VIEWPOINT: PROLIFERATION IN NORTHEAST ASIA: SOUTH KOREA'S DUAL-USE TECHNOLOGY IMPORTS FROM JAPAN

by Reinhard Drifte[1]

The Korean Peninsula is generally recognized as one of the most volatile areas in the post-Cold War era, with both North and South Korea highly armed and in a state of tense confrontation. Since this situation continues to pose a danger to both regional and global security, understanding the factors that underpin this military stand-off—such as arms production capabilities—is therefore important.

While North Korea faces great economic difficulties in maintaining its high degree of militarization, South Korea is economically and politically in an infinitely better position to maintain an effective military deterrent. However, in view of the global changes in the post-Cold War era, the U.S. security guarantee appears to some South Koreans to be no longer as strong or reliable as before. In addition, South Korea is animated by an extremely strong sense of nationalism, which motivates its dual quest for security and technological independence.

As a result, South Korea is involved in a major effort to upgrade its high technology industries and to develop a more independent arms production capability. This goal seems achievable in view of South Korea's industrial development (by growth rate, scope, and sophistication) and the emergence of specific local high technology industries. For example, South Korea is now the world's second largest producer of dynamic random access memory (DRAM) chips, and Samsung is the world's single largest manufacturer of DRAM chips.

This essay analyzes to what extent South Korea's strong economic relationship with Japan is contributing to Seoul's effort to create a more autonomous arms industry. The case of Japan is particularly interesting because Japan has not only banned the export of arms but also the export of arms-related technology (with the exception of exports to the United States).

The Japanese case, therefore, raises important questions regarding the relevance of dual-use technology, which has become increasingly prominent in economic relations between technologically advanced (or advancing) countries. The Japanese technological advantage in electronics is particularly relevant for military systems because—with recent changes in weaponry—the electronics content of these systems has grown from 34 percent in 1981 to 40 percent in 1990 and continues to increase.[2] Other industrial sectors important for military production where Japan is leading and that have dual-use capability are advanced industrial ceramics, advanced carbon composites, radar technology, and miniaturization of electronic hardware. Japan's strength in many dual-use technologies makes it a latent force in the global arms industry despite its strict ban on the exports of arms and arms technologies. According to the U.S. Department of Defense (DOD), of the critical technologies it has identified, at least 15 are dual-use; and Japan is considered at present the leader in five.[3] A U.S. study of Japan's aircraft industry, which is over 70 percent dependent on procurement from the Japanese armed forces, concluded that its research and development (R & D) and defense production systems "actively foster an integrated and flexible dual-use technology and production base."[4]

As shown below, electronics, information technologies, advanced materials, and advanced manufacturing technologies form a substantial part of the transfer of civilian technology from Japan to South Korea. Given the fact that a considerable part of South Korea's high technology R & D and production is in the hands of the big industrial conglomerates (*chaebol*), which are also the major arms producers, the transfer of Japanese technology and production technology to these companies

Dr. Reinhard Drifte is Chair of Japanese Politics in the Department of Politics at the University of Newcastle, United Kingdom. He has written extensively on the Japanese economy, including a book, ***Arms Production in Japan. The Military Applications of Civilian Technology*** *(Westview Press, 1986). During 1997-98, he will be visiting scholar at National Saitama University in Japan.*

likely has also affected their arms production capabilities.

Japanese export control efforts are unlikely to prevent unwitting Japanese assistance to Korean "spin-ons" (technologies that originate in civilian industries and move to the defense sector) because Japanese companies, outside the very few companies involved in arms production for Japan's armed forces, lack even a basic knowledge of weapons and dual-use technology[5] (although this is beginning to change due to joint training efforts by government and business circles).[6]

The case of Japanese high technology transfers to South Korea and its military-industrial implications also deserves attention because of similar transfers between Western developed countries (with fewer restrictions on arms exports than Japan) and other Asian countries, like South Korea, which have serious potential security problems, an inclination to build up their armaments, and a desire to develop more independent arms production capabilities. The dual-use technology flow from Japan to Korea also has implications for the efficiency or even feasibility of any new global technology export control regime in the post-Cold War era.

THE FLOW OF HIGH TECHNOLOGY FROM JAPAN TO SOUTH KOREA

South Korea's economic development since the 1960s has relied heavily both on trade with Japan and on Japanese development aid, foreign direct investment, and technology. Although the political relationship is burdened by scars from the past, the similarities between Korea's and Japan's economic structures and development patterns (going back to Japan's occupation of the Korean Peninsula from 1905 to 1945), as well as cultural affinities, have promoted close cooperation and created a considerable dependence of South Korea's economy on Japan.[7] Although South Korea's economy is now much more developed and sophisticated, the dependence on Japan has not disappeared. The more South Korea expands its industrial capacity, the more it has to import intermediate goods, equipment, parts, and technologies from Japan. Korean dependence on Japanese capital goods and components for technologically sophisticated products is mainly due to the weakness of small- and medium-sized companies and the lack of research and development.

Technology can be transferred in many direct and indirect ways, including 100 percent equity investments, joint ventures, technology collaboration, the purchase of complete production facilities, license agreements, the transfer of know-how, the provision of technical aid, the purchase of equipment and machinery, or even reverse engineering. In earlier days, the main vehicle for technology transfer from Japan to South Korea was Japanese Foreign Direct Investment (FDI). Japan is South Korea's most important partner for license imports, capital goods imports, and FDI. Between 1962 and January 31, 1996, there were 2,647 projects involving Japanese investment in South Korea, amounting to $5.3 billion. These figures can be compared to only 1,316 U.S. projects, totaling $4.2 billion. Of these 2,647 Japanese projects, 2,025 were in manufacturing, with the highest number of cases in this category for machinery (418) and electricity/electronics (411). In terms of value, however, electricity/electronics was highest, followed by chemicals, machinery, and transport equipment.[8]

Between 1962 and 1994, 4,502 licenses (48.5 percent of all licenses) came from Japan, followed by 2,584 licenses from the United States, and 522 from Germany. In fiscal year 1993 (April 1, 1993, to March 31, 1994), South Korea became the top recipient of Japanese technology exports with 104 licenses, compared with 100 for the United States, and 80 for China.[9]

Obstacles in Japanese-Korean Technology Transfer

However, there are considerable impediments that inhibit technology transfer between Japan and South Korea and affect particularly the dual-use sector. Japan's ban on arms exports, as well as arms technology exports, makes transfers that are relevant to weapon systems officially impossible. In addition, most obstacles limiting the transfer of technology in purely civilian and commercial cases affect similarly the dual-use technology sector.

South Korea's regulations for foreign direct investment are also still rather restrictive, despite several stages of a general liberalization of the Korean economy.[10] As part of its import source diversification plan—introduced in the 1970s and directed exclusively against Japan—162 items from Japan are still subject to restrictions, down from 258 in 1993. A further 20 items were freed in July 1, 1996.[11]

The South Korean government has in the past issued a "window guidance" to technology importers from Ja-

pan, ordering the importers to keep royalties below a certain threshold. This helps partly to explain why the total royalty payments to Japan are lower than to the United States. This "window guidance" was officially abolished around 1990.[12]

In addition, the Japanese private sector is said to be reluctant to transfer technology because of the feared "boomerang effect," which refers to South Korea's growing status as a serious competitor. Bitzinger and Kosiak quote a South Korean newspaper report that stated in 1990 that the Japanese government went as far as banning the export of 200 high technology items, including electronics, communications, and new materials to South Korea for five years. According to the same source, only seven percent of all Japanese technology transfers to Korea in 1991 were listed as "sophisticated" technologies.[13] True or not, the number of instances of technology transfer declined steadily from 146 in 1990 to 112 in 1991, and 72 cases in 1992, before going up again to 85 instances in 1993, 132 in 1994, and 168 in 1995.[14]

The mutual distrust between the two countries due to the past makes both sides very suspicious of any technology transfer. On the Japanese side, it exacerbates possible concerns about a "boomerang effect." On the Korean side, the suspicion continues to linger that Japan, as the technologically further advanced country, is trying to keep Korea "down" by reducing the value of the transferred technology (outdated technology; inflated costs; partial transfer, etc.).[15] At the same time, the Korean side expects more generosity from Japan because of its colonial record in Korea.

Another level is the legal framework. The Japanese side demands a comprehensive agreement on intellectual property rights protection along the lines of the agreement concluded with the United States and the European Union.[16] However, the U.S. investment in Korea has gone down recently and the reason given for this is still concerns over international property rights.[17]

New Trends in the Bilateral Flow of Technology

As a result of South Korea's growing technological sophistication, however, the channels for the flow of technology are changing and increasing. These changes have a considerable influence on the likelihood and feasibility of the transfer of dual-use technology and partly circumvent the Japanese ban on arms technology exports, as well as other transfer obstacles. These trends also renew doubts about the feasibility of any new export control regime.

In order to offset its trade deficit with Japan ($15.5 billion in 1995) and free itself from dependence on Japan in the long term, the South Korean side has been demanding with increasing insistence that Japan be more generous with transfers. However, despite some agreements relative to small- and medium-sized companies, it has to be noted that the two goals of correcting the South Korean-Japanese trade balance and simultaneously stepping up the transfer of technology are incompatible.[18] Of total South Korean imports from Japan (amounting to $32.7 billion in 1995), 61.6 percent were in machinery, electronic parts and components, transportation systems, and precision equipment.[19] Ironically, the more South Korea exports to other countries, the more it has to import technology, equipment, and parts from Japan. One of the fundamental flaws in South Korea's economic development can be traced to the related weakness of its small- and medium- sized industrial sector.

More relevant to the analysis of possible dual-use technology transfer is the increase in the channels of technology transfer, the rise in the sophistication of the technology involved, and the growing equality between both sides in at least certain sectors, notably electronics. There is now a renewed Japanese interest in transferring technology to South Korea (and other newly industrialized economies) in view of the high value of the yen, which makes many domestic production lines uneconomic. The growing sophistication and financial endowments of the big South Korean companies are also seen as a plus. Cooperation of various kinds with South Korean companies can help Japanese companies gain a foothold in the Korean market, allow them to remain viable in a given product segment (e.g., through joint development or import of cheaper Korean parts), or assist them in expanding to third markets, like China.

This growing parity of South Korean industry in at least certain sectors is demonstrated by the rise in the number of new and more equal transfer arrangements (as they are known between advanced industrialized countries). The growing number of so-called "strategic alliances" are motivated by the desire of Japanese companies to share risks, complement their own technologies in case of complex projects, shorten the time required to introduce new products, and gain access into protectionist markets.

Today, Japan has become South Korea's most important partner in collaborative R & D. From 1985 to 1993, South Korea and Japan cooperated on 165 joint R & D projects (out of a total of 554 joint projects with all countries), compared with 106 projects with the United States and 76 with Germany.[20] South Korean companies have reached this position *vis* a *vis* Japan because the big companies have concentrated on certain specialized areas, such as DRAM chips and made investments in these areas that equal if not surpass those made by Japanese and American companies.[21]

A growing number of top South Korean companies started in the 1990s to establish research centers in Japan to observe the Japanese technology market and to facilitate the exchange of technology and information with Japanese producers (for example, Kia Motors, Samsung Electronics, and Pohang Iron & Steel).[22]

What has received the greatest attention since 1994 is the acquisition by major South Korean companies of smaller Japanese companies. For example, in January 1995, Samsung purchased Union Optical (a producer of semiconductor equipment and precision optics) as well as Lux Ltd. (a high-range audio equipment producer).[23]

Electronics is the sector with the greatest relevance for Japanese dual-use technology, and the data above show that Japanese-South Korean technology transfer and cooperation are particularly well-developed in this area. In 1993, the rate of localization in South Korea's semiconductor industry was 18 percent for equipment and 37 percent for materials, with over 50 percent coming from Japan.[24] From 1960 to 1990, technology imports from Japan in the fields of home electronics, communication equipment, and electronics parts have been higher than those from the United States. (Recently, however, technology imports from the United States in the fields of computers, computer peripherals, and semiconductors have been higher.) In the case of semiconductors, the 101 instances of technology transfer from the United States compared with only 36 from Japan.[25]

Japanese companies have been instrumental in building up South Korea's semiconductor industry, and they have been the only ones to help Korean companies with the development of their own flat display panel production. Recently, the relationship between Japanese and Korean electronics companies has moved from a one-way transfer to the swapping of technology, joint technological development, procurement by Japanese companies with Korean companies, and cooperation between equals. In March 1993, Samsung and NEC announced their intention to cooperate in designing technology needed for a 256-megabit DRAM chip to reach the market near the end of the decade. In 1993, Samsung became the world's largest DRAM producer. As a result of South Korea's success, Japan's share of the DRAM market fell from 65 percent in 1988 to 49 percent in 1993.[26] Under an agreement signed in October 1993 between Fujitsu and Hyundai, both companies work together on 4-megabit and 16-megabit DRAM chips because Fujitsu could not afford to invest sufficient funds on its own anymore.[27]

Increasingly, Japanese companies are procuring high technology electronic parts and components from Korean companies. Since February 1995, Samsung Electronics has been exporting samples of its liquid crystal display units (thin-film transistor type) to various Japanese companies, and LG (formerly Lucky Goldstar) was reported to plan production also for the American and Japanese markets.[28]

JAPAN'S CONTRIBUTION TO SOUTH KOREA'S ARMS PRODUCTION CAPABILITY

In order to link this substantial Japanese high technology flow to South Korea with the country's growing arms production capability, one has to proceed at two different levels. One is to link the transferred technology (or part) with the nature of the production activities of the recipient South Korean company (i.e., to ask whether the recipient is involved in arms production). The other level is to investigate how civilian and military production are linked in Korea.

But before this can be done, we must recognize the difficulty of separating civilian, commercial technology from dual-use military technology.[29] Murayama Yuzo explains that each technology has its own unique degree of duality (or "multifacetedness"). In the research and development stages, the technology duality tends to be higher in basic research than in applied research because the development path to the final product, which is either commercial or military, has not yet been clarified. At a product level, technology duality tends to be lowered as we advance from materials and parts to final products. A similar distinction can be made between product and process technology (e.g., machine tools) in which the latter technology's duality tends to be higher. Tech-

nologies with high duality tend to develop toward military applications at one time and toward commercial applications at another time. This tendency is not due to a change of the dual-use capability of each technology, but instead due to the direction of dual-use technology, which is influenced by the cost-benefits environments in military and commercial markets.[30]

The greater the sophistication of a country's industrial base, the more dual-use technologies and dual-use components will be available. The most difficult sectors for separating high technology and dual-use are electronics, information technologies, advanced materials, and advanced manufacturing technologies. In the end, the transfer from civilian to military use (spin-on) is determined by structural factors at the enterprise level: the existence of military production and civilian production in a single enterprise; the physical contiguity of both sectors; and interactions between both sectors. At the state level, it is determined by the nature of state involvement in arms production through its own production facilities, the regulatory framework for arms production, and, finally, the intention of the end-user (either at the level of the production unit or the military).

An additional difficulty for investigating the Japanese-South Korean case lies, on the one hand, in the secrecy surrounding arms production in South Korea, which is enhanced by the strong involvement of government institutions in arms technology development and arms production, and, on the other hand, in the Japanese companies' general ignorance of and disinterest in the problems raised by dual-use technologies.

It is therefore difficult to assess in South Korea's case what has been called "civil-military integration"(CMI):

> Under CMI, common technologies, processes, labor equipment, material, and/or facilities are used to meet both defense and commercial needs…. This includes cooperation between government and commercial facilities in research and development, manufacturing, and/or maintenance operations; combined production of similar military and commercial items, including components and subsystems, side by side on a single production line or within a single firm or facility; and use of commercial off-the-shelf items directly within military systems.[31]

Links between Civilian and Military Production in South Korea

The South Korean government has been playing a decisive role not only in the creation, development, and technological upgrading of Korean industry, but even more so in the fostering of a defense industry. Most of this intervention concerns the *chaebols*, which were encouraged to take on both civilian as well as military production. These seem to be ideal conditions for the permeation of imported high technology through both production sectors. However, there have been other forces working against this permeation, and the government is now trying to change this.

At present, 83 defense contractors—composed of 21 prime contractors for systems and 62 contractors for components and subsystems—are producing about 308 defense articles.[32] The top 10 companies account for 80 percent of defense sales and the average ratio of commercial sales to defense sales of these companies is 15.1 percent.[33] Concerning the industry's sophistication, South Korea is said to have reached the level of technology of industrialized countries in the case of the Ulsan frigate, although all of its major weapon systems are either imported or license-produced: only the hull is indigenous.[34]

South Korea's arms production capabilities have been helped by the (initially state-sponsored) rise of the *chaebols* and the active involvement of state institutions in defense R & D. The Korean government has been very actively encouraging the defense industry: providing concessional financing to defense contractors, raising a special "Defense Tax" from 1975 to 1990, offering R & D support, and exempting capital and intermediate goods for the defense sector from import tariffs.[35] The Special Law on the Defense Industry in 1973 continues to support the defense industry through tax reduction, exemption, and financial backing.[36]

However, secrecy, low production runs, and high dependence on U.S. military technology account for the low permeability of the civilian and military defense sectors, even within individual company. Defense production does not rank very high with Korean industry because civilian industrial production is booming and the defense budget is under various constraints.[37]

According to General Ahn Byoung-gil, vice chairman of the Korea Defense Industry Association, the operation rate of Korea's defense industry has dropped to 56

percent as a result of pressure to reduce the defense budget, a decreasing demand for traditional weapons, and American reluctance to allow U.S.-licensed weapons to be exported.[38]

A strong wall exists between defense production and civilian production within the private sector, in contrast to the Japanese case. Defense production and civilian production are located in separate plants.[39] Although one can assume that the same specialists, machine tools, and test equipment (mostly imported from Japan) could be drawn upon by both production sides, the actual spin-offs and spin-ons to date have in fact been limited by this separation. To date, the strict control of defense production by governmental institutions, the monopolization of defense R & D by the Agency for Defense Development (ADD), and the limited potential of domestic procurement have not worked in favor of greater interest by the private sector in defense production.

In order to enhance Korea's arms production capability and reduce the dependence on foreign (i.e., mostly American military technology and arms), the government is initiating various changes—ranging from providing a higher budget for defense R & D to bringing civilian and military R & D and production closer together. The government has made it a policy of reducing dependence on foreign technology, foreign weapon procurement, and foreign materials for defense procurement and to become instead an important exporter of military hardware.[40] At the same time, the government has had to address the problem of its limited domestic procurement market, growing public suspicion about the inefficient use of defense expenditures, and South Korea's low level of both civilian and military R & D. There is, therefore, a contradiction between the goal of technological independence and the contingent need to rely on imported technology. South Korea will need more foreign technology in order to be at least competitive in a few areas of defense technology. This contradiction has been realized by a defense economist at the Korean Institute of Defense Analysis (KIDA), who mentioned Israel—with its high technology niches in certain defense areas—as the model for South Korea.[41]

One major step to realize these goals is to break down the high wall between the civilian and military production sectors and to make better use of the existing high technology base that relies very much on imported technology. With this aim in mind, the government has decided to promote the joint use of military and civilian production facilities.[42] In order to prove the value of defense spending in the face of heightened public scrutiny as a result of recent disclosures of corruption, the *Defense White Paper 1995-1996* makes a point of showing how advanced military technology has spread to the civilian industrial sector and thus has benefited the whole economy.[43]

The South Korean Defense Ministry is also interested in increasing procurement of dual-use items from local civilian industry.[44] The government is even willing to sacrifice quality for the achievement of autonomy in defense production. The *Defense White Paper* states clearly that "instead of introducing weapon systems from abroad, Korean-made models of weapons systems will be adopted as much as possible to meet future requirements, even though they might be more expensive or lower in quality and performance."[45] Such an attitude would, of course, encourage spin-on efforts, even though economically they may not make sense. It is still unclear how far this rhetoric will be translated into practice. Bitzinger and Kosiak concluded in their earlier study on the East Asian newly industrialized economies—which included South Korea—that there were no systematic or concerted efforts to take advantage of "discrete, indigenously available advanced commercial products for military-industrial purposes" nor did the authors find any concrete, long-term plans to do so.[46]

The Links between Japanese and Korean Companies and Dual-Use Technology Transfers

It is obvious from the history of Japan's involvement in South Korea's industrial development that Japan has directly and indirectly contributed significantly to the rise of South Korea's arms production capability. The biggest companies with arms production facilities were and are still on the list for Japanese foreign direct investment and technology transfers. An increasing number of channels for technological cooperation and the growing sophistication of this cooperation in sectors most relevant to dual-use technology indicate that Japan's contribution to South Korea's arms production capability has not stopped.

There are observers who say that Japanese industry has been exporting significant dual-use components to other countries, proving that the ban on arms exports is outdated.[47] According to a report by the U.S. Office of Technology Assessment:

> Vigorous trade in dual-use technologies often

> enables them [Japanese firms] to skirt the [arms export] ban at the component level. Japanese firms can sell dual-use defense components and parts on a company-to-company basis, largely circumventing government policies on arms exports.[48]

In 1981, it became known that one Japanese company had sold semi-finished trench mortar barrels to South Korea between 1976 and 1979.[49] It can safely be assumed that many more such cases occurred without becoming public knowledge.

The Korea Machine Tool Manufacturers' Association mentions openly in its 1994 yearbook that the Japanese-Korean joint venture company Korea Miroku, Inc., imported in 1986 (date of approval) a "gun drilling M/C [machine tool]" from its Japanese mother company Miroku Machinery Sales Co., Ltd.[50] Almost all other technology imports mentioned in the yearbook are dual-use, among them a considerable part going to companies listed in the Korean Defense Industry Association's *Korean Defense Products Guide* as official arms manufacturers.

It is also true that dual-use items, components, and technologies do not have to be at the cutting edge to help the arms production of a less-developed country like South Korea. An official of the Korea Defense Industry Association confirmed that at least the subcontracting companies of Korea's arms producers have links with Japanese companies and the Association itself has "friendly links" with Japanese companies.[51] Ironically the heavy reliance on American weapons and licensed production of American weapons must also contribute to the spread of Japanese dual-use parts in South Korea since many advanced American weapon systems have, notably in the electronic sector, substantial Japanese parts. In the case of licensed production of U.S. weapon systems by South Korean companies, the procurement of parts is left to the American side.[52]

Bitzinger and Kosiak mention in their study that Hitachi is supposed to have supplied Samsung Aerospace (which is license-producing the F-16 aircraft, among other weapon systems) with programmable controllers for industrial robots. Similarly, Tsugami Corp. provided precision processing machinery for manufacturing opto-electronic devices to Korean Explosive Co., a major producer of bombs and propellants for the South Korean armed forces.[53] However, Bitzinger and Kosiak conclude that they did not find any direct evidence of any actual spin-on of Japanese technology by South Korea related to information or advanced manufacturing technologies.

What may also facilitate the transfer of high technology in dual-use areas is the degree of control South Korean companies gain over the imported technology. The ratio of transfers as agreements with patents—compared with transfer agreements covering know-how or trademarks—is very high with Korea (52 percent in FY 1992). Notably, this high ratio was the exception in technology transfer agreements between Japan and other Asian countries, with the exception of China (a 50 percent ratio).[54] Another factor giving South Korean companies greater control over Japanese technology may also be the fact that the proportion of technology exports by Japan to companies in which no financial interest was held was high in the case of South Korea (87.6 percent).[55]

Another structural factor possibly helping to make the transfer of dual-use technology to South Korea more relevant for its arms production is the close involvement of the major Japanese companies in the civilian and military sectors without there being much of a wall between the two sectors.[56]

This fact is particularly important in areas most relevant to dual-use technology and component transfer such as the aerospace, electronics, and machinery sectors. South Korea's aerospace industry is still technologically very weak, and Japan's aerospace industry has been a singular failure in its inability to achieve the kind of parity that other Japanese industrial sectors have reached with their counterparts in other advanced industrialized countries. Japan is not a direct provider of high technology for the Korean aerospace industry. Mitsubishi has contracted out to Samsung Aerospace some of its contract work on the Boeing 767 aircraft, but it does not involve any high technology items. However, Kawasaki Heavy Industry supplies Hyundai with kits for the licensed production of the BK-117 helicopter, which is a German-Japanese collaborative venture (with 15 helicopters produced since 1989). The helicopter can be considered a dual-use item, but the kit assembly will hardly result in much technology transfer. Hyundai Space & Aircraft Corp., however, is now going to invest 1.2 trillion won ($1.5 billion) in various aircraft projects, including involvement in a multi-purpose helicopter project. The cooperation with Kawasaki has given Hyundai valuable know-how and technology for this project.[57] Dual-use transfer from Japan to Korea in the aerospace industry can therefore be said to be generally

indirect through the acquisition of Japanese production technologies, numerically controlled (NC) machine tools, and other production technologies.[58]

As shown above, the links between Japanese and Korean electronics companies have become closer, thanks to the new level of parity between the sectors of both countries. In addition, it is fair to assume that South Korean arms producers rely on Japanese electronic components for the manufacture of weapons, either of Korean or foreign origin. A concrete case is the licensed production by Samsung Electronics of a fire control system for naval vessels from Ferranti (now Ferranti-GEC) where replacement boards are bought from Japan.[59]

One way to illustrate the high reliance of Korean industry on Japanese technology transfer and how this involves the major Korean arms producer is to juxtapose the 64 officially registered defense companies listed in the 1995 edition of *the Korean Defense Products Guide* with the companies listed in the *1994: Annual Report on the Introduction of Technology* as having received technology from Japan.[60] This exercise shows that 11 out of 67 Korean companies received high technology and manufacturing technology from Japanese companies during 1994 alone (31 technologies). The top recipient in that year was Samsung Electronics with 15 separate entries. Of all the technology transfers listed in the 1994 *Annual Report* to the 11 officially listed arms manufacturers, 15 are dual-use technologies. Many other technologies transferred from Japanese companies to other Korean companies mentioned in the 1994 *Annual Report* are also dual-use, and some of these South Korean companies are certainly subcontractors to the officially listed arms manufacturers.

However, we have seen that there is still a very strong separation between civilian and military production even within the big conglomerates. The recent statements in Korea's *Defense White Paper* on the promotion of links between the two sectors are intentions rather than new realities. One cannot, therefore, conclude with total confidence that—beyond the use of previously from Japan acquired manufacturing technology and equipment and Japanese parts and components—any of the listed technologies find their way directly and immediately into the arms production sectors of the same companies.

However, Japanese technology, manufacturing equipment, manufacturing technology, parts, and components are so pervasive in South Korea's manufacturing industry that, over time, even relatively recently acquired ones must have an impact on South Korea's arms production capabilities. The intention of the South Korean government to bring R & D and production from the civilian sectors and the military sectors closer together can only enhance the impact of Japanese technology transfers.

CONCLUSIONS

Short of access to confidential company information (or weapons systems themselves), it is impossible to show directly the use of Japanese dual-use technology for the development of South Korea's arms industry. However, we can detect sufficient circumstantial evidence (in addition to illegal cases disclosed over the years) to suggest that Japanese high technology flows to South Korea have not only helped Seoul to build up its civilian industry, but also its arms production capability.

It is clear that previous Japanese investment in notably the machinery sector (e.g., in the Changwon Machinery Industrial Zone that is South Korea's center of arms production) has directly helped the development of South Korea's arms production capabilities. There are strong indications that illegal Japanese exports of arms components occurred on a minor scale. It can safely be assumed that the availability of Japanese production technologies, Japanese test equipment, and Japanese production equipment in the private sector (notably numerically controlled machine tools) is benefiting the military production sector as well.

New developments in the bilateral economic relationship are likely to make Japanese high technology exports even more relevant for South Korea's goal to upgrade its civilian and military technology. The growing sophistication of the South Korean technological base, the financial prowess of its companies, and Japan's need for a partner (for sharing development costs, entering third markets, etc.) have created a more level playing field between the two countries. In many cases, these factors have encouraged Japanese as well as South Korean companies to overcome technology transfer impediments and to use new channels of technology transfer. Not only do new channels open new opportunities for technology transfer that are particularly relevant for dual-use technology and dual-use parts, but they also make any government or company export controls both less desirable and—from a nonproliferation standpoint—more difficult to implement.

The South Korean government's intention to reduce the wall between the civilian and military production sectors will also provide greater opportunities for increasingly sophisticated Japanese high technology transfers into specific sectors of South Korean industry (notably electronics and machinery) in order to provide greater future benefits to South Korea's growing arms production sector.

These new developments will also enhance the use of high technology imports from other developed countries for South Korea's arms producing capability, corresponding to a similar pattern developing between other newly industrialized countries and developed countries. South Korea has also been very active in tapping the Russian potential for high technology transfers (e.g., new materials).

The establishment of research centers at public universities (notably at Seoul National University, the Korean Advanced Institute of Science and Technology, and Pohang Institute of Technology) means that civilian and academic cooperation by foreign and Korean institutions with these organizations may increasingly have military implications. Notably, this is important for public European universities suffering from severe budget cuts. South Korean institutions have become very attractive for these European bodies because they are very generously endowed, and Seoul is actively encouraging their cooperation with foreign institutions. In 1995, South Korea and France agreed to participate in large-scale projects in aerospace technology, and during President Kim Young-Sam's visit to Europe in 1995, the establishment of 13 overseas research centers of five Korean government-funded research institutes and eight university research centers was agreed to.[61] In this context, it is also interesting to note that Seoul is now seeking to participate in the European Commission's EUREKA program to share expenses for technology R & D.[62] Another example is the establishment of the South Korean-United Kingdom Research Center between Rolls-Royce and the Korea Institute of Machinery and Metals, aimed at conducting research in aerospace materials. The Korean side will provide R & D funds and researchers while Rolls-Royce will provide the facilities.[63]

South Korea's growing technological sophistication has made its participation necessary in international export control regimes. It is now member of all major export regimes except the Missile Technology Control Regime (MTCR) and the Australia Group. Japan has been playing an important role in bringing South Korea into these export control regimes. The result of Korea's growing involvement in export controls is that Japan can deal with Korea in a congenial framework that allows the transfer of increasingly sophisticated technology without having to worry that these exports of high technology and high technology parts may end up in the very few outlawed countries (like North Korea, Iraq, Iran, or Libya), which are the object of the post-COCOM regime (Wassenaar Agreement). Japanese export controls, as such, do not constitute an obstacle to technology exports to South Korea, nor is the author aware that they are used by Japan to limit technology exports to Korea. Since the granting of export licenses depends on the technology's specific end-use, rather than its origin or potential applications, the Japanese export control system may actually facilitate the export of dual-use components, items, and technologies.

But why do these findings matter? First of all, they clearly demonstrate that Japan's strict ban on arms exports (including the export of arms-related technology and equipment) is being circumvented by the close commercial cooperation between Japan and South Korea, the effect of "globalization," and the increasing parity of the two countries' technological and financial strength. In addition, Seoul is pursuing a policy of building up a more autonomous defense industry in sectors where civilian high technology can be more easily applied to military equipment or can help to produce such equipment (e.g., flat screen display panels, electronic parts, production equipment/production technologies, etc.). Politically, this implies that Japan's political leaders accept this "hollowing out" of their arms export ban, either openly or implicitly.

Secondly, the economic relationship between Japan and South Korea shows that the "leakage" of high technology and dual-use technology between highly developed countries like Japan and technologically advancing countries like South Korea is not only unavoidable but increasing. This fact has to be borne in mind when discussing the impact of cooperation and interaction between countries like Japan and South Korea on the technological competitiveness of the more advanced partner. Cooperation may mean "loss" or "gradual leakage" of the most advanced technology to the technologically advancing countries, but the alternative for the highly developed countries may mean lack of funding

for moving up the increasingly expensive ladder of technological development or the loss of export opportunities.

Thirdly, the inclusion of South Korea into Western arms control regimes should reduce—from a nonproliferation perspective—concerns about dual-use technology falling into unauthorized hands. This development should also solve the problem of differentiating between high technology and dual-use technology that is getting more complex, the higher the level of technology involved. Due to the limits of the author's data and technical expertise, this essay cannot establish in detail which Japanese transferred dual-use technology is most relevant to South Korea's arms industry. However, there are two political problems deriving from the present findings that do affect the security situation on the Korean Peninsula.

The strengthening of South Korea's arms industry through the kind of cooperation as exists with Japan will affect the attitude of the Korean government and population towards the weakening position of North Korea. Most signs so far seem to indicate that the growing overall asymmetry in national strength reduces rather than strengthens South Korea's willingness to compromise and cushion the demise of North Korea, although many other factors (e.g., political instability, political leadership weaknesses, and North Korean provocation) are also involved. The impact of a stronger and more independent arms industry goes even further than just the relationship with North Korea. It also affects South Korea's relationship with its regional neighbors now, as well as in the post-reunification era (as is illustrated in the advocacy by some South Korean military leaders of a blue water navy or the growing perception of Japan as the "next greatest military threat"[64]).

Finally, the growing sophistication of the South Korean defense sector and the strong encouragement of exports will have considerable impact on at least the medium level of the world arms export market and force Western companies to move constantly up the ladder of sophistication. The United States seems to be relying on its political clout and established position as South Korea's major arms supplier and supplier of production licenses and tries to limit the exports of weapons based on American technology. Other countries do not have such leverage or are interested instead in exploiting South Korea's eagerness to develop its high technology, arms production, and arms export industry. Herein lies the future challenge.

[1] The author gratefully acknowledges the Economic and Social Research Council in the United Kingdom for its research support.

[2] Steven Vogel in Wayne Sandholtz, *et al*., *The Highest Stakes. The Economic Foundations of the Next Security System* (Oxford: Oxford University Press, 1992), p. 61.

[3] U.S. Congress Office of Technology Assessment, *Redesigning defense: Planning the transition to the future U.S. defense industrial base* (OTA-ISC-500) (Washington, D.C.: U.S. Government Printing Office (GPO), July 1991).

[4] National Research Council, "High-Stakes Aviation: U.S.-Japan Technology Linkages in Transport Aircraft," Washington, D.C., 1994, p. 2.

[5] On this point, see Bates Gill, Kensuke Ebata, and Matthew Stephenson, "Japan's Export Control Initiatives: Meeting New Nonproliferation Challenges," *The Nonproliferation Review* 4 (Fall 1996), pp. 35-36.

[6] Kensuke Ebata, "The role of technology transfers in economic development," in Sverre Lodgaard and Robert L. Pfaltzgraff, eds., *Arms and technology transfers: Security and economic considerations among importing and exporting states*, (New York and Geneva: UNIDIR/UN, 1995), p. 181.

[7] See Patrick Kollner, "Japans Technologietransfer nach Sudkorea: Entwicklungstendenzen und Problempunkte" (Japan's technology transfer to South Korea: Developments and issues), in Deutsches Institut fur Japanstudien der Philipp-Franz-von-Siebold-Stiftung, ed., *Japanstudien. Jahrbuch des Deutschen Instituts fur Japanstudien*, Band 6/1994, (Munich: Iudicium Verlag, 1994), pp. 297-336.

[8] International Economic Policy Bureau, "Trends in foreign investment and technology inducement as of January 31, 1996" (Seoul: Ministry of Finance and Economy, 1996), p. 8.

[9] *Korea Tribune*, January 12, 1996, reporting on a report of the Science & Technology Agency.

[10] For a short overview of recent FDI liberalization steps see Patrick Kollner, "Zwischen strategischen Allianzen und struktureller Abhangigkeit: Anmerkungen zur japanisch-sudkoreanischen Industriekooperation" (Between strategic alliances and structural dependence: Annotations to Japanese-South Korean industrial cooperation), in Manfred Pohl, ed., *Japan 1994/95 Politik und Wirtschaft* (Hamburg: Institut fur Asienkunde, 1995), pp. 17-18.

[11] *Korea Times*, May 8, 1996.

[12] Author's interview with Japanese official in Seoul, April 9, 1996.

[13] Richard A. Bitzinger and Steven M. Kosiak, *Windows of Opportunity: The Potential Military Application of Japanese Advanced Commercial Technology Transfers to East Asia* (Washington, D.C.: Defense Budget Project, September 1995), p. 38, quoting *Dong-Ah Ilbo*, September 30, 1990.

[14] International Economic Policy Bureau, "Trends in foreign investment...," pp. 8-9.

[15] The recent cooperation on automotive technology transfer from Nissan to Samsung is an illustration, since it has run into difficulties because the Korean side wants more advanced technologies than Nissan is willing to provide.

[16] Kollner, "Zwischen strategischen Allianzen und struktureller Abhangigkeit," p. 21. See also "1995 Report on the WTO consistency of Trade policies by major trading partners," MITI, Tokyo, 1995, pp. 53-54.

[17] *Korea Times*, December 21,1995.

[18] See Matsumoto Koji, "Misunderstandings in technology transfer to South Korea," *Economic Eye* (September 1985), pp. 7-11.

[19] *Korea Times*, February 25, 1996.

[20] Bitzinger and Kosiak, *Windows of Opportunity*, p. 26.

[21] *Japan Times*, May 3, 1995.

[22] Kollner, "Zwischen strategischen Allianzen und struktureller Abhangigkeit," p. 330.

[23] For Union Optical, see *Yomiuri Shimbun*, January 21, 1995. For Lux, see *Nikkei Shimbun*, May 20, 1994.

[24] Kollner, "Zwischen strategischen Allianzen und struktureller Abhangigkeit," p. 343.

[25] Bon-Jae Koo, "The Korean electronic industry's dependency on, and future prospects in relations to Japanese industry," National Institute of Science and Technology Policy, Science & Technology Agency, Tokyo, April 1995, p. 23.
[26] *International Herald Tribune*, March 2, 1994.
[27] *Financial Times*, October 8, 1993.
[28] *Nikkan Kogyo Shimbun* (Tokyo), June 4, 1995.
[29] For a very comprehensive attempt at defining dual-use goods, software, and technologies, see the European Community's document on the establishment of a Community regime for the export control of dual-use goods in *Journal officiel des Communautes Europeennes*, L 367, December 31, 1994.
[30] Yuzo Murayama, "Dual-use Technology and Export Controls: An Economic Analysis," in Gary K. Bertsch, Richard T. Cupitt, and Takehiko Yamamoto, eds., *U.S. and Japanese Nonproliferation Export Controls: Theory, Description and Analysis* (Lanham, Maryland: University Press of America, 1996), p. 37.
[31] Office of Technology Assessment, U.S. Congress of the United States, ed., *Other approaches to civil-military integration. Background Paper. The Chinese and Japanese arms industries* (Washington, D.C.: U.S. GPO, March 1995), p. 3.
[32] Ministry of National Defence, *The Defence White Paper 1994-95*, Seoul 1995. *The Defense White Paper 1995-1996* (p. 103) mentions 82 defense contractors producing 308 defense products. The 1995 edition of the *Korean Defense Products Guide* of the Korea Defense Industry Association lists 67 main contractors. The Association itself has 83 main companies and main component suppliers. Author's interview with an official of the Association April 9, 1996.
[33] Dong-Joon Hwang, "The Role of Defense Industry," conference paper presented at the "ComDef '96" meeting, April 1-3, 1996, Washington, D.C.
[34] Michael Brzoska, "The Spread of Conventional Weapons Production Technology," in Sverre Lodgaard and Robert L. Pfaltzgraff, eds., *Arms and technology transfers…*, p. 26.
[35] Sung K Min, "Defense industry of the Republic of Korea," conference paper presented at the 24th Pacific Area Senior Officer Logistics Seminar, Seoul, September 17-23, 1995, pp. 8-9.
[36] *Defense White Paper 1995-1996*, p. 103.
[37] This is also confirmed by Hwang, "The Role of Defense Industry," pp. 160, 170.
[38] *Maeil Kyongje* (Seoul), March 30, 1996.
[39] Author's interview with a defense economist at the Korean Institute of Defense Analysis (KIDA), Seoul, April 12, 1996.
[40] For more on this point, see the chapter on arms production in *Defense White Paper 1995-1996*; also, Min, "Defense Industry of the Republic of Korea."
[41] Author's interview with a defense economist at KIDA, Seoul, April 12, 1996.
[42] Min, "Defense Industry of the Republic of Korea," p. 27.
[43] *Defense White Paper 1995-1996*, p. 203.
[44] Bitzinger and Kosiak, *Windows of Opportunity*, p. 13.
[45] *Defense White Paper 1995-1996*, p. 101.
[46] Bitzinger and Kosiak, *Windows of Opportunity*, p. 34.
[47] Office of Technology Assessment, *Global arms trade* (OTA-ISC- 460) (Washington, D.C.: U.S. GPO, June 1991) p. 115.
[48] *Ibid.*
[49] Reinhard Drifte, *Arms Production in Japan. The Military Applications of Civilian Technology* (Boulder, CO: Westview Press, 1986), p. 76. For a short background of Korea's arms production, see Bitzinger, "South Korea's defense industry at the crossroads," *The Korean Journal of Defense* 7 (Summer 1995), pp. 233-250; also Office of Technology Assessment, *Global arms trade*, pp. 131-140.
[50] Korea Machine Tool Manufacturers' Association, *Machine Tool Industry Korea 1994*, p. 19.
[51] Author's interview with Japanese official in Seoul, April 9, 1996.
[52] Author's interview with an official of KIDA, Seoul, April 12, 1996.
[53] Bitzinger and Kosiak, *Windows of Opportunity*, p. 35.
[54] Takashi Yamanaka, Takao Kiba, and Itaru Watanabe, "Trends in technology exports from Japan - 1992 Fiscal Year," Science & Technology Agency, Tokyo, November 1994, p. 17.
[55] *Ibid*., p. 8. Given the arguments presented in this essay, China too can be considered a country of concern regarding its use dual-use technology transferred from Japan. However, this subject is beyond the scope of the present study.
[56] Drifte, *Arms Production in Japan*.
[57] *The Korea Economic Weekly*, March 11, 1996.
[58] Carol Reed, Robert Karniol, and Ron Matthews, "South Korean business. Diversify for survival," *Jane's Defence Weekly*, July 31, 1993, pp. 15-25.
[59] Author's interview at the British embassy in Seoul, April 1996.
[60] "1994 Annual Report on the Introduction of Technology," in *Korean Defense Products Guide* (Seoul: Korean Defense Industry Association, 1995).
[61] Proceedings of the seminar on "Korea-EU relations in the future," organized by the E.U. Delegation in Seoul, October 7, 1996, p. 113.
[62] *Korea Economic Weekly*, April 15, 1996. EUREKA has been open on a selective basis to non-European companies.
[63] *Korea Times*, February 14, 1996.
[64] On May 28, 1996, the South Korea Naval Chief of Staff advocated that a unified Korea must possess a blue water navy including aircraft carriers. See "Kankoku kaigun shuno ga Kubo hoyu ni genkyu," *Yomiuri Shimbun*, May 29, 1996. For Japan as the next greatest threat, see "Korea's common enemy in the 21st century will be Japan," *Defense News Reports* (Seoul), November 28, 1996.