The Potential Economic Impact of Introducing High Capacity Transport (HCT) Solutions in China's Road Transport Sector

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Abstract

The Chinese leadership is pursuing restructuring of its economic growth model away from low value fast GDP growth toward high value slower GDP growth. At the Third Plenary Session of the 20th conference[1] of the Chinese Communist Party in 2024, the concept of high-quality productive forces was launched.

This paper examines official statistics and relevant industry associations to assess how the introduction of High-Capacity Transport (HCT) [2] solutions would impact the profitability and efficiency of the truck Original Equipment Manufacturers (OEMs) and transport companies in a largely stagnant market, supporting the validity of a high-quality productive resource approach.

Through analysis of statistics and projections of trends and with certain assumptions, this paper sets out to show that it is possible to achieve a sustainable turn-around of China's present dire situation in the road transport sector by introducing the HCT concept. The results demonstrate that it is indeed possible to achieve top line growth on the supply side by offering more efficient and more highly priced transport equipment. With strict enforcement of rules and regulations this can translate into higher profit levels for both the OEMs and for the road transport sector. That would contribute to reducing the GDP cost of transport and logistics in China, whilst at the same time improving the quality of transport services.

Keywords: HCT, Transport Efficiency, Profitability, CO2 reduction, total society Freight cost

[1] At each five-year political cycle different Plenary Sessions are held. The third Plenary session focuses on economic growth policy for the next 5-10 years.

[2] Defined as two trailers 25.25meter combinations with the possibility to go for even longer combinations

1. Introduction

China's road transport sector is currently facing significant challenges due to overcapacity and a stagnant market. The excess production capacity of heavy-duty trucks (HDTs) and the high number of trucks on the road have led to distortions in the domestic transport market, resulting in deteriorating prices for both equipment and transport services. Despite efforts to reduce emissions through scrapping programs, the overall efficiency and profitability of the sector remain low compared to international standards.[3]

In this context, the introduction of HCT solutions offers a potential avenue for improving the efficiency and profitability of China's road transport sector. HCT solutions encompass a range of innovations, including advanced technologies, design enhancements, and operational strategies, aimed at increasing the capacity and efficiency of transport vehicles and systems. In this paper we focus on HCT, meaning long vehicle combinations, i.e. 25,25-meter truck and trailer combinations.

This paper examines the theoretical economic impact of introducing HCT solutions in China's road transport sector using an extreme scenario where overnight 2026/2027 all new sales of tractors are replaced by HCT combinations. By analyzing official statistics and making certain assumptions[4], we aim to assess how HCT solutions can contribute to improving profitability and efficiency for truck OEMs and transport companies in a stagnant or even shrinking market. Or to express it differently: the impact of creating more value with less resources.

[3] In 2023, the total social logistics expenses were 18.2 trillion yuan, up 2.3% year-on-year. The ratio of total social logistics expenses to GDP was 14.4%. CFLP, February 7, 2024; Expenditure in the logistics sector amounted to 7.1 % of the EU27 GDP, Statista Research Department, Jan 31, 2015; U.S. business logistics costs (USBLC) exceeded $2.316 trillion in 2022, which equated to 9.1% of the U.S.'s nominal gross domestic product (GDP) that year, SupplyChainBrain, June 20, 2023

[4] Assumptions include, but are not limited to, the adoption rate of HCT solutions, the impact of stricter regulations and standards on truck specifications, and the positive response of consumers and businesses to the introduction of more efficient and highly priced transport equipment

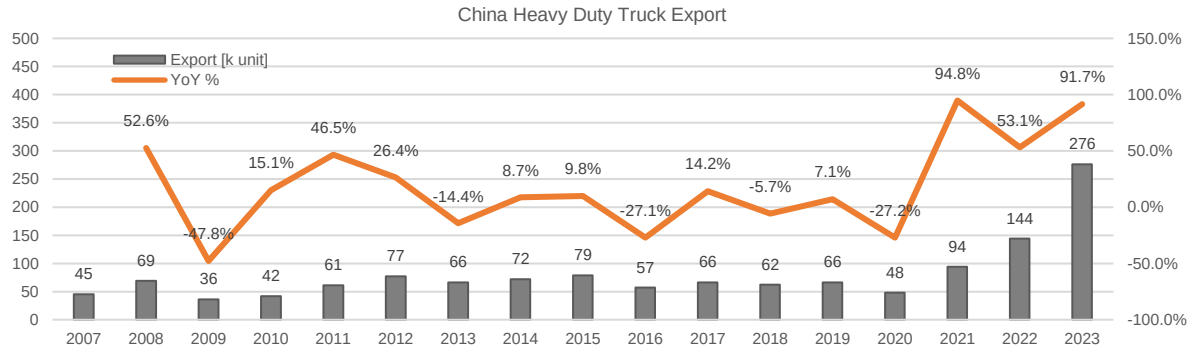
2. Background

China's road transport system is plagued by overcapacity throughout the entire value chain. The installed production capacity of HDTs exceeds global annual demand by almost 50%[5], leading to significant excess transport capacity. Although it can be estimated that as much as 1/4 [6] [7] of the installed population has been absorbed by export markets, it is still not sustainable in the long run.

The high number of trucks on the road, estimated at approximately 7.1 million, is a significant challenge. Despite further efforts to reduce emissions through scrapping programs, the truck population remains too large for the road transport needs in China. As a result, annual sales of HDTs are likely to stagnate around 500,000 to 700,000 vehicles[8], depending on factors such as efficiency improvements and economic growth.

[5] Reference: Scania China Strategic Office report

[6] Reference: State Information Center Source of export



Analysis of the Current Heavy Truck Market and Future Outlook, China State Information Center, 2023 Dec 12

[7] According to the General Secretary of China Commercial Vehicle Dealers Association, Mr Zhong Weiping export of used HDT in the past ten years amounts to 1 million units.

[8] Reference: Analysis of the Current Heavy Truck Market and Future Outlook, China State Information Center, 2023 Dec 12

Aggregated, these circumstances have led to serious distortions in the domestic transport market, with ensuing price deterioration for both equipment and transport services. Despite this, the cost of transport and logistics as a percentage of GDP remains high, around 14%, compared to less than 10% in Europe and the US.

Although there have already been many EU-studies on the introduction of HCT and similar studies in China described in our HVTT17 paper (Feasibility Study on The Application Of Modular Combination Vehicles In China Road Transport). Chinese stakeholders still worry that long vehicle combination will lead to reduced sales volumes which in a GDP focused society as China leads to immediate resistance. This paper aims to credibly reduce such feelings of resistance.

3. Methodology

To assess the potential economic impact of introducing HCT solutions in China's road transport sector, this paper access official statistics from the National Bureau of Statistics, the Ministry of Transport, and relevant industry associations. Based on these data, a simplified theoretical model was developed to analyze the interdependence of the most influential factors on road efficiency, industry revenue, and profit.

Table 1 - Total Freight Statistics, Source: China Statistics Bureau

	Road Freight turnover (billion-ton km)	Road Freight volume (million ton)	Average Transport Mileage (km)
2019	5,963.6[9]	34,354.8[8]	173.6
2020	6,017.2	34,264.1	175.6
2021	6,908.8	39,138.9	176.5
2022	6,895.8	37,119.3	185.8
2023	7,395.0	40,336.8	183.3

As shown in Table 1, despite the impact of the world financial crisis and the COVID-19 on China's economy in the past decade, the road freight volume and freight turnover volume still developed, albeit at a slow pace. However, the average transportation distance, using reverse calculation based on the overall population of trucks, was only about 180 kilometers[10]. The average transport distance has basically not changed in the past decade.

Considering the overall truck population of 11.7 million[11], consisting of 7 million heavy-duty trucks (GTW>14 tons), 1.5 million medium trucks (14 tons>GTW>6 tons), and 3.2 million light trucks (6 tons>GTW>1.5 tons) and micro trucks (GTW<1.5 tons), the average short haul distance of many light and medium trucks has even become shorter.

[9] Because the statistical calibration of road freight volume and freight turnover was adjusted in 2019 based on the special survey of road freight transportation volume in 2019, the data is not comparable to the previous year Therefore we choose to use only data from 2019.

[10] Divide the Road Freight turnover by Road Freight volume give a general average road transport distance. Not relevant to individual truck; as a comparison using the same calculation method base on 2022 statistics, EU was 141km and USA was 771km

[11] Statistical Bulletin on the Development of Transportation Industry in 2023, Ministry of Transportation, June 18, 2024.

This paper simplifies the model design and only studies the scope of the long-distance haulage which is dominated by tractor-semitrailer combinations.

Using data from SinoIoV[12], below in Figure 1, it is evident that import tractor brands have higher average mileages than domestic brands.

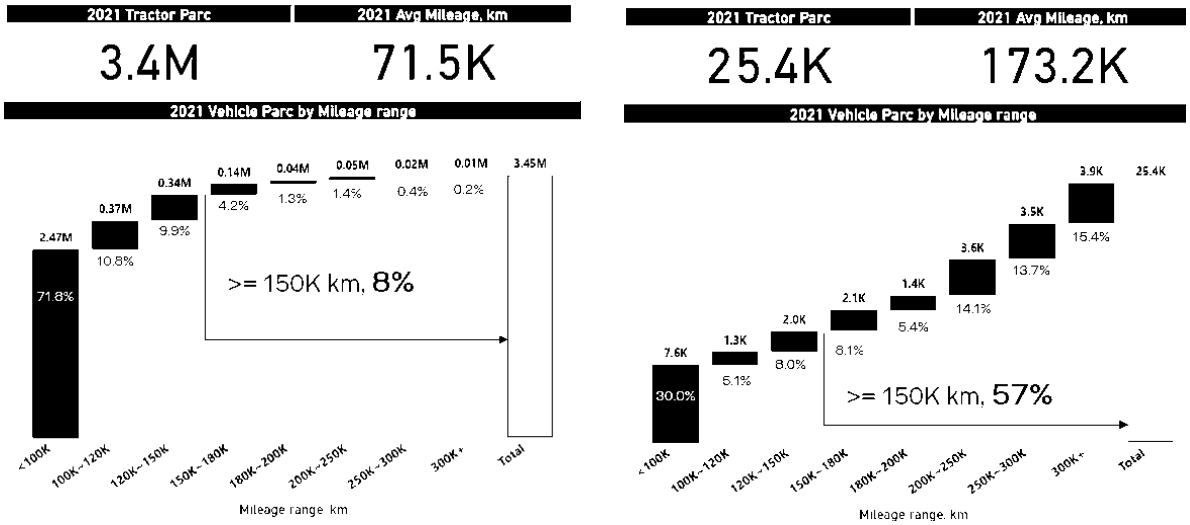


Figure 1, 2021 average milage distribution of all tractors (left) & import tractors(right), source: SinoIoV

According to SinoIoV statistic the tractor population was 3.4 million by the end of 2021, with an average mileage of only 72k a year. In contrast European import tractors had much longer mileages reaching 173k km in the same year.

[12] The Sino-Internet of Vehicle (SinoIoV) is an agency under Ministry of Transportation authorized to monitor all operational trucks data.

For the analysis, 2022 figures are skipped since that year was heavily influenced by the strict Covid pandemic control regime. Hence only the 2023 data was used as the baseline for the reference mileage calculation.

In the model several assumptions had been made to simplify the complex data sets and to enable focus on the key variables. These assumptions include, but are not limited to, the adoption rate of HCT solutions, the impact of stricter regulations and standards on truck specifications, and the positive response of consumers and businesses to the introduction of more efficient and highly priced transport equipment.

Table 2 - Model Assumption with a set of parameters

		2023	2024	2027
1	GDP growth (%)	5.0%	5.0%	4.0%
2	Total Road Freight Volume (bn ton km)	7395	7765	8734
3	Long haul proportion (%)	70%	70%	70%
4	Long haul Freight Volume (bn ton km)	5,177	5,435	6,114
5	Average mileage per truck (km)	75,000	77,000	78,000
6	Average payload (ton)	25	25	25
7	Utilization rate (%)	79%	80%	80%
8	Required tractor population (unit)	3,494,684	3,529,432	3,919,232
9	Annual Replacement (%)	10.0%	10.0%	10.0%
10	Annual Tractor Sales forecast (unit)	331,103	349,468	381,743
11	Tractor proportion of total HDT (%)	53%	60%	60%
12	Annual HDT sales Forecast (unit)	624,722	582,447	636,239

The model is based on the following assumptions:

- China GDP will grow at a slower rate which impacts the freight volume increase.
- The proportion of long-haul based on tractor trailer combinations is estimated to account for 70% of total freight, which gradually increases to 71% by 2030.

- Based on 75k km annual milage and 25 tons payload per tractor and an average load utilization rate (79% in the base year 2023)[13], the needed total tractor population can be easily calculated.

Table one row number using the V(value)

Long haul Freight Volume (bn ton km): V4 = V2 x (1+V1) x V3
Required tractor population (unit): V8 = V4 ÷ (V5 x V6 x V7)
Annual HDT sales Forecast (unit): V12 = V8 x V9 ÷ V11

As shown in Figure 2, a 10-year replacement cycle (V9=10%) is used since many tractors has shorter life length while others have long life length but with less annual milage.

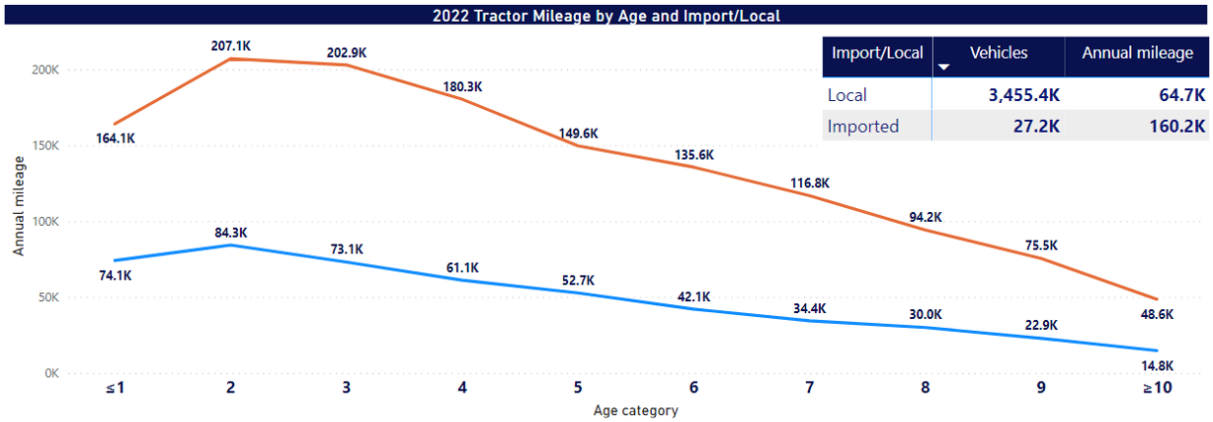


Figure 2, 2022 tractor average milage by age, source: SinoIoV

[13] 79% may seem very high. However, Chinese transport companies tend to wait several days in order to get a return freight. The efficient fleets manage to keep high filling rates for each transport leg.

To calculate the total HDT sales volume real figures of tractor proportion to total HDT sales, (53% in 2023, up to 60% in 2024-2027) are used.

4. Preliminary Results

We now want to create an extreme scenario to visualize the impact of moving toward larger vehicles combinations. Based on the above assumptions and calculating with the introduction of HCT from 2028, theoretically replacing all truck + semitrailer combinations with 25 tons payload, the average payload will increase to 37.5 tons and with better utilization rate (more goods consolidation brings better efficiency), the required tractor population would be reduced from 3.9 million in 2027 to 2 million in 2030. This in turn directly influences annual new tractor sales. If the 10% replacement rate remains, the tractor sales volume is reduced to 273 000 units and consequently the annual total HDT market goes down to 440 000 units[14].

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Table 3 - HCT introduction impact to the Tractor and HDT market size

		2023	2024	2027	2028	2029	2030
1	GDP growth (%)	5.0%	5.0%	4.0%	4.0%	4.0%	4.0%
2	Total Road Freight Volume (bn ton km)	7395	7765	8734	9084	9447	9825
3	Long haul proportion (%)	70%	70%	70%	71%	71%	71%
4	Long haul Freight Volume (bn ton km)	5,177	5,435	6,114	6,449	6,707	6,976
5	Average mileage per truck (km)	75,000	77,000	78,000	78,000	79,000	80,000

[14] Tractor proportion of total HDT estimated to 62% as per table 3

6	Average payload (ton)	25	25	25	37.5	37.5	37.5
7	Utilization rate (%)	79%	80%	80%	81%	83%	85%
8	Needed tractor population (unit)	3,494,684	3,529,432	3,919,232	2,722,126	2,727,822	2,051,667
9	Annual Replacement (%)	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
10	Annual Tractor Sales forecast (unit)	331,103	349,468	381,743	391,923	272,213	272,782
11	Tractor proportion of total HDT (%)	53%	60%	60%	62%	62%	62%
12	Annual HDT sales Forecast (unit)	624,722	582,447	636,239	632,134	439,053	439,971

So, in such an extreme scenario, facing the prospects of selling fewer tractors will the manufacturers suffer from less revenues? To answer that question assumptions about the trucking selling price and average profit margin need to be made.

Table 4 - OEM Economical Result

		2023	2024	2027	2028	2029	2030
13	Average price (CNY)	350 000	350 000	350 000	500,000	500,000	550,000
14	Total Tractor turnover (BCNY)	116	122	134	196	136	150
15	Average profit (5)	2%	4%	5%	6%	8%	10%
16	Total profit (BCNY)	2	5	7	12	11	15

In Table 4, it is calculated that the introduction of HCT solutions in 2028 will lead to a significant increase in the average sales price of tractors (in today's prices), from CNY 350 000 to CNY 550 000. The reason for this price increase is that prime movers for long vehicle combinations need to be equipped with more active and passive safety features, have stronger engines and better braking systems, e.g. hydraulic retarder etc. This price increase, combined with a decrease in domestic sales due to the shift towards higher-quality vehicles, results in a

29% increase in industry turnover 2030 vs 2023. With more focus on efficiency, it will be easier for the OEMs to shift focus from the selling price to value creation, making it feasible to increase margins on the vehicles. Assuming that possible profit level could reach the average levels of today's European truck OEMs, profits have a potential to increase from 2% to 10% by 2030.

Table 5 – Economic Impact to the Logistic Sector for Society

		2023	2024	2027	2028	2029	2030
17	Long Haul Cost per km (CNY)	5.79	5.75	5.73	6.303	6.303	6.303
18	Efficiency improvement	1%	1%	1%	1%	1%	1%
19	Long Haul Cost per ton km(CNY/ton km)	0.232	0.230	0.229	0.168	0.168	0.168
20	Total Long Haul annual cost (BCNY)	1696	1768	1982	1512	1572	1635
21	GDP (BCNY)	126,058	132,361	148,888	154,844	161,037	167,479
22	Long Haul Freight Cost as % of GDP	1.35%	1.34%	1.33%	0.98%	0.98%	0.98%

With a new focus on value creation, the improved efficiency of HCT solutions leads to a significant reduction in road freight cost per ton-km, from CNY 0.23 to CNY 0.17. This reduction, in turn, means that, while total road freight volumes increase by 44%, the total annual road freight cost remains unchanged. Lower costs per ton/km furthermore means that transport companies can improve their own profit margins.

Consequently, improved profitability of both the truck OEMs and of transport companies contributes to reducing the cost of transport and logistics to GDP in China, from today's 1,33% to 0,98%, which is, as a reference is approaching the levels seen in EU[15].

Table 6 - Summary of Simulation Results

	2023	2030	Change
Manufacturer			
HDT domestic sales	624 722	439 971	-30%
Average sales price CNY	350 000	550 000	157%
HDT Industry turnover bn CNY	116	150	129%
HDT Industry profitability	2%	10%	500%
HDT industry net profit	2.3	15.0	652%
Road Transport			
Total Road Freight Volume bn ton km	7395	9825	133%
Cost per ton/km	0,232	0,168	-28%
Total Annual long-haul freight cost bn CNY	1696	1635	-4%
Long Haul Freight Cost as % of GDP	1.35%	0.98%	-27%

This simulation does not include the economic and environmental impact of fewer trucks burning less fuel and generating same or even lower maintenance and repair cost[16]. Fewer trucks on the road generate less road accident etc. all of which are benefits not quantified in this paper.

[15] This reference is often made in China benchmarking transport and logistics cost to GDP in the EU and the US. However, that reference is not entirely valid since fuel cost, taxes and salaries differ between China and EU.
[16] HCT tractors will require higher maintenance and repair costs than today's tractor + semitrailer combinations, which may lead to total costs being the same, or possibly slightly lower.

Preliminary calculations indicate that, even in a stagnant or shrinking market, it is possible to achieve top-line growth on the supply side by offering more efficient and highly priced transport equipment. By focusing on quality instead of quantity, HCT solutions can contribute to higher transport efficiency in the system, leading to lower costs per transport unit.

The analysis is relatively simple and based on existing statistical data, however there is uncertainty regarding assumptions made in Table 2. Still to assess the economic impact of a shift from the current focus on low cost to a future focus on value creation the uncertainty of the assumptions is of relatively minor importance, as we believe the assumptions are the best possible given the aggregate data available.

Although the paper often makes comparison with EU it does not consider political, economic, logistic, population density, urbanization, cross-border etc. differences between China and EU. The purpose of comparing relevant data from Europe is merely to verify whether the assumptions of the model are reasonable.

5. Conclusions

This paper demonstrates that the introduction of HCT solutions, support the recently launched development directions by the Chinese political leadership, of going from low-end production to developing so called high-quality productive forces, to drive maturity of the Chinese economy. As we have shown, the shift from traditional, low-priced tractors to sophisticated HCT tractors, has the potential to improve the profitability and efficiency of China's road transport sector, even in a stagnant or shrinking truck market.

Efficiency improvements will as a side effect lead to emission reductions per road transport unit. In conclusion, HCT is a sustainable path forward from an economic, environmental and social point of view.

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