creative commons

COMMONS DEED

저작자표시-비영리-변경금지 2.0 대한민국

이용자는 아래의 조건을 따르는 경우에 한하여 자유롭게

- 이 저작물을 복제, 배포, 전송, 전시, 공연 및 방송할 수 있습니다.

다음과 같은 조건을 따라야 합니다:

저작자표시. 귀하는 원저작자를 표시하여야 합니다.

비영리. 귀하는 이 저작물을 영리 목적으로 이용할 수 없습니다.

변경금지. 귀하는 이 저작물을 개작, 변형 또는 가공할 수 없습니다.

- 귀하는, 이 저작물의 재이용이나 배포의 경우, 이 저작물에 적용된 이용허락조건을 명확하게 나타내어야 합니다.
- 저작권자로부터 별도의 허가를 받으면 이러한 조건들은 적용되지 않습니다.

저작권법에 따른 이용자의 권리는 위의 내용에 의하여 영향을 받지 않습니다.

이것은 이용허락규약(Legal Code)을 이해하기 쉽게 요약한 것입니다.

Disclaimer

dCollection

Master's Thesis

The Impacts of China-Korea Free Trade Agreement on Thin Film Transistor- Liquid Crystal Display Ecosystem

August 2015

Graduate School of Seoul National University

International Commerce, Graduate School of International Studies

Yushan Huang

Abstract

The Impacts of China-Korea Free Trade Agreement on Thin Film Transistor-Liquid Crystal Display (TFT-LCD) Ecosystem

Yushan Huang

International Commerce

Graduate School of International Studies

Seoul National University

Thin film transistor-liquid crystal display (TFT-LCD) is the core technology in the information technology industry. The analysis on the populations of TFT-LCD ecosystem shows its significance to East Asia. According to Water-Lily Model, Free Trade Agreement (FTA) is a major factor in current East Asian economic development. Therefore, this study conducts an impact analysis of China-Korea FTA by SMART simulation tool developed by World Integrated Trade Solution (WITS). The results present that the China-Korea Free Trade Agreement will lead a significant shift in TFT-LCD ecosystem.

Key Words: TFT-LCD, business ecosystem, Water-Lily Model, China-Korea FTA, Partial Equilibrium Model, SMART

Student ID: 2013-23978

요약

중한자유 무역 협정이 Thin Film Transistor-Liquid Crystal Display (TFT-LCD) 생태계에 미친 영향

황욱선

국제통상전공

국제대학원

서울대학교

Thin film transistor-liquid crystal display (TFT-LCD) 는 정보 통신 기술에 있어 핵심 기술이다. TFT-LCD 생태계의 구성은 동아시아에서의 TFT-LCD의 중요성을 보여준다. Water-Lily 모델 이론에 따르면, 자유 무역 협정은 동아시아 경제 발전에 주요한 요인이다. 그래서 본 연구는 WITS의 SMART 시뮬레이션 도구를 통해서 중한 자유 무역 협정의 영향을 분석했다. 분석결과에 의하면 중한 자유 무역 협정은 TFT-LCD 생태계에 상당한 변화를 이끌 것으로 보인다.

기준어: 박막 트랜지스터 액정 표시 장치, 비지니스 생태계, Water-Lily 모델 이론, 중한 자유 무역 협정, 부분 평형 모델, SMART

학번: 2013-23978

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURE PAGE

I. Introduction

High technology advancement has played an important role in East Asian economic development. As the fast growth of the flat panel display (FPD) in information technology, the attention to thin film transistor-liquid crystal display (TFT-LCD) industry has been raised rapidly. There are several reasons to focus on the impacts of China-Korea Free Trade Agreement (FTA) on TFT-LCD industry in this study. First of all, information technology (IT) industry has been one of the major sectors to accelerate the deeper economic integration. Currently, TFT-LCD is especially a core industry of the global IT manufacturing. Secondly, the production of TFT-LCD in East Asian countries account for almost all the world market share, which makes East Asia own a vital position for the TFT-LCD ecosystem. Thirdly, LCD industry presents the significant changes of the economic development tracks in East Asian region.

Since the negotiations on China-Korea FTA started in May 2012, the impacts of the tariff liberalizations on the domestic industries, especially on the TFT-LCD ecosystem, have been seriously discussed. The bilateral trade liberalization is believed to contribute to trade creation that the sectors with more comparative advantages will export more (Samuel 2015). Therefore, the whole TFT-LCD ecosystem, including trading countries without the tariff liberalization, will likely be influenced and lead to the role changes. Moreover, the model of economic development in East Asian region has been changed due to the globalization and liberalization. From Japan-led Flying-Geese model (Schröppel & Mariko 2005; Linden et al. 1998) to China-centered Bamboo Capitalization (Roland-Holst 2003; Lee et al. 2004), the track of the regional economic development has currently moved towards economic integration-based Water-Lily Model (Han et al. 2012).

The previous studies of TFT-LCD industry (Mathews 2004; Hu 2008; Hung et al. 2012) present the sophisticated supply chains, supporting actors and the other resources such as capital, infrastructure and government policy involved in the TFT-LCD production. However, it is rare seen to analyze the TFT-LCD industry in the business ecosystem framework (Moore 1993). Besides, the economic development in East Asia has a long scholarly pedigree. The routs of TFT-LCD industry development present various economic development models from Flying-Geese Model, Bamboo Capitalism to current Water-Lily

Model. The importance of economic integration such as FTAs has been rising in the regional economic development. However, the quantitative analysis on the economic agglomeration is not thoroughly investigated.

In accordance with China-Korea FTA, China and Korea have decided a tariff reduction on the TFT-LCD products within an eight-year framework. It is believed to increase bilateral trade flows and give a rise to the power shift in the TFT-LCD ecosystem. Nonetheless, quantitative analysis of the effects of China-Korea FTA on TFT-LCD ecosystem is rarely seen. In order to examine the China-Korea FTA's impacts on TFT-LCD ecosystem, partial equilibrium model appears to be the most feasible solution that it can present the effects of bilateral tariff liberalization on a specific industry. Besides, this research utilizes SMART program developed by World Integrated Trade Solution (WITS) of the World Bank, which is an analytic tool to simulate the effects of global tariff cuts. Hence, this study presents the quantitative simulation of the impacts on TFT-LCD ecosystem for a better understanding of current economic development in East Asia.

The next section will start with a brief overview of TFT-LCD development in order to show the significance of capital investment and cyclical strategies. In the section 2, the dynamic changes and strategic alliances are illustrated. In the section 3, Moore's ecosystem is applied to analyze the current TFT-LCD industry, where the TFT-LCD is used as a subject to study the changes of East Asian economic development from Flying-Geese Model to Water-Lily Model. The last part of section 3, the potential gains in TFT-LCD development is presented by previous studies on China-Korea FTA. In the section 4, partial equilibrium analysis is conducted by using SMART simulation tool developed by WITS of World Bank. The ex-ante trade analysis presents the significance of tariff liberalization on the TFT-LCD trade. The conclusion summarizes the main findings and the implications of China-Korea FTA on TFT-LCD ecosystem.

II. Overview of TFT-LCD Development

The TFT-LCD technology can be traced back to 19^{th} century when Friedrich Reinitzer first discovered the liquid crystal, which is in a mesophase-state between liquid and solid (Kawamoto 2006). In the early stage of the TFT-LCD technology development, the research was mainly established in the United States, Europe and Japan. However, TFT-LCD was not developed in a commercial basis until Japanese companies Sharp, Toshiba and IBM Japan developed the first generation (G1) of TFT-LCD production line in 1992. Ever since, flat panel displays (FPDs) have successfully replaced the cathode ray tube (CRT) displays for the revolutionized technology in the global display market.

FPDs exhibit higher brightness and contrast, bigger viewable image range, and slimmer size than CRT displays. Compared to CRTs, the technology of FPDs also exhibit more advantages in eye health and environment protection (Hung et al. 2012). Unlike the mechanism of CRT that the image is made by the scanning beam of electrons at the tiny phosphor dots, the TFT-LCD has a sandwich-like structure that the liquid crystals are filled between two transparent electrodes of LCD (Kuo 2013). The liquid crystal displays (LCDs) block some paths of the backlights to reach to exhibit the images, and the pixels are the picture elements determined by the intersections of rows and columns of electrodes (Hung et al. 2012).

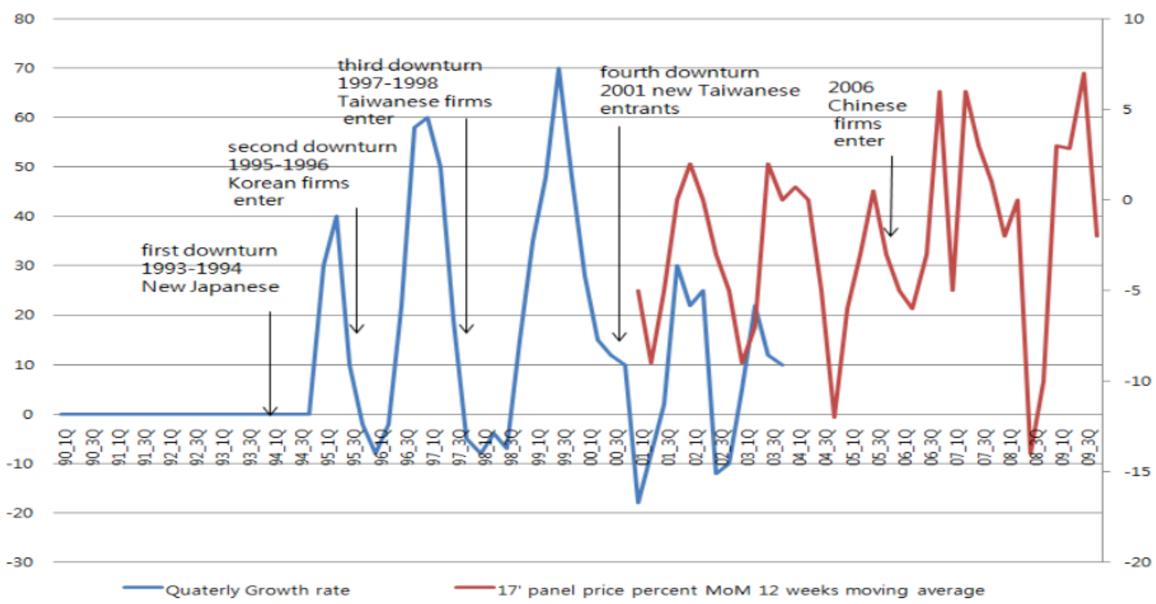
TFT-LCD technology has dominated the market by occupying 78 percent of the total FPDs market share (Han et al. 2012). Along with, the global TFT-LCD makers have focused on pursuing the development of large-sized TFT-LCD panel fabrication since Japanese firms developed the first generation (G1). The generation technology in LCD production is determined by the size of the mother glass that used at the beginning of the fabrication. It is noted that the production of TFT-LCD generation 8.5 is currently available in the market, and the mother glass can be as large as a pool table (220 x 250 cm)[1].

In pursuit of the generation technology advancement, capital investment and cash flow management are two essential elements (Hung et al. 2012). Due to the high entry barriers that require US$ 2 billion initial investment, potential incumbents would need to adopt counter-cyclical strategy on order to enter the TFT-

[1] Size matter. AU Optronics; 2015

LCD production. The crystal cycle occurs mostly in capital-intensive and fast-changing technology industries when the mismatches of investment and market demand lead to downturns (Mathews 2004). A downturn not only creates a room for potential incumbents but also drives existing players to reform and release resources. Therefore, strategic alliances or clusters tend to be formed during the industrial downturns.

Figure 1. Industrial Downturns and Strategic Entries in TFT-LCD Industry



Source: Brief history of the LCD industry in East Asia (Mathews 2004; Han et al. 2012)

There were four significant downturns (See Figure 1) in the TFT-LCD history that new entrants stimulated innovative developments as "creative destruction" (Mathews 2004). During the first downturn (1993-1994), other Japanese firms such as Matsushita and Hitachi also entered the TFT-LCD market. Korean companies started to engage in the TFT-LCD research during the first downturn, and therefore, Samsung, LG and Hydix[2] successfully joined the TFT-LCD production during the second downturn (1995-1996). When the third downturn occurred due to Asian financial crisis (1997-1998), six Taiwanese companies managed to enter the industry with Japanese technology transfers. The fourth downturn (2005-2006) gave

[2] Korea companies entered the TFT-LCD production without receiving Japanese technology transfer. Samsung received some transferred technologies from Corning (U.S.); LG later was allied with Philip (Dutch) as LG Philips.

Chinese firms the entry to the TFT-LCD production by the means of earlier generation LCDs and LCD module assembly (Wang 2006).

The TFT-LCD panels are widely used in numerous commercial products, such as notebook PCs, LCD TVs, monitors, printers, and other display applications. Despite the fact that TFT-LCD has been developed for decades, the new trend of display applications has started in many other fields. In current car industry, the cars are often equipped with various in-car displays such as global positioning system (GPS) or event data recorder (EDR). Even keyless car remote that attached to jacket sleeve was innovated based on the TFT-LCD panel technology (Starr 2015). The other recent significant accomplishments in TFT-LCD innovation are such as 3D technology, touch panels and so on.

Future TFT-LCD development will continue to focus on more efficient large-panel production in terms of masking steps and unit processing time (Kuo 2013). Also, many TFT-LCD manufacturers are in pursuit of green technology to eliminate the sources of contamination. For instance, replacing the cold cathode fluorescent lamps (CCFL) with light-emitting diodes (LED) as backlight can save more energy. It is believed that the development of organic light-emitting diode (OLED) can provide an energy-effective and high quality displays. Aside from the huge capital investment, it requires about three years to establish a new production line in panel industry[3]. Hence, TFT-LCD producers notably as LG Display already invested about 200 million dollars for seeking a more effective OLED solution (Salmon 2015).

---

[3] Guo, the Chairman of Foxccon, was interviewed on the issue of China-Korea FTA and the development of FPD industry at Sisy's World News on November 15th, 2014.

III. Literature Reviews

3.1 Business Ecosystem

The original concept of ecosystem was generated from ecology of natural science, where ecosystem is a system of interrelationship between the living organisms and the nonliving organisms (Tansley 1939). Based on the previous studies on ecosystem, many economists started to use the ecosystem framework to analyze the interactions between business actors and environments. James F. Moore (1993) is one of the most representative scholars who proposed the idea of business ecosystem as a systematic strategy approach to business innovation.

In a business ecosystem, a company is not viewed as a single player but as a part of ecosystem that crosses a variety of industries (Moore 1993). That is, the living organisms such as consumers, competitors, suppliers and media at individual, organizational and governmental levels are included in a business ecosystem. The nonliving organisms in a business ecosystem are composed of capitals, infrastructures, government policies and other environment factors. Being similar to the ecological ecosystem, the successful business actors gain from the interaction with the resources of capital, customer interest and talents generated by innovation.

One of the most important contributions of Moore's work is the emphasis of fierce and fair competition in a business ecosystem. As the ecological evolution is the result of the cooperation and competitions, the business innovation requires the alliances and stimulus from the counter parties. In the course of pursuing innovation like new product developments or customer needs satisfactions, not only cooperation but also competitions between the units are needed. Accordingly, the stimulus from other players in the business ecosystem would benefit the ecosystem as a whole. Therefore, it is mutually beneficial to establish long-term relationships to all the units in the ecosystem.

The ecosystems of high technology industries are characterized as capital-intensive and dynamic. Specially for information technology industry, Guo (2009) specially illustrated the innovation ecosystem in terms of innovation behavior and innovation community evolution (See Table 1). He put an emphasis on the composition of the innovation ecosystem in the IT industry, since the interactions and adjustments between living organisms and non-living organisms are the main elements in the ecosystem. The innovation ecosystem in IT industry comprises innovation entity population, innovation supporting population and innovation environment to support the dynamic and interactive ecosystem (Guo 2009).

Table 1. The Structure of Innovation Ecosystem in IT Industry

Innovation Ecosystem in IT Industry			
Innovation Entity Populations	**Innovation Supporting Populations**	**Innovation Environment**	
		Resource Environment	Soft Environment
- Research Organization - Universities - Enterprises	- Industry Organizations - Information Agents - Service Organizations - Financial Organizations	- Infrastructure - Human Resource - Capital Supply	- Macro Economy Environment - Government Policy - Humanity Environment

Source: The structure of innovation ecosystem in IT industry (Guo 2009)

Based on the previous studies on ecosystem (Moore 1993; Guo 2009), we can therefore illustrate TFT-LCD ecosystem in *structure, supply chain,* and *evolution* three main aspects. First of all, identifying the living organisms and non-living organisms will give us a bigger picture of the TFT-LCD ecosystem. Along with, illustration of the supply chain in TFT-LCD ecosystem will help to identify each player's roles and the mutual relationships. Lastly, the evolutionary stages will present different innovation strategies involved with cooperation and competition in TFT-LCD industry.

3.1.1 TFT-LCD Ecosystem Structure

In applications of Guo (2009)'s innovation ecosystem structure to business ecosystem level, TFT-LCD ecosystem is composed of entity populations, supporting populations, and environment. First, the entity populations are core materials and equipment suppliers, panel and components producers, final product assemblers. The Korean and Taiwanese entity populations differ greatly in the sizes that they are likely to take different approaches due to the heterogeneity of economic structure (Kawakami & Abe 1997).

The supporting populations composed of governments, research centers, service organization and financial organizations play important roles in the TFT-LCD ecosystem. Taiwanese Government appointed TFT-LCD manufacturing industry as its major strategic industry and established Industrial Technology Research Institute (ITRI) to enhance its capabilities. Korean government also support in deregulation and cheaper credit access give Korean FPD firms the capabilities to develop newer generation production lines.

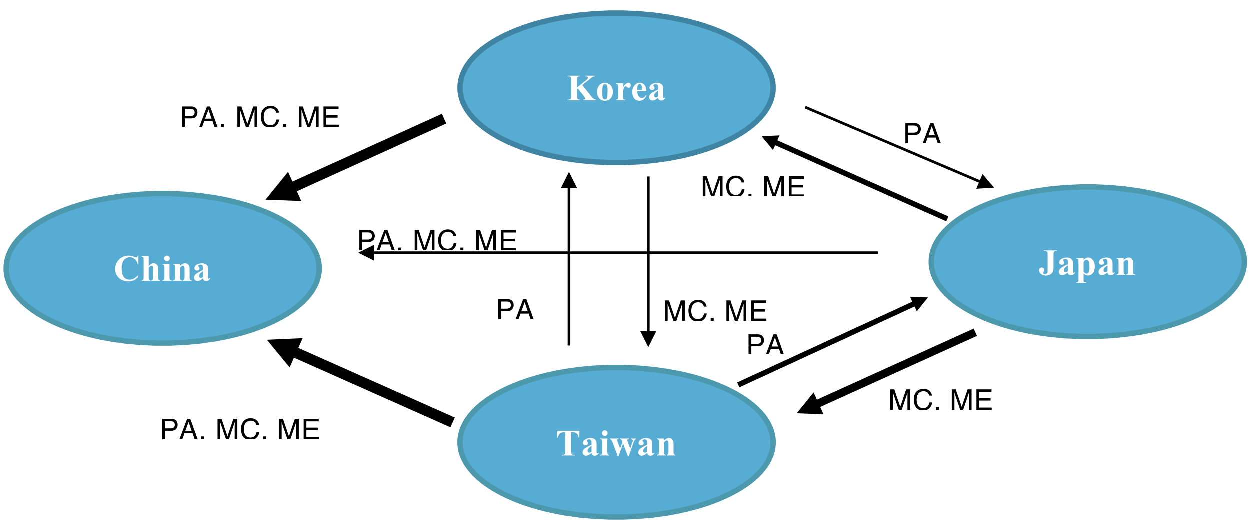
Lastly, the environment of TFT-LCD ecosystem includes capital investment, human resources, government policy, macro-economic environment, as well as humanity environment. The environment plays a decisive factor in terms of business innovation in TFT-LCD ecosystem. Take the cultural factors of humanity environment for instance. Some scholars (Hamilton & Biggart 1988; Dodgson 2009) pointed that the Chinese norms of equal inheritance formed the unique Taiwanese small and medium-sized enterprises, which maintain financial linkages but operate independently in Taiwanese TFT-LCD ecosystem.

3.1.2 TFT-LCD Ecosystem Supply Chain

Despite the fact that Japanese firms lost most of the market share in TFT-LCD panel, Japanese firms still own most of the essential material and equipment technology for TFT-LCD productions. Some U.S. companies also engage in TFT-LCD fabrication by some key panel technology patents and some material and equipment supplies. For example, Kodak previously transferred some patents over organic light-emitting diodes (OLEDs) to Sanyo through Kodak-owned JV. Even though Korean companies have developed TFT-LCD technology for long, they still need depend on core upstream equipment and key materials from Japanese providers[4].

Korea and Taiwan dominate the TFT-LCD panel productions, accounting for more than 80% of the global market share (Hung 2006). The major Korean companies in manufacturing TFT-LCD panels are Samsung and LG Displays (previous LG Philips), which are the merger outcome after the restructures led by Korean Government during the Asian financial crisis in 1998. The current biggest Taiwanese TFT-LCD panel maker is AU Optronics Corp. (AUO), which is also a merger of Acer Display Technologies and Unipac Optoelectronics Corp in 2001 (Chang 2005).

Figure 2. International Supply Chain of TFT-LCD Ecosystem (Han 2012)



Source: Trade structure in the data (Han et al. 2012)

Japanese companies export almost all the material and components (MC) and manufacturing equipment (ME) in the supply chain. As for Korean manufacturers, the panel is its main exporting industry, which is more significant than their materials and components (MC) and manufacturing equipment (ME) production. Taiwanese TFT-LCD producers are mainly focusing on the panel and MC as the exporting force. Overall, TFT-LCD panel is the main force of Korean and Taiwanese exportations. <Figure 2> illustrates the international supply chain of TFT-LCD ecosystem (Han et al. 2012).

[4] Han (2012) pointed that the technology development of Korean firms is only equivalent to 20% of Japanese firms.

Most all of the semi-finished LCDs products made by Korean or Taiwanese firms are exported to China for the final assembles. That is, a large portion of the materials and components are exported to China. In the current TFT-LCD supply chain, Chinese firms focus on the production of earlier generation TFT-LCDs and the LCD module assembles (Han et al. 2012).

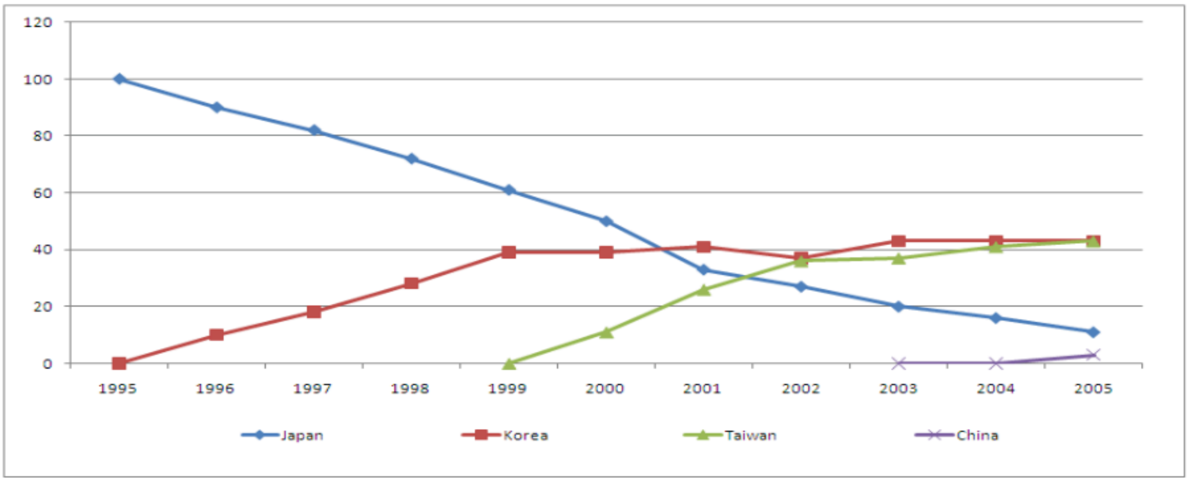
3.1.3 TFT-LCD Ecosystem Evolution

Just like other high technology, the TFT-LCD ecosystem is not static but in great dynamics (Linden et al. 1998; Mathews 2004). It can be influenced by any policy changes or strategic alliance across national borders. The entity populations, supporting populations and environment in the TFT-LCD ecosystem are also interactive in form of cooperation and competitions. Each unit in the ecosystem will evolve through the different strategies to innovation. There are four main stages of a business ecosystem, respectively as birth, expansion, leadership and self-renewal (Moore 1993). The companies in TFT-LCD ecosystem also have evolved from stage to stage as a result of the business strategies to innovation.

Korea's entry in 1995 changed Japan's monopoly position in TFT-LCD industry ecosystem (See Figure 3). Japanese companies lost its comparative advantages in TFT-LCD panel production, especially after Korean companies' independent technology development and lower cost production line struck the market (Chung 2015). To overcome the challenges from Korean competitors and 1998 Asian financial crisis, Japanese firms sought to form international strategic alliances and reform the internal business structure. Therefore, Japanese firms transferred some of its core technology to six Taiwanese manufacturers to earn royalty income and ensure the cheaper panel supplies from the collaborations.

Through the strategic collaboration, six Taiwanese companies made the entry in generation 3/3.5 production lines. The external technology acquisition is an effective strategy to keep R&D costs low for small- and medium-sized enterprises (SMEs) and large corporations (Granstrand et al. 1992; Hu 2008). This strategy also allowed Japanese firms to transform themselves to higher value-added niche sectors such as low-temperature polysilicon TFT-LCDs, specialized LCDs like screens for industrial goods or small LCDs of less than 10 inches (Mathews 2004; Han et al. 2012). It is noted that Japan focused on more advanced technology such as high value-added components to demonstrate its entrepreneurial resilience (Hu 2012).

Figure 3. TFT-LCD Global Market Share of Large-Panel (by Countries)



Souce: Brief story (Shintaku 2008; Han et al. 2012)

Due to the technology development and lower labor cost, Korean latecomers surpassed Japan first movers in the production of TFT-LCD panels in 2000 (Han et al. 2012). In the early development stage, Korean companies adopted a strategy of fast followership and made use of its good mass-production capacity on the basis of semiconductor competence (Mathews 2004). Hu (2008) also claims that Korean firms had been actively engaged in higher TFT-LCD generation development even during the downturns. Instead of the high risk of independent investment without any linkages to global players, Korean firms developed a vertically global networking to acquire and assimilate other technology sources (Hung et al. 2012).

Korean companies tend to challenge the first mover in TFT-LCD and compete with the frontier Japan under the government support (Tseng et al. 2009; Hung et al. 2012). SME-centered Taiwanese firms tend to adopt niche strategies to build low initial resource commitment without challenging the first leader within the global competition. Industrial latecomers unlike leaders tend to develop dominant knowledge in specific sectors of the industry instead of dealing with new market demands (Helfat & Raubitschek 2000). Linden (1998) called this kind of flexible specialization as "guerilla capitalism", which presents the flexible and fast response to the market changes with less commitment to a specific industry.

To conclude, Japanese firms are the leading suppliers of core materials and equipment for production in the current TFT-LCD ecosystem; some U.S. firms are also engaged in TFT-LCD fabrication through some patent transfers. As for the TFT-LCD production, Korean and Taiwanese companies are the main TFT-LCD panel manufacturers, specializing in intermediary goods. Chinese companies mostly participate in earlier generation TFT-LCD production and the final assembles, which makes China the main importer of the intermediary materials in the TFT-LCD ecosystem. As a fast-growing player, China also seeks for more strategic alliances to receive technology transfers (Han et al. 2012).

3.2 From Flying-Geese to Water-Lily

3.2.1 Flying-Geese Model

Kaname Akamatsu firstly developed the Flying-Geese Model to demonstrate the economic development of East Asian region (Schröppel & Mariko 2005). The theory of multi-tier hierarchical Flying-Geese Model is that the industrialization will be spread from developed countries to less developed countries (Han et al. 2012). It depicts the East Asian economic development track as Japan leading the regional development, which considers Japan leads the economic development while other countries follow the leader in East Asian literature.

Besides, the ideology behind the Flying-Geese Model is that no other East Asian countries could ever challenge or even surpass Japan's superior position. Li (2007) used cultural implications in Chinese classic literature to interpret the Flying-Geese metaphor as an order based on leadership and collective action within a nation-state. Many scholars use the notion of Flying-Geese Model to explain the rise of newly industrialized countries (NICs), so-called as East Asian "Economic Miracle" (MacDonald, Lawrence Page et al. 1993). This model indicates that the release of Japanese resources such as technology transfers is the main boost to the economic development in NICs.

Linden (1998) further divided the perspectives of Flying-Geese Model into two camps: Asian skepticism and network globalization. Asian skeptics mainly argue that the newly industrialized countries (NICs) are only developed on the basis of resource mobilization rather than technology improvements. Krugman

(1990) argued that there still would be a "technology gap" between the newly industrialized countries (NICs) and other developed countries. However, network globalization researchers argue that the pluralist relationship is presented in East Asian network production. Some proponents of network globalization perspectives pointed out the interpenetration of U.S. firms in the TFT-LCD supply architecture, which controvert the claims that Asian skeptics proposed.

Nonetheless, the traditional rationale of Flying-Geese Model cannot fully describe the East Asian economic development trajectory, especially in the case of high technology development. Cumings (1984) argued that the followers would become leaders once they originate new industries by redefining the concepts of Flying-Geese Model. Hu (2008) stated that the transfer of technology could be also defined as information exchange. The knowledge internalization of the technology transferred from foreign country is essentially important factor contributing the East Asian "Economic Miracle" (MacDonald, Lawrence Page et al. 1993).

Therefore, it is not impossible to close the technology gap between developing countries and more advanced countries. There are three factors to bring down the gap, such as capabilities of firms, access to capital of firms, and access of technology of firms (Linden et al. 1998). Besides, Linden (1998) also pointed that both Taiwan and Korea have continued to use tax incentives and administrative to promote high technology industries. He revised the conventional definition of Flying-Geese Model by examining TFT-LCD development in East Asian countries. Hence, Linden (1998) suggested that TFT-LCD industry like other high technology is rather a moving target (Linden et al. 1998).

3.2.2 Bamboo Capitalism

Since the rise of China made it become the second largest economy in the world, the role of China in the regional economic development has been frequently discussed. Therefore, the attention on the "bamboo perspectives" has been rising to describe the China-centered economic development in the East Asia. The China-centered perspective mainly derives from new investment and segmentation in globalization era.

Based on the comparative advantages of countries, each country produces specific parts of production lines and forms the international division of labor.

Roland-Holst (2003) developed the theory of Bamboo Capitalism to describe the international supply chain decomposition of the global economy. In the Bamboo Capitalism, the supply chain is considered as a root system of the bamboos and the enterprises like leaves sprout from the bamboo nodes. The firms that sprout from the nodes in the root system are in the support of global intermediate supply. Hence, the Bamboo Capitalism Model emphasizes the economic agglomeration and globalization at the firm level.

Park (2005) pointed out that the relevant period in presenting the characteristics of the bamboo capitalism is from 1985 to 2011, about the years that the significant segmentation of production took place in East Asia. The favored examples of newly industrialized countries (NICs) are the four Tiger economies in East Asia, respectively as Hong Kong, Singapore, South Korea and Taiwan. Harvie & Lee (2002) claimed that the process of bamboo capitalism was long established in these Tiger economies and gradually spread to China and other emerging economies.

To be followed, there will be more vibrant new enterprises as the root system is enlarged (Roland-Holst 2003). In this economic phenomenon as described, foreign direct investment (FDI) plays an essential role to create distinct local industries in the global supply chains. In addition to the capital allocation, FDI also presents more employment opportunities, values to the root system and hierarchy of technology. Cheow (2004) asserted the China-centered horizontal networks of trade and capital are created by FDI flows in the region and the exchange of parts, components and other intermediate products[5].

3.2.3 Water-Lily Model

The Flying-Geese Model cannot explain the current economic development anymore for ignoring the facts that some countries may also develop their own technologies instead of receiving the technology achievement from Japan (Han et al. 2012). Although Taiwan entered the TFT-LCD industry in 1998 with

[5] Li (2007) argued that the success of ethnic Chinese family business and networks connecting interlocking in East Asian region presents the spill over effect of the regional network.

Japanese technology transfer, the strategic alliance with Japan cannot be counted as the main reason for the TFT-LCD development in Taiwan (Hu 2008). In addition, Korea entered TFT-LCD manufacturing without licensing intellectual property (IP) from Japan and even pushed for more advanced generations of the TFT-LCD modules.

The Bamboo Capitalism presents the importance of the globalization on the industrial supply chain based on comparative advantages. However, it only focuses on the China-centered agglomeration at the firm level. Since the economic integration has been more significantly vital in the economic development, the tariff liberalization has a decisive position especially in high technology sectors. Therefore, there are some limitations of the Bamboo Capitalism to explain the economic development in the East Asian content.

Han (2012) proposed "Water-Lily Model" to emphasize the effects of regional integration and international trade dynamics on TFT-LCD industry. Just like the sprouting order of water lily leaves, which come first in the close area of stalk and then in a more distant area, Water-Lily Model indicates the TFT-LCD cluster firstly appeared in Japan, then Korean and Taiwan to China. Besides, it also emphasizes that the leaves are floating at the same time despite the distance and also the clusters are likely to enlarge. As noted, the clusters might be expanded to other regions such as Malay Peninsula, Mekong River Area or East India Area.

In the Water Lily Model, the cluster will expand through creation, development and maturation of a product. Through international trade or foreign investment, the other stalks and leaves will come out when the first stalk faces the diseconomies of agglomeration and enters the maturation stage. It is said that the first stalk exports the materials and components to the second one; the second stalk will also produce the materials and components and exports to the next comers (Han et al. 2012). This model concentrates on the economic agglomeration that international integration saves the link cost and present the regional comparative advantage.

Table 2. Models for the development in East Asia

	Flying-Geese Model	Bamboo Capitalism Model	Water-Lily Model
Relevant Period	1960-mid 1990	1985 (Plaza Accord)-2001	Late 1990-present
Economic Principle	Industrial life cycle - Foreign transfer of declining industry - Theory of comparative advantage	Segmentation of production = Agglomeration and globalization of the firms - International comparative advantage	Economies of agglomeration - International integration, saving of link cost - Regional comparative advantage
Background	- Enhancement of industry structure in Japan after WWII - Outward looking policy in NIEs	- Plaza Accord and high Yen - Investment to South East Asian countries - Entry of China into world economy	- China's accession to WTO and high growth rate - FTA in the region
Economic Performance	- Development of Asian countries one by one - Vertical integration with the center of Japan	- Stronger linkage with East Asian countries - Complication of vertical integration - Vertical division of labor	- Agglomeration in the wider area - Growth in the region and increase in international trade

Source: Theories explaining the dynamics of industrial development among East Asian Countries (Han et al. 2012)

With the background of the rise of China and the increased importance of FTA in East Asia, the economic development of water lily model is more relevant to current industrial development, presenting the period from late 1990s to present (Park 2005). Han (2012) claims that the economic development of East Asia has already moved from Flying-Geese Model to Bamboo Capitalism Model, and further to Water-Lily Model that can best picture the current economic development in the East Asian content (See Table 2).

3.3 China-Korea Free Trade Agreement

3.3.1 Free Trade Agreement as Mainstream

As the rapid progress of IT industries and economic integration, countries are turning to the deeper liberalization and globalization by the means of Regional Trade Agreements (RTAs) or Free Trade Agreements (FTAs). Economic integration has been a global trend for the benefits from the competition, FDI flows and the mechanism to complement the current multilateral trading system. Li (2007) argued that regional integration of East Asia has become remarkably favored research topic for several reasons.

First of all, the population of East Asian countries is around 2 billion, more than four times of the population of European Union countries or the population of NAFTA. Secondly, East Asia owns the fast growing rates, high domestic savings and over than the half of the world's foreign exchange reserves. Moreover, the rise of China makes the economic cooperation with China more vital in the global market. Since China joined WTO in 2001, it has been active in participating in the preferential treatments to lower the trade costs and increase the trade flows and foreign direct investment (Li 2007).

Free Trade Agreements (FTAs) help the contracting countries reallocate its resources in a more efficient way based on its comparative advantages. FTAs can stimulate the less-competitive domestic industries to reform to more efficient and advanced actors. The benign competitions are needed in pursuit of liberalization and globalization in the international commerce. Furthermore, the FTAs are believed to increase the trade flows as well as foreign direct investment. World Trade Organization (WTO) has faced some serious difficulties to address Singapore issues, and the Doha Round still could not be concluded which give the multilateral trading system a big defeat. FTAs are complementary to the existing multilateralism. Therefore, establishment of the Regional Trade Agreements (RTAs) or Free Trade Agreements (FTAs) can be an alternative option in the global economy.

3.3.2 Korea's Position in China-Korea Free Trade Agreement

Korean Government has been actively engaged in the establishing FTAs with other countries to enhance its economic competitiveness. Lee (2005) contends that the Korean Government has adopted simultaneous FTA-driving strategies in develop economic cooperation with the major economies, such as China, the United States and European Union etc. In other words, Korea pursues to develop a FTA based economic framework on a multi-track basis. Since Korean economy is based on the export-oriented industries, the international trade plays an essential role in the national economy. It is expected that the FTAs will give Korea positive effects not only on net exports, GDP, but also on the inward foreign direct investment (FDI).

According to a study on China-Korea FTA by Korean Institute for International Economic Policy (KIEP) (Lee et al. 2005), Korea's economic activities account for more than 70 percent of its GDP. Further, it is estimated that the GDP of Korea and China will increase by 0.5 percent (from 2.4% to 3.1%) and 0.2 percent (from 0.2% to 0.4%) respectively. China-Korea FTA will give Korea a better access to Chinese market and secure its trade by reducing the one-sided safeguard measures. Lee (2005) also asserts that China cannot become an economic super power without foreign direct investment for the fact that foreign-invested enterprises contribute majorly to the Chinese exportations. The flows of FDI brought under FTA will also be vital in Chinese economic development.

In terms of competition, Korea has more comparative advantages in more capital and technology-intensive industries such as chemicals, machinery and metal manufacturing. China has abundant labor resources and nature resources, which make it more competitive in agriculture and marine industries etc. The competition will lead the countries pursue higher value-added technology and release some resources to the trading partners. Therefore, some Korean companies are likely to move the parts of the production lines to China when there are no tariff barriers between the two countries. This Off-shoring effect is not necessary to harm the Korean economy; instead Korean domestic firms could improve its efficiency and focus on advancement of technologies.

China is a major foreign direct investment destination for many Korean companies, the scale of Korean investment reached many billions of dollars (Song 2012). China-Korea FTA will lead more Korean companies to invest in China or develop more production lines by exploiting the benefits of no tariff barriers. Lee (2005) claims that Korea will also attract more FDI from non-member countries, which want to enter both Korean and Chinese markets. Korea has more advantages in the supply chain, labors and infrastructure for foreign investors, especially in high-value industries like parts and basic materials, R&D services or logistics.

Besides, Through the China-Korea FTA, Korea can act like a bridging role for the intermediary position between China and Japan or other developed economies in terms of its economic development level (Choi 2013). Song (2012) illustrated the FDI relationship between China and Korea by the triangle "Asian Production Network" (Roland-Holst 2003). Take TFT-LCD industry for an example. It says that the countries with more advanced technology like Japan, Korea and Taiwan are at one point of the triangle. The first point of triangle produces TFT-LCD components and panels and exports to the second point. As the second point, China assembles the parts and components to the final products. These products are exported to the world market, which is the global market.

WTO has been faced efficiency problems during the Doha Round negotiations; therefore, many countries turned to RTAs or FTAs to pursue further economic integration. China-Korea FTA can help to establish not just a more stable bilateral economic development, but it is also beneficial to the political, diplomatic and cultural relationships in the region (Lee et al. 2005). In the current global economy, preferential trade agreements like RTAs or FTAs are the trend for being complementary to the existing multilateralism. It is believed that the tariff liberalization will benefit the export-oriented industries and further the national economy as a whole[6].

[6] Although the spillover effects will harm the weaker industries, the Governments need to help industry restructures and provide exit mechanism to reduce the loss from tariff liberalization to the most.

3.3.3 Implications of China-Korea Free Trade Agreement on TFT-LCD Industry

There are several criticisms of the China-Korea FTA regarding to automobile and LCD sectors. In order to compromise with the agriculture protection measure Korean government adopted, Korean government had to agree to put automobile sectors aside from the liberalization schedule and TFT-LCD productions in an eight-year tariff reduction schedule. Therefore, the benefits for the Korean TFT-LCD producers from the China-Korea Free Trade Agreement cannot be seen immediately. Korean government argues that the current tariff schedule on TFT-LCD sector, which was concluded at the end of 2014, would not harm the dominance position of Korean firms for Korean companies' tendencies to build more panel factories in China.

On the other hand, despite the fact that the tariff reduction on TFT-LCD productions will been enacted eight years later than other sectors. It will still give Korean manufacturers a very significant advantage for the fact that it usually takes about three years to develop a new generation production line in the TFT-LCD industry. Therefore, the expectations of tariff reduction will attract significant FDI flows. By deeper economic integration with China, Korean companies can exploit the comparative advantages to build a much more efficient production network.

In addition, Korean companies have been focusing on higher value-added technology development in the FPD industry, while Chinese companies have been seeking for technology transfers to upgrade its TFT-LCD productions. Korean companies are more likely to export its earlier generation production technology to Chinese producers to earn loyalty fees. They might benchmark the experience of how Japanese firms transferred some core technology to Taiwanese firms during the Asian financial crisis and transform themselves to higher value-added technology developers.

IV. Methodology

4.1 Background

The impact analysis on market access is decisive to determine the international trade policy. Thus, it is necessary to undertake a quantitative analysis in order to present the potential effects on the international trade.

There are two types of analysis to simulate the effects of tariff rate changes on the trade such as preferential trading agreements (PTAs). In ex-ante analysis, the scenarios in which trade agreements are simulated in order to access likely trade policy changes. In contrast, ex-post analysis requires that policies have been in place for a certain time. Both ex-ante analysis and ex-post analysis aim to estimate trade flows by comparing conditions under selected parameter values.

Over the years, three major analytical tools have been established as a predictor of changes in trade flows, which include the computable general equilibrium (CGE) models, partial equilibrium model (PE) for ex-ante analysis and gravity model for ex-post analysis, which in fact simulates before and after policy changes, respectively. Hence, the choice of the analytical tool depends on the range of focused industry sectors as well as the stages of policy-making in the simulation.

CGE models are based on general equilibrium analysis in the computer applications, which capture wide links between economy sectors and long-term effects. PE models, on the other hand, focus on the disaggregated effects on specific sectors by a trade policy change (Aunkoonwattaka 2015). Besides, partial equilibrium models do not account for any economic interactions between various markets in one economy of interest, whereas all markets are simultaneously models and interact with each other in general equilibrium model (See Table 3).

Table 3. The Comparison of Partial Equilibrium Model and General Equilibrium Model

	Partial Equilibrium	General Equilibrium
Capturing economy wide linkages		X
Consistency with budget constraints		X
Capturing disaggregated effects	X	
Capturing complicated policy mechanisms	X	
Use of timely data	X	
Capturing short and med. term effects	X	
Capturing long term effects		X

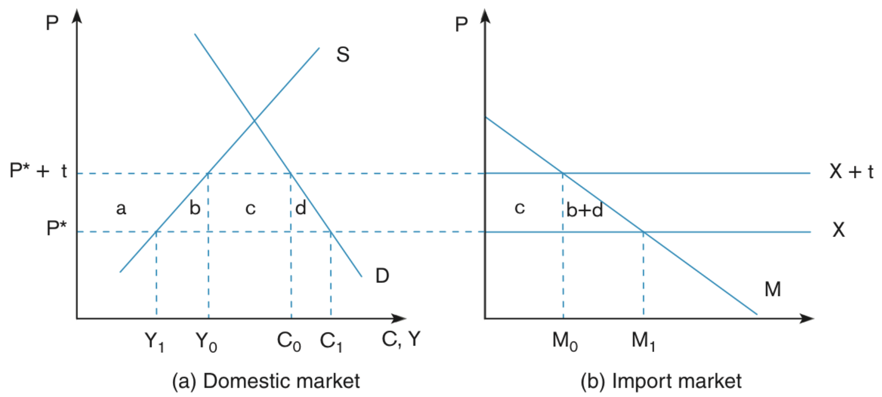
Source: WITS Advanced Course Presentation (World Bank 2008)

Differing from the ex-ante analysis, gravity models are often used to assess the impacts of implemented Free Trade Agreements (FTAs) based on historical trade data. The gravity model assumes that the trade volume has a positive correlation with the size of the economies and a negative correlation with the distances between the economies (Teh & Piermartini 2005).

4.2 Partial Equilibrium Model

Partial equilibrium model presents the tariff reduction effects on a specific industry in the short-term period. The basics of the partial equilibrium model can be presented in the graphical illustration respectively for the case in a small country and a large country. The effects of eliminating tariff present in different level as followed.

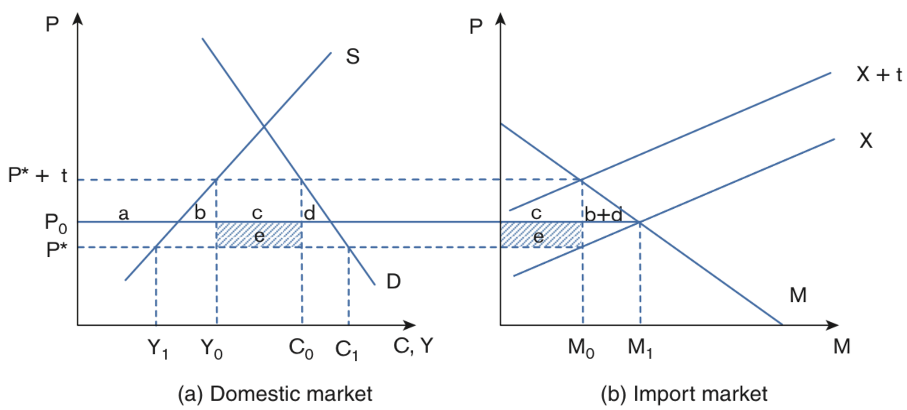
Figure 4. Tariff Reduction in the Small Country Case



Source: Partial-equilibrium trade-policy simulation (World Trade Organization 2012)

<Figure 4> portrays the tariff reduction in the small country case. When the tariff is removed in the small country, the demand *C* is increased as much as *(C1-C0)*, supply *Y* is decreased as much as *(Y1-Y0)*, and the imports *M* are also increased by the amount *(M1-M0)*.

Figure 5. Tariff Reduction in the Large Country Case



Source: Partial-equilibrium trade-policy simulation (World Trade Organization 2012)

In the case of tariff reduction in the large country (See Figure 5), the foreign export supply curve exhibits an upward sloping. When the tariff eliminated in the large country, the export supply curve *X+t* is shifted to *X* and the new domestic price is *P0*. The decrease in the domestic price is less than the full amount of tariff *t*. This means foreign price *(P*)* in presence of tariff is lower than free trade price *P0*, which creates the trade gain *e*.

In particular, in this thesis the partial equilibrium model SMART will be employed with a focus on the LCD panel industry. This model seeks to estimate trade effects and tariff revenue changes under determined scenarios. Under the Armington assumption, PE assumes that imported goods from different countries are seen as imperfect substitutes. Additionally, further assumptions including incomes, exchange rates, remain unaffected after policy changes in the model.

The advantage of the partial equilibrium lies in the simplicity and the minimal requirement of data. Bilateral trade flows, tariff changes and behavioral parameters (elasticities) are sufficient to conduct the market access analysis. Another major advantage of partial equilibrium model is that it allows conducting an analysis on a disaggregated level. Therefore, it is feasible to focus on TFT-LCD industry regardless of other industrial development with partial equilibrium model.

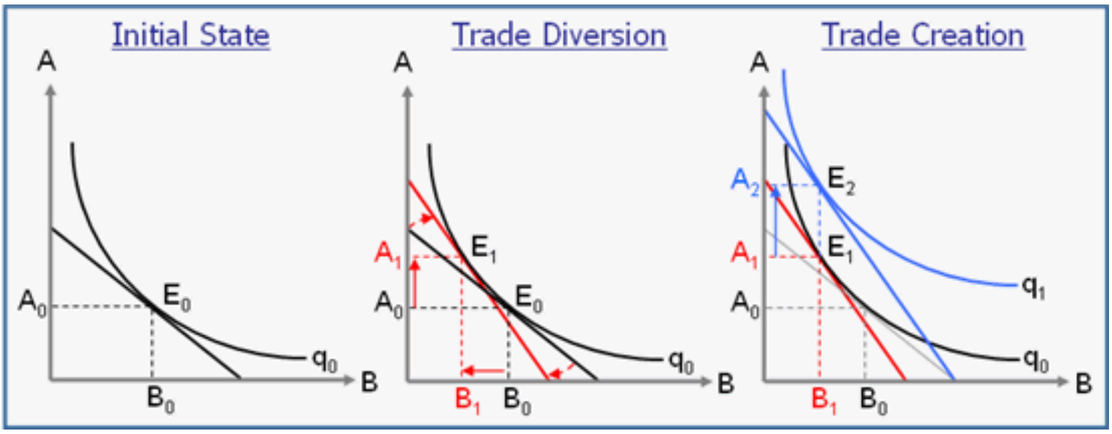
However, partial equilibrium model are not without flaws. Due to its simplicity, partial equilibrium models tend to be very sensitive to economic variables such as the behavioral elasticities. Besides, the neglects of the relevant interactions between markets might lead to biased results.

4.3 SMART- Theoretical Framework

The general idea in SMART is that, it tries to predict the outcome of market changes according to certain trade policy changes on a number of variables. As a result, it reports the trade flow effects in terms of trade creation, trade diversion and total trade effect.

Below, <Figure 6> displays the effect of trade diversion and trade creation, which will be explained in more detail. A and B, here, are two partner countries from which the home market imports the good g. In the initial state the consumed quantity q0 is determined by A0 and B0. Furthermore, the line illustrates the relative price between the partner countries A and B. The intersection of the import quantity q0 and the line from A and B is given by the intersection point E0, which is the equilibrium.

Figure 6. Trade Creation and Trade Diversion in SMART



Source: WITS Online Help on SMART (World Bank 2010)

If partner A is granted a preferential tariff such as tariff reduction, its relative price will therefore get reduced compared to B. The consumption q0 does not change but the relative price gets steeper. This results in a shift in import demand and thus to a new equilibrium E1 where imports from A (A0 -> A1) increase and at the same time decrease in B (B0 -> B1). This effect is termed as trade diversion.

Furthermore, if the tariff is reduced on imports from A the domestic price of good g is automatically lowered. This causes a revenue effect where consumption of the good imported by partner country A is higher. A new consumption quantity q1 is triggered leading to increased import from partner country A. Additionally, a new equilibrium point E2 is established. This effect is termed as trade creation. The total trade effect is the sum of trade diversion and trade creation.

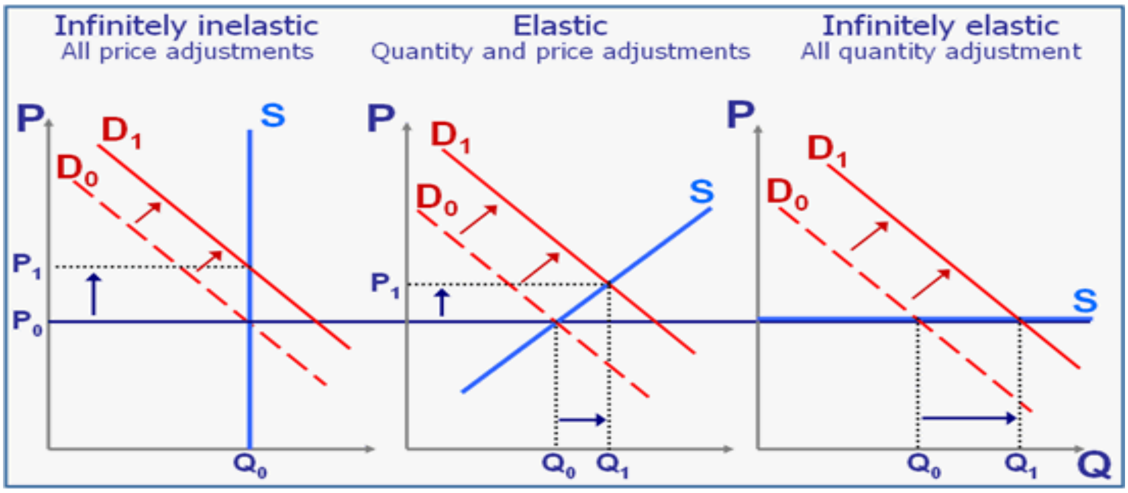
In summary, a positive value in trade creation and trade diversion (as in partner country A) would be seen as beneficial in SMART whereas all other countries suffer from decreased trade flow (B0 -> B1) with no trade creation.

Elasticities

Generally speaking, elasticity presents the level of responsiveness of an economic variable to a change in another. When using SMART two sides need to be taken into consideration, namely the exporter side (the one who exports into the home market) and the demand side (the one who imports goods from competing countries).

In case of the exporter side, a certain good is exported by different suppliers into the home market. Export supply expresses the relation between good (exported by the country supplier) and relative price on the export market. The scale of "responsiveness" to changes in export prices is termed export supply elasticity. Typically, three types of export supply elasticities describe the behavior of export market changes with regard to imported quantity for a given price. The following <Figure 7> depicts the changes of the export supply curve (S) resulting in a shift of the demand curve (D0 -> D1). This reflects the relative change in either price (infinitely inelastic) or quantity (infinitely elastic) or both (elastic).

Figure 7. Export Supply Elasticity



Source: WITS Online Help on SMART (World Bank 2010)

- Infinite inelastic supply elasticity: In case of fixed quantity offered by the export supplier the market is only adjustable through price (P0->P1)

- Infinite elastic supply elasticity: In case when suppliers "can meet with level of demand at same price level" (P0) the market is only adjustable through quantity (Q0 -> Q1).

- Elastic supply elasticity: Market is adjustable both through quantity (Q0 -> Q1) and price (P0 -> P1)

In our analysis we used the infinite export supply elasticity, which is the default parameter in SMART, hence it assumes that the export supply curves are flat and world prices for each good (LCD panel etc.) with an exogenous change.

4.4 Data Analysis

In order to gain a better understanding of the ecosystem between China, Korea, Japan and Taiwan regarding the LCD industry, we will utilize SMART to access possible trade flow changes. Thus, the simulation aims to predict the likely outcome of the FTA between China and Korea. Therefore, two main scenarios present trade flow changes in the perspective of China as well as Korea.

Table 4. HS Classification of LCD Industry

LCD Panel	853120, 854390, 901380
LCD materials and components	853939, 853940*, 853990, 900120, 900190, 901390
LCD equipment	848630, 848690

Source: Concepts and classification of LCD industry (Han et al. 2012)

The data is predicated on the harmonized system (HS) classification at the six-digit level. At this level tariff rates become disaggregated and enables individual policy change analysis. In particular, in this thesis three HSC codes are used for SMART simulation (853120, 854390, 901380) that are relevant in the LCD panel industry (See Table 4), which are indicator panels incorporating electronic displays (HS code 853120), parts of electrical machines and apparatus (HS code 854290) and optical devices, appliances and instruments (HS code 901380) (Han 2012).

In order to examine with precise database, the bilateral trade data are retrieved from UN Comtrade database, Korea Customs Service and Bureau of Foreign Trade, Taiwan. We obtained the Chinese tariff rates from China-customs.com, which is currently the most informative database of Chinese tariff rates, as well as Korean tariff rates from Korea Customs Service on an 8- and 10-digit HS classification basis. In consistence with the 6-digit HS code based SMART analysis, we calculate the average tariff rates by adding up all of the tariff rates and dividing by the number of import categories (Suranovic 2006).

The trade policy simulation can be described as a four-step procedure (World Trade Organization 2012), which will be listed below:

(a) Choose theoretical model most suitable for the prediction of the effects of the policy under consideration

(b) Collect corresponding trade (import and export flows as well as tariffs) and the production data for the specific sector before policy change

(c) Select values for the model's key parameters (elasticities)

(d) Change value of the policy variables (tariff) of interest and recalculate prices and trade volume for comparison with baseline one

There are three elasticities as import demand elasticity, export supply elasticity and export substitution elasticity required to conduct SMART simulation[7]. Since the elasticity exhibits the level of responsiveness of an economic variable to a change in another, it is one of the main elements in the simulation. That is, the changes of import demand elasticity are determined by the reporter economic market, so that the import demand elasticity differs from country to country. As for the exporters' side, the export substitution elasticity presents the level of the response to the various goods based on the relative prices.

In this simulation, the import demand elasticity, export supply elasticity, and export substitution elasticity are default parameters as determined by SMART. The import demand elasticity, export supply elasticity, and export substitution elasticity of China respectively are 1.01114, 99 and 1.5; the import demand elasticity, export supply elasticity, and export substitution elasticity of Korea are 1.0176, 99 and 1.5. Besides, the simulation is conducted for each year separately from 2008 to 2013 for the selected East

[7] In SMART simulation, a trade policy change will affect the price index as well as the relative prices of various goods (World Bank 2011).

Asian countries. Below, the results have been summarized in terms of trade creation, trade diversion and trade total effect.

The full simulation results of SMART partial equilibrium modeling can be found in the appendix of this thesis. These values represent trade creation, trade diversion and trade total effect after applying tariff liberalization, respectively. Furthermore, the elimination of the tariff barrier for each product code is expressed in the change of the old tariff rate to the new one. Each table describes the scenario for each year when the tariff is reduced for imports from Korea or China with regard to three disaggregated markets playing a major role in the LCD panel industry (HS code: 853120, 854390, 901380).

Additionally, it also gives rise about the degree of trade flow changes among the East Asian countries of interest. Tables A1-A6 describe the result for China as the reporter, to which goods are imported from Taiwan, Japan and Korea. Table A7-A12 show the results for Korea as the reporter in analogue. From the results, it is apparent, that when reducing the tariff rate on one supply country while leaving the tariff rate unchanged for the other supply countries the trade flow of the one with no tariff barrier will increase tremendously.

In most cases the trade diversion in the East Asian countries (Taiwan, Japan) with no policy change decreases almost to 100 percent relative to the import trade value. Economically this means that, for instance, if reporter China reduces tariff on imports from supplier Korea on a certain good (here LCD panel in three different HS codes) the domestic price gets lowered resulting in a higher consumption quantity and thus to an increase in imports from Korea. Then, China will decrease imports from the same good from Taiwan and Japan.

The summarized results, shown in <Table 5> and <Table 6>, list the trade total effect, the import trade value as well as the impact factor of trade flow increase/decrease defined by the ratio of trade total effect and import trade value averaged over the years (2008-2013). We calculated it for the three different HS codes separately. Hereby, it can be observed that in the case of China as the reporter the impact factor for Korea ranges from 12654,379 to 23916,723, whereas in the case of Korea as the reporter the impact factor for China ranges from 665,56 to 754,176.

Furthermore, China imports from Korea on HS codes 854390 and 901380 are twice bigger than that of HS code 853120. Trade flows in HS 901380 will have a bigger change among three commodities. As expected, Taiwan and Japan show a very low (Taiwan: 0,06 to 0,189) to negative (Taiwan: -1 to -0,517, Japan:-1.052 to -1) impact factor. Hereby, among the countries of interest, Japan has the biggest trade flow decrease while Taiwan still can reach a positive trade diversion effect. Generally, the results state that exportations from Japan and Taiwan will likely decrease highly and be substituted by Korea when the tariff liberalization is reached.

Table 5. SMART Simulation Results for China as the Reporter

Reporter China					Product Code: 853120
Partners	Old Duty Rate	New Duty Rate	Averaged Import Trade Value in $	Averaged Trade Total Effect in $	Impact factor
Taiwan	70	70	1,582,408,022	8,706,782	0.006
Japan	70	70	20,076,262	-21,129,455	-1.052
Korea, Rep.	70	0	268,382,833	3,396,218,103,999	12654.379
					Product Code: 854390
Partners	Old Duty Rate	New Duty Rate	Averaged Import Trade Value in $	Avaergaed Trade Total Effect in $	Impact factor
Taiwan	30	30	61,742,703	-42,132,230	-0.6824
Japan	30	30	91,973,892	-24,816,910	-0.2698
Korea, Rep.	30	0	241,829,500	5,642,916,530,176	23334.27696
					Product Code: 901380
Partners	Old Duty Rate	New Duty Rate	Averaged Import Trade Value in $	Averaged Trade Total Effect in $	Impact factor
Taiwan	70	70	6,832,769,159	-3,534,367,435	-0.517
Japan	70	70	4,802,642,553	-4,802,642,553	-1.000

Korea, Rep.	70	0	15,586,329,167	372,773,916,584,646	23916.723

Table 6. SMART Simulation Results for Korea as the Reporter

Reporter Korea					**Product Code: 853120**
Partners	**Old Duty Rate**	**New Duty Rate**	**Averaged Import Trade Value in $**	**Averaged Trade Total Effect in $**	**Impact factor**
China	8	0	1,399,795,400	931,649,328,815	665.56
Taiwan	8	8	8,041,500	-8,041,500	-1
Japan	8	8	31,243,614	-31,243,614	-1
					Product Code: 854390
Partners	**Old Duty Rate**	**New Duty Rate**	**Averaged Import Trade Value in $**	**Avaergaed Trade Total Effect in $**	**Impact factor**
China	8	0	81,705,167	61,620,116,014	754.176
Taiwan	8	8	1,219,833	230,074	0.189
Japan	8	8	32,806,667	-32,806,667	-1
					Product Code: 901380
Partners	**Old Duty Rate**	**New Duty Rate**	**Averaged Import Trade Value in $**	**Averaged Trade Total Effect in $**	**Impact factor**
China	8	0	1,562,080,500	1,177,777,179,924	753.980
Taiwan	8	8	132,306,167	-97,805,644	-0.739
Japan	8	8	217,797,500	-217,797,500	-1.000

V. Conclusions

High technology industry, especially information technology, has been one of the main forces to globalization and liberalization. Flat panel display, which is dominated by TFT-LCD, is exclusively the core of the information technology. Thus, the development of TFT-LCD has an essential position in the East Asian economic development. Due to the high barriers to enter the TFT-LCD production, the cyclical strategy is required to overcome the huge amount of capital in the initial investment. As the devastating competitions in the TFT-LCD market after Korean companies joined TFT-LCD manufacturing, the clusters and strategic alliances have been formed.

The TFT-LCD ecosystem is in great dynamics. The downturns brought in more competitors and changed the TFT-LCD ecosystem. Aside from the huge capital investment, there are other key factors contributing to the successful entries of the new TFT-LCD incumbents. Both Korean and Taiwanese companies have benefitted from the government supports such as the cheaper credits granted by Korean Government or the Industrial Technology Research Institute (ITRI) established by Taiwanese Government. In the recent development, Chinese Government also has a notable engagement in developing TFT-LCD production in China.

To comprehensively analyze the TFT-LCD industry, the business ecosystem developed by Moore can be applied to the TFT-LCD production in three main aspects as industrial structure, supply chain and evolution. The ecosystem applications in TFT-LCD provide a broader scope to identify the living organisms and non-living organisms, understand the roles and relationships between the organisms, and innovation undertakings during the cooperation and competitions. In this study, the characteristics of the TFT-LCD actors and the relationship between them are highlighted. Besides, it further illustrates the strategic cooperation and competitions from new entrants in TFT-LCD ecosystem.

As the rapid technology development in East Asia, there are several models depicting the economic development during different periods. From Akamatsu's Flying-Geese Model, Roland-Holst's Bamboo Capitalism Model to Han's Water-Lily Model, these models not only present the region economic development but also the TFT-LCD development in East Asia. The TFT-LCD development changed from

Japanese outward looking policy in NIEs, vertical integration of the firms, and to now, international economic integration regarded as the mainstream. The Water-Lily Model emphasizes the significance of the FTAs in the economic development of TFT-LCD.

Developing a TFT-LCD production line is rather time-consuming, which is estimated to require three years. Therefore, the future trade policy changes have important implications for TFT-LCD firms in terms of business planning. Among the trade policies, Free Trade Agreements especially become the mainstream, which is believed to have positive effects in trade creation (Samuel 2015). Since China and Korea are the main trading partners in the TFT-LCD panel productions, China-Korea Free Trade Agreement will be an influential element in the development of TFT-LCD ecosystem as well as East Asian economic development.

From the SMART simulation results obtained by partial equilibrium models, it can be concluded that the tariff liberalization provides beneficial effects to the FTA contracting countries, which are China and Korea in our case. The outcomes of the trade total effects defined by the sum of trade creation and trade diversion show that China and Korea will have a noticeable increase in the TFT-LCD panel trade while Japan and Taiwan's trade may be decreased tremendously. Further investigation includes the variation in supply elasticity, hence for our analysis we assume an infinite elastic supply (supply elasticity is set 99 which is the default value chosen by SMART) between marketers.

Due to the partial equilibrium model's sensitivity to the elasticities, the chosen values might drastically vary the simulation results. Therefore, it is important to note that defining elasticities play an important role. The partial equilibrium is the optimal choice to conduct simulation on a specific sector, on which the simulation is computed on basis of disaggregated markets (6-digit HS code). In future studies, gravity models that allow for the market interactions can be used to compare with the SMART results. To conclude, the simulation results strongly support the argument that China-Korea FTA will lead a noticeable shift in the TFT-LCD ecosystem.

VI. Bibliography

Chang, S.C., 2005. The TFT-LCD industry in Taiwan: Competitive advantages and future developments. *Technology in Society*, 27(2), pp.199–215.

Cheow, E.T.C., 2004. China As The Center Of Asian Economic Integration. *Jamestown*, pp.6–8.

Choi, N., 2013. Korea-China FTA : Expected Effects and Future Directions. *KIEP Opinions*.

Chung, I.-J., 2015. Korean LCD Makers Emerge as Worlds Top Brands. *Korea Times*, pp.1–8.

Cumings, B., 1984. *The Origins and Development of the Northeast Asian Political Economy: Industrial Sectors, Product Cycles, and Political Consequences*,

Dodgson, M., 2009. Asia's National Innovation Systems: Institutional Adaptability and Rigidity in the Face of Global Innovation Challenges. *Asia Pacific Journal of Management*, 26(3), pp.589–609.

Granstrand, O. et al., 1992. External Technology Acquisition in Large Multi-Technology Corporations. *R&D Management*, 22, pp.111–134.

Guo, W., 2009. Research on Innovation Ecosystem in IT Industry. *2009 Chinese Control and Decision Conference, CCDC 2009*, pp.6004–6007.

Hamilton, G.G. & Biggart, N.W., 1988. Market, Culture, and Authority: A Comparative Analysis of Management and Organization in the Far East. *American Journal of Sociology*, 94(s1), p.S52.

Han, I., Oh, K. & Yoo, J., 2012. From Bamboo Capitalism to Water Lily : LCD Industry in East Asian Countries. *Internaional Telecommunications Policy Review*, 19(Iciim), pp.15–41.

Harvie, C. & Lee, H.-H., 2003. *Korea's Economic Miracle: Fading or Reviving?*, Palgrave Macmillan.

Helfat, C.E. & Raubitschek, R.S., 2000. Product Sequencing: Co-Evolution of Knowledge, Capabilities and Products.

Hu, M.C., 2008. Knowledge Flows and Innovation Capability: The Patenting Trajectory of Taiwan's Thin Film Transistor-Liquid Crystal Display Industry. *Technological Forecasting and Social Change*, 75(9), pp.1423–1438.

Hu, M.C., 2012. Technological Innovation Capabilities in the Thin Film Transistor-Liquid Crystal Display Industries of Japan, Korea, and Taiwan. *Research Policy*, 41(3), pp.541–555.

Hung, S.W. et al., 2012. Analysis of the Development Strategy of Late-Entrants in Taiwan and Korea's TFT-LCD Industry. *Technology in Society*, 34(1), pp.9–22.

Hung, S.W., 2006. Competitive Strategies for Taiwan's Thin Film Transistor-Liquid Crystal Display (TFT-LCD) Industry. *Technology in Society*, 28(3), pp.349–361.

Kawakami, M. & Abe, M., 1997. A Distributive Comparison of Enterprise Size in Korea and Taiwan. *The Developing Economies*, 35(4), pp.382–400.

Kawamoto, H., 2006. The History of Liquid-Crystal Displays. *Technology in Society*, 35(3), pp.279–304.

Krugman, P., 1994. The Myth of Asia's Miracle. *Foreign Affairs*.

Kuo, Y., 2013. Thin Film Transistor Technology—Past, Present, and Future. *The Electrochemical Society*.

Lee, H., Lee, I. & Park, S., 2005. Economic Effects of a Korea-China FTA and Policy Implications (I). *Policy Analysis 05-03*, pp.15–116.

Lee, H., Roland-Holst, D. & van der Mensbrugghe, D., 2004. China's Emergence in East Asia Under Alternative Trading Arrangements. *Journal of Asian Economics*, 15(4), pp.697–712.

Li, X., 2007. *East Asian Regional Integration : From Japan-led " Flying-geese " to China-centred " Bamboo Capitalism ,"*

Linden, G. et al., 1998. Flying Geese as Moving Targets: are Korea and Taiwan Catching up with Japan in Advanced Displays. *Industry and Innovation*, 5(October 2014), pp.11–34.

MacDonald, Lawrence Page, J. et al., 1993. The East Asian Miracle : Economic Growth and Public Policy. *Oxford University Press*.

Mathews, J. a, 2004. Strategy and the Crystal Cycle. *California Management Review*, (October).

Moore, J.F., 1993. A New Ecology of Competition Harvard Business Review. *Harvard Business Review*, pp.75–86.

Park, B.S., 2005. Rising China and Changes in Model for Regional Development in East Asia. *Issue Paper, Samsung Economic Research Institute*.

Roland-Holst, D., 2003. Global Supply Networks and Multilateral Trade Linkages: a Structural Analysis of East Asia. *New East Asian Regionalism*.

Salmon, A., 2015. Bright Outlook ? LG Strives To Switch On OLED Light Market. *Forbes*, pp.1–5.

Samuel, G.M., 2015. Uganda ' s Trade and Revenue Effects with the EAC Countries , DRC and Sudan. *Modern Economy*, pp.338–357.

Schröppel, C. & Mariko, N., 2005. The Changing Interpretation of the Flying Geese Model of Economic Development. *Japanstudien: Jahrbuch des Deutschen Instituts Fur Japanstudien / Yearbook*, pp.203–236.

Shintaku, J., 2008. Measuring Technology Strategy in Korean LCD Industry. *Akamon Management Review*, 7(1), pp.55–74.

Song, B., 2012. Korean Economic Trend and Economic Partnership between Korea and China.

Suranovic, S.M., 2006. *International Trade Theory and Policy*, Flat World Knowledge, Inc.

Tansley, A., 1939. *The British Islands and their Vegetation. Volume 1 of 2*, Cambridge University Press.

Teh, R. & Piermartini, R., 2005. *Demystifying modelling methods for trade policy*, Available at: http://www.mendeley.com/catalog/demystifying-modelling-methods-trade-policy/\nhttp://dspace.cigilibrary.org/jspui/handle/123456789/20700.

Tseng, F.M., Chiu, Y.J. & Chen, J.S., 2009. Measuring business performance in the high-tech manufacturing industry: A case study of Taiwan's large-sized TFT-LCD panel companies. *Omega*, 37(3), pp.686–697.

Wang, W.C., 2006. The Dynamics of FDI of the TFT-LCD Cluster: A Study of Japanese Firms in Taiwan. In *Enterprising Worlds: A Geographic Perspective on Economics, Environments& Ethics*. pp. 29–39.

World Bank, 2008. WITS advanced course presentation tools for market access analysis.

World Bank, 2010. WITS Online Help on SMART. Available at: http://wits.worldbank.org/wits/wits/witshelp/Welcome.htm.

World Bank, 2011. *WITS SMART Single Market Partial Equilibrium Simulation Tool*,

World Trade Organization, 2012. Partial-Equilibrium Trade-Policy Simulation. In *A Practical Guide to Trade Analysis*. WTO and the United Nations Conference on Trade and Development, pp. 137–177.

VII. Appendix

Table A1.

Reporter China				Product Code: 853120			
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2013	**Taiwan**	2,182,282,847	70	70	0	7,427,506	7,427,506
	Japan	13,525,224	70	70	0	-25,206,346	-25,206,346
	Korea, Rep.	364,887,000	70	0	15,192,134,830,863	17,778,914	15,192,152,609,778

Table A2.

Reporter China				Product Code: 853120			
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2012	**Taiwan**	1,566,713,015	70	70	0	5.397.797	5,397,797
	Japan	17,089,508	70	70	0	17,089,508	-17,089,508
	Korea, Rep.	299,913,000	70	0	1,248,643,686,595	11,691,803	1,248,655,378,398

Table A3.

Reporter China				Product Code: 853120			
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2011	**Taiwan**	1,146,835,930	70	70	0	5,278,433	5,278,433
	Japan	15,098,098	70	70	0	-15,098,098	-15,098,098
	Korea, Rep.	281,548,000	70	0	1,172,183,708,853	9,819,688	117,219,352,854

Table A4.

Reporter China		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $s
2010	Taiwan	1,471,730,390	70	70	0	9,437,221	9,437,221
	Japan	16,961,248	70	70	0	-31,284,568	-31,284,568
	Korea, Rep.	245,305,000	70	0	1,021,291,306,279	21,847,306	1,021,313,153,585

Table A5.

Reporter China		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2009	Taiwan	1,286,232,678	70	70	0	12,540,451	12,540,451
	Japan	20,451,152	70	70	0	5,263,828	5,263,828
	Korea, Rep.	229,398,000	70	0	955,092,197,301	27,347,102	955,064,850,198

Table A6.

Reporter China		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2008	Taiwan	1,840,653,270	70	70	0	12,159,283	12,159,283
	Japan	37,332,340	70	70	0	-43,362,040	-43,362,040
	Korea, Rep.	189,246,000	70	0	787,897,900,769	31,202,723	787,929,103,493

Table A7.

Reporter Korea		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2013	China	983,220,321	8	0	741,129,634,151	15,166,287	741,144,800,438
	Taiwan	2,978,000	8	8	0	-2,978,000	-2,978,000
	Japan	12,188,287	8	8	0	-12,188,287	-12,188,287

Table A8.

Reporter Korea		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2012	China	939,578,390	8	0	708,233,316,138	15,841,982	708,249,158,121
	Taiwan	4,089,000	8	8	0	-4,089,000	-4,089,000
	Japan	11,752,982	8	8	0	-11,752,982	--11,752,982

Table A9.

Reporter Korea		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2011	China	1,392,888,378	8	0	1,049,928,314,083	33,622,195	1,049,961,936,279
	Taiwan	11,347,000	8	8	0	-11,347,000	-11,347,000
	Japan	22,275,194	8	8	0	-22,275,194	-22,275,194

Table A10.

Reporter Korea		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2010	China	1,522,330,866	8	0	1,147,499,185,765	50,663,384	1,049,961,936,279
	Taiwan	9,264,000	8	8	0	-9,264,000	-9,264,000
	Japan	41,399,386	8	8	0	-41,399,386	-41,399,386

Table A11.

Reporter Korea		Product Code: 853120					
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2009	China	1,892,644,654	8	0	1,426,633,492,044	79,861,393	1,426,713,353,437
	Taiwan	7,395,000	8	8	0	-7,395,000	-7,395,000
	Japan	72,466,388	8	8	0	-72,466,388	-72,466,388

Table A12.

Reporter Korea					Product Code: 853120		
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2008	**China**	1,668,109,788	8	0	1,257,384,098,456	40,555,445	1,257,424,653,902
	Taiwan	13,176,000	8	8	0	-13,176,000	-13,176,000
	Japan	27,379,445	8	8	0	-27,379,445	-27,379,445

Table A13.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2013	**Taiwan**	132,069,830	30	30	0	-132,069,830	-132,069,830
	Japan	58,179,754	30	30	0	-58,179,754	-58,179,754
	Korea, Rep.	295,140,000	30	0	6,886,796,794,207	190,249,587	6,886,987,043,794

Table A14.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2012	**Taiwan**	102,357,631	30	30	0	15,305,207	15,305,207
	Japan	17,089,508	30	30	0	-17,089,508	-17,089,508
	Korea, Rep.	175,303,000	30	0	4,090,520,222,317	1,784,325	4,090,522,006,643

Table A15.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2011	**Taiwan**	77,832,625	30	30	0	-77,832,625	-77,832,625
	Japan	127,540,262	30	30	0	-127,540,262	-127,540,262
	Korea, Rep.	286,550,000	30	0	6,686,357,733,211	205,372,879	6,686,563,106,090

Table A16.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2010	**Taiwan**	33,906,286	30	30	0	-33,906,286	-33,906,286
	Japan	141,232,057	30	30	0	31,539,306	31,539,306
	Korea, Rep.	266,403,000	30	0	6,216,247,632,876	2,367,013	6,216,249,999,889

Table A17.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2009	**Taiwan**	9,321,170	30	30	0	-9,321,170	-9,321,170
	Japan	85,636,798	30	30	0	8,400,898	8,400,898
	Korea, Rep.	160,770,000	30	0	3,751,407,198,633	920,271	3,751,408,118,904

Table A18.

Reporter China					Product Code: 854390		
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2008	**Taiwan**	14,968,673	30	30	0	-14,968,673	-14,968,673
	Japan	122,164,971	30	30	0	13,967,859	13,967,859
	Korea, Rep.	266,811,000	30	0	6,225,767,904,923	1,000,814	6,225,768,905,737

Table A19.

Reporter Korea					Product Code: 854390		
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2013	**China**	144,274,000	8	0	108,750,535,921	45,041,975	108,795,577,896
	Taiwan	908,000	8	8	0	113,025	113,025
	Japan	45,155,000	8	8	0	-45,155,000	-45,155,000

Table A20.

Reporter Korea		Product Code: 854390					
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2012	**China**	111,275,000	8	0	83,876,622,847	38,575,068	83,915,197,915
	Taiwan	1,249,000	8	8	0	157,931	157,931
	Japan	38,733,000	8	8	0	-38,733,000	-38,733,000

Table A21.

Reporter Korea		Product Code: 854390					
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2010	**China**	50,985,000	8	0	38,431,360,286	26,666,293	38,458,026,580
	Taiwan	877,000	8	8	0	198,707	198,707
	Japan	26,865,000	8	8	0	-26,865,000	-26,865,000

Table A22.

Reporter China		Product Code: 901380					
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2013	**Taiwan**	6,862,580,489	35	35	0	-6,862,580,489	-6,862,580,489
	Japan	5,435,985,027	35	35	0	-5,435,985,027	-5,435,985,027
	Korea, Rep.	17,382,218,000	35	0	455,670,328,669,013	12,298,565,232	455,682,627,234,245

Table A23.

Reporter China		Product Code: 901380					
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2012	**Taiwan**	7,119,395,407	35	35	0	-711,939,540	-711,939,540
	Japan	5,578,040,798	35	35	0	-5,578,040,798	-5,578,040,798
	Korea, Rep.	19,611,192,000	35	0	514,102,302,953,001	12,697,436,404	514,115,000,389,405

Table A24.

Reporter China		Product Code: 901380					
Year		Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2011	**Taiwan**	7,823,289,619	35	35	0	-7,823,289,619	-7,823,289,619
	Japan	5,055,469,444	35	35	0	-5,055,469,444	-5,055,469,444
	Korea, Rep.	19,455,379,000	35	0	468,562,947,608,785	12,878,758,663	468,575,826,367,448

Table A25.

Reporter China		Product Code: 901380					
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2010	**Taiwan**	9,290,609,444	35	35	0	4,092,345,033	4,092,345,033
	Japan	3,518,933,172	35	35	0	4,338,536,659	-4,338,536,659
	Korea, Rep.	12,570,180,000	35	0	468,562,947,608,785	246,183,883	468,563,193,792,668

Table A26.

Reporter China		Product Code: 901380					
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2009	**Taiwan**	5,648,771,221	35	35	0	5,648,771,221	-5,648,771,221
	Japan	3,518,933,172	35	35	0	3,518,933,172	-3,518,933,172
	Korea, Rep.	12,570,180,000	35	0	329,524,002,749,744	9,167,704,096	329,533,170,453,840

Table A27.

Reporter China		Product Code: 901380					
Year		**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2008	**Taiwan**	4,251,968,776	35	35	0	-4,251,968,776	-4,251,968,776
	Japan	4,888,890,215	35	35	0	-4,888,890,215	-4,888,890,215
	Korea, Rep.	6,624,980,000	35	0	173,672,129,415	9,140,857	173,681,270,273

Table A28.

Reporter Korea					Product Code: 901380		
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2013	**China**	1,623,999,000	8	0	1,224,134,366,453	312,816,008	1,224,447,182,462
	Taiwan	126,152,000	8	8	0	-126,152,000	-126,152,000
	Japan	186,664,000	8	8	0	-186,664,000	-186,664,000

Table A29.

Reporter Korea					Product Code: 901380		
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2012	**China**	2,036,716,000	8	0	1,535,231,271,882	312,816,008	1,535,561,610,898
	Taiwan	119,908,000	8	8	0	-119,908,000	-119,908,000
	Japan	210,431,000	8	8	0	-210,431,000	-210,431,000

Table A30.

Reporter Korea					Product Code: 901380		
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2011	**China**	2,099,941,000	8	0	1,582,888,872,237	306,158,013	1,583,195,030,250
	Taiwan	157,574,000	8	8	0	-157,574,000	-157,574,000
	Japan	148,584,000	8	8	0	-148,584,000	-148,584,000

Table A31.

Reporter Korea					Product Code: 901380		
Year	Partner	Import Trade Value (in $)	Old Duty Rate	New Duty Rate	Trade Creation in $	Trade Diversion in $	Trade Total Effect in $
2010	**China**	1,563,681,000	8	0	1,178,667,998,115	467,706,590	1,179,135,704,705
	Taiwan	220,101,000	8	8	0	-63,174,580	-63,174,580
	Japan	404,532,000	8	8	0	-404,532,000	-404,532,000

Table A32.

Reporter Korea		Product Code: 901380					
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2009	**China**	958,528,000	8	0	722,517,111,160	206,398,291	722,723,509,452
	Taiwan	69,020,000	8	8	0	-18,943,283	-18,943,283
	Japan	187,455,000	8	8	0	-187,455,000	-187,455,000

Table A33.

Reporter Korea		Product Code: 901380					
Year	**Partner**	**Import Trade Value (in $)**	**Old Duty Rate**	**New Duty Rate**	**Trade Creation in $**	**Trade Diversion in $**	**Trade Total Effect in $**
2008	**China**	1,089,618,000	8	0	821,329,840,786	270,200,988	821,600,041,774
	Taiwan	101,082,000	8	8	0	-101,082,000	-101,082,000
	Japan	169,119,000	8	8	0	-169,119,000	-169,119,000