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Catch-up with Generative State: Lessons from Chinese Telecom Equipment Industry

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Abstract

Neoliberal catch-up policies are definitely useless to create suitable environment for latecomers in order to close the gap with forerunners. This paper investigates an alternative policy to the neoliberal development policies in the scope of the high-technology industrial catch-up of the latecomers with guidance of the state and the state-led development policies. By this approach, the state's active and interventionist role is suggested in all phases of the catch-up. It is a triple system of state, foreign investment, and national industry-capital, and this system has a dynamic and interactive relation with each other. Telecom equipment industry of China is chosen as a case study for this research.

The suggested model is managed by the state and "transfer of modern technologies via JVs between MNCs and national companies", "funding of industrial activities by state-owned banks and markets" and "re-organizing or creating competitive SOEs (State-owned enterprises) in these industries" are the major characteristics of the model.

This system is named in this paper as “generative state” in which the state creates and sets up all related institutions and processes which are necessary to development and catch-up in a continuous manner. On the contrary to “passive and regulative role of state” in neoliberal policy suggestions, state actively manages all these phases with state-owned instruments. General finding of the study is noteworthy, China succeeded significant catch-up in a high tech industry- telecom equipment industry in 21st century with state-led policies of “state capitalism”.

Keywords: State-led, catch-up, China, telecom, telecom equipment

1. Introduction

Economic and political transition of 1978 changed the destiny of China. The hybrid model of open market economy and state-planned socialist development model brought significant growth rates which have not been replicated yet. By the decision of integration with global markets, Chinese authorities defined national priorities and roles in strategic industries with top-down decision making process. In that respect, one of the major goals was to catch-up with advanced countries in the scope of strategic high-tech industries. By accurate state policies, China transformed its disadvantageous of huge population through an effective market in order to attract multinational investments and thus enabled know-how flow in strategic industries. State has also defined and managed the actors of the system with predefined strategies. As a result of these state-led policy and strategies, today China has own multinational companies in these strategic industries.

One of recently emerged and remarkable high-tech industries is the telecom equipment industry. In early 1980s, this industry had focused on selling imported equipment and systems, however, today the industry created its own MNCs such as Huawei and ZTE, and developed one of the three globally accepted technology standard for third generation mobile technology (TD-SCDMA).

In this successful case, key factor is the active role of state. Additionally, true state polices have enabled know-how dissemination from foreign investments, technology transfer and learning processes, created innovative indigenous industry and also used the advantageous of domestic market during that catch-up period.

2. Catch-up Phases of Chinese Telecom Equipment Industry

Between 1949 and 1978, China was quite closed and isolated from other markets. Except the relations between CCCP, there was

limited contact with rest of the world in global perspective. Thus, there was insufficient know-how exchange with western R&D lobbies and foreign markets. By the leadership of Deng Xiaoping, China opened doors by economic reform of market-oriented economic system. This new economic system aimed to update national technological infrastructure and create awareness for emerging strategic industries with foreign investments to succeed national catch-up and development. This open economy system was a strategic attack to enhance technological and industrial capability of China via the know-how dissemination from foreign investments of advanced industries.

Through this paradigm shift, strategic industries have been determined by Chinese state authorities. One of these strategic industries was "telecommunication", because until 1978 Chinese telecom infrastructure was quite old-dated, insufficient and should have been upgraded. Therefore, Chinese government took a strategic political decision and opened Chinese telecom market to foreign enterprises with state-controlled mechanism.

As a part of this strategy, National People's Congress passed the "Equity Joint Venture Law" and gave legal permission for foreign investments in 1979. Through this strategy, foreign investments would be encouraged in strategic industries. For this strategy, Chinese great market potential would be the main attractive point for foreign investments. Chinese state settled "joint venture" formations mainly on "The Law of the People's Republic of China on Sino- foreign Equity Joint Ventures". As mentioned in Article 1, approval of the Chinese government was a mandatory for this kind of investments. The investments which had potential for China's catch-up were allowed by approval of the state authority.

> …in order to expand international economic co-operation and technological exchange the People's Republic of China shall permit foreign companies, enterprises and other economic entities or individuals (hereinafter referred to as foreign partners) to establish, within the territory of the People's Republic of China, equity joint

> ventures with Chinese companies, enterprises or other economic entities (hereinafter referred to as ~ partners), in accordance with the principles of equality and mutual benefit that are subjected to the approval by the Chinese government. (http://english.mofcom.gov.cn/aarticle/lawsdata/chineselaw/200301/20030100062855.html)

Attractiveness of Chinese market was the key point for joint-venture strategy. The official strategy of "Trading Markets for Technology" (TMFT)" encouraged and promoted the establishment of joint ventures between foreign firms and state owned enterprises since 1978. By means of this strategy, foreign companies would be allowed to access to Chinese domestic market with the requirement of sharing its technology with state-owned companies. Through this strategy, international technology spillover and know-how dissemination was the main objective. This strategy is also known as "providing market access in return for technology". Thanks to this policy, major multinational telecom equipment companies were strictly attracted by China's market size and began to invest in China.

2.1. First Phase: Joint Ventures for Digital Phone Switches

As a strategic decision, Chinese government selected signaling system No. 7, which enabled to integrate different kinds of switches to the same phone network. Main aim of this policy was to enable the entrance of various foreign companies with different kinds of products through the infrastructure and also encourage latecomer domestic firms to develop their own products.

First foreign joint venture was Shanghai Bell Telephone Equipment Manufacturing Co. was established in 1983. Technology transfer agreement was signed between Belgian and Chinese governments, the Ministry of Posts and Telecommunications (MPT), Bell Telephone Manufacturing Company (BTM), International Telephone and Telegram Corporation (ITT) and the Posts and Telecommunications

Industrial Corporation (PTIC) (Mu, 2003). Shanghai Bell's shareholders were, PTIC of MPT had 60%, Bell Telephone Manufacturing Company (BTM) had 32% and the remaining 8% belonged to the Belgian government. Through this agreement, Shanghai Bell took nearly half of switch market in China via the assistance and support of Chinese government. (He, Mu, 2012). The main product was S-1240 and Shanghai Bell has become a major player in Chinese telecom equipment industry and in 1990s it was the largest manufacturer of telecom equipment in China. Another major joint venture was established in 1988 with three Chinese partners and German Siemens; Beijing International Switching Company (BISC). Its main product was digital programmed control switch (EWSD) developed by Siemens. The rest of the main joint ventures in the digital phone switch market is presented in the table.

Table-1: Main Joint Ventures in the Digital Phone Switch Market

Product Type	Company	Multinationals	Equity share by Chinese Partner	Start Year of Production	Sales Volume (10000 lines) 1997
S-1240	Shanghai Bell	Alcatel Belgian	60%	1986	500
EWSD	Beijing International Switching Communication	Siemens Germany	60%	1992	300
AXE10	Nangjing Ericsson	Ericsson Sweden	43%	1993	80
NEAX-61E/61	Tienjing NEC	NEC Japan	60%	1994	70
5ESS	Qingdao Lucent	Lucent USA	49%	1995	150
DMS-100	Guangdong Nortel	Nortel Canada	60%	1995	100
F-150	Jiangsu Fujitsu	Fujitsu Japan	35%	1995	100

Source: "Key Industry Innovation" Project Team Report of Ministry of Science and Technology, 1997

Although Chinese market was strongly dominated by foreign products because of joint venture operations, there was mismatch

between the existing products and potential market needs specifically for rural regions. These product prices were also higher for towns and rural regions of China. Thus, the products were widespread mainly urban provinces of China; rural markets were neglected by foreign enterprises.

2.2 Second Phase: Know-How Transfer about Digital Switch Technology

During JVs settled their operations in China, spillover from joint ventures through Chinese indigenous companies was an important source in order to absorb and assimilate necessary know-how related to switch technologies. As a state policy, this strategy became beneficial in order to create technology transfer channels[1].

According to Shan, Jolly (2011), in earlier phases, domestic firms, universities, research organizations did not have sufficient know-how about digital switch technology.[2] Knowledge diffusion from joint ventures to latecomers was critical (Mu and Lee, 2005). Meanwhile, joint ventures with foreign partners (for instance Shanghai Bell) gave opportunity to experience about core technological areas and operating and manufacturing about related technologies.

[1]The Chinese industrial ministries intentionally organized engineers from other parts of the domestic industry to get training or job rotations at the JV firms. In cases like Shanghai-Bell in telecommunications equipment, this training was the JV returning the favors granted by the Ministry of Posts and Telecommunications (Mu and Lee 2005). In other industries like automobiles and semiconductors, the nation's elite engineers were mobilized to facilitate technology transfer (Feng 2010; Li 2011). In both cases, the JV firms became industry-specific "schools" for the domestic engineers. After gaining experience at the JV, many of these engineers moved on to higher salaries and even more challenging positions at emerging indigenous companies (Mu and Lee 2005). (Lazonick, Li, 2012: 10)

[2] Ministry of Post and Telecommunication (MPT) would sometimes use the advantage of that to ask Shanghai Bell to have R&D consortium with domestic firms. For instance, in the process of adapting the system-12 to the Chinese environment, Shanghai Bell cooperated with local universities and research institutes. This process brought about the diffusion of related knowledge and skills and later on conducted the success of indigenous switch, HJD-04 (Shan and Jolly, 2011: 160).

Mu, Lee (2005) studied on the growth of technological capability in telecom equipment industry of China. The study explicitly found determinative factors about catch-up; strategy of "trading market for technology", knowledge diffusion from Shanghai Bell (first JV) to research consortium and to Huawei, and industrial promotion by Chinese government. According to Xielin and Dalum (2009), labor turnover is seen as an important mechanism for knowledge transfer. As a result of interview in this study, employees acquired a lot of knowledge through joint venture with Nokia and then these employees were transferred by Huawei and ZTE. Thus, critical know-how from Nokia has been transferred to Chinese multinationals via these employee transfers.

2.3.Third Phase: Awareness and Attempt to National Digital Switch

In 1986, the first national digital switch DS-2000 was developed by a government research institute under the Ministry of Posts and Telecommunications (MPT), however not succeeded in commercial side. Post and Telecommunication Industrial Corporation (PTIC) settled a new strategy in order to develop large scale digital switches; signed a contract with Zhengzhou Institute of Information Engineering of the People's Liberation Army. Luoyang Telephone Equipment Factory of MPT as the producer of crossbar switches and joint venture Shanghai Bell were also included to research consortia. The project team had experienced on Fujitsu F-150 system and this technical team developed a new type of digital switch which had superiorities of Fujitsu F-150 and Shanghai Bell's S1240 model and recent novelties on telecom technologies. After two years, in 1991, this research consortium developed a new switch HJD-04[3] which adapted a multi-processor distributed control system for the new switch. (Gao, 2004)

[3] To produce the HJD-04 in a large scale, the consortium cooperated with the joint initiatives by the MPT and MET (Ministry of Electronics Industry) to establish a manufacturing company called Great Dragon (Julong). By 1994, the market share of HJD-04 had grown from zero to 16 percent. (He, Mu, 2012: 277)

HJD-04 was not a large scale switch and designed for lower levels of network, on the opposite market position of dominant multinationals (MNCs) and JVs' switches which had targeted only high-end city markets. After research and development activities, HJD-04 was firstly commercially marketed by the company of Great Dragon which had been established as an affiliate of Luyang Telephone Equipment Factory in collaboration with other Chinese SOEs. Great Dragon attained to a significant market share with national switch of HJD-04, product entered the market with a marginal price (nearly half price of similar products of JVs) and became the best seller in China by focusing on rural market which had been previously neglected by MNCs. HJD-04 was a milestone in the history of China's telecom equipment industry. (Feng, 2010)

Under the leadership of MPT, technological know-how diffusion of HJD-04 was transferred through national telecom equipment industry. HJD-04 development team provided consultancy services to domestic telecom equipment firms, specifically to Huawei and ZTE.[4]

Table-2: Breakdown of Market Share in Central Office Switches Market

	1982	1987	1992	1997	2000
Direct Import	100%	89%	54%	5%	0%
Joint Venture	0%	11%	36%	63%	57%
Indigenous Suppliers	0%	0%	10%	32%	43%

Source: Tan, 2004

Transformation of market from directly imported products to indigenous supplier equipment could be seen as in Table-2. In early

[4] After the development of HJD-04 in 1991, knowledge diffusion was further amplified through the inter-flowing of engineers or related persons, which finally led to successive development of four types of digital automatic switches (EIM- 601, ZXJ-10, SP-30 and C&C08) by other indigenous firms. The later development of other types of digital switches by Jinpeng, ZTE (Zhongxing), Datang, and finally Huawei benefited from knowledge diffusion via inter-firm mobility of skilled engineers. (He and Mu, 2012:278)

1980s, the market fully relied on direct imported equipment. In late 1980s and early 1990s, the new strategy was “attract foreign investment and absorb the technology” which increased the dominance of joint ventures in the market. The third stage aimed to “promote the indigenous equipment suppliers” via diffusion of technology with technology transfer and local R&D efforts of domestic firms. Thus, in 2000 indigenous suppliers attained to 43% percent, this segment had not had any market share in ends of 1980s. Starting from 10% market share in 1992 four domestic manufacturers- Great Dragon, Datang, ZTE and Huawei held 43% of the market. (Tan, 2002)

For digital telephone switches (SPC switches), market share of domestic firms’ (inc. sino-foreign joint ventures) products was less than 50% in 1980s, however, increased to more than 90% in 1996. In 1982 first foreign SPC switch was imported, but after only ten years China developed its own national digital switch with own intellectual property rights. 98 percent of newly added SPC switches in China were made by local national firms; as Great Dragon, Huawei and ZTE (He, Mu, 2012).

2.4. Fourth Phase: Focus on Mobile Technologies

History of mobile technologies in China began with the deployment of wireless 1G phone system in 1987, a variant of 900 MHz TACS. MNCs Motorola and Ericsson were the major equipment providers. Only after 7 years, TACS system was replaced by Chinese government with new generation 2G technology GSM (European digital 2G technology). Major MNCs Ericsson, Motorola, Nokia, Siemens, Lucent and Northern Telecom dominated Chinese domestic 2G market for both of infrastructure and terminals.

In mobile market competition, Chinese telecom equipment manufacturers attempted to search opportunity as in digital switch market, however, GSM technologies have much more strict patent

protection than digital switch product group. Qualcomm licensed CDMA to Huawei, ZTE and Datang in fields of switches, base stations, handsets etc. because of Chinese government pressure and attractiveness of the Chinese market. Thus, Chinese domestic forerunner enterprises penetrate to mobile market with manufacturing switches, base stations, handsets etc. with the license agreement of Qualcomm's CDMA technology. This strategy brought significant sales revenue for Chinese domestic firms in both of domestic and international markets. Besides financial achievement, this attempt brought high-segment know-how related to mobile technologies and next generation technologies; 3G and 4G.

Addition to 1G and 2G technology experiences, third generation (3G) mobile communication created a new opportunity to Chinese telecom equipment companies. As a state-led project, Chinese telecom industry developed a national standard for 3G by encouragement of MPT (Ministry of Posts and Telecommunications) and Ministry of Science and Technology. This attack could be defined as a leapfrogging catch-up, because by this innovative project, China succeeded development of one of the three internationally approved 3G standards; TD-SCDMA. Therefore, China could be able to manufacture equipment and systems, which use TD-SCDMA infrastructure, without the obligation of signing license agreements with US and EU patent holders.

2.5. Fifth Phase: Chinese 3G Standard; TD-SCDMA

Datang- is a former state research institute under Ministry of Post and Telecommunication- is the most important actor during TD-SCDMA (Time Division – Synchronous Code Division Multiple Access) development project which is the most innovative effort of Chinese telecom equipment industry. Through this state-led development project, China telecom industry has become patent holder for a technology standard. In 2000, this technology was approved by International

Telecommunication Union (ITU) as one of three 3G mobile communication standards.

Although business and development operations need long term and costly operations (chips, terminals, operational platform, network management and optimization systems, operation support and business support systems etc.) Chinese government put pressure to support the industrialization of TD-SCDMA. Thus, a joint group was set up by The State Development and Reform Committee, Ministry of Science and Technology and Ministry of Information Industry; TD-SCDMA Alliance was settled. On the other hand, multinational telecom companies and Chinese domestic firms contributed to development and industrialization projects of TD-SCDMA.

The leader Chinese telecom equipment manufacturing companies (Datang, Huawei, Potevio) have also joined to TD-SCDMA alliance by establishing joint ventures with foreign companies in order to develop and commercialize TD-SCDMA. Huawei established joint venture with Siemens in 2004 focuses on research and development of TD-SCDMA and also manufacturing, sales and service activities. (Siemens holds 51% share, Huawei 49%) (People's Daily, 2004), Potevio established joint venture with Nortel in 2005 focuses on TD-SCDMA development; (Potevio holds 49%, Nortel 51% share) (Beijing Evening Daily, 2005), Potevio also established joint venture with Nokia in 2006 in order to construct TD-SCDMA base stations; Potevio has 51%, Nokia has 49% share (China Economy Network, 2006). Additionally, Alcatel and Datang, Ericsson and ZTE, NEC and Torch also established joint ventures related to TD-SCDMA technology and development opportunities.

During the development of TD-SCDMA, Chinese government actively intervene to the period as a conclusion of "generative state" policies. Chinese government postponed the launch of 3G schedule several times because of delays during development of TD-SCDMA. Essentially, government could have launched 3G with imported standards

as in many countries; with WCDMA (EU) and CDMA2000 (US). However, government planned to support TD-SCDMA and give an opportunity to get share in national market and thus proved its potential. In sum, TD-SCDMA is a state-supported innovation project in which most of R&D budget of TD-SCDMA project came from Chinese state-owned bank loans[5].

After the launch of third generation wireless communication by Chinese government, 3G technology standard selection for operators was conditioned under the impact of state, mobile operators and equipment manufacturers, as another example of generative state policies. In fact, if Chinese operators selected W-CDMA or CDMA2000 technologies for 3G network, would invest smaller budget because of operating in same standard family (for instance Qualcomm's 2G standard of CDMA), however, China Mobile (state owned operator), which is world's biggest operator in the scope of number of subscribers, chose to change the infrastructure radically and move through the national technology standard; TD-SCDMA. China Telecom selected CDMA2000 and W-CDMA became 3G standard for merger of China Unicom and China Netcom. This selection was also a state policy in order to support national standard with the biggest mobile operator, China Mobile. In fact, these policies could be applied because China state is the owner, operator and regulator of the telecommunication industry.[6]

[5] MII (Ministry of Information Industry) gives vigorous support to TD-SCDMA development, arranging special funds as part of mobile projects and electronic development funds. MII and MST (Ministry of Science and Technology) and other government departments have invested 1 billion RMB ($120 million) since the late 1990s, involving nearly 3,000 scientists and engineers across the country. A team of 10 thousand technicians and researchers have been involved in the research, development and market promotion in 3G mobile services. In 2002, MII established the TD-SCDMA industry alliance with other ministries. They also support theoretical research in TD-SCDMA, including design and R&D in crucial chips, system, antenna, terminal, network plan, testing and construction. MII invites more and more Chinese and foreign manufacturers to join the alliance. At present, more than 50 manufacturers are engaged in the development of TD-SCDMA.. - Liu Jin (2005) Summarization of MII's Promotion of TD-SCDMA Development, China Electronics. (Yan, 2007: 7)

[6] After China submitted its 3G file to the ITU, manufacturers from Europe, America and Japan unanimously opposed to it immediately. MII gave a tough stand right away:

Chinese authorities consider TD-SCDMA as a national hero. China mainly aimed to change the monopoly of foreign standards (CDMA2000 and WCDMA) by nationally developed core technology and decrease the domestic companies' patent fees which are paid to foreign corporations (Shen, Jolly, 2011).

In sum, TD-SCDMA is an important attempt of indigenous innovation in Chinese telecom industry. The project includes a value chain which covers core system, chips, terminals, software systems, test environments, TD-SCDMA mobile phone, data cards etc. Thus, there is network of production around TD-SCDMA and this value chain will also bring great value for national economy.

Finally, Table-3 also summarizes these all phases of catch-up of Chinese telecom equipment industry

Table-3: History of Chinese telecom equipment industry chronologically

Policy	Date	Strategy/Action	Policy Maker/Strategy Owner
Paradigm Shift	1978	China reform of transition from central planning to market dominated economy	State, Communist Party
	1978	Chinese Communist Party declared a program of modernization for China on the base of "four modernizations"; industry, agriculture, science and technology and national defense.	State, Communist Party
	1979	Allowance for foreign investments	State, Communist Party
	1983	First foreign joint venture was Shanghai Bell Telephone Equipment Manufacturing Co.	State, MNCs

"Even foreign forces tried to block the Chinese standards to be adopted, the Chinese market has sufficient space to support their own standards, we are fully capable to develop and operate TD-SCDMA in China!". Taking into account the importance of the Chinese market and unwillingness to offend the Chinese government, the large telecommunications manufacturers did not take more radical opposition this time. (Yan, 2007. 6-7)

National Industry Emerges	1985	ZTE was founded	State
	1986	In 1986, the first national digital switch DS-2000 was developed by a government research institute under the Ministry of Posts and Telecommunications (MPT), (commercially not successful)	State
	1987	History of mobile technologies in China began with the deployment of wireless 1G phone system	State
	1988	Huawei was founded	Private, State, (Military, Communist Party)
Knowledge Diffusion for Switch Technology	1991	First national switch HJD-04 was developed by a government consortium and successful in market	State
		Knowledge diffusion to private firms Jinpeng, ZTE (Zhongxing), Datang, and finally Huawei switches	State, MNCs
	1993	Huawei developed own central office CC08-A for rural market	National firm
	1994	1G system was replaced by 2G technology GSM	State, MNCs
	1995	ZTE developed its own switch ZXJ10 for rural market which was neglected by MNCs	State
	2000	Central Office Switch Market was in 1982 %100 direct import, in 2000 %57 joint venture, %43 indigenous suppliers	State, MNCs
Knowledge Diffusion for Mobile Technologies	2001	Qualcomm licensed CDMA technology (2,5G) to Huawei and ZTE in fields of switches, base stations, handsets	State, MNCs
Supreme Board & State Management	2003	SASAC (The State-owned Assets Supervision and Administration Commission of the State Council) was founded	State, Communist Party
Innovation Phase	2005	TD-SCDMA (3G) was developed by a consortium under the leadership of Datang (government research institute); MNCs, national firms and state	State
	2009	Under the management of SASAC; China Mobile selected TD-SCDMA as 3G infrastructure technology in 2009	State

3. The Major Multinationals of Chinese Telecom Equipment Industry

3.1. ZTE (Shenzhen Zhongxin Technology Corporation)

ZTE was founded in 1985 by a group of engineers affiliated to Ministry of Aerospace Industry. The aerospace industry in China has a quasi-military characteristic. ZTE is a government initiative to support Chinese national capability in telecommunication equipment industry.

ZTE is a state-owned company. The biggest shareholder of ZTE Zhongxingxin (32.45%) also has its shareholders; Xi'an Microelectronics, Shenzhen Aerospace Guangyu Industrial (Group) Company Limited ("Aerospace Guangyu") and Zhongxing WXT. Xi'an Microelectronics (established in 1965), a subsidiary of China Aerospace Electronics Technology Research Institute, is a large state-owned research institute. The second authority Aerospace Guangyu is a subsidiary of CASIC Shenzhen (Group) Company, is a wholly state-owned enterprise, established in 1984. Third authority, Zhongxing WXT is a private high-technology enterprise incorporated in 1992. Business scope includes development and production of telecommunication and transmission equipment, ancillary equipment, computer and peripheral equipment. (ZTE Annual Report, 2010)

MPT (Ministry of Posts and Telecommunications) focused on the differences between telecom infrastructure of urban and rural regions of China, because MNCs neglected to sell products for peripheral markets in first years. Thus, MPT decided to encourage indigenous firms to develop PBX and small PDSS for peripheral markets. ZTE was one of the firms which have been included in official recommended list for telecom operators in rural areas. (Feng, 2010)

As an output of that strategy, ZTE began to cooperate with government research institutes- such as, No.10 Research Institute, Nanjing College of Posts and Telecoms- and developed its own switch ZXJ2000 and attained to significant market share in rural market. This

was a significant success story and the revenue of this operation funded the following researches and product development projects of ZTE.

In time, emergence of mobile technologies also created a new opportunity for Chinese telecom equipment industry and also ZTE. Technology licensing and manufacturing under these technologies were popular strategy for ZTE. Through this strategy, ZTE signed license agreement with Qualcomm; Qualcomm has granted ZTE a license under Qualcomm's CDMA patent portfolio to develop, manufacture and sell cdmaOne and third-generation (3G) CDMA2000 1x/1xEV network equipment. After the development and launch of TD-SCDMA (Chinese 3G standard), ZTE positioned itself as one of the major equipment manufacturers of TD-SCDMA.

3.2. HUAWEI (Huawei Technology Corporation)

Huawei Technologies Corporation (Huawei) is a multinational enterprise in telecom equipment industry and the largest telecom-equipment provider in China. Huawei was set up in Shenzen economic zone as a privately owned enterprise in 1988. Ren Zhengfei is the co-founder and CEO of Huawei[7].

During the first years, Huawei dedicated to sales operation of imported equipment. Then, Huawei management team decided to develop independent design Huawei branded telephone switches. By the advisory of Huazhong Science and Technology University professors, Huawei began to develop small scale switch systems with reverse engineering imported switches and network equipment. During this time,

[7] As the founder, Ren only holds 1.42% while the rest 98.58% are owned by 65% internal employees through two unions, which endows organizational members the sense of participation and the foundation for being mobilized and integrated. During our investigation, some Huawei engineers said, ―*our boss has only very small share of this firm – Huawei is not his private property. However, he can work so hard, day and night for the collective. Certainly we shall also do like this*! (It is according to the interview with LIU ChunQiang (2003,2005) and CHE HaiPing (2003). (Feng, 2010: 251)

many attempts were failed; however, in 1990 analog private SPC switch HJD48 with 512 lines and in 1992 the rural terminal switch JK1000 was developed. This small-scale switch system became popular in China's countryside markets.

After this succession, Huawei began to invest in R&D for large capacity central office SPC switches. Huawei R&D team firstly developed the central office SPC exchange CC08-A with 2000 lines in 1993, and then developed CC08-C with 10.000 lines in 1995 (He, Mu, 2012). During these R&D projects, Huawei team also worked with uncommon tradition of work. He and Mu (2012) gives an impressive example in order to show the effort and willingness of employees. This could be defined as China specific work culture in which engineers work, eat and sleep in their offices[8].

By this effort, Chinese first large-scale digital program control switch was launched. Huawei had transformed the certain amount of budget for R&D activities of C&C08 switch which would be the flagship of Huawei product group and provide the infrastructure for Huawei's today leading position (Milestones of Huawei). When Huawei penetrated to the market, Chinese telecom equipment market had been dominated by multinational foreign enterprises and there was certain competition in the market. As ZTE, Huawei focused on the rural market, which had been neglected by foreign enterprises.

[8]In the process of researching SPC switches, Huawei formed a special corporate culture, including the well know ''mattress culture'' and ''eating culture''. ''Mattress culture'' held that in order to finish new product R&D as soon as possible, Huawei's founders worked, ate and slept in their office. They just covered a mattress and put it under their desks. From then on, newcomers were given a mattress and an area of carpet when they joined Huawei. Even now, the president and many whitecollar employees have mattress under their desks. ''Mattress culture'' has embedded the firm with the spirit of collectivist effort and survival. ''Eating culture'' was formed by R&D division engineers. Since they usually worked facing computer screens day and night, they had no time to meet and communicate with each other. So they adopted a way of ''talking while eating'' while having dinner or lunch together at restaurants around Huawei. Following the growth of Huawei, they moved their office many times, accordingly restaurants nearby their offices grew prosperous on account of their ''eating culture'' (Cheng, 1999). ''Eating culture'' has prompted engineers' communication and cooperation on technology innovation. (He, Mu, 2012: 279)

In early 1990s, Huawei focused on wireless and 1G technologies. Since late 1990s, Huawei began to diversify the product group as; access equipment, optical transmission, data and wireless network product fields by accumulated know-how sourced from R&D activities of large scale digital switch technology.

In order to get the benefit of mobile technologies market, Huawei signed license agreement with Qualcomm, pioneer and world leader of Code Division Multiple Access (CDMA) digital wireless technology. Huawei successfully combined the licensed technologies with R&D and manufacturing capabilities and increased the market share in mobile technologies for both of China and world markets.

Success on domestic market encouraged international operations of Huawei. There were several reasons for international investments; although Chinese domestic telecom market supported growth and expansion of Huawei, fierce competition with multinational rivals was also a strong problem mostly for urban markets. Additionally, rapid innovative characteristic of telecom industry requires investing on R&D activities in order to enhance the competitiveness and maintain sustainable development. Thus, internationalization approach aimed to increase the cooperation opportunities with leading foreign parties. According to Cheng (2006); some researchers claim that Ren's internationalization strategy was also influenced by Mao Zedong whose "guerilla war strategy" guided Huawei during the partial battles with multinational telecom rivals specifically in early terms of internationalization period. Chen adds that customer-centric strategy of Huawei is another important characteristic of this success story.

According to Mathews (2006), MNCs of developing countries prefer alliance or overseas cooperation to overcome the existing disadvantages. One of these alliances is R&D alliance and Huawei used that strategy effectively as a "learning" process in technology improvement. Addition to R&D alliances, Huawei also settled market alliances specifically for European and U.S markets. For instance,

Huawei established joint ventures with Siemens and 3Com in order to sell its products in European and U.S markets. These joint ventures were beneficial for Huawei in order to overcome the branding problem via reputation advantages of telecom giants. These market oriented joint ventures also provided infrastructure for overcome the trade and technology barriers and risk of entrance to EU and US markets.

4. Role of State for Catch-up

Since the reform of 1979, there exists a definite state policy behind the catch-up of Chinese telecom equipment industry. In this success story, setting state policies as the central authority, managing foreign investment opportunities, using the potential of the enormous domestic market and the state-led financing mechanism have become critically important subjects which are connected to the state policies in a broad sense. Figure-1 illustrates transformation of economic system from Socialist China to Market Socialism and also transformation of poor telecom equipment infrastructure to globally leader telecom equipment industry via state-led catch-up policies.

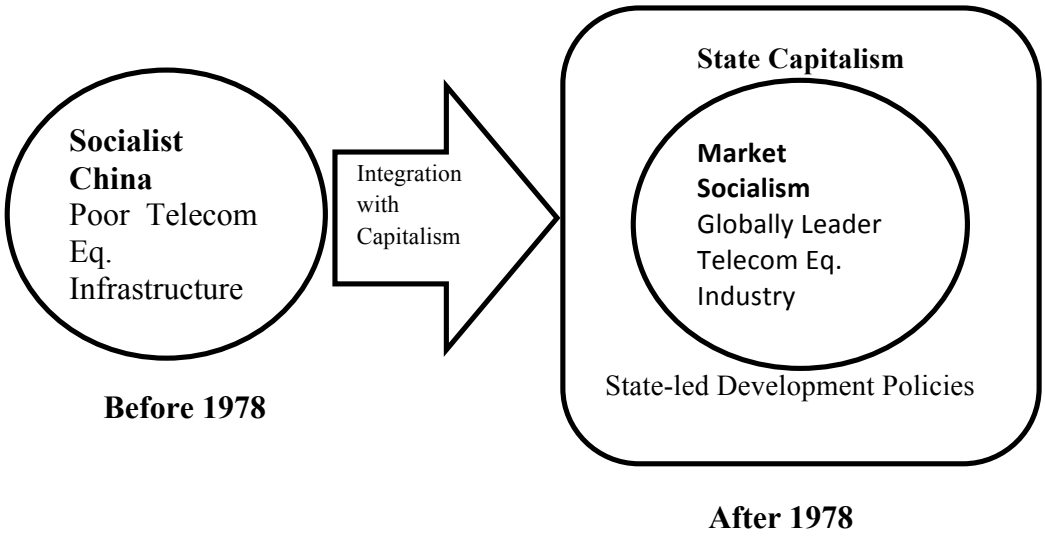

Figure-1: Transformation of Economic System in China after 1978

In fact, Chinese state has strong effect on telecom equipment industry with a different model and U.S. House of Representatives

Permanent Select Committee (8th October, 2012) underlined these strategic relations after a long period investigation about the industry. This report has strong evidences specifically about Chinese telecom equipment major vendors Huawei and ZTE and their foundation, relations with Chinese state and other official authorities. This report is final output of an investigation period about Chinese major telecom equipment companies, Huawei and ZTE.

Additionally, according to report of "Background Material for US-China Economic and Security Review Commission" (2012), China's top telecommunication equipment firms, Huawei and ZTE, strongly benefited from aggressive government support. Chinese government protected and promoted Huawei and ZTE via increasing domestic telecommunications infrastructure and providing enormous financial and political advantages for these national firms. Moreover, according to the report of US-China Economic and Security Review Commission Hearing- "China's State-Owned and State-Controlled Enterprises", Huawei's close relationship with the PRC (People's Republic of China) and PLA (People's Liberation Army) is documented by many official sources. U.S. Department of Defense's most recent report of "Military and Security Developments Involving the People's Republic of China 2011" emphasizes the Huawei's, Datang and ZTE's close ties with PLA.

All these reports and other related sources are used in order to prove the role of state during this catch-up succession.

4.1. Telecom equipment industry has been defined as a strategic industry by Chinese state that actively managed all phases during catch-up of the industry

After 1979 reform period, Chinese state authority defined strategic industries which would bring China for future decades. Telecommunication was also defined as one of these strategic industries in which Chinese state aims to maintain "absolute control".

Chinese telecom industry has powerful state-owned enterprises. Operators (China Mobile, China Telecom, China Unicom) are state-owned enterprises which dominate telecom equipment market. Additionally, there are major multinational telecom equipment vendors; ZTE is known as a state-owned enterprise, although Huawei also describes itself as a private company, there are significant suspicions about Huawei's relations with Chinese state and People's Liberation Army (PLA).

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[9]The government is the owner, operator, and regulator of the telecommunications sector in China, and decisions regarding the procurement of telecommunications equipment are made accordingly.... The Telecommunications Industry Association reports that, in some procurement by the big three (China Mobile, China Telecom and China Unicom), "companies are ignoring published criteria for bid evaluation, resulting in the selection of 'national' champions." An investment advisory on China's telecom market states that MIIT "has encouraged Chinese operators to purchase telecommunications equipment from Chinese manufacturers, including leading suppliers such as Huawei, ZTE, Datang and Great Dragon."... In 2010, for example, ZTE and Huawei received massive equipment purchases from China Mobile for the rollout of its first Package Transport Network, with each company getting a 35% share of the revenue.[9]" (McCarthy, 2012: 5-8)

The House of Representatives Permanent Select Committee on Intelligence report "Investigative Report on the U.S. National Security Issues Posed by Chinese Telecommunications Companies Huawei and ZTE" is published in October 8, 2012. In this recent report, Huawei's founder of Mr. Ren Zhengfei and its ties to military was one of the research topics for the Committee.

Moreover, report claims that Huawei officials did not give information about the role and status of Mr. Ren Zhengfei in Chinese Communist Party.

> In his official biography, Mr. Ren admits that he was asked to be a member of the 12th National Congress of the Communist Party of China[10] in 1982. The National Congress is the once-in-a-decade forum through which the next leaders of the Chinese state are chosen. The Party members asked to play a role in China's leadership transition are considered key players in the state apparatus. Mr. Ren proudly admits that he was invited to that Congress, but he will not describe his duties. Shortly after being given such a prestigious role, Mr. Ren successfully founded Huawei, though he asserts he did so without any government or Party assistance. Huawei likewise refuses to answer whether Mr. Ren has been invited to subsequent National Congresses or has played any role in Party functions since that time. (U.S. House of Representatives Permanent Select Committee on Intelligence, 2012a: 23)

According to report, the Committee received no information about the role of Chinese Communist Party in Huawei and also Huawei's formal interaction channel with Chinese government. Huawei specifically denied having any links to Chinese government.[11]

[10] 12th National Congress of the Chinese Communist Party was convened on 1 September 1982. This congress has also a strategic meaning which was the first Congress of the Party after Deng's reform of 1979 and before this congress, strategic industries for China had already been defined and one of them was telecommunications.

[11] Many industry analysts, however, have suggested otherwise; many believe, for example, that the founder of Huawei, Ren Zhengfei, was a director of the People's Liberation Army (PLA) Information Engineering Academy, an organization that they believe is associated with PLA, China's signals intelligence division, and that his connections to the military continue.... many analysts believe that Huawei is not actually controlled by its common shareholders, but actually controlled by an elite subset of its management. The Committee thus requested further information on the structure of the company's ownership. For example, the Committee requested that

The report also emphasizes role of Chinese Communist Party in Huawei management team. According to report, Huawei admits that Chinese Communist Party maintains a Party Committee in the company, however, Huawei failed to explain the role of this Party Committee and who are attendees of the committee. Huawei also advocates this position as; "party committee is an obligation in all companies in China according to Chinese laws." These committees also influence, pressure and monitor of corporate activities according to experts of Chinese political economy. (U.S. House of Representatives Permanent Select Committee on Intelligence, 2012a: 22-23)

Moreover, on 5th October, 2011, a report was prepared by U.S. Open Source Center of the Office of the Director of National Intelligence. The report emphasizes that China's leader telecommunication company Huawei has links with Chinese intelligence services. Huawei has series of formal and informal relations with Chinese People's Liberation Army and Ministry of State Security. Additionally, the report indicates that Huawei's chairwoman Sun Yafang was an employee of the Ministry of State Security (MSS) Communications Department prior to joining to Huawei in 1989.[12] Sun's another critical role was related to provide financial sources to Huawei. Prior to joining to Huawei, Sun helped Huawei and provided financial support when the company was founded in 1987.[13]

According to the Washington Post- John Pomfret, the representatives of the National Security Agency (NSA) - the nation's

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Huawei list the ten largest shareholders of the company. Huawei refused to answer. (U.S. House of Representatives Permanent Select Committee on Intelligence, 2012a: 13-14)

[12] Xinjing Bao reported that Huawei Chairwoman Sun Yafang worked for the Communications Department of the Ministry of State Security for an unspecified period of time before joining Huawei (28 October 2010). (Open Source Center, 2011: 2)

[13] Sun also used her "connections" at the Ministry of State Security to help Huawei through financial difficulties "at critical moments" when the company was founded in 1987, according to an undated report on Feng Huang Wang, the website of pro-Beijing Hong Kong broadcaster Phoenix Satellite Television Holdings Ltd. (Open Source Center, 2011: 2)

electronic spying agency - warned with a call AT&T's (US telecom operator) senior executives about the risk of purchasing telecommunication equipment from Huawei during AT&T's LTE network investment planning. The reason is that China's intelligence agencies could embed digital trapdoors to Huawei's technology and products and thus secret listening on U.S. communications network could be possible[14]. AT&T did not make any public announcements about this case, however, at the end in February 2010 Swedish-owned Ericsson and Paris based Alcatel-Lucent were chosen as equipment suppliers for next generation LTE network.[15]

Because of these links with state authorities, Huawei had certain problems specifically with the network projects of other countries. For instance Australian government prohibited Huawei from the tender due to advice of the Australian Security Intelligence Organization (ASIO), because of the notion of the having strong links with the Chinese military.(http://afr.com/p/national/asio_forced_nbn_to_dump_huawei_FaglE6qWrqd5utgLpR0IdO). Additionally, in Germany's national research and education network project (DFN), Chinese telecom equipment suppliers were excluded because of security concerns, as similar to Australian case. (Economic and Security Review Commission, 2012: 18)

As another critic topic, Huawei's ownership model is quite suspicious. Huawei officials claim that Huawei is an employee-owned company, however, official reports of other countries have questions about actual ownership structure of the company. According to Huawei officials' declarations, Chinese government has no influence on corporate behavior and decisions, and Huawei is managed as an employee-owned enterprise through Huawei's Employee Stock Ownership Program (ESOP). This program provides an option to high-performing employees to buy dividend-providing shares and share in the value of company.

[14] Pomfret, J. "Between U.S. and China, a Trust Gap," *Washington Post*, October 8, 2010.
[15] Bender, R., Sandstrom, G. (2010) "2nd UPDATE: Ericsson, Alcatel Get 4G Network Deal From AT&T," *Foxbusiness.com*, February 10, 2010.

These employees can only sell these shares when they leave Huawei or with corporate approval. According to Huawei, Union holds 98.7% of the ESOP shares; Mr. Ren Zhengfei has only 1.3%[16] In sum, ownership status of Huawei is not a definite matter, namely, owners of the ESOP shares is not known.

U.S. The House of Representatives Permanent Select Committee on Intelligence report (2012a) also investigated ZTE by interviews with ZTE officials, document reviews and so on. According to report, ZTE has current and historical ties with Chinese government and military research institutes and there is strong government effect on corporate management level.

ZTE's largest shareholder is Zhongxingxin which is owned by other two state-owned enterprises -Xi'an Microelectronics and Aerospace Guangyu- there is ownership ties to Chinese state and ZTE manages technological research and development projects for military and government. Moreover, ZTE officials also did not give detailed answers to the Committee related to "formal interactions with Chinese government", "financial information beyond publicly announced" and "the former role of ZTE Communist Party Committee". As similar with Huawei case, ZTE's relation with Chinese Communist Party is one of the key concerns. Communist Party Committee takes place in the company; however "its functions", "who chooses the members and relations with Chinese Communist Party" are unclear aspects. [17]

Another example for the effect of Chinese state over domestic telecom companies is that, in October 2004 Chinese government shuffled the top management of three major telecom companies; a senior executive of China Unicom became the new head of China Mobile, a vice president of China Mobile was made the head of China Telecom and

[16] U.S. House of Representatives Permanent Select Committee on Intelligence, 2012a: 15-16
[17] U.S. House of Representatives Permanent Select Committee on Intelligence, 2012a: 40

head executive of China Telecom was moved to China Unicom.[18] This sudden management shift was directed by the Central Organization Department of the Chinese Communist Party.[19] Another sudden personnel shuffle was in 2008[20]. At last, in 2010 new personnel shuffle and reorganization was carried out in telecom sector. The chief executive of China Mobile was removed and appointed party secretary of China Mobile's Communist Party committee. The Financial Times evaluated this management change as "left observers confused… underscoring the opaque nature of China's state enterprises".[21] State's active and strong effect on telecom operators provides advantageous to national telecom vendors of Huawei and ZTE in order to sell equipment and systems to these state-owned operators.

In sum, Chinese state has critically important effect on Chinese telecom equipment industry; such as determined the industry as strategically important industry in five-year plans. Most of the players in the industry are state-owned and now are managed by SASAC (The "State-Owned Assets Supervision and Administration Commission), the rest of the companies are named as privately held; however, ownership structure of these companies is also suspicious. Market relations are also effected by state authority, because the most of the infrastructure equipment are demanded by telecom operators which are state-owned and in their tenders the greater shares always belong to domestic suppliers. Thus, the industry is strongly affected by Chinese state and related policies.

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[18] Hille, K. (2010) "China Mobile in Board Shake Up," *Financial Times,* May 31, 2010.
[19] ibid
[20] The president of China Tietong (China Railcom) and the vice president of China Unicom were all transferred to China Mobile; and the vice president of China Unicom, and the head of the CCP Discipline Inspection Team of China Unicom, were transferred to China Telecom.20 The restructuring also mandated the merging of China Mobile and the smaller China Tietong and for China Unicom to be divided, with its CDMA network sold off to China Telecom and its GSM network business merged into China Netcom.20 (U.S.-China Economic and Security Review Commission, 2011: 27)
[21] Hille, K. (2010) "China Mobile in Board Shake Up," *Financial Times,* May 31, 2010.

All above mentioned cases and issues support that Chinese state has involved and managed the catch-up of this strategic industry telecommunication. In some manners, state actively intervenes to the process, in other periods, state indirectly manages the period with its own instruments. In fact, there is a clear strategic map of state since Deng's 1979 economic reform. After the decision of integration with global economies, strategically important industries have been defined; one of these industries was also telecommunication. Since then, Chinese state has always actively involved through the industry with related strategies and policies and directly intervenes to the market via national players. As an owner, operator, and regulator of the telecommunication sector, Chinese state manages the industry according to interest of China.

4.2. Chinese domestic market financed emerging and growth stages of the telecom equipment industry

The potential of domestic market has become important tool for the growth of national firms. Emergence of indigenous firms in the market started with development of their own national digital switches and focus on rural market which had been neglected by multinational rivals in 1990s.

Table-4: Breakdown of Market Share in Central Office Switches Market

	1982	1987	1992	1997	2000
Direct Import	100%	89%	54%	5%	0%
Joint Venture	0%	11%	36%	63%	57%
Indigenous Suppliers	0%	0%	10%	32%	43%

Source: Tan, 2004

Transformation of market from directly imported products to indigenous suppliers' equipment could be seen as in Table-4. In early 1980s, the market fully relied on direct imported equipment. In late 1980s and early 1990s, the new strategy was "attract foreign investment

and absorb the technology" which increased the dominance of joint ventures in the market. The third stage aimed to "promote the indigenous equipment suppliers" via diffusion of technology with technology transfer and local R&D efforts of domestic firms. Thus, in 2000 indigenous suppliers attained to 43% percent, this segment did not have any market share in ends of 1980s.

The sales revenue, market experience and know-how accumulation of switch technology were used for the development of next generation telecommunication technologies. Addition to specific network products (switch, router and so on), telecom equipment industry focused on a new field; as mobile technologies. 1G, 2G and finally 3G became popular technologies and created great markets in worldwide. China is also a significant market for mobile technologies for telecom equipment vendors, too. Both of foreign telecom vendors and Chinese vendors have become in a fierce competition in the market.

Moreover, there are national telecom operators which has creates important market for telecom equipment vendors. These Chinese operators have significant investment budgets for telecom infrastructure because of China's geographic and crowded population characteristics.

China Telecommunication Corporation (China Telecom) was established as a government monopoly that had control of all telecommunication services until 1993. In time, China Telecom monopoly position was broken by spinning off China Unicom in 1994, spinning off mobile services to form China Mobile in 2000. China Mobile Communication is the largest mobile phone operator in the world with over 720 million subscribers- April, 2013. China Unicom is a government owned company and founded by Ministry of Electronics, Electric Power and Railways in 1993. China Unicom is the second largest mobile operator in China. China Netcom Group Corporation (CNC) is a government controlled company and Government of Shanghai, the China Academy of Sciences, the State Administration of Radio, Film and TV, The Ministry of Railways have been in founding

members. CNC was formed in 2002 on the basis of the former China Telecom Group Corporation and its affiliated telecom companies. China Netcom Group Corporation (Hong Kong) was incorporated into China Unicom in 2008.

Ministry of Industry and Information Technology of China issued third-generation mobile telephone licenses with China Mobile, China Telecom and China Unicom. China's three major mobile carriers were achieved their first phase of 3G wireless network deployments in 2009. China Telecom received CDMA2000 (US developed), China Unicom got the license to set 3G network on WCDMA technology and China Mobile obtained approval to operate the nation's self-developed TD-SCDMA technology. It is clear that China is a member of WTO and a hybrid network which includes three standards in China is the most probable solution.

> China's three telecom operators invested RMB 1.16 trillion in the 3G network to construct a total of 325,000 3G base stations in 2009: 108,000 TD-SCDMA base stations covering 238 cities for China Mobile; 117,000 3G base stations covering 342 cities for China Telecom; and 100,000 3G base stations covering 335 cities for China Unicom, 163.com reports quoting data released by China's Ministry of Industry and Information Technology (MIIT) (Annual Telecom Industry Press Conference on January 27, 2009).

China Unicom's 3G tender result in 2009 was; Huawei 30.6% (cooperation with Motorola which outsourced manufacturing parts to Huawei), Ericsson and its partners (New Postcom and FiberHome) 25.6%, ZTE[22] 21.5%, Nokia Siemens Networks took 11.1% and Alcatel-Lucent took 10.2%.

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[22]Based on this analysis, iSuppli ranked the vendors of wireless equipment in the 3G market before the second quarter of 2009. ZTE gained the largest share in the domestic 3G market, with 610,000 transceivers deployed in all three 3G wireless technologies nationwide. Huawei ranked second nationwide, with 520,000 transceivers. ZTE took the No-1 position in both TD-SCDMA and CDMA2000.(http://www.isuppli.com/China-Electronics-Supply-Chain/MarketWatch/Pages/Chinas-3G-Network-Deployment-Update.aspx)

China granted TD-SCDMA 3G license to China Mobile in January, 2009. China Mobile is the world's largest mobile phone operator with over 720 million subscribers, in April 2013. China Mobile's first large scale tender for TD-SCDMA network equipment's total value was 26.7 billion Yuan (3.53 billion USD). ZTE and Datang had nearly 75% share (ZTE 46.3%, Datang 28.6%), TD 14.8%, 2.4% Potevio, 0.9% Ericsson, 7% others. China Mobile's second tender covered 23.000 wireless base stations in 28 Chinese cities. Datang Mobile, FiberHome and Postcom, which use equipment of Datang Mobile, gained 40% share, ZTE had 25% to 28% share, Huawei 17% to 18%, Nokia Siemens Networks 8%, Potevio 6% and Ericsson 4.5%. Third-phase tender of TD-SCDMA network covered 200 cities. Chinese equipment vendors got 72% share; ZTE gained 34%, Huawei 22% and Datang 16%. (http://wirelessfederation.com/news/17178-china-mobile-announces-results-for-third-phase-of-td-scdma-tender/)

Table-5: China Telecom Operator Tender Statistics

	China Mobile	**China Telecom**	**China Unicom**
Owner	SASAC	SASAC	SASAC
3G Standard	TD-SCDMA	CDMA2000	WCDMA
3G Vendor Equipment Shares (2009)	**ZTE 36% Datang %26,9 Huawei + NSN %20.2 New Postcom 6.4% Potevio 3.7%** Ericsson 3.6% **Fiberhome 3.2%**	**ZTE had 42.4%, Huawei at 38.2%** Alcatel-Lucent 16.4%	**Huawei 30.6%**, **Ericsson + Fiberhome Telecommunication + Guangzhou New Postcom Equipment 26.5%, ZTE 21.5%**; Nokia Siemens Networks 11.1%; Alcatel-Shanghai Bell 10.2%.

Source:
http://www.zte.com.cn/cn/events/wireless_success_stories/china/200912/P020121108530838262598.pdf
http://www.isuppli.com/china-electronics-supply-chain/marketwatch/pages/zte-holds-off-china-competition.aspx
http://www.telegeography.com/products/commsupdate/articles/2009/01/28/china-unicom-selects-w-cdma-vendors/

As shown in Table-5, Chinese domestic telecom equipment vendors have majority of market in 3G investments of three telecom operators; China Mobile selected TD-SCDMA and Chinese telecom

equipment vendors (Huawei, ZTE, Datang, Potevio) has 93.1%, China Telecom selected CDMA2000 and Chinese vendors (Huawei and ZTE) have 80.6% market share and finally China Unicom selected WCDMA as 3G standard and Chinese telecom vendors (Huawei, ZTE, Fiberhome Telecommunication, Guangzhou New Postcom) has 78.6% market share.

On the other hand, Chinese national third generation (3G) telecommunications standard, TD-SCDMA, has been also developed homegrown by the support of Chinese state. This research and development project is also planned and completed in order to support domestic market and national suppliers. Through this project, the license costs which are paid to CDMA2000 (US) and WCDMA (EU) standards were decreased. For instance China's biggest mobile operator China Mobile (state-owned) chose national standard of TD-SCDMA as its 3G infrastructure standard.

Lastly, Huawei and ZTE won the bulk tender of 4G infrastructure of China Mobile in 2013, the amount of the deal was $3.2 billion.[23] Additionally, China Mobile has awarded its second batch of 4G telecom equipment contracts with Huawei (31%) and ZTE (34%). Ericsson and Alcatel-Lucent both only won 9% of the tender and Nokia secured 8%.[24]

In sum, China succeeded converting the disadvantageous of crowded population and large geographical area to an enormous market which has sales revenue potential for national telecom equipment vendors. Addition to the population and consumer markets, state-owned telecom operators also purchase equipment and services mostly from national suppliers. Although this market provides sales revenues for national vendors, market feedbacks and R&D operations also provide advantageous for overseas sales operations.

[23] http://www.reuters.com/article/2013/08/23/us-chinamobile-4g-idUSBRE97M02020130823
[24] http://www.reuters.com/article/2014/05/22/us-chinamobile-4g-idUSBREA4L08820140522

4.3. "State-led financing by state-owned banks" policy funded national industry for domestic and export market activities

Chinese leader telecom equipment manufacturers; Huawei and ZTE benefit from export credit support from Chinese government[25]. For instance, Huawei received $30 billion line of credit from China Development Bank- state-owned bank- in 2009.[26] This credit could be defined as export oriented credit and aims to finance Huawei's overseas customers to finance the equipment purchases from Huawei. Additionally, ZTE secured credit from China's Export-Import Bank for $10 billion and from China Development Bank for $15 billion in 2009.[27] Terms of conditions related to these credits are not public.

International credit of Chinese state-owned banks is one of the most important reasons for the growing market share in African telecom market. Cisse (2012) claims that between 2005 and 2010 Huawei and ZTE won over $3 billion from contracts with African telecom operators in Algeria, Angola, Ethiopia, Ghana, Libya, Nigeria and South Africa.[28]Moreover, Indian telecom operator -Reliance Communications- received $1.93 billion credit from China Development Bank in 2010 to use for 3G network infrastructure investment with the requirement of purchasing equipment and services from Huawei and ZTE [29] .

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[25]Huawei is ostensibly privately owned, although many of its shares are owned by the local state telecoms authorities to whom it has sold equipment. It enjoys a $10 billion low-interest credit line from the China Development Bank, whose mission is to make concessional loans in support of the state's policy goals. Huawei also has strong ties to China's military. (U.S.-China Economic and Security Review Commission, 2006: 56)

[26] TradingMarkets.com, (2009) "China Development Bank Enhances Support to Huawei".

[27] Light Reading Asia (2009), Mobile Tech News (2009)

[28]According to the former head of Huawei's operations in West Africa, Wilson Yang, Huawei's profit margins in Africa can be up to 10 times greater than those it realizes in China. Huawei manages to achieve tremendous margins while still pricing itself only 5%-15% lower than its major international competitors, Ericsson and Nokia. Furthermore, Huawei is cautious not to price itself too low so that it will not be seen as yet another low-cost Chinese provider. In contrast, Huawei's main Chinese competitor in Africa, ZTE, consistently prices 30%-40% below European competitors and, consequently, its products are perceived as being of inferior quality. (The Wharton School of the University of Pennsylvania, 2009: 4)

[29] http://www.marbridgeconsulting.com/marbridgedaily/2010-12-17/article/41906/china_development_bank_finances_huawei_zte_deals_in_india

Additionally, China Development Bank provided $375 million loan to Nextel Mexico to use the credit for purchasing 3G network equipment from Huawei.[30] China Development Bank (CDB) also signed the agreement with Russian operator Megafon and gave $1 billion loan for LTE development in 2011.[31] There are also similar countries to which China Development Bank provided export credits with the requirement of purchasing telecom equipment from Chinese telecom equipment vendors; Huawei and ZTE.

Recently, ZTE also announced its strategic partnership with China Development Bank in March, 2009 on ZTE's official website. This agreement will be in force for 5 years and during this time China Development Bank will provide US$15 billion credit line for ZTE's overseas telecom projects and ZTE[32]'s credit limits.[33] China's Xinhua news agency also reported that these state bank loans are quite strategic to provide opportunity for national companies in order to expand to overseas markets in the scope of China's globalization strategy.[34] China Development Bank's Chairman Chen Yuan told to Bloomberg News (2011) that "Our support for Huawei and ZTE and other high-technology companies has opened up the overseas market. We have become the principal source of finance of our country's overseas investments."[35]

Huawei and ZTE advocates that China Development Bank credits are given only to foreign countries in order to expand international sales

[30] http://www.prnewswire.com/news-releases/nextel-mexico-announces-375-million-loan-from-the-china-development-bank-cdb-to-fund-3g-network-build-out-126275733.html

[31] http://www.globaltelecomsbusiness.com/Article/2886858/Regions/25187/Megafon-signs-1bn-Chinese-loan-agreement.html

[32] ZTE announced on May 25, 2009, that it has entered into a strategic partnership with the Export-Import Bank of China (China Exim Bank) by signing a "Strategic Cooperation Agreement" for a US$10 billion credit line. This agreement further helps strengthen the leading edge of China Exim Bank in the financing area, as well as ZTE's leading position in the telecom technology industry. (http://wwwen.zte.com.cn/endata/magazine/ztetechnologies/2009year/no6/articles/200906/t20090612_172527.html)

[33] http://wwwen.zte.com.cn/en/press_center/news/200903/t20090323_350829.html

[34] http://www.telecomasia.net/content/huawei-gets-30b-credit-line-cdb

[35] http://www.bloomberg.com/news/2011-04-25/huawei-counts-on-30-billion-china-credit-to-open-doors-in-brazil-mexico.html

of these firms, however, China Development Bank annual reports underlines that these credits also enhance R&D capabilities of Chinese telecom equipment vendors.

> CDB also provided strong financial support to communication equipment manufacturing enterprises that have independent R&D capabilities, such as Huawei Technologies Co., Ltd., ZTE Corporation and Datang Telecom. (China Development Bank, 2007)
> …. The Bank focuses on supporting leading telecommunications device manufacturers, including Huawei Technologies, ZTE Corporation and Datang Telecom Technology, to enhance their R&D capabilities, develop their proprietary products, upgrade their technologies and equipment and explore international markets. (China Development Bank, 2006)

Furthermore, while China state funds telecom equipment vendors, R&D projects of government research institutions are also financed by the state in telecom industry. Chinese 3rd generation (3G) mobile standard of TD-SCDMA is also a state-led financing project[36]. Datang - the leader of the development consortium- has also been financed by Chinese state-owned banks during the development of TD-SCDMA.[37] This is one of the most strategically important R&D project for Chinese telecom industry.

According to article of "Datang Telecom Receives another RMB 20 Billion Line of Credit" Datang Telecom received RMB 20 billion credit from China Construction Bank. In June 2007, Datang Telecom

[36] State directed national bank, such as Industry and Commerce Bank (ICBC), Construction Bank of China and Huasia Bank, to offer loans Datang group approximately RMB$ 1.5 billion. Additionally, China Development Bank offered RMB$ 38 billion during 2005~ 2007 for TD SCDMA network building and testing (Liu, 2008: 63-64; Whalley et al., 2009: 13-14; Datang, 2010). (Tsai, Wang, 2011:11)

[37] Datang subsequently signed strategic cooperation agreements with financial institutions such as the China Development Bank, China Construction Bank, Huaxia Bank, Export-Import Bank of China, and Shanghai Pudong Development Bank. These agreements provide financial support in the follow-up process of the technological development and industrialization of TD-SCDMA. Such a financial arrangement in the TD-SCDMA industry chain would create a strong support for innovation work in enterprises and create growth in the industry.
(http://en.datanggroup.cn/templates/00Content%20Page/index.aspx?nodeid=58)

signed a new agreement with China Development Bank for RMB 30 billion line of credit to develop TD-SCDMA.

In sum, China state-owned financial institutions directly and indirectly support Chinese telecom equipment industry, as seen in these cases. The national infrastructure investments indirectly finance national vendors, because most of these investments are also supplied by Chinese vendors. Because of the enormous population of China, these national investments become sufficient in order to grow the national industry. Additionally, state-owned banks directly support domestic/overseas operations of telecom equipment companies. This direct support is mostly seen as the form of export-oriented credits, funding of research and development operations and tax incentives.

5. Conclusion

The paper aims to signify that there is a certain alternative way to the neoliberal policy suggestions during the catch-up of latecomer industries. This model advocates and suggests the state-led catch-up with "active involvement of the state mechanism".

The state actively manages and controls all phases of catch-up with its own arguments which have direct or indirect relations with the state. This new type of state does not look like the socialist, neoliberal or recently emerged entrepreneurial state (Mazzucato). This state is actively involved in the economy with both policies and strategies and applies these strategies with state tools under a central planning mechanism. Additionally, this form of state differs from the closed economy structure of the socialist state by linking with the capitalist economic system and the capitalist markets. In this catch-up model, there are sub-mechanisms; "foreign investments", "national industrial capabilities" and "national capital" which are managed by the state authority with the nation's own dynamics in a systematic perspective. This type of state-led catch-up and its success in the case of China could be modeled for other latecomers

with a general concept, and this type of catch-up could take its place in the literature as a novelty.

In this model, one of the major concerns is “the role of the state”. While today’s laissez-faire and free market approaches are certainly opposite to any kind of intervention to the market system, this state-led catch-up model provides active role to the state in each phases. State intervention mechanisms- for instance, guidance of the state and the role of the financial subsiding- could be considered as effective policy tools. In addition to the state’s role, acquiring and assimilating modern technology is the milestone for this catch-up model. Especially, foreign investments could be the major channel for transferring the latest and modern technologies to latecomers regarding especially knowledge intensive, high-tech industries. The other factor of this model is “the national industry and capital” which have to establish related infrastructure and national capabilities in which national industries transfer, disseminate and use the modern technology according to the strategies of the state.

Role of the state in China has certain differences from the common understanding of the state. The state is managed by related bureaucratic organizations which are directly/indirectly linked with the Communist Party. The state plays an active role in industries with state-owned companies, credits of state-owned banks, state-owned markets and state-owned research networks and so on. Specifically, after Deng’s reform period, China state changed the direction from delinking with global economic systems and to integration with the capitalist economy, however, by giving importance of nation interest and strategies. In sum, China chose the way of struggle against capitalism by linking with the global economic system, thus, China constituted a new model by active role of Communist Party and integration with capitalist system and taking the benefits of the global economy. This model is newly emerged from China’s own dynamics; has its roots from socialism and succeeded

the integration into the capitalist market with the state-led, interventionist policies.

The underlying policies behind the catch-up of Chinese telecom equipment industry could be summarized as follows:

Policy-1: State defines the strategic industries for next decades and invests in these industries.

After Deng's reform, China defined strategic industries which would support China economy and close the gap with developed countries. One of these strategic industries was telecommunication industry.

Policy-1.1.: State funds industrial activities by state-owned banks.

State-led financing (directly and indirectly) has had a strategic role for Chinese economic development after Deng's reform of 1978; financing mechanism was used as a tool according to the strategic priorities. Chinese state-owned financial institutions have supported the Chinese telecom equipment industry directly and indirectly. The national telecom infrastructure investments finance national equipment vendors indirectly, because most of these investments are also supplied by the Chinese telecom vendors. Additionally, state-owned banks support the domestic/overseas operations of these telecom equipment companies directly; significant amount of credits are given to these firms in order to fund their operations.

Policy-1.2.: State-owned market is also a strategic policy to fund SOEs in a strategic industry.

State-owned enterprises (SOEs) which operate actively in the industry are also a strategic policy. SOEs in the strategic industries are not privatized and re-organized in order to compete with the multinationals. State-owned telecom operators have been also founded and most of their equipment is supplied by the SOEs and the national companies. China Mobile, which is the biggest mobile telecom operator in the world, is the biggest customer of the Chinese telecom equipment suppliers.

Policy-2: Integration with global economy in order to transfer modern technology via foreign investments.

The initial point of the catch-up period was forming JVs for digital switches. Multinationals were allowed to enter the attractive Chinese market with a prerequisite to establish JVs with national partners. The strategy of "Trading Markets for Technology" (TMFT) promoted joint venture (JV) establishment between foreign firms and state owned enterprises since 1978. In the period of transformation, the main strategy was the know-how transfer from foreign investments, absorbing and assimilation by indigenous local industry and achieving in-house R&D. Technological know-how from multinational investments became an important source for national industry. National firms enhanced their own technology production capacity including reverse engineering, imitation and internal and international R&D activities.

Policy-3: National private companies and capital invest and operate in these strategic industries via encouragement and support of the state.

There are many private telecom equipment companies in China and they operate in telecom equipment industry network. There are official reports of the US and the EU which indicate these firms' strategic relations with the state, the military and also the Communist Party of China. The Party also has committees in all these companies legally, however, the responsibility and the effect on the decisions, the operations, and the strategy of these companies is unanswered by the company officials. The most import one is Huawei which is as a private company however there is also suspicion about its strong relations between state authorities. Huawei is in a fierce competition with ZTE in all fields of telecom equipment industry in both of domestic and export markets; however, China state gains advantage from this competition.

Consequently, there is a clear strategic map of the Chinese state since Deng's economic reform of 1979, as a national policy. After the decision of integration into the global economies, strategically important

industries have been defined; and one of these industries was also telecommunication. Since then, Chinese state has always involved actively in the industry with its related strategies and policies and intervened directly in the market by the national players. As the owner, operator, and regulator of the telecommunication sector, Chinese state manages the industry according to the interests of China.

Table-6 compares general catch-up strategy of China with the strategy of telecom equipment industry after 1978. The reflections of the state policies are seen in telecom equipment industry with industry specific policies.

Table-6: General Catch-up Strategy of China vs. Telecom Equipment Industry Strategy, after 1978

General Catch-up Strategy after 1978	Telecom Equipment Industry Catch-up Strategy
Transformation to open-door and socialist-market economy	Deng reform and integration with global economic system
Determining of strategic industries by State and Communist Party	Telecom industry was determined as a strategic industry in 1980s.
Allowing foreign investments and encouraging JVs with local partners	First foreign joint venture was Shanghai Bell Telephone Equipment Manufacturing Co.
Emerging of national firms and reorganizing strategic SOEs in pre-defined strategic industries	ZTE was founded in 1985 as a SOE, Huawei was founded in 1988 as privately owned national firm
State-led financing for these strategic industries	State-owned Banks; specifically China Development Bank funded the industry
Using the attractiveness and potential of domestic market for JVs and support of national firms	After Bell, other MNCs also invested in China; Cisco, Alcatel, Motorola, Nortel and so on.
Establishing of SASAC and management of SOEs of strategic industries under state control	ZTE as a supplier, telecom operators as demander are managed by SASAC.
Strong relations with state research institutes and strategic firms via national science and technology programs	Datang as a leader of consortium developed TD-SCDMA standard for 3G and gave licenses to ZTE and Huawei

Finally, China defined and implemented state-led catch-up policy which is based on China specific advantageous. China succeeded in converting the disadvantages of the crowded population and the great geographical area to an enormous market which has a significant sales revenue potential for the national telecom equipment vendors. In this success story, setting state policies by the central authority, managing foreign investment opportunities, using the potential of the enormous domestic market and the state-led financing mechanism have become the critically important subjects which are connected to the state policies in a broad sense.

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