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A Neo-Developmentalist Approach to Chinese Semiconductor Industry¹

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ABSTRACT

China's recent ambitious plan to develop cutting-edge semiconductor technology and industry was mainly led by Chinese government. Why, in China, does the central government continue to play a large role in semiconductor development policy? For answering the research question, this study suggests two points. One is that Chinese nationalist ideology is embedded in industrial policy making system in strategic industries like semiconductor technology. Based on the ideology, building indigenous and self-sufficient innovation become overarching policy goals. The other is that IC sectors are considered to belong to critical military technology in the context of global competition between China and the United States in economic and military terms. Among various IT sectors, semiconductor sector is selected as the subject matter. It can be argued that the neo-developmentalism properly can explain China's active IC development policy. The research tries to analyse China's IT industry from neo-developmental approach. Due to the top-down implementation, China's government continues to retain control over the selection of priority sectors, technologies and areas of public development. However, under indigenous technological development, it is uncertain that strong role of state in highly competitive IC sectors leads to success.

Keywords: China's IT industry, neo-developmental state perspective, semiconductor sector.

1. THE ARGUMENT

The Information Technology (IT) is one of the most important technologies in the current global economic competition among states and firms since the late 1940s. IT is, in itself, a leading technology. Also, as

general purpose technology, IT has been converged with other technologies into new high-tech industrial sectors.

Because of these strategic natures of IT, economic powers such as the United States, China, Germany, and Japan have made all efforts to lead technological innovation and development in IT industrial sectors. Of course, these states have different approaches to advancement of IT industry. For example, the US and Germany have maintained market driven development strategy, though variant in detail between these two states. In case of China, three competing approaches have evolved in emphasizing different aspects of its IT development strategy respectively: institutionalist perspective, global production network approach, and neo-developmentalism.

In contrast to advanced countries, it shows that China has an IT development strategy in which the state has played large roles. That is to say, neo-developmentalism is persuasive in explaining the nature and effects of China's developmental efforts in its IT industry. Recently, China's State Council announced very ambitious semiconductor development policies, that is, the National Guidelines for Development of the IC Industry in 2014 and 'Made in China 2025 (中国制造 2025)' in 2015¹. It is reported that the central government of China planned to mobilize large scale financial resources and technological manpower (Economist January 23, 2016). We argue that in China's semiconductor industry, though many foreign firms and domestic private firms have played considerable roles in production, sales, and R&D segments, the central government has dominated in policy making. Even local governments, another important stakeholder in upgrading China's IC (integrated chip) industry, are just implementing policy made by the central government.

This study tracks the reason why state still leads IC development policy in much globalized IT market environments that IC sectors are very important not only in economical terms but also in political and military terms. Top Chinese political leaders have serious concerns that the United States has continued to impose export control over licensing its cutting edge IC technologies to Chinese domestic firms for their dual-use application.

For the argument, in next section, comparing with two other approaches, we describe the outline of neo-developmentalism. And then, it tries to analyse empirically China's IT industry from neo-developmentalism. Among various IT sectors, semiconductor sector is selected as the subject matter. Lastly, this paper concludes and proposes some theoretical and practical implications.

2. NEO-DEVELOPMENTAL STATE PERSPECTIVE

Neo-developmentalism is basically state-centric explanation of economic and industrial development. In contrast to market oriented explanation of successful economic growth of some East Asian countries during the 1950s-70s, the neo-developmentalism emphasizes the role of state in economic development in East Asian region. It is defined in terms of central coordination by development oriented government agencies and relatively direct industrial policy instruments such as large public financial investment and domestic market protection.

¹ In fact, 'Made in China 2025' is for achieving a manufacturing superpower and not solely for semiconductor industry. This plan includes many important industrial sectors and technologies such as energy industry, industrial manufacturing, IC technology. This plan is covering smart manufacturing, industrial internet, and digitization of economy which may mean the Chinese version of 'Industrie 4.0'.

In the age of WTO (World Trade Organization) and global economy, the neo-developmentalism may be strongly criticized for its statist traits by many scholars. However, they argue that China is a developing country and still is undergoing the catch-up developmental phase. Especially in strategic technology like semiconductor, the developmental role of state is supposed to be very crucial in building indigenous and high-tech industrial base. Moreover, in IC (integrated circuits) sector, China has been struggling with the United States to win global hegemonic competition. The sense of purpose in the competition is perceived to be closely related to not only economic interests but also politico-military interests. Under a new grand plan announced in 2014, the Chinese central government will muster 100-150 billion dollar in public and private funds. The aim is to catch up technologically with the world's leading firms by 2030, in the design, fabrication and packaging of chips of all types. The development oriented government policy of China can be conceptualized as neo-developmentalism. It means that China attempts to promote home-grown semiconductor industry in globalizing economy in the 21st century (Ning, 2009).

Unlike neo-developmentalism, institutionalist approach pays attention to institutional environments concerning central-local governmental relations in economic development policy domain. According to the perspective, local governments in China have heavily influenced in implementing phase in economic and industrial policy areas (Breznitz & Murphree, 2011). China's industrial policy objectives mainly reflect the intention of the central government trying to achieve world-class leading technological innovation in strategic industries such as IC sectors. However, by institutionalist approach, because of considerable structured uncertainty lurked between policy design and implementation under the context of central-local governmental relations, the ambitious policy goal of central government may be unintendedly twisted and considerably difficult to materialize in local policy environments. It causes structured uncertainty defined as "an agreement to disagree about the goals and methods of policy, which leads to intrinsic unpredictability and to inherent ambiguity in implementation" (Breznitz & Murphree, 2011: 38). In such institutional environments filled with structured uncertainty, it can be said that policy priorities of the Chinese central government and those of many local governments are much diverged in industrial and technological development. Some local governments have tended to have interests in promoting local SMEs (Small and Medium-size Enterprises) rather than just implementing policy objectives imposed upon by the central government.

Global production networks approach emphasizes global nature of IT industry. Large private IT firms rather than national states are considered main actors in global competition in IT technology (Yeung, 2013). Global giant IT firms have been organizing and managing efficient global supply chains to lead globally developing IT industry. Many Chinese IT firms have participated not only as middle-tech components supplier but also fabricating and packaging companies in the working of these global production networks. Foxconn, a packaging company for Apple, is a typical example. Global production networks approach is somewhat skeptical of weather that China's IT industry would acquire competitive position in global markets. In non-memory chip sectors like high-end CPU (Central Processing Unit), China's semiconductor firms are still much behind leading global firms like Intel. Overall, this approach can be criticized for underestimating China's active industrial policy in strategic industries like high-value IC chip sectors.

3. DEVELOPMENT POLICIES OF CHINA'S SEMICONDUCTOR SECTOR

Although the Chinese government has been interested in building an indigenous semiconductor industry since the late 1970s, it was much later in the second half of the 1990s that China actually began to promote

meaningful industrial policy. Developing domestic semiconductor industry was recognized as a strategic imperative.

On June 2000, China government issued 'Document No. 18' aiming to develop software and IC industries. On February 2006, China government announced 'Long and Medium-term National Scientific and Technological Development Program (2006-2020)' which partly included some projects for the development of IC technology and large scale chip equipment and materials sectors. On February 2011, China government issued 'Document No. 4' including a few of policy measures to further boost the software and IC industries.

Despite of these policy efforts in semiconductor industry, China still was far behind not only the United States but also other East Asian countries. In 2015, China's manufacturers, both domestic and foreign-owned, consumed 145 billion dollar-worth of ICs of all kinds. But the output of China's domestic IC industry was only one-tenth of that value. And in some types of high-value semiconductor—the processor chips that are the brains of computers, and the rugged and durable chips that are embedded in cars, all most of China's consumption is imported. The reliance of China's IC industry on foreign semiconductor technology and IC production is estimated to be up to 90 percent. For instance, 43% of the inputs for handsets and networking equipment of China's second largest telecom company, ZTE, are supplied by US companies like Qualcomm, Micron, and Intel (Ernst, 2016).

China's top political leadership was seriously concerned with persistent technological dependence on foreign firms in the IC industry. It was perceived to need rather drastic policy change to upgrade China's IC industry. Against the backgrounds, 'the National Guidelines for Development of the IC Industry', for the purpose of developing the leading edge semiconductor technology, was announced June 24, 2014. In addition to the National Guidelines, 'Made in China 2025' was announced by China's State Council in May 2015. Both the National Guidelines and Made in China 2025 were conspicuously different from previous IC development policies of China in terms of top political leadership's strong will, far-reaching policy goal, and strong policy means.

First, policy ideas driving indigenous development of semiconductor industry in China can be considered based on the 'rich nation strong army' idea. In addition to this nationalist ideology, Chinese political leaders are supposed to perceive their country as a rising superpower to challenge the United States, current hegemonic power. It is important to understand that the policy for the indigenous upbringing of the semiconductor industry is to pursue political and military interests beyond the economic interests of the Chinese government. In fact, both China and the United States have clearly recognized that IC sectors are important not only for economic development and security but also national military security. It is understandable why Chinese political leaders are eager to maintain indigenous innovative technological and industrial base in IC sectors.

Second, the specific policy vision and policy objectives proposed in the National Guidelines include developing indigenous world class IC technology from the design of high-end logic chips to semiconductor equipment manufacturing sectors. A key policy objective is to immensely reduce the heavy reliance of domestic IT industrial sectors on foreign IC chips, especially in case of high-end CPU chips.

Third, the policy system including task force was built to design and implement the National Guidelines. Four ministries such as the Ministry of Industry and Information Technology, Ministry of Science and

Technology, Ministry of Finance, and the National Development and Reform Commission, which monitors the policy process and reviews the policy drafts, are key players. Also, the top 10 to 15 leaders in China's semiconductor industry from fables designers, foundries, and equipment manufacturers were main participants and, overarching leadership for the industrial policy was Vice Premier, Ma Kai, also a member of the Politburo of Chinese Communist Party(CCP). High-ranking members which lead the policy system were perceived to reflect prevailing ambition and firm will of China's top political leaders.

Fourth, China's government has been mobilizing powerful industrial policy instruments. Above all, Chinese central government provides financial support to IC sectors up to 170 billion dollar to upgrade IC sectors and support research and development efforts in academies and industries over the next 5 to 10 years. The National Industry Investment Fund was established and some provincial governments are participating in investment fund raising.

Also, in IC fabrication sector, China government strives to create a few national champions, state-owned enterprise such as Tsinghua Unigroup in chip foundry and R&D, SMIC (Semiconductor Manufacturing International Corporation) in chip foundry, and HiSilicon in chip design². Tsinghua Unigroup recently bought two Chinese companies, Spreadtrum for 1.7 billion dollar and RDA Microelectronics for 0.9 billion dollar. Among these national champions, Tsinghua Unigroup, a company spun out of Tsinghua University in Beijing, has emerged in the past a few years as the chosen champion among champions, a Chinese challenger to the mighty Intel. Tsinghua University is the first largest shareholder of Tsinghua Unigroup (Economist, January 23, 2016).

From an economic point of view, the recent ambitious Chinese semiconductor industry upbringing policy reflects the shift in China's economic development strategy. The Chinese economy has been pursuing investment-driven economic development as a whole. China faces the limits of quantitative growth through the input of large-scale capital and labor and they are looking for a change in the paradigm of economic development through innovation-driven economic development³. One of the industrial sectors that China is most actively seeking to transform into an innovation-led development strategy is the semiconductor industry.

However, given the challenges of this paradigm shift, China's state-led development strategy in the semiconductor industry has significant weaknesses. First of all, top-down policy implementation can be potentially contradictory with innovation-driven industrial strategy which needs bottom-up, private sector led innovation activities. But, the so-called national IT champions such as Tsinghua Unigroup and R&D, SMIC (Semiconductor Manufacturing International Corporation) in chip foundry, and HiSilicon in chip design are not genuine private firms but a kind of state controlled firms.

Secondly, because policy goals of China's state-led IC industrial strategy to especially emphasize self-sufficiency (自主保障) and indigenous innovation (自主创新) are perceived to be closely related with national security objectives, other competing countries are also quick to employ non-market policy tools

² Tsinghua Unigroup is located in Beijing, SMIC in Shanghai, and HiSilicon in Shenzhen. HiSilicon is part of Huawei, maker of telecom equipment. Beijing, Shanghai, and Shenzhen are top three regions famous for IT industry in China.

³ On the conceptual framework of investment-driven growth and innovation-driven growth, refer to Porter (1990). In China, the concept of innovation-driven economic growth was firstly introduced into the 13th Five-Year Plan for Economic Development (13-5) (2016-2020).

such as export control and restricting foreign investment. For example, Tsinghua Unigroup reportedly made a \$23 billion bid for Micron in 2015, a big American maker of DRAM—the type of memory chips used to store data on desktop computers and servers. However, the bid faltered due to political opposition from the United States government.

Also, following advice from the Committee on Foreign Investment in the United States (CFIUS), which is chaired by the US Department of the Treasury, on December 2 in 2016, U.S. President Barack Obama issued an executive order prohibiting the acquisition of the US subsidiary of deposition equipment maker, Aixtron, a German firm by Grand Chip Investment (GCI) of China⁴.

Thirdly, Chinese top political leaders are beginning to be conscious of cybersecurity concerns. China enacted a new Cybersecurity Law that introduces restrictive requirements on both domestic and foreign technology firms. According to the proposed law, “China essentially can force software companies, network-equipment makers, and other companies to disclose source code to supposedly prove their products can’t be compromised by hackers”(Cory, 2017). Since the beginning of 21st century, the U.S. government continued to blame Chinese hackers for infiltrating public and private networks to access to public data and to steal commercial intellectual property. Chinese government also rebuked that US government also conducted cyber espionage, given US NSA (National Security Agency) contractor E. Snowden’s revelations of reported NSA attacks on Swiss bank, Chinese telecom companies, and other countries’ public and private organizations (Segal, 2016). In short, the increasingly deepening of cybersecurity conflict between China and the United States contributed to make Chinese government to intervene into China’s IC industry and market⁵.

4. CONCLUSION

As the research shows, China’s recent ambitious plan to develop cutting-edge semiconductor technology and industry was mainly led by Chinese government. It can be argued that the neo-developmentalism properly can explain China’s active IC development policy. The competing approaches, Institutionalism and global production networks approaches are based on assumption that the role of central government has declined due to influential local governments in implementing industrial policy and the increasing role of domestic and foreign firms in IT market in China. However, China’s central government continues to retain control over the selection of priority sectors, technologies and areas of public financial investment. Chinese top political leadership well understands that IC sectors are important not only for economic development but also national security.

The problem is that in globalizing economic environments, it may probably be uncertain that strong role of state in indigenous technological development in highly globalized IT industry leads to intended successful policy results, even in case of China, still developing country. China’s recent ambitious two long-term development policies for semiconductor industry are somewhat not certain to accomplish policy goals of building indigenous and self-sufficient innovation and industrial system in IC sector.

⁴ U.S. government estimated that Chinese government may utilize Aixtron’s technology to produce IC chips for nuclear technology development program.

⁵ In September 2015 when Xi Jinping, Chinese President, visited US, two countries concluded a Cybersecurity Agreement to mitigate intensifying cyber disputes between US and China. China accepted the US proposal to distinguish between political or military espionage and commercial espionage for theft of intellectual property. The ‘Cybersecurity Agreement’ is essentially based on not conducting commercial espionage each other.

Why, in China, does the central government continue to play a large role in semiconductor development policy? For answering this question, this paper suggests two points. One is that Chinese nationalist ideology is embedded in industrial policy making system in strategic industries like semiconductor technology. Based on Chinese nationalist ideology, building indigenous and self-sufficient innovation become overarching policy goals. The other is that IC sectors are considered to belong to critical military technology in the context of global competition between China and the United States in economic and military terms. As is analyzed above, China sometimes experienced export control and investment restriction by the United States in critical technologies like high-end IS sectors.

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