China’s Industrial Policy, Strategic Emerging Industries and Space Law

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Abstract

China’s transition economy experiment continues to rely heavily on state-driven industrial policy to structure the economy. In 2016, five-year plans on strategic emerging industries were formed by State Council ministries and transmitted to lower levels of government bureaucracy. Building on existing industrial geographic complementarities and technology clusters, developments were expected to dovetail with broader 13th Five-Year Plan and Made in China 2025 industrial policy trajectories. This article explores the policy program of industrial upgrading and innovation in national strategic emerging industries, regional innovation and industrial cluster plans, space and ocean industrial strategies and places China’s policy trajectories for industrial development, technology innovation and upgrading in context of institutional economic analysis.

Key words: industrial policy, institutional economics, industrial clusters, China politics, space policy, ocean policy

1. Introduction

The 2016 strategic emerging industries catalogue is the clearest indication of China’s industrial upgrading and technological development blueprint for the coming 5-year plan period. Industrial catalogues are the policy transmission method that coordinate the planned/transition economy in China. Institutionally, a Soviet industrial planning tool, industrial catalogues pervade the state-capital industrial sector in contemporary China. They are top-down, hierarchical command mechanisms, replicated in increasingly finer detail down the line ministry bureaucratic structure to the lowest levels of government.

Made in China 2025, the 13th Five-Year Plan and the strategic emerging industrial catalogue segue with existing industrial clusters and industrial policies. Clear technological upgrading and production progress is expected in the energy equipment sector, with a civil nuclear energy program that will double China’s nuclear power bases to nearly 50 by 2020 (Staff Writers 2016c); satellites, aerospace and associated technologies, which will use the capacity cooperation policy to develop China’s global reach; and Internet of Things (IOT) and cybersecurity upgrades, which will put China’s network and backbone infrastructure at the forefront of global cyberspace. Other industrial upgrades, including in robotics, new materials and new energy may prove aspirational as the necessary industrial complementarities fail to develop in harmony. Regional industrial clusters may also prove unable to upgrade to a Chinese version.
of Germany’s Industrie 4.0, deindustrialising ‘dirty’ industries and promoting innovation in technological development in advanced manufactures.

Three macro techno-industrial strategies define China’s future technological trajectory, Revitalisation of the Northeast, Develop the West and Rise of Central China. Added to these domestic-focused capital reallocation and technological upgrading plans are the Belt and Road geopolicy and capacity cooperation industrial policy that are designed to offshore excess industrial capacity. Current industrial planning mechanisms are reminiscent of Japanese ‘destructuring’ in the 1970s as China has struggled with New Normal low industrial growth rates as a result of stimulus investment in the period 2008–2013. However, where Japanese capital left in search of cheaper labour inputs (Johnson 1982; Wade 2004) Chinese capital will remain in an investment-driven paradigm for another decade as industrial policy is set to persist much longer than it did in the German or Japanese models of industrial development. China is not letting go of state-driven product-cycle development as entrepreneurship continues to be state funded and technological innovation guided along industrial policy rails.

This article first analyses China’s technological and industrial policy from a Kaldorian economic geography perspective, citing regional industrial policy and institutional economic theory and reviewing the geographic industrial clusters responsible for enacting state industrial (Argyrous 1996; Toner 1999; Fujita 2004). Applying a Kaldorian method (Kaldor 2013) of regional economic analysis combined with the historical institutionalism of China’s industrial policy (Martin & Sunley 2006), we see from the policy evidence in 2016 a clear trajectory to move past catch-up industrialisation strategies and push techno-industrial policy into global innovation and science-technology research and industrial development. The contemporary state of China’s industrial policy is then examined from three perspectives: the 2016 national strategic emerging industries from extant and expected policy and regulatory evidence, the policy setting and legal apparatus in elite Chinese politics and policy transmission from executive to administrative organs of power, and finally, the satellite and communications industrial policy trajectory in geopolitical context and in relation to other industrial complementarity policy goals.

2. Industrial Policy, Cumulative Causation and Capacity Utilisation

In 2008, the Global Financial Crisis gifted Chinese capital a position in the global economic order for which its industries were unprepared. As a result, 2016 plans for the coming 10 years of industrial development will affect the post-industrial innovation structure of Europe, North America and Northeast Asia more than they otherwise would have. Where China should, by Akamatsu (1962) principles, be letting go of industrial policy and offshoring capital under labour and balance of payments contraints, it is instead doubling down, relying on industrial policy to generate next generation innovation. The strategic emerging industry policy trajectory laid out in 2016 will be returned to, not only through the Xi administration but well into the 2020s and the first few years of the 6th generation leadership.

China’s economic planning apparatus through its economic transition utilises aspects of Kaleckian and Keynesian aggregate demand economic theory, while maintaining heavy state-investment policies inherited from Fel’dman, Preobrazhensky and Leontief (Carr & Davies 1971). Its industrial policy trajectory is in part path dependent on the history of Stalinist 5-year planning cycles and a centrally planned economy coordinated by China’s version of gosplan, the State Planning Commission, later the National Development and Reform Commission (NDRC). Analysis of contemporary industrial policy centres on the administrative power structure responsible for transmitting policy decisions to first central then local governments, the State Council, and the nexus of industrial policy central line ministries, the NDRC, the Ministry of Industry and Information Technology (MIIT), the Ministry of Science and Technology and the
State Administration of State-Owned Assets. Ministry of Industry and Information Technology 2015a, 2015b, 2015c; National Development and Reform Commission 2015, 2016a, 2016b, 2016c, 2016d, 2016e; State Council 2016).

China’s institutional legacies in industrial policy do not always follow a straight path. Heilmann and Shih (2013) argue that overt industrial policy only emerged as a result of reform and opening, while Chen and Naughton (2011) offer analysis of a Chinese techno-industrial policy from a perspective inherited from Johnson (1982). For industrial policy studies in the earlier phases of China’s economic spatial planning, Naughton (1988) examines an early form of industrial policy before the need to calve it from holistic state economic plans after reform and opening. The treatment of Riskin (1987) of the institutional political economy of the heavy industrialisation period from 1949 to the eve of reform also demonstrates the industrial policy function within the first incarnation of China’s Leninist bureaucratic administration. Contemporary domestic theoretical justification for the transition’s blend of state investment and export-oriented development has recently been packaged as ‘new structural economics’ by Justin Lin Yifu and surrounding academics in the centre of the policy-making process in China (Ju et al. 2013; Lin et al. 1995).

Throughout the decade of the 2000s, there was widespread speculation that China would follow a similar pattern to the industrial development trajectories of Japan, Korea and Taiwan during their industrial policy-driven catch-up industrialisation periods, using industrial policy as a crutch to leverage itself into Organization for Economic Cooperation and Development per capita income rates before conforming to the global trade regime (Johnson 1982; Wade 2004; Chang 2002; Suehiro 2008). However, the persistence of industrial policy into a 13th Five-Year Plan and into bleeding edge industries such as cybersecurity, satellite communications, gene industrialisation and deep-sea electricity transmission mean that China is unlikely to let the crutch go anytime soon. Indeed, the nature of China’s geopolitical position and its use of domestic primitively accumulated capital rather than foreign direct investment mean that it is in a very different economic development scenario to the trade and industrial development of other East Asian economies before it. This means that Akamatsu’s flying geese model of capital accumulation fails to hold true for China and also means that China will likely continue to overinvest in the capital goods sector for much longer than industrial policy advocates in the Hamiltonian tradition would justify (Hamilton 1793, List 1856, Gerschenkron 1962).

The investment-driven economic model problem in China is one of Keynesian macroeconomic accounting where a two-sector economy is either investment (capital) or consumption (wages). In a command economy, this is not such a problem due to the Fe’dman model of growth accounting that relies on reinvestment in the capital goods sector (Halevi 1992). This is, very crudely, what happened under China’s first heavy industrialisation drive in the 1950s. Peasants and workers had incredibly limited consumer goods in order for the state to be able to invest capital surplus into the heavy industry sector.

The theoretical problem that emerges from such a planned economy (apart from obvious shortages in consumer goods) is a misallocation of industrial capacity without a mechanism to redress it. The need for industrial restructuring in China is no longer theoretical. Acute slowing growth in the industrial bases of the Northeast and North China plain from 2013 and widespread industrial overcapacity have highlighted the need for industrial upgrading and restructuring (Staff Writers 2016c). Policy updates have focused on improving industrial complementarities while exploring public and private routes to innovation and research and development. To drive economic growth and deliver future industrial upgrades, the centre is maintaining a planned heavy industry strategy. Capacity utilisation is an essential feature of capitalist industrial production that allows for the increase and decrease of output to match consumer demand. It is simply the ratio between actual production and potential

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production in an industrial economy, but it is a supply/demand gauge that allows plants to increase and decrease their productive output relative to potential output to match market price signals (Prior & Filimon 2002). In a socialist planned economy, we can expect full employment and full capacity utilisation at both the firm level and the national aggregate. In a capitalist economy, the capacity utilisation rate should fluctuate somewhat below full capacity, around 80 per cent is a common target. However, in China’s transition economy, plant capacity across a range of core industries between 2008 and 2016 has been drastically underutilised, with ratios as low as 50 and 60 per cent (European Union Chamber of Commerce in China (2016)). That is, nearly one in two factories in some sectors have been producing nothing, or else dumping what they do produce. As such, China’s overcapacity problem—too many factories, too much factory output and not enough consumption—is a problem only exacerbated by industrial policy investing in national strategic emerging industries.

3. China’s National Strategic Emerging Industries

In 2016, a host of industrial policy plans has emerged in the wake of the central 13th Five-Year Plan. Eight strategic emerging industries are highlighted: energy-saving environmental protection, next generation IT, biotechnology, advanced manufacturing, new materials, new energy vehicles, digital creative industries and high-tech services. While creative industries and high-tech services seem aspirational, the other six industries dovetail with the broader Made in China 2025 10 strategic industries plan. Both plans fit the macro 13th Five-Year Plan that centres on a few core industrial upgrades: integrated circuits and new information technology, biotechnology and genetic industrialisation, green energy and nuclear power, and advanced equipment and new materials (Staff Writers 2016a). As the national manufacturing upgrading strategy reaches implementation stage, a series of supporting policies to facilitate ‘Made in China 2025’ will be rolled out (State Council General Office 2015; Hou 2016a; Staff Writers (2016a)).

All three macropolicies rely upon further development of sectorally integrated industrial bases. Specific manufacturing sectors have completed 5-year industrial upgrading plans in line with the wider Made in China 2025 program. NDRC and MIIT have launched major industrial upgrading packages for promoting manufacturing industries between 2016 and 2018. The implementation of

| Strategic Emerging Industries | Made in China 2025                                      | 13th Five-year Plan                      |
|-------------------------------|---------------------------------------------------------|-----------------------------------------|
| biotechnology                 | biopharmaceutical and high-end medical equipment       | gene industrialisation                  |
| energy saving equipment       | energy equipment and technology                         | green energy and nuclear power         |
| next generation information technology | integrated circuits and new generation IT | integrated circuitry                   |
| new materials                 | new and advanced materials                              | advanced equipment and new materials   |
| new energy vehicles           | new energy vehicles                                     | advanced manufacturing                  |
| advanced manufacturing        | advanced rail and equipment                             |                                         |
|                               | agricultural machinery and technology                   |                                         |
|                               | aviation and aerospace equipment                        |                                         |
|                               | advanced marine equipment and high-tech vessels         |                                         |
| high technology services      | advanced manufacturing control equipment and robotics   |                                         |
| digital creative industries   |                                                         |                                         |
these policy packages is to coordinate a series of strategic industrial complementarities (Figure 1).

3.1. Robotics

Targeted industries include computer numerical control devices, advanced manufacturing, new materials and robotics. Integration of robotics and Industrial Internet is also an important strategy as China pushes for industrial upgrading in traditional manufacturing clusters (Liu & Qiao 2016a). Industrial Internet chains are needed to develop IOT clusters. However, the rapidly expanding the robotics sector has been flooded with low-end investment and faces overcapacity if local subsidies fail to force mergers and acquisitions (Du 2016). Local governments have rushed to spend central fiscal subsidies and have sown the seeds of future overcapacity, as local governments opt to invest in production capacity at similar technology levels.

3.2. High-Speed Rail

Advanced rail has been a case study in technology transfer and advanced manufacturing led growth. It is a Made in China 2025 key industry, but stalled capacity cooperation operations abroad and an uninspired domestic production strategy are likely to leave this sector mired in overcapacity. A new national railway plan is to have all cities over a population of 200,000 covered by 2030 with a total length of 200,000 km (Chen J 2016). Although the plan aims to facilitate industrial upgrading and urbanisation, it also risks overcapacity in rail manufacturing and places the financial burden of subsidies on multiple levels of government. New electric multiple unit trains will promote China’s standards internationally as intellectual property promotion increases in importance (Wang 2016b). China’s high-speed rail technology is expected to continue (Hou & Lin 2016). Aviation and aerospace equipment is focused on the development of space flight and satellite technologies. The industrial chain for the beidou (compass) navigation system continues development with stress on service provision as commercial end-use rolls out across China (Liu J 2016; Staff Writers 2016i, 2016j). While awaiting satellite regulations announced in the 2016 legislative work agenda, the system is being integrated with Belt and Road as China’s outward foreign direct investment strategy matures (Suo 2015; Liu X 2016). China’s capacity cooperation fund plan for the Middle East highlights geostrategic positioning in satellite ground stations and satellite technologies. Development of private sector satellite technology and satellite launches is expected to continue (Chen M 2016). More clarity in the satellite development trajectory will come with the passage of the Spaceflight Law and Satellite Navigation Regulations, expected to come out of deliberative committee and go before the National People’s Congress Standing Committee in early 2017.

3.4. Integrated Circuits, Internet of Things and Cybersecurity

The decade 2010–2020 is finally seeing the upgrade of the world economy to ubiquitous computing. The size of China’s economy is likely to push the IOT into mainstream affordability on the pattern of photovoltaic
technology. However, inducing widescale development of the IOT involves massive industrial chains covering many sectors and geographic industrial clusters. Ministry of Industry and Information Technology will pursue development of an internationally competitive industrial system and deepen the integration of IOT and socio-economic development. Ministry of Science and Technology will also promote the IOT to enhance technological research and industrial application through technological, institutional and policy innovation.

Alongside upgrading the Industrial Internet is a parallel policy narrative in cybersecurity (Yu 2016). Critical information infrastructure has been a high-profile national priority, with a Cybersecurity Law currently in draft and a Critical Information Infrastructure Protection Working Committee (Yin 2015). The working committee will provide support in developing technological research and cooperation and preferential policy formation for cybersecurity firms and industrial chains. Current basic IT infrastructure is not equipped to safeguard the growing attacks on industrial control and information systems, says the MIIT Cybersecurity Bureau (Zhang 2015). The development of advanced information technologies will be accompanied by improvements in cybersecurity built on domestic innovation, because of the impracticality of technology transfers in matters of national security (Yang 2016, Staff Writers 2016d).

3.5. Energy Equipment

Expansion of the energy equipment industry is expected following the release of the Made in China 2025 energy equipment plan. Foreign mergers and acquisitions are to be supplemented with central fiscal support. Development of smart grid technology and ultra-high-voltage transmission systems will integrate and upgrade the existing domestic transmission network, with an eye on developing intercontinental transmission networks. Renewable energy generation is particularly promoted for the three megapolis clusters of Jingjinji, Pearl Delta and Yangtze Delta. Following guiding opinions on promoting Internet + smart energy issued by NDRC, China’s nuclear power generation plan is leading its energy strategy. With reactor technology AP1000, CAP1400 and HL1000, China has embarked on an international capacity cooperation agenda focusing on nuclear power equipment manufacturing plant transfers. China Shipbuilding Industry Corporation (CSIC) also announced in 2016 beginning construction and assembly of China’s floating nuclear power stations (Yang 2016; Staff Writers 2016d). The floating power stations are designed to use China General Nuclear Power Group’s ACPR50S reactor technology, with 20 reactors slated for construction.

3.6. New and Advanced Materials

The development of the new materials industry will play a crucial role in accelerating the industrial upgrade of traditional industries, developing high-end manufacturing and nurturing strategic emerging industries. The plan is to upgrade basic materials in advanced iron and steel, advanced non-ferrous metals, advanced petrochemicals, advanced light industry, advanced materials and advanced textiles; target key strategic materials in high-end equipment with special alloys, high-performance separation membranes, high-performance fibres and compound materials, new energy materials, a new generation of biomedical materials, advanced semiconductors and rare earths (Staff Writers 2016f). China will prioritise new materials such as graphene, three-dimensional printing, superconductive materials and intelligent bionics. The 13th Five Year Plan for new materials has been completed and China has set up a graphene industry association to coordinate the industry’s development.

3.7. New Energy Vehicles and Batteries

Government policy directions for promoting new energy vehicles are designed to tackle technological, institutional and political barriers facing the industry (Staff Writers 2016g). Qinghai is to build an international-focused
lithium-ion battery industrial base by 2020, and a National Battery Power Innovation Centre has been established to promote technical collaboration in the industry (Wang 2016c). However, batteries are likely to follow the overcapacity path of photovoltaic and wind. Subsidy-driven overinvestment in renewables led to widespread overcapacity and extensive energy curtailment. Overinvestment in the battery sector is following the robotics and numerical control industry into overinvestment in low-level technology, led by local government subsidies (Du 2016). New energy vehicles although are a clear objective across all plans.

3.8. Pharmaceuticals and Medical Equipment

Biotechnology is to focus on biopharmaceutical, biomedical engineering, biotech farming (including livestock breeding, pesticides, fertilisers, feed and veterinary medicines), marine biomedical, medical imaging devices, medical implant technologies, and conventional chemical and medicine manufacturing. A new Pharmacy Law is expected early 2017. Inclusion of marine bioactive substances and biological products in the strategic emerging industries catalogue is indicative of China’s oceans strategies and targeting of marine living resources. China’s wider gene industrialisation policy stretches from seeds, feeds and animal husbandry to industrial cloning, marine bioresources and innovation in genetics. The 2016 Legislative Work Plan includes Human Genetic Resources Management Regulations for domestic technology as well as Access to Genetic Resources Management Measures draft for access to global commons genes. The forthcoming Basic Ocean Law will spell out China’s geopolitical and industrial strategy for the wider oceans. Passage of the Seabed Law in 2016 was pushed through the legislative work agenda quickly to catch up to other nations’ domestic seabed laws in line with updated International Seabed Authority regulations concerning contracting firms’ responsibilities to third countries. China recently renewed a 15-year exploration lease over the Clarion Clipperton Fracture in the Eastern Pacific. The forthcoming Mineral Resources Law draft revision is also expected to define offshore mineral exploitation measures.

4. Industrial Policy Coordination

Success of China’s strategic emerging industries plan over the course of the coming 5 years is largely dependent on the industrial complementarities of all sectors upgrading at a uniform pace. Some sectors, such as satellites, aerospace, artificial intelligence, IOT and cybersecurity are likely to succeed given such strong state support. However, creative industries and high-tech services are likely to fall flat, and new energy vehicles, robotics, wind and energy-saving environment protection will be prone to familiar cycles of overinvestment and overcapacity. The marginal calls are in chemicals, biomedicines, gene industrialisation, agricultural machinery, new materials and medical devices. If China can win these line-ball industries and leapfrog the value chain, its industrial policy will have a stronger base for the 14th Five-Year Plan.
due in 2021 before the 20th Party Congress that will set the course for the 6th generation of political-economic leadership.

Government policy in China is set by leading groups, or ‘steering committees’, in both party and state at all levels of government. Policy is formed by the party, set into administrative regulation by the state bureaucracy and finally molded into legislation for passage through the National People’s Congress. While widely derided in the past as little more than a rubber stamp, the National People’s Congress has in the recent years become a more transparent institution for transmitting state legislative and political agendas. Key party leading groups during the Xi–Wang administration although have exercised more direct control over government than in previous administrations.

Core party leading groups on Deepening Reform and Financial and Economic Affairs set state agendas on broad economic, financial and social issues (Figure 2). Directly or indirectly, Zhang Gaoli now runs key state leading groups on infrastructure, energy, resources and environment (Figure 3). As the first Xi administration has evolved, Zhang has assumed many of Li Keqiang’s roles. Zhang sits on the most important energy and environment leading groups, balancing energy and environment security on a continental scale. However, his wide remit will create a policy vacuum as he is due to retire at the 19th Party Congress under age restrictions.

Key state leading groups for industrial policy are led by Ma Kai and Wang Yong. Ma drives Industry 4.0 advanced technology through the groups for retiring obsolete capacity, advanced manufacturing, integrated circuits, state-owned enterprise reform, small and medium-sized enterprise development and migrant workers. Wang Yong cleans up old industry through the industry association reform leading group. Mergers and acquisitions in the industrial sector have clear headway in the 2016 ‘supply-side reform’ agenda pushed by the party leading group for economic and financial affairs.

Institutionally, there are factional and ideological divides within the caucus of the party, and there are a host of ideologically opposed institutions of national importance.

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**Figure 2**  Key Party Leading Groups and Leadership of the First Xi Administration

| Key Party Leading Groups                  | Chair       | Key driver             |
|-----------------------------------------|-------------|------------------------|
| Comprehensive deepening reform          | Xi Jinping  |                        |
| Financial and economic affairs          | Xi Jinping  | Liu He                 |
| Internet security and digitisation      | Xi Jinping  |                        |
| Foreign Affairs                         | Xi Jinping  |                        |
| National Security Commission            | Xi Jinping  |                        |
| Propaganda and ideology                 | Xi Jinping  |                        |
| Taiwan Affairs                          | Xi Jinping  |                        |
| Government restructuring                | Zhang Gaoli |                        |
| Hong Kong and Macao                     | Zhang Gaoli |                        |
| Rural affairs                           | Wang Yang   |                        |
| Party Building                          | Liu Yunshan |                        |
| Xinjiang Affairs                        | Yu Zhengsheng|                      |
| Tibet Affairs                           | Yu Zhengsheng|                      |
| Political and legal commission          | Meng Jianzhu|                        |
| Stability maintenance                   | Meng Jianzhu|                        |
However, despite periodic gravity shifts between market liberals and state planners, techno-industrial policy has never been off the table. The manifest policies that emerge from these leading group debates ensure that spatial and structural planning is to remain a critical feature of China’s economy.

5. Legislative Agenda and Space Policy for Scientific Research

Laws for the development of satellite technologies and wider aerospace development currently in committee include the *Spaceflight Law* drafted by the State Administration of Science, Technology and Industry for National Defence, forthcoming *Satellite Navigation Regulations draft* by the Central Military Commission Equipment Development Department, the *Telecommunications Law* being developed at Ministry of Industry and Information Technology and the new *Aviation Law* drafted by the Central Military Commission Joint Staff Department, Ministry of Transport and the Civil Aviation Administration.

The *Satellite Navigation Regulations*, listed on the ‘State Council Legislative Work Plan 2016’ (Figure 4), are to become the first in the navigation satellite area, providing a legal

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**Table: Key State Leading Groups**

| Industrial Policy                                      | Chair          | Key driver       |
|-------------------------------------------------------|----------------|------------------|
| Belt and road                                          | Zhang Gaoli    |                  |
| Retiring obsolete capacity                            | Miao Wei       |                  |
| Jingjinji integration                                  | Zhang Gaoli    |                  |
| Advanced manufacturing                                | Ma Kai         |                  |
| Energy resources                                       | Li Keqiang     | Zhang Gaoli      |
| SOE reform                                             | Ma Kai         |                  |
| Yangtze river delta restructuring                     | Zhang Gaoli    |                  |
| Small and medium enterprises                           | Ma Kai         |                  |
| Science & technology & education                      | Li Keqiang     | Zhang Gaoli      |
| Integrated circuits                                    | Ma Kai         |                  |
| Revitalise northeast industrial base                   | Li Keqiang     | Zhang Gaoli      |
| Oil and gas pipeline safety                            | Wang Yong      |                  |
| Migrant workers                                        | Ma Kai         |                  |
| Rural affairs                                          | Lou Jiwei      |                  |
| Develop the west                                       | Li Keqiang     |                  |
| South-North river project                              | Zhang Gaoli    |                  |
| Industry associations and chambers of commerce         | Wang Yong      |                  |
| Development of the services sector                     | Ma Kai         |                  |
| Digitisation                                           | Li Keqiang     |                  |
| Science & technology institutional reform and innovation system building | Liu Yandong | |
| Three gorges dam                                       | Zhang Gaoli    |                  |
| Intellectual property and counterfeit goods             | Wang Yang      |                  |
| Civil military relations                                | Wang Yong      |                  |
| Poverty alleviation                                    | Wang Yang      |                  |
| National energy commission                             | Li Keqiang     | Zhang Gaoli      |
| Climate change, energy pollution reduction             | Li Keqiang     | Zhang Gaoli      |
basis for the Beidou Navigation Satellite System (BNS 北斗卫星导航系统) (Song 2016). Beidou is China’s domestic answer to the US Global Positioning System, Russia’s GLONASS (globalnaya navigatsionnaya sputnikovaya sistema ГЛОНАСС) and Europe’s GALILEO (Global Navigation Satellite System). The forthcoming regulation will legalise China’s strategic positioning in the satellite navigation sector and facilitate the application and industrial development of Beidou (State Council Information Office 2016). Other peripheral legislative affairs affecting the development of China’s space

| 2016 Legislative Work Plan | | |
|---------------------------|----------------|------------|
| Spaceflight Law | SASTIND | draft |
| Aviation Law | CMC Joint Staff Department, MoT, CAA | draft |
| Satellite Navigation Regulations | CMC Equipment Development Department | draft |
| Astronomical Products and Export Administrative Measures | SASTIND | draft |
| Opening the Defence Technology Industry to Foreign Investment Management Measures | SASTIND | draft |
| Civil Aviation Security Protection Regulations | MoT, CAA | draft revision |
| Basic Ocean Law | SOA | draft |
| Civil Aviation Law | MoT, CAA | draft revision |
| Telecommunications Law | MIIT | | |
| Standardisation Law | AQSIQ | revision |
| Metrology Law Revision | AQSIQ | draft |
| Human Genetic Resources Management Regulations | MoST | | |
| Maritime Transportation Safety Law | MoT | draft revision |
| Customs Inspection Regulations | GAC | | |
| Maritime Environmental Protection Law | SOA | draft revision |
| Environmental Protection in Offshore Oil Exploration and Exploitation Regulations | SOA | | |
| Regulations on National Awards for Science and Technology | MoST | revision |
| Vocational Education Law | MoE, MoHRSS | revision |
| Rare Metal Administration Regulations | MIIT | | |
| Nuclear Energy Administration Regulations | NDRC, Energy Administration | | |
| Grain Law | NDRC, SAG | | |
| Energy Law | NDRC, Energy Administration | | |
| Price Law | NDRC | revision |
| Anti-Monopoly Law | MofCOM, NDRC, SAIC | revision |
| Commodity Circulation Law | MofCOM | | |
| Resource Tax Law | MoF, SAT | | |
| Tariff law | MoF, GAC | | |
| Railway Law | MoT, Railway Administration | revision |
| Export Control Law | MofCOM | | |
| State-owned Assets of Enterprises Basic Management Measures | MoF, SASAC | | |
| Port of Entry Administration Regulations | GAC | draft |
communications strategy are the Astronomical Products and Export Administrative Measures, Opening the Defence Technology Industry to Foreign Investment Management Measures and the Civil Aviation Law revision at the Civil Aviation Administration and the Basic Ocean Law being drafted by State Oceanic Administration.

The latest legislative work plan specifies laws going through the drafting, revision and legislative process. Laws are passed by National People’s Congress standing committee at special sessions, after coming through specialised committees such as the Financial and Economic Affairs Committee or the Agriculture and Rural Affairs Committee. These are similar to United States Senate subcommittees. Laws are drafted and revised over several years with wide academic, legal and government input usually under the jurisdiction of a ministry-level State Council institution. Laws in China are often the culmination of policy practice, regulatory testing and pilot programs—the law codifies what has already been ‘live policy’ for years.

The 100 National Science and Technology Research Projects (Figure 5) also have a clear aerospace agenda and reveal future space industrial policy trajectories (Staff Writers 2016h). First and second priorities are aircraft engines and gas turbines, and deep-space stations. Priorities 6 and 9 are deep-space exploration and space vehicles in orbit, servicing and maintenance systems and earth integrated information networks. Other space technology research projects in the top 50 include the accelerated development of large aircraft, development of a new generation of heavy launch vehicles, satellites, space platforms and new payload technologies; commercial applications of remote sensing satellites; and the construction of high-speed large-capacity optical communication transmission systems.

Figure 5  Top 10 and Satellite Communications Relevant National 100 Science and Technology Projects

| National 100 Science and Technology Projects |
|---------------------------------------------|
| **Top 10**                                   |
| 1. aircraft engines and gas turbines         |
| 2. deep-space station                        |
| 3. quantum communication and quantum computers |
| 4. brain science and research                |
| 5. national security in cyberspace           |
| 6. deep space exploration and orbital space vehicle servicing and maintenance systems |
| 7. seed industry innovation                  |
| 8. clean coal                                |
| 9. integrated satellite communications network |
| 10. new materials and applications           |

| Satellite communications industrial policy relevant |
|------------------------------------------------------|
| 24. accelerate the development of large aircraft     |
| 25. new generation of heavy launch vehicles, satellites, space platforms and new payloads |
| 34. IC foster industrial system, foster artificial intelligence, intelligent hardware, the new display, mobile intelligent terminal, the fifth generation of mobile communication (5G), advanced sensors and wearable devices have become a new growth point. |
| 36. accelerate beidou, commercial applications of remote sensing satellites |
| 38. develop a shape-memory alloy, self-healing materials, intelligent materials, graphene nano-materials, super-high-end materials and other functional materials |
| 40. construct high-speed large-capacity optical communication transmission systems |
| 42. support public cloud services platforms, the layout of cloud computing and large data centers. Guizhou and other large data push comprehensive experimental zone construction |
| 49. build new Beijing airport, add more than 50 civil transport airports |
| 79. gradually form a three-dimensional view of the global ocean monitoring measurement system |
Following the science and technology research agenda naturally places analysis upstream of future industrial deployment State Council General Office (2016b). Liu Yandong, State Council 2nd Vice-Premier, leads science and technology institutional reform and innovation system building.

Traditional satellite communications arrays will be gradually supplemented with a three-dimensional global ocean monitoring system (Wang 2015). While massive expansion of China’s airport infrastructure will develop the traditional aerospace base and provide new spaceport infrastructure.

Industrial complementarities in other areas relevant to space policy include development of shape memory alloys, self-healing materials, intelligent materials, graphene and nanomaterials, super-high-end materials and other functional materials; and fostering the wider IT industrial system through artificial intelligence, intelligent hardware, new displays, mobile intelligent terminals and fifth generation mobile communications (Liu & Qiao 2016b). Support for public cloud services platforms is set to increase, with government supervising the layout of cloud computing and large data centres in Guizhou and Zhejiang under the Big Data Five-Year Plan (Hou 2016b; Staff Writers 2016b).

Development of China’s domestic Global Positioning System rival beidou and advances in mobile communications standards will deliver material benefits to China’s citizens (Liu J 2016). However regional spaceport infrastructure is undeveloped and unnetworked (Figure 6). Catch-up industrial policy in space infrastructure would allow China to pursue ever more complex science and technology agendas in aerospace, materials, communications and robotics. A space Infrastructure backbone will serve multiple purposes in future techno-industrial policy. And an extremely important economic geography that we must all shift towards understanding is uninhabited geography: outer space, cyberspace, subsurface oceans and poles. China has an increasingly sophisticated approach to domestic legal architecture governing uninhabited geographies and an institutional right to be heard in international law and governance (National Security Law of the People’s Republic of China 2015). The development of rival communications systems, competition in space technologies and innovation in aerospace and satellite

![Figure 6 Regional Space Infrastructure](image)
technologies pushes human knowledge and ability to the bleeding edge. An advanced internet backbone has already been constructed (Figure 7). However, further expansion and upgrading would be improved with greater international interoperability. Advances in supercomputing, artificial intelligence, cybersecurity, communications standards, satellite craft, satellite ground stations and submarine communications and construction all feed into mutual industrial complementarities. For China to be leading the world into deep space stations and deep ocean technologies is fundamentally positive. However, as we look past fifth generation development, satellite constellations and cloud computing infrastructure, consider the benefits of global interconnected and interoperable satellite and submarine communication networks. And consider the alternative of parallel capacity in state-controlled networks working in opposition to each other. Beggar thy neighbour not only hurts industrial economic growth, it inhibits effective research and limits, rather than broadens, human scientific progress.

6. Conclusion

Techno-industrial policy has never been off the policy table, and as China continues to pursue regional industrial development strategies, the manifest policies that emerge from central party leading group debates and national legislative processes ensure that spatial and structural planning is to remain a critical feature of China’s economy. A firm-level market analysis of China’s industrial and technological development is grossly insufficient to understanding the causal relationships between China’s institutions and ultimately its sectorally integrated responses to macroeconomic problems. The nexus between techno-industrial policy, policy banking and national strategic industries is not going to disappear; rather, much as Listian scholars have successfully defended the industrialisation strategies of other East Asian
national economies, it is likely to redefine the institutional framework of modern industrial economics and persist in national systems of economic analysis and policy strategy for as long as states like China persist with the concept of the nation.

Industrial policy is not an answer; it is a manifestation of a structural economic system. In analysing key industrial sectors of China’s national strategic importance and the subnational state–market nexus in which they operate this article has presented a Kaldorian regional economic analysis as well as a cumulative causation sectoral integration analysis under the framework of a Listian model of national system of economic development. Such institutional economic analysis broadens our understanding of national systems of political economy to encompass history, social and political institutions and change, while cumulative causation and industrial cluster theory gives us a clearer understanding of the material nature of economic development, its limitations, and presents possibilities for planning future stages of unknown economic activity.

China’s approach to domestic and international law means a new institutional legacy is being formed. Chinese legislative and policy affairs should be taken seriously and are as capable of breaking new institutional ground as the science and technology base is of pushing human knowledge into the next frontier. Integrating China’s domestic legal architecture with international law and institutional norms will create new forms of institutional goods. China’s development of law for uninhabited geographies is extremely progressive and the legislative architecture to support research and technology for communications in outer space, oceans and cyberspace are perhaps masked by the persistent use of national industrial policy. However, the world is entering a new period of global institutional rule setting where the gravity of legitimacy recentres on the Eastern Hemisphere, where Northeast Asia is a growth pole in industry, technology and consumption. Any growth in scientific research, post-industrial development, outer space, space-to-earth and submarine communications networks should be welcomed, but standardised for the benefit of humanity, not as a tool of any nation state.

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