The Theoretical Gap in the Study of New Quality Productive Forces and the Economic Analytical Perspective of "Heterogeneity"

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Economic studies on the new quality productive forces NQPF are mushrooming, however, on the whole, the majority of existing studies primarily focus on revealing and summarizing the economic laws guiding the development of NQPF based on the"general"characteristics of individual organizations at the microlevel and institutions at the macro level. This paper argues that the background of "getting great" and the competition scenario between countries determine that "heterogeneity" is the most relevant and theoretically challenging issue in the NQPF, and also the most likely to yield significant academic outcomes. In view of the fact that the existing problem setting, conceptual framework, and analytical tools of existing eccomics fail to effectively address the unique prescriptive phenomena of NQPF, including direct competition between countries, power countries, and heterogeneity, future academic research on new quality productive forces should go beyond the current "general" issues orientation, directly address the extreme phenomena and problems in the "genesis" stage in the latest round of scientific and technological revolution, and strive to push forward the frontiers of theoretical research.

Keywords: new quality productive forces, heterogeneity, great power, competition between countries

Examing the series of expositions of the CPC Central Committee and the State Council on new quality productive forces, the issue of new quality productive forces (NQPF) mainly involves scientific and technological innovation, industrial transformation and upgrading, optimal allocation of factors, and improvement of total factor productivity in academic research. Although the economic research on these topics does not reach a universally accepted conclusion, its problem setting, analytical framework, theoretical concepts and empirical methods are close to maturity at the academic level. So, what is the incremental challenge posed by the new policy concept of NQPF to academic research of China's economics? This paper attempts to provide an exploratory answer to this question, which is helpful to fundamentally improve the efficiency of academic research on China's NQPF.

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1. The Gap in Economic Research on the Problem of New Qualitative Productive Forces

1.1. The Unique Meaning of the Theme of the Era of "Getting Great" and the Issue of NQPF

At the policy level, the CPC Central Committee and the State Council have given a complete and clear elaboration and deployment of the NQPF. However, at the academic level, it is difficult to say that there is a consensus in the economic community has been reached on the typical facts corresponding to the new qualitative productive forces, the connotations of abstract problems, the academic concepts of dialogue, and the theoretical framework of analysis. Different researchers abstract and deduce the problem of NQPF from different fields such as political economy, development economics, macroeconomics, and industrial economics. This kind of multi-dimensional dialogue and debate seems to be different from each other, but it is still meaningful, and most importantly, it is conducive to narrowing the distance between China's economic academic research on economics and economic reform practice, and driving Chinese economic researchers to respond more directly to the policy concerns and practical needs of economic reform and development. Different from the existing studies, this paper does not attempt to propose the concept, framework or proposition for analyzing the NQPF problem from a given discipline or theory, but rather tries to put forward a new abstract dimension of the NQPF problem that has been ignored by the academia, so as to arouse the attention of researchers on the marginal contribution and the most theoretically challenging aspects.

As a major strategic policy concept at the national level, the NQPF inevitably orientated towards a clear practical problems and be mapped to the grand themes of the times. To understand the differences in orientation and goals between NQPF and strategic policy concepts such as high-quality development, modern industrial system, and new industrialization, we should analyze the unique connotation as an "incremental" policy concept from the perspective of the theme of the times. Only in this way can we complete the transformation of NQPF from policy concepts into a theoretical issue, and thus realize the dialogue and mutual promotion between the policy community and the academic community.

A simple textual statistics on the reports of the Party's national congresses in recent years show that the scope and frequency of the concept of "great power" have been significantly expanded since the 19th National Congress of the Communist Party of China. In 2007, the report of the 17th National Congress of the Communist Party of China mentioned a total of 2 and 3 times of "talent make the country great" and "human resources talent make the country great", in 2012, the report of the 18th National Congress of the Communist Party of China mentioned a total of 4 and 10 times of

"make the country great" of "talent", "human resources", "culture" and "oceans", and in 2017, the report of the 19th National Congress of the Communist Party of China mentioned a total of 13 and 18 times of "make the country great" such as "make the country great" of "socialist modernization", "talent", "manufacturing", "science and technology" and "quality". The report of the 20th National Congress of the Communist Party of China in 2022 further added the concept of "agriculture make the country great" on the basis of the report of the 19th National Congress of the Communist Party of China, and a total of 25 expressions of "make the country great" appeared.[1] It can be seen that since the 19th National Congress of the Communist Party of China, the status of 'great power' has been raised in a series of major strategic programmes of the Party and the State, and 'great power' has become a keyword in the system of national strategic visions and goals. As General Secretary Xi Jinping pointed out in the report of the 19th National Congress of the Communist Party of China, "Socialism with Chinese characteristics has entered a new era, which means that the Chinese nation, which has endured long and difficult times since modern times, usher in a great leap from standing up, getting rich to getting great, and ushering in a bright prospect of realizing the great rejuvenation of the Chinese nation." Since "getting great" become the theme of the new era of socialism with Chinese characteristics, how to achieve "getting great" become the primary task facing the Chinese government. In this regard, the report of the 20th National Congress of the Communist Party of China pointed out that "without a solid material and technological foundation, it is impossible to build a modern socialist country in an all-round way". The founding of New China and the reform and opening up have enabled China to achieve a historical leap in standing up and becoming rich, and to achieve a new leap in getting great on the basis of standing up and getting rich, it is necessary to build a solid technological and material foundation through further emancipating and developing the productive forces. High-quality development, modern industrial system, and new industrialization are all major strategies related to the construction of technological and material foundation. However, in the context of "getting great", the great significance of further proposing the new policy concept of NQPF lies in the fact that the existing policy concept is still not enough to fully respond to the challenge posed by the theme of the era of "getting great", so it is necessary to condense the new policy concept of NQPF to make up for the gap between the supply of existing policy concepts and the demand for "getting great" policies. Correspondingly, the theoretical analysis of the problem of NQPF should face up to the theme of the times and the background of the problem of "getting great". If the academic debate on the NQPF is detached from the basic starting point of "getting great", it is likely to fall into a state of "old wine in new bottles" or "repeated investment".

[1] The text statistics excludes the verb-only expression of "great" in "make the country great", such as "reform and opening up is the road to make the great power" proposed in the report of the 16th National Congress of the Communist Party of China.

1.2. The Challenge of Economic Research on NQPF

In contrast to social surplus and productivity in economics, "make the country great" is a concept with a distinct national competition scenario. From the perspective of national competition, "make the country great" can be divided into two levels: first is security, that is, although passive, in the face of extreme containment and suppression, the national economy, industrial system and innovation system will not collapse, and can basically operate normally. The second is to take the lead, that is, to have sufficient "asymmetric competitive advantage" to form a sufficiently credible threat-of-loss commitment to competing countries, so as to prompt the other side not to choose containment and confrontation as an equilibrium strategy. Given the premise of "non-cooperation", the strategy choice of the leading country depends on the power gap between the catching-up country and it: if the competitive power is not strong enough, the leading country will choose to challenge the national security bottom line of the latecomer and to contain its growing power. If late-developing countries are able to build asymmetric competitive advantages in a sufficient number of technologies and industries, the containment strategy will incur losses that the leading state can hardly bear, thus forcing it to abandon containment. Therefore, in the scenario of non-cooperative game between countries, as long as the competitive strength of late-developing countries does not reach a level sufficient to threaten the leading countries to give up suppression, its security will at most reach a state of passive security or bottom-line security. If late-developing countries want to achieve active security, they need to form a leading edge in a sufficient number of technological and industrial fields.

In the sense of forming enough asymmetric competitive advantages to build the advantage of the great power game, the NQPF and the grand theme of the era of "getting great" establish a logical interface. Compared with the existing strategic policy concepts, the NQPF emphasize the development implications of technology and industry at the micro level. High-quality development is a policy concept at the level of the overall development model of the national economy, as General Secretary Xi Jinping emphasized, "High-quality development is development that can well meet the people's growing needs for a better life, and it is a development that embodies the new development concept". As the general secretary pointed out, "accelerate the construction of a modern industrial system supported by the real economy", "promote industrial intelligence, green, integration, and build a modern industrial system with integrity, advancement, and safety". It can be seen that the concept of modern industrial system emphasizes the overall development quality of the industry. According to General Secretary Xi Jinping's statement that "the Chinese dream that is specific to the industrial front is to accelerate the promotion of new industrialization", combined with the relevant interpretation of the Ministry of Industry and Information Technology (Jin, 2023), new industrialization is also a portraying of the overall characteristics of

China's industry compared with the traditional industrialization path of the past and other countries. Although the NQPF is closely related to the above overall strategy, unlike these concepts, the core connotation of the NQPF falls on the micro level such as technology and industry. It is also in this sense that General Secretary Xi Jinping emphasize that "it is necessary to promote industrial innovation with scientific and technological innovation, especially to promote new industries, new models and new kinetic energy with disruptive technologies and cutting-edge technologies, and to develop NQPF". At the micro level of new technologies and new industries, the logic and context of "make the country great" behind the NQPF can be clearly presented: each round of scientific and technological revolution and industrial transformation will go through the introduction stage of fierce competition with multiple technology routes, multiple business models and multiple industrial organization forms, and give birth to new scientific and technological powers and manufacturing powers in the process of reshaping the global industrial map (Perez, 2010). The new round of scientific and technological revolution that the world is currently experiencing with digitalization, networking, and intelligence as its core characteristics has a significant "short cycle" characteristic (Li, 2016), which creates a particularly important window of opportunity for the emergence of emerging technology and manufacturing powers. If China can lead disruptive technological innovation and the cultivation of emerging industries in the power industry and leading industries[1], it will have the opportunity to build enough and strong asymmetric competitive advantages to become an emerging technology and manufacturing power. In view of this, this paper understands the NQPF strategy as the expansion and supplementation of macro strategies such as high-quality development, modern industrial system and new industrialization at the micro level, and specifically points to the theme of the "getting great" era.

"Make the country great" is the essence of the problem of NQPF. Regrettably, however, the established economic research is inadequate in terms of the sophistication and accuracy of its theoretical concepts and analytical tools in answering the question of the 'Great Power'. In standard economics textbooks, maximizing social welfare is the fundamental criterion for evaluating the effectiveness of economic activities and policy arrangements. Economic growth theory and development economics, which are important research fields in economics, both regard economic aggregate or per capita income as the main orientation of normative analysis, and economic efficiency is the key factor determining long-term economic growth and social welfare, so that

[1] The growth sectors generated by each wave of science and technology are divided into four categories: power industry, guiding industry, new infrastructure industry and leading industry. According to Perez's definition, in this round of technological revolution, the underlying digital technology with artificial intelligence as the core is general-purpose technology, and the industry that carries these technologies can be regarded as a power industry, and the industries that take the lead in applying these general-purpose technologies and driving them to accelerate their maturity, such as intelligent driving and industrial Internet, constitute the leading industries (Perez, 2010).

the issue of 'getting great' has been reduced to an efficiency race among countries in these economic studies. Of course, efficiency improvement is important, but the the efficiency race paradigm can easily induce researchers to focus only on the domestic factors that promote efficiency improvement, and ignore the impact of inter-country competition factors, especially the extreme factors of "inhibition and anti-inhibition", on economic development. Some branches of economics pay attention to the situation of competition among countries, such as the strategic trade theory proposed by Krugman, which believes that under the conditions of an oligopoly market and increasing returns to scale, the protection of the domestic market can enhance the trade and industrial competitiveness of the country. However, its policy ideas and tools are still limited to domestic policy tools such as subsidies and tariffs, and the problem scenarios it depicts are obviously far from the fact that the United States implement extreme suppression such as "small courtyards and high walls" in strategic areas and "China+1" in traditional industries. Compared with other fields of economics, the factors of inter-state science and technological and industrial competition receive sufficient attention in the study of industrial economics, and some studies go beyond the efficiency thinking of mainstream economics and put forward the orientation of industrial development from the perspective of capacity building (Lall, 1992). However, due to the fact that this kind of research is limited to the analysis of the phenomenon of "catching up" in late-developing countries, and does not pay enough attention to the conditions and mechanisms of "leading". More importantly, although such researchers are well aware of the "heterogeneity" of a country's activities, institutions and organisations that is at the heart of capabilities, their research has been limited to the abstraction and distillation of the general characteristics of capabilities, and thus there is still room for correcting the problem and expanding the theory.

This paper argues that from the perspective of promoting the marginal development of academic research, "getting great" is the perspective that needs to be introduced and paid attention to when observing and analyzing the problem of NQPF. In view of the gap between the current academic supply of economics and the practical demand for NQPF, future academic research on economics around the problem of NQPF should focus on the theoretical opening of strategic heterogeneity and institutional heterogeneity of China's leading position in new technologies and new industries under the context of a new round of scientific and technological revolution and high-intensity national competition.

2. The "Heterogeneity" Analysis Perspective on the NQPF Problem

Although the NQPF is a new policy concept, the phenomenon of late-developing countries becoming emerging powers in the new technological revolution corresponding to the NQPF becomes a characteristic fact in economic history. Sorting

out these facts that occurred and showing specific regularity is a scientific and feasible way to propose and open up the new theoretical perspective of "heterogeneity" analysis. Considering that enterprises are the direct creators of new technologies and organizations, and the innovation activities of enterprises are embedded in the economic structure and institutional framework shaped by the state, this paper develops the heterogeneity perspective at the micro-strategy and organisation of firms, and the macro-economy and institutions of the state, respectively.

From the second half of the 18th century to the beginning of the 19th century, Britain took the lead in a technological revolution that lasted for about 70 years. The micro foundation of Britain's rapid rise from a relatively backward agricultural country to the world's most powerful industrial country is that its entrepreneurs and engineers not only led the development of new technologies and industries such as water-powered spinning machines, steam engines, and steamships, but also created a new mode of production organization that matched mechanized production - the factory system. Compared with traditional handicraft workshops, the factory system, which is more compatible with mechanized production methods, greatly improves economic efficiency. From the perspective of production, the factory system and the deepening of capital jointly expand the professional division of labor within the organization, which is conducive to the formation of a positive feedback of the division of labor and the expansion of the market scale, and at the same time, the factory system provides a centralized physical space and organizational structure for industrial workers and machinery and equipment, promotes the standardization of process and management, and enables a large number of industrial workers and a variety of machinery and equipment to integrate and work together. More importantly, from the perspective of knowledge creation, the organized and centralized production under the factory system is conducive to the decoding, exchange and accumulation of knowledge, and greatly improves the speed and quality of industrial knowledge creation compared with decentralized production. Clusters of disruptive technologies emerge at the micro level in the UK, and organizational structures are created that are compatible with emerging technology paradigms, mainly due to the heterogeneity of the UK's macro institutional structure. For example, in terms of property rights, the British parliament checks and balances the absolutist monarchy, cultural traditions and legal systems attach great importance to the protection of individual property rights (especially land rights) and private interests, and the establishment of enterprises and the fact that enterprises engage in international trade without government approval or concessions, creating a cycle of investment, wealth accumulation and production expansion, which stimulates investment in productive activities more effectively than other countries (Acemoglu *et al*., 2005). In addition, Britain pursue a mercantilist and foreign trade policy, and through colonization and the establishment of maritime hegemony, it provided large-scale capital accumulation for the industrial revolution characterized by the large machine industry, coupled with the

innovation of financial organizations such as the banking system and credit institutions, which achieved the efficient flow and allocation of capital. In the field of intellectual property protection, the United Kingdom take the lead in other capitalist countries in promulgating the Monopoly Law, formally establishing an intellectual property protection system in the modern sense, and providing strong incentives for knowledge protection and creativity. In addition, the British government flexibly uses ex-ante financial support measures such as rewards to effectively make up for the shortcomings of patent compensation in technological innovation financing, and establish a relatively complete system of technological innovation incentive policies earlier.

By the end of the 19th century, Germany had risen to become an emerging industrial power in the fields of organic chemistry and other industries. Previously, the UK's dominance in the chemical industry was mainly based on its advantage in the field of inorganic chemicals, but its production methods mainly relied on the accumulated experience in the production process. Unlike the United Kingdom, German enterprises began to set up R&D centers within the enterprise, and this new R&D organization model is like the mechanization pioneered by the United Kingdom, which greatly empowers the technological innovation of enterprises, making technological innovation gradually become the focus of competition between enterprises and the core competence within enterprises. First of all, the enterprise R&D center promote the transformation of the industrial knowledge creation model from individual experience to collective scientific research, and technological innovation change from individual behavior to organizational behavior, which greatly improve the specialization and efficiency of technological innovation. Secondly, the establishment of R&D centers by enterprises improves the ability of enterprises to create and protect their technological achievements, thereby improving the profitability of enterprise technological innovation in the environment of weak intellectual property protection. Finally, the improvement of enterprise technology development capabilities strengthen the industrial demand for basic research, and promoted the combination and mutual promotion of basic research and technological innovation. It can be said that the heterogeneity of German enterprises promote the core competence carrier of enterprises from factories to laboratories. The formation of this strategic and organizational heterogeneity is rooted in Germany's unique macroeconomic structure and institutional supply. With its distinct decentralized and standardized education system, Germany construct a more efficient large-scale training system for chemical talents, providing key technical and talent support for the innovation and growth of chemical enterprises. The extensive and close student-faculty relationship in Germany also plays an important role in fostering close informal networks and partnerships among German industry, academia and government. This kind of social capital of teachers and students shows a strong voice and collective action ability in the formulation of the German patent law and the reform of the industry-oriented education system, which provides an institutional foundation for Germany's

continuous innovation and leadership in chemistry and related fields. On the one hand, the advantages of the German education system come from the development ambition of the German government, that is, the states increase their economic strength to cope with the urgent need of the crisis of aggression, so as to strive to promote the development of public services such as education, and actively use industrial policies to promote industrial catch-up. On the other hand, as a country that relies on the rise of land-based standing armies, Germany has more practices than other European countries in terms of centralized administration and rapid decision-making, and can more effectively promote rapid changes in the education system and industrial policy (Murmann, 2003).

In the 20th century, the United States successfully became an industrial power with its large-scale production line method and breakthroughs in electrification technology. Originating from Ford, the Model T pioneered the combination of large-scale production line and electrification technology, which greatly improve the degree of specialization and standardization of production, significantly reduce the dependence on workers' skills and experience, and improve the efficiency of workers' professional skills training, accumulation and diffusion. Most importantly, large-scale production line pushes economies of scale to the extreme, greatly reducing the cost of industrial products and improving the efficiency of industrial production while ensuring product quality. More importantly, this mode of production reduces intra-enterprise transaction costs, making large enterprises the protagonists of industrial organizations. The expansion of internal resources controlled by these "corporate empires" further enhances the economies of scale of enterprise R&D, significantly increases the scope economy of enterprise knowledge creation, and makes enterprises gradually become the most important providers and coordinators of scientific and technological innovation in the economic system. Matched by large-scale production line and enterprise expansion, the United States also becomes a source of global management and organizational innovation. For example, the Taylor system, which opened the prelude to scientific management, effectively overcome the loss of management efficiency that may be caused by the expansion of enterprise scale by introducing systematic management methods, task decomposition and standardization, and differential piecework wages. The division system introduced by companies such as General Electric enables large enterprises to form an effective organizational structure and incentive structure. The most important reason why the United States is able to catch up with European countries to become the new global technological hegemony and maintain its long-term scientific and technological leadership is that the United States provides a more effective market system than European countries, including more effective intellectual property protection, a stricter legal framework for antitrust and unfair competition, and a corporate legal system that can more effectively protect the interests of shareholders and facilitate the transfer of control. The reason why these systems can be effectively supplied is directly related to the political

system of the United States. For example, an important reason why corporate law in the United States is moving in the direction of giving companies greater autonomy is that the state government wants to attract investment through institutional innovation in corporate law (Zhong, 2012). In addition to the unique market regime, the U.S. government create many new models for building a strong national innovation system. For example, the research university system pioneered in Germany is further deepened, universities are given a high degree of autonomy, the Bayh-Dole Act is introduced to promote the transformation of basic research and industrial technology in universities, the strategic procurement of the Defense Advanced Research Projects Agency and NASA promote disruptive innovation, and the construction of a strong national laboratory system led to mission-oriented innovation, all of which provide strong public knowledge support for micro enterprise innovation activities.

Since the 70s of the 20th century, Japan has built a leading edge in many emerging fields such as consumer electronics, energy-saving automobiles, and integrated circuits by virtue of lean production methods. In view of the defects of the large-scale production line mode of European and American enterprises, the lean production system pioneered by Toyota Corporation of Japan realize the continuous improvement of the production process, the minimization of resource waste, the efficiency of product development and the timeliness of demand response, which greatly improve the production efficiency at the same time, improve the flexibility of the industrial chain and production process, and significantly improve the product quality. Compared with the R&D advantages built up by European and American companies in the "laboratory", Japanese companies form a strong competitive advantage in the "factory", which enable the scientific and technological achievements born in Europe and the United States to be more effectively engineered and commercialized in Japan. Matching their unique strategies and capabilities, Japanese companies also pioneer new management and organizational models that match lean production, including a heavy project system that facilitates cross-departmental knowledge interaction, rapid decision-making, and task collaboration, a job rotation system and a lifetime employment system that stimulates the spirit of craftsmen, and a cooperative supply chain relationship that emphasizes long-term cooperation, information sharing, and R&D interaction among organizations (Fujimoto, 2001). Similarly, the strategic and organizational heterogeneity of Japanese micro-enterprises is profoundly influenced by their macroeconomic and institutional heterogeneity. The strong tendency of collectivist behavior and teamwork originated from the village tradition led Japanese companies to form a management and transaction style based on relationship contracts between and within organizations. Both industrial workers in factories and enterprises in the supply chain will be severely punished by social culture and organizational culture for violating the rules of trust and cooperation, thus promoting the cooperative labor relations and supply chain relations of Japanese enterprises, and providing a

unique informal institutional basis for Japan's lean production system. The strong entrepreneurial ambition and sense of crisis led Japanese companies to form dynamic evolution capabilities that are difficult for European and American companies to imitate and transplant in the field of integrated architecture (such as machinery and automobiles) that are in line with the advantages of Japanese organizations and institutions (Fujimoto, 2012). In Japan, the development-oriented government, which has a distinct characteristic of "embedded autonomy", also plays an important and irreplaceable role in motivating enterprises to carry out high-intensity learning and coordinating inter-industry and inter-enterprise activities (Johnson, 1982), and this unique government-enterprise relationship also becomes an important element of Japan's macroeconomic system heterogeneity.

Based on the above simple economic history combing, we can extract three basic propositions for the emergence of emerging powers in the wave of science and technology: First, the essence of developing NQPF is to achieve a country's leading position in new technologies and new industries under the background of a new round of scientific and technological revolution and high-intensity national competition. Second, the basis for late-developing countries to achieve leadership in new technologies and new industries is their strategic heterogeneity and institutional heterogeneity. Third, this kind of strategic heterogeneity and institutional heterogeneity must match the technological paradigm of the new round of scientific and technological revolution. Therefore, in response to the theme of the era of great power game and "getting great", academic research on NQPF should focus on the exploration and abstraction of the heterogeneity of market system and government intervention in late-developing countries relative to leading countries, rather than the orientation of existing research that simply emphasizes general characteristics. Correspondingly, the state's strategic arrangements and policy arrangements for NQPF should also strive to explore, identify, and build China's unique strategic, capable, and institutional advantages while fully absorbing the general laws of economics and the common experience of other countries.

3. Implications of the "Heterogeneity" Perspective for Policy Arrangements and Academic Research on NQPF

3.1. The Policy and Academic Implications of Market Institutions Heterogeneity

An efficient market system is a necessary condition for China's sustained economic development and leading the world in NQPF. As some scholars have emphasised, "a higher level of reform and opening up should determine higher-quality development with the commonality of the market economy", and "the commonality of the market economy is price regulation, factor flow, and property rights protection" (Lu *et al*., 2023). The general laws of economic development, as presented by the experience

of various countries and revealed by rigorous economic research, are of course important, and countries that violate these laws will never be able to seize the window of opportunity formed by the scientific and technological revolution to leap into a great power. But it is also important to note that generality is not a sufficient condition for late-developing countries to lead the development of NQPF. An important fact is that many European countries have a very complete market economy system in form, and are the main advocates of the so-called horizontal industrial policy or functional industrial policy in terms of science and technology policy and industrial policy, but they are significantly behind the United States and China in global competition in strategic fields such as artificial intelligence and intelligent driving. Heterogeneity and generality are not opposites, but if China can lead the development of new global productive forces in the future, it must not be simply because China's system and economic structure meet all the general conditions revealed by economic theory. Rather, it is because China further possesses institutional and economic heterogeneity in its choice of strategic direction, government-firm relations, industrial organisation, protection of knowledge creation, factor transactions, infrastructure provision, etc., that are more compatible with the technological paradigm of the new scientific and technological revolution than those of other countries, i.e., it is the supply of 'unique' relations of production that enables the creation of new productivity.

The scientific and technological revolution is a process of the emergence of disruptive technologies and new industries, in which a large number of technological innovation models based on different technical routes and a large number of commercialization paths based on different business models are competing fiercely among and within countries. The high degree of uncertainty inherent in the competition of dominant technologies and dominant business models can only be identified and resolved in the process of large-scale trial and error, learning and selection in the whole society by fully stimulating the innovative spirit of various subjects in society. This requires that countries that lead new technological breakthroughs and the creation of new industries can provide institutions and economic environments that stimulate innovation more effectively than other competitive countries. This institutional and economic environment is, of course, first and foremost a market mechanism that can more effectively stimulate entrepreneurship, knowledge and factors that match the technological paradigm of the new round of scientific and technological revolution. The most direct reason for late-developing countries to win the technological revolution and become emerging technological powers is that their enterprises collectively adopt certain strategic activities that have commonalities and complementarities and at the same time are different from those of other countries. Behind the large-scale production of American companies and the lean production system of Japanese companies mentioned above are the unique types and spirits of entrepreneurs in the country, such as the highly innovation-oriented entrepreneurial

spirit of the United States, and the high-intensity catch-up willingness and quality-oriented entrepreneurial spirit of Japan. Entrepreneurs in the digital era have a high degree of ambition for technological disruption and business model disruption, and at the same time, they have a tendency to go beyond simple commercial value and hope to solve the technological, economic, social and ecological challenges faced by the country and even mankind through innovation. If China is able to become one of the great powers in the competition among countries in the digital technology revolution, it must be because China has a social value orientation, government governance mechanism, market system, industrial organization and education system that are different from competing countries but more conducive to the growth and success of such entrepreneurs. Among them, the differentiation characteristic of "different from competitive countries but more favourable" should become the focus of policy innovation and academic research.

New technologies and industries are the process of formation, configuration and combination of new knowledge and factors. An important condition for leading the digital technology revolution is that China's formal and informal systems can more effectively facilitate the production and integration of key knowledge and core input factors contained in the digital technology revolution. Due to the high complexity and integration of digital technology, the great power emerging from the digital technology revolution should not only strengthen the powerful intellectual property rights protection and enhance the incentives for knowledge creation in a general sense, but also match the characteristics of digital knowledge and create a new system that is more conducive to the formation and convergence of digital knowledge. For example, software-based innovation, open source innovation systems based on reputation mechanisms, and open innovation ecosystems based on internal and external entrepreneurship and combined innovation are all new innovation models that are adapted to the characteristics of the digital economy, and these new innovation modes require the government to make creative arrangements in terms of the focus of intellectual property protection, optimal patent design, and legal regulation of intra-industry competition. At the same time, with the deep integration of science and technology in the field of artificial intelligence, the boundary between science and technology may be blurred, and technological innovation may enter the paradigm of science and technology integration after experiencing the previous science-driven paradigm, market-driven paradigm and scientific market interaction paradigm, while the science policy and the transformation policy of scientific and technological achievements of leading countries must also be adjusted in advance.

From the perspective of input factors, it becomes a consensus that data has become the core input factor of the new round of scientific and technological revolution. In the same way, whoever can form a micro-organization and macro-system that can effectively overcome the bottleneck of data factor production and aggregation will

take the lead in forming a leading edge in the factor competition dimension of the scientific and technological revolution. The unique economic nature of data elements determines that they face a different dilemma from traditional production factors such as metals and energy in terms of formation and flow. On the one hand, data, as the core competitive resource and capability of enterprises, has a high degree of inflexibility in the sense of management or specificity in the sense of economics. On the other hand, if data elements cannot be flowed and converged in transactions, from the perspective of the whole society, it will not be able to make full use of the advantages of economies of scale, scope and network economy formed by the reusability of data. In order to solve this "data transaction paradox", China needs to be able to innovatively form a more efficient factor property rights system in terms of the separation and confirmation of data ownership, possession, use, income and disposal rights.

3.2. Policy and Academic Implications of Heterogeneity of Government Intervention

Whether it is the entrepreneurial spirit that matches the new scientific and technological revolution, or the formation, motivation and combination of key knowledge and core elements of its connotation, the most fundamental logic is to develop a market for entrepreneurs, knowledge and data that are more effective than competing countries and match the digital economy. However, emphasizing the importance of new entrepreneurs, new knowledge, and new factor markets in no way negates the importance of the government in promoting new production relations that match the NQPF. On the contrary, in the period when major changes take place in both the productive forces and the relations of production, governments with a strong sense of leadership and the ambition of institutional innovation should be more effective and active.

First of all, and most importantly, the state is the supplier of the basic market system, and the government should be willing and able to provide the basic institutional framework for the emergence of new factors and the formation of new markets, especially for the formation of new markets with innovative and more effective property rights systems (Yao, 2022).

Second, even after the market is formed, the profound impact of digital technologies on security, income distribution, and ethics will still require appropriate government regulation. Nobel laureate economist Spence (2021) argues that "China achieves a good balance in developing the digital economy. On the one hand, innovation is fully permitted. On the other hand, it can be regulated in a timely manner before problems arise", and too strict regulations in the United States are not conducive to the development of the digital economy. Whether there is enough evidence to support Spence's argument remains to be aside, but it is certain that the direction, speed and effect of a country's digital technology development are directly determined by the

orientation, intensity and capacity of government regulation, and the orientation, intensity and capacity of government regulation must be country-specific.

Finally, in addition to the formation of new knowledge and data markets, the formation and development of science and technology, data, and industry, which constitute the NQPF factors, also need to be driven and supported by a more effective national innovation system (Freeman, 1995) and a new infrastructure that matches the new industrial system (Perez, 2010). The performance of the dominant technology in the early stages of competition depends largely on access to and utilization of basic research (Murmann and Frenken, 2006). The basis for the high-quality scientific output of American research universities is academic autonomy and fierce competition among universities. If China can design a more flexible and effective academic system of free exploration, university competition, and government guidance, and provide high-quality common technologies and application scenarios for enterprises to cross the "valley of death" of scientific and technological transformation, China may be able to form an asymmetric competitive advantage in areas that suit its institutional advantages. In terms of infrastructure, China form a local government-driven infrastructure investment model, which is also an important reason why China's industry has been able to grow rapidly over the past 40 years. However, it should be noted that, on the one hand, the changes in China's local fiscal structure make large-scale infrastructure investment unsustainable, and more importantly, unlike traditional infrastructure such as railways and electric power, information infrastructure such as cloud computing and big data is not typically non-exclusive and non-competitive. Therefore, the fiscal system and investment policies at the national level should be more structured, not only to encourage local governments and central state-owned enterprises to invest in infrastructure fields with strong public goods attributes (such as mobile communications), but also to fully release the enthusiasm of social capital to invest in infrastructure fields whose economic attributes are closer to those of private goods.

In short, for China to become one of the great powers in the scientific and technological revolution with artificial intelligence as the underlying technology, it is necessary to stimulate the entrepreneurial spirit that matches digital technology, and create a unique and more effective new type of production relationship composed of market system, regulatory framework and policy system in the formation and combination of knowledge and elements. However, so far, the economics profession has paid little attention to the heterogeneity of productive forces and the heterogeneity of production relations. In this regard, research related to the NQPF should deepen the general issues of fair competition, intellectual property protection, and the dominance of functional industrial policies, while devoting sufficient attention to China's heterogeneous characteristics in terms of market institutions, intellectual property protection, government intervention, and industrial regulation relative to the

general characteristics revealed in Europe, the United States, and standard economics textbooks. From the perspective of methodology, researchers should appropriately go beyond the paradigm of empirical research based on large samples, and on the basis of focusing on the overall characteristics and established patterns, the extreme phenomena of "generation" or "emergence" that are not fully applicable to large-sample empirical research should be included in the analytical vision, and various research methods such as survey research and qualitative research should be included. Taking the discussion on the issue of NQPF as an opportunity, the relevance and applicability of China's economic research should be greatly improved.

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