6 Taiwan and China in a global value chain: the case of the electronics industry

***Chun-yi Lee*[1]**

This chapter aims to examine how Taiwan impacted upon China through the technology flow from Taiwan to China, and how Taiwan played a part in linking China's manufacturing with the United States. Theoretically this chapter challenges the Global Value Chain (GVC) theory in that it overlooks the possibility that first-league countries may not be willing to share all the knowledge insights. This chapter also investigates the role of Taiwan in the GVC ladder. In the high-tech industry - for instance, the semiconductor industry - the reason for developed countries to preserve more is directly linked to security or political considerations. On this note, this chapter links Taiwan to China, and explains the past changes of Taiwanese investment in China, especially in the IT/electronic industries. The structure of this chapter is as follows: the first part is the definition of GVC theory, whilst the second part explains the importance of IT/electronic industry, and the implication of IT industry in relation to national security. The third part focuses on the importance of the IT industry in Taiwan and provides a brief history of Taiwanese investment in China. The fourth part is composed of three sections, USA-Taiwan technology connections, Taiwan-China technology connections, and finally USA-Taiwan-China connections. The fifth part explores the impacts of Taiwanese manufacturers in China on the Chinese IT/electronic industry, using Foxconn as a case study, and, finally, I conclude that Taiwanese IT/electronic industries will have to face fierce competition with domestic Chinese entrepreneurs.

Global Value Chain Theory

From the Global Value Chain's (GVC) perspective: on the positive side, Bernard *et al* indicated that in the developed countries, such as the United States, firms tend to be larger,

earn higher profits, spend more resources on Research and Development (R&D), and pay higher wages.[2] For developing countries, the trade, investment, and knowledge flows that underpin GVCs can provide mechanisms for rapid learning, innovation and industrial upgrading[3]. GVCs can provide better access to information, open up new markets and create new opportunities for fast technological learning and skill acquisition. Sturgeon and Memedovic argue that because GVC-linked transactions and investments typically come with quality control systems and prevailing global business standards that exceed those in developing countries, suppliers and individuals in developing countries can be 'pushed' to acquire new competences and skills through their participation in GVCs.[4] Sturgeon and Memedovic also describe the negative aspects of GVCs; for instance for developed countries, GVCs perhaps will not guarantee the creation of vast job opportunities because innovation and new industry creation no longer comes along with large-scale domestic employment.[5] For developing countries, they also state that GVC provides a 'compressed' development which can create a series of policy challenges to host countries and force the host country to cope with a wide range of issues at the same time,[6] for instance, uneven social development and limits of knowledge transferring from developed countries to developing ones.

The development of the electronic industry has been characterized by rapid upgrading from low-cost consumer goods to higher-technology items. Information technology (IT) is the key to the manufacturing of personal computers (PC), cell phones, handheld computers and consumer electronics such as game consoles. There is also a shift of the electronic industry's key sector, chip making, to China. The characteristic of Taiwan in the information industry is its local industrial clustering, which is the main reason for Taiwan's success in the supply chain.[7] The importance of industrial clustering means once the Taiwanese manufacturers receive an order from the brand companies, all the collaborative factories are

reachable within short distances, thus the fulfilling of finishing of the brand companies' orders can be achieved within the shortest timeframe and also with good quality control. The success of IT/electronic products lies in efficiency. For instance, new generations of mobile phones are launched almost every half year, and therefore, the capacity to keep pace is the strong suit of Taiwanese IT manufacturers. It is the main reason that Taiwanese IT manufactures can produce the key components in the global value chain. The following section explains the strategic significance of the IT/electronic industry and asks how the IT/electronic industry links Taiwan and China's industrial development.

The Importance of the IT/ Electronic industry

Taiwan has long viewed her technology sector as a 'national champion' and therefore sharing it with mainland China is a matter of national security. The reason that the IT sector has far more strategic importance than other sectors is because modern IT affects all sectors of an economy by providing both forward and backward linkage.[8] As Wang argues[9], the development of the IT industry of a country is not a purely economic matter; it has more to do with political implications. Furthermore, in Chu's research, IT industry especially in terms of the semiconductor industry has not only political but also security concerns; and it relates to not only the cross-Strait relationship but also to the China-Taiwan-United States triangular relationship.[10] The reason for this is that the broad usage of semiconductor industry, the chip making, applies to almost all civil and military high-tech equipment, consumer data processing, communication, automotive, industrial, medical, military, and aerospace. It is important to understand the triangular link among China/Taiwan/US not only from its conventional security perspective, but also from the perspective of knowledge transfer. I shall explain in the fourth section of this chapter the link between the USA and Taiwan, following Taiwan and China, and in the recent development, an emerging possible link between USA

and China directly. In this section, firstly I shall explain the significance of the IT industry in Taiwan; secondly I shall illustrate the link between Taiwan and China in this field.

The significance of the IT industry can be understood not only from political/security perspective, but also from an economic perspective. The electronic hardware industry is arguably the world's most important goods-producing sector. Not only does it employ more workers and generate greater revenue than any other manufacturing sector, its products also facilitate productivity in other sectors and stimulate innovation across entire economies.[11] As Sturgeon and Kawakami pointed out, '[i]n the past two decades, East Asia in general and China in particular, have become increasingly important in electronics as well as other industries, both as production location and final markets. This is also reflected in the flow of intermediate goods. Latest available figures show 'Greater China' account for 35.5% of world intermediate electronic exports, up from 6.2% in 1991. Exports of electronics intermediates from Mainland China have grown greatly, from less than one percent of world total in 1991 to 15%in 2008. Much of this growth has come at the expense of the USA, Japan, and the UK, which ranked Numbers 1,2, and 4 in the world in 1991; and Numbers 5,4, and 14 in 2008.'[12]

Since the 1990s Taiwan has aimed to transform itself from a reliable OEM (Original Equipment Manufacturer) to ODM (Original Design Manufacturer). This means that Taiwanese high-tech companies not only want to do low-end assembling or packing, but also aim to establish their own brands. However, wishful thinking will not establish branded-name companies in the high-tech sector. It requires huge support from the government, and also the supply of human capital. In terms of governmental support, as Wang and Wong indicate, the Taiwanese government played a significant role in promoting the development of high-technology industries in Taiwan.[13] The state is important in concentrating national resources

on R&D spending, and also in building up new innovation infrastructure, for instance the establishment of Hsinchu Science Park (HSP) in the late 1980s.[14] In terms of accumulating human capital, the connection between Silicon Valley and HSP is a crucial one, which will be explained in section fourth below.

Apart from the Taiwanese government's efforts in creating an environment of innovation, the early business model of most Taiwanese IT/electronic industries was to reserve the upstream factories in Taiwan and set up low-end factories in China for cheap labour and favourable tax-waiving policies. As Lutheje pointed out, Taiwanese contract manufacturers in the chip industry have taken the lead to build wafer-fabrication plants in China[15]. The advantage of Taiwanese firms is their strong link to Silicon Valley; therefore Taiwanese firms play a key role in managing relationships between Chinese factories and American IT firms[16]. However, since the start of the 2000s, Chinese domestic firms - such as Lenovo and Huawei - have also emerged, as Hart-Landsberg and Burkett pointed out. They are multinational firms themselves, though it is doubtful whether these Chinese domestic firms could be internationally competitive or could develop further in the realm of R&D.[17]

China is a net importer of hi-tech goods: between 1997 and 1999 hi-tech goods accounted for 14% of its imports and 8% of its exports These percentages are relatively high - for example, for the EU during the same period hi-tech accounted for 9.5% of both exports and imports.[18] Dean *et al* also indicated that China's processing trade is concentrated mostly in relatively hi-tech products and carried out largely by foreign firms. In 2005, more than two-thirds of processing trade was found in three key sectors: electrical machinery, machinery and optical, medical and precision instruments[19]. Foreign-invested enterprises (FIEs),[20] accounted for more than 80 per cent of China's processing trade. It can be argued that China has become the centre of gravity of the global processing trade, due to its huge market of cheap

labour and resources. Hi-tech products are concentrated heavily in two categories of products: radio and TV equipment and office machinery and computers. China's hi-tech imports in terms of parts and components amount to more than three-quarters of their hi-tech suppliers to China, as China served as the final assembly base. West European hi-tech products are mostly capital goods: it is argued by Lemoine and Uanal-Kesenci that European transfers of knowledge to China follow a more traditional way, as they are aimed at modernizing investment capacity and not at re-exports[21]. China has been the country with the largest trade deficit with United States since 2000, and a large proportion of China's imports from the U.S. (23 per cent) and exports to the U.S. (65 per cent) were processing trade.[22]

In the region of East Asia, in 1999 Japan was the first supplier of China's imports for processing (25 per cent), but the New Industrialized Economies (NIEs) accounted for the largest share of these imports (40 per cent), with Taiwan being the most important supplier (20 per cent), followed by South Korea. In contrast, European and U.S. firms contributed only marginally to the supply of goods for China's processing industries (the percentage of European and US imports were 5 per cent and 7 per cent respectively for processing in 1999[23]). Recent research also finds strong evidence for the Asian countries' suppliers to China. From 2000, Japan and the NIEs accounted for more than half of the value of imported inputs in China's exports, both at the beginning and the end of ten year period. However the US and European market combined together accounted for 16-17 per cent.[24] The structure of processing exports from China to Asian countries and western countries indicates that China became an export platform for Asian industries which were aimed at world market, whereas western countries' importing from China was aimed at domestic markets.[25] Huang uses a very interesting metaphor to describe this regional economic structure: 'This structure can be seen as a team of servants with China at the head, leading the others in providing cheap

exports to the US and using its hard-earned savings to finance American purchases of those exports'[26]. Nevertheless, our picture of regional economic structure is slightly different from Huang's metaphor; China is not the head servant to lead East Asian countries to sell out their cheap labour. On the contrary China is the footman in serving, as on top of China, there are Japan, South Korea, Taiwan as subcontractors to serve western markets. Chinese cheap labour therefore is the capital for East Asian countries to secure their positions in global economic structure.

Taiwanese Investment in China

This section will first provide a historical overview of Taiwanese investment in China, and more specifically, will explain the reason why Taiwanese IT industries have gradually taken root in China in the past three decades.

Cheap labour and Chinese governmental encouragement attracted Taiwanese businesses to invest in China[27] at the beginning of the 1980s.[28] However, before the government of Taiwan lifted martial law in 1987,[29] business people were completely prohibited from investing in China. After the lifting of martial law, the Taiwanese government[30] gradually released the controls on investment in China.[31] Nevertheless, by then Taiwanese business people still needed to transit through a third area or country, most of the time Hong Kong or Macau, to invest in China. The types of Taiwanese investment around the end of the 1980s were mainly in traditional manufacturing. However, from the 1990s onwards, Taiwanese investors in China no longer focused on the advantages of cheap Chinese labour or natural resources. More and more big Taiwanese companies came to China because a more sophisticated industrial environment had been created.[32] The end of the 'Temporary Provisions Effective during the Period of Communist Rebellion'[33] announced by then

President Lee Teng-hui on May 1 1991 also encouraged more Taiwanese investors to enter the Chinese market.[34]

The end of these temporary provisions signified that the Taiwanese government no longer regarded commercial activities in China as crimes. Therefore the smoothest period for cross-Strait economic development was from 1992 to 1994. According to the statistical data from the Mainland Affairs Council (MAC) in Taiwan, even the missile crisis from 1995 to 1996 [35] did not affect Taiwanese investment in China. From the end of the 1990s up until the present, Taiwanese investment in China has mainly consisted of high-technology industries. According to statistical data from the Ministry of Economic Affairs in Taiwan, until the end of June 2010, Taiwanese investment in China amounted to 59.6% of total Taiwanese external investment.[36]

China has great attraction to Taiwan's IT/electronic industries for more reasons than the generic benefits that China can offer: cheap labour and governmental preferential tax-waving policies. China has a peculiar combination of competitiveness that would mould the shape of the global IT industry development:[37] it has a huge and booming market for electronics products and services. It is important to bear in mind that the advantage of comparatively cheap and easily retainable labour declined after 2008, following the implementation of the New Labour Contract Law. This raised the minimum wage and enhanced the rights of workers[38]. But China still proved the most attractive country for IT/electronic industries because it has a growing pool of skilled workers, not all of them. The Chinese government has strategically recruited talented people to the country, be they foreign workers or Chinese graduates of universities aboard. The following section introduces the linkage between USA-Taiwan-China in terms of talented human resources, which are the backbone of IT industry.

US-Taiwan, Taiwan-China, US-China technological nexus

I mentioned earlier the nexus that link USA, Taiwan and China in high-technology transfer. This section aims to scrutinize this dynamic hierarchy within the global economic structure.

USA-Taiwan link

As Saxenian and Hsu point out[39], attracted by the promise of better working opportunities, a return to their families, and also the missionary sense of contribution to their home country, there were a growing number of US-educated engineers who returned to Taiwan in the 1990s. Along with the establishment of HSP in 1980, this group of technological elites is the backbone of Taiwan's high-tech human capital. The HSP certainly is not the sole reason for Taiwan's IT success, but the HSP became the destination for hundreds of talented returnees from Silicon Valley to open new technology companies. Furthermore, the Taiwanese government also provided very good policy incentives to encourage this group of talented people to come back to the HSP: for instance, preferential access to scarce and high-quality housing and access for returnees' children to enter the only Chinese–American school in Taiwan[40]. However, the tie of Silicon Valley and HSP was not meant to be competitive: rather, it was complementary and mutually beneficial. New product definition and cutting-edge innovation still remain in Silicon Valley, whereas Taiwanese companies whose leaders were trained in Silicon Valley continue to enhance their capacity to modify the products, and adapt as well as rapidly commercialize technology. In other words, Silicon Valley and HSP are in different leagues. From the perspective of knowledge flow, Silicon Valley does not worry about Taiwan as a competitor; it is more of a mode of flying geese pattern. In the framework of GVC, the Silicon Valley-HSP connection fit in well, mainly because the knowledge flow from Silicon Valley to HSP triggers the technology revolution in Taiwan, and pushes Taiwan's main industry into the high-technology era.

However, one point has to be noted, which is that Taiwan always lags behind the Silicon Valley in this matter.

Taiwan-China link

According to Tom Miller, eight of China's top ten exporters are Taiwanese electronic companies supplying branded PC sellers such as Dell or Intel with unbranded computers and components.[41] Taiwanese original design manufacturers (ODM), in contrast to original equipment manufacturers (OEM), contributed a great percentage of global computer manufacturing, using China as the production base. In other words, the impressive number of China's production in the high-technology sector, mostly computers, does not represent growth opportunities in the GVCs for Chinese domestic companies. The ODM contract manufacturers use cheap land and labour force from China to produce high-technology products with very little value added. According to Miller, the worldwide computer industry could be understood as a pyramid. Microsoft and Intel sit at the top, rich in intellectual capital and profit, below them are the global PC brands, Dell, Apple, Hewlett-Packard (HP), and Sony. Those branded companies were supported by Taiwanese ODMs with factories in China that receive components.[42] However, what Miller does not mention is that many contract manufacturers have already started to produce entire computers. According to an interview with Luethje in 2012 January,[43] many Taiwanese ODM companies produced different styles of computers to Intel or Microsoft for their selection. Branded companies would choose one type and authorized their logos. The design therefore was not from Intel's own R&D but rather from the ODM's contract manufacturers.

The situation in fact started to change in two dimensions from 2005 onwards. First of all, as reflected in Luethje's interview, since the subcontractors already had the capacity to design a whole computer, they tried to compete on their own terms, marked by Lenovo's

purchase of the IBM personal computer division that year. This was the first successful attempt by the Chinese electronics industry to compete against the international brands. Secondly, Chinese industrialists used the global financial crisis of 2008 to make changes. As the credit crunch severely hit the leading Western economies, China maintained growth at over 8 percent.[44] The shrinkage of the leading Western economies meant China had to replace its export driven growth. This was achieved partly by massive infrastructural investments, but it was also secured by increase in domestic consumption. As Feenstra and Hong has pointed out, while export remains important in stimulating employment in China, gains could be and were obtained from growth in domestic tradable goods.[45]

As I mentioned at the beginning of this section, the Taiwan-China connection originally built upon Taiwan's manufacturers' ODM production model to produce global branded computer in China. Taiwanese manufacturers relied on their advanced production knowledge and their close relationship in US-Taiwan Link, to bring lots of profit from the Taiwan-China link from early 1990s to early 2000s. The change started from early 2000s, when China began to produce Chinese branded electronic appliances including personal computers and mobile phones. This was possible as the domestic market continued to grow despite the 2008 global financial crisis. Following this development China started to by-pass its Taiwanese partners and forges, as will be examined in the next section, its own links with Western countries, such as the USA-China Link.

US-Taiwan-China or US-China Connection?

The Chinese government's enthusiasm to attract FDI not only aimed to boost local economic development, but also begin a process of technology transfer through foreign investment. Nevertheless, as Leifner *et al*. concluded, most of the foreign investors were attracted to China either by low production cost, primarily in the shape of cheap labour and

resources, or by the huge market potential of the country. This often resulted in a transfer of knowledge as they usually belong to more technology-intensive sectors, or needed to adapt their products to Chinese markets and thus had to respond positively to the Chinese government's pressure to transfer technology[46]. But such foreign companies usually only transferred technology reluctantly, as they were concerned about nurturing competition[47]. A second source of new knowledge transfer to developing countries is to build up their own technological base in domestic public research institutes or higher-education institution. This requires government support and collaboration with companies. In order to encourage research institutes not to rely solely on government capital and to follow closely the needs of enterprises, the Chinese government cut basic funding and started to link funding to performance. Instead, it encourages universities and research institutes to attract funding through cooperation with industry, patenting, licensing and even the creation of new technology intensive companies such as the Tsinghua Unigroup.[48] The rest of this section examines how Taiwan in the late 80s and 90s paved the foundation of electronic or high-technology products' manufacturing models for China, and how their Chinese partners took advantage of this after 2000 and worked to build up their own networks with the Silicon Valley and thus reduced the role of Taiwan as a key link in a global value chain that connects Chinese manufacturers to American technology production.

To be more specific, the successful experience of Silicon Valley-HSP connection provides a model for China's high-tech development[49]. Therefore major Chinese high-tech centres, such as Beijing's Zhongguancun and Shanghai's Zhangjiang, also provide incentives to attract international IT talent and returning students from aboard. Numerous ethnic Chinese technology associations in the Silicon Valley also serve as a bridge to link technology and talent between two regions. Furthermore, the state also played a crucial role

by founding the Hua-Yuan Science and Technology Association in Silicon Valley in 2001. The goal of Hua-Yuan was to promote a high-tech development module of 'designed in Silicon Valley, manufactured in China'. Naturally, this goal setting competed with a Taiwanese government-supported association, Monte Jade Science and Technology Association in Silicon Valley, which originally had a very similar agenda and was established in Silicon Valley in 1990.[50] The competition and alliance of these two organisations with Silicon Valley therefore could be denoted as a symbol of triangular technology flow among US-China-Taiwan. However the bigger question for Taiwan is, where is the strategic position among this triangular technology flow? Taiwan's role as a technology or capital broker or a bridge between China and developed countries is facing serious challenge. China might still have a large technology gap to bridge in order to catch up with first league states - for instance the United States or European countries - but the gap between Taiwan and China is lessening. In order to gain higher profits, Chinese companies sidestep Taiwanese contractors and deal with the Americans where they can.

What are Taiwan's Impact on China's electronic industry? Foxconn as a case study

The most significant impact of Taiwanese IT/electronic factories in China, is to serve as a 'teacher' for most of the domestic Chinese manufacturers. As I mentioned the main strength of the Taiwanese is the industrial clustering effect which enabled Taiwanese OEM/ODM factories to complete brand companies' orders efficiently and with good quality. Taiwanese OEM/ODM factories in China managed to do so by combining cheap and retainable labour in China, with management skill imported from Taiwan. Most of the Taiwanese OEM/ODM factories are crucial to the supply chain, but the profits of OEM/ODM factories are rather thin. Using Apple's iPod as an example, an iPod is sold at price of US$299, of which Apple's margin is $80, and Taiwanese manufacturers' margin is only $5,

though the parts of iPods are mostly manufactured in China through Taiwanese manufacturers[51]. That means that Taiwan's ODM factories are not earning much of the profits: if the Taiwanese factories can only earn $5 net profit from a $299 iPod, what sustains the factory is the exploitation of the labour force by the lowering of wages and tightening up of the management skills. Hence, the problem of giant Taiwanese ODM factory, Foxconn, exploded into view in 2010[52]. In this section I use Foxconn as a case to illustrate the pattern of production of Taiwanese ODM manufactories in China.

The Hon Hai Precision Industry Co. Ltd was founded in 1974; and the Foxconn name originated as the trade name of Hon Hai and then became Hon Hai's subsidiary. Foxconn technology group processes and assembles parts for personal computer, communication and consumer electronics (3Cs), digital electronics and even automobile components. Recently, it focused on fields of nanotechnology, heat transfer, wireless connectivity, material science and green manufacturing processes[53]. After the CEO Terry Guo founded the group, the first manufacturing plant in mainland China started to operate in Longhua, Shenzhen in 1988[54]. Though it was established in the 1980s, Foxconn grew exponentially after 2000. In 2001, Foxconn was the biggest private enterprise in Taiwan, with sales reaching forty-four billion US Dollars (USD). Since 2003, Foxconn became the biggest exporting company in China, with a total income of six hundred and eighteen billion USD, and exports valued at five hundred and sixteen billion USD in 2008: 3.9% of China's total export at the time.[55] In 2011, Foxconn ranked number 60 on the Fortune Global 500 Enterprises list.

Foxconn established a reputation among the business partners as a producer with efficiency, high quality, and high flexibility. The Foxconn Longhua campus is known as the world's largest 3C manufacturing base and the shortest supply chain[56]. Foxconn has contracts

with numerous branded electronic companies: for instance, Acer (Taiwan), Apple (United States), Dell (United States), Hewlett-Packcard (United States), Intel (United States), Microsoft (United States), Motorola Mobility (United States), Nokia (Finland), Samsung Electronics (South Korea), Sony (Japan), and Toshiba (Japan).[57] Having processed so many brand companies' contracts simultaneously, Foxconn became the biggest processing factory in the world, supplying more than fifty percent of the components in the global electronic industry.

However, Foxconn's reputation has been tainted by seventeen suicides that happened between January and August 2010. Since then, Foxconn became the focus of global concern. From the perspective of academia, Pun Ngai organised a team of students and scholars from Taiwan, Mainland China and Hong Kong to start a series of investigations outside several Foxconn's factories[58]. According to their book *To Live On, Foxconn Workers*, their investigation is an ongoing process. The publication of this book is the result of first stage investigation, and they will continue to monitor Foxconn workers. From the perspective of the media, after the exposure of suicidal cases, Foxconn adopted a strict manner to block media reporting. However, from the end of 2011, Foxconn decided to let the western media inspect their factories[59]. Those reports unsurprisingly showed a very rosy picture of Foxconn and the vast campus of Foxconn city in Longhua, Shenzhen. These reports do not sit comfortably with the reality that more than ten workers committed suicides in more than half a year, however. Academia, the media, and international non-governmental organizations (NGOs) paid great attention to the aftermath of suicidal events in Foxconn. In March 2012, an American-based NGO, Fair Labour Association (FLA) published their independent investigation of Foxconn.[60] The FLA report was commissioned by Apple. Whether the act of investigation was a way for Apple to clean the name of labour exploitation, Apple and

Foxconn showed some resolution after the investigation. Apple and Foxconn agreed to reduce overtime working hours and also, in order to compensate the loss of labour force from overtime working hours' reduction, Foxconn agreed to hire more workers. Apple and Foxconn also agreed with the FLA to undertake a second examination in July 2013 to oversee those changes[61].

Foxconn's case echoes what was argued earlier: the thin profit margin of processing trade or ODM factories, which leads to exploitation of labour. It is not because Foxconn is a giant factory that enjoys exploiting workers' rights and wages, or that the CEO Terry Guo is a ruthless businessman who cares only about profits; it is the nature of capitalism. The race-to-the-bottom exercise drives factory owners to reap profits from workers. Apart from the exploitation of working condition, the R&D level of those ODM/OEM Taiwanese factories in China is not high, which is another major weakness of Taiwanese IT/electronic factories in China.

The Taiwanese OEM pattern of production does not need ground-breaking innovation; all the Taiwanese OEM factories receive the orders from brand name companies and have relatively low-skilled barriers to finish the products. As a Chinese analyst from the Institute of Shanghai Social Science Taiwan studies center states:

> Taiwan is very protective of its patent or industrial knowledge. However, Taiwan's know-how is not at the high-end, it is not innovative, and Taiwan is still learning from western countries' know-how and is merely popularizing this knowledge to the local market. In other words, the 'know-how' from Taiwanese factories, can very easily be copied or learned by Chinese entrepreneurs.[62]

This is what I argue at the beginning of this section: most of small and medium size Taiwanese OEM factories became 'teachers' of Chinese local manufacturers. After 2008 Taiwanese investors faced both financial downturn and tighter legislation governing labour contract. It meant orders from the brand companies fell while the wage bill increased. As a result, small and medium size Taiwanese factories closed down, and were replaced by domestic Chinese factories, whose owners had previously worked for Taiwanese companies and learned the 'know-how' there.

It would be a gross exaggeration to assert that Chinese electronic industry's growth only happened because of Taiwanese investments. In fact, as Ernst and Naughton argue, the Chinese state played a crucial role in the development of the IT industry. State ownership is significant in the whole industry, including the fostering of Science innovation parks, for instance Zhongguancun in Beijing, and Zhangjiang high-technology park in Shanghai.[63] Furthermore, domestic Chinese entrepreneurs receive great support from the government for R&D and innovation. Nevertheless, the small and medium size Taiwanese OEM electronic/IT factories paved a good foundation for the Chinese electronic/IT industry to take off. The Chinese factories learned from Taiwanese experiences in linking up with the brand companies and cost-effective factory management, and they out-competed their 'teacher', Taiwanese manufacturers, as they secured a place in the supply chain. Recent IT/electronic industrial developments in China indicate that the Taiwanese 'industrial cluster' in China are now being replaced by Chinese domestic factories. According to one leading manager of a LED company in Kunshan:

> the government encouraged us to purchase components which are made from domestic Chinese factories instead of non-Chinese factories. Even though the price from the Chinese factories will be probably higher, the quality might not be as good

as other non-Chinese factories, the government would provide us tax incentives for us to purchase from Chinese factories.[64]

This is why most of the Taiwanese manufacturers are worried about the emergence of the so-called 'red supply chain'.[65] Chinese manufacturers have gradually decreased their dependence on non-Chinese subcontractors, and the threat to Taiwanese electronic/IT factories in China could be lethal. Simply put, the strength of Taiwanese factories lies very much on the industrial cluster and collaborative supply chain.

Conclusion

Based on the argument presented above, four points can be concluded. Firstly, the GVC theoretical framework overlooked many empirical limits. For instance, developed countries would transfer some though not all technological knowhow due to their concern over national security or economic competition. The GVC framework therefore only reflects the positive side of knowledge transfer among different countries, but neglect some realistic constraints. Taiwan joined the GVC in the electronics industry after it managed to create a flow of human capital between Silicon Valley and HSP, which enabled the Taiwanese electronic industry to take off in the 1990s though it remained at a lower level in the GVC. Secondly, Taiwan played a critical role in incorporating Chinese manufacturing capacities into the bottom of the GVC in the electronics industry in the early 1990s by capitalising on the symbiotic relationship it had with Silicon Valley. However, with the opening of the Chinese market and the transfer of skills from the Taiwanese to their Chinese partners, the competitive capacity of China in the high-technology industry increased significantly. Thirdly, with the rise of the 'red supply chain', Taiwanese IT/electronic industries' clusters in China are becoming a victim of their own success. They are now facing severe competition,

even a threat, from the emerging Chinese supply chain, which was built on knowhow transferred from Taiwanese companies. For small- and medium-size Taiwanese OEM factories in China, industrial upgrading is easier said than done. For most of them it is nearly impossible to create a global brand and own the design. The creation of a new brand requires huge capital input and recruitment of talented human resource, and this is not affordable for most small- and medium-size Taiwanese ODM manufacturers. Finally, while Taiwan played a key part in helping mainland China to join the GVC in the fast changing electronics industry in the first instance, the Chinese themselves have quickly taken full advantage of this break and make themselves a major player in their own right. The tremendous and impressive successes of the Chinese in securing a place in the global GVC does not negate the contribution the Taiwanese have made, but it shows the limits of how Taiwan is impacting upon China in a significant sector.

Interview data

Interview data G1, Guangzhou, January 13 2012.

Interview data S1: Shanghai, date: April 21 2014.

Interview data K2: Kunshan, date: 29 July 2015.

[1] The author would like to thank the Chiang Ching-kuo Foundation for financial support for some of the interviews conducted for this project.

[2] Bernard, Bradford and Schott, "Survival of Best Fit," 219-237. Cited in Sturgeon and Memedovic, "Mapping Global Value Chains," 2.

[3] Lall, "Technological Structure," 337-69.
Humphery and Schmitz, "Insertion in Global Chains,"1017-27. Cited in Sturgeon and Memedovic, "Mapping Global Value Chains," 2.

[4] Sturgeon and Memedovic, "Mapping Global Value Chains," 2.

[5] Davis, “Corporate Innovation.” Cited in Sturgeon and Memedovic, “Mapping Global Value Chains,” 4.
[6] Whittaker et al., "Compressed Development,” 439-67. Cited in Sturgeon and Memedovic, “Mapping Global Value Chains,” 3.
[7] Chen, "Taiwan’s IT firms,” 338.
[8] Nau, “National Policies.” Cited in Wang, “Developing the Information Industry,” 551.
[9] Wang, “Developing the Information Industry,” 551.
[10] Chu, “Controlling the Uncontrollable," 54-68.
[11] Sturgeon and Kawakami, “Global Value Chains,” 121.
[12] *Ibid*, 122-123.
[13] Wang, “Developing the Information Industry,” 551; Wong, “Innovation and Taiwan’s Vitality,”169-175.
[14] Hsinchu Science Park, “Introduction Hsinchu Science Park.”
[15] Luthje, “Why China Matters,” 345.
[16] *Ibid.*
[17] Hart-Landsberg and Burkett, “Dynamics of Transnational Accumulation,” 20.
[18] Fontagne, Freudnberg, and Unal-Kesenci, “Trade in Technology and Quality,” 561-582.
[19] Dean, Feng and Wang, “Measuring the Vertical Specialization,” 6.
[20] FIE refer to three types: wholly foreign-owned, equity joint venture and contractual joint venture.
[21] Lemoine and Unal-Kesenci, “Assembly Trade Technology Transfer,” 839.
[22] Dean, Feng and Wang, “Measuring the Vertical Specialization,” 6.
[23] Lemoine and Unal-Kesenci, “Assembly Trade Technology Transfer,” 839.
[24] Athukorala, “Multinational Production Networks.”; Baldwin, “Managing the Noodle Bowl.”. Cited in Dean, Feng and Wang, “Measuring the Vertical Specialization,” 4.
[25] Lemoine and Unal-Kesenci, “Assembly Trade Technology Transfer,” 833.
[26] Hung, “America’s Head Servant,” 16.
[27] In this paper, ‘China’ refers to the People’s Republic of China (PRC or ‘the Beijing government’). ‘Taiwan’ represents the Republic of China (ROC or ‘the Taipei government’). I will use the different terms alternatively.
[28] Sung, *Emergence of Greater China*, 63.
[29] On lifting martial law in July 1987, the Taiwanese government allowed Taiwanese businesses to invest in China. In November of the same year, the Taiwanese government allowed Taiwanese people to go to China to visit relatives. Many Taiwanese businesses sought the chance to invest in China in light of the new regulations.
[30] My use of the word ‘Taiwanese’ in this chapter refers to all residents and businesses who live in Taiwan. It does not imply any ideological position on Taiwan’s current identity or international status.
[31] Kao and Lin, “The Changing Economic,” 262.
[32] Steinfeld, “Cross-Strait Integration Industrial Catch-Up,” 234-235.
[33] The ‘Temporary Provisions Effective during the Period of Communist Rebellion’ were promulgated by the ROC’s secretary general to the office of the President on June 15, 1950. TDP, “History of Constitutional Revisisons.”
[34] Baum, “ Direct Trade with China,” 40~43.
[35] The Chinese government was furious that the United States issued a visa for then Taiwanese president Lee Teng-hui to visit Cornell University for his alumni reunion, as this violated the bilateral agreement between China and America. This triggered the so-called 1995-1996 cross-Strait missile crisis: the Chinese army launched a volley of nuclear-capable missiles into the sea 90 miles north of Taipei. This constituted a threat and thereafter some missile fire continued until 1996. Gilley, *Tiger on the Brink*, 251~253.
[36] MAC, “Statistic data.”
[37] Ernst and Naughton, “China’s Emerging Industrial Economy,” 48.
[38] Wang, et al., “New Labour Contract Law,” 485-501.
[39] Saxenian and Hsu, “Silicon Valley-Hsinchu Connection,” 905.
[40] *Ibid*, 908.
[41] Miller, “Manufacturing That Doesn’t Compute.”
[42] *Ibid.*
[43] Interview data G1, Guangzhou, January 13 2012.
[44] World Bank, “Chinese economic development update.”
[45] Feenstra and Hong, “China’s Exports and Employment,” 1
[46] Liefner, Hennemann and Lu, “Cooperation in Innovation Process,*”* 113.
[47] Hayter and Han, “China’s Open Policy,” 1-16; Young and Lan, “Technology Transfer to China,” 669-679, cited in *Leifner et al*: 133.
[48] Gu, “New Technology Enterprises,” 475-505.; Liu and Jiang, “Nature and Implications,” 175-188, cited in *Leifner et al:* 114.

[49] Leng, "Taipei/Shanghai/Silicon Valley Triangle," 238
[50] *Ibid,* 239-240.
[51] Linden, Kraemer and Dedrick, "Case of Apple's iPod," 143.
[52] Chan and Pun, "Suicide of Migrant Workers," 1-50.
[53] Foxconn, "Company Intro."
[54] *Ibid.*
[55] Pun, "To Live On," 188.
[56] Foxconn official website English version. Foxconn, "Manage Concept."
[57] Pun, "To Live On," 5.
[58] *Ibid*.
[59] John Biggs is a reporter for Techcrunch, an on-line blog which constantly updated the news in IT field. Mr. Briggs wrote four pieces of diary-style articles to describe his four-day visit to Foxconn's plant in Longhu, Shezhen. Biggs, "The future of Foxconn." Rob Schmitz is the second western reporter to enter Foxconn Longhau plant, he is the Chief reporter of Marketplace's (an American public media) Shanghai Bureau. Apart from writing down articles, Mr. Schmitz filmed a two-minute clip to show the making of iPhone on the site. *Inside Foxconn.*
[60] Fair Labour Association, "Foxconn Investigation report."
[61] *Ibid.*
[62] Interview data S1.
[63] Ernst and Naughton, "China's Emerging Industrial Economy," 56.
[64] Interview data K2
[65] China Post, "China Supply Chain Plan."

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