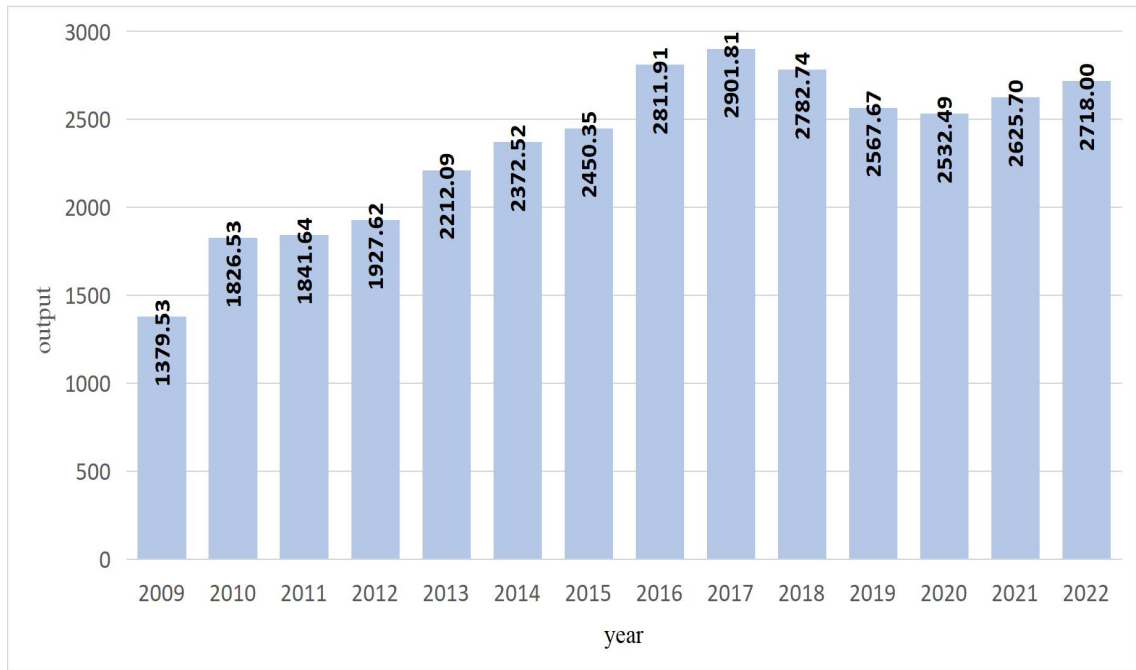
The importance of China for the world’s auto production is evident. As shown in Figure 1.2, the global auto production increased by 45% from 2000 to 2022, whereby China’s global auto production has grown 9-fold. In the 15 years from 2007 to 2022, the global auto production fell by 9.9% without China.



**Figure 1.3:** Automobile Production in China and Global (2007 – 2022) (Unit: '00, 000)

Source: Organisation internationale des Constructeurs d’Automobiles (OICA, 2021)

Based on Figure 1.3, the declined average annual rate of the world’s automobile production was 0.7%. However, with China, the global auto production increased by almost 16% from 2007 to 2020, with an average annual growth rate of 1%. China’s automobile production has increased 3-fold during the 15 years.



**Figure 1.4:** Output of China Automobile Industry from 2009 to 2022 (Unit: ' 000)

Source: National Bureau of Statistics (2023)

In the past decade, China's automobile industry has developed at high speed. As shown in Figure 1.4, the output of automobile industry has increased sharply from 13.8 million vehicles in 2009 to 27.2 million cars in 2022 (National Bureau of Statistics, 2023). Since 2009, China's automobile production and sales have been ranked first in the world for 14 consecutive years, which has made it the world's largest automobile producer. The leading own brand automobile corporations and their brands are presented in Table 1.1. The Build Your Dreams (BYD) vehicles, amongst which, was ranked 12th in the world's most valuable automobile brands ranking in 2023, as shown in Table 1.2.

**Table 1.1:** China Brand Automobile Corporations

<b>Corporation</b>	<b>Main Brands</b>
Shanghai Automotive Industry (Group)	Wuling, Shanghai Shenwo, Mingjue, Rongwei
Dongfeng Motor Co., Ltd	Dongfeng, EV NewEnergy, Shenglong, Chenglong, Huashen, Lantu, Fengshen, Fengxing, Xiaokang, Baolong, Longka
China First Automobile Group	FAW Jiefang, FAW Sedan, Red Flag, FAW Haima, FAW Pentium
BAIC Motor Group Co., Ltd	Jihu, Beijing, Futian, Ouake, Aoling, Wise Smurf, Xiangling, Ruiwo, General, Jixiang, Ouhui, Proko, Navigation, Foton
Guangzhou Automobile Industry Group	Trumpqi, Gonoe, Aion
Chang'an Automobile (Group)	Changan, Hafei, Changhe, Lufeng, Hafei, Dong'an, Chang'an star, Chang'an Xingguang, Chang'an Benben, Chang'an Jiexun, Chang'an Zhixiang, Chang'an Ruixiang
China Heavy Truck Group	Yellow River, Shandeka, Howao
Brilliance Auto	Brilliance Zhonghua, Brilliance Jinbei

**Table 1.1 continued**

Chery Automobile Co., Ltd	Chery, Kairui, Weilin, Ruiqi
Anhui Jianghuai Automobile Group	JAC, Ankai
BYD Co., Ltd	BYD
Geely Automobile Group	Geely

Source: China Association of Automobile (2021)

**Table 1.2: World's Most Valuable Automobiles Brands**

<b>2023 rank</b>	<b>2022 rank</b>	<b>Brand</b>	<b>Country</b>
1	3	Teda	United States
2	2	Mercedes-Benz	Japan
3	1	Toyota	Germany
4	5	BMW	Germany
5	6	Prosche	Germany
6	4	Volkswagen	Germany
7	7	Honda	Japan
8	8	Ford	United States
9	12	Hyundai	South Korea