The Shifting Role of Taiwanese Enterprises on China's Technological Upgrade

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Abstract

Focusing on mobile-phone industry, this paper examines the shifting roles of Taiwanese enterprises in China and their significant contributions on endogenous industrialization and technological catching-up of Chinese firms. The results show that the original type of cross-Strait division of labor has been transformed. Since 2004, some Taiwanese enterprises have promoted the growth of Mainland's grassroots Copycat phone by offering turn-key IC chipset, training R&D staffs, and bridging cross-Strait supply chain. Moreover, increasing Taiwanese enterprises have been recruited by China's state-owned enterprise (SOE) to assist the take-off of Chinese third-generation (3G) mobile-phone standard since 2009, and which was one of S&T programs supported by the Chinese government. In all, Taiwanese enterprises has begun to function as the important catalyst in China's technological upgrade, rather than simply played as foreign direct investments (FDIs).

Key word：Taiwanese enterprises, Mainland China, Industrialization, Copycat phone, TD-SCDMA

1 Introduction

Since open-market policies undertaken by Mainland government from 1978, the foreign direct investors (FDIs) has poured into China and hence promoting economic growth of China. As the original equipment manufacturer (OEMs), Taiwanese enterprises followed their global flagship contractors to relocate manufacturing factories to China. Particularly for high-tech sector, 80% of Taiwanese enterprises relocated production factories to China since late 1990's (Tung, 2003). The increasing cross-Strait economic integration[1] in high-tech sector represents the classical division of labor within Greater China that Taiwan industry enjoyed China's low-cost labor and remained other high value-added activities, such as R&D and marketing in Taiwan (Naughton, 1997; Kao and Wang, 2008), In short, Taiwan enterprisers merely functioned as foreign investors with limited contribution to technological upgrade.

On the other hand, global economy has been driven by MNCs' power in leading technology or control in market (Gereffi, 1994), and China is also influenced. Take for mobile-phone industry for example, MNCs such as Nokia, Samsung, and Motorola, not only exported 582 million handsets from China to global market in 2009 (MIC, 2010), but also dominated 70% of China domestic market by selling 114 million handsets at the same period (IEK, 2010). Particularly, Nokia and Qualcomm dominated China market with superior R&D capacity, patents, and industrial standard (Nolan, 2008; Wen and Yang, 2010) that caused China's production value and loyalty fee flowed out about 70 billion[2] during 1990-2005 (Yearbook of China

[1] For instance, Taiwan has grown a large trade deficit with China: from 1988 to 2011, the total deficit has accumulated to US$ 556.3 billion. Also, the total Taiwanese investment in China has accumulated to $111.7 billion, comprising of 62.8% of Taiwan's total outwards investment (Mainland Affairs Council, 2012).

[2] All amounts are in U.S. dollar unless otherwise indicated.

Communications, 2005).

However, the original type of cross-Strait economic integration was subjected to the changes of China's growing market and strong state. First of all, due the booming of Mainland's huge market, increasing MNCs regard China as emergent market (Yeung, 2008). Second, Chinese government initiated a 15-year plan, Medium-to-Long Term Science and Technology Development Plan (2006-2020) (hereafter MLP), with high hopes to transform China from "world factory" to "innovative country" (Naughton, 2007) . Thus, there're two emergent and divergent forces driving China's endogenous industrialization to compete against MNCs in mobile-phone industry. First, the grassroots small-and-medium enterprises (SMEs) networked in Shenzhen region to produce Copycat phone. Another is state-led industrial policy that Chinese government. Chinese government not only privileged supported certain state-owned enterprises (SOEs) to created Chinese 3G standard TD-SCDMA (see Appendix 1 for more technological terminology), but also intended to foster local firms towards "indigenous innovation" (Linden, 2004; Naughton, 2007; Liu, 2008).

Based upon above changes in China's mobile-phone industry, this paper examines[3] the transformation of cross-Strait economical integration as well as the impact of Taiwanese enterprises on China's industrial development and/or technological upgrade. The findings confirmed that Taiwanese enterprises had played significant roles beyond traditional FDIs by promoting the growth of China's endogenous industrialization. In Copycat markets, Taiwanese enterprises removed the technological barriers posted by MNCs, support the learning of native SMEs, and

[3] The author conducts several field studies at both Beijing and Taipei sites during 2011-2013. The interviewees include Chinese government officials, personnel of state-owned enterprises, industrial experts, academic professors, and journalists.

bridged the collaboration of cross-Strait firms. Meanwhile in TD-SCDMA markets, Taiwanese enterprises compensated the technological backwardness and diseconomy of TD-SCDMA supply chains, hence accelerated the development of state-led technonational industrial plan. In all, the cross-Strait economic integration has altered in both qualitative and quantitative terms.

2 Open market: China Integration into Global Production Networks (GPNs)

2.1 MNCs: Function as FDIs

Since mid-1970's, China government has adapted "open market" strategy and leverage on foreign direct investors (FDIs) to boost the growth of China's economy. Local governments followed central's strategy with entrepreneurialism; that is, they manage to attract MNCs to invest with preferential packages, aiming to purse regional growth (Duckett, 2000). Regarding the mobile-phone industry, first case was that Beijing government offered land incentives and tax allowance to Nokia to induce later relocating production site into Beijing Xingwang Industrial Park (Liu et al., 2004). Subsequently, Nokia's global suppliers, including Taiwan OEMs, benefit from the collective bargain power and follow leading flagship firms to relocate production activities to China (Yeung et al., 2006) (See below Table 1). Likewise, more MNCs, such as Motorola Siemens, Ericsson and Phillips, entered China market with original supply-chain partners to China. China has integrated into GPNs by offering low-cost of labor and government institutional privileges and became "world factory". As a result, FDIs has boosted the growth of China's economy in term of urbanization in Pearl River Delta (PRD) and Yangtze Pearl River Delta (YRD) regions (Zhao and Zhang, 2007), but dominated the majority high-tech export category (Lemoine and Ü nal-Kesenci, 2004) .

Table 1 Beijing Nokia and supply-chain list

Name of manufactures	Home country/region	Product	Investment (US$ Mn)
Nokia-Capitel Telecommunication	China-Finland Venture	Mobile phone	173.90
RF Micro Device Beijing	USA	Component test and pack	29.99
Foxconn Precision Component Beijing	Taiwan	Motherboard and shell	29.80
Beijing Elcoteq Electronics	Finland	Electronic parts	29.00
Sanyo Beijing	Japan	Battery	24.94
Molex Interconnect Beijing	Singapore	Interconnected parts	3.00
Allogon Telecom Beijing	Sweden	Antennas	2.60

Sources: Liu et al., (2004: 398) ;Yeung et al. , (2006: 531)

The scale of “China factory” and “China market” had grown enormously at the same time. On one hand, MNCs have increased their export of mobile-phone products from China to global market, such as 146 million in 2004 to four time of that in 2009. China is currently the largest mobile phone market in the world. It has over 600 million subscribers in 2008, and has produced approximately 1 billion handsets in 2010, accounting for 71% of the global shipment (RIC, 2011). On the other hand, MNCs started to sell mobile-phone products into local market (See Table 2). The top five MNCs including Nokia, Motorola, and Samsung had dominated China mobile-phone market since 1999 by 90% of market share (Liu, 2008; USITC, 2011). Although the ratio of domination had been declined in early 2000’s due to Chinese state’s regulation as well as the emergence of grassroots Copycat phone (will discuss more later), the quantity remained growing at steady rate. Overall, China’s RMB 500

billion outflow of production value in telecomm-mobile sector implied the approaches of China integrated into globalization that most Chinese firms engaged in low value-added manufacturing without much investment in R&D and innovation (Steinfeld, 2004).

Table 2 China mobile-phone export and import shipment by MNCs, 2004-2009

Unit: million

Shipment/ year	2004	2005	2006	2007	2008	2009
Export	146	228	385	483	532	582
Import*	33	57	89	108	107	114

Sources: IEK(2010: 2-19); MIC (2010)

Note: *only top five MNCs are included

On the other hand, some scholars argue that the fragility of China market is most attributed to the technology dis-asymmetry among the actors dispersed in GPNs. MNCs such Nokia and Qualcomm, created and consolidated their leading positions the GPNs through engaging in high-value-added R&D activities in term of expertise in software design or IC chipset design. Top five manufacturers, such as Ericsson, Nokia, and Alcatel, annually invested US $5 billion on R&D. These market and R&D concentration has constructed the nature barriers for the latecomers to catch up (Nolan, 2008:29-39). Furthermore, MNCs dominated the global market by means of patents and setting global standard, such as GSM and CDMA in 2G era (Hess and Coe, 2006; Wen and Yang, 2010). Last but not least, MNCs focused on brand management or core technology while they outsourced low value-added activities to supply-chain partners (Hess and Coe, 2006).

2.2 China state's experiments: from "trading market for technology" to license

control

Anxious about market dominated by MNCs, Chinese government had undertaken several experimental attempts to regulate mobile market and fostering domestic firms. Along with the opening market to FDIs, state forced MNCs to establish joint-ventures (JVs) with local firms, with the intent of upgrading technology capacity of local firms. The bifurcated method is the well-known "trading market for technology" strategy (Liu et al., 2004), and the final goal is to achieve "import substitution". As mentioned, the JVs case in mobile-phone industry are Motorola allied with Hangzhou Eastcom in 1992; Nokia allied with SOEs Putian Group in 1992; and Siemens, Ericsson and Phillips followed suit to establish several JVs with China partners during 1993-1996 (Xie and White, 2006). However, "trading market for technology" strategy has not worked quite well that MNCs in fact dominated 90% China market until 2003 without any local rivals to compete with (Liu, 2008).

To prevent the market further penetrated by MNCs as well as accession to World Trade Organization (WTO), China government altered to issue "Document No. 5" in 1999. According to the Document, China government attempted to regulate market by controlling the quantity of mobile-phone production licenses granted to MNCs and domestic firms, in addition to forbidding MNCs' export quota lower than 60% of total production (Xie, and White, 2006; Kao and Lee, 2009). It echoes the regulating preferences of central government in maintaining *structured* market competition and privileging *state-chosen* Chinese firms, normally incumbent SOEs (Pearson, 2005).

Table 3 China mobile-phone top five producers , 2004-2009

unit: market share

Rank	2004	2005	2006	2007	2008	2009
1	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia

	20.7%	31.2%	34.3%	36.4%	37.5%	38.4%
2	*Ningbo 20.7%*	Moto 13.3%	Moto 14.0%	Moto 8.1%	Samsung 16.1%	Samsung 22.7%
3	Moto 12.7%	Samsung 9.1%	Samsung 7.4%	Samsung 6.9%	Moto 7.9%	Moto 7.5%
4	Samsung 10.9%	*Ningbo 8.2%*	Sony Eric 5.9%	*Tianyu* 6.9%	*Tianyu* 7.9%	*Tianyu* 7.5%
5	Others, 35%	Others, 38.2%	Others, 38.4%	Others, 41.7%	Others, 30%	Others, 23.9%

Source: IEK (2010: 2-18)

Under new measurements, the local mobile-phone makers began to emerge from scratch, such as Ningbo Bird, Legend TCL, Haier, South High-tech, and so forth. The number of local firms soar dramatically to 37 by 2004, compared of 5 by 1997 (Jin and von Zedtwitz, 2008). In 2004, the market share of Ningbo Bird reached peak at 20.7% and became the rival of Nokia (see Table 3). These Chinese mobile makers succeeded in market by offering entry-level, namely cheaper but inferior, products to compete with MNCs. They facilitated their knowledge in local market and access to Taiwanese and Korean components clustering in PRD and YRD and outsourcing assembly to them (Xie and White, 2006). But the advantages of locality and cheap products strategy had not sustained long. Later in 2005, the market share of Ningbo Bird dropped to 8.2% only.

Overall, the license controlling strategy had not sustained long and been abolished in 2007. Also, most domestic phone makers remained little investment on R&D. Instead, they engaged in low value-added assembly activities, some even outsourced the whole production activities to Taiwanese or Korean OEMs, in the name of “renting” the privileged licenses to new-entrant FDIs (Cheung, 2005; Hu and Hsu, 2007). When MNCs learned to launch low-end products as local firms did, they

soon continued to lead the China again (Ni and Wan, 2008).

2.3 Role of Taiwanese enterprises and their impact

Back to 1980's, the low-end manufacturing activates outsourced from MNCs were originally offered to East Asian (EA) countries, such as Taiwan and South Korea. It had laid the foundation for EA latecomers to catching-up through accumulating production knowledge (Gereff, 1999). Hereafters, Taiwanese OEMs not only had formed production networks in a vertical integration shape to cope with changing demand from US and European market (Hamilton, 1997), but also clustering in Hsin-Chiu industrial regions that they could collaborate to design their parts and products as a whole, and later upgraded as ODMs (Original design manufacturers) (Hobday, 1995).

The rise of China prompted the separation of R&D and production activities into two geographical spaces. Again, following MNCs, 80% of Taiwanese ICT firms has relocated their production site to China (Tung, 2003), but R&D activities (Kao and Wang, 2008) remained in Taiwan headquarters. As a result, the relative position of Taiwanese firms in GPNs had shifted up to the middle one that Taiwanese firms has mediated the market demands from US as well as assembled and exported the final products from China. Such triangular trade seemingly complicated the increasing trade deficient among US and Greater China countries (Naughton, 1997), but in fact Taiwanese enterprise followed flagship MNCs to invest China by simply utilizing local cheap labor force and land.

Under these circumstances, the cross-Strait economic integration is simply the division of labor that neither Taiwan-China firms collaborated to form vertical supply

chain nor to promote any bilateral knowledge flow. It's because the whole Taiwanese OEMs/ODMs network, from upstream component suppliers to downstream assembler, had de-embeded in Taiwan in geography term alone, but re-embed in China with original social network intact (Yang and Hsia, 2007). The separation of FDIs' global production network and Chinese enterprises, either SOEs or private firms, coined the dualism of China industry policy. Thus, China local firms had not interacted with Taiwanese enterprises nor benefited from knowledge spillovers effects (Wang, 2006). In short, Taiwanese enterprises had not contributed to technological upgrade of Mainland's industries, nor transformed local regions from FDI-oriented toward indigenous development. Even for the disputable and high-profile cross-Strait JVs cases in semiconductor industry, such as SMIC and Grace Semiconductor (Naughton, 2003), there has no indication of Taiwanese enterprise had exercised further influence on China's technological upgrade more than training human capital by employing Chinese engineers (Fuller, 2008).

Even after the issuing of Document No 5, the role of Taiwanese enterprise had not fundamentally transformed, only some of them start to OEMs for Chinese local makers, such as Legend (Zhou, 2008). Again, OEMs of Taiwanese firms only involved expansion of production capacity without flow of tacit knowledge among outsourcer and producers (Sturgeon, 2002) [4]. Second, Korean and Taiwanese OEMs (such as BenQ and HTC) had lower bargain power than flagship Nokia or Motorola, and once were dis-approval from China production licenses (Fuller, 2008). In turn, they're forced to "rent" the limited production licenses from the state-chosen makers (Kao and Lee, 2009). It indicates that China government has not included Taiwanese

[4] According to the theory of "modular production network", Taiwanese turn-key suppliers, such as Foxcoon, Quanta, Compal, etc. are competitive due to the capacity of coordinating Taiwanese components makers and extension service of global logistics provided to leading MNCs; however, there's no tacit knowledge flow between two parties.

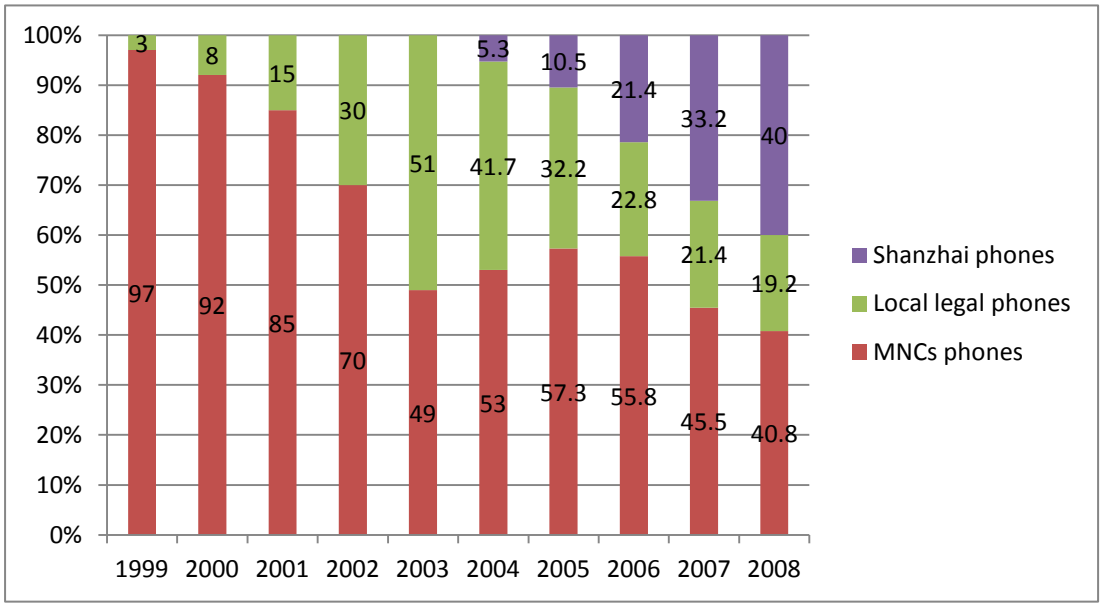
enterprises into her national S&T roadmap (Fuller, 2008). In short, Taiwanese enterprises had been driven by leading MNCs to relocating low-end production activities to China and subsequently upgraded to be ODMs by sustaining R&D in Taiwan. This commenced the classical type of cross-Strait economic integration.

3 Booming of Copycat phone

3.1 Rise of the low-end market and alternative innovation

As stated, there're some changes in China market, most one is the boom of domestic market that drives FDIs to design localized products (Yueng, 2008). Indeed, the growing market of China would shape new developmental patterns (Naughton, 1997). Recent cases in China' automotive and machine tool sector also demonstrate the size of China's huge market matters that it laid the foundation for native firms to experiment the customized products in order to satisfy local needs, and subsequently upgrade their technology in the process. Thus, Chinese firms moved from low-end to middle-end segments of the market, meanwhile MNCs shirked to keep high-end one alone (Brandt and Thun, 2010). This argument still holds valid in grassroots copycat phone this author surveyed, but there're some divergences in term of industrial structure and government policy. First, Chinese local firms, composed of small-and-medium private (*minying)* enterprises, experiment to offer customized products regardless of state regulation in licensing control, etc. Moreover, these underground firms not only offer cheap mobile-phone products by copying the new features developed by MNCs, they additionally customize a variety of special features of their own, and combined altogether to become "alternative innovative" phones.

As for government policy, the institutional and cultural background of Shenzhen region gave the birth of grey market. The Copycat phones or Shanzhai [5] phones makers reduced cost in taxes and related kinds by illegal evading license control from Beijing central (Kao and Lee, 2009); also, they took advantages of the rigid policy that Ministry of Industry and Information Technology (MIIT) required legitimate makers to wait for at least six months of inspection quality before launching every new product to the market (Author's interview). Moreover, Chinese private-owned SMEs choose to create Shanzhai phones in order to bypass the expensive loyally fee charged by MNCs (Author's interview). In short, Shanzhai not only implies illegal imitating in international patent law, but also denotes the local and sub-culture defiance against central authority that weak SMEs grew in an informal way (Keane and Zhao, 2012).



Sources：Chen (2009)

Figure 1：The market share of Chinese mobile-phone market, 1999-2008

[5] Originally, Shanzhai (in Cantonese dialect) means family-based factories.

With the advantages in all terms, industrialization of Shanzhai phone has taken off since 2004, and gradually won the lion's share of domestic market and even prevailed the state-supported firms in 2008, despite that both foreign and Chinese legitimate phone maker also offered low-end products (see Figure 1). In 2008, the Shanzhai markers became the *de facto* rival of MNCs that the market share of both equals to 40%. According to iSuppli's survey (2009, 2011), the shipment of Shanzhai phones had soared from 37 to 228 million during 2005-2010. When MNCs and local legitimate markers are fighting in low-end segment market, Shanzhai makers also join to share the rise of the huge low-end market.

3.2 Cross-Strait vertical collaboration

Again, the rise of huge market offered the window of opportunities for native entrepreneurs to experiment diversified products. This is the case of Shanzhai phones that increasingly entrepreneurs entered the market and experimented on offering a variety of copying products with the additionally customized features such as extra-louder speaker, ultra-large screen, higher-definition camera, longer duration of battery, housing etc. These *improved products* require the collaboration among local firms as well as with Taiwanese suppliers who compensated to offer high-end components. In short, the value chain of Shanzhai phones is different from MNC-driven type (see below Figure 2). First, Chinese local distributors requested local independent design houses (IDHs) the special specification in small quantity, usual only a few thousand units. Upon Taiwanese MediaTek all-in-one chipset, IDHs designed the requested features by recoding associated software into motherboard and testing the compatibility of whole system with new customized components. On the

other hand, the local component manufacturer molded and produced customized speaker, screen, camera, battery, or housing in small lots as customers (distributors or IDHs) requested. Finally, the local assembler put all the components altogether.

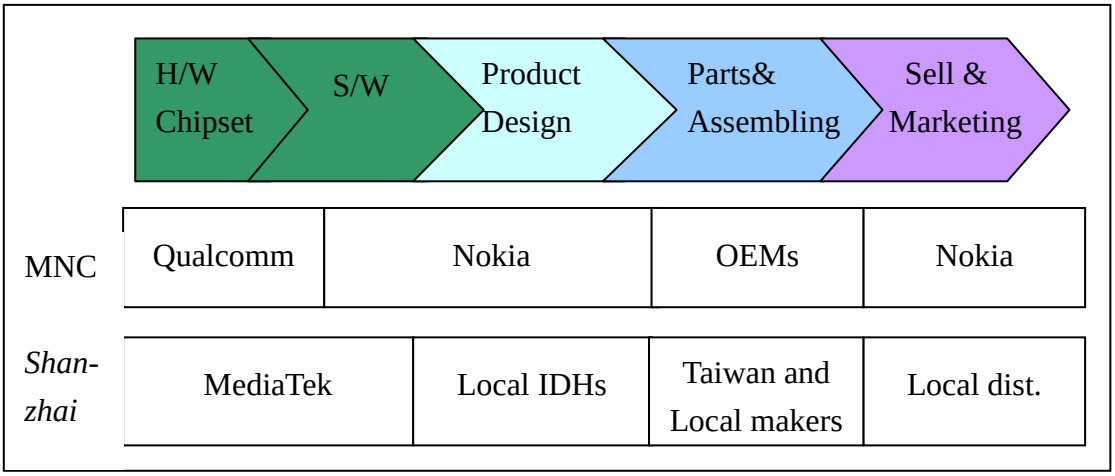


Figure 2: Value chains of two divergent ways mobile phones

Therefore, unlike MNCs internally integrated the whole activities—from product design to sell and marketing, the governance of Shanzhai supply chain is further dis-integrated and composed of a group of SMEs. Yet, it took shorter time and lower cost in developing new products in Shanzhai approaches (Marukawa, 2009; Kao and Lee, 2009), given the higher R&D efforts were completed by Taiwanese IC designer. For instance, IDHs can fulfill the a new mobile phone design in five weeks (Chiang, 2008) and ID component provider can mold a new housing in three weeks, (Chiang, 2010). Altogether, The customization and speed are the source of profits and competitive advantage of the Shanzhai makers. For instance, the biggest Shanzhai distributor Tianyu developed more than 80 models of Shanzhai phones in 2007, compared to 30 models mass produced by Nokia (Ding and Shen, 2009)。

Similarly to Taiwan Hsin-Chiu industrial regions as mentioned, Shanzhai makers clustered in Southern Shenzhen region with approximately two thousands of IDHs and distributors in Huaqiangbei electronic street as well as hundred thousands of

customized component manufacturers and assemblers distanced within 10 kilometers of Huaqiangbei's hinterland. Local Shanzhai SMEs began to contribute the endogenous growth of Shenzhen region step by step. According to optimist statistics by Shenzhen municipal officials, total labor force dedicated in Shanzhai market is around five millions, including majorly four millions in parts and assembly (Chiang, 2010). In 2008, the estimated production value of Shanzhai phones is RMB 20 billion, and which equals to 10% of MNCs-driven production value in Shenzhen region (Nfmedia, 2010). In all, the mobile phone industry in Shenzhen region is mixed of both FDIs investment and emergently endogenous growth.

3.3 Role of Taiwanese enterprises and their impact

Again, these Shanzhai makers explored and exploited the low-end segment of huge Chinese market, but the core technology such as chipset design, software design as well as high-end components (such as TFT-LCD panels) were complementarily offered by Taiwanese enterprises. The role of Taiwanese enterprises could be summarized as three kinds. First of all, Taiwanese MediaTek created all-in-one IC chipset to combine the hardware and most software in one single system-on-chip (SoC), and played as fast-followers of Silicon Valley (Ernst, 2005). The innovation not only resolved the issues of native SMEs lacking the capacity and R&D resources to engage in high-end R&D, but also remove the entry barriers of mobile-phone industry naturally posted by MNCs (Marukawa, 2009;Kao and Lee, 2009). With MediaTek's innovation, Chinese IDHs can further to design customized Shanzhai mobile phone with less R&D efforts[6], hence led to faster time-to-market and cash

[6] MediaTek is responsible for offering all-in-one chipset with the catalogue of recommended for lists generic components; meanwhile, the downstream China customers simply select the functions from the catalogue offered by MediaTek, procurement and assembly the components. IDHs, as the intermediary between Taiwan and Chinese networks, furthered to customize software design and/or housing design.

flow (Author's interview). It eventrually leads to a network effects (Ding and Pan, 2011) that MediaTek ranked top first Shanzhai chipset provider (Marukawa, 2010). In short, Shanzhai phone industry could not be boosted without MediaTek (Author's interview).

Second, the Shanzhai makers had undertaken a learning process to keep them competitive, with the supports from Taiwanese chipset provider. During 1990s', US chipset giant Intel transferred technology to Taiwan PC industry by sending engineers to help and support Taiwanese production lines. It prompted the Taiwanese OEMs keep up with Intel's cutting-edge technology in global market. Gradually, the design capacity of Taiwanese PC firms was upgraded as ODMs that they can independently propose the final product design to wholesale customers like Dell as well as feedback the bugs of chipset to Intel (Kawakami, 2010: 26-28). Meanwhile, the turn-key suppliers and upstream components suppliers keep close relationship and they collaborate to create and improve products, following every renewal version of Wintel platform. This is the gradual path that Taiwanese ODMs choose to upgrade their technology, given subordinated to Wintel standard. Similarly, Taiwanese MediaTek transferred technology to Chinese Shanzhai maker by sending engineers to help and support their R&D and production lines, especially when MediaTek introduced every new platform to the market. The CEO of Taiyu once confirmed, "MediaTek is the R&D coach of the Chinese firm, MediaTek helped to establish our pilot-run and R&D team, and which laid the foundation of Taiyu to become biggest Shanzhai distributor (Chiu, 2010)." In the long run, the products launched by key Shanzhai makers, including Taiyu, had accumulated the capacity so the product they created with lesser and lesser clues of imitation (Author's interview).

Lastly, although Chinese native firms have the capacity to manufacture and

design customized Copycat phones by improving on low-end components (MIC, 2004), the high-end components, such as small-size TFT-LCD, PCBs, LED etc., were complementarily provided by Taiwanese enterprises (Chiang, 2008). Both parties were primarily introduced that MediaTek for most Chinese firms are SMEs and lack of economic scale. In short, MediaTek has functioned as structural hole to bridge Chinese firms and Taiwanese suppliers (Author's interview). The mutual-beneficiary act not only solved the issue of components procurement, but also bridged the cross-Strait production networks for the very first time as well as commenced increasing inter-firm cooperation. In the case Shanzhai phone, Taiwanese firms not only prompted the growth of bottom-up endogenous industrialization, but also nurtured technological upgrade of *minying* SMEs enterprises that were inaccessible to central state resources.

4 State-led TD-SCDMA Industrial Policy

4.1 Creation of Chinese standard and mega S&T plan

China economy is characterized by co-existing of divergent developmental models in different regions coupling with localized intuitions and history. For instance, the economy in Southern Guangzhou is mainly composed of FDIs and private-sector enterprises, under the lassie-free style of local government; meanwhile the economy in Shanghai centers more on large SOEs group with intervention from both central and local governments. The fragmentation of industrial and regional developments occurred not only in automobile industry (Thun, 2006) or high-tech industry (Segal, 2003; Breznitz, D. and Murphree, 2011). Such fragmentation also emerged in the mobile-phone industry that Shanzhai phone burgeoned and matured in Southern Shenzhen region as per stated; meanwhile, Beijing central government re-intervened

the market by formulating of mega S&T plan, in order to encourage support large-scale SOEs to conduct R&D and create Chinese mobile standard.

First, Chinese-proprietary standard in third generation (3G) of mobile communication, that is TD-SCDMA[7], was created in 2000 under the circumstances that Chinese government aggressively participated in global economy and curtained new round of international technological competition (Suttmeier and Yao, 2004; Kennedy, 2006). In 2006, the Chinese government furthered to initiate long-term S&T plan called MLP, aiming to promote China firms engage "indigenous innovation". Along with TD-SCDMA becoming one of 16 mega projects of MLP, China intended to transform her global economy presence from market taker to market maker (Linden, 2004; Naughton, 2007; Liu, 2008) and to leapfrog Chinese firms from engaging OEMs to the front-end R&D (Ernst and Naughton, 2008).

However, the global and domestic factors made TD-SCDMA fail to achieve above targets in preliminary stage of MLP. Again, the leading MNCs and their global supply chain followers had invested tremendous R&D efforts on mainstream WCDMA standard so that associated mobile products had already been maturely commercialized for years (Fan, 2006)[8]. In other words, MNCs, such as Qaulcomm and Nokia, dominated majority of key patents of telecommunication technology (Wen and Yang, 2010). Apart from entry barriers, Chinese state chose SOEs-centered

[7] In 1998, a task force led by Chinese Academy of Telecommunications Technology (CATT), the research unit under previously Ministry of Posts and Telecommunications (MPT), who cooperated with Siemens to develop TD-SCDMA and submitted to the International Telecommunications Union (ITU). In 2000, TD-SCDMA was approved by the Institute of Electrical and Electronic Engineers (IEEE) as one of the 3G mobile communications standards worldwide, in addition to WCDMA and CDMA 2000 (Fan, 2006; Suttmeier et al., 2006).

[8] By comparison, WCDMA has 27 companies as its main supporters, which includes Japan's NTT, European Ericsson and Nokia; while CDMA 2000 has most of its supporters in North America and Korea, such as Qualcomm, Motorola, and Samsung. These global firms have invested US$40 billion and US$10 billion on R&D to support WCDMA and CDMA 2000, respectively. Moreover, there were over 50,000 and 10,000 worldwide R&D staff for WCDMA and CDMA 2000 systems.

strategy that most financial resources were allocated to few SOEs and closed-ties firms. The captive TD-SCDMA supply chain indicated the strong protectionism, in turn hardly had MNCs and Chinese private enterprises engaged in R&D TD-SCDMA. As a result, the small scale of TD-SCDMA supply chain, composed of a few Chinese firms, led to problematic commercialization (Kennedy et al., 2008). Moreover, the immature commercialization developed by native local firms stroke another setback of "national industrialization "until further adaptation by Chinese government.

4.2 Further administrative intervention

Since 2000's, central government intended to replace the engine of economy growth from export-oriented investment capitalized by FDIs, to fixed investment (in term of public infrastructure) initiated by SOEs (IMF, 2012). The domestic investment-led developmental strategy was *strengthened* in 2008 when global financial crisis severely shrank Chinas' export. In order to maintain steady GDP growth, China government proposed "expand domestic demand" project and prepared to finance RMB $ 4 trillion (approximately US $70 billion) to stimulate GDP growth (Zhang, 2009). Accordingly, MIIT proposed to center on ICT sector and enlarged investment on 3G. They estimated if all state-owned telecom carriers invest RMB $280 billion for building 3G infrastructures, including RMB $150 billion in TD-SCDMA, then it will boost 1% of GDP growth (TDIA, 2010:54).

Under these circumstances, MIIT chose world's biggest telecom-operator[9], China Mobile, as the conduit of implementing TD-SCDMA industrial policy and commanded the firm to finish uncompleted tasks: expand the scale of TD-SCDMA network contraction and initiate the procurement of TD-SCDMA handsets. It suggests

[9] By the end of 2008, China Mobile has 500 million subscribers.

that state picked incumbent national champion to foster weak manufacturing firms (Tsai and Wang, 2011) and force the former to support the latter at the firm's own expense. For TD-SCDMA network construction, China Mobile had invested RMB$168 billion to build nationwide 227,000 base stations across 600 cities by the end of year 2011. Along with the enact of "Indigenous Innovation Products for Public Procurement Law"[10], four major domestic manufacturers, Huawei, ZTE as well as SOEs Datang and Putian Group, won 90% of market share.

On the other hand, China Mobile confronted great difficulties in completing the second tasks in promoting TD-SCDMA mobile-phone industrialization since it is the weakest part of TD-SCDMA development, particularly the shortage of high-end IC chipset. Thus, China government decided to open TD-SCDMA handset market to encourage multiply international firms and embracing Taiwanese enterprises invest R&D on this regards, in order to improve the previously locked-in situation (Author Interview). Moreover, China Mobile offer carrots and/or stick to induce and threat/or their current (such as Nokia) and potential suppliers (such as HTC), to promptly develop handsets compatible for TD-SCDMA standard (Tsai and Wang, 2011). But due to international technology contest (Kennedy, 2006), MNCs were either reluctant to develop TD-SCDMA products, nor conservative to develop one or two products with reservations (Author's interview). Without any interests conflict, Taiwanese enterprises have become the most backbone contributor as well as the beneficiaries of international standard war. Hence, the economic integration across the Taiwan Straits had expanded in both qualitative and quantitative way (Tsai, 2013)[11]. Taiwanese

[10] Since accessed to World Trade Organization (WTO) since 2001, China government can no longer explicitly protect domestic firms through public procurement. Therefore, central enacted alternative "Indigenous Innovation Products for Public Procurement Law" that it requires central and local governments purchase "domestic innovative products" as first priority and the amount of which is no less than 60% of total public procurement (Liang, 2009; Liu and Cheng, 2011).

[11] However, the possible downside is that Taiwanese enterprise help Chinese firms learning so as to

enterprises were granted by Chinese government to participate China's technological S&T program rather than previously excluded from, given the urgency of China side to complete the industrial goal of "import substitutions".

4.3 Role of Taiwanese enterprises and their impact

Foremost, China Mobile has approached Taiwanese vendors and encouraged them to be a member of TD-SCDMA alliance since early 2009. As the President of China Mobile, Mr. Wang Jianzhou, once claimed the purpose of his visiting Taiwan is to " leverage on thirty-year experience of Taiwanese enterprises in high-tech industry and accelerate the development of TD-SCDMA" (Ma, 2009). In short, China intended to leverage on Taiwanese industry advantages and experience in global market in order to accelerate the TD-SCDMA industrialization (Author's interview) , in order to compete with alliance of WCDMA or CDMA 2000 standard dominated by MNCs.

First, China Mobile approached MediaTek to solve the shortage of mature IC chipset for Chinese standard. Although MediaTek and China Mobile had never officially cooperated before, China Mobile in fact has profited from the wide-spread of Shanzhai phones that the majority of subscribers came from rural areas, and these low-income users purchased Shanzhai phones. Therefore, China Mobile sought the technology capacity of MediaTek and hoped for another success in TD-SCDMA market (Author's interview). Similarly, the China Mobile was not satisfied with the quality of handsets developed by local firms and requested Taiwan HTC[12] to R&D high-end smartphone for TD-SCDMA. Again, HTC was restricted from selling into China's domestic market under Document No. 5 regulation, but now HTC and MediaTek can *legally* enter Chinese market for cooperating on TD-SCDMA project.

upgrade technology. See Tsai (2013) for more discussions.

[12] HTC ranked as the number nine of global handset provider in 2009 (IDATE, 2010).

Third, Taiwan OEMs/ODMs and component suppliers are the major supporters for TD-SCMDA industrialization. According to China's official statistics, major category of imports in ICT sector is electronic components, including ICs, TFT-LCD, PCBs, and other key components for mobile handsets. Among top 10 import country/region, Taiwan is the number one region in 2011 at amount of US 74 billion, and which grew 41% of previous year (see below Figure 3) (Yearbook of China Information Industry, 2012: 271).

Due to expansion in 3G investment, China also increasingly outsourced mobile-related components to Taiwan, and reaches US 5 billion in 2011 (Huang, 2012), in comparison to US 74 billion in whole ICT sector. Among US 5 billion, Huawei is the major buyer that the single firm alone procured US 4 billion from 100 Taiwanese suppliers, and which was almost four times of 2008 (see Figure 4). With supports from government and Taiwanese suppliers, Huawei defeated Nokia-Siemens and ranked No.4 of global telecom-equipment provider next to Cisco, Ericsson, and Alcatel-Lucent by 2009 (IDATE, 2010).

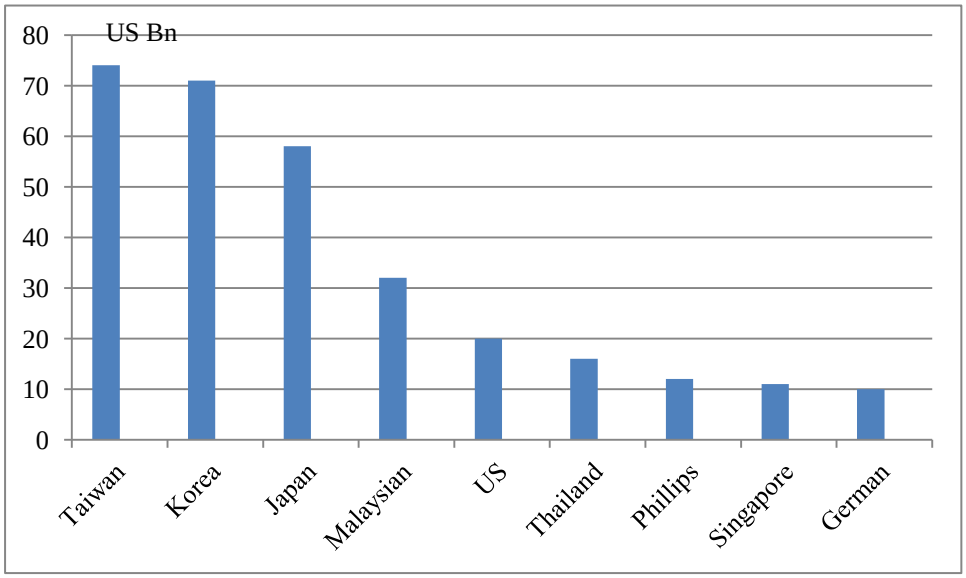


Figure 3 Top 9 Import Country/Region of China's ICT products, 2011
Sources: Year book of China information industry (2012)

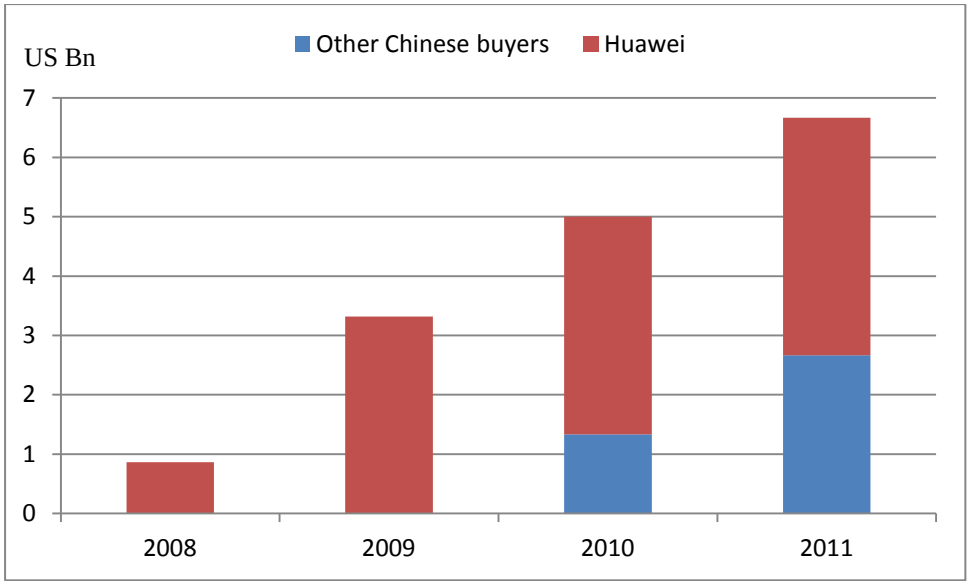


Figure 4 Taiwan's export to China in mobile-related products, 2008-2011

Overall, without much participation from MNCs, Taiwanese enterprises boosted the take-off of TD-SCDMA handset market. First, with the MediaTek's IC chipset as the foundation, HTC and Samsung offered high-end smartphone; meanwhile four domestic manufacturers, such as ZTE, Huawei, and Lenovo, started to produce low-end handsets with significant subsidies offered by China Mobile (Chu, 2011) [13]. TD-SCDMA has not become the mainstream technology in China' mobile domestic market; however, the TD-SCDMA handset significantly grew to 35 million units by August, 2012 and four domestic manufacturers gradually dominated 84% of TD-SCDMA handset market (Li, 2012), rather than 45% back in 2010 (see Table 4).

Table 4 The Market Share of China's Top Ten Handset Provider (3G), 2010

Rank	TD-SCDMA		WCDMA		Overall	
	Company	%	Company	%	Company	%
1	Samsung	21.5	Nokia	49.4	Nokia	33.5
2	HTC	16.4	Samsung	15.9	Samsung	23.7

[13] China Mobile offer RMB 12 billion for year 2010 and RMB 17.5 billion for year 2011.

3	**Coolpad**	13.7	Apple	7.5	**Coolpad**	8.3
4	**ZTE**	11.5	Sony	6.6	Sony	5.4
5	LG	8.9	Motorola	5.3	**Huawei**	5.3
6	**Huawei**	7.9	LG	3.0	LG	5.1
7	Nokia	5.5	**Huawei**	2.7	Motorola	4.6
8	**Lenovo**	4.0	**ZTE**	2.3	Apple	3.2
9	Motorola	2.6	HTC	1.8	**ZTE**	2.6
10	**K-Touch**	1.7	Others	5.5	Others	8.3

Source: IIMedia (2011)

Note: Data of CDMA 2000 not listed, and Chinese makers are in **bold** font

5 Conclusions and Discussions

Driven by MNCs competition in global market, most Taiwan ICT enterprises had relocated low-end production activities to since late 1990s', but remained high value-added activities, such as R&D and marketing in home headquarters (Naughton, 1997; Kao and Wang, 2008). Despite the economic integration between Taiwan and China has been preliminarily structured, there's limited knowledge spillover effects (Fuller, 2008) since Taiwanese enterprises had not recruited Chinese local firms into their supply chain networks (Yang and Hsia, 2007), hence promoting none of bilateral knowledge interaction (Wang, 2006).

Nevertheless, along with the dynamics of China market and state, this paper found out that there're dramatic changes between Taiwan and China mobile industry and transformed the cross-Strait economic integration to a different level, but varying in Shanzhai and TD-SCDMA markets and responded to varieties of Chinese developmental paths. First, Along with the boom of Chinese market composed of large-scale low-income population, the entry-level Shanzhai phone with localized innovation prevailed and in which Taiwanese enterprises have integrated into China market which initiated by local distributors. It indicates that Taiwanese enterprises no

longer played as FDIs that simply relocated factories to China; instead, Taiwanese enterprises started to function as an upgrade promoter for these *minying* SMEs and a catalyst boosting bottom-up industrialization.

In details, the Taiwanese high-tech enterprises and Chinese indigenous SMEs *voluntarily* cooperate to seize the window of opportunities and organize the very first Chinese-led production network. On one hand, Taiwanese chipset and high-end component suppliers play the leading roles in technology; meanwhile, Chinese enterprises play significant roles in identifying local market demands, designing modified products, and producing customized products. Foremost, the chipset platform created by MediaTek not only dominates the Chinese mobile-phone market, this firm also nurtures downstream Chinese customers and inherently upgrades their technology from scratch. Despite that the technological capacity of these Chinese SMEs is limited for improving imitation products, yet it indicates the preliminary bilateral knowledge interaction with to some degree.

Shanzhai *market* attracted thousands of Chinese start-ups and millions workers participating to produce 200 million handsets per year; by contrast, TD-SCDMA is the product of *state-led program* that primarily planed to foster a few SOEs and closed-ties enterprises, but led to immaturity in technology and diseconomy in supply chain until 2008. Moreover, the impact of successful Shanzhai developmental model is so phenomenal that it enhanced another of cross-Strait inter-firm cooperation, but with political mission involved as well as adaptation of Beijing's industrial policy towards Taiwanese enterprises. As a conduit of executing policy, Chinese Mobile solicited Taiwanese high-tech enterprises in order to accelerate the development of TD-SCDMA and eventually prevailing MNCs at domestic market. On the other hand, Taiwanese enterprises can *officially* cooperate with state-privileged SOEs and

closed-tie firms, such as China Mobile, Huawei, and so on, for the very first time.

Therefore, the transformation of cross-Strait economic integration has been furthered in a complicated way that it appears Taiwan industry has became beneficiaries for building relationship with key Chinese enterprises who received state's capitalized resources. However, China government furthered to enlarge the plan of Chinese 4G standard with greater hope of technological leapfrog and "Going global". This author predicts two scenarios of cross-Strait industry cooperation for coming future. The optimistic scenario is that Chinese firms remained deficient in R&D and supply chain, then cross-Straits economic integration remained more of *cooperative* relationship than competitive one. The pessimistic scenario is that China industry upgrade in a leapfrog approach and can more or less compete with MNCs. In this case, Taiwan industry was not only subordinated to the technological standard and associated global production networks led by MNCs, but also subordinated to those led by Chinese firms. Then, cross-Straits economic integration relationship would be composed more of *competitive* than cooperative. Either way, the dynamic of China market and state's industrial policies had drove the transformation of cross-Straits industry cooperation that Taiwan industry no longer was solely driven by MNCs' power in technology and market.

Appendix 1 Global mobile standard and terminology

Standard	Terminology	China's role
1G (1st Generation)		
TACS	Total Access Communication system	Adopter
2G (2nd Generation)		
CDMA	Code Division Multiply Access	Adopter
GSM	Global System for Mobile communication	Adopter
SCDMA	Synchronous CDMA	Creator
3G (3rd Generation): divide into 2 main types by the way of transmit data		
1. FDD	*Frequency Division Duplex*	
WCDMA	Wideband Code Division Multiply Access	Adopter
CDMA 2000	Upgrade version of CDMA	Adopter
2. TDD	*Time Division Duplex*	
TD-SCDMA	Time Division-Synchronous Code Division Multiply Access	Creator, combined from SCDMA and TDD etc.
4G (4th Generation): convergence and centering on LTE standard, but China still created the improved version with TDD technology		
1. LTE-*FDD*	Long Term Evolution, *FDD type*	Adopter
2. LTE-*TDD*	Long Term Evolution, *TDD type*	Creator
3. WiMAX	Worldwide Interoperability for Microwave Access	Adopter

Sources: author's compile

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