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A Study of High Technology and Self-Sufficiency Based Defense Industry as Middle Power: Focus on The Republic of Korea and Sweden		
<p><u>ABSTRACT:</u></p> <p>This research focuses on understanding the defense industry of Sweden and the Republic of Korea (ROK), two middle powers renowned for advanced technology and weapon self-sufficiency. Previous studies have not explained why Sweden and Korea are competitive in the defense industry. This research aims to answer the question: What determinant factors have made the ROK and Sweden to develop competitive defense industries on their own with sophisticated technology? The study seeks to enrich our understanding of the defense industry in Sweden and the ROK. Utilizing a case study approach, this research closely examines the specific contexts influencing the defense industries of these countries. The key findings are that Sweden needs to strike a balance by expanding government-led arms production facilities. In contrast, the ROK needs to cooperate more actively with its allies, including the U.S. This thesis contributes by presenting future development directions based on the results.</p>		
Keywords: Defense industry, middle-power, national competitiveness theory, the Republic of Korea, Sweden, production capacity		

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1. INTRODUCTION

1.1 Background and Problem Formulation

Morgenthau (1993) emphasizes that national power resources are important as national power when it contributes to military strength. Waltz (1979) argues that the state continues to strengthen its abilities for national security if domestic and foreign conditions allow. From this point of view, for national security, states will try to improve their military power by fostering their defense industry. However, not all countries produce weapons through their initiatives.

Small states prefer to purchase rather than develop their weapons due to limited defense budgets and the need for reliable products (De France, Mampaey & Zandee 2016). In contrast, defense industry powers have the advantage of supplying high-quality weapons more efficiently through mass production systems (Ploom, Kalvet & Tiits 2022, p. 125). As a result, the five major suppliers of the United States (U.S.), Russia, France, China, and Germany accounted for 77% of total defense industry exports worldwide from 2017-2021 (SIPRI 2022a, p. 12). Furthermore, as most of the top 25 defense companies belong to great powers such as the U.S., the defense industry has been recognized as an area dominated by great powers.

However, to secure economic autonomy and efficiency, several middle powers are increasing self-sufficiency in the defense industry and securing solid positions through highly competitive high-tech defense industry exports. As a result, the global defense market has begun to diversify. Some middle powers even export high-tech weapons to great powers (FOI: Swedish Defence Research Agency 2022a, p. 90).

However, existing studies do not explain why these countries have competent defense industries with cutting-edge technology and high weapon self-sufficiency. For example, Bitzinger (2015, pp. 467-468) argues that defense policies in Asian countries, including the ROK, have selectively developed military technologies that can be done rather than military needs. Cheung (2017, p. 312) argues that countries receiving security guarantees from the U.S. are mainly focusing on private-sector industrialization and technology development, and consequently defense industrialization is the second priority. However, this theory does not seem to fully account for the robust defense industries of the ROK, which has a military alliance with the U.S., and Sweden, which has maintained armed neutrality for a long time. This study acknowledges these gaps.

1.2 Research Purpose, Questions, and Contribution

This study provides implications by analyzing the conditions that enabled the ROK and Sweden to develop their defense industries. This study aims to broaden the understanding of the defense industry of middle powers such as Sweden and the ROK, which have a high weapon self-sufficiency rate and high-tech export platforms such as fighter jets. Furthermore, the two cases of Sweden and the ROK, from 2000 to 2022, aim to answer the following research question.

“What determinant factors have made the ROK and Sweden to develop competitive defense industries on their own with sophisticated technology?”

This study intends to contribute to the theoretical and methodological discussion by expanding the understanding of the defense industry of middle powers with sophisticated technology and high weapon self-sufficiency and by providing an analytical framework. In addition, it aims to contribute practically to developing the defense industries of Sweden and the ROK by presenting the future development direction.

1.3 Research Scope and Delimitations

The defense industry has no consistent conceptual definition of great, middle, and small powers. Therefore, for research purposes, this study classified great, middle, and small powers, inspired by the classification method of FOI (2022a, p. 19) in **Figure 1**.

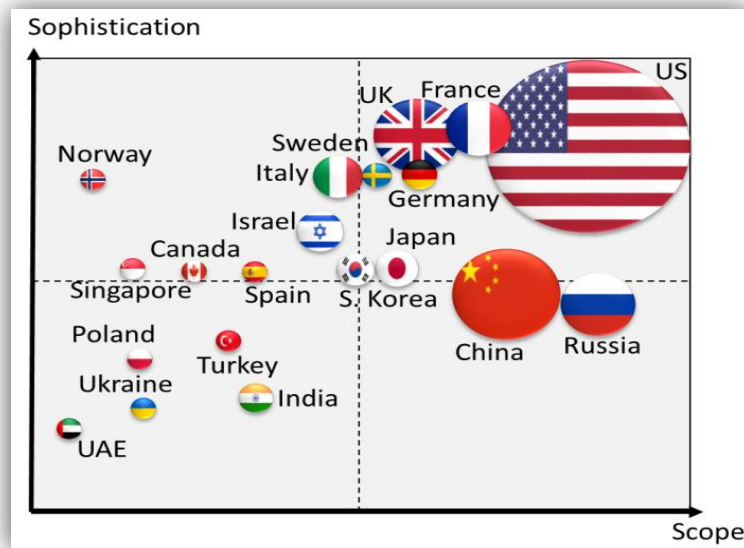


Figure 1 Major Defense Industrial Countries (FOI 2022a, p. 34)

FOI categorizes defense industry capabilities by country in size, scope, and sophistication. According to FOI, the author calls the ‘top 5’ countries, such as the U.S., Russia, China, UK, and France as Great powers, and 10 other countries, such as the ROK, Sweden, Japan, Germany, Italy, Israel, Spain, India, Turkey, Canada, Singapore, Poland, Ukraine, UAE, and Norway as Middle powers. This study’s scope of research is limited to middle powers, and to the 20th century (2000-2022) when these countries began to export high-tech weapons and to emerge in earnest.

1.4 Case Selection

Among the above middle power countries, the ROK and Sweden are the only countries that develop fighter jets and export them in large quantities, except for the case of joint development (Eurofighter) by several countries. The fact that countries, except for traditional great powers export high-tech weapons systems such as fighter jets in large quantities means that they have secured technological autonomy (Lee 2009, p. 28). Furthermore, according to Lundmark (2020) and Korea Defense Industry Association (KDIA 2021), Sweden's arms self-sufficiency rate is 69.9% and the ROK is 77.2%, higher than Israel’s 44% (DeVore 2016). However, most countries with insufficient defense budgets cannot generally develop advanced modern weapons systems and find it challenging to create economies of scale (Markowski, Hall & Wylie 2010, pp. 86-93). Namely, producing advanced defense industries such as fighter jets is not

economically efficient because pursuing self-sufficiency generally requires more costs and resources (Bitzinger 2017, p. 308). Nevertheless, the ROK and Sweden were chosen as cases of this study because they were uniquely well worth studying as countries that achieved high self-sufficiency and technological progress.

1.5 Research Overview and Disposition

The rest of this study is organized into five chapters. Chapter 2, reviews previous studies. Chapter 3 deals with definitions and the theoretical basis of terms related to the defense industry and presents a revised analytical framework. Chapter 4 deals with research methods through research methodology, basic research design, data sources, and operationalization. Chapter 5 analyzed the causes of the development of the defense industry in Sweden and the ROK and the factors that influenced it, and derived the results. The last chapter presents discussions, self-reflection, and recommendations for further research.

2. PREVIOUS RESEARCH OF SMALL STATE'S DEFENCE INDUSTRY

2.1 Literature Review

Since the defense industry requires high-level technology and capital investment, there are considerable entry barriers for small and middle powers (DAPA 2008, p. 352). As a result, many countries strengthen their defense capabilities by forging alliances with great powers and importing weapons. However, some have fostered their defense industries while reducing their dependence on arms imports from great powers. Scholars identify three reasons for this: economy, security, and identity.

First, regarding economic efficiency, many types of military equipment cause unsustainable cost increases, making them a more discussed topic in defense acquisition (Amann, Kihlander & Magnusson 2021, p. 847). Therefore, especially for small and middle powers, they should be aware of the cost of operating weapons when attempting to develop them for the first time. Jang (2005, p. 27) emphasizes the positive effects of the development of the defense industry, that economic benefits such as significant maintenance cost reduction and weapon system exports can be expected. Finally, Lee (2009, p. 23) argues that technologies introduced through arms production can lead to private-sector transfers and have positive economic ramifications. Second, in terms of security effects, it is generally agreed that the fostering of defense industries in small states is to secure political autonomy and overcome vulnerabilities in external security, away from the form of relying on great powers. Bitzinger (2015, pp. 454-455) argues that the most powerful motive for fostering the defense industry has been pursuing security in the chaotic international security system. Through this, a state naturally acquires an independent defense capability. Jang (2005, p. 27) argues that the ability to procure and develop weapons independently brings political autonomy to a small state. Rosh (1990, p. 58) argues that countries that cannot produce weapons find it difficult to escape from political influences like arms embargoes or export restrictions by great powers. Ditrych and Kucera (2023, p. 7) consider the defense industry as an important tool of diplomatic power politics and emphasize the importance of the defense industry in terms of security.

Third, from the perspective of identity and prestige, countries can secure independent status and enhance their status in the international community by having independent arms production and defense industry capabilities (Bitzinger & Kim 2005, p. 184).

From a different perspective, Murray, McGregor and Alvin (1994) present geo-political locations, history, culture, ideology, religion, economic, and political systems as factors influencing national strategic choices and present a wide range of interpretations.

2.2 Research Gap

Defense industry-related studies have focused on two perspectives: small states that are more sensitive to diverse issues and rapid changes, and great powers with hegemony. This study is distinguished from existing studies in that it was difficult to explain the defense industry of countries with outstanding technology and high weapons self-sufficiency due to the extensive scope settings of middle powers. It argues that as some countries' contribution to the defense industry is increasing globally, it is necessary to classify and analyze the defense industry of countries that have high weapons self-sufficiency and export high-tech weapons. The prevailing interpretation is that when weapons supply and demand instability occur during a security crisis, the relevant countries recognize the need to produce weapons to develop their defense industry (Brauer 2004, p. 250). However, this study starts from the assumption that the development of the defense industry of middle powers with high weapons self-sufficiency and technological prowess will be motivated by additional factors apart from the security crisis and arms supply issues. Therefore, this study is differentiated from previous studies by focusing on understanding the defense industries of these countries.

3. THORETICAL FOUNDATIONS FOR DEFENCE INDUSTRY

3.1 Terminology Definition

3.1.1 Defence Industry

Depending on the situation and context, there are various definitions of what the 'defense industry' means (Markowski et al. 2010, p. 82). For example, Korea's Defense Acquisition Program Administration (DAPA 2013, p. 213) defines the 'defense industry' as 'an industry that produces, researches, and develops weapons systems and major non-weapon systems, including defense materials designated by the government.' Also, in Sweden's FOI (2022a, p. 17), the 'defense industry' is defined as a company or military business sector within a company involved in munitions' research, production, sale, and maintenance. Namely, countries and scholars define the defense industry in various ways. Still, it is summarized as an industry that researches, develops, and produces materials required from a military point of view for national defense.

3.2 National Competitiveness Theory

Porter (1990) argues that there are four endogenous variables (factor conditions, demand conditions, relative and supporting industry, and firm strategy/structure/rivalry) and two exogenous (government, chance) variables as national factors that create and maintain a competitive advantage in a particular industry. By interacting with each other, these factors affect the competitiveness of a specific sector. **Factor conditions** are factors related to production, and subcomponents including human resources, material resources, knowledge resources, capital resources, and infrastructure (Porter 1990). **Demand conditions** are primarily divided into the size and quality of demand. If the quality of demand is high, the level of expectation of the consumer rises, leading to industrial technology development (Porter 1990). **Related and supporting industry** is an element that explains a country's competitive advantage increases through synergy when there are internationally competitive suppliers or associated industries (Porter 1990). **Firm strategy/structure/rivalry** refers to the business environment in which companies are created and organized that can improve product quality and reduce costs through competition

under the influence of the national environment (Porter 1990). Finally, **Government** affects as the form of policy (defense industry policy), and **Chance** refers to the impact of external shocks such as technological inventions, natural disasters, and wars (Porter 1990).

3.2.1 Diamond Model

Porter (1990) presents a diamond model as shown in **Figure 2** below to evaluate competitiveness of a country or industry through these factors.

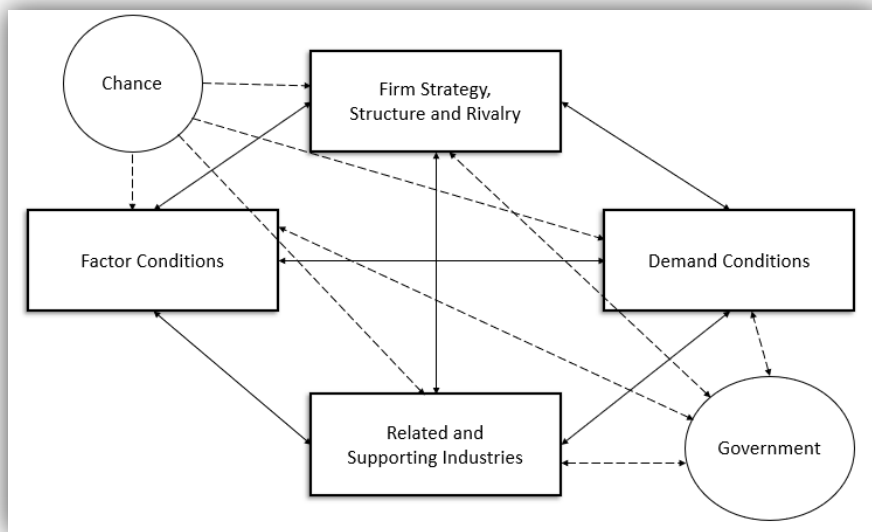


Figure 2 The Diamond model (Porter 1990, p. 127)

As Korkmaz and Topcu (2021) analyzed Turkey's defense industry using the Diamond Model, this model combines and integrates various factors to analyze the factors that inform the country's competitiveness and the industry. Therefore, inspired by Porter's theory and the competitiveness evaluation factors of the diamond model, this study aims to identify the reasons why the ROK and Sweden's defense industry were able to be competitive and factor conditions, demand conditions, related and supporting industries, and government are set as variables to identify the factors that affect it.

3.2.2 Modified Analytical Framework

Sub-variables corresponding to **factor conditions** are classified into **facility/manpower capacity** and **R&D**. Having the technology and production facilities of the defense industry on

its own reduces dependence on other countries and contributes to the development of the defense industry (Bitzinger 2009, p. 230). Furthermore, Markowski et al. (2010, p. 102) emphasize the importance of dynamic capabilities and supply chain management in securing a competitive advantage in the defense industry. This is possible only when supported by human/facility infrastructure. Also, competitiveness in the R&D field is important because it leads to the development of the defense industry (Cho 2021, p. 262). Therefore, defense industry companies invest in R&D to meet the ROC (Required Operational Capability) required by the government, which acts as a competitive edge in the defense industry (Blom, Castellacci & Fevolden 2014, p. 433).

The sub-variable corresponding to **demand conditions** is **domestic market size**. Suppose the size of the domestic market is small. In that case, it is difficult to pursue independent defense by fostering the defense industry in terms of economic efficiency, so the scale of domestic market demand acts as a factor influencing the development of the defense industry (Sandler & Hartley 1995, p. 194). Furthermore, sufficient domestic market size enables the development of the defense industry by achieving economies of scale without exports, and even when exporting, it is possible to secure price competitiveness through sales in the domestic market (Lee 2009, p. 57).

The sub-variable of **related and supporting industries** is **Technology** in defense and related industries. Lee (2009, p. 58) also argues that the more well-developed the defense industry-related industries are, the easier it is for the defense industry to develop because the technological and productive conditions are well prepared. It is because the international competitiveness of the engineering industry is a prerequisite for national defense industry construction, and technological collaboration and diffusion across the defense industry and the private engineering industry can promote the development of the defense industry (Singh 1998, p. 255). Therefore, in general, if a country has technology and production facilities in shipbuilding, semiconductor, and information and communication related to the development of various advanced weapons and these industries are well linked to the defense industry, the synergy between industries will be great (Ministry of Strategy and Finance 2023).

The sub-variables of **government** are **the government's self-defense will** and **support policies**. Since the government is a key consumer in the defense industry, defense policies such as defense acquisition policies related to the military's future capabilities are an important factor in determining the direction of the defense industry (DAPA 2008, p. 362). Namely, the development of the defense industry is an interaction between the requirements of each service for

building and maintaining defense capabilities, the capabilities of defense companies that meet the requirements, and the government's defense acquisition policy that supports them. It is influenced by the direction of the government's policy, method, will and preference (Lee 2009, p. 53). In general, the greater the ability of a country's defense industrial base to independently provide and support weapons, the greater the national security and the greater the range of autonomous action. Therefore, governments of each country attempt to provide policy support to foster the defense industry (Bitzinger 2009, pp. 230-236). War and natural disasters, which can be sub-variables of 'chance', are excluded from this study because they are uncontrollable external variables that did not directly affect the study period. Various support policies, national strategies, and environments that can be sub-variables of firm strategy/structure/rivalry are included in the government variable because they are determined by the government's decision in the defense industry.

Figure 3 shows the modified analysis tool used in this study.

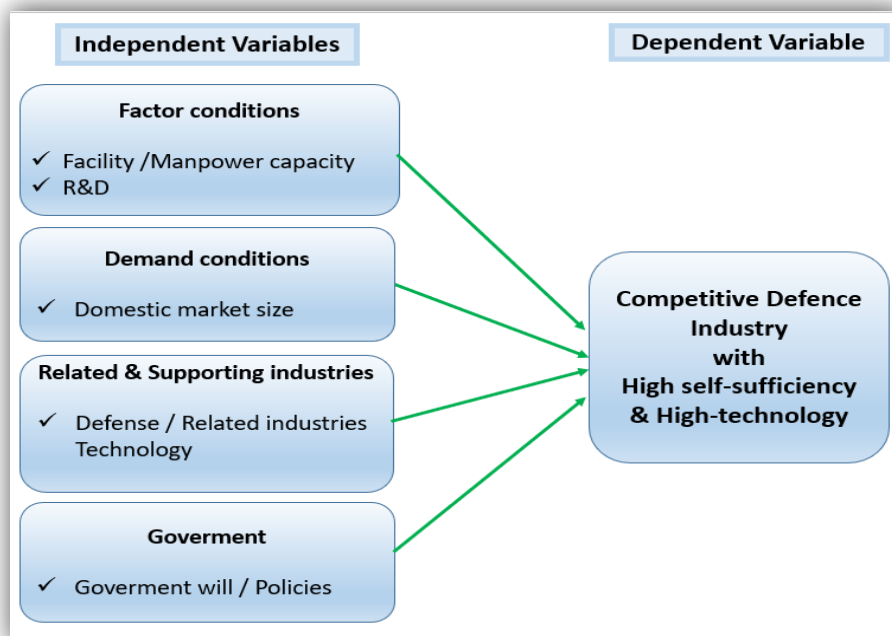


Figure 3 Analytical Framework

4. METHOD

4.1 Research Design

This study is a qualitative research method and text analysis conducted through two case studies. The reason for conducting a qualitative case study is that concepts such as security, government policy, and government's will are difficult to quantify, and it is necessary to understand the context through case studies in this study.

4.2 Data Sources

The sources of data used in this study are government or parliamentary documents, documents of government research institutes such as FOI, KRIT (Korea Research Institute for Defence Technology Planning and Advancement), research materials of specialized research institutes such as SIPRI, documents of the Ministry of Defense such as white papers of each country, previous literature data, and various official research websites.

4.3 Operationalization

4.3.1 Factor Conditions

This study examines the facility capacity of defense companies (capacity utilization, capital expenditure, total sales), the number of global defense companies and the number of professionals in the defense industry. Furthermore, since private technology and defense technology are closely related, GERD (Gross Domestic Expenditure on R&D), defense R&D budget, and the proportion of R&D budget in the defense budget are also investigated.

4.3.2 Demand Conditions

To measure the domestic market size of the defense industry, this study investigates the defense budget and the defense budget relative to Gross Domestic Product (GDP).

4.3.3 Related and Supporting Industries

This study investigates defense technology through data measuring the technological level of each country by KRIT. In addition, some data related to IMD is used to measure technology in the private sector.

4.3.4 Government

This study reviews the government's defense industry policy (arms export support policy, support policy, weapon localization policy, etc.) and science and technology policy (R&D support, project incentives, etc.).

Figure 4 below summarizes the operationalization.

Factors	Variables	Operationalization	Data Sources
Factor conditions	Facility / Manpower capacity	Total sales of defense companies Utilization rate / CAPEX Number of defense companies in the world's top 100 Number of employees and professional manpower	Government documents / SOFF Korean statistics SIPRI Korean statistics / SOFF
	R & D	GERD R & D expenditure (% of GDP, Government spending, defense budget) Defense companies investment	OECD OECD Korean statistics / SOFF
Demand conditions	Domestic market size	Defense budget Military expenditure (% of GDP)	Defense White paper / Parliament / SIPRI SIPRI
Related & Supporting industries	Defense / Related industries Technology	Technology level measurement data Competitiveness Index	FOI / KRIT IMD
Government	Government will / policies	Government support policies (support policy, weapon localization policy, R&D support, project incentives)	President of office / Legislation /Government / Parliament documents

Figure 4 Operationalization

Figure 5 below shows the research design overview discussed.

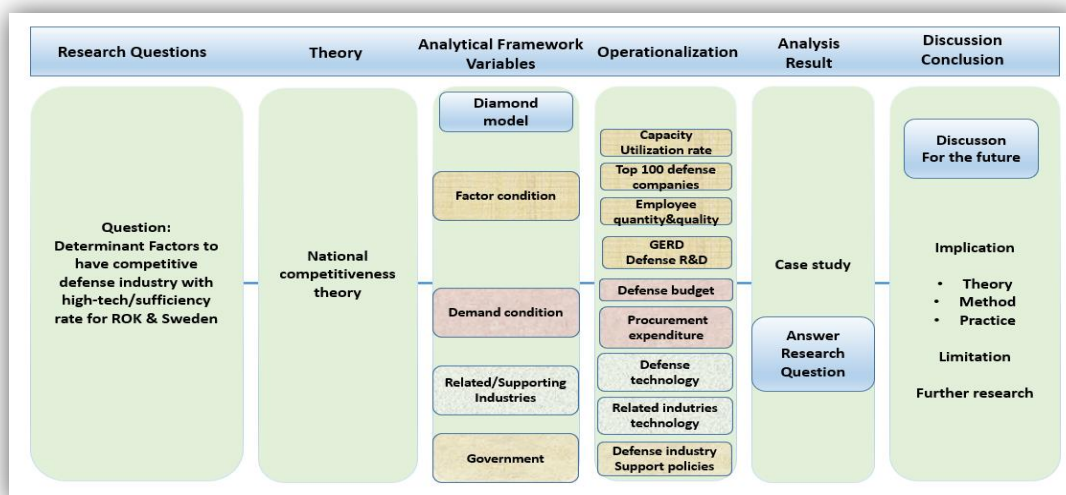


Figure 5 Research Design

5. ANALYSIS AND RESULT

The 2000s were significant when changes began regarding the ROK and Sweden's defense business and national security. In terms of the ROK national security, the 2000s was when the will of independent defense was strengthened against North Korea's continuous high-intensity provocations, which are not only shelling into the territory but also developing nuclear weapons. Since the 2000s, the ROK has begun exporting high-tech weapons to countries worldwide (The Blue House 2012, p. 5). Sweden continued to increase defense spending even after the end of the Cold War, but started to go downhill in 2000. Since 2019, Sweden's defense spending has risen significantly again. The Russia's threatening actions against Georgia in 2008, the annexation of Crimea in 2014, and Syria in 2015 remind Sweden of threats again (FOI 2021, p. 49). This stance has continued to the present, with Sweden applying to be a member state after the onset of the war in Ukraine (Riksdagen 2022).

In this chapter, the research question will be answered by the conducted analysis and summarized results.

5.1 Analysis

5.1.1 Factor Conditions

5.1.1.1 Facility / Manpower Capacity

The ROK

The ROK has a total of 86 defense companies, with 33,000 people engaged in the defense industry, including about 8,000 researchers, among which roughly 4,000 have master and doctoral degrees, and 3,600 with bachelor's degree, most of whom have a bachelor's degree or higher (Korean Statistical Information Service: KSIS). Total sales of defense companies in 2022 are 11.8 billion USD (domestic 88.2%, overseas 11.8%) (The Export-Import Bank of Korea 2022, p. 13). The ROK has four companies in the world's top 100: Hanwha Aerospace (50th), KAI (65th), LIG Nex 1 (71st), and Hanwha Corp (82nd) are the primary defense companies (SIPRI 2022b). **Figure 6** shows the annual changes in production capacity and the number of employees of the ROK defense companies.

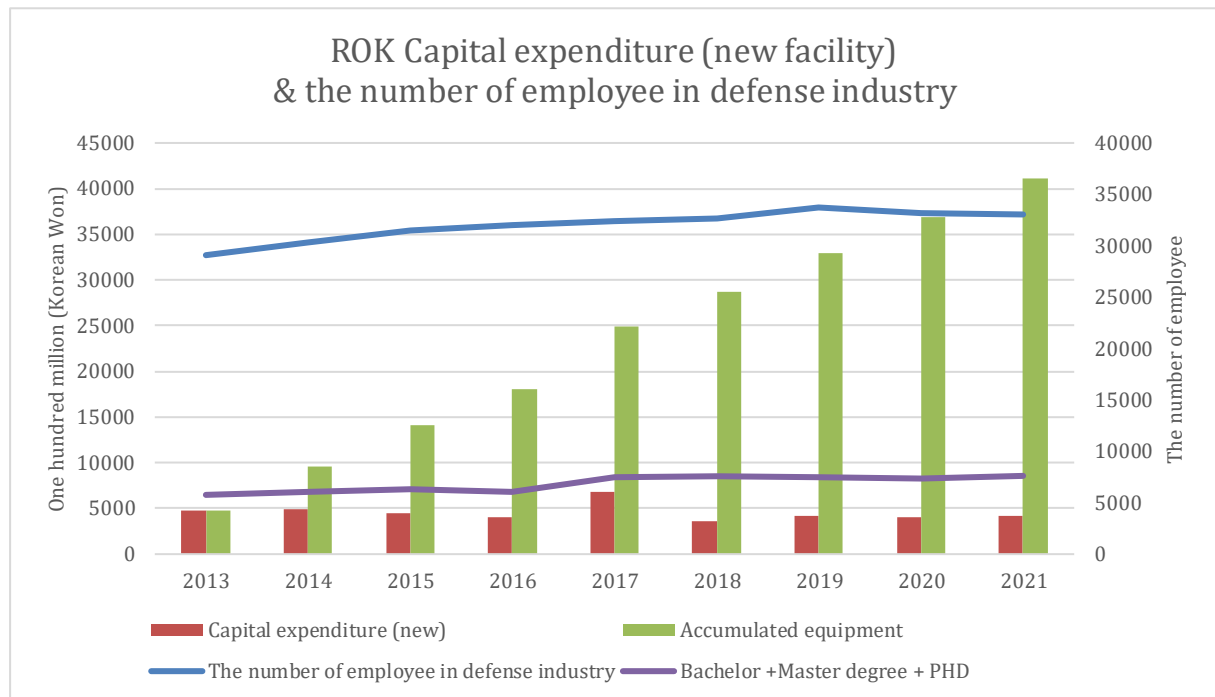


Figure 6 ROK Capital expenditure and employee (KSIS)

The ROK's defense companies are still expanding their production facilities by investing in new capital expenditures. The ROK's defense companies have a structure that is easy to expand because they have peacetime production facilities that can quickly respond to sudden increases in demand and accommodate even when orders explode (KDIA 2008, p. 33). As an example, through active cooperation between the government, the military, and related agencies and special extension work by defense companies, initial supplies delivered only four months after receiving large orders for K-2 tanks from Poland in August 2022, the tanks are now being delivered sequentially earlier than stated in the contract period (Choi 2023). There are several reasons why the ROK's defense companies have such short lead times. **Figure 7** below shows the total sales of the ROK defense companies and the corresponding capacity utilization rate.

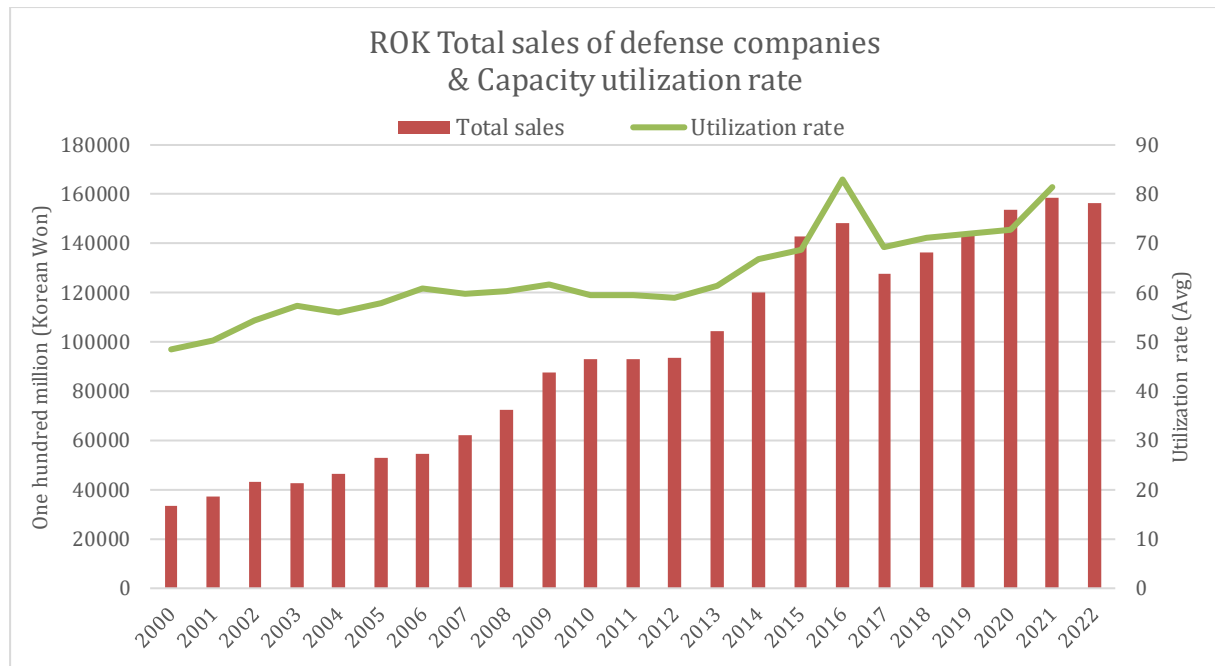


Figure 7 ROK Capacity utilization rate (KSIS)

The ROK's defense companies maintain an additional capacity utilization rate of about 30% on average, and show that they can flexibly increase production according to the government's request, when necessary, which is a good option for countries that need arms imports in a short time. In particular, Poland had the effect of imprinting the ROK's production speed and production capacity on the world. The reason for such continuous expansion of capital expenditure is based on the mindset that a certain amount of surplus production capacity should be maintained in peacetime in case of wartime or blocked overseas procurement. In other words, the ROK stipulates that the government may transfer 'major defense materials' of defense companies in accordance with the Defense Project Management Regulations in case of war or a severe threat to national security (Ministry of Government legislation 2022, article 54). In addition, the government cooperates by giving notable exceptions in various ways to companies that procure the necessary major defense materials and weapons systems (Ministry of Government legislation 2022, article 46). After the Korean War, the ROK defense companies were fostered by large companies such as Samsung and Hyundai with the government. After privatizing, it still has some of the characteristics of public institutions under the 'Defense Acquisition Program Act.'

Sweden

There are more than 100 defense companies in Sweden, and about 28,000 employees are engaged in the defense industry, among which 13,000 (46.5%) have received a university

education, and 655 have received master's and doctoral education related to the defense industry (SOFF 2023, pp. 5-6). Compared to the size of the Swedish defense industry, the proportion of research personnel is relatively high. In addition, Sweden has stakes in Bofors AB and Hägglund AB, which are subsidiaries of BAE Systems, along with Saab, the world's 34th largest defense company (SIPRI 2022b). Total sales of Swedish defense companies reached about 4.7 billion USD in 2021 and are entirely privatized. (SOFF 2022).

Sweden has a long tradition of producing defense equipment for its needs and mainly relies on overseas production (Regeringskansliet 2019, pp. 279-280). Like other European Countries, Sweden's defense industry has undergone extensive restructuring for the last ten years due to institutional changes and parliamentary political demands. Concerns about this shortage of domestic production industries in Sweden are reflected in the results of interviews conducted by FOI, where respondents emphasized the need for domestic production infrastructure and insisted on proper deployment at home and abroad (FOI 2022b, p. 24). The defense industry needs to supply ROC weapon systems required by the buyer in a timely manner, and the safest means of providing weapons free from shipping and political issues is to produce and supply weapons in the country. In this respect, even if Swedish defense companies are multinational and have production facilities overseas, the lack of domestic production facilities may negatively impact production flexibility. This is because each government, which is a purchaser of the defense industry, considers the prompt and guaranteed delivery of weapons as an important factor. Saab (2022) has already officially acknowledged the lack of production facilities in preparation for demand, which can extend the deadline for delivery and cause costs to rise, providing an excuse for buyers to find other alternatives.

5.1.1.2 R&D Investment

Figure 8 below shows GERD as a percentage of GDP, which means R&D intensity.

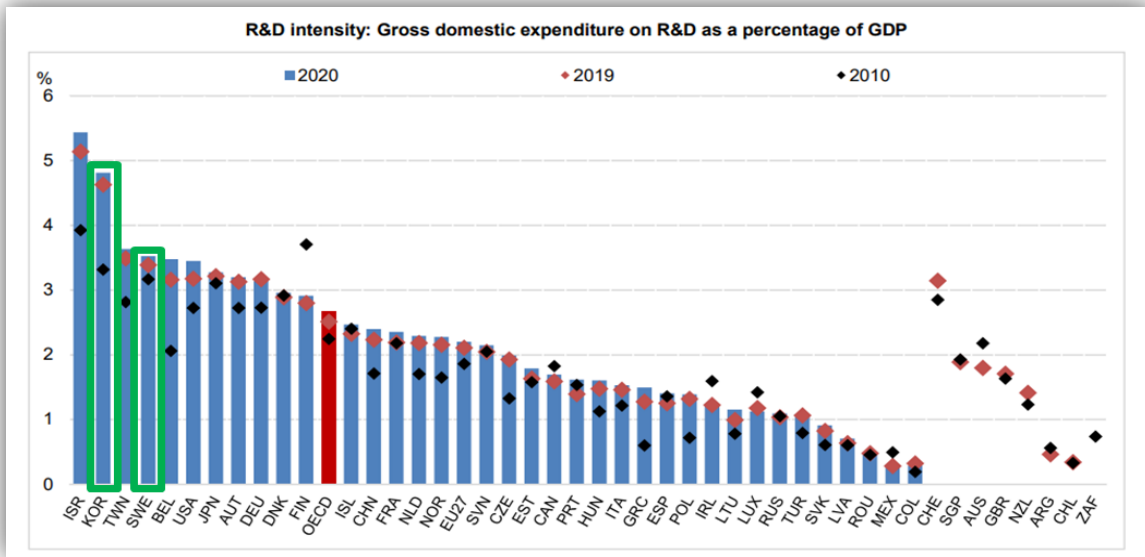


Figure 8 R&D intensity (OECD 2022)

In the ROK (2nd) and Sweden (4th), R&D intensity data relative to GDP exceeded the OECD average and the great powers, even though their GDP continued to increase over the period. **Figure 9** below shows the two countries' long-term GERD (% of GDP) data. While the increase in the ROK stands out, it is observed that Sweden shows a slight decrease in the long term.

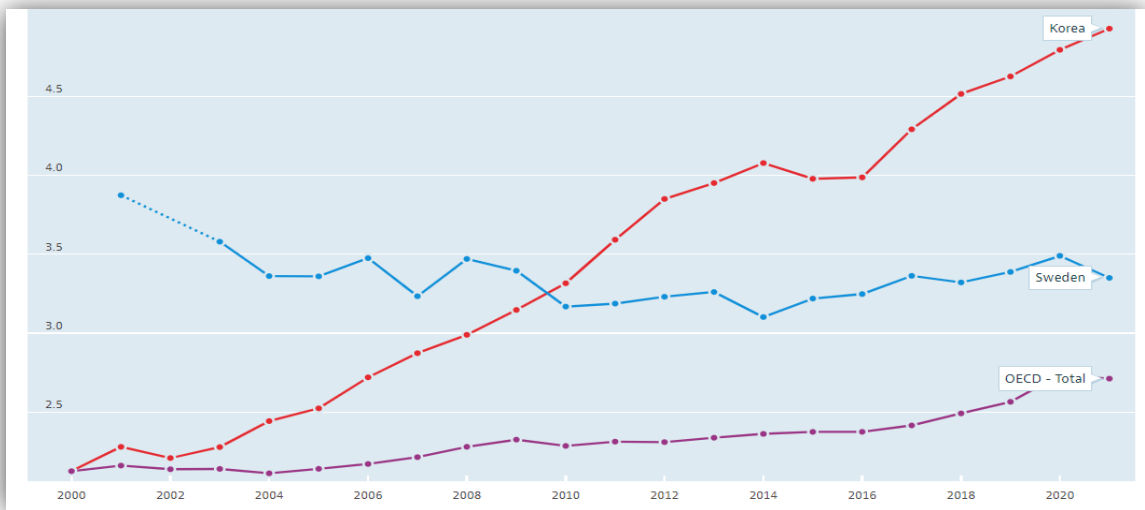


Figure 9 GERD as a percentage of GDP (OECD 2022)

Figure 10 provides insight into the extent to which public funds are allocated to R&D for military purposes relative to government budgets. The ROK and Sweden are also ranked high in this statistic, although compared to the ROK, Sweden is ranked lower than the above R&D

intensity index. Like most European countries, Sweden's ratio of defense R&D to government budget reduced compared to 2010, while the ROK saw a significant increase.

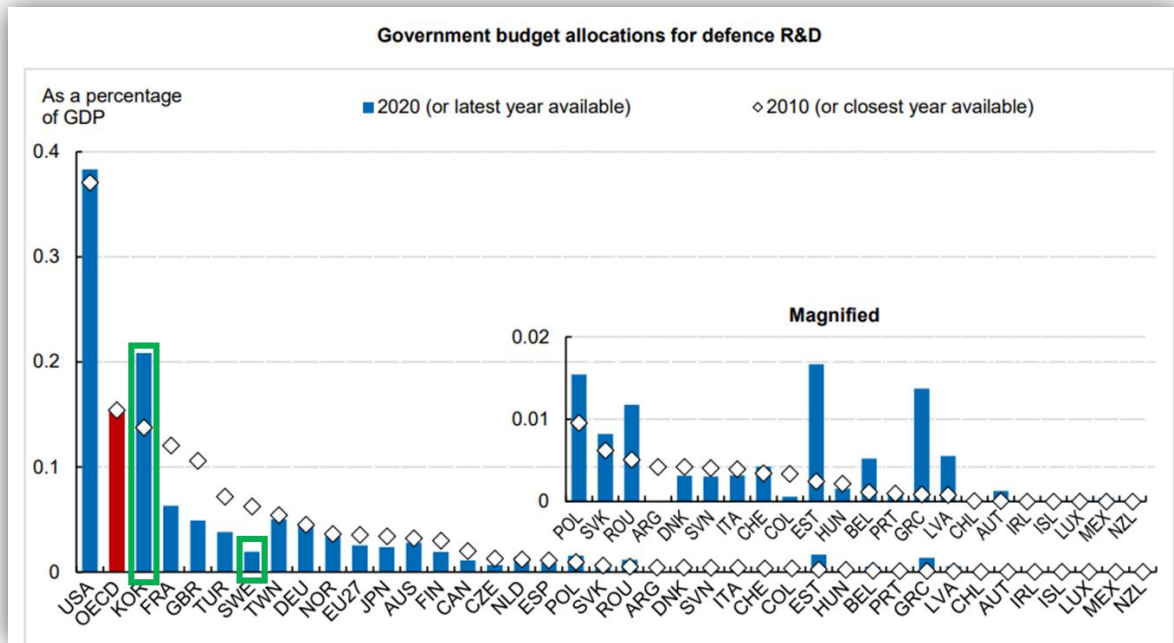


Figure 10 Budget allocations for defence R&D (OECD 2022, p.6)

However, Sweden has a high amount of R&D investment by defense companies. For example, Saab reinvests 18% of its annual revenue in R&D, a large percentage compared to the yearly 9% of Hanwha Aerospace, the ROK's largest defense contractor (Saab 2022, p. 31). Moreover, the ROK reinvests 5.2% (KSIS) of total defense industry sales, and Sweden 14% (SOFF 2023, p. 8) in R&D.

5.1.2 Demand Condition

5.1.2.1 Domestic Market Size

Out of the ROK's defense budget of 42 billion USD in 2022, the defense capability improvement cost for securing new weapon systems was 12.8 billion USD (Ministry of National Defense: MND 2022, p. 255). About 2.2 billion USD of Sweden's 2022 defense total budget of 7.4 billion USD was spent on defense equipment purchases (Riksdagen 2022, p. 8).

Figure 11 below compares the two countries with major countries, excluding the U.S. (approximately 811 billion USD in 2022) and China (approximately 298 billion USD) in the defense industry.

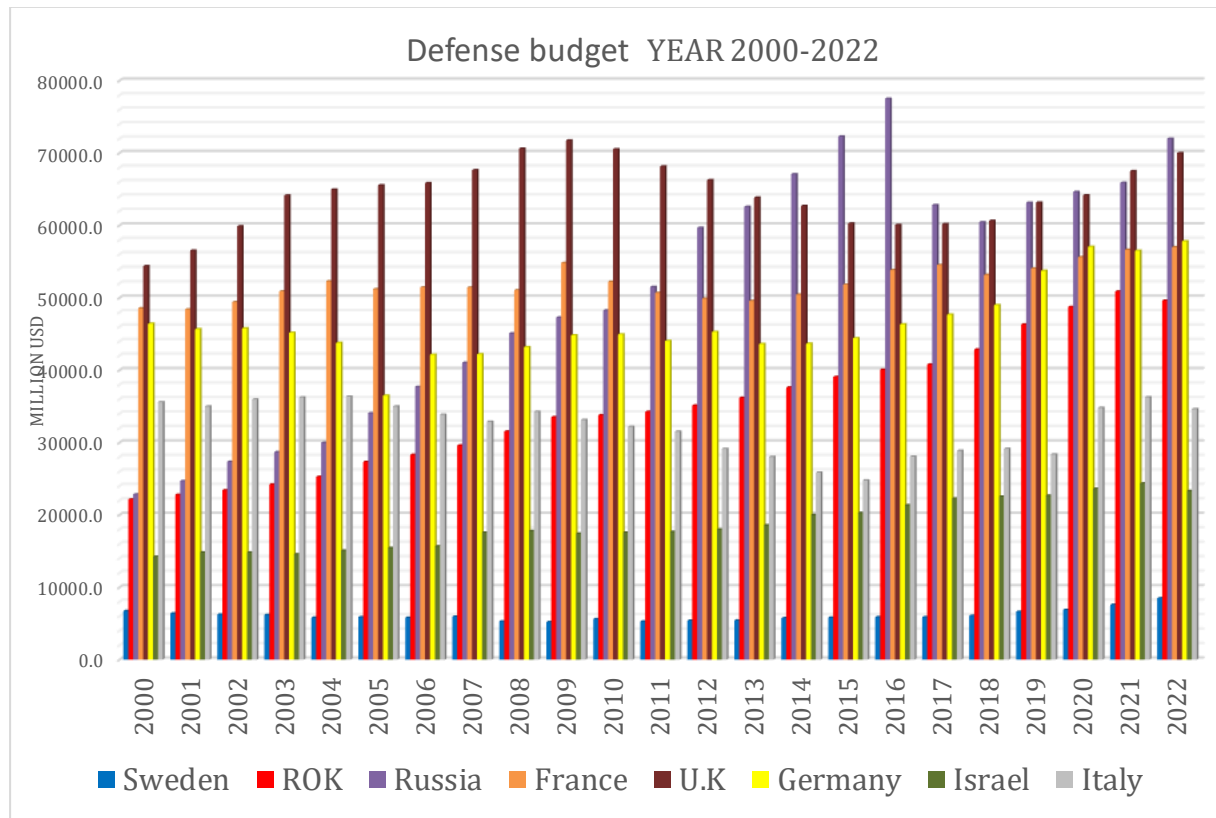


Figure 11 Defense budget comparison (SIPRI 2022c)

The defense budget data above helps show the market size, but the country's economy is not considered. **Figure 12** shows the military budget as a percentage of GDP.

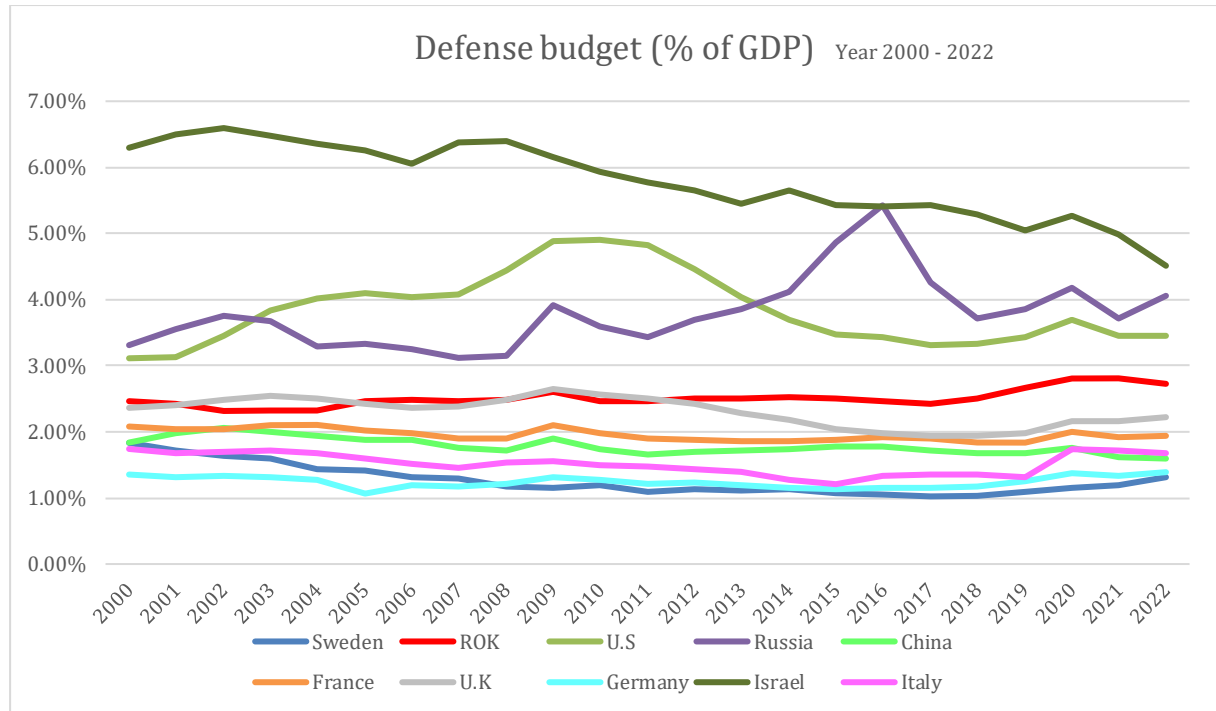


Figure 12 Defense budget (% GDP) (SIPRI 2022c)

Compared to the great powers, the ROK has a slightly smaller defense budget, but there is no significant difference in defense budget as a percentage of GDP. However, data for Sweden clearly shows that the market is small. conclusionally, even in the case of the ROK, it is still a small market as it accounts for only about 6% of the U.S. and about 16.6% of the Chinese markets (SIPRI 2022c).

5.1.3 Related and Supporting Industries

5.1.3.1 Technology

KRIT collects and analyzes quantitative indicators in 26 fields, including defense R&D, defense export scale, and science and technology level, every three years. Through this, when the US technology is converted into 100 points, the relative score of the top 16 countries is announced to present the level of national technology (Figure 13).

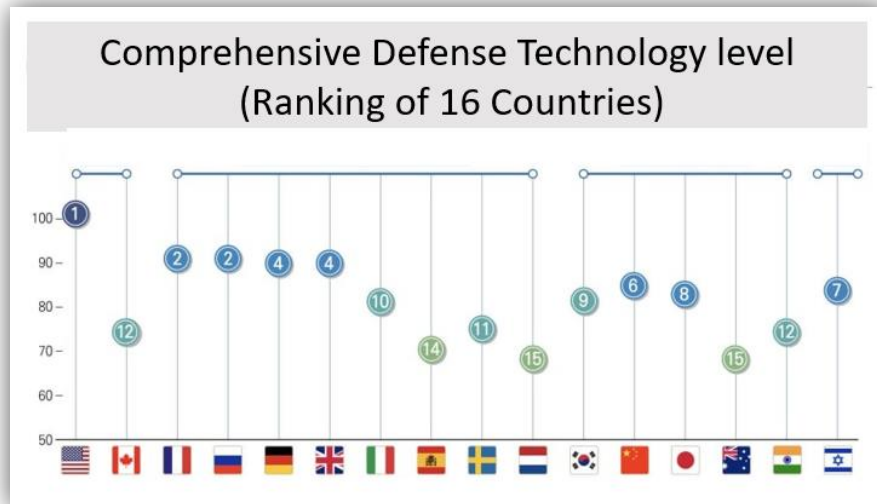


Figure 13 Defense comprehensive technology level in 2021 (KRIT 2022, p. 21)

The two countries' competitive defense technologies form a group of forces similar to those of China, Japan, and Israel. Based on the significant defense R&D investment, the ROK has achieved results such as SLBM (Submarine-Launched Ballistic Missile) and space launch tests and has been found to have superior technology in self-propelled artillery, unmanned systems, and command and control. On the other hand, Sweden has been found to have high technology in the fixed-wing field, such as developing its fighter model and AESA radar. **Figure 14** shows the ROK and Sweden's defense technology in detail.

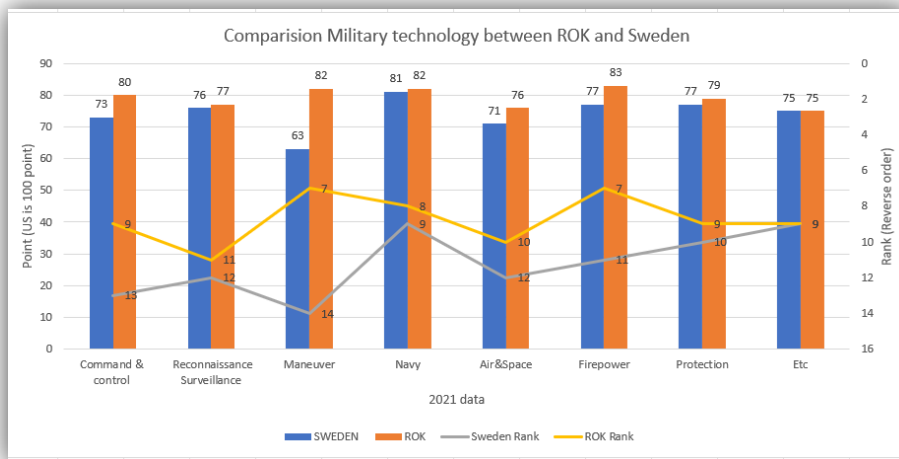


Figure 14 Sweden and ROK Defense technology detailed (KRIT 2022, pp. 20–24)

Sweden and the ROK are evenly competitive in all defense technology areas, but the ROK has relatively well-developed attack-related technologies (firepower, maneuver), while Sweden is

well-developed in protection. Clues can be found in the defense strategies of the two countries. Based on the 'Total Defense' concept, Sweden recognizes the ability to wage war for at least three months and the recognition of high costs to potential enemies as the basis of deterrence (Regeringskansliet 2019, pp. 273-274). In contrast, the ROK is based on performing a more active defense that suppresses provocations in advance in case of emergency, and resolutely punishing through an overwhelming response (MND 2022, pp. 37-39). This difference in defense strategy improved the technology in the field needed by each country, which in turn developed the corresponding defense weapon. For example, the ROK has relatively more advanced attack weapons such as K-2 (tank), K-9 (self-propelled gun), Hyunmoo (ground-to-ground missile), SLBM-capable submarines, and various long-range cruise missiles. Sweden, whereas, has also developed offensive weapons such as Robot-15. Still, defensive weapons such as Gripen (engineered mainly), Robotssystem 98 (ground-to-air missiles), and Giraffe (air defense radar) are found to be more advanced and self-sufficient.

Historically, it has been the defense sector that has driven the development of technology and innovation. Still, today it is the civilian market that drives technology development and is increasingly used in various military applications. As a result, Sweden and the ROK ranked 3rd and 8th in the world, in the 'Digital Competitiveness Ranking' announced by IMD (2022). The ROK is classified as a country that stands out in fields such as semiconductors, secondary batteries, shipbuilding, IT, automobiles, heavy industry, steel, nonferrous metals, and chemicals. In contrast, Sweden is classified as a country that stands out in cars, high-tech IT, networks, mining, and heavy industries.

5.1.4 Government

5.1.4.1 Government's Will for Self-defense and Support Policies

The ROK

"The growth of the defense industry [...] become a solid foundation for self-defense." (The Blue House 2012, p. 5)

The ROK's defense industry has been fostered and developed through government planning, coordination, and control in the form of companies participating under the leadership of the government (National Assembly Budget Office 2008, p. 16). According to the ROK's National

Assembly Budget Office (2008), defense industry policies aim to build independent military forces, made possible through defense science and technology, weapons systems and localization of defense materials. Since the Korean War, the ROK has consistently fostered the defense industry targeting self-reliant defense. The ROK subsequently presented a strategy of 'establishing a virtuous cycle of advanced power construction and defense exports' and four key tasks to leap forward to become one of the world's top four defense exporters by surpassing 5% of the global defense export share by 2027.

Specifically, the government stipulates that the proportion of project expenses spent overseas should not exceed 20% when drafting budgets for defense capability improvement projects, also prioritizing domestic defense companies for project promotion, inducing the localization of necessary weapons (Ministry of Government legislation 2022, article 25:2). Moreover, in accordance with the *Defense Industry Development and Support Act* (2021, article 3:9-16), to strengthen the competitiveness of the defense industry, localization of parts, unlimited R&D funds and technical support, various subsidies, professional manpower training support, export support, support for testing and evaluation of R&D weapon systems, and various programs for international cooperation is held.

Sweden

Sweden's will for self-defense begins with understanding the 'Total defense' concept. 'Total defense' includes the conscription of Swedish troops and civic duties such as rescue services or medical care determined by the government. This means that all Swedes are obligated to contribute (Lag 1994:1809). Total defense is a product of its willingness to mobilize all of Sweden's resources to fight back with a holistic response (Regeringskansliet 2019). The emergence of this concept could eventually be attributed to Sweden's long "non-alignment" history and "armed neutrality" strategy, for which defense industry autonomy was considered an essential prerequisite (FOI 2021, pp. 46-7). The Swedish government's policy stance recognized the necessity of fostering the defense industry and independently promoted the development and production of weapons systems.

The Swedish government adheres to an efficient form of policy that enables defense companies to compete in the free market economy in the way of 'Public procurement' and become competitive in terms of quality, performance, and price. Moreover, FXM (Försvarsexportmyndigheten) was established to support Swedish defense industry, but it was closed when negative opinions on defense equipment exports emerged. Considering this, Sweden's political structure

makes it challenging to implement an active defense support policy (Svenska Freds 2020). Furthermore, Sweden has a rule that arms exports can only be carried out for security reasons. When they do not conflict with Sweden's international obligations or foreign policy, anti-arms export groups such as 'Svenska Freds' are also active. Therefore, it is one of the most challenging countries to export arms due to many restrictions despite the advanced performance and technology (Regeringskansliet 1992:1300).

5.2 Result

Table 2 shows the results of domestic market size, R&D, and technology factors.

Table 1 1st Result

Factors		The ROK	Sweden
Domestic market	Similarity	- Still small market compared to the great powers - Growing since 2018	
	Difference	- Relatively big market compared to the size of the economy - Growing since 2000	- Relatively small market compared to the size of the economy - Reducing from 2000 to 2017
R&D	Similarity	- High R&D intensity tendency - High defense R&D budget compared to the government budget	
	Difference	- Continuously increasing trend of defense R&D investment - Primarily government-led funding support	- Continuously reducing the trend of defense R&D investment - Primarily defense company's investment
Technology	Similarity	- Possessing sophisticated defense technology and related industrial technology - High-tech IT, heavy industries, and automobiles technology	
	Difference	-Development of more various and extensive related industries -Semiconductors, secondary batteries, ship-building, steel and nonferrous metals, and chemical fields - Remarkable development of offensive weapons	- Development of specific related industries such as network and mining industries - Remarkable development of defensive weapons

The size of the small domestic market has not significantly impacted the defense industry’s development in both countries. However, the ROK has a high proportion of the defense budget compared to the size of the economy. On the other hand, Sweden has a low ratio, eventually leading to the ROK's market growth since 2000, while Sweden further reduced the domestic market size in 2017. The two countries have high investment tendencies in the R&D sector in common, but the two differences have affected them in different ways. First, the ROK's investment in defense R&D has continued to rise, but Sweden has been the opposite. Second, the ROK has grown mainly through government-led R&D investment support, while Sweden has increased by reinvesting a high proportion of total sales individually in the R&D sector. In terms of technology, the two countries have competitiveness in sophisticated defense technology such as high-tech IT, heavy industry, and automobile industries that can facilitate defense technology development, which has positively impacted the development of the defense industries. **Table 3** below shows the results of capacity and government factors.

Table 2 2nd Result

Factors		The ROK	Sweden
Facility / Manpower capacity	Similarity	- Having legal devices for the government to control production facilities in case of a national crisis directly - Reduction or stagnation in the total number of employees	
	Difference	- Sufficient production facilities with rapid production and delivery time - Privatized but public defense industry - The relatively low percentage of researchers	- Relying mainly on foreign countries for production and outsourcing - Privatized defense industry - A relatively high percentage of researchers
Government	Similarity	- Strong will for self-defense through the development of the defense industry	
	Difference	- Government-led growth (support policy) - Supportive government’s arms export policies	- Defense companies compete and grow on their own in the global market - Government's strict arms export regulations

The two countries show the biggest difference, especially in facility capacity. The ROK has significantly impacted on the defense industry’s growth by enabling rapid production and delivery based on a sufficient defense industrial base. At the same time, Sweden has limited its

response to rapid demand growth because it relies on overseas production facilities or outsourcing. In addition, the ROK and Sweden have significant differences regarding the government's role in the defense industry. While the ROK actively encourages arms exports through government-led defense industry promotion policies, Sweden enables defense companies to grow and become competitive in a free-market economic system and implements stricter export control policies than the ROK.

Based on the above results, the research questions are answered as follows:

Research Question1 (factors influencing the growth of a competitive defense industry)

The ROK

Due to the continuous increase in the government's defense budget, the ROK is forming a relatively large domestic market and defense R&D investment scale for a middle power. Compared to great powers such as the U.S. and China, the size of the domestic market is still tiny. Still, the rapid increase in exports and the growth of the domestic market have created economies of scale and increased capital expenditure to ensure sufficient facility capacity. This eventually enables the ROK to supply ROC-met weapons quickly and cost-effectively, and a virtuous cycle continues to occur as the government's strong export support policies are added. Various government-led support policies and sophisticated defense and civil technology have been harmonized, creating an environment where the defense industry can quickly develop. A wide range of industries, such as semiconductors, secondary batteries, IT, shipbuilding, automobiles, and heavy industries, is one of the areas where the ROK has the most technology in the world and is essential for defense technology with a synergy effect. In particular, the continuous expansion of production facilities serves as a desirable alternative to the governments of each country, which are buyers, by having room to respond flexibly and expand to sudden increases in weapons orders. Moreover, the government's various support policies greatly expand exports by synergistic effects, and as a result, the ROK defense companies reduce delivery time to improve the price-to-performance ratio, and a virtuous cycle is established simultaneously and continuously. In particular, the government-led policy to support the localization of various defense weapons and the will for independent defense are projected to defense companies that are privatized but still have public characteristics, increasing the self-sufficiency of weapons. Furthermore, collaborative projects between governments or defense companies in the Korea-U.S. alliance and technology development played a key role in developing high-tech weapons.

Sweden

Sweden's domestic market has been grown but it is still tiny. Although the government's defense R&D investment has been reduced, Sweden has still developed sophisticated defense technology through intensive defense R&D investment and voluntary R&D investment by defense companies. This technology has been influenced by Sweden's security strategy and promoted the development of more defensive weapons, which are applied to defense procurement, leading to a high self-sufficiency rate. In addition, sophisticated defense technology and specific private industries such as advanced IT, automobiles, and networks have accumulated since the Cold War had provided positive environmental conditions for Sweden's competitive defense industry development. Regarding production facilities, Sweden's case has grown through a more efficient way for multinational defense companies to grow by relying on production in overseas factories or mainly by outsourcing. Furthermore, the government has increased its defense capabilities to adhere to the non-alignment/armed neutrality policy. In the process, it realizes that the defense industry's development is required for freedom of action. However, in terms of fostering the defense industry, the government chose to play the role of a "buyer" rather than government-led support policies. In other words, the Swedish government, paradoxically, has made defense companies competitive in the international market by investing a large portion of their sales in R&D through the 'No-policy' policy for self-defense. In the defense industry, the consumer is each country's government, and the state intervenes or promotes it in any way, except for very few countries with a large-scale defense market in their own country. Nevertheless, this 'Swedish model' is a unique case that overturns the conventional wisdom that the defense industry develops only when the government strongly supports it and develops in proportion to military power.

6. DISCUSSION

6.1. Conclusions

Through the cases of Sweden and the ROK, this paper newly classifies the defense industries of middle powers with the technological prowess and self-sufficiency. First, it interprets the defense industries of these countries through the window of national competitiveness theory. Then, based on the results, what elements should be supplemented for the future? There are two things to be discussed.

Supply Chain and Production Facilities

Recently, Western procurement officials said that as stockpiles of munitions decreased in the United States and NATO (North Atlantic Treaty Organization) countries, the issue of arms shortage became a reality. As a result, the importance of arms production capacity began to emerge (CNBC 2022). Even the U.S., the only country capable of building its defense industry in the world, has revealed a vulnerability that undermines the reliability of its defense industry base, suffering from a lack of production and inventory in the overall supply chain (National Defense Industrial Association: NDIA 2022, p. 42). Moreover, this trend might probably continue for some time. This is because the insufficient production capacity increase is not a problem that can be solved in a short period compared to the rapid growth in demand for weapons due to the rise in the global defense budget. Moreover, the conflict between China and Taiwan and sanctions on Russian weapons will inevitably lead to a surge in weapons demand worldwide (SIPRI 2023, p. 5).

This issue needs a long-term approach concerning national security and should be discussed at the Swedish government level. As part of this effort, FMV (Försvarets materielverk 2022, p. 4) has discussed the production with Finland, the European Defense Agency (EDA), the Six-Nation initiative (UK, Germany, France, Italy, Spain, and Sweden), NORDEFECO (Nordic Defense Cooperation), and NATO to try to optimize the available capacity of production capacity. This might be a good starting point, but since Europe is in a shortage of production facilities, Sweden should recognize that the requirements from these organizations can become more demanding in the future crisis. Moreover, when national security is threatened, the Swedish government

can take over private property to enhance preparedness called 'Höjd beredskap', but this also cannot be a fundamental solution (Lag 1994:1809).

Production facilities in the defense industry should consider their strategic location in terms of national security. Dependence on production facilities in foreign countries may lose Sweden's freedom of action, even if guaranteed delivery and production by treaty or agreement, and expose the uncertainty that defense equipment cannot be adequately supplied to the desired time and place, especially in a national security crisis. It reminds Sweden of the key takeaway that Sweden paid to the U.S. and France but did not receive the aircraft during World War II (Pashakhanlou 2018, p. 11). Moreover, not only does the defense industry base not work efficiently through international defense industry cooperation, but it also involves political interests between multinational defense industry companies and countries, followed by time delays and price hikes (Regeringskansliet 2019, pp. 269-270).

From this perspective, Sweden's domestic production capacity can reduce supply chain vulnerability. Therefore, the Swedish government must conduct a systematic supply chain risk check. After that, the Swedish government should determine the size of its production facilities necessary for national security and construct them domestically. After this, the Swedish government should decide the level and degree of cooperation with other countries and organizations, such as the EU and NATO. The Swedish government needs to expand cooperation with Asian countries such as the ROK, which have sufficient defense industrial bases, to diversify routes and reduce uncertainty.

The ROK has already strengthened cooperation on arms production through close collaboration with the U. S. and has also started having conversations with NATO. Notably, the U.S. Department of Defense (2022) recognizes the vulnerability of the defense industry supply chain in the fields of microelectronics, energy storage and batteries, kinetics capabilities, casting and forming, and cooperating with the alliance. With competitive manufacturing facilities and technology in industries such as batteries and semiconductors, the ROK needs to strengthen further supply chain cooperation with the U.S., which has an advantage in core defense technology, and develop ways to create synergy.

R&D / Technology

The current state of the recent war in Ukraine reminds us again of the importance of developing and utilizing advanced science and state-of-the-art systems in defense (OECD 2022, p. 6).

However, the Swedish government's defense R&D investment has decreased to less than half compared to 10 years ago. The Swedish Defense Research Survey assesses that the resources allocated to R&D activities are insufficient and argues that additional funds should be given to defense R&D activities (Regeringskansliet 2019, pp. 310-311). In this respect, Sweden needs to make more R&D investments lead to technological development output. To this end, investment in manpower, education, training, and equipment must be combined to grow simultaneously to lead to effective technological development. To this end, investment in manpower, education, training, and equipment must be connected to grow simultaneously to lead to effective technological development. Moreover, military and civilian R&D must collaborate through systematic and complementary relationships.

The ROK's defense industry needs to be more competitive with individual companies by referring to the Swedish model. For the defense industry to reach a global level, breaking away from the current government's existing system that guarantees a certain level of demand, individual companies must actively increase R&D investment and develop core technologies.

The main implication of supporting Russia and Ukraine, which suffer from a shortage of weapons and semiconductors in Ukrainian warfare, is that government-level efforts are needed to strengthen sustainability and long-term production. In particular, the government's role in securing production facilities of various routes and cooperating in technology development is essential because Sweden's 'Total Defense' basically requires sustainability. In addition, collaboration with the international community is necessary because the current global defense industry cannot implement all supply chains and technology development independently, even in the U.S. However, as long as the defense industry is closely related to security, finding a 'balance' between collaboration and stand-alone is important.

6.2. Reflection and Limitation

This study holds theoretical significance as it expands the 'national competitiveness theory' to the defense industry realm, introducing an analytical framework for understanding self-sufficient, technologically advanced middle-power countries' defense industries. Moreover, it shifts the narrative from solely exploring motivations for defense industry development to examining conditions that enable it, incorporating previously overlooked elements like capacity utilization rates and the symbiosis between private sector technology and the defense industry.

In terms of methodology, this study attempts a deeper understanding of the context through qualitative analysis. Since it is challenging to analyze factors such as government policy and will, which are difficult to measure numerically, without understanding the context of each country, qualitative research through case studies is considered appropriate. Moreover, the author can avoid generalization errors by selecting a plurality of cases rather than a single case. Therefore, Sweden and the ROK are suitable subjects for the comparative case study.

The practical implications of this study contribute empirically by providing data and insights on production facilities that have recently attracted attention. Moreover, this thesis contributes practically by providing insightful perspectives and discussions for the future development of the defense industry in Sweden and the ROK. It also identifies vulnerabilities in the defense industries. It provides proposals for national security, especially to Sweden, which is now about to join NATO, and the ROK, which has considered exporting weapons to NATO countries. Furthermore, this study contributes practically in that it gives implications for what topics should be discussed for defense industry cooperation between the ROK and Sweden, which has begun with the recent visit (March 2023) to the ROK by Swedish Supreme Commander Michael Byden and the meeting between the prime ministers of the two countries in Sweden (Kim 2023).

Regarding operationalization, this study has limitations in that it is difficult to measure all variables such as government will and policies. Due to some of the 2022 data missing and some undisclosed Swedish data that the author is not allowed access to, this study relies on open sources. Due to the nature of the defense industry with 'sensitivity' data, the author has difficulties analyzing, but tries to exclude subjective interpretation as much as possible based on various credible government documents and interview data from research institutes. Despite the limitations mentioned above, this study is meaningful in itself because, based on author's knowledge, no existing research directly classifies and compares the defense industries of Sweden and the ROK.

6.3. Proposals for Further Research

Further research requires a specific study on how to expand the defense industry's production capacity for Sweden with a detailed practical application plan based on feasible government support measures and how to optimize it in accordance with its context. Furthermore, verifying whether the national competence theory and the proposed analysis framework in this study

apply to other middle power, such as Israel, and confirming the causal relationship between presented variables is recommended. Lastly, when approaching the Swedish defense industry, it is required to analyze the industrial structure from a more overall and comprehensive perspective, considering the European Defense Fund (EDF) and NATO to be joined soon.

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