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DEFENSE INDUSTRY AND ITS
IMPACTS ON ECONOMIC GROWTH IN KOREA

by

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Because of the apparent diffusion of tension between South and North Korea, the domestic pressures to reduce the national budget are growing stronger. Consequently, some have questioned whether the Korean defense industry should be maintained. In fact, the Korean defense industry has had both negative and positive effects on economic growth since 1970s. It is time to analyze the Korean defense industry and enter a new phase which considers both security and economic implications. The Korean defense industry is still necessary for national security. It can also be more helpful for economic growth.

This thesis will be based on a study of real Korean defense industry data from the Korean Institute for Defense Analysis (KIDA) and Korean economic statistics. The data is analyzed using the Feder and Ram Model and Robert M. Solow Model.

In order to improve the Korean defense industry's structure and organization, this thesis suggests desirable future directions for the Korean defense industry based on economic analysis.

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DEFENSE INDUSTRY AND ITS IMPACTS ON ECONOMIC GROWTH IN KOREA

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ABSTRACT

This thesis reviews the connection between the Korean defense industry and Korean economic progress. The defense industry has both costs and benefits. Some argue that the benefits outweigh the costs; others argue the reverse.

Because of the apparent diffusion of tension between South and North Korea, the domestic pressures to reduce the national defense budget are growing stronger. Consequently, some have questioned whether the Korean defense industry should be maintained. In fact, the Korean defense industry has had both negative and positive effects on economic growth since the early 1970s. It is time to analyze the Korean defense industry and enter a new phase which considers both security and economic implications. The Korean defense industry is still necessary for national security. It can be more helpful for economic growth.

In order to improve the Korean defense industry's structure and organization, this thesis suggests desirable future directions for the Korean defense industry based on economic analysis.

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I. INTRODUCTION

A. OBJECTIVES

Over the past decade, a growing number of developing countries have began to pursue military industrialization focusing on conventional weapon systems. The Republic of Korea (South Korea, hereafter ROK or Korea) played an important role in this new wave. Though a late industrializer, Korea became the fifth largest conventional arms exporter in the Third World (including China). The Korean defense industry, which began to accomplish the important national goal of self-reliant defense in the early 1970s, has contributed greatly to national security. The Korean defense industry has built a base for highly precise weapons production and is being converted from a government-controlled system to a civilian-operated system. It now produces an almost complete line of conventional arms.

The tension between South Korea and North Korea appears to be diffusing. For example, South and North Korea entered the United Nations on September 23, 1991, North Korea announced that they will accept International Atomic Energy Agency's (IAEA's) nuclear inspections, and there has been a series of meetings between high ranking government officials from South and North Korea. This suggests that a decrease in defense spending is likely in Korea.

Some argue that the Korean economy would have developed much faster without the burden of the defense spending. We could have invested more in the civilian sector by reducing the defense budget. The question of large peacetime defense expenditures raises the macroeconomic question of whether such expenditures have a positive or negative effect on the Korean economy. This question is not purely academic and is extremely difficult to answer. There are experts and data to support both arguments and the answers seem highly dependent upon such factors as the overall national economic conditions, the type of alternative expenditures or fiscal policies with which the military spending is compared, the economic and social objectives of the policies, and the structure of and conditions within the defense industry.

Korean defense expenditure is 27.6 percent of the national budget. Defense investment is 35% of defense spending and 60% of defense investment is spent on the defense industry. (See Table 1 and Figure 1.) We cannot deny that such a big investment in the defense industry has a great influence on the national economy. Clearly, the Korean defense industry is a significant factor in the Korean economy and in the nation's strategic posture. In value, it provides more than one-tenth of the goods and services to the Ministry of Defense per year. It employs between 20 and 30 percent of all Korean scientists and engineers and between 10 and 20 percent of the manufacturing labor force. Korea wants both "guns and butter."

However, defense industrialization has aroused sharp scholarly and policy debates in Korea on the appropriateness and desirability of such a course of action. Those who

support defense industrialization argue that possession of a domestic arms-making capability provides political autonomy, status, and security by reducing dependence on dominant suppliers and minimizing uncertainties such as embargoes on external arms supply. They further assert that its capital and technological spin-off effects through heavy capital investment in modern industrial sectors and through the acquisition and dissemination of advanced technology serve as engines of growth for the entire national economy.

Table 1. The FY 1991 Defense Budget as a Proportion of the Government Budget (in billions won)

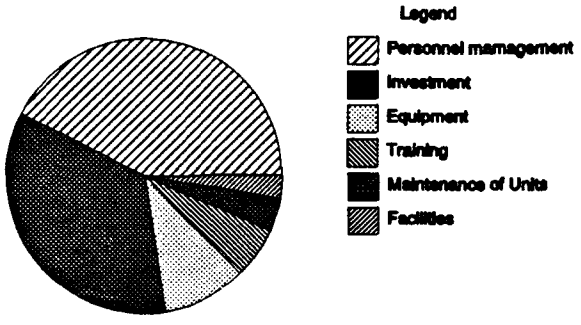
	1990	1991	Increase	%
Government Budget	22,689	26,980	4,290	19.9
-Defense Budget	6,638	7,452	815	12.3
-Others	16,051	19,518	3,475	21.7
Proportion of Defense Budget in the Government Budget	29.3	27.6		2.7

*based on the Finalized Budget

Source: ROK Ministry of National Defense, *Defense White Paper*, 1991

For those who are skeptical about military industrialization, developing a defense industry is a costly and risky venture. Small market size, diseconomies of scale and capital and technological intensiveness make it extremely costly for developing countries to pursue defense industrialization. Export market uncertainty associated with the

Figure 1. The FY1991 Defense Budget by Sector



Source: ROK Ministry of National Defense, Defense White Paper

oligopolist structure of the global conventional-arms market further threatens the survivability of the defense industry. Draining effects on the social welfare sector and inflationary pressure on the economy are often cited as the likely results of defense industrialization in developing countries. [Ref. 1:p. 214]

The primary mission of the Korean defense industry is to provide for national self-defense and contribute to national development. In this connection, this study focuses on surveying the role of the Korean defense industry in national economic growth as well

as on examining the conversion from the military industry to the civilian industry in Korea.

The intent of this study is to determine how much impact and influence the Korean defense industry has had on national economic growth. This study will also suggest some ideas for future development in the Korean defense industry.

B. METHODOLOGY

The basic methodology of this study is descriptive. This thesis will be based on a study of real Korean defense industry data from the Korean Institute for Defense Analysis (KIDA) and Korean economic statistics. The data is analyzed using the Feder and Ram Model and Robert M. Solow model.

C. SCOPE, LIMITATION, AND ASSUMPTIONS

The scope of this thesis is to identify how the defense industry has influenced economic growth in Korea since 1975. This thesis will develop and update previous papers about the Korean defense industry.

A major problem in assessing the Korean defense industry's role in national economic growth is the limited resources which describe this role. Furthermore, although available, some classified materials and some sensitive political matters will not be discussed. This thesis assumes that the two models used in this study can be applied to analyze the impacts of the Korean defense industry on national economic growth.

D. ORGANIZATION

The rest of the thesis consists of five chapters.

Chapter II reviews the literature. This chapter presents the previous papers.

Chapter III describes the history of the Korean Defense industry.

Chapter IV suggests two models and identifies the factors of the Korean defense industry influencing economic growth.

Chapter V suggests the desirable directions of the future Korean defense industry.

Chapter VI concludes this thesis.

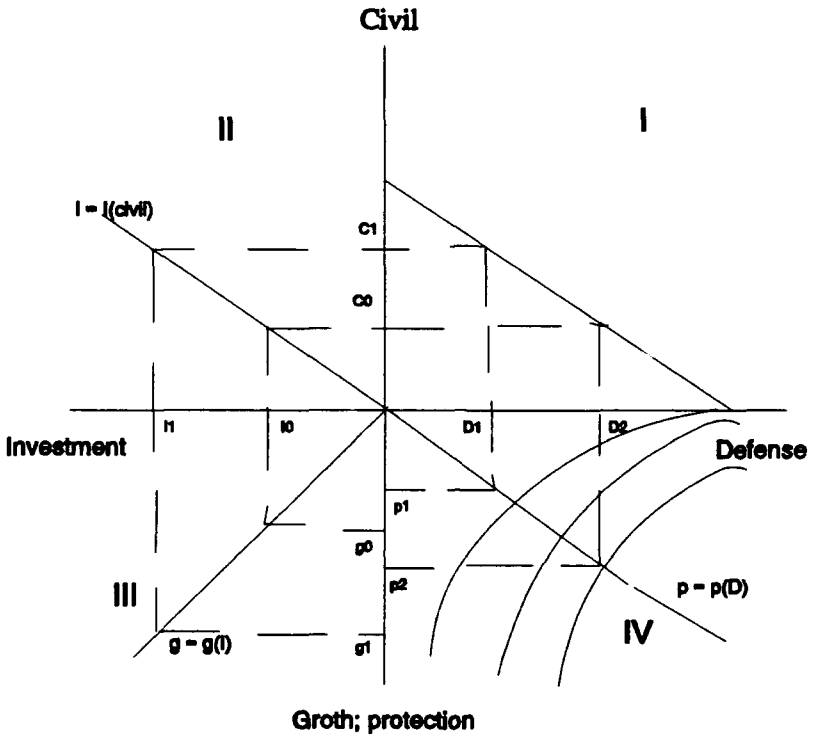
II. LITERATURE REVIEW

Until recently, defense was one of the major components of government expenditure. It was frequently ignored by economists and simply assumed to be autonomous.

Economists can represent defense choices in series of diagrams. Figure 2 uses the classic guns-versus-butter "trade-off" to link defense spending to investment and growth. It provides a simple model for the belief that defense is a burden on the economy. If the economy is operating on its production frontier, where its resources are fully and efficiently employed, then more defense is purchased at the expense of civil goods and services (quadrant I, Figure 2). If investment depends on the level of civil spending, then more defense expenditure means reduced investment. This has an adverse effect on the economy's growth rate (quadrants II and III of Figure 2). However, increased defense spending is likely to produce benefits to society in the form of greater protection and security for its citizens, as shown in quadrant IV of Figure 2. [Ref. 2:p. 12-13]

Estimates of the impact of defense expenditure on growth naturally differ. The results will depend on the specification of the model, which transmission mechanisms (input-output model, dynamic model, ridge regression model and so on) are allowed for; the type of data, time-series or cross-section; the assumptions about certeris paribus

Figure 2. Classic guns-versus-butter trade-off



As defense spending rises from D1 to D2, civil expenditure falls from C1 to C0, hence investment declines from I1 to I0 and the growth rate falls fron g1 to g0. At the same time, at D2 there is more protection; for simplicity, growth and protection are shown on the same axis.

conditions, such as how other policies adjust in response to the changes in military expenditure; and the estimation method and sample adopted. The range of estimates can be illustrated with a personal selection. Dunne and Smith (1984) calculate the effect of reduced military expenditure in the UK economy using a simulation of a large economic model. Their results suggest that, after allowing for all the feedbacks, a reduction of the share of defense expenditure in GDP by 1.5 percent would increase GDP by 0.5 percent, assuming that total public expenditure was kept constant. [Ref. 3:p. 85]

The productivity of resources employed in the defense sector may not be the same as productivity in the civilian sector. The defense sector is a relatively less competitive part of economy. However, in Korea the largest part of defense expenditure is procurement of weapons, ammunition, and military logistics supplies. These items come from a defense industry controlled by the Korean government. As a result, the Korean defense industry may have contributed to national economic development.

Therefore, the Korean defense industry may have greatly influenced various aspects of the national economy. Until now, only a few studies have reviewed relations between defense spending, gross national product and technological advance. Dr. Sung G. Min analyzed defense R&D and its impacts on technological advance from 1979 to 1985. Dr. Ja Song studied the impacts of the defense industry on the civilian sectors in Korea based on 1987 data. Dr. Dong J. Hwang studied the future of the Korean defense industry. But none of these authors studied the defense industry as a whole.

Dr. Min analyzed defense R&D and technological advance using R. M. Solow's model (1957). According to his study, Korean defense technology has improved by about 240 percent since 1975. This resulted from defense R&D investment. He concluded that the technology improved as defense R&D investment increased.

Dr. Song studied how the Korean defense industry influenced the civilian sector. His methodology was descriptive and based on statistics. He categorized effects into three areas: contributions to GNP growth, creation of employment opportunities and spill-over effects of military technology to the civilian sector. According to his paper, defense industry output accounted for 1.52 percent of GNP in 1987 and 1.68 percent of total employment, but the pervasive effect of technology was weak.

Dr. Hwang summarized and analyzed the Korean defense industry development and suggested the desirable direction of the future Korean defense industry.

This thesis addresses the overall economic aspects of the Korean defense industry.

III. HISTORY OF KOREAN DEFENCE INDUSTRY

A. WHAT IS THE DEFENSE INDUSTRY?

The defense industry is defined as the industry that researches, develops and produces material and weapons for national security. [Ref. 4:p. 155-162] As defined here, the defense industry has different characteristics from the civilian industry. In particular, the defense industry is a national industry. To develop the nation politically, economically and socially, it is required to ensure stable national security. To consolidate the national defense, we should maintain the existing military strength as well as reinforce the military power against the changing external environment. Based on the above reason, the defense industry is said to be a national industry.

Second, the government is the only demander for defense industry products. These products are manufactured on the contract ad libitum between government and industry. The relationship between the government and the defense industry is not a normal market. Table 2 presents a long list of the "imperfections and failures" of the defense industry in relation to traditional free market theory. This table gives over thirty important assumptions of free market economic theory that are violated by what actually takes place in the defense market. [Ref. 5: p.29-30] The defense market also differs significantly from traditional oligopoly and monopoly markets in which the buyer and seller are still essentially in an adversarial bargaining position. In the defense market, the

buyer and seller have a far greater mutuality of interest: performance and accuracy of defense products and their timely supply. Price plays a relatively minor role.

Table 2. Some examples of "Market Imperfection and Failures" in Defense

Free-Market Theory	Defense Market
Many small buyers.	One buyer (Ministry of National Defense).
Many small suppliers.	Very few,large suppliers of a given item.
All items small, perfectly divisible, in large quantities	One ship built every few years, for and hundreds of millions of dollars each.
Market sets prices.	Monopoly or oligopoly pricing-or "buy in" to "available" dollars.
Free movement in and out of market.	Extensive barriers to entry and exit.
Prices set by marginal costs.	Prices proportional to total costs.
Prices set by marginal utility.	Any price paid for the desired military performance.
Prices fall with reduced demand.	Prices rise with reduced demand.
Supply adjusts to demand.	Large excess capacity.
Labor highly mobile.	Greatly diminishing labor mobility.
Decreasing or constant returns to scale.	Increasing returns to scale in region of interest.
Market shifts rapidly to changes in supply and demand.	7-10 years to develop a new system, then 3-5 years to produce it.
Market smoothly reaches equilibrium.	Erratic behavior from year to year.

Table 2, continued.

Profits equalized across the economy.	Wide and consistent profit variations between sectors; even wider between firms.
Perfect mobility of capital (money).	Heavy debt, difficulty in borrowing.
Mobility of capital to changing demand.	Large and old capital equipment "locks in" companies.
No government involvement.	Government is regulator, specifier, banker, judge of claims, etc.
Selection based on price.	Selection often based on politics, sole source, or "negotiation"; only 8% of dollars awarded on price competition.
Prices fixed by market.	Most business with any risk is for "cost plus fee."
All products of a given type are the same.	Essentially, each producer's products are different.
Competition is for share of market.	Competition is frequently for all or none of a given market.
Production is for inventory.	Production occurs after sale is made.
Size of market established by the buyers and sellers.	Size of market established by "third party" (Congress) through annual budget.
Demand sensitive to price.	Demand "threat"-sensitive, or responds to availability of new technology; almost never price-sensitive.
Equal technology throughout industry.	Competitive technologies.
Benefits of the purchase go to the buyer.	A "public good."
Buyer has the choice of spending now or saving for a later purchase.	MND must spend its annual congressional authorization.

Table 2, continued.

Relatively stable, multiyear commitments.	Annual commitments, with frequent changes.

Third, highly precise technology and highly skilled technical manpower are required to produce defense industry products. Fourth, while it takes a long time to prepare for military production and to return the investment on capital, new technology soon becomes outdated because weapon systems change rapidly. Not only are defense choices complex, but they have to be made in a world of uncertainty. No one can predict the future accurately: today's threat might be tomorrow's ally; today's technology equipment might be tomorrow's dreadnoughts. [Ref. 2:p. 26] Finally, defense industry activities have the secrecy inherent in military technology, so they should be kept secret. [Ref. 6:p. 16]

There is still a question of why Third World countries should develop and improve their own defense industry. Third world countries seek to produce their own weapons for a combination of political, military, and economic reasons. A domestic weapons production capacity can be seen as an expression of national sovereignty, tangible evidence that a country intends to defend its independence. It is also believed to demonstrate that a country controls its own affairs and, because arms industries use some of the most sophisticated technology available, that the country is well along the path to modernization. In addition, a domestic weapon industry can ensure vital supplies of arms and ammunition in time of war, thereby reducing a country's dependence on foreign

supplies; it can enable a country to obtain weapons that it would otherwise have trouble procuring abroad; and it can be a useful element in promoting the foreign policy of the state.

Third world countries that set up domestic arms production facilities often have at least two economic objectives: to spur their industrialization program and to reduce the financial costs, particularly outlays of foreign exchange associated with weapons procurement. The creation of a military industry is said to promote the industrialization process by upgrading both technology and manpower and making economies of scale possible in certain supply industries.

The expectation that foreign exchange can be saved by producing weapons domestically is based on the belief that the cost of importing licenses, know-how, raw materials and components will be less than the purchase price of a complete weapon. Some saving might also occur because the cost of labor in Third world countries, even skilled labor and technical manpower, tends to be considerably less than in the industrialized countries. [Ref. 7:p. 175].

The development of a nation's defense industry is always important. First, a defense dependent upon imported weapons will likely lead to political subordination to the exporting nation. In addition, advanced nations are increasingly unwilling to transfer their military technology, and thus they strengthen their control over sales. To cope actively with the increasing technology protectionism of advanced nations and the rapid

development of military technology, our local defense industry should be nurtured.[Ref. 8:p. 163]

B. KOREAN DEFENSE INDUSTRY DEVELOPMENT PROCESS

Since the Korean War, the Republic of Korea Armed Forces' structure and operational and tactical concepts were developed according to United States military doctrines. Most weapons systems and logistic support to Korea has depended on the United States. Until the late 1960s, most weapons and equipment of ROK Armed Forces were provided by the U.S Military Assistance Program (MAP) funding. At that time, the Korean economic, industrial and technological level were too low for domestic weapons production. As can be seen from Table 3, this represents more than 27% of all U.S. military aid given to East Asia and the Pacific during this period, and over 30% in the period before Vietnam started to absorb increasing amounts of U.S. assistance.

The decision to move toward defense industrialization was largely motivated by the quest for increased military self-reliance to cope with the eroding security environment. Since the division of the Korean peninsula following World War II, there has been constant military tension between South and North. North Korea has traditionally maintained a military edge over the South, whose relative weakness has been offset by the U.S security commitment. In fact, the presence of U.S. troops in South Korea has served as a crucial deterrent force. In the late 1960s, however, North Korea began to step up its military hostility through a series of bold provocations. On January 21, 1968, North Korea commandos raided the Blue House, the South Korean presidential residence.

Table 3. **U.S. Military Assistance to East Asia and the Republic of Korea (1949-1968)**

(millions of dollars)

Fiscal Year	Total Military Assistance to Korea	Total Military Assistance To East Asia	% to Korea
1949-1952	11.7	160.7	7.2
1953-1957	527.8	2,403.7	21.9
1958	331.1	627.8	52.7
1959	190.5	606.7	31.4
1960	190.2	501.6	37.9
1961	192.2	495.4	38.8
1962	136.9	523.3	26.2
1963	182.5	651.8	28.0
1964	124.3	563.7	22.1
1965	173.1*	648.9	26.7
1966	153.1*	535.6	28.6
1967	149.8*	673.0	22.3
1968	197.4*	1,026.9	19.2
Total 1953-1961	1,431.8	4,635.2	30.9
Total 1949-1968	2,560.6	9,419.1	27.2

*Excludes military assistance funding related to South Korean forces in Vietnam.

Source: SIPRI. *The Arms Trade with the Third World* (London: Paul Elek Limimted. 1971); pp146-147.

Two days later, North Korea seized the USS Pueblo and its eighty-two crew members. A year later North Korea shot down a U.S. EC-121 reconnaissance plane with thirty-one crew members. These incidents led South Korea leaders to perceive a dangerous vulnerability in its security in the event of an all-out attack by the North.

This perceived threat did not by itself drive Korean leaders to search for self-reliance in defense matters. The translation of this threat perception into actual decisions to pursue military self-sufficiency through defense industry build-up was a result of the rapidly weakening U.S. security commitment. Contrary to the Korean government's anticipation of tough retaliatory measures to the above incidents, the United States response consisted of mere verbal denunciations. This posture, conditioned no doubt by U.S. entanglement in an unpopular and unwinnable war in Vietnam, disappointed and worried the South Korean government. But the major shock was yet to come - the July 1969 declaration of the Nixon Doctrine ("Asian hands must shape the Asian future") with which the Nixon administration began to disengage from the Far East. Shaped by domestic budget politics, the doctrine provided, among other things, for the withdrawal of an entire combat division from Korea by March 21, 1971 (the Seventh Division, with a force of 24,000). This reduction in forces caused the government in Seoul to panic. Both the government and the people began to doubt the dependability of the U.S. commitment. The doubt grew stronger after the United States abandoned Vietnam in 1975. It was especially pronounced following Carter's announced intention to withdraw U.S. ground troops from Korea in 1977.

This diminishing U.S. commitment in the face of heightened North Korean military hostility pushed the South Korean government to opt for a policy of domestic military industrialization. The security motive coincided with a set of opportunities then available. Defense industries differ sharply from other industrial sectors in that they require a

synchronized combination of defense technology, heavy capital investment, industrial infrastructure and qualified labor. These prerequisites were available in Korea at the time of the decision to move toward defense industrialization.

National development plans in Korea have emphasized the military industry since the early 1970s. Prior to that time, Korea had more than one government arsenal producing ammunition and small arms. However, the defense industry as a whole did not command top priority until after the announcement of U.S troop withdrawals in connection with the 1969 Nixon Doctrine. In the early 1970s, worldwide tension and internal crisis on the Korean peninsula provided the incentives for the Korean government to develop the Korean defense industry and self-defense capabilities. President Park Chung Hee set up the ROK Armed Forces Improvement Plan to accomplish this national goal as soon an possible. In response to the Korean Improvement Plan, during the annual US-Korea Security Consultative Meeting in 1973, the United States formally pledged to assist Korea in developing its munitions industry. This was to be part of the compensation for reducing the US military presence. [Ref. 9:p. 62]

The Carter Administration's policies gave Korea incentives to promote the growth of an independent production capability. The Carter Administration's troop-withdrawal plan, later canceled, served as a major impetus for President Park Chung Hee's administration to accelerate investment in heavy industries (chemicals, metals, and machinery). This investment was to provide the infrastructure needed for a larger defense-industrial program. At the same time, the Carter administration provided a series

of coproduction agreements as a palliative for the U.S withdrawal policy. These were designed to bolster Korean weapon production capabilities. They exceeded in quality and sophistication those offered during the Nixon administration. [Ref. 9:p. 63]

To balance potential losses resulting from the troop pullout, the United States committed a substantial amount of military aid. Although it was far short of Korean requests, the aid eased the burden on the defense budget and improved Korean force levels. More importantly, the United States provided Korea with a wide range of defense-related technology by means of technical data packages, manufacturing license agreements and coproduction in the framework of security technical assistance. The availability of defense technology through United States security assistance was one of the key factors enabling the Korean defense industry buildup.

The Korean defense industry began in the early 1970s but it could not succeed without the economic growth and improvements in the industrial base experienced since the late 1960s (See Table 4). The growth of the Korean economy since independence and after the vast destruction caused by the Korean War is among the most remarkable instances of national economic developmental success in the contemporary world. Void of natural resources, Korea has created an economy, if not yet a political system, vibrant with internal hope--an example to which other nations now aspire. From the dark nadir of 1953, progress of this magnitude was virtually unthinkable; few foreigners realized Korea's potential. [Ref. 10:p. 122]

Table 4. Basic Economic Data, 1953-91

	1953	1960	1970	1980	1982	1991
Land area (sq. km.)	98431	98431	98447	98969	99022	99239
Population (thousands)	21502	24954	31435	38124	40578	43520
Percentage distribution of labor forces:						
• Agriculture	...	63.1	50.4	34.0	27.1	18.2
• Manufacturing & Mining	...	8.7	14.3	22.6	24.2	27.3
• Services	...	28.2	35.2	43.4	48.7	55.5
		100.0	100.0	100.0	100.0	100.0
Percentage shares of GNP (at 1980 prices)						
• Agriculture	51.7	47.2	28.7	14.4	13.9	9.1
• Manufacturing & Mining	6.3	9.1	16.3	30.2	30.7	29.7
• Services, etc.	42.0	43.7	54.9	55.4	55.4	61.2
GNP at current prices (million $)	1353	1948	7534	61203	81073	280/ 800
Per capita GNP ($)	67	78	240	1605	1998	6498
Gross domestic fixed capital formation (current prices) (%)	7.2	10.8	34.4	31.3	30.0	39.3
Gross domestic savings (%)	8.8	0.8	17.3	21.9	27.4	36.1
Foreign savings (%)	6.6	8.6	9.3	9.4	2.3	2.0
Ratio of exports/GNP	3.2	4.1	16.0	40.2	41.5	24.8
Ratio of imports/GNP	9.8	12.7	25.3	50.4	43.8	22.4
GNP growth rate	3.7	8.5	8.1	4.6	8.4	
	(1953-60)	(1960-70)	(1970-80)	(1980-84)		

... = not available.

Source: Bank of Korea, *National income in Korea 1982*; Economic Planning Board (EPB), *Major Statistics of the Korean Economy*, 1985; Hangook Daily Newspaper (April 2, 1992).

There were valid reasons for pessimism. The Republic of Korea suffered perhaps a million casualties and damage estimated at more than $2 billion during the Korean War. Per capita income for 1953 was $67, lower than before the war and one of the lowest in the world, as shown in Table 5. Some 40 percent of all structures in the nation had been destroyed or damaged, as was two-thirds of Korea's industry. Agricultural production was 27 percent below that of prewar years.

Today Korea has been described as "economic miracle" or model of new industrialized countries. Per capita GNP had grown to $5,659 in 1990. Exports, which have led the ROK's economic growth, rose from $50 million in 1962 to $46 billion in 1987.

Before reviewing the dynamics of the Korean economic performance, it is desirable to consider the stages of its development since the Korean War. The economic development of the Republic of Korea following the Korean War may be classified, somewhat arbitrarily, by political eras. Critical economic policies received different emphases under each administration. Thus, this discussion is divided into three parts: import substitution and foreign-aid maximization under the First and Second Republics; export-led growth under the Third and Fourth Republics; and unstable growth and second take-off under the Fifth and Sixth Republics. [Ref. 11:p. 125]

Table 5. Per capita and Total GNP, 1953-1990

(current dollars)

	Per Capita GNP	Total GNP (billion dollars)
1953	67	n/a
1960	94	n/a
1965	114	3.7 (66)
1970	248	13.1
1975	594	28.0
1980	1,592	62.3
1981	1,734	72.4
1982	1,824	82.5
1983	2,002	96.5
1984	2,158	109.4
1985	2,194	120.6
1986	2,505	139.7
1987	3,110	162.5
1988	4,127	188.4
1989	4,994	210.1
1990	5,659	229.0

(Per capita income is estimated to have been about $50 in 1948.)

Source: Economic Planning Board, various publications.

1. Post-War Reconstruction and Stabilization (1953-1961)

The First Republic era was marked by a poor record of growth, a virtual absence of economic planning and an intense effort to manipulate the foreign aid program on which Korea relied. At that time, the government necessarily emphasized the reconstruction of infrastructure and industrial facilities that had been destroyed during the Korean War. The more urgent programs for reconstruction of industrial plants and infrastructure were completed around the middle of 1957 and the government gradually shifted its policy emphasis from reconstruction to price stabilization.

Both the reconstruction and stabilization programs during the post-Korean War period were largely financed and supported by United States and United Nations assistance. Beginning in 1953, a large amount of aid-financed imports arrived for relief and reconstruction. During 1953-1960, total assistance provided by the United Nations Korea Reconstruction Agency (UNKRA) amounted to approximately $120 million and official United States assistance reached approximately $1,745 million. Over 70 percent of Korea's imports were financed by foreign grants during this period. Foreign assistance was important for the reconstruction programs, not only because it provided necessary imports, but also because the "counterpart funds" generated by the sales of grant-aid dollars provided a non-inflationary source of domestic-currency financing for investment. During 1954-1960, almost half of the total general government expenditures were financed by counterpart funds.

Despite the volume of aid which the Republic of Korea received, it was not all utilized effectively. A very high portion of aid came in the form of either non-essential consumer goods or agricultural surplus items (which depressed domestic agriculture) rather than as capital which would be used to redevelop the country. [Ref. 10:p. 9]

In addition, rapid inflation continued during the immediate post-war period. Although the annual rate of inflation, measured by the wholesale price index, declined from a peak of 531 percent for 1951 to about 25-28 percent in 1953-1954, it rose to 82 percent in 1955. The rate of inflation for 1956 was about 31 percent. In order to cope with domestic inflation, the government and the United States aid mission to Korea agreed to implement a financial stabilization program beginning in the second half of 1957. This stabilization was able to reduce the annual rate of growth in the money supply to about 20 percent in 1957, from 62 percent in 1955 and 29 percent in 1956. Despite some relaxation in the control of the money supply during 1958, relative price stability was attained in 1958 and 1959, helped greatly by consecutive bumper crops in 1957 and 1958 which sharply reduced grain prices. The political and social instability caused by the Student Revolution in 1960, however, brought a return to inflation. [Ref. 12:p. 41-42]

The period of the Second Republic (1960-1961) was an economic limbo. The political and social instability after the Student Revolution disrupted the economy and effectively prevented anything more than regime maintenance. There were no changes

in economic planning or progress of a magnitude reflecting the political revolution that had occurred. [Ref. 10:p. 128] During this period, Korea depended heavily on the United States, both economically and militarily.

2. Export-led rapid growth under the Third and Fourth Republics (1961-1979)

"Increase production and export" and "Build the nation on exports" were the national slogans of the Third and Fourth Republics. The military group which was to rule the Republic of Korea for next 17 years was determined to achieve economic development and energetically set about creating a climate in which economic growth became a primary national goal.

Since the beginning of the 1960s, Korea has been experiencing remarkable changes: from a unilateral relationship to bilateral economic cooperation, from grant-in-aid to development loans and foreign direct investment, from a dependent to a self-sustaining economy and from labor-intensive to capital-intensive industries. Someday Korea will become a "developed" nation.

For the first time in her history, Korea launched a Five-Year Economic Plan in 1962. The First Five-Year Economic Development Plan was geared to attain an annual growth rate of 7.1 percent during the period 1962-1966. The basic goal was to create the economic base for industrialization and self-sustaining growth. [Ref. 13:p. 9] In view of the poor growth performance of the previous years, the plan's growth target seemed too ambitious, particularly for the first year of the plan. But the target was exceeded by the high growth rate that began in 1963 and has continued ever since. Following the

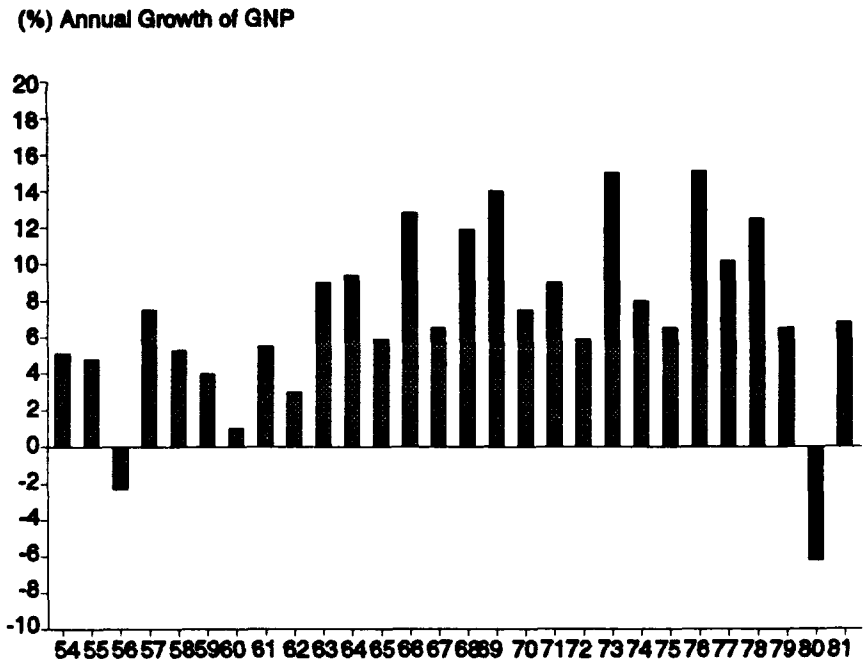
success of the First Five-Year Plan, Second, Third and Fourth Five-Year Plans were formulated and implemented by the government. [Ref. 12:p. 44]

During the second half of the current century, the term "economic miracle" began to appear in economic literature to describe Germany and Japan. Now Korea has been added to the honor roll. In the past decades, Korea has managed extraordinary and spectacular economic performance despite considerable odds. Yet the actual economic growth surpassed the ambitious planners' expectations and surprised the rest of the world. Many of the third world nations would like to "emulate South Korea's 20-year leap from poverty to relative prosperity."

Throughout the 1960s and 1970s, as Figure 3 shows, the average rate of growth was more than 10 percent a year, and per capita income increased from $87 in 1962 to $1,324 in 1979. With manufacturing the fastest growing sector and agriculture the slowest, the structural transformation was dramatic. Agriculture's contribution to GNP dropped from 38.7 percent to 18 percent between 1961 and 1981. In the same time period, manufacturing's contribution rose from 13.5 to 29.5 percent. [Ref. 10:p. 25] The most remarkable growth occurred in international trade: exports rose from a mere $41 million in 1961 to $21.2 billion in 1981. This is an average growth of 37.1 percent a year for the last two decades. In 1977, Korea celebrated breaking the $10 billion export target and has doubled the total within four years.

During the First Five-Year Plan (1962-66), exports increased at an annual rate of 38.6 percent while GNP grew 7.8 percent per annum (See Table 6). During the

Figure 3. Korean Annual Growth of GNP, 1954 - 81



second period (1966-71), the growth in exports slowed slightly to 33.8 percent per year while GNP growth accelerated to 9.7 percent per year. During the third period (1972-76), both exports and GNP continued to grow rapidly: the former at a 32.7 percent annual rate and the latter at 10.1 percent. This was accomplished in spite of the energy crisis.

Table 6. Korean Five-Year Economic Development Plan, 1962-1986

	First 1962-66	Second 1967-71	Third 1972-76	Fourth 1977-81	Fifth 1982-86
GNP Growth	7.8	9.7	10.1	5.6	5.4
Agriculture, forestry, fisheries	5.6	1.5	6.1	-0.7 (a)	4.5
Manufacturing	15.0	21.8	18.7	9.4	11.2
Social/other services	8.4	12.6	8.4	6.0	4.7
Foreign trade					
Exports	38.6	33.8	32.7	10.5	5.0
Imports	18.7	25.8	12.6	10.3	0.7
(a) Largely a result of the failure of the rice crop in 1980.					

Source: Derived from World Bank data.

The World Bank has observed Korea's trade from a different angle, i.e., efficient export growth can attain efficient import substitution. During the early stage of industrialization, Korea emphasized selective import substitution which brought favorable results. Her approach was to produce for both domestic and international markets. This caused an increase in export-led growth and also an expansion of the domestic market.

Clearly, the process illustrates complementarities between the two. [Ref. 14:p. 439] At the same time, Korean trade policy indicates that there is a positive correlation between exports and GNP. Based on comparative advantage, better utilization of productive capacity and improvements in technology which create economies of scale, a nation reaps the gains from foreign trade. Of course, the Korean experience

presupposes a favorable international milieu and prosperous economic conditions in industrial market economies.

Although it is essentially correct to characterize the Park's period as one of export promotion, there is no absolute dualism inherent in the dichotomy between export promotion and import substitution. At the same time that exports were an obsession, major efforts were directed at import substitution for two products--arms and rice (rice production will not be discussed in this thesis). Following the formulation of the Nixon Doctrine, which called for the withdrawal of U.S troops from Korea and the shock of improved U.S relations with the People's Republic of China in 1972, the Korean government felt that it could no longer rely completely on the United States supply of defense armaments. [Ref. 11:p. 136]

The Government concern was reflected in a new strategy putting great emphasis on building up a new generation of Korean industries. In the mid-1970s, under President Park's personal direction, the state began to commit extensive funds to develop the heavy, chemical, and defense industries. [Ref. 10:p. 13] This was an epoch-making event in the process of industrialization in Korea. Korea began to shift its development sequencing from labor-intensive light manufacturing sectors to capital-intensive heavy chemical industrial sectors with the initiation of the Third Five-Year Plan(1972-76).

During the Fourth Five-Year Plan (1977-81), active industrial deepening took place in various sectors in the anticipation of high forward linkage effects with the defense industry. The Korean defense industry accelerated industrial diversification.

During this period, heavy machinery, iron and steel, shipbuilding, metallurgy, and electronic industries were made strategic sectors for defense industry development and massive investments poured into them. As Table 7 indicates, almost 80 percent of investment in manufacturing during 1977-79 went to heavy industry. While investment in light industry was severely depressed, that in basic metals (an essential to the defense industry) exceeded its planned target by 30 percent three years before completion of the plan. In the case of machinery, electronics, and ships (other sectors essential to defense industrialization), 72 percent of the planned investment was used up within two years. To finance these defense-related heavy industries, a National Investment Fund was created. This fund absorbed public employee pensions and a fixed portion of all bank deposits. In addition, a wide range of policy and administrative incentives was offered. [Ref. 1:p. 250]

Table 7. Korean Investment in Manufacturing, 1977-1979 (In billions won, 1975 price)

	Plan 1977-81 (A)	1977	1978	1979	1977-79 (B)	% (B/A)
Investment in Heavy Industry	2,893	588	1,024	1,194	2,806	87%
Basic Material	731	263	357	331	951	130
MES*	1,145	139	309	379	827	72
Chemicals and others	1,107	186	358	484	1,028	93
Light Industry	1,621	193	252	304	749	46
Textiles	900	152	140	155	447	50
Others	721	41	112	149	302	42
Total	4,514	718	1,276	1,498	3,555	79

Source: World Bank, *Korea: Current Developments & Policy Issues*, 1980.
MES*: machinery, electronics, and ships.

The Korean defense industry was first incorporated into the overall defense policy. This policy fell into three distinct phase: The Force Modernization Plan (1971-75), the Force Improvement Plan (1976-80), and the Second Force Improvement Plan (1982-86). At the time the new defense industry was established, the crux of defense policy consisted of the rapid improvement of domestic defense forces to prepare for a possible power imbalance after the planned U.S. troop withdrawal. Although the relative weight of the defense industry was still minor, the Force Modernization Plan paid serious attention to the defense-industrial sector. As shown in Table 8, the Korean government began to allocate investments into defense-related research and development for the first time in 1971 (0.2 percent of total military expenditure, or 341 million won). Since then, there has been an incremental increase in resource allocation to the R&D sector (a 1.6 percent average annual increase during 1976-80, for example). The most important event during the Force Modernization Plan was the creation of the Agency for Defense Development (ADD) in 1970. The ADD was commissioned to serve as a defense-related technical data center and to assist the private sector's defense-related R&D. It also acquired foreign defense technology and engaged directly in defense product development. Since then, the ADD has played an important role in determining the growth rate and direction of the Korean defense industry. In the early stages of development, the Korean defense industry relied on the U.S technical assistance agreements and data package and reverse engineering to produce simple munitions and

communications equipment. This helped offset the lack of technology and engineers with sufficiently specialized skills. [Ref. 2:p. 290]

Table 8. South Korean Military Expenditures by Appropriation Category, 1961-1981
(current million won)
(figures in parentheses represent percentage of total annual military expenditures)

	Military Personnel	Maintenance	R&D	Investment	Total
1961	12,743 (76.8)	2,948 (17.80		896 (5.4)	16,587
1969	55,780 (66.1)	17,457 (20.7)		11,146 (13.2)	84,383
1970	69,073 (67.5)	22,968 (22.4)		10,295 (10.1)	102,336
1971	81,825 (60.7)	38,217 (28.4)	341 (0.2)	14,365 (10.7)	134,748
1972	96,987 (55.9)	55,500 (32.0)	2,054 (1.1)	19,097 (11.0)	173,638
1973	108,131 (58.9)	60,391 (32.9)	2,137 (1.1)	12,971 (7.1)	183,630
1974	144,107 (48.6)	123,153 (41.4)	8,234 (2.8)	21,348 (7.2)	296,842
1975	208,720 (47.2)	141,169 (31.9)	12,726 (2.9)	79,854 (18.0)	442,469
1976	298,920 (42.5)	170,975 (24.3)	36,035 (5.1)	197,818 (28.1)	703,748
1977	393,301 (41.4)	234,934 (24.7)	36,334 (3.8)	285,165 (30.0)	949,633
1978	483,557 (37.5)	336,539 (26.1)	30,878 (2.4)	438,379 (34.0)	1,289,353
1979	591,828 (38.8)	451,776 (29.6)	45,389 (3.0)	436,868 (28.6)	1,525,861
1980	792,401 (35.1)	751,607 (33.3)	70,751 (3.1)	642,624 (28.5)	2,257,383

Source: Kyung Heon Lee, *National Defense and National Budget*, in Chong Ki Park and Kyu Uk Lee (eds.). *National Budget and Policy Objectives* (Korea Development Institute, 1982), pp.168-69.

While the Force Modernization Plan paved the way for the basic infrastructure, it was the subsequent Force Improvement Plan that was responsible for a big spurt in the Korean defense industry. In fact, the Force Modernization Plan fell short of its planned objectives because of several factors: delayed and shrinking U.S. military aid, the oil crisis, economic recession, and administrative inefficiencies. Acutely sensing this trend, President Park gave orders to step up defense industrialization to the self-supporting level. This soon resulted in an impressive array of financial, administrative, and policy support measures expediting defense industrialization during this period. (See Table 8)

More importantly, it is during this period that the Korean government cultivated a defense-industrial complex. The defense industry was perceived as a losing proposition due to small market size and diseconomoies of scale. Thus, most private firms were reluctant to became involved in defense-industrial production. In order to co-opt them as agents of defense industrialization, the Korean government provided them with immense corporate-level incentives within the legal framework of the newly created "Special Law for the Promotion of Defense Supply." These incentives included: congressional financing to defense contractors four points below market rates; special provisions for excise and value-added tax credits; advance payment for up to 90 percent of sales contracts; exemption from import tariffs; concession of plant sites; and finally the military draft exemption for skilled employees in the defense industry. Perhaps most attractive to the defense contractors was the virtual government guarantee of corporate

survival through procurement pledges and the promise to extend rescue efforts to defense contractors operating in the red. These policy incentives produced a rapid growth of defense contractors (ninety-one firms as of 1981) which was in turn responsible for the acceleration of defense industrialization.

The Korean government financed massive resource needs in the defense sector by enacting the National Defense Tax, which imposed a 10-percent income and sales tax surcharge. Moreover, a nation-wide fund raising campaign was launched to meet financial needs for special defense projects. Funds raised through this campaign, which went into an account called "YulKok," were instrumental in funneling additional financial resources into the defense industry, particularly the R&D sector.

The concerted efforts to integrate economic policy into defense policy in lieu of defense industrialization were successful. The result was increased diversity and volume in conventional weapons production. This impressive performance was a function of the relative insulation of the defense industry sector from conflicting political pressures. It received top priority in resource allocation and was exempted from bureaucratic tribulations. Furthermore, government authorities prohibited any public debate on the validity of the rate and direction of defense industrialization for national security reasons.

The insulation of defense industrialization from competing political claims was a result of a highly centralized decision-making system. While other economic policies were subject to pluralist debates among technocrats, business-people, and

scholars, policies related to the defense industry (including heavy industry) were confined to the hands of only three persons during the Force Improvement Plan period (1976-79). These three people were President Park, Won Chul Oh (then economic secretary to the president in charge of heavy and defense industry) and Mun Taik Shim (then director of the ADD). All decisions on the defense industry were made by these three. Once decisions were made, they were implemented quickly. In fact, it was this highly centralized decision-making structure that was responsible for the rapid implementation of the defense industrialization plan. As shall be discussed, such a concentration of decision-making power and the hasty implementation of the plan resulted in inefficiency, duplication, and surplus capacity in the defense industry.

In the middle of the second decade of intensive military production, Korea's new entrepreneurs are feeling the effects of an overcrowded market. In the absence of effective government planning and coordination, companies compete viciously for larger shares of the military procurement market. Although competition was apparently desired by the Park administration, the result has been redundancy and excess capacity as firms have attempted to became proficient in the production of all the components related to their sector. This in turn has denied Korea the higher quality and economies of scales that come with specialization. [Ref. 15:p. 220]

3. Unstable growth and second take-off under the Fifth and Sixth Republics (1980-present)

Political and social uncertainty after Park's assassination in 1979 was exacerbated by economic trauma. Not only was there an urgent need for structural adjustment in the economy because of heavy industry policies, but agriculture was in disarray because of rice failures. In 1980, for the first time since the Korean War, there was economic decline. GNP dropped by 5.2 percent. [Ref. 10:p. 138] Exports recovered in 1980, but were insufficient to rescue growth. Exports grew at a slightly slower pace in 1981.

The Korean defense industry critically undermined macroeconomic performance during the later part of the 1970s. Hasty emphasis on the defense industry resulted in massive investment in the heavy and chemical industries during 1976-79. This investment exceeded the levels dictated by market size, financing capacity, and even technical and engineering capability. This investment pattern contributed to waste and inefficiencies, and more importantly to the artificially overheated economy. As evidence that the economy was overheated, the inflation rate leapt from the average annual rate of 19.5 percent experienced between 1970 and 1978 to over 35 percent in 1979 and 1980. Of course, there were a number of other factors responsible for spiraling inflation and the economic collapse in 1979 and 1980: the second oil crisis, foreign-exchange shortage, supply bottlenecks and real estate speculation. However, the defense-motivated massive investment in the heavy-chemical industries appeared to be a crucial variable leading to the economic crisis of the late 1970s.

Because of these circumstances, a radical reappraisal of the economic management policies used in the 1960s and 1970s was undertaken in 1980. The government adapted a strategy which would put tighter reins on the money supply - it was believed that this would keep inflation under control. The Fifth Plan, which came into effect in 1982, was devoted to reducing government involvement in the economy. This created the conditions for a "second take-off" into high and stable growth rates. Since 1983, high growth and low inflation (around 3 percent) have been achieved.[Ref. 10:p. 14]

In the 1980s, the government policies toward the defense industry also changed. During the Fifth Republic, the authority and responsibility for weapons system development and the defense industry were shifted from the President to both the Ministry of National Defense and Ministry of Commerce and Industry. Thus, military R&D and defense industry did not command as high a priority and did not obtain as large a budget.

There is some evidence that the government of President Chun Doo Hwan tried to introduce changes in arms production. For example, the role of technicians and planners within the government has been strengthened through the creation of new agency called the Korean Institute for Defense Analysis (KIDA). Patterned after the US Institute of Defense Analysis, KIDA employs most of the talented systems analysts who were formerly at ADD and enjoys direct lines of communication with the higher echelons of the Ministry of National Defense. [Ref. 15:p. 221]

In addition, the Korean defense industry, which was in an infant stage in the early 1970s, is now able to domestically produce all basic arms and equipment. Thus, it has already satisfied the needs of the Ministry of Defense. Therefore, the defense industry was kept as status quo. The decreasing demands for weapons and equipment discouraged the defense industry from committing to new investment.

Apart from the macroeconomic effects discussed, defense industrialization has also produced a variety of microeconomic effects. As mentioned earlier, Korean firms were initially reluctant to venture into the defense industry because of market uncertainty and heavy capital investment needs. But the carrot-and stick policy of the government gave them few alternatives. Ranging from big business conglomerates to small businesses, over ninety firms engaged in military production. Of course, their risks were tentatively cushioned by subsides, long-term low interest congressional financing and guaranteed procurement. However, limits to subsidized military industrialization began to surface. As Korea achieved self-sufficiency in conventional weapons needs in the early 1980s, the domestic defense contract market began to shrink. Defense production capacity became underutilized. For example, the utilization rate of defense-industrial plants hovered below the 50-percent level in 1984. Moreover, nine defense contractors went bankrupt during the period 1980-84. [Ref. 2:p. 254]

In 1990, Korean defense industries are classified by the Ministry of Commerce and Industry and other related research agencies to avoid waste. Because defense firms were not specialized and serialized based on technology and capabilities,

they overlapped industrial sectors. This created conflicts. Critical and strategic materials for military purposes are also designated by the Ministry of Defense to guarantee their purchase, improve their quality, better manage these materials and revitalize research and development. By the end of 1990, critical and strategic materials include 262 items. 82 defense firms are designated to produce these materials effectively and efficiently. Table 9 presents the defense materials and defense industry status by function.[Ref. 16:p. 260]

In summary, Table 10 provides an overview of the Korean defense industry. Table 11 shows the principal producers in the Korean defense industry.

Table 9. Defense Materials and Defense Industry Status

	Total	Fire[a]	Aero[b]	Veh[c]	Vess[d]	Ammo[e]	Comm[f]	Others
Defense Materials	262	40	9	16	16	85	46	50
Defense Firms	82	11	4	10	10	8	9	34

Source: ROK MND, *Defense White Paper*, 1991.
a includes gunnery
b means areospace and guided missiles
c means all transportations
d means all kinds of warship
e includes ammunition and mines
f means communications and electronics

Table 10. Korean Defense Industry Progress

Period	Objectives	Policy Contents
1st phase 1970-1976	• Establish cornerstone for defense industry. • Home production of basic arms.	• Formation of Agency for Defense Development (ADD) • Begin research and develop for basic arms. (Introcution of U.S. technical data packages.) • Cultivate the reverse-planning capability. • Installation of the bureau of defense industry in MoD. • Legislation of special laws related to defense industry. • Designation of defense industry and military materials.
2nd phase 1977-1981	• Accomplish the cornerstone for basic weapons production. • Begin to produce precise weapons.	• Formation of fund for improving defense industry. • Build up mass production systems of basic arms. • Begin to research and develop highly precise weapons.
3rd phase 1982-1986 (Fifth Republic)	• Construct cornerstone for highly precise weapons production.	• Reorganiztion of weapons system acquisition structure. • Localization of raw material. • Cultivate design capability for weapon system.
3rd phase 1987-now (Sixth Republic)	• Formation of production systems of defense material.	• Guide pre-planned production of defense material. • Specilization of defense industry. • Increase the ratio of localization.

Source: MND, *Defense White Paper*, 1989.

Table 11. Korean Defense Industry: Principal Producers

Producer	Products
Dae-Dong Insustrial	Jeep, trucks; APC assembly
Daewoo Heavy Industries	Upgrading of APCs: ordnance
E-HWA Electric Mfg	Ammuniction; mortars, multiple rocket launchers; electronics; engines
Gold Star	Missiles; electronics
Hyundai Shipping and Heavy Industries	Warships
KIA Industrial	Jeeps; APCs; trucks
Kangwon Industries	Tank conversion
Korea Heavy Industry Construction (KHIC)	Tank parts
Korea Heavy Machinery Industry (KOHEMA)	Larger ordnance
Korea Integrated Steel	Preproducts
Korea Explosives	Explosives; propellants; bombs
Korea Shipbuilding and Engineering	Warships
Korea-Tacoma Marine Industries	Warships
Korean Air Lines	Aircraft
National Plastic	Mines
Oriental Precision	Ordanance; electronics
Poongsan Metal Mfg (PMC)	Ammunition; small arms
Samsung Precision Industries	Aircraft engines
Sam Yang Chemical	Chemicals
Taihan Electronic Wire	Optronics; electronics
Tong-Il Industry	Guns, grenade launchers
Tong Myung Heavy Industries	Preproducts

Source: SIPRI

C. LOCALIZATION OF COMBAT EQUIPMENT

1. Research and Development

In the initial stage, the research and development efforts emphasized production imitation in order to speedily produce basic military equipment. By the end of the 1970s, the ROK accumulated sufficient technologies to develop guided weapons and various other sophisticated military systems. More recently, Korea has emphasized the development of its own weapon systems and the improvement of quality.

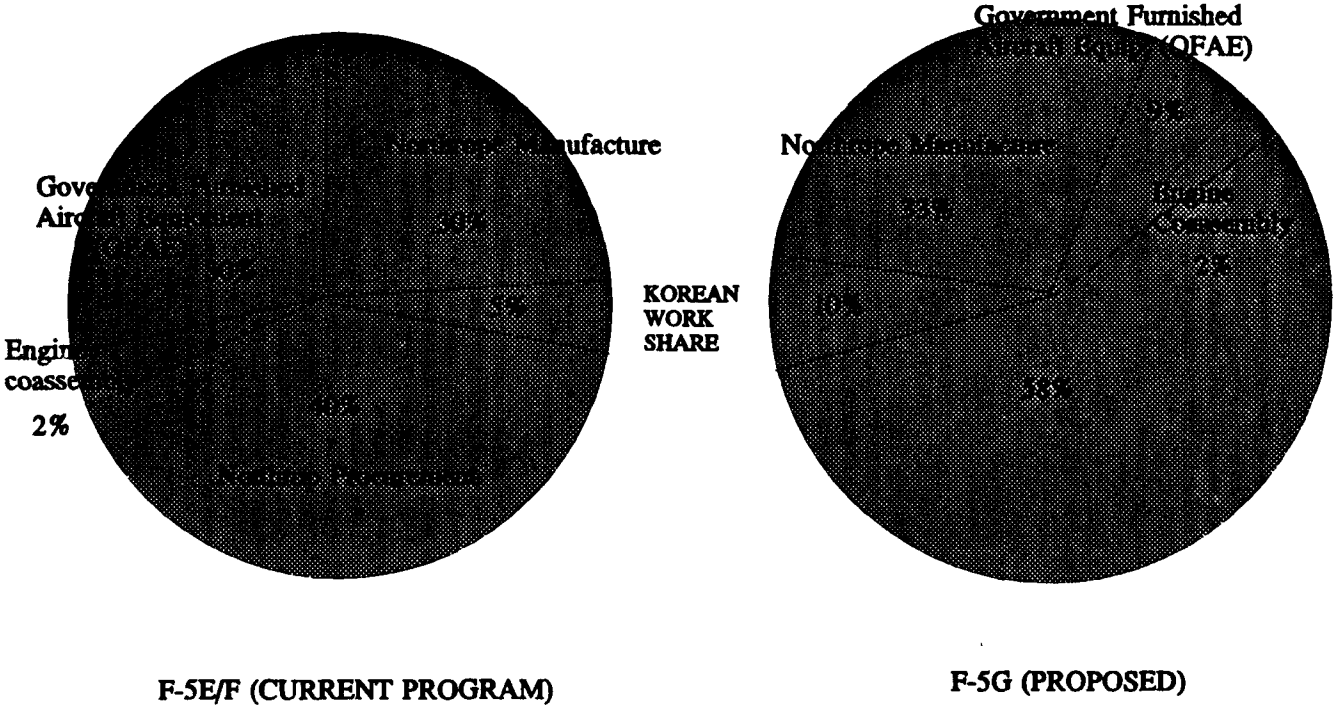
However, advanced nations are unwilling to transfer their technology and the ROK lacks expertise in advanced technology and basic applied science. Thus, it has not been easy for the ROK to independently research and develop highly-sophisticated weapons. To secure the science and technology needed for developing the next-generation weapon systems in an independent, timely and economical manner, the ROK has concentrated on basic preliminary studies. A "national defense science and technology information center" is now being established to collect advanced technology from home and abroad. Efforts have been made to streamline cooperative research and development systems between the ADD and the defense industries to insure utilization of technology on the basis of comparative advantage. To stimulate defense research, R&D investment will be increased from 1.5 percent of the defense budget in 1988 to 5 percent in 2000.

2. Aerospace and Guided Missiles

One important factor in developing the Korean aerospace industry was the 1979 agreement for Korea to co-produce the F-5 fighter. A program for F-5E/F models was initially approved under the Carter administration. However, it may phase into production of the newer and more capable F-5G, according to the plan proposed to the Korean government by the Northrop Corporation (Figure 4). Koreans had originally sought coproduction rights for the F-16, but this was turned down by the Carter administration. Having decided to co-produced the F-5s, however, Korea also received approval from the Regan administration to acquire 36 F-16s. The original contract was to co-produce 68 F-5E/F aircraft (36 F-5Es and 32 F-5Fs). This was estimated to cost $62 million. This program includes full logistical support, training, technical assistance, and tooling for production.

The first major program of Korea's aircraft industry, apart from the construction of four simple trainers in the early 1970s, was the coproduction of 500 MD helicopters in 1976. The original agreement provided for 75 light combat helicopters (equipped with 2.75 inch rockets and machine guns) to be assembled from kits produced by Hughes Aircraft. Assembly of the 75 helicopters was completed in March 1979. It was then reported that another 48 would be built at a facility in Kimhae. The program did produce certain technological spin-offs to the civilian sector. At least six civilian versions of the helicopter were delivered to local companies like the Korea Tacoma Company, with plans for a similar number to be delivered in later years.

Figure 4. F-5 Production Elements



F-5E/F (CURRENT PROGRAM)

F-5G (PROPOSED)

Source: Northrop Corporation, Fighter Coproduction and Security Assistance

In September 1982, the ROK Air Force launched an aircraft development project and became the third nation to produce airplanes in Asia. It has produced 500MD helicopters and has locally assembled and co-produced the F-5E/Fs (called Jegongho in Korean).

The Korean Fighter Program (KFP) is one of the Force Improvement Plans to upgrade the quality of Korea's aircraft to enable all-weather operation and secure command of the air in any emergency. To counter the sophisticated MiG-29s and SU-25s that North Korea received from the Soviet Union, the ROK Air Force introduced the advanced F-16s for high performance, multi-purpose operational fulfillment. The most recent contract for F-16 Falcon coproduction was signed in March, 1991. The F-16 fighter was selected to replace the F-5G (the current major Korean fighter). According to the ROK Ministry of National Defense, 120 F-16 Falcons will be introduced and coproduced with General Dynamics Company. Among them, 12 F-16s will be introduced as an end item, 36 F-16s will be produced under licensed production by the prime contractor, Sam-Sung Aerospace Company, and the remaining F-16s will be coproduced. This program will increase the deterrence against North Korea for national security as well as develop the domestic aerospace industry by means of military technical spillovers and coproduction. [Ref. 15:p. 210]

Equally important, at least under the Park administration, was the development of an indigenous capability for missile design and production. Development of this capability began in 1972 with a MAAG-supervised maintenance facility for the

Hawk and Nike Hercules missile systems. At the time, the U.S government recognized that locating such a facility in Korea could save several million dollars over the life cycle of these missiles, given lower labor costs, reduced transportation costs and utilization of local repair parts. This program led to a commercial maintenance facility in Korea, under the aegis of a local firm, Gold Star Precision Industries, Ltd. Korean personnel have received training from the US military and, among others, from the Raytheon Corporation. Based on this training, Korea has continued making improvements in this commercial facility.

Domestic missile R&D and production were undertaken within the Agency for Defense Development, at least until quite recently. President Park staked his personal prestige on the development of missile production capabilities, with special emphasis on the development of a long-range SSM capable of reaching Pyong-yang.

South Korea tested its first SSM successfully in 1978. The missile is believed to have a range of 100-160 km. The SSM is designated NH-K. It is a modification of the US Nike Hercules, although it is presented domestically as having been made with entirely indigenous components. A military display in mid-1979 revealed three Korean-developed missile systems, although it is not possible to determine the extent to which these relied on US technical data.

ADD gained experience in missile technology in part through a program for maintaining the US Nike Hercules system. Under the agreement, the United States provided technical specifications for upgrading reliability through electronics

improvements, improving conventional warheads and adding a capability for use in a surface-to-surface mode. The latter may have resulted in considerable augmentation of the missile's range, although this has not been verified. In principle, the new guidance systems should increase range. In any event, one analyst has suggested that this system could be turned fairly easily into "a fine tactical nuclear weapon." In addition to the NH-K, Korea has had a program to modernize the Honest John missile by improving the guidance systems to increase its accuracy.

3. Naval Production

The purpose of naval production in Korea is to prevent North Korean insurgent operations on the South Korean coast. As a result, the country has concentrated on the production of high-speed patrol boats for guarding shallow inshore waters. In 1972, Korea built its first successful naval vessels--fast patrol craft--under US supervision. In 1979-80, the US and Korea jointly produced four multimission patrol ships armed with Harpoon missiles. Four more were ordered in 1982. To counter North Korean submarines (now 24 submarines), the ROK launched an anti-submarine warfare development project in 1976 and produced the first Korean-design frigate in 1980. The successful development of the frigate has contributed greatly to strengthening the ROK's anti-submarine warfare capability and its maritime forces. Various landing craft have also been produced, including four capable of carrying tanks. [Ref. 9:p. 161]

Eleven corvettes are currently under construction. These are equipped with a Dutch weapon-control system, US-Italian gas turbines and West German diesel engines.

Armed with one 76 mm and two 30 mm guns, the corvettes may be fitted with electronic warfare equipment if testing proves successful. A prototype submarine was developed in the late 1970s. However, Korea will not have the technical ability to manufacture a modern submarine for some time to come. The South Koreans have also built a guided-missile frigate, but do not seem to have the capability to build larger naval craft. Korea's major naval producer is Hyundai Shipbuilding and Heavy Industries, which has a massive shipyard in the southern part of the country near Ulsan. Another firm, Korea Tacoma Marine Industries, built the patrol boats controversially exported to Indonesia. Although the country has the capability to produce basic naval craft, major weaknesses include engines, naval armaments and components such as fire control systems. These must be imported.

4. Ground Forces

Most Korean design and production programs are concentrated on ground-force equipment, ranging from simple munitions to armored personal carriers (APC), tanks and fairly sophisticated ordnance. About half of Korean defense needs are met by domestic production; the great majority of this intended for ground forces.

One major program is standardizing the M-48 tank to the M-48A5 configuration. The US army has deployed this configuration in Korea. This package includes a 105 mm gun, a standardized engine, fire -control equipment and night-vision devices. Korea has wanted to produce a tank domestically since the mid-1970s. In 1976, extensive discussions were held between the South Korean Joint Chiefs of Staff and the

US Military Assistance Advisory Group (MAAG) to consider options for improving Korean armored forces. Korea pressed for acquisition of the M-60A1 tank, but was denied. For the M-48 project, granted in its place, South Korea reportedly produced up to 30 percent of the conversion components.

Korea's ambition in the tank field came a step closer to fulfillment under a recent agreement with General Dynamics to produce "several hundred" main battle tanks. Designated ROKIT, for Republic of Korea Indigenous Tank, the new tank carries a 105 mm gun. It is reported to be either an upgraded M-60, similar to that which Korea sought unsuccessfully in the late 1970s, or an "austere version" of the M1 Abrams. Prototype testing began in April 1984. In 1985, the ROK finally succeeded in producing a tank of its own design. Dubbed the "88 tank," it is now mass-produced and deployed for combat. [Ref. 8:p. 160]

Another upgrade program to improve the Korea's Second Division fleet of M-113 APCs is being undertaken by Daewoo Heavy Industries at Inchon. In the future, Daewoo is to be responsible for performing routine depot and maintenance work for all army tracked vehicles. Thus, vehicles will not have to be sent to the United States for overhaul. Korea has also received assistance from Italy in this area. An agreement for coassembly of the Fiat 6614A four-wheeled APC was signed in 1976.

South Korea also produces military trucks. KIA Industries (a merger company that includes the former Asia Motor Corporation) was designated the major contractor for all wheeled military vehicles produced domestically. One program calls for the

insertion of a Korean-made four-cylinder engine in military jeeps while larger trucks are being retrofitted with a Korean-produced German diesel engine. A quarter-ton truck of KIA design was under development in 1978 and plans called for the design and production of a two-and-a-half ton truck by the end of 1982. Korea also has a contract with American Motors General Products for the assembly of a five-ton truck (M-809 series) using the Korean-produced diesel engine.

Korea produces a full range of ordnance, artillery and ammunition, as well as propellants and explosives (Table 12). Prototypes for the 105 mm and 155 mm howitzers were manufactured in Korea from US technical data packages (TDPs) as early as 1973 and 1974, respectively. ADD simply copied the TDPs and redrew the designs to Korean specifications without US assistance. Then they were provided to Korean firms. As defects increasingly surfaced in the manufacture of these weapons in the mid-1970s, the Koreans requested further technical assistance. This was provided by personnel from American arsenals. The quality of small-caliber weapons and ammunition in Korea is reputed to be very good, while weapons of larger caliber and components are approaching military-grade quality. The improvements have much to do with improvements in training, although shortages of both skilled inspectors and modern testing equipment are still in evidence today.

Table 12. Ammunition and Ordnance Production in Korea

Item	Comment
M-16 rifle (5.56mm)	Produced under liscence with Colt Industries and the U.S. government
M-14 rifle (7.62mm)	Estimated 100,000 produced by 1982
M-60 machine gun (7.62mm)	U.S. design
155mm howitzer	U.S. design
105mm howitzer	U.S. desing
8-inch self-propelled howitzer	U.S. design
81mm mortar	Permitted for export by U.S.
60mm mortar	No longer produced
4.2-inch mortar	U.S. design
106mm recoiless rifle	Permitted for export by U.S.
90mm recoiless rifle	U.S. design
Vulcan anti-aircraft gun	U.S. design
Oerlikon anti-aircraft	Swiss co-production; exports have to be sold through the Swiss who take 50% of sale revenues
M-19 anti-tank mine	U.S. design
M-18 anti-personnel mine	U.S. design
M-72 rocket launcher	U.S. design
M-203 rifle grenade	U.S. design
90mm armor-piercing projectile	U.S. design

Source: Defense Market Survey, Inc., *DMS Market Intelligence Report for China (Taiwan) and South Korea* (Greenwich, CT: Defense Market Survey, Inc.,1981)

The munitions sector in Korea is suffering most acutely from excess capacity because it has satisfied needs of Ministry of National Defense. The Poong-San Metal Manufacturing Company (PMC), the major ammunition and ordnance producer in Korea, is 90 percent idle in some areas.

The electronics industry in Korea advanced in recent years, especially in the area of data processing, communications and computers. Electronics are a major focus of the most recent five-year development plan. The government has developed a state-run organization, the Fine Instruments Center, to oversee advances in electronics, machinery and related industries. This is a major area targeted for expansion, in part through the initiation of research institutes with special emphasis on industrial electronics, including semi-conductors and communications equipment.

IV. KOREAN DEFENSE INDUSTRY AND ITS ECONOMIC IMPACTS

A. CONTRIBUTION TO GNP GROWTH

Economic growth is defined as the rate of change in GNP. [Ref. 17:p. 465] This thesis will determine how much the Korean defense industry has contributed to the growth in GNP. This thesis will use the Feder and Ram Model (see Appendix A). The data used is from the "Economic Statistic Yearbook," issued by Bank of Korea, and the KIDA Report (Korean Institute for Defense Analysis). Finally, the regression equation is estimated by the Ordinary Least Squares (OLS) method.

The final equation of the Model can be written as follows:

$$\overline{Q} = \alpha\left(\frac{I}{Q}\right) + \beta(\overline{L}) + \left[\frac{\delta}{1-\delta} + C_D\right]\left[\overline{D}\left(\frac{D}{Q}\right)\right]$$

In this equation, an overlined variable denotes a rate of growth and I/Q and D/Q are the conventional notations for the ratios of investment and defense spending to total output, respectively. Q is real gross national product (GNP). I is real gross fixed investment. I includes only private investment spending data. Public investment spending was not available in the National Income accounts. Gross rather than net investment is used. Deducting capital consumption allowances, which are poor estimates of depreciation, would make net investment an empirically erroneous measure.

L is civilian employment. This of course does not mean that L only includes the employment associated with the production of civilian goods and services. Since, as noted in Appendix A, a large portion of defense supplies and equipment is produced by civilian firms, "civilian employment" includes both civilian and military production.

The OLS results are reported below with the absolute value of the t-statistics in parentheses.

$$\overline{Q} = 17.060 - 0.323\ (\frac{I}{Q}) + 1.601\ (\overline{L}) - 0.053\ [\overline{D}(\frac{D}{Q})]$$

$$(1.18) \qquad (2.84) \qquad (2.13)$$

Period: 1975-1990 R^2=0.4338 DW = 2.225

The coefficient estimate for the employment growth effect has the theoretically expected positive sign and is statistically significant at the usual levels of significance. On the other hand, the sign of the investment coefficient of the opposite of the theoretically expected result. However, this coefficient is not significant at the usual levels of significance. Therefore, the negative relationship between investment and GNP growth may be ignored.

Furthermore, the coefficient estimate for the defense spending growth effect variable has a negative sign and is statistically significant at the usual levels of significance. If $C_D \geq 0$ and/or $\delta \geq 0$, increased military spending will imply a higher rate of growth of total output Q (the defense plus civilian sectors) for a given usage of

labor and capital. The negative sign of defense spending growth variable reflects that either the defense sector generates negative externalities for the civilian sector or that productivity in the defense sector is lower than in the civilian sector.

Unfortunately, this model does not separate defense spending into consumption and investment areas. A large portion of defense budget was spent for investment on defense industry and military R&D, as mentioned earlier.

To determine how much the defense industry has contributed to GNP growth, the proportion of defense industry output in the GNP can be the defined as the proxy for economic contribution of the Korean defense industry. Table 13 presents the ratio of defense industry purchases to GNP. As shown in Table 13, the ratio of defense industry purchases to GNP has increased since 1975, despite fluctuations from year to year.

The defense industry has contributed about 1 percent to GNP growth. Table 14 shows domestic purchases by function. For convenience, the defense industry is categorized into seven sectors by function. As shown in Table 14, until 1978, ammunition is the number one item for defense purchases. Since 1979, vehicles are the largest part of defense product purchase. This means that the defense industry is oriented toward import substitution for conventional arms and ammunition and focuses on maintaining the military balance between South and North Korea. Therefore, vehicle, ammunition and firepower occupy the 66 percent of total purchase of defense products.

Table 13. The ratio of Defense Products Purchase to GNP

(In Billions Won = Current price)

Year	GNP (A)	Defense Products Purchased (B)	Ratio (%) (B/A)
1975	10,135.8	16.8	0.17
1976	13,912.7	44.2	0.32
1977	17,806.6	57.6	0.33
1978	24,001.6	139.3	0.58
1979	30,801.8	203.3	0.67
1980	36,749.7	327.7	0.89
1981	45,528.1	441.3	0.97
1982	52,182.3	466.0	0.90
1983	61,722.3	638.1	1.04
1984	70,083.9	602.8	0.86
1985	78,088.4	739.4	0.95
1986	90,598.7	1,053.2	1.17
1987	106,024.4	1,123.2	1.06
1988	126,230.5	1,384.1	1.10
1989	141,794.4	1,343.1	0.95

Source: KIDA, *Analysis on Defense R&D and Defense Industry in Korea,* 1990.

Table 14. Domestic Purchase of Defense Products by Function (In millions won)

Year	Fire	Ammo	Veh	Comm	Vess	Aero	Others	Total
1975	0	6598	2	3167	4116	0	2642	16525
1976	10	14995	199	8436	14810	574	4327	43372
1977	2979	16494	4190	8536	9732	5072	7357	54180
1978	6641	34817	27176	10566	4462	28508	10410	122610
1979	10574	41686	65789	1746	6793	21874	12019	180697
1980	24770	51901	95524	27759	18544	34804	18442	271744
1981	26205	85788	115743	52749	14092	32210	19748	346535
1982	26037	80095	120258	56116	21794	45027	16501	365828
1983	28967	102002	109439	54060	36000	76321	23216	430005
1984	91173	129178	118942	39205	49332	74318	35678	537826
1985	149479	12744	184775	37972	44410	83197	37374	664651
1986	206943	208716	337715	58668	52271	77760	42741	984814
1987	193652	250619	305240	62896	63105	81939	62823	1020174
1988	225162	238313	288096	63645	208921	166789	74239	1265465
1989	227690	271475	299119	58727	166291	117246	95887	1236435
Total	1224682	1660121	2072207	559784	714673	845659	450266	7527392
Ratio	16.3	22.1	27.5	7.4	9.5	11.2	6.0	100.0

Source: KIDA, *Analysis on Defense R&D and Defense Industry in Korea*, 1990

B. INDUSTRIAL DIVERSIFICATION

Defense industrialization cannot be effectively implemented without appropriate forward and backward linkages with other industrial sectors. A push effect of defense industrialization on industrial capability cannot be discounted despite some crucial negative consequences. Through the 1979s, Korea was losing its competitive advantage

in conventional export items from the light manufacturing sectors. Wage increases, severe horizontal competition among developing countries and mounting protectionist trends among OECD countries were rapidly depriving Korea of its comparative advantage. The high uncertainty regarding investment in capital-intensive heavy industrial sectors and the structural rigidity of the Korean economy as a whole prevented the private sector from actively adjusting to changing market realities. The Korean government's commitment to pursue defense industrialization at any expense and the resulting incentives reduced such uncertainty and facilitated Korean firms' industrial adjustment.

The immediate consequences of this industrial adjustment turned out to be disastrous. From the long-term perspective, however, expediting heavy industrialization via the defense-industrial impetus can be considered a constructive move. Indeed, if national security concerns had not dictated defense industrialization, the Korean government would not have invested over $10 billion in the heavy-chemical sectors within such a short time span. Moreover, since the late 1970s domestic production and exports of military hardware helped ease the foreign-exchange burden, though minimally.

Jurgen Bauer analyzed industrial diversification with-in the arms production-relevant industries in his paper, "Arms Production in Developing Nations." Table 15 summarizes his research and is organized as follows. Nine International Standard Industrial Classification (ISIC) Categories (at the three-digit level) are entered column-wise and data for Third World arms producers row-wise. Each cell entry denotes the

number of ISIC sub-categories (at the six-digit level) in which a country was producing items. For example, the three-digit ISIC code 351 (manufacture of industrial chemicals) consists of 74 sub-categories (at the six-digit level) standing for 74 distinct chemical products. Burma produced in 3 of those 74 sub-categories, Saudi Arabia in 2, and Venezuela in 15. As shown in table 15, it is clear that the Korean defense industry has contributed to the industrial diversification.

Table 15. Third World Arms Producers' production in ISIC categories, 1975-1984

	351 (74)	352 (12)	371 (32)	372 (36)	381 (15)	382 (59)	383 (27)	384 (21)	385 (6)	Total
Saudi Arabia	2	0	1	0	0	0	0	0	0	3
Sudan	0	1	1	0	1	1	1	0	0	5
Zimbabwe	4	0	5	4	0	0	0	0	0	13
Singapore	3	3	0	0	0	2	3	2	0	13
North Korea	4	0	3	9	0	0	0	0	0	16
Nigeria	1	2	1	4	1	3	2	3	0	17
Malaysi	3	4	5	2	2	0	3	4	0	23
Pakistan	11	4	0	0	0	3	4	6	0	28
Burma	3	3	2	2	1	6	9	4	0	30
Thailand	9	2	5	3	1	2	5	4	0	31
Venezuala	15	1	10	6	0	0	1	4	0	37
Isreal	17	3	1	0	1	5	5	5	5	37
Peru	11	4	4	9	2	3	4	7	0	44
Iran	8	3	2	7	4	10	8	6	0	48
Egypt	20	2	14	4	2	4	9	8	0	63
South Africa	11	6	18	11	2	5	6	5	0	64
Indonesia	16	7	3	5	5	8	10	9	2	65
Argentina	18	5	17	10	0	7	4	7	0	68
Phillipines	18	4	9	6	4	9	11	6	1	68
Chile	21	6	10	8	3	6	11	4	0	69
Greece	26	7	10	14	7	21	15	9	0	109
Mexico	47	5	17	22	0	10	10	7	0	118
Portugal	41	8	16	14	3	27	18	14	0	133
India	55	8	13	22	3	17	10	12	2	142
Turkey	39	7	23	16	6	29	19	12	0	160
South Korea	**54**	**8**	**21**	**18**	**6**	**28**	**15**	**11**	**4**	**165**
Brazil	62	7	22	31	5	41	20	13	4	205
Yugoslavia	50	8	29	19	9	47	26	20	3	211
Spain	73	10	30	32	11	48	24	14	4	246

Source: *United Nations Yearbook of Industrial Statistics*, 1984 (Volume II, Commodity Production Statistics, 1975-1984).

Note: ISIC codes

351 Manufacture of industrial chemicals
352 Manufacture of other chemical products
371 Iron and steel basic industries
372 Non-ferrous metal basic industries
381 Manufacture of fabricated metal products, except machinery and equipment
382 Manufacture of machinery except electrical
383 Manufacture of electrical machinery, apparatus, appliances and supplies
384 Manufacture of transport equipment
385 Manufacture of professional and scientific, and measuring and controlling equipment not elsewhere classified, and of photographic and optical goods

As for the backward linkage effects, it is defined as the ratio of output from arms production-relevant industries to total defense industry purchases. Table 16 shows the backward linkage effects of the Korean defense industry. According to Table 17, the highest dependency of the defense industry on arms production-relevant firms belongs to the communication sector. The general sector has the second highest dependency. The gunnery and plastics sectors also have high dependency. On the other hand, the aerospace and material sectors have low dependency on the defense industry. This means that the backward linkage effects are low in some high technology sectors such as the aerospace and materials, but high in others such as the communications. The overall dependency of the Korean defense industry on domestic arms production-relevant industries is 0.16. [Ref. 18:p. 81]

Table 16. Dependency of Arms Production-relevant Industries on Defense Industry, 1987 (in millions won)

	No. of Arms Production-Relevant Industries	Output of Arms Production-Relevent Industries (A)	Defense Industry Purchase (B)	Dependency (A/B)
General	354	18,494	36,855	0.50
Plastics	45	2,699	10,627	0.25
Vehicles	311	55,625	274,849	0.20
Gunnery	343	14,659	87,470	0.17
Ammunition	604	36,598	222,438	0.16
Missiles	35	1,163	10,017	0.12
Communication	136	2,126	29,068	0.67
Ships	266	2,981	55,727	0.05
Aerospace	7	1,440	29,288	0.05
Others	401	3,427	86,993	0.04
Materials	8	583	21,830	0.03
Electronics	59	102	20,962	0.00
Total	2,589	139,907	886,134	0.16

Source: Ja Song, *Defense industry and its impacts on the civilian sector in Korea*, 1990.

C. INCREASE IN CAPITAL STOCK

After the Korean industry mastered the labor-intensive industrial sectors during the Second Plan period (1967-72), the Korean government began to reshape the industrial structure in the direction of capital-and technology-intensive sectors, including heavy machinery, iron and steel, shipbuilding, and electronics. As a result, the Korean government began to invest on these sectors intensively. In particular, the "Special Law on the Defense Industry" was legislated in 1973 in order to provide defense firms with

financial assistance, tax incentives, cost accounting and special contracts. [Ref. 19:p. 290] Table 17 shows the composition of fixed investment in manufacturing by sector.

As mentioned before, the Korean National Assembly approved a defense tax measure in 1975, increasing total tax revenue by about 10 percent to finance a second five-year $5 billion modernization program.

Table 17. Composition of Planned Fixed Investment in Manufacturing, by Sector, 1967-1981 (percent)

Sector	Second Plan 1967-1971	Third Plan 1972-1976	Fourth Plan 1977-1981
Basic Metals	12.5	14.3	16.2
Chemicals[a]	30.7	17.4	22.5
Machinery, electronics and shipbuilding	11.6	16.8	25.4
Textile and clothing	23.6	16.5	19.9
Other light manufacturing	21.6	35.1	16.6

Note: The figures for the second, third, and fourth plans respectively are in 1965, 1970, 1975 prices.

Source: EPB, *Second Plan*; EPB, *Third Plan*; EPB, *Fourth Plan*.
a. Indicates cement and other glass, clay, and stone products.

The delayed first five-year plan ($1.5 billion, American financed) was to be completed in 1977. The second five-year plan was largely financed by Korea, although

the United States had promised support in the form of loans and other assistance.[Ref. 20:p. 135-136]

Table 18 presents the ratio of defense taxes to total tax revenue during the period 1976-1981. Special Law and defense taxation facilitated the physical investment in order to develop the defense industry and to carry out the Forces Modernization Plans.

Table 18. Ratio of Defense Tax to Total Tax Revenues

	Percent of Gross National Product					
Item	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**
Internal Taxes	11.2	11.0	12.1	12.5	12.8	13.2
Direct Taxes	4.4	4.1	4.3	4.6	4.8	5.1
Indirect Taxes	6.4	6.7	7.6	7.7	7.8	7.9
Others	0.4	0.2	0.2	0.2	0.2	0.2
Customs Duties	2.0	2.2	1.6	1.6	1.6	1.6
Monopoly Profits	1.5	1.5	1.5	1.6	1.7	1.8
Local Taxes	1.7	1.7	1.9	2.0	2.1	2.2
Defense Taxes	1.9	1.9	2.1	2.1	2.2	2.2
Total Tax Revenue	18.3	18.3	19.2	19.8	20.4	21.0
Ratio of Defense Tax to Total Tax revenues	10.4	10.4	10.9	10.6	10.8	10.5
Gross National Product (billions of won)	13912.7	17806.6	24001.6	30801.8	36749.7	45528.1

Note: All figures are in current prices.

Source: EPB, *Fourth Plan*.

The period from 1970 to 1978, during which massive defense industrialization took place, was an era of capital abundance. The country's excellent economic performance and good credit ratings attracted massive foreign capital inflows. At the same time,

increased foreign earnings from exports provided the capital needed for defense industrialization. Finally, the Middle East Construction booms facilitated the allocation of scarce resources for the defense industry. Foreign earnings from the Korean companies' construction of bridges, highway and harbor in Middle East were invested in the defense sector.

Due to increases in gross fixed capital investment, investment in plant and equipment has increased. Non-residential fixed investments per employee can be defined as the capital stocks index. Table 19 presents the capital stocks index of defense industries by sector. As shown in Table 19, fire and ammunition sectors have increasing indexes during the second half of 1980s. This indicates that investment was significant in conventional arms industries. But Korea should invest in communications and aerospace sectors to develop technology-intensive industries.

Table 19. Capital Stock Index of Korean Defense Industry by Sector (percent)

Year	Fire	Veh	Vess	Comm	Aero	Ammo
1985	0	0	0	0	0	0
1986	-7.6	15.8	3.1	7.2	26.1	1.1
1987	19.8	-2.9	102.5	6.9	38.6	29.2
1988	8.0	2.4	-6.5	22.9	-16.1	-12.0
1989	25.3	10.0	32.1	42.6	19.0	25.6
1990	43.1	27.7	-21.6	21.8	7.1	31.9
Annual Average Rate	17.7	10.8	21.9	20.3	14.9	15.2

Source: Korean Defense Industrial Complex, *Analysis on Korean Defense Industry*, 1991.

This massive investment in the defense industry, particularly in 1976-1979, brought macroeconomic problems such as waste, inefficiency and a record inflation rate, as discussed before. Another negative result of military industrialization was Korea's increased dependence on foreign credit. Of the investment funds required in 1978 (see Table 7), over 75 percent was financed through foreign borrowing and foreign direct investment in joint ventures. This heavy reliance on foreign credit coincided with higher interest rates in the international capital market. The result was a drastic increase in foreign debt, from $3.3 billion in 1975 to over $35 billion in the early 1980s. This burgeoning debt burden--along with expanded payment for the purchase of parts, machinery, and technologies essential to the defense industry--aggravated the balance of payment position.

An equally troublesome aspect of defense industrialization has been the increasing tax burden. Since the National Defense Tax was introduced in 1975, its portion of government revenue has continually expanded. For example, defense surtaxes constituted only 3.8 percent of total revenues in 1975. They increased to an 11-percent level in 1978 and to over 15 percent in 1982. Apart from the National Defense Tax, the government's enforcement of voluntary contributions to a defense fund further aggravated private firms and citizens.

Despite growing displeasure with the defense tax surcharge, the government decided to extend it beyond 1985. Of course, the increasing burden of the defense tax is a natural outcome of expanding defense expenditures. However, this was considered necessary because of the North Korean military buildup and alliance commitments. Given the growing portion of total military expenditure allocated for equipment acquisition and R&D investment, the continuing tax burden is closely correlated with the subsidized expansion of the defense industry.

A related negative outcome is the substitution effect between guns and butter. When measured simply in terms of an aggregate correlation between military industrialization and economic growth, there is a positive relationship. Thus, there appears to be no trade-off between guns and butter. This is because the Korean economy grew at an average annual rate of over 8 percent during the period 1976-82 (with the exception of 1980, when it shrank 6.2 percent). These are the years during which defense industrialization rapidly expended.

Viewed in terms of allocation of public expenditure and the resulting pattern of opportunity costs, however, there appears to be a substantial substitution effect. As table 20 indicates, defense expenditures drastically increased, from 25.9 percent of government expenditure in 1972 (the first year of military industrialization) to 32.4 percent in 1976, the year defense industrialization was expedited. While defense expenditure has continued at over 30 percent since 1976, expenditures for social welfare and education have remained constant or shown only incremental increases. Furthermore, public expenditure on economic development has decreased. Despite the increase in capital stock, the massive investment in the defense industry during 1976-79 brought on the macroeconomic and foreign debt problems discussed before. Furthermore, the growth in GNP may have been even greater if the defense burden had been lower during this period. Government expenditures could have been focused on social or economic investment instead of defense. Alternatively, government expenditures could have been reduced, lowering the federal tax rate and further stimulating the economy.

Table 20. Korean Public Expenditures by Appropriation Category, 1972-83 (percentage)

	1972	1976	1979	1980	1982	1983	1983
Defense	25.9	32.4	30.3	37.0	33.8	34.5	32.8
Social development (including education)	20.2	21.8	22.5	24.4	23.9	27.0	27.2
Economic Development	16.6	24.2	20.4	18.9	18.6	17.5	17.4
Others	37.3	21.6	26.8	19.7	23.7	21.0	22.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Korean Economic Planning Board.

D. HUMAN CAPITAL DEVELOPMENT AND CREATION OF EMPLOYMENT

Investment in physical plant is not the only prerequisite to military industrialization. Investment in human capital is also required. Education and training that improve the knowledge and skills of workers can vastly improve their productivity. Modern defense forces provide training in technical and managerial skills which a growing industrial economy requires. [Ref. 15:p. 135]

The educational impact of the military is especially noteworthy. In Republic of Korea's early years, the military served as the largest primary educational institution for young recruits without any formal schooling. Recruits are trained to fill the various administrative and managerial posts with military institutions. The military also maintains

a variety of training institutes to train officers and enlisted men in various areas. According to one account, there were at one time 110 and 227 different courses dealing with various fields of knowledge and skills respectively for officers and enlisted men. [Ref. 21:p. 19]

Korea has been remarkably successful in developing a stock of skills to meet the changing needs of a rapid industrial development process. A diverse array of training mechanisms--private and public, formal and informal, institutional and on-the-job--were developed to meet growing needs for skills, particularly in manufacturing. [Ref. 22:p.158]

At the beginning of the Korean defense industry, it lacked skilled workers and technicians, particularly scientists and engineers. Korea has adopted measures to increase its human capital. For example, the Korean Institute of Aeronautical Technology increased its recruitment of foreign engineers (called reverse brain-drain) and boosted its efforts to send Korean students overseas for rigorous training. A new facility was initiated at Inchon, near Seoul, stressing training in structural engineering, aerodynamics and avionics and other high-technology areas. The Gumho National Technical High School was also established, providing scholarships and dormitories for the students who were both in top 1 percent of their middle school and recommended by their principals. After graduating, they were employed in the defense industry. These graduates are proud of their jobs and highly motivated. Tables 21 and 22 present the investment on education and enrollment in educational institutions.

Table 21. Investment Program for Social Development, by Sector, 1972-1981

Service	1972-1976		1977-1981	
	Billions of Won	Percentage of total Investment	Billions of Won	Percentage of total Investment
Education and Manpower development	254	2.2	749	3.9
Health	38	0.3	211	1.1
Housing	1,670	14.6	2,641	13.9
Water Supply and Sewerage	61	0.5	182	1.0
Total	2,023	17.7	3,783	19.9

Note: All figures are in 1975 prices.

Source: EPB, *Fourth Plan.*

Table 22. Enrollment in Educational Institutions, 1965-1975

Type of Institutions	1965		1975		Annual Growth Rate	
	Public	Private	Public	Private	Public	Private
	(thousands)		(thousands)		(percent)	
Primary School	4917	25	5529	70	1.2	10.9
Middle School	418	333	1204	823	11.1	9.5
General High School	105	149	257	391	9.1	10.4
Vocational High School	37	26	226	249	19.9	25.4
Junior Technical Vocational School	4	3	17	40	16.1	27.8
College, University, other	35	99	70	169	7.1	5.5
Tertiary[a] Others	12	84	8	150	-4.3	5.9
Total[b]	5528	720	7312	1892	2.8	10.1

Source: Ministry of Education, *Annual Survey of Education, 1965; idem, Statistical Year Book of Education*, 1975.

a. Includes junior college, junior teachers' college, four-year colleges and universities, graduate school, miscellaneous undergraduate institutions, and nurse training institutions.

b. Excludes preprimary institutions.

Defense industrialization also contributed to the reverse brain-drain trend through its aggressive recruitment strategy. In the initial phase of defense industrialization, one critical task is to secure highly qualified personnel. Through various incentives, the Korean government was able to recruit Korean-born scientists and engineers working in

North America, Japan and Western Europe. The resulting pool of qualified professionals not only helped the defense industry, but also the private sector and academic training institutions.

In addition, the formation of the defense industry in the early 1970s created employment opportunities. The defense industry has provided new jobs since 1970. However, this has had negative spillover effects on the civilian sector considering the opportunity cost of this labor. The demand for military manpower is a derived demand, dependent on the amount of defense services required as well as on the availability of alternative factors of production in the defense sector. [Ref. 23:p. 141] There are about 600,000 military personnel. This has contributed to reducing the unemployment rate as well as creating demand for consumption goods by these personnel. In 1982, the economically active population was recorded at 15 million and unemployment rate was 4.4 percent. If 600,000 military service jobs were added to the unemployed population, the unemployment rate would increase from 4.4 to 8.0 percent. This is a short run effect. Overtime this unemployment would depress wage rates and lead to further employment in the non-military sector.

In 1983, the 3,240 billion won defense budget accounted for the 33 percent of the government budget. However, 58 percent of defense budget, 1,980 billion won, was returned to the civilian economy. [Ref. 24:p. 167] Table 23 shows the ratio of defense industry employment to total employment. This ratio is 1.68 percent. From the national economic point of view, this means that the defense industry has played a great role in

creating employment opportunities. The highest proportion is in industrial chemicals, 9.19 percent. The aerospace sector is the second highest proportion of defense to total employment at 8.39 percent. This means the defense industry is going to change from conventional arms production to high technological weapons system production.

Table 23. Proportion of Defense Employment by Economic Activity, 1987

Industrial Base	Total Employment	Defense Employment	Proportion (%)
Industrial chemicals	41,625	3,822	9.18%
Aerospace	15,012	1,260	8.39
Basic metals	51,870	3,197	6.16
Non-metallic products	11,056	415	3.75
Fabricated metal products	203,085	7,320	3.60
Machinery	175,776	6,080	3.46
Transports/equipment	184,533	5,542	3.00
Electronic/electrical machinery	440,148	5,094	1.16
Others	125,521	1,406	1.12
Other machinery	40,866	164	0.40
Coal products	12,281	38	0.31
Paper and paper products	56,022	129	0.23
Trade	135,502	304	0.22
Rubber products	87,630	122	0.14
Plastic products	88,203	75	0.09
Textile products	431,517	349	0.08
Total	2,107,252	35,317	1.68%

Source: Ministry of Labor, *Labor Statistic Yearbook*, 1989.

Table 24 presents the proportion of defense industry employment by sector. As shown in Table 24, one-third of total employment is in the ammunition and communication sectors, one-fourth is in the basic materials, aerospace and firearms. Table 25 shows the growth rate of defense industry employment by sector. The highest average annual rate is in the vehicles sector. Employment in the aerospace sector has grown above the average 10 percent in the second half of 1980s. On the other hand, the ammunition and communication industries declined in the late 1980s. This indicates that there are trends of increasing the employment in high-tech sectors. The decline in the communications and ammunition sectors resulted from market saturation of conventional arms.

Table 24. Proportion of Defense Employment by Functional Sector, 1987.

	Number of Firms	Total Employment	Defense Employment	%
Ammunition	7	32,886	11,361	34.55%
Communication	7	5,712	1,849	32.37
Basic Materials	9	14,533	4,013	27.61
Aerospace	3	14,850	3,718	25.04
Fire Power	9	28,605	6,667	23.31
Generals	10	8,232	1,469	17.84
Vehicles	9	34,871	3,408	9.77
Plastic/Chemical	7	10,429	922	8.84
Ship	4	39,066	2,615	6.69

Source: Ministry of Labor, *Labor Statistic Yearbook*, 1989.

Table 25. Growth Rate of Korean Defense Industry Employment by Sector

Year	Fire	Veh	Vess	Comm	Aero	Ammo
1985	0	0	0	0	0	0
1986	18.3	21.2	-3.6	80.2	5.3	9.5
1987	15.5	32.7	-16.8	-10.0	24.3	16.8
1988	1.1	19.3	0.3	7.4	17.4	4.3
1989	8.5	8.0	6.8	-0.6	8.1	-10.8
1990	-15.5	22.3	-7.9	-3.7	5.1	-9.8
Annual Average Rate	5.6	20.7	-4.2	14.7	12.1	2.0

Source: Korean Defense Industrial Complex, *Analysis on Korean Defense Industry,* 1991.

E. TECHNOLOGICAL ADVANCES AND SPILLOVERS

Technological spin-offs were another by-product of defense industrialization. The extensive transfer of defense technology helped upgrade the state of the art in metallurgy,

communications, and electronics, and has stimulated new research and development in science and technology. Until the early 1970s, R&D investment belonged to the realm of plans and ideas. Defense industrialization allowed cumulative, though limited, investments in R&D. For the first time, this made it possible to undertake long-term as well as basic research projects for the first time.

According to Min [Ref. 25], technological changes in the Korean defense industry were calculated using the R. M Solow Model. (see Appendix B)

The final equation can be written below:

$$\frac{\overline{A}}{A} = \frac{\overline{Y}}{Y} - \alpha \frac{\overline{L}}{L} - \beta \frac{\overline{K}}{K}$$

where α = (wage÷value added) times 100, β = (interests, profits÷value added) times 100, Y stands for output, L for labor and K for capital. The model assumes that $\alpha + \beta = 1$. From this equation, the level of technical change A(t) can be calculated by:

$$A(t) = A(t-1) \left[1 + \frac{\Delta A(t)}{A(t-1)} \right], \quad t = 2, 3, \ldots$$

Table 26 represents the technological advances in the Korean defense industry, assuming A(t)= 1 in 1979. As shown in Table 26, the vehicle sector recorded the highest index of technological advances. This sector relies on sophisticated technology. Communications & electronics and aerospace & missile have also had sharp advancements in technology since 1985. The sectors with the greatest absolute amount of government-funded R&D have the highest growth rates.

Table 26. Technical Change Index in Korean Defense Industry

Year	Fire	Veh	Vess	Comm	Aero	Ammo	Total
1979	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1980	0.89	0.97	1.12	1.45	1.12	1.14	1.08
1981	1.71	2.41	1.43	1.30	1.24	1.52	1.37
1982	1.93	1.18	2.27	1.40	1.37	1.66	1.66
1983	2.25	1.37	3.07	1.47	1.63	1.80	1.67
1984	3.15	2.11	2.84	1.35	1.82	1.86	2.36
1985	2.25	2.37	2.42	1.66	2.06	1.96	2.36
1986	2.61	3.15	2.35	3.32	2.37	2.19	2.92
1987	3.47	4.18	2.05	3.05	3.19	2.82	3.75
1988	3.61	5.14	1.72	3.69	3.48	2.77	4.16
1989	4.13	5.90	1.80	4.42	3.97	2.56	4.65
1990	3.83	7.85	2.05	4.53	4.25	2.47	5.29
Annual Average Rate	16.6	28.5	8.9	17.9	14.3	9.2	17.1

Source: Chung, Koog I., *Defense R&D and Technical Advances*, 1991.

Technological advancement makes it possible to generate additional output with the same amount of resources. Technological advancement is brought about by capital formation and research investment. Modern technological breakthroughs are generally the results of systematic investments in research and development. Therefore, the Ministry of Defense set up a plan to increase the military R&D investment to 5 percent of the defense budget by the year 2000. Table 27 shows the increasing trends in the military R&D investment in the late 1980s.

Table 27. Ratio of Military R&D to Defense Budget

Year	1981	1982	1983	1984	1985
Ratio	2.0	2.0	1.9	1.6	1.4
Year	1986	1987	1988	1989	1990
Ratio	1.1	1.2	1.6	2.1	2.3

* 1970-1980; Average ratio: 2.3 percent

Source: Ministry of National Defense, *Defense Statistic Yearbook*, 1990.

Assuming that there is a positive correlation between military R&D investment and the technical change index, we get the following the regression equation:

$$A(t) = a_0 + a_1 \left(\frac{\sum RD_{Dn}}{RD_{DI}}\right) + \epsilon_t$$

where A(t) is the technical advancement in year t, and RD_{Dt} is Defense R&D investment in year t.

The results of the regression equation are shown in Table 28. Theses results show that defense R&D has a positive effect on technical advancement. In terms of Table 28, the coefficients of the conventional sectors such as fire, vehicles and vessels are larger than those of the aerospace and communications sector. This means that defense R&D had large impact on technological change in fire, vehicles and vessels than in aerospace and communication. But Korea should funnel investment in R&D for high technological sectors in order to develop the aerospace and electronic industries. Most importantly, the

technological advancement in sectors where military R&D was invested increased the growth rate of GNP.

Table 28. Relationship between Defense R&D and Technical Change Index in Korea

Sector	a_0	a_1	R^2
Fire	0.573	2.73	0.776
Vehicles	0.606	4.81	0.788
Vessles	0.825	5.40	0.905
Communication	1.037	0.64	0.576
Aerospace	0.630	0.44	0.885
Ammunition	0.783	1.69	0.979
Total	0.593	1.81	0.948

Source: Chung, Koog I., *Defense R&D and Technical Advances*, 1991.

F. INTERNATIONAL ARMS TRADE

South Korea military exports grew fast since their inception in 1975, reportedly rising from $ 5 million in 1975 to a peak of $975 million in 1982 (See Table 29). Since then, military export revenues have reportedly averaged $250 million annually. There is a concerted government-supported effort to expand sales. [Ref. 15:p. 225]

The achievement of self-sufficiency in conventional weapon systems, however, was followed by widely anticipated negative consequences: market saturation and resultant underutilization of defense-production capacity. To avoid these consequences of market saturation, Korea has to actively export military hardware.

Table 29. Major Weapon Exporters in the Third World

	1975	1976	1977	1978	1979	1980	1981	1982	Total	%
Isreal	50	140	60	120	260	140	260	360	1,390	9.62
China	180	140	110	160	130	250	370	1,000	2,340	16.19
S. Korea	5	5	110	70	190	250	250	400	1,280	8.86
Saudi Arabia	10	0	10	20	90	0	525	0	655	4.53
Brazil	30	80	20	110	120	150	150	625	1,258	8.89
N. Korea	10	80	20	90	90	190	470	480	1,430	9.89
Cuba	30	120	10	0	0	0	10	20	190	1.31
Egypt	0	0	50	90	10	0	30	290	470	3.25
Iran	50	30	30	20	0	0	0	0	130	0.90
Libya	5	0	20	10	90	5	60	290	480	3.32
Turkey	5	10	0	10	10	150	150	160	495	3.42
Others	245	275	375	405	355	565	795	1,285	4,310	29.82
Total	620	890	815	1105	1345	1700	3070	4910	14455	100.0

Source: Arms Control and Disarmament Agency, *World Military Exprnditure and Arms Transfer 1972-1982,* (Washington, D.C.:ACDA,1984), pp. 53-94.

As Table 29 demonstrates, the value of Korean military exports was minimal before 1979. At that time, most military exports were composed of uniforms and other nonlethal equipment. Since 1979, however, Korea has not only increased the dollar value of its military exports, but also shifted its export items from soft goods to conventional weapon systems. It is now one of the most competitive exporters of infantry munitions, weapons and light naval vessels (see Table 30). As a result, from 1975 to 1982, Korea emerged as the fifth largest exporter in the Third World (People's Republic of China included) with the total trade value of $1.28 billion (8.86 percent of the Third World's total).

Table 30. Exports of Defense Industry by Function (In million won)

Year	Fire	Ammo	Veh	Comm	Vess	Aero	Other	Total
1975	0	200	0	0	109	0	0	309
1976	0	800	0	0	0	0	0	800
1977	0	1726	0	0	1731	0	0	3457
1978	416	3473	0	0	12764	0	44	16697
1979	395	7222	0	0	14875	0	115	22607
1980	4363	28229	0	0	18315	4039	1188	56134
1981	6325	28331	6313	18	42839	6939	4039	94804
1982	7373	34567	6469	34	32848	7796	11103	100190
1983	12931	84933	29315	603	57154	9158	14094	280080
1984	8222	21380	2882	480	20142	9261	2625	64992
1985	5866	28360	15673	762	9138	12845	2099	74743
1986	7647	28628	9865	780	6258	12582	2633	68363
1987	24278	27317	7510	502	21574	15197	6635	103013
1988	22723	23592	13839	106	23495	31430	3717	118902
1989	14464	21120	5193	359	19404	44613	1530	106683

Source: KIDA, *Analysis on Defense R&D and Defense Industry in Korea*, 1990.

Table 31 shows the regional distribution of Korean military exports during 1983-84. The largest market was the Middle East ($140 million), followed by the Western hemisphere, particularly Latin America. The Asian region was the third largest importer of Korean military hardware ($110 million), while Europe and Africa were insignificant markets.

Table 31. Korean Military Exports by Region, 1983-1984 (in million dollars)

	Asia	Middle East	Latin & S. America	Europe	Africa	Total
1983	90	120	70	0.4	20	300.4
1984	20	20	60	0.7	2	102.7
Total	110	140	130	1.1	22	401.1

Source: Korean Ministry of National Defense.

Notes: Figures in this table indicate deliveries of hardware excluding software.

One interesting trend in Korean military exports has been the relatively high fluctuation by year. Tables 29 and 30 indicate that while exports grew rapidly from 1978 tc 1982, there has been a sharp downturn since 1983. Export volume in 1984 returned to the level of 1977, although the variety and volume of hardware products has substantially increased. Korean military exports expanded due to surplus capacity, price competitiveness, the diffusion of regional conflicts, and the growing demand for conventional arms. As shall be discussed, however, growing pressure from the United States to restrict Korean sales to other nations (i.e., third-country arms sales) as well as increased competition from other Third World arms exporters have undermined Korea's military export efforts.

As for arms imports, the major rationale for domestic arms production is that it should substitute for arms imports. The ratio of arms imports to domestic arms production measures this substitution. Table 32 shows the ratio of arms imports to

domestic arms production. Although arms imports are increasing year by year, the ratio of arms imports to total imports and the ratio of arms imports to domestic arms production is decreasing. This means that the defense industry saved foreign exchange by producing weapons domestically.

Table 32. Arms Import and Domestic Arms Production (in million dollars)

Year	Import (A)	Total Import (A)	% (A/B)	Production (C)	% (A/C)
1970	150	1984	7.5	...	
1971	220	2394	9.1	...	
1972	350	2522	13.8	...	
1973	170	4240	4.0	...	
1974	80	6582	1.1	...	
1975	190	7274	2.6	34.7	547
1976	340	8774	3.8	91.3	372
1977	300	10811	2.7	119.0	252
1978	525	14772	3.5	287.8	182
1979	525	20339	2.5	420.0	125
1980	480	22290	2.2	497.2	96.5
1981	390	26130	1.5	630.4	61.9
1982	430	24150	1.8	622.3	69.1
1983	390	26190	1.5	802.0	38.5
1984	380	30630	1.2	728.5	52.5
1985	430	31140	1.4	830.6	51.8
1986	550	31580	1.7	1222.6	44.9
1987	625	41020	1.5	1417.6	44.0
1988	600	51810	1.2	2023.2	29.7

Source: U.S. ACDA, *World Military Expenditures and Arms Transfers*, Several editions.

International trade in arms is very sensitive to international relationships. The Korean defense industrialization has depended on the United States from the beginning

in the forms of technical data packages, manufacturing licenses, and coproduction schemes. Based on two legal constructs (the United States Arms Export Control Act and the International Traffic in Arms Regulations), the items and destination of Korean military exports must be approved by the United States in advance. This 3CS (third-country sales) regulation is dealing a serve blow to Korea's military hardware exports.

V. THE FUTURE OF KOREAN DEFENSE INDUSTRY

A. THE DISPARITY IN MILITARY STRENGTHS OF SOUTH AND NORTH

The tumultuous changes in the socialist nations, including the Soviet Union, have set off a wave of drastic changes in the world's security environment. The solidifying peace in Europe tends to heighten the strategic importance of Northeast Asia in the world. On the Korean peninsula, military tension continues unabated principally because of Pyongyang's unchanging anachronistic bid for the forceful communization of the South. North Korea leaves no doubt about its intention to communize the whole Korean peninsula. Persistent plots to instigate a procommunist revolution in the South together with a war-preparation campaign for another full-scale war on the Korean peninsula are in line with this policy goal. The South-North Korean relationship may take a turn for the better in the future, but there is an equally high likelihood that the relationship will undergo a very dangerous turn--depending on how the North Korean leadership reacts to external changes and manages internal demands for reform.

Safeguarding national security requires an adequate military capability. Table 33 shows the disparity in military strength between South and North Korea. The present imbalance of military strength between the two Koreas stems principally from the fact that the South did not start its force improvement program until 1974, twelve years later than North. The North Korean force reinforcement program commenced as early as

1962. (See Table 34.) Since then, North Korea has spent from twenty to twenty-four percent of its GNP on defense. South Korea's military spending was limited to five percent of GNP. Furthermore, North Korea could funnel forty-eight percent of its military budget into force buildup, whereas the South has been able to spend only twenty to forty percent of its defense budget for this purpose. In the future, South Korea's GNP is expected to grow to more than ten times that of the North. As Figure 5 illustrates, South Korea overtook the North in defense outlay in 1976. South Korea spent 3.69 billion dollars at the 1989 fixed price in comparison with the 3.16 billion dollars expend by the North in the same year.

Table 33. Military Disparity between South and North Korea in 1990

		South Korea	North Korea	Ratio
Active Troops (in 1000 people)	Total	655	955	1:1.5
	Army	540	868	1:1.6
	Navy	60	45	1:1.8
	Air Forces	55	82	1:1.5
Ground Combat Equipment	Tanks	1550	3600	1:2.3
	APCs	1600	2500	1:1.6
	Artillery	4300	9500	1:2.2
Naval Vessels	Surface Combatants	170	436	1:2.6
	Submarine Support	.	24	1:24
	Ships	50	250	1:5.0
Air Combat Equipment	Tactical Aircraft	520	850	1:1.6
	Support Planes	190	480	1:2.5
	Helicopters	580	290	1:0.5

Source: ROK MND, *Defense White Paper*, 1991-1992

Table 34. Ratio of Military Expenditures against GNP

Classification	North Korea	South Korea
Beginning year of Force buildup	1962	1974
Defense spending	20 to 24 percent of GNP	5 percent of GNP
Force buildup investment ratio	48 percent of the military outlay	20 to 40 percent of the military outlay

Source: ROK MND, *Defense White Paper*, 1991-1992

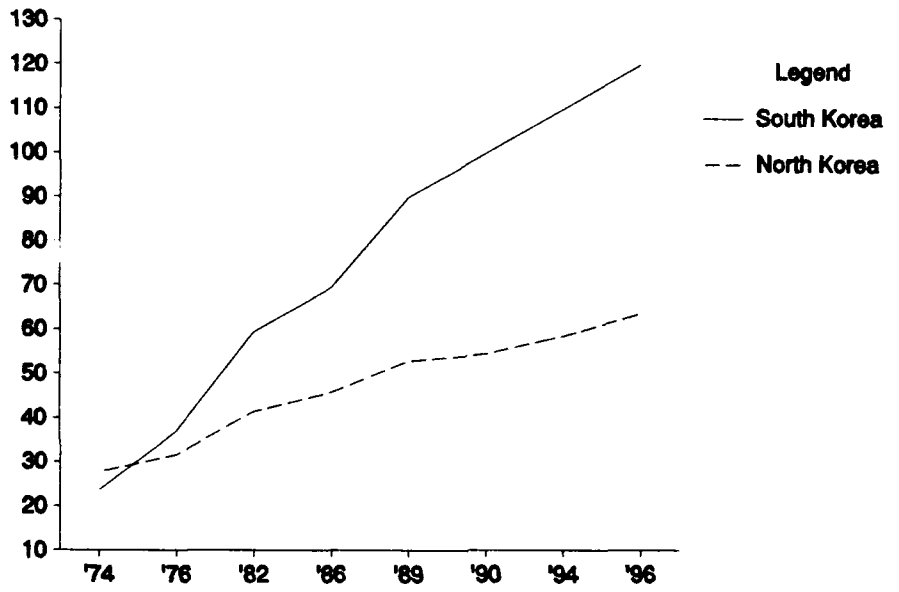
Assuming that the North will continue spending twenty to twenty-four percent of its GNP on defense, with forty-eight percent going to force buildup, and that the South will maintain its defense spending at five percent of GNP with thirty-eight percent invested in force buildup, South Korea will outstrip the North in terms of cumulative investment in force buildup beginning in the mid-1990s.

If these assumptions hold, the military imbalance between the Koreas will soon be rectified. However, in view of the differences in decision-making and the weapon-acquisition processes between socialist and capitalist countries, it is not likely to be until the early 2000s that an overall military balance will be achieved on the Korean peninsula.

Since the 1960s, South Korea has given top priority to economic development rather than to military buildup. In contrast, North Korea's top policy priority has always been building military strength in preparation for another war against the South. In 1988, South Korea's defense spending fell below five percent of its GNP. This level of military

spending relative to GNP is not much more than half that of other countries under military confrontation, as is illustrated in Figure 6.

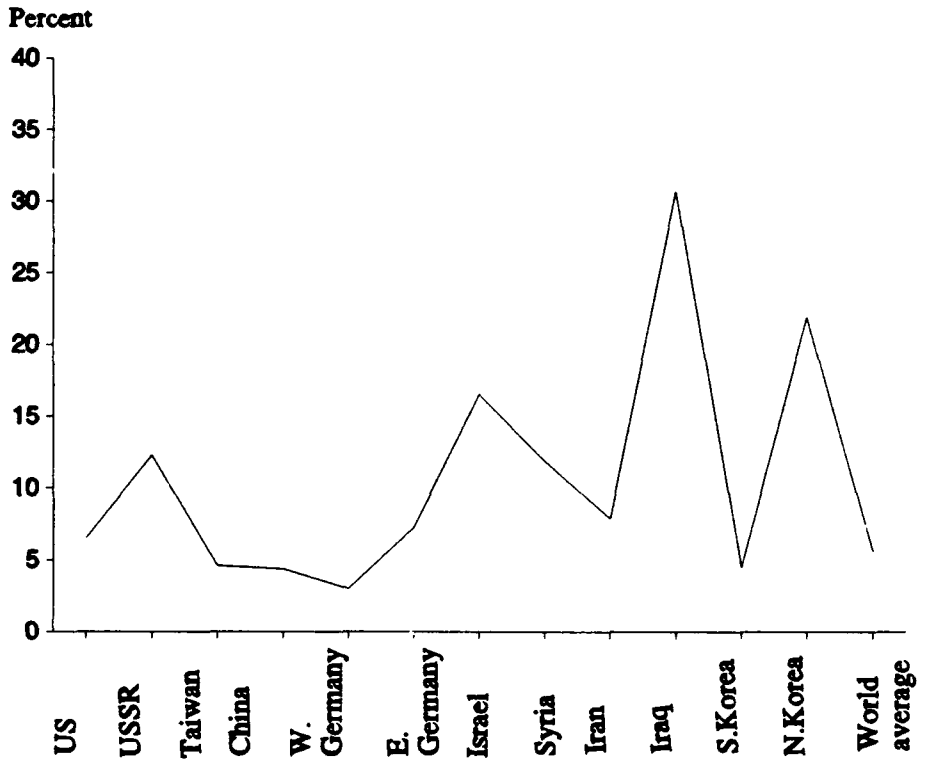
Figure 5. Military Spending Trends of South and North Korea



Source: ROK MND, Defense White Paper, 1991-1992

In 1989, as is shown in Table 35, South Korea's defense budget was equivalent to 4.99 percent of the GNP and 32.4 percent of the government budget. The FY 1990 defense budget stands at 6,887.3 billion Won (approximately $9 billion). When excluding

Figure 6. Levels of Military Spending against GNP



Source : US Arms Control and Disarmament Agency, 1988

the costs of conscription administration and maintenance of combat and maritime police, which amount to 249.5 billion Won, the defense budget accounts for 4.35 percent of GNP and 29.3 percent of the government budget.

Table 35. South Korean Defense Spending against GNP, 1990 (percent)

	'75-'79	'80-'84	'85	'86	'87	'88	'89	'90
Defense spending/GNP	avg. 5.7	avg. 6.0	5.5	5.53	5.55	5.43	4.99	4.35
Defense spending /Government budget	avg. 34.3	avg. 33.9	31.2	31.2	31.6	32.8	32.4	30.4

Source: ROK MND, *Defense White Paper*, 1991-1992

According to North Korea's official announcements, the proportion of its defense spending in the government budget has continued to fall from fourteen percent in 1986 to 13.2 percent in 1987, 12.2 percent in 1988 and twelve percent in 1989. When the size of the North Korean armed forces and the recent purchase of advanced weapon systems are taken into account, however, these figure are not reliable. Much of it is concealed under the headings of "people's economic expenditures" and socio-cultural expenditures. North Korea's real defense budget is believed to amount to 30 percent of the government budget. Expressed in dollars, North Korea's FY 1990 defense budget reached 5.28 billion dollars, whereas that of the South amounted to 8.98 billion dollars, a ratio of one to 1.7. (See Table 36.)

Table 36. Official North Korean Defense Outlay, 1989

Classification	Amount (1,000 won)	Portion (%)	Increase over '88 (%)
Revenue	33,608,100		5.3
Expenditure	33,382,940	100.0	5.4
People's economic expenditure			5.8
Socio-cultural expenditure			5.8
Defense expenditure		12.0	

* There is no official information available for the boxes left empty in the above table. In the case of defense expenditure, it amounts to $1,763.9 million according to the following calculation. 33,382,940,000 x 0.12 /2.23 = $1,763.900,000.

* The International Institute for Strategic Studies (IISS) estimates North Korea's defense spending of FY 1989 at 4,170 million dollars. The comparable estimate given by South Korean experts on North Korea is 4.5 billion dollars.

Source: ROK MND, *Defense White Paper*, 1991-1992

In sum, South Korea began outstripping the North in terms of annual defense spending in 1976. However, its cumulative defense investment amounts to only seventy - one percent of North Korea's. As mentioned before, it is anticipated that this disparity will not be resolved until the mid-1990s.

North Korea has an advantage over the South in terms of conditions for military buildup. North Korea saves from uncompensated land expropriation and forced labor mobilization. Its salary and food expenses for soldiers amount to only half of those borne

by the South. In addition, it benefits from cheap electricity and other utility cost. North Korea is also able to purchase military hardware more cheaply than the South because the overall weapon and part prices in the communist world are lower than those in the free world. In contrast, South Korea has to acquire military equipment at much higher prices, not only from foreign suppliers but also from local defense industries in order to guarantee them a decent profit.

From the military point of view, the Korean Defense Industrialization has contributed to military modernization and force improvements. Indeed, the ambitious buildup of the defense industry has given a sense of confidence and a feeling of security to the Korean people. South Koreans have been obsessed with military inferiority vis-a-vis North Korea during the past three decades. Furthermore, the widened variety and increased production capacity of defense industry have drastically improved the South Korean defense forces's combat capability. For example, until the mid-1970s the majority of Korean soldiers used M-1 or Calvin rifles manufactured during World War II or the Korean War. The M-16 rifle was a rare item, allocated to elite divisions such as special combat forces. Today, all soldiers and even reserve forces use the M-16 because it is domestically produced. Improvement has been realized in armored, artillery, and infantry units. Their units had primarily depended on outdated weapons from World War II and the Korean War. Furthermore, domestic production and increased availability of military helicopters enhanced the Korean defense force's maneuverability in antiguerrilla operations. In addition to this equipment improvement, the existence of the relatively

diversified defense industry contributed to peacetime industrial readiness in logistics supply.

B. THE FUTURE OF KOREAN DEFENSE INDUSTRY

In the past decades, the Korean economic development strategy has been traditionally characterized by "growth first and redistribution later." Emphasis on growth substantially constrained social welfare services. Although the emphasis has shifted from economic growth to social development since late 1970, resource allocation for social development has been limited due to the defense burden. Sagging progress in the provision of social welfare to meet rising expectations can drastically undermine the regime's legitimacy and political stability. This is particularly true because ruling regimes are exhausting their ability to make political hay of "national security" issues. Though acutely aware of their vulnerability, the Korean people, particularly the youth, no longer accept national security as *deus ex machina.* To them, equality and welfare should not be sacrificed in the name of security.

The trade-offs between economic growth and defense industrialization in Korea seemed equally apparent. Considering the threat from North Korea, the Korean defense industry is necessary to ensure national security. Also the Korean defense industry should contribute to improving national welfare. For this purpose, this thesis will suggest some ideas about the future of the Korean defense industry.

First, the Korean defense industry needs better coordination in defense-industrial policy. Rapid military industrialization was initiated without due attention to technical

engineering, financial capacities, and medium and long term industrial consequences. The result was excess capacity, duplication of facilities and licenses and a fragile and non-competitive corporate structure. This eventually threatened the very survival of the defense industry. In the past, decisions involving the defense industry belonged exclusively to the Blue House and the ADD. But the defense industry is closely related with other Ministries, agencies and the civilian industry. Defense-industrial policy should be better coordinated among the Ministry of National Defense, the Economic Planning Board, the Ministries of Commerce and Industry, Communications, Science and Technology, Energy and Resources, the Agency For National Security Planning, civilian research agencies and private businesses related to the defense industry. This coordination would enable the Korean defense industry to eliminate duplication and excess capacity.

Second, competition is required in the Korean Defense market. The significant political implication of Korean defense industrialization is a military-industrial complex. The military-industrial complex in Korea played a strong role in shaping the nature of the defense establishment. In Korea, defense contractors are not differentiated by their specialty and capability. Big business conglomerates virtually dominate the defense industry. As Table 37 illustrates, seven of the top ten Korean business conglomerates, whose annual gross sales account for over 40 percent of GNP, are actively engaged in the defense industry. In fact, they account for the majority of the defense industry. Other

defense contractors are small-scale parts manufacturers except for a few firms such as KIA, Poong San Metal, and Tong IL Industry.

Table 37. Leading Korean Businesses: Finances and Defense Production Lines

Rank	Company	1984 Gross Sales (in won billion)	Debt/Equity Ratio (%)	Bank Credit (%)	Defense Production Line
1	Sam Sung	7,851	656	4.11	Jet engine
2	Hyundai	7,849	340	7.68	M-48 tanks ROKIT vehicle vessels
3	Lucky-Gold Star	7,717	456	2.97	grenades; comm; Vulcan missile
4	Daewoo	5,535	442	6.09	106mm rifle; Patrol boats; M-16 rifle; M202 rocket
5	Sun-Kyung	5,273	485	2.56	N.A.
6	Snagyong	2,452	433	3.35	Tank engine
7	Korea Explosive	2,099	320	1.35	Explosives
8	Kukje	1,791	914	2.14	N.A.
9	Hanjin	1,732	422	1.47	Helicopters; F-5E/F
10	Hyosung	1,719	784	1.23	N.A.
18	KIA	719	335	N.A.	Vechiles
37	Poong San Metal	309	1,129	N.A.	Ammunition; Small arms

N.A. means not available.
Rank is by gross sales in 1984.
Source: Hankuk Ilbo, May 11,1985, p.10

The fusion of the defense and commercial industries in the hands of these big conglomerates resulted from the political process. There is no competition in defense contracts. Defense firms should be designated by their specialty and capability based on the competitive market. No competition in defense market may be the reason for low productivity in the Korean defense industry.

The government should attempt to reorganize the overall structure of the defense industries so they can be more productive. In addition, the government should privatize the defense industry as appropriate, to improve productivity.

Third, defense R&D investment should increase. As discussed earlier, technical advances depend on R&D investment. Compared to other countries, Korea has invested a small proportion of its defense budget on defense R&D (e.g., U.S. (4.3 percent) and Japan (5.4 percent)). Defense R&D was also oriented to develop conventional arms. Now it is time to review and determine the level of the defense technology accumulated since the early 1970s. The direction of defense technology development should be re-established based on the current technological trends that have applications in the civilian sector (e.g., semiconductors, computers and communications, information industry, new materials, aerospace, and bio-engineering). Because productivity growth is positively related to long-term R&D projects, defense R&D should be directed toward longer term basic research.

Fourth, Korea should make an effort to diversify sources of weapon technology and markets in order to reduce its heavy reliance on the United States. Because of this

dependence, the Korean defense industry has limited maneuverability and a subtle form of vulnerability. Korea had no choice in defense contracts with the United States.

Finally, the 3CS (third-country sales) regulation is another problem. Despite the limited demand for its products, the Korean defense industry requires highly-sophisticated technology and heavy investment. To overcome the limited domestic demand and the defense budget constraints, the Korean defense industry has no alternative but to turn to overseas market. To acquire highly-sophisticated weapons technology and to increase exports, the Korean defense industry should seek agreements on defense industry cooperation, quality assurance, and cooperative exchanges with foreign nations, including advanced western countries and the developing countries of the Third World.

V. CONCLUSIONS

The historical evolution of the ROK Defense industry has been mainly influenced by continuing tensions between South and North Korea, U.S. alliance policy in Northeast Asia, South Korea's domestic economic and technological factors, and economic interests of U.S. defense industries. Among these factors, military confrontation between South and North Korea will continue to be one of the most important factors influencing the expansion of the ROK defense industry in the near future.

The Korean defense industry was dependent upon the parallel development of its economy and technology. Korean defense industrialization has entailed both costs and benefits. Rapid defense industrialization brought negative effects on economy, including macroeconomic constraints (overcapacity, inflation, increasing tax burden, and foreign debts), formation of military-industry complex, sectoral trade-offs, and a substitution effect between guns and butter. But the Korean defense industry also had positive effects on economy, including GNP growth, physical and human capital formation, technical spillovers and arms import substitution. It is unlikely that these goals would have received as much attention without the significant security threats from North Korea over the past two decades.

The justification for defense industry should come from national security rationales. Investments in defense are not completely wasted as far as economic benefits are

concerned. Thus, defense is not as much of a burden on the economy as many suggest. The Korean defense industry has contributed to economic growth as well as national security. However, economic goals could be achieved more effectively through policies designed for economic purposes. National defense expenditures should not be supported based on their economic side effects. National defense expenditures have an opportunity cost in terms of forgone private or public sector economic opportunities. A final assessment would be to determine if the benefits of defense expenditures outweigh the opportunity costs.

APPENDIX A
FEDER AND RAM MODEL IN LESS DEVELOPED COUNTRIES

The economy is considered to have two sectors - civilian and defense. The defense sector is assumed to indirectly influence the civilian sector. The civilian sector may be stimulated due to positive spillovers from the defense sector, such as technological advance. In addition, skilled labor is also available due to government spending on defense sector research and training. Without the defense sector, the civilian sector would bear the cost of training this labor. Also, the civilian sector may be retarded because of negative spillovers, including labor shortages in some areas, lack of investment funds and paucity of research scientists. All of these influences are outside the control of the civilian sector and are best described in general as external effects.

Considering these interactions, an aggregate production model of the economy is constructed which includes both the externality and productivity effects of defense spending. The basic two sector production model described here is derived from the article "*Defense spending and Economic growth*" written by H.SONMEZ ATESOGLU and MICHAEL J. MUEUER and "*Military Expenditure and Economic Growth in Less Developed Countries*" written by BASUDEB BISWAS and RATI RAM. Defense spending is used as an index or measure of defense industry externality so it is included in the production function of the civilian sector.

The aggregate production function for each sector is:

$$D = D(L_d, K_d) \tag{1}$$

$$C = C(L_c, K_c, D), \tag{2}$$

where D is defense output, C is the civilian output and the subscripts represent the two sectors. Specifically L_d and L_c are productive labor inputs employed in the defense and civilian sectors, and K_d and K_c are capital stocks in the defense and the civilian sectors.

In this economy, aggregate output is:

$$Q = D + C, \tag{3}$$

where Q is real output, and other variables are as defined above. The total inputs are:

$$L = L_d + L_c, \tag{4}$$

$$K = K_d + K_c, \tag{5}$$

where L and K are the total labor and capital stocks in the economy.

Here the marginal productivities of the factors of production--labor and capital--in the defense sector may not be the same as they are in the civilian sector. Allowance is made for this by assuming that the marginal productivity of factors used in the defense sector is equal to $1 + \delta$ times the corresponding marginal factor productivity in the civilian sector, ie.

$$\frac{D_l}{C_l} = \frac{D_k}{C_k} = 1 + \delta$$

where the D_i's and C_i's are the marginal products of labor and capital in the two sectors.

The implicit assumption that the productivity differential is the same for labor and capital is a simplification. It would be possible to develop a simultaneous equations model, based on the two sectoral production functions, taking into account separate productivity differentials and cross externality effects, but it could not readily be estimated due to data limitations. Separate data would be needed for the capital stock and labor employed in the defence sector and for that used in the civilian sector.

Defence production is not completely separate physically from civilian production because a large portion of defence supplies and equipment is produced by civilian firms on contracts with the military. Thus, part of what is measured as civilian capital and labor is used for defence purposes. The distinction between the defence and civilian sectors is a theoretical difference. Empirically, civilian output or spending is just the difference between real output and defence spending, $C = Q - D$, because data is only available for D and Q. One of these variables must be eliminated for estimation purposes. Thus, it is necessary to develop single equation models which eliminate variables that are based on this theoretical distinction, i.e., C, K_d, L_d, K_c, and L_c -- for which data is not readily available. This is accomplished below.

Taking the total differential of $Q = D + C$ using equations (1) and (2) gives:

$$dQ = D_l dL_d + D_k dK_d + C_l dL_c + C_k dK_c + C_D dD$$

Eliminating D_l and D_k using $(1 + \delta)$ and collecting yields:

$$dQ = C_k(dK_d + dK_c) + C_l(dL_d + dL_c) + \delta(C_l dL_d + C_k dK_d) + C_d dD.$$

From equations (4) and (5), $dL = dL_d + dL_c$ and $dK = dK_d + dK_c$. Also, since $C_l = D_l/(1 + \delta)$ and $C_k = D_k/(1 + \delta)$, the last term in parentheses is equal to $\{1/(1 + \delta)\}\, dD$.

Making the substitutions gives:

$$dQ = C_k dK + C_l dL + (\delta/(1 + \delta))dD + C_d dD, \tag{6}$$

where C_l and C_k are the marginal productivities of labor and capital in the civilian sector and C_d is the externality effect of defence output on the civilian sector. If $C_d \geq 0$ and/or $\delta \geq 0$, increased defense output will imply a higher rate of growth of total output Q.

Dividing each side of equation (6) by Q, it can be written in terms of growth rates as:

$$dQ/Q = C_k(I/Q) + C_l(dL/L)(L/Q) + [\delta/(1 + \delta) + C_d](dD/D)(D/Q), \tag{7}$$

where $I = dK$, i.e. aggregate real investment spending in the economy, I, is used as a proxy for the change in the capital stock. Values for C_k, C_l, and $(\delta/(1 + \delta) + C_d)$ are empirical parameters to be estimated.

In general, a form such as dX/X is the relative growth rate of variable X over the period in question. Since the purpose of the paper is to determine the effect of changes in defence spending on economic growth of the economy, it is appropriate to express the independent variables, as well as the dependent variable, in terms of growth rates. Thus, the last two terms include dL/L and dD/D, and the estimation uses relative growth rates

as data. It is not useful to express the first term as a relative growth rate because data is not readily available for capital stock.

APPENDIX B
ROBERT M. SOLOW MODEL (1957)

In the 1950's, some U.S economists tried to use empirical data to determine how much technological change occurred. Among them, Robert M. Solow suggested a model and calculated technological changes in his paper, "Technical change and the aggregate production function." (Review of Economics and Statistics, Vol 39, 312-320, 1937)

He used the aggregate production function as below:

$$Q(t) = A(t)\ F(\ K_t, L_t\ )\ ,$$

where K stands for capital and L for labor.

Differentiating with respect to time and denoting the derivatives by putting a line over variable, hence $dQ/dt = \dot{Q}$, we have

$$\dot{Q} = \dot{A}\ F(\ K_t, L_t\ ) + A\frac{\partial F}{\partial K}\dot{K} + A\frac{\partial F}{\partial L}\dot{L}\ .$$

Dividing by Q gives an equation for the proportionate rate of change of output:

$$\frac{\dot{Q}}{Q} = \frac{\dot{A}\ F(K_t, L_t)}{Q} + A\frac{\partial F}{\partial K}\frac{\dot{K}}{Q} + A\frac{\partial F}{\partial L}\frac{\dot{L}}{Q}.$$

Now we add the assumption that factors are paid their marginal products:

$$\frac{\partial Q}{\partial K} = A\frac{\partial F}{\partial K} = \frac{r}{p} \quad , \quad \frac{\partial Q}{\partial L} = A\frac{\partial F}{\partial L} = \frac{w}{p} \; .$$

In Solow's notation, the shares of capital and labor are denoted respectively by $w_K = rK/pQ$ and $w_L = wL/pQ$. With this assumption the preceding equation becomes

$$\frac{\dot{Q}}{Q} = \frac{\dot{A}}{A} + w_K\frac{\dot{K}}{K} + w_L\frac{\dot{L}}{L} \; .$$

Assuming constant returns to scale gives $w_L + w_K = 1$ by Euler's theorem and we can convert to per capita variables $q = Q/L$ and $k = K/L$. The proportionate rates of change of the per capita variables are expressed in terms of the proportionate rates of change of the total volume variables as follows

$$\dot{q} = \frac{\dot{Q}}{L} - \frac{Q}{L^2}\dot{L}, \quad \dot{k} = \frac{\dot{K}}{L} - \frac{K}{L^2}\dot{L},$$

and so

$$\frac{\dot{q}}{q} = \frac{\dot{Q}}{Q} - \frac{\dot{L}}{L}, \frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L}.$$

Substituting in, and using $w_L = 1 - w_K$,we have

$$\frac{\dot{q}}{q} = \frac{\dot{A}}{A} + w_K\frac{\dot{k}}{k}.$$

Approximating the continuous time derivatives by first differences in annual data, and given data on output per man-hour, capital per man- hour and the share of capital,

the technical change index $A(t)/A(t-1)$ can be calculated year by year from this relation. The results of this calculation then permit a series for $A(t)$ to be constructed by assuming an arbitrary initial value $A(1)=1$ and repeatedly using the relation,

$$A(t) = A(t-1)[1 + \frac{\Delta A(t)}{A(t-1)}], \quad t=2, 3,...$$

The resulting series has a strong upward trend; the average rate of technical progress in the U.S. over the period 1909-1949 was 1.5% per annum.

Having obtained an estimate of how much the production function was shifting, Solow then asked how much of the increase in output per man-hour during the forty years was due to technical change, and how much was due to the increase in k. An idea of the fixed function corrected for technical progress can be obtained by dividing q(t) by A(t). This estimates what would have occurred without technical change, that is the increase in output per man-hour attributable to the increase in capital. Solow found that technical change over the sample period accounted for 90% of the improvement in output per man-hour and the growth of capital the remaining 10%. As Solow acknowledged, his measure is a catch-all, incorporating any kind of shift in the production function--"slowdowns, speedups, improvements in the education of the labor force" (an embodied technical change) all appear as "technical change." A further difficulty with an aggregate measure such as this is that it ignores changes in the composition of output. For example, if the economy utilizes more intensively sectors which enjoy comparative advantages, but there is no technical progress, the overall productivity measure will still increase.

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