




Research Article

Government Policy or Market Mechanism, Which Is Better for Chinese Private Rocket Enterprises

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Abstract

In 2015, Chinese Government issued the *Notice on the National Civil Space Infrastructure Medium - and Long-Term Development Plan (2015-2025)*, announcing that it would support and guide social capitals to participate in the application and development of national civil space infrastructure construction. Later, Chinese private companies are allowed to apply for launch licenses, breaking the traditional model of allocating funds from the state budget and developing rockets only by the "national teams". Many Chinese private rocket companies were registered and established afterwards, and some of them have successfully launched rockets several times in recent years. At the same time, Chinese private rocket enterprises are also facing with many problems, including the low success rate of rockets, the risk of rocket debris falling, high space insurance rates, space junk, talent competition, and corporate survival, etc. In 2023, the Chinese Government issued *Notice on Strengthening the License Management for Civil Space Launch Projects*, which requires the third-party liability insurance policy and space debris mitigation plan for launch licenses application, meanwhile the last sub-stage of the launch vehicle should de-orbit according to the regulations after taking measures such as passivation, using government policy tools to regulate and guide the development of private rockets. In conclusion, in order to promote the healthy development of commercial launch service industry, the market mechanism should play a leading role, while appropriately regulation and adjustment from the government policy are also needed. In addition, this paper also suggested that the Chinese government should carry out overall planning for the division of labor and product models of state-owned and private rocket companies.

Keywords

Rocket, Private Enterprise, Government Policy, Market Mechanism

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Received: 22 November 2023; **Accepted:** 4 March 2024; **Published:** 13 March 2024



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1. Introduction

Space has always been an respectable and honorable field in China. Starting from the establishment of the first space research institution in 1956, going through the successful launch of the first artificial satellite in 1960, and the accomplishment of manned spaceflight in 2003, as well as major projects including Lunar exploration, Mars exploration and space station in recent years, China space has made remarkable achievements, demonstrating its strong national strength and innovation capability. Meanwhile, Chinese private rocket enterprises also started from scratch and experienced incredible rapid development. This paper reviews the related Chinese government policies, analyzes the current situation and problems of Chinese private rocket enterprises, and proposes suggestions on using policies and market mechanisms to further promote the development of Chinese private rocket enterprises.

2. History of Chinese Private Rocket Enterprises

2.1. Launch Permit Restriction Relieved

Rocket technology, with the character of sophisticated technology, vast investment and high risk, was funded allocated by the state budget in China, and the "Chinese national teams" take the responsibility for research and manufacture in the past [1]. Situation changed around Year 2000, with the rapid development of technology, satellites were widely used in communication, remote sensing, navigation and other fields, and has been playing an important role in the network construction, infrastructure mapping, environmental monitoring, transportation, precision agriculture, smart cities and other aspects in China [2]. Meanwhile, considering the international regulation, satellite orbit resources follows the principle of "first-come, first-served", many countries are actively deploying satellites in order to get orbit positions as many as possible [3]. Rocket is the only vehicle for the satellites, so the increasing demand of satellite launching puts forward higher requirement on the launch capacity and launch density. However, the long manufacture period, high cost and low capacity of Chinese rocket resulted in serious shortage of rocket supply, comparing to the booming domestic small satellite market and the huge demand of launching.

In December 2002, the Commission of Science, Technology and Industry for National Defense, PRC (now stated as the State Administration of Science, Technology and Industry for National Defense, PRC, briefly stated as SASTIND) published the *Interim Regulation about the Licenses for Civil Space Launch Projects*, announcing the implementation of license application regulation for civil space launch projects and clarifying the qualifications and procedures for applying for launch licenses [4]. However afterwards, for a long time, only state-owned space corporations were allowed to apply

for launch licenses.

In order to increase rocket supply, reduce rocket costs, and improve launch efficiency, the Chinese government decided to allow, encourage and guide the domestic private enterprises enter the rocket launch market and develop commercial rocket, so as to make up for the gap in the rocket spectrum, and form differentiated competition between private enterprises and "national teams", and enhance the vitality and competitiveness of Chinese space industry.

In October 2015, the National Development and Reform Commission, the Ministry of Finance and SASTIND, PRC jointly issued the *Notice on the National Civil Space Infrastructure Medium - and Long-Term Development Plan (2015-2025)*, which declares to establish new market-oriented and commercial mechanisms combined with reformation and innovation for national civil space industry, and support and guide social capital to participate in the application and development of national civil space infrastructure construction, therefore to improve the Chinese space ability which will support economic and social development. Afterwards, the SASTIND allowed private enterprises to apply for launch licenses. By the way, Year 2015 is also known as the "First Year of China Commercial Space" [5].

Moreover, in May 2019, the SASTIND and other department jointly issued the *Notice on Promoting the Standardized and Orderly Development of Commercial launch Vehicles*, setting out comprehensive norms and requirements on matters related to scientific research, production, testing, launch, safety and technical control of commercial launch vehicles.

2.2. Primary Development of Chinese Private Rocket Enterprises

Before and after the release of the above regulations, a large number of private rocket companies have been established in China:

- a) One Space Company was registered in 2012;
- b) Linkspace Technology Co., LTD. was registered in 2014;
- c) Landspace was registered in 2015;
- d) Ispace was registered in 2016;
- e) Galactic Energy was registered in 2018.

In addition, dozens of private rocket companies, including Space Pioneer, Deep Blue Aerospace, Star Trek Space, Jiu-Zhou Yunjian, etc. were established [6].

The core technical personnel of the above private companies are mainly from the "national teams". On the basis of mature overall scheme of the rocket, the private enterprises carry out low-cost optimization and innovation, and start manufacture and launch work rapidly. Although some failures occurred in the early stage due to lack of technicians and supply chains, their success rate has been increased significantly recently after the adjustment.

- a) In March 2019, "Chongqing Liangjiang Star" rocket developed by Onespace only carried out its first launch, however failed its mission. The reason of failure was the rate gyroscope broke down at 45.68 seconds after ignition.
- b) On 7th November, 2020, "Ceres-1" rocket developed by Galactic Energy Company made its first launch successfully from Jiuquan Satellite Launch Center, and delivered the Apocalypse-11 satellite into orbit. Until now Galactic Energy Company has made 9 successful launches, and the last of them was launched from the Huanghai Seacon on 5th September, 2023, which was the first time that a Chinese private rocket company carried out a successful sea launch mission. However this company met its first failure in the next launch dated 21th September, 2023.
- c) TL-2 rocket developed by Space Pioneer Company made its first launch successfully in April 2023.
- d) Hyperbola-1 rocket developed by Ispace Company failed 2 times in 2021 and succeeded in its third launch in April, 2023.
- e) ZQ-2 rocket developed by Landspace Company failed its first mission in December 2022 and succeeded in the second launch in July 2023.

3. Problems Chinese Private Rocket Enterprises Are Facing with

In recent years, the rapid development of Chinese private rocket enterprises also brings problems. Here listed some of the problems that they are facing with.

3.1. Cost Reduction Strategy Reduces Technical Reliability

As a typical kind of company, private rocket enterprises also holds the principle that Profit is the fundamental purpose. With rocket launch prices becoming transparent, reducing cost is the only way that private rocket companies will increase profits, for instance, replace some non-core space-grade components and chips with industrial-grade, slightly sacrificing their upper and lower limits of performance and useful life. Moreover, for some components and part in short supply, private enterprises which do not have stable upstream supply chain resources could only seek for alternative solutions, which also lead to the reliability reduce of private rockets, and increasing risk of launch [7].

3.2. Risk of Accidents Caused by Falling Rocket Debris

Satellites and rockets, as two important parts of space missions, may re-enter the Earth's atmosphere, posing the risk of falling. Compared with satellites, the situation of

rocket debris is relatively complicated. Although the fall area of the debris can be planned in the design stage, the specific landing point of the debris are sometimes difficult to accurately predict, due to various unpredictable failures may occur during the launch. In particular, it seems that there are higher risk of injury caused by the fall of private rocket debris, because of the limitation of their management system and technology. The falling rocket debris may also cause diplomatic accident.

3.3. Higher Insurance Rate

Space insurances are divided into following 4 types [8]:

- a) Pre-Launch insurance: covers the loss of rocket and satellite, and duration starts from start of manufacture and end by ignition.
- b) Launch insurance: covers the loss of rocket and satellite, and duration starts from ignition and end by separation of rocket and satellite.
- c) In-Orbit insurance: covers the loss of satellite in a designated period after the satellite enter into orbit.
- d) Third-party liability insurance: covers damage to any third parties during the launch.

Due to the relatively low technical reliability of private rockets, insurance enterprises may be reluctant to provide launch insurance service, or only provide with higher insurance rate.

Meanwhile, private rocket enterprises may choose to buy only the third-party liability insurance for cost reduction considerations. However, it may lead to the failure of private rocket enterprises to get compensation after the launch, so the enterprises would have to bear heavy economic losses; If the third-party liability insurance amount is not enough to cover the losses caused to the third party by a failed launch, the private company will have to bear the spillover part of the compensation.

Besides, though it is required by Chinese Government that rocket companies must purchase Third-party liability insurance, the insurance policy wasn't required to submit when applying for the launch permit, which has been a regulatory risk.

3.4. The Risk of Space Trash Generation

The final stage of rocket, as the last part with engine, is responsible for delivering the payload/satellites into orbit and separating it. Once the satellite is separated and in-orbit, the final stage of rocket becomes a giant piece of trash floating in space.

At present, all Chinese national rockets have passivation and deorbit capabilities.

Note:

- a) Passivation means emptying the remaining high-pressure gas, fuel and electricity in order to prevent the final stage of the rocket from exploding in space and pro-

ducing more trash.

- b) De-orbit means move the final stage of rocket out of the orbit and burns up in the atmosphere.

Due to technical limitations and cost reduction considerations, the private rockets may not have the abilities above. If so, the rockets will float in space and may collide with other space debris, which may result in an “avalanche effect”, producing a large number of small debris and threatening the in-orbit satellites [9].

3.5. Compete for Talent with National Team and Mission

In 2018, Zhang Xiaoping, deputy design director of the cryogenic engine of China Academy of Aerospace Propulsion Technology (CAAPT), quit his job and worked for a private company at a much higher salary. At that time, CAAPT requested to prevent Zhang Xiaoping from job-hopping, which caused widespread discussion.

3.6. Risk for Survival

Before their successful launch, private rocket companies can't get commercial orders and they can only rely on financing to survive [10]. The investors may withdraw their investment if the companies can't make a successfully launch in a short period, which may result in break down of the companies. Considering the high risk of launch in the early stage, the private companies are under heavy pressure.

3.7. Different Opinions

The problems above have led to different opinions in China. Some people believe that private rocket enterprises:

- a) in market aspect, are competing fiercely with state-owned companies, decreasing launch price, disrupting launch market and squeezing industry profits;
- b) in resource aspect, they have higher failure rate and caused investment waste;
- c) in talent aspect, they attract talents from national teams, affect the development process of advanced national rocket models.

Therefore they propose to formulate policies to restrict the development of private rocket enterprises.

4. New Chinese Government Policy on Private Rocket Launch Permits

Despite the problems and controversies above, decision was made by related departments of Chinese Government, on the basis of extensive consultation with experts, that China will continue to support the commercial space enterprises, while using policy tools for regulation and guidance.

In response to the problems arising after the implementa-

tion of Interim Regulation about the Licenses for Civil Space Launch Projects, SASTIND issued the Notice on Strengthening the License Management for Civil Space Launch Projects in March 2023, which includes the following provisions relating to rockets:

- a) Add third-party liability insurance policies and space debris mitigation programs to the license application documents.
- b) The satellite or spacecraft should take the initiative to deorbit when it reaches its design life according to the license application document. it shall, When the design life of and The last stage of rocket should passivate and deorbit according to the regulations.
- c) The license holder must purchase third-party liability insurance and other relevant insurance for launching space objects in accordance with regulations. If third party losses are not fully covered by the third-party liability insurance, the license holder shall bear the liability for the remaining losses.

It can be seen that the above policies proposed mandatory requirements for the problems existing in private rocket enterprises at this stage in a targeted way of administrative management. The policies also reflected that Chinese Government holds encouraging attitude towards the development of private rocket enterprises.

5. Considerations

5.1. The Market Should Take the Lead for Commercial Launch Services Industry

Traditional aerospace industry, as an important field serving national defense, was supported by national finance, and its rockets and satellites are generally used for scientific exploration or networking applications, serving national security and development, and the people generally receive the benefits. Therefore traditional aerospace industry are typical public goods.

Relatively speaking, the commercial launch service, as a kind of organized business behavior, aims to provide customers with required services, which allocates resources according to the market mechanism and for the purpose of profit. It includes the attributes of "space" and "commercial", and should consider both success and economy [11]. Rocket companies are the main bodies to provide commercial launch services, and different companies have different technical routes, technical levels, product prices, delivery periods, customized services, and the companies carry out fair competition under market mechanism.

Consequently, from the current view, the market mechanism has played a good role in resource allocation in the Chinese private rocket industry, such as:

- a) Chinese private rocket enterprises are carrying out investment, financing, acquisition, merger, division, bid-

ding, bargaining, compensation, research, collaboration, manufacturing, operation and other commercial behaviors orderly under market mechanism, and investors and enterprises are allowed to enter or exit the industry with freedom.

- b) Considering the private enterprises are responsible for their own profit and loss, they must reduce cost, increase ROI (return on investment), encourage innovation and maximize benefits.

Therefore, giving the leading role to market mechanism will benefit private enterprises, including [12]:

- a) integrate resources,
- b) discover and train talents,
- c) improve technical capabilities,
- d) formulate and adjust marketing strategies in time according to market demand,
- e) develop products with strong reliability, lower costs, domestic and international competitiveness, etc.

5.2. Government Should Regulate and Adjust Moderately

According to *the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, which China participated in 1967, every Government is internationally responsible for all space launch activities of its country, and every States have an obligation to supervise space launch activities carried out by their own non-governmental entities. Therefore, space activities have their particularity and cannot be dominated by the market alone.

In order to foster the emerging commercial aerospace industry, Chinese government has implemented a series of policies and measures, such as:

- a) Lower the entry threshold, support social capital to invest and establish companies that develop rockets.
- b) Coordinate launch sites and other related resources, allowing state-owned launch sites accessible to private enterprises. Moreover, Chinese government also approved the construction of the first commercial launch site in Hainan Province in 2022.
- c) Include private rockets in the national space long-term development plan, considering their long-term research and revenue period problem, so that social capitals are willing to invest with confidence.

At the same time, Chinese government minimized its interference in the commercial activities of private rocket companies and maintained a more free and fair market competition environment. For example, Chinese government:

- a) Didn'T limit the proportion of state-owned capital in private rocket companies,
- b) Didn'T restrict their financing channels or the free transfer of shares,
- c) Didn'T designate personnel to guide the operation and management of enterprises,

- d) Didn'T investigate the responsibility for their launch failures,

- e) Allow private rocket companies to organize their own technical return-to-zero activities ("return-to-zero" means that after a launch failure, the institute/company have to find the reasons of failure, by tracing and re-verifying each step one by one and abandoning subjective assumptions, until the problem is solved before re-launching, which may take several months or even more than a year [13]).

- f) Allow private rocket companies to attract technical talents in the form of high salaries and equity incentives.

On the other side, in response to the problems that private rocket enterprises have encountered during their development, Chinese government has introduced some new policies, with the main purpose of regulating their behavior, urging them to undertake social responsibilities, maintaining space order and reducing the adverse influence of marketization without intervening the free market and their normal business activities.

6. Policy Suggestions

6.1. Both Policy Support and Market Mechanisms Matters

Considering the status of Chinese private rocket enterprises, the following suggestions are proposed:

- a) The Government shall support and encourage the development of private rocket enterprises continually and firmly. For Chinese commercial space is still in its initial stage, and there is a big gap before industrialization and large-scale. Private rockets are still trying to ensure their success, and shelf products of rockets with reliable technology and low price haven't been developed.
- b) The Government shall continually provide public policy support for the industry on the basis of market mechanism. The government shall maintain or reduce entry restrictions of industry, insist preferential policies for private high-tech enterprises, continue to coordinate public resources such as launch sites, promote the perfection of relevant laws and regulations, create a benign development and fair competition environment, organize and encourage international cooperation, in order to promote the common development of the industry.
- c) The private rocket enterprises shall invest their main resources into talent construction and technology research and development at this stage. In the current situation, there are many satellites and less rockets, so the rocket sellers have the pricing power. The enterprises who have stable and reliable rocket products will receive a large number of satellites ride-share and advertising orders on the basis of moderate publicity, and no need to carry out specialized marketing scheme.

Meanwhile, private enterprises should take the initiative to undertake social responsibilities and follow international obligations about space order, and maintain the international reputation of China Space.

6.2. The Government Shall Carry out Overall Planning for State-Owned and Private Rockets

In order to promote the development of the industry, avoid repetitive construction and waste of resources, it is recommended that the government carry out overall planning for the technical direction and product models of domestic rocket enterprises.

6.2.1. Divide the Work of State-Owned and Private Rocket Enterprises Reasonably

The state-owned space enterprises have the advantages such as:

- a) owning best technical teams,
- b) solid technical foundation,
- c) complete supply chain,
- d) strong product reliability,
- e) ensure success rate regardless of the cost, due to the national task requirements,

And problems such as:

- a) low efficiency,
- b) long development period,
- c) slow technology iteration,
- d) high research cost,
- e) waste of resources, etc. [14].

Therefore, it would be best for the state-owned space enterprises to undertake national designated tasks and concentrate on carrying out high-tech research works.

The private rocket enterprises have the advantages such as:

- a) flexible cooperation mechanism,
- b) more optional upstream suppliers,
- c) diverse organization and research modes,
- d) highly professional and concentrated field,
- e) concern on cost control and value creation in details,
- f) fast customer response,
- g) rapid technological upgrading and market expansion, etc.

And problems such as:

- a) lack of funds and talent,
- b) non-controllable supply chain,
- c) lower reliability.

Therefore, it would be better for the private rocket enterprises to act as a supplement to state-owned rockets, and moderately undertake some of national launch missions, which will encourage them to develop lower cost commercial rockets, seize the domestic and global commercial launch market.

6.2.2. Coordinate Product Models Among Private Rocket Enterprises for Healthy Competition Guidance

There are many kinds of rockets.

- a) Divided by number of stages, there are single stage, two stage and three stage rockets.
- b) Divided by type of energy, there are solid propulsion, liquid propulsion and mixed propulsion rockets. Liquid rockets are also divided into liquid oxygen kerosene, liquid oxygen hydrogen, liquid oxygen methane and other rockets.
- c) The orbital heights differs from 200 km to 1000 km.
- d) The carrying capacity differs from 200 kg to 4 tons.

Various kinds of rockets have their own advantages. It is recommended that the Government shall guide different private enterprises to develop different types and models of rockets, in order to avoid repeated development, waste of research and production resources, as well as to avoid vicious competition between private rocket enterprises to some extent.

6.3. Include Private Rockets Deeply in the Overall National Space Development Plan

Private rocket enterprises, as a new model of deep integration of space technology and social capital, have made great contribution to the national economic development and technological progress, such as [15]:

- a) led to a flourishing market,
- b) promoted the accelerated integration of industrial resources and market demand,
- c) constantly promoted technological progress and cost reduction,
- d) spawned new economic growth points,
- e) stimulated many related industries,
- f) provide a new invest industry and optimize the allocation of social capitals.
- g) helps with better division of labor among social organizations. The state-owned space institutions will concentrate on the development of most advanced technologies and the execution of national space missions, while commercial space enterprises concerns more about reducing costs and increase efficiency to fulfill the increasing needs of the market.
- h) In addition, private rockets, with a strong social mobilization potential, can be used as a supplement to state-owned rockets when in peacetime, and can also be used to serve national defense when in emergency.

In conclusion, the benefits above of private rocket enterprises for the country have gradually emerged in the near future. It is suggested to:

- a) include private rockets deeply into the national space development plan,
- b) guide private rocket enterprises to serve the overall development and construction of the country,

- c) make full use of the price advantage of private rockets to reduce the construction cost of national space mission projects.
- d) The measures above will also enable social capitals to judge the good prospects of private rockets, strengthen investors' confidence, help private rocket enterprises to obtain long-term and stable development opportunities, and make their contributions to promote technology progress and economy development.

7. Conclusion

Although Chinese private rocket enterprises have shown a prosperous scene in recent years, they are, objectively speaking, in their infancy, considering their problems, such as low launch success rate, talent shortage, high external dependence on the supply chain and have not been able to obtain government orders. In order to promote the development of the industry, China should give full play to the decisive role of the market mechanism, and maintain the freedom of enterprises in obtaining financing, equity transfer, operation and management. At the same time, on the basis of not interfering in the free competition market environment and normal business activities of enterprises, the Government should standardize the behavior of enterprises by government policies, in order to urge enterprises to undertake social responsibilities, and reduce the adverse impact of marketization.

Abbreviations

SASTIND: State Administration of Science, Technology and Industry for National Defense

Conflicts of Interest

The authors declare no conflicts of interest.

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