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The Impact of Military Tension on Economic Growth

Comparative study of Israel and South Korea

MASTERS THESIS

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Author’s declaration

I have written this Master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

Author’s signature

The defense will take place on June 5, at Lossi 36, Tartu.

Opponent ..... / name / (..... / academic degree /)……. ... / position /

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Abstract

In development literature, there is a debate over what exactly causes rapid economic growth. There is a variety of opinions starting with market liberalization, big amount of FDI, support to education and healthcare and ending with good governance and development aid. This thesis suggests an alternative approach, when it comes to development – "people respond to incentives" and none of the well-proven strategies will work if the incentives are not right. Thesis suggests that military tension can be one of those motivators. Paper examines economic effect of military industrialization in Israel and South Korea, and more specifically spin-off effects of defense Research and Development. These countries are interesting because they spend the highest percentage of their GDP on Research and Development and bigger portions of these funding go to defense R&D. The research paper found out that in South Korea defense R&D has a significant correlation to innovation indicator which is patent applications per year. In Israel defense R&D data is classified which gives us a basis to think that their defense R&D is even higher than South Korea's. Data indicating the money spend in other fields of R&D in Israel do not have a significant correlation with innovation indicator. In sum, the thesis suggests that there is considerable evidence to assume that military tension has a positive impact on growth rate. Also, thesis assumes that in the case of Israel impact might be less because the positive impact that defense R&D has on growth - compensates crowding out effects overall military burden intensified by wars.

Glossary

– Crowding-out: when expenditures by the government in one economic sector prevent resources being used in other sectors [1]

– Frascati Manual: a document stipulating the methodology for collecting and using statistics about research and development in countries that are members of the Organization for Economic Co-operation and Development (OECD).

– Domestic DIB (Defense Industrial Base): companies that produce arms and support the military and are based in the home economy.

– Fordism: methods of mass production (using conveyor belts) introduced by Henry Ford, together with mass consumption as workers' pay also increased.

– GBAORD: government budget appropriation or outlays for R&D (OECD).

– GDP (Gross Domestic Product): the total market value of all final goods and services produced in a country in a given year.

– Military R&D: the expenditure by government on research and development that is absorbed by the military as opposed to the civil sector of the economy.

– Political economy approach: an approach that emphasizes the concerns of the Classical economists and focuses on growth and accumulation and the role of the state, rather than focusing upon markets

– Spill-overs: the effects that spill over from one sector to another. For example when military spending leads to demand for civil goods as well as military.

-"Purchasing Power Parity (PPP) is an economic theory that compares different countries' currencies through a "basket of goods" approach. According to this concept, two currencies are in equilibrium or at par when a basket of goods (taking into account the exchange rate) is priced the same in both countries."(Investopedia" n.d.)

[1] Most of the Definitions are taken from Flemish Peace Institute's article (Dunne and Braddon 2008)

"People respond to incentives."

William Easterly

Introduction

War has an evident impact on economic growth, it destroys productive inputs: infrastructure and human capital. It also causes political instability and uncertainty which is harmful to economic growth (Feng 2003). The First World War was an illustration of how pointless war can be. Millions of people died during the four years, but it seems a bigger mistake when we think how rapidly world economy was developing and globalizing before the war started. However, like the coin has two sides, military conflicts have some other characteristics that are not all destructive. Some say that conflicts contribute to the rapid human progress. (Cowen 2014,, Milward 1977, Ruttan 2006, Schumpeter 1942). An idea is linked to creative destruction, competition, and motivation. Many of the seemingly beneficial aspects of war, however, can take place without real large-scale combat. These are the cases where there has been a threat of war, but the situation has not actually got to the point of large-scale escalation. It seems quite useful to study the cases where countries had such kinds of tensions and find out what consequences did it bring to them. Because it would show us general trends of economic growth in conflictual states. It will answer the question: - did the existential threat on a state contribute to achieve sustainable economic growth?

This thesis explores the way negative aspects of military tension are compensated by some positive aspects of economic growth by using the cases of Israel and South Korea.

Accordingly, the central research question is factor-oriented: **How does prolonged military tension affect the economic growth of a country?**

Sub-question is:

- How do countries facing existential military threats for an extended period of time end up modernizing their economy so they can achieve a faster economic growth than countries that are not exposed to the same kind of threat?
- What is the main mechanism through which military tension affects economic growth?

I will be examining two conceptual phenomena: military tension and economic growth. Because there is no definition of military tension I will use definitions of war and lower it down to a lesser scale. War is conceptualized as organized violence perpetrated for political ends. David Singer and Melvin Small (1972) created a database – The Correlates of War (COW) "It sets a threshold of 1,000 battle-related deaths within a 12-month period for a sustained conflict, involving organized armed forces, to qualify for inclusion as a war." ("Concepts in World Politics | SAGE Publications Ltd" n.d.) Bull defines war as "organized violence carried on by political units against each other" (Bull, 1977: p184) Therefore, military tension is a tension between two governments of opponent countries, and battle-related deaths are below the threshold of 1000 per year. However, it should be more than diplomatic disputes. For instance, governments declare each other as enemies and have plans for fighting each other in an offensive or defensive way. Military tension can be unidirectional or bidirectional. But in this study, we are looking at unidirectional threat in the sense that selected countries are rather defensive. There is a prolonged conflict which leaves a possibility of renewal or start of the war. According to Tyler Cowen, such kind of tensions create national mobilization and push governments to make right decisions. ("Is the Lack of War Hurting Economic Growth?" 2014)

As for economic growth W. Arthur Lewis (Lewis 2003: p10) defines economic growth as "Growth of output per head of population', it is an increase in the inflation-adjusted market value of economy to produce goods and services, compared from one period of time to another. It can be measured in nominal or real terms, the latter is adjusted for inflation," which I will be using as it is more accurate measurement than the former. This thesis examines economic growth as an above average growth in the region. Thus, the growth rate is higher than other countries of the region which did not have significant military tensions.

I am going to examine linkages and correlations between these two phenomena. My preliminary hypothesis is: **Military tension can stimulate economic growth through the increased budget of Defense Research and Development.**

The thesis will apply the few-N comparative method and will use two cases: Israel and South Korea. South Korea and Israel do not share many characteristics except economic outcome which is above average economic growth rate and some explanatory variable that are crucial to this outcome, which is prolonged conflict or maintained threat of war. "This system is based on Millian

method of agreement, which seeks to identify those features that are the same among different countries in an effort to account for a particular outcome." (Landman 2008: p70) Most Different Systems Design "is typical of comparative studies that identify a particular outcome that is to be explained, such as" "Economic miracles" (Geddes 1990 cited in Landman 2008: p72). I selected these cases because of the dependent variable, specifically both countries are considered to have performed economic miracles – above-average economic growth rate compared to their neighbors and generally among all countries. This paper seeks to find out the incentives and then policies that stimulated this particular outcome. I do not argue that independent variable which I introduced is the only sufficient mean to this outcome. However, I believe that military tension is one of the major explanatory variable.

These countries have inherently different features including region, history, culture, language, socio-economic conditions, the political structure as well as the institutional framework, administrative system, but share the same key explanatory factor; both countries fought in the war. They are still in active conflicts. They have been defensive for decades, and even now they face similar threats. South Korean envoy to Israel Kim Il-Soo said that "both countries are coping with similar geopolitical threats, for instance nuclear-armed enemies that have each country as their primary target." (Shamah n.d.) Both of the counties were under the risk attacks over sixty years, and now they live under a constant nuclear threat. Most importantly, it is very surprising that both countries have the highest expenditure as percentage of Gross Domestic Product (GDP) on Research and Development. For example, Israel spends 4.25 percent of its GDP on R & D, and South Korea spends 4.23 percent. For comparison, next highest spending country – Switzerland, only spends 3, 37 % of its GDP on R & D ("Research and Development (R&D) - Gross Domestic Spending on R&D - OECD Data" n.d.)

As for the presence of the outcome: both countries' economic boom is impressive. They have a high quality of defense industry, sustainable growth and modernized, advanced economy.

As for conceptual framework, I argue that there is a correlation between military tension and economic growth. It is evident that defense spending specifically in the defense industry and defense R&D promotes overall industrialization and creation of high-tech factories not only in the field of defense but commercial fields too. Also, because of competition, threatened countries can introduce more advanced governance methods and policies to elevate their chances of winning.

From the research design type which I proposed, emerged quantitative data gathering. As for operalization, dependent variable – economic growth is measured by the average growth rate of GDP from the beginning of the conflict until now. The growth rate is compared to other countries, which did not have conflict. Information about GDP is taken from World Bank world tables (WT). The growth rate is from 1961 because that's that time World Bank started to measure it.

As for operalization of military tension, formal measurement is not necessary because military tension indicators and economic growth rate do not capture the explanation that this thesis concludes. The intermediate variable which I presented in the hypothesis, is Defense Research and Development. OECD ("Government Budget Appropriations or Outlays for RD" n.d) provides data about the exact amount of money which was spent in different fields of Research and Development. The increased funding for the defense R&D clearly speaks about the military tension because defense research and development targets military advancement and a country which seeks to obtain most advanced arms are either defensive or plans an offensive move. But there is a problem of data too. "The Frascati Manual defines R&D in terms of an 'appreciable element of novelty, a definition that provides considerable scope for discretion for defense ministries in reporting their countries' spending." (Dunne, Braddon 2008: p.8) It was possible to obtain data for defense R&D for South Korea, but it is classified for Israel. Even for South Korea data might have validity problems. As Hartley (2006) claims it is not always easy to understand which companies are involved in defense industries because of the factor of subcontracting. Civilian technologies have been gaining more importance in military industries, and therefore distinction between civil and military technologies are quite blurred. Some of the companies might not even be aware that they are involved in arms production. That makes the measurement of military R&D more difficult, nevertheless, OECD data has basis for reliance.

Next difficulty arises from the fact that it is quite hard to capture the link between defense Research and Development and above-average economic growth. That is why Solow's growth theory is used to overcome such difficulty. Solow argues that long-term economic growth is impossible without innovation. In order to see the trends of innovation in both countries "Global Innovation Index" and "technological change index" would be very useful. But the "Global Innovation Index" produced by Cornell's university was created in 2011, and data is so small that it wouldn't prove useful for correlation analysis. As for technological change index, it is calculated

with Solow's growth model and demands lots of precise data about the separate defense industries, labor, wages, interest rates and so on. In the framework and timescale of this comparative study, it was not possible to obtain this kind of detailed data. This is why I believe innovation and technological index can be replaced by the amount of patent application in a country per year. Now, the patent application does not capture the whole picture of technological change because some of the patents might not be related to technology at all or some of them might not have a significant impact on technology. However, all the innovative ideas are definitely applied to be recognized as intellectual property. I think patent data is the next best thing available after innovation index and complicated calculations of technological change index. It is justified to use patent data because it is a common practice to study innovation through patent data. For example, Manuel Trajtenberg has studied innovation in Israel with patent data in the period of 1968–1997(Trajtenberg 2001). Fortunately, World Bank has been collecting the data for quite some time.

Another problem with this methodology is that it is not possible to prove any causation. It is mainly because of the character of economic growth and lack of data. It would take controlling for a lot of variables to have a proper regression analysis. We deal with economic growth and scholarship does not agree on any growth theory or any specific factor that causes it. Growth is a result of many different complex variables working together. The aim of this study is to show general tendency of growth stimulated by military tension, and it relies more on the logical chain rather than mathematical calculations.

Chapter 1 Theoretical Background

Economist Tyler Cowen claimed during his interview with New Yorker that "when there is no threat of war higher rates of economic growth are less urgent and less likely. The possibility of conflict and rivalry or tension focuses the attention of the government on getting some basic decisions right –for instance investing in science and education (or liberalizing the economy). The conflict also mobilizes national will to useful economic ends" (Cowen 2014). He was heavily criticized by Forbes ("Tyler Cowen Promotes A Scary Narrative About War And Economic Growth" n.d.) and Economist ("The War Dividend - Political Economy" n.d.) on the basis that his arguments were provocative and he was calling for a major war to achieve economic growth. But both of the authors ignore that it was also Cowen who said that fighting war itself does not improve the economy, it brings deaths and destruction and if the chance of war is too high, property rights are too insecure, and it is not good for economic growth either.("Is the Lack of War Hurting Economic Growth?" 2014). However, he does not really provide any solid evidence to prove his claim. His recent book "The Great Stagnation - How America Ate All The Low-Hanging Fruit of Modern History, Got Sick, and Will (Eventually) Feel Better" discusses slowdown in economic growth of the U.S. in recent hisotry. He says that there has been an exhaustion of major innovative breakthroughs which happened in last two centuries and mostly at the beginning of 20th century. He illustrates it by showing how different the life became in the 1950s and 1960s for the people who were born at the beginning of 20th century and how similar technological landscape looks like for the people who were born in 1960s and now live in the 21st century. He claims that lack of major innovations stagnates the economy in the U.S. and the world, in the way that, all the "fruits" that have been ripping at the beginning of the century have been picked until the 1960s. And even though people had great expectations for the next 50 years, the high pace was lost. There has not been as big innovation as inventing cars, electricity, modern medicine or such a fruitful event for the economy as moving people from farms to schools. He claims the internet is the exception, but the internet did not have a big effect in economic terms as the invention of cars. He adds that maybe internet does not work in its full capacity yet and in the future, it might be employing much more people. But still, his argument makes sense.

He does not really continue his logical thought to explain why these innovations have happened and to add that major military threat was a stimulus to have these life-changing innovations. He concludes by suggesting a solution - we should value science and scientists as we did before and stimulate further progress. Even though he does not develop the idea of what was causing these innovations in his book, but he shares it with New Yorker. Next chapters of the thesis provides arguments that backs up his argument.

In political economy literature, there is not much said or proved about the correlation between the military tensions and economic growth. Most of the literature focuses on the relations between arms race and economic growth or military spending and economic growth (Larrosa 2015; Ihori 2003; Yildirim and Ocal 2007; Melman 1988; Korkmaz 2015; Cappelen 1984; Lee and Chen 2007; Alexander 1990). An arms race and military spending are not that far from each other because in an arms race military spending grows dramatically, but still, there are some differences between these variables because military spending is often examined without a framework of the arms race. Let's begin with the arms race literature.

Arms Race and Economic Growth

Huntington's definition of an arms race is "a progressive, competitive peacetime increase in armaments by two states or coalitions of states resulting from conflicting purposes or mutual fears" (Huntington 1958: As cited in Buzzan, Herring 1998: p80). However, there is a difference between maintenance (routine upgrading) of armaments and competitive improvement of military capability (Buzzan, Herring 1998: p80). So there is a threshold between regular competition and arms race which is suggested by Grant Hammond (1993 cited in Buzzan, Herring 1998: p80). According to him an increase of military expenditure at a high rate – more than 8 % per annum (of previous defense budget) should be bilateral. If it is only one country which only excessively spends on the military than it is not considered "race". There also should be a specific designation of the adversary in the sense that there should be an official declaration of the adversary against each other. The third characteristic is that states military and diplomatic capabilities should be specifically directed to the opponent country. There also should be the high rate of antagonism between the public of hostile states. A state's political action strategy should most frequently be linked to the military. State's goal should be to increase particular weaponry which is already

obtained by opponent country in a specific ratio. The purpose of such extensive increase (at least 8% per annum of previous defense budget) is to dominate and intimidate the rival country in political and military affairs.

An arms race more likely occurs when states mobilize for full-scale war. So it is commonly accepted that it makes war more likely. In contrast to an arms race, there is a concept called "maintenance of the military status quo or just maintenance" (Buzan, Herring 1998: p80) There is one more concept between arms race and normal maintenance which is called arms competition sometimes referred to as arms buildup. This is a grey zone between maintenance and arms race. Competition borrows most of the characteristics of the arms race except the increase of defense expenditure is not as high as 8 % per annum.

Arms races are quite rare, and definitely not the subject of this thesis (neither South Korea nor Israel when it comes to arms competition does not follow the arms buildup pattern of their opponents). But it is still interesting to understand what kind of effect it has on overall economy because arms race has a somewhat similar pattern as tension. Many scholars have found proof that arms races or buildups have positive and also a negative effect on economic growth, depending on the circumstances.

Toshino Ihori has found that in the framework of an arms race when defense spending portion of GDP increases, the overall economy also increases if only defense technology has a stable benefit. However, he adds that if private savings are little and defense spending is still increasing at a high rate – "GDP growth will be little in terms of dynamic efficiency." (Ihori 2003: p27) He has used the conventional overlapping generation's growth model to prove his point.

Julide Yildirim and Nadir Ocal (2007) have researched the causality between the arms race and economic growth between India and Pakistan. They employed a vector autoregressive causality analysis in the time frame of 1949 – 2003. They found that there was a causality from military expenditure to economic growth in India, but the causality was absent in the case of Pakistan. However, a vector autoregression (VAR) analysis also showed that arms race had a negative impact on growth rate in the long run. It only had a positive effect on a short run. (Must have been the Keynesian multiplier effect on which we will talk later)

Last and not least there is a study by Seymour Melman on the arms race of U.S. and the Soviet Union. He concludes that the winners of the Cold War were Germany and Japan and losers

U.S. and the U.S.S.R. because such a high rate spending in the military took away investment in other industries and it appears that there is the incompetence of production in entire U.S. industries. "As a consequence of its normal operations, that preempted capital resources and installed a cost-maximizing micro-economy in U.S. industry, the federal government and Department of Defense have spearheaded the creation of a second-rate industrial economy." (Melman 1988: p58) He predicted that if military spending would continue to grow there would be a sharp decline in the standard of living for Americans. However, the arms race has a different economic effect on hegemons than for smaller countries. With that note let's move on to the second branch of literature which is more focused on military spending.

Military Spending and Economic Growth

High military spending is one of the indicators that can show the arms race and generally military tensions but it is not enough to measure military tension in the context the presented thesis. Even though Israel and South Korea have continued threat of war their military expenditure steadily decreases as a percentage of their GDP and I need an indicator that would show the increase of military tension: military expenditure as a percentage of GDP fails to do that. However, I will make an overview of the literature on military spending and its effects on growth as long as it shows general tendencies how military expenditures affect the economy.

Similarly, the literature is not homogeneous here as well; scholars are divided and argue whether military spending is good or bad for the growth. For instance, the classical school of economics argues that higher expenditures in military stagnate growth in the way that it takes away necessary capital from the fields of education, health, public infrastructure which are considered to be fields that have positive effects on growth. This is called crowding out it economic terms. Also, because of the increase in military spending, there are a lower private investment and domestic savings. "A higher level of military spending will lead to an increase in the interest rate, which will crowd out the private investment" (Korzmaz 2015: p274). There has been several case studies, comparative studies and also Large-N studies which all show different results. The methods that authors usually use is mathematical models. For example, Cappelen made a study of 17 OECD countries. The timescale was from 1960-1980 years. He found that military expenditures had negative influence on investment and growth. (Cappelen 1984 cited in Korkmaz 2015).

Another study is done by Alexander (Alexander 1990 cited in Korkmaz 2015) he took a sample of developed countries. Paper concluded that military spending did not have significant positive or negative effects on growth. Equally, the paper concludes that there are other more productive fields than defense sector. Dunne (2002) also did small-N research of industrializing states and found out that military expenditure has a negative impact on investment and economic growth. Yidirim (2005) has different results, he studied Middle Eastern states and Turkey and found out that military spending does enhance the economy. Lee and Chen (2007) had a positive result for 27 OECD countries however they add that results are negative for 62 non-OECD countries. Korkmaz (2015) conducted a research on 10 Mediterranean countries for a period of 2005-2012 and found a positive link between growth and military spending. Kidron (1970) argues that military spending deprives the country of recourses that would be used in highly productive fields. It slows down the growth. Mandel (1987) in contrast argues that if military expenditures are used for military industry there is a high organic composition of capital and it has an influence on the other fields of economy.

Overall, even though there is no consensus on the topic most of the macro literature proves that military expenditure is bad for economic growth. There are of course some exceptions, but these countries live in exceptional circumstances. These countries are usually the ones with large military industries. Only then defense spending has a major spin-off effect. These countries have "the defense industrial and technological base (DIB) which could have potential positive externalities for the civilian sectors in terms of scientific innovation and technological progress" (Broude, Deger, and Sen 2013: p38). If countries capitalize on these spin-offs, then military expenditures can prove to have a positive effect on the growth. But it will only happen if the spending is used on procurement and research and development practice.

Moreover, Aizenmen and Glick (Aizenman and Glick 2006 Cited in Broude, Deger, and Sen 2013) add that defense spending can help the growth if the country is in conflict. Conflictual economies differ from normal economies. They argue that in conflictual economy countries gain more from the defense expenditure because military helps to create an environment with secure property rights which is essential for investment and growth. Now Cowen also was talking about the importance of secure property right. Cowen said in case of war, property rights are less secure, and it harms the economy. However, Aizenmen's point still holds because external threat does not prevent a government to have very secure property rights. Although there is a question how

secured property rights can help the economy if we talk about Foreign Direct Investment (FDI) however secure rights may be, there still is a doubt that external actors might destroy investor's property. And such kind of threat still ruins the inflow of FDI. We will later see that FDI was not the major cause of economic miracles in Israel and South Korea.

So "They consider the non-linear interaction between military expenditure and external threat and demonstrate that defense spending *per se* reduces growth, but when it is accompanied by external conflict then the impact of military expenditure on growth may be positive." (Broude, Deger, and Sen 2013: p38) Aizenmen and Glick (Aizenman and Glick 2006 Cited in Broude, Deger, and Sen 2013) prove their argument with the classic Solow growth model. They found out that military spending indeed has a negative impact on the economy because it is a burden, considered only as an input rather than output. However, when there is an existential threat, military expenditure becomes to have a positive impact on the growth rate. They conclude that when there are high levels of military spending, growth rate falls but if other independent variables are added they show that in the case of threat growth increases.

Many of the articles mentioned above which found a positive relationship between economic growth and military expenditure used Keynesian theory to explain it. Indeed Keynesian multiplier effect can explain why military spending can stimulate growth.

Keynesian Multiplier Effect

According to Keynes when there is an under-employment, it causes the decrease in demand. One thing government can do to alter this is to invest in construction and other fields to create jobs. When people have enough money to buy supply - they do. So demand increases, the increase in demand increases supply and economy grows. (Keynes 1965)

Keynes's Multiplier theory shows that government spending creates a cycle of spending and it causes the increase in employment and economic growth. He emphasizes that it does not matter in what field the government is going to spend money. For example, a government project to build a dam which costs 100$ million will generate 50$ million salaries. The workers will spend 50$ million minus average savings rate. That's the biggest portion of the salary. They will spend it in favor of different businesses. Therefore, business sector gets more money and expands through producing more products and for that they need to hire more employees. Hiring more workers and giving them salary kicks of another cycle of spending. The theory of multiplier is

based on the principle that there is a close linkage between different fields of production. It is widely acknowledged that the increased demand on one particular product automatically increases demand on products of another field. The interesting thing that Keynes says is that it does not matter on what the government spends money on, even if it pays people to dig up a huge hole and then fill it up again – It is going to have the same stimulus on the economy.

To sum up, Keynes's multiplier theory is built upon the argument: Government's investment in public sector increases employment and then increase of income. Bigger income increases consumption of goods. The higher the demand for consumption goods the better the environment for production and business. Therefore multiplier is directly proportional to spending and inversely proportionate to savings. Keynes thought that the bigger is the consumption the bigger is the multiplier effect and there is progressive employment. And the key actor here is the government who starts the chain of positive outcomes because none of the other actors could generate such a big stimulus for the economy. Also, the theory of multiplier shows the linkage between different areas of production. It emphasizes the functional interdependence between economic categories. In the end, he states the core of the GDP growth is government investments. Because of the government's capital investment the industries grow progressively.

We can fairly assume that military spending can be used as a Keynesian multiplier. Increase in military spending, constructing new defense infrastructure increases demand and reduces unemployment of resources. A good example is a Great Depression and WWII. Roosevelt's New Deal was a manifestation of Keynesian multiplier. He invested in construction and infrastructure. If we look at the graphs in Herbert Stein's book "Presidential Economics" (Stein 1994), we will see that when Roosevelt's administration was investing heavily there was a relief in an economic depression, but it was not enough to recover the economy. When the investments decreased, the economy got worse again. We can assume that the amount of investment was not enough and right before the start of WWII when there was a much bigger investment in war industry Keynesian multiplier worked much better and the economy recovered fully.

However, Keynes himself asserted that his theory was the only short-term solution. The people who criticize continued policies based on Keynesianism often forget that and state that theory does not work. Well, Keynes did not really promise that it would work for a long run. He evens said we are dead in the long run so we should focus more on the present. For long-term

sustainable economic growth, Sallow is more relevant, and his theory could also be used to argue that military tension can stimulate certain field of the economy that will result in long-term growth.

Chapter 2 Question of Conceptual Framework

Solow's Growth Theory

Robert Solow in his paper (1956) argued against the commonly accepted notion that increased number of machinery is the source of growth in a long run. He said that investment in technology is very useful in the beginning, but it gets to the point where only increasing of machinery is not able to give a sustainable growth. Solow suggested that only source of sustainable growth in the long-run is innovation in technology. Technological change works in the way that even with the fixed number of laborers - industry grows. Because it gives a better way of producing, it economizes time and resources.[2] He also added that technological changes happen because of the development of different, basic sciences. He argued that steady economic growth in the U.S. was due to the major technological progress throughout the past two centuries. Also, there was a constant rate of creating innovative technologies.

According to Easterly (2002) to illustrate his theory, Sollow described a factory where there was a fixed number of workers and only increased number of machinery. We are supposed to think of technology as a blueprint which tells how workers and machines work. Workers, in the beginning, had a blueprint according to which workers had to follow the item which was being manufactured. It meant that one worker had an item and used many different machines to get it done. If we increase the number of machines for that fixed worker, in the end, workers run around chaotically and cannot make labor more effective. But, technological change means that the blueprint arranges machines and workers better and makes the process of production more efficient. For example, when Ford suggested that it would be more efficient to use only one worker per machine, the process of production took lesser time, and the factory was able to manufacture much more goods and of better quality. Because a worker who stayed with the same machine became better skilled in that one particular job. The better blueprint comes along accompanied by the increase of machines, the better is the growth of the company. So technological innovation gives us increase of workers without actually increasing the number of workers. With the better blueprints the supply which was supposed to be fixed: labor - keeps increasing and this is the only

[2] Nozadze 2014 - What challenges stand in the way of development and how can they be overcome? University College London

way for the long-run growth of production per worker, which in itself is the way how the economy of country increases. Solow got a noble prize for establishing the labor-saving technical innovation as an answer to long-term growth problem.

. "One response to to (growth problem) was to incorporate technology-related mechanisms to overcome diminishing returns to capital" (Dunne and Braddon 2008: p28). This implied change in policy which would result in "1) Knowledge spillovers: knowledge translates into skill and influences labor productivity 2) Human capital accumulation: human capital is seen as an externality that augments the growth of total factor productivity 3) Research and development: the output of innovations and blueprints, if excludable, in the sense that firms can benefit from their findings, leads to supernormal profits for a time and allows them to finance more" R&D (Dunne and Braddon 2008: p28). However, critics of the theory asserted that it was rich in theoretical details but lack empirical support (Fine 2000 cited in Dunne and Braddon 2008)

The problem with the Solow's growth theory is the one that is wrong with all growth theories. It does not explain everything that contributes to growth. It is hard to understand how technological progress explains all the processes that are at work internally in the rapid growth

I think this theory still holds its validity because it might not show all the ways the economy can grow fast but the ways it is showing it - is definitely valid. It might not be the perfect basis for policy that would fit every country and every economy but, it definitely is useful to explain why some of the economies grow fast in the long run.

Spill-over effect of military procurement to the commercial sector

How is the Solow's growth theory connected to military tension? Vernon W. Ruttan's book "Is War Necessary for Economic Growth?" is the glue that holds everything together. He starts his book by stating that we shouldn't dismiss the idea that war can have positive effects on economic growths. Without war, there wouldn't be fundamental innovations like nuclear power, computer, modern aircraft and even internet. All of these major breakthroughs in technology became possible because one state or another was striving to defeat the opponent. For example, the internet was initially created to ease the nuclear exchange. Another good example is Silicon Valley, which was designed for military purposes and not at all for entrepreneurial social media start-ups.

Ruttan's book examines military procurements which had a spillover effect on six commercial general-purpose technologies. He proves his hypothesis that military procurements was and still is the source of technology developments in the various fields of commercial industries. These are "(1) interchangeable parts and the advent of mass production; (2) military and commercial aircraft development; (3) nuclear energy and electric power; (4) the computer, semiconductor, and software industries; (5) the Internet; and (6) the space industry." (Ruttan, 2005: p7)

For example, he argues that it was the New England armory system which was introduced in the first half of 19th century and had a massive impact on the development of interchangeable parts and the advent of mass production in American manufacturing. That exact armory system was an ancestor of "Fordist" system in mass production. In the second half of the 19th century transportation and communication became much easier and "armory practice" was introduced all over the United States. Most importantly, it was diffused into other branches of mass manufacturing. Not only the blueprint, but skilled mechanists were also moving from arms manufacturing in New England's arms factories to other industries and regions. It was the "assembly of standardized parts" that was taken from the manufacturing of firearms into manufacturing of clocks, locks, watches, sewing machines, and other industries. Sheet steel stampings which replaced drop forging and machining in the armory practice became the core innovation that made bicycles. And bicycles on their own are responsible for the establishment of the automobile industry.

Next example is the military and commercial aircraft development which largely benefited from aeronautics research and development. These two principle instruments made possible to develop commercial aircraft industry. Aircraft industry was special in the sense that it had its own research organization called National Committee on Aeronautics NACA which later became NASA. Early advances of NACA was both applicable for military and commercial aircraft. The effect of military procurement on the commercial industry is well illustrated by the development of Boeing 707. Boing Company wanted to create commercial jet airliner, but they doubted that cost of sales wouldn't justify the cost of development. Financial problems were solved when Boeing won Airforce contract to build military tanker. With the design Boeing created for the military, they build Boeing 747 which later became the standard defining modern commercial jet.

Nuclear power industry was also a result of military procurement. First splitting the atom was designed to have a powerful explosion, but soon it became a reliable source of energy. Already "In 1962 there were seven prototype commercial nuclear power plants using different cooling and moderator technologies in operation" (Ruttan 2005:p76).

Computer industry's development was financed by the Army's Aberdeen Ballistics Missile Laboratory. Computer manufacturing company IBM was producing computers for defense purposes, and the development of it was acclaimed as the Cold War was intensifying. IBM was soon replaced by a commercial company - Cray. Cray manufactured the first supercomputer, but it failed to find the market outside the defense industry. So it was the military procurement that pushed for such a fast development of modern computers.

Next field is the internet, development of it happened as a transformation of a computer network which was created by the Defense Department Advanced Research Projects Agency (ARPA) in the 1960s. In 1982 it was decided to split APRA into two parts. First would have been oriented on research and would be called ARPANET and the second MILNET would stay encrypted military network. It wouldn't have possible to meet scientific, technical and financial needs required for the creation of internet without public financing that came from the defense expenditure.

The space industry which was pushed by the launch of Sputnik in the Soviet Union became the source of developing the air force surveillance. Later these projects had a spillover effect in weather forecasting and earth observing systems.

At the end of the book, Ruttan argues that in each of his cases commercial advances would have been delayed without the initiative and financing from the military and defense procurement. In the case of nuclear power, he doubts that it would have been developed at all without the order of the government. He does not argue that it is an efficient and complementary way to advance technology from the defense expenditure or defense-related research. He only says that global technological landscape would have been quite different if it was not for the military technology advancement which then spilled in the commercial sector.

However, he concludes that it is very doubtful that anytime soon private sector without massive public funds for research and development will be able to become the main source of a new- general purpose technologies during the next century. He adds that because the modern warfare has shifted into insurgencies and counterinsurgencies governments do not have incentives to revolutionize the military industry. Thesis suggests that what he means is that these types of warfare are not threatening enough. He says that there is a certain level of public support for nonmilitary and military technology development, but state should not depend on it to become a major breakthrough. What they do is develop technologies in an evolutionary manner. "The rationalization of the processes involved in the allocation of resources to R&D in defense and defense-related procurement, combined with changes in the structure of the defense-related industrial base, has placed serious constraints on the ability of military R&D and defense-related procurement to continue to play a dynamic role as a source of new general-purpose commercial technologies" (Ruttan 2005: p184).

Thesis has discussed Solow's growth theory and Ruttan's argument that military R & D had a major spillover in the commercial sector thus had a huge impact on the overall economic growth. Keynes showed in the previous chapter how public investment can take the country out of economic stagnation and it happened many times through military expenditures, he also added that money spent in one sector of the industry has a spillover effect on other industries. Solow showed that only investment is not enough for long-term growth and innovation is the key. Ruttan proved that major innovations have almost always come from military research and development. This innovation might have come along in the history but not so rapidly and not with the same scales. It is clear that military expenditure is it through direct investment or research and development can have a major impact on economic growth. The way one can check it is to observe if after the major

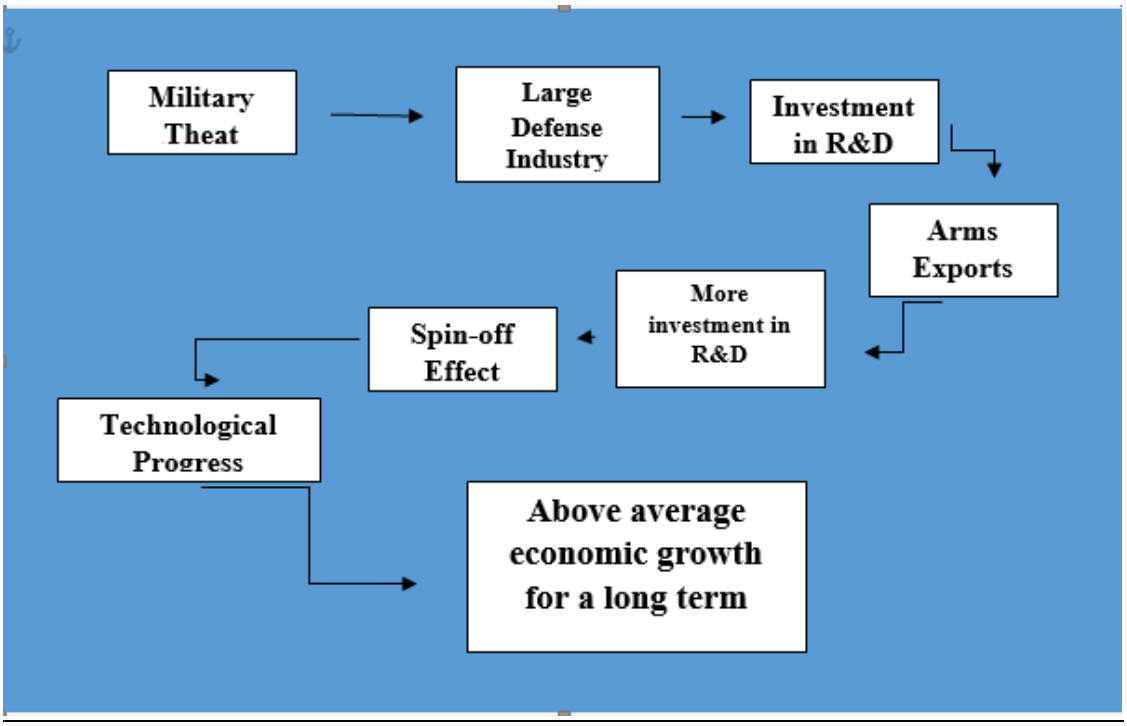
expenditures in the military through Keynesian multiplier or expenditure in military R & D correlates with economic growth.

However, Easterly (2002) couldn't have emphasized it more that, what really matters in development is that people respond to incentives. Aizenmen and Glick (Aizenman and Glick 2006 Cited in Broude, Deger, and Sen 2013) have proved that when there is a threat to a country, military expenditure tends to have a positive influence on fast growth rather than in the countries which do not have an existential threat. This also points at Easterly's points about incentives. Governments also respond to incentives. If there is a threat government starts to invest or advance R & D. Solow's growth theory is not enough to solve growth problems. Even if a country has a good amount of blueprints, it is not guaranteed that it is going to achieve sustainable growth. The environment should be relevant to production if a country is lucky enough to have friendly environment next step on the road to growth is governance. If the government fails to provide a safe and friendly environment for business - amount, quality of machines and know-how won't matter. So government needs to make some basic decisions right. And it helps when it has strong incentives to do so.

Now, a military tension which incentivizes governments to industrialize military has various effects on economic growth, according to Lee (1992); 1) It has a direct impact on GDP because it is a production, but because it is less competitive it is not significant. 2) It creates industrial diversification 3) It develops human capital and creates employment 4) It creates international arms trade; and most importantly 5) technological spill—over and spin-off effects. Thesis suggests that the last two and especially R&D has more significant effects on overall economic growth because only this one fits into Solow's growth model.

So here is the logical chain: Military threat leads to military industrialization and creation of large industrial capacity. For supporting it industrial capacity government needs to have advance defense R&D so it invests in science and technology. Growing of the industry demands international market because domestic market is not able contain such amount of output. Military industry reaches international market and because of international competition government needs to advance technology more so it invests even more in defense R&D. Such a high quality of R&D has significant spin off effects in commercial sector too. Technology thrives. Because of Solow's growth model, we know that technological change and GDP growth rate have a positive relationship so economy grows faster than other countries with initial push in this chain.

Table 1. Conceptual framework



What exactly is defense-related R&D? "It is the funding committed by a country to develop and improve military capability, through improvements in technology. This can lead to benefits for the civil economy through the spin-off of technologies and can also lead to indirect effects, such as spillovers." (Dunne and Braddon 2008: p16) A spin-off means that positive economic results are not intended. However, it is possible to have a dual-use strategy in terms of defense-related R&D. These strategic calculations are possible because it is historically known that major developments in military and warfare have an important influence on the civil economy (Ruttan 2005; Parker, 1998 Cited in Dunne and Braddon 2008). However, the relationship between defense R&D and growth is not simple. We know that R&D generally is an input as well as military expenditure (unless there is a large military industry and exports). It means that having an output from spending money in R&D is not guaranteed. It might fail to create necessary innovations, and if it does, it might not spur the economy. For instance, Soviet Union spent millions on R&D and they produced various products, but they failed to find markets for these products. That is why having a dual strategy towards defense R&D might not be very sufficient. Developing already existing innovations might be much more useful for the economy than inventing something new.

As mentioned before, there is no consensus on what concrete source causes economic growth, however many theories concentrate on technology. In theory, the focus is only on technological change *per se*, but it often ignored the input in general R&D results in the output of technological change. There are two approaches which pay attention to the process of putting money in R&D and actual outcome - technological change. These are "1) the dominant neoclassical paradigm's growth theory, and 2) a political economy approach that links with the earlier approaches of the classical economists and their concern with economic development and structural change" (Dunne and Braddon 2008: p22). We had already discussed the first approach when we described Solow's growth theory. The second approach, however, is the work of Schumpeter. He gave technological progress the central role in economic growth. He agreed with Kondratieff's work who was a scholar that argued that there were waves of rapid economic growth and which were followed by downswings. So rapid economic growth was caused by major innovations and downswings with the exhaustion of these innovations (Solomou 1990 cited in Dunne and Braddon 2008). From this Schumpeter derived a theory of creative destruction. A concept which shows how major negative events can lead to rapid growth. These major negative events destroy infrastructure and innovations are brought about to replace outdated technologies. (Schumpeter 1942 cited in Dunne and Braddon 2008).

However, Freeman and Louca (2001 cited in (Dunne and Braddon 2008) disagree with Schumpeter when he says "there is a bunching or clustering of innovations." (Dunne and Braddon 2008: p26) Similar to Keynes, they say that productions are closely interrelated and strongly affect each other. So innovation in one field of production will definitely be interrelated to other basic innovations in another field. So if a country has an innovation in technology system, it will be reflected in science, consumption and surprisingly on the political and cultural institution. So they assert that there is no such thing as national waves of economic development (trough innovation) they say it is not that simple, many factors like institutions, education, history, and culture have an impact on economic growth. So according to them, technological progress should be examined in the light of "social relationships" because these endogenous factors have a higher role in the development of innovations. There is powerful factors in play rather than investors in R&D, entrepreneurs, and large industrial companies. In the development of technology are involved market and non-market actors, governmental institutions as well as private sector. That is why it is hard (Archibugi & Michie, 1997 cited Dunne and Braddon 2008); Freeman and Louca, (2001

cited Dunne and Braddon 2008) understanding R&D and it' effects on the economy, is a very vague field and very difficult to measure. That is why there is a debate between different theoretical approaches. If we consider how hard it is to understand the impact of the whole R&D on the economy it must be even harder to draw conclusions from defense research and development.

Lastly, there is a criticism that military R & D after the Cold War period, instead of stimulating spin-off effects has a spin-in effect. Dunne and Braddon (2008) argue that indeed defense-related R&D used to drive civil technological innovations. However, it is no longer so. "Investments in the military R&D exert an adverse effect on the civil sector (crowding-out); that the eventual military results are very slow in their public release (secrecy for reasons of security considerations); and that any possible contribution is due only to the expenditure of taxpayers' money (for both the R&D and the acquisition of the end-product)." (Dunne and Braddon 2008: p41) To answer their criticism, it is important to mention that they reviewed literature which was on the U.S., U.K, and major players in the Geopolitics. This criticism is not relevant to this comparative study because it says that only in a major threat can R&D have a spin-off effect. And the cases which they reviewed lack such kind of circumstance.

Even though all the elements which construct my conceptual framework are heavily criticized, I still think that these elements although not fulfilling are great tools to analyze growth. Solow's growth theory is criticized because it ignored many endogenous growth factors and is not sufficient. Ruttan's approach (although it is not only his: Parker (1998) Milward (1977) both state the same cited in Dunne and Braddon 2008) that military procurement has a spillover effect on civilian productions is criticized because innovation in the military would have still be brought about in the civilian sector. R&D is criticized because there is a vague link between R&D and technological progress and it is not guaranteed. Technological change's source cannot only be R&D because there are many other factors in play. If we sum up the critics, it will be boiled down to the point that we cannot control for every factor that is interrelated to the outcome. It is a fair point but not very useful in social sciences. We can have basic frameworks that can help us to see general patterns, and if these patterns help us explain some of the factors that played a role in the outcome, it is already a success. I strongly believe that this framework although is not perfect, it is suitable for looking at Israel and South Korea. Both countries of this study invest a higher percentage of their GDP in R&D than any other country with similar or higher GDP. These countries started off with helping companies to acquire new technologies and 2) they did not leave

companies dependent on foreign technological assistance, they built domestic R&D capability, and they did it by attracting various established engineers and scientist from all over the world. This basic statistics and information give a reason to be optimistic about the framework.

Technological progress was central to South Korea's high growth of output per worker.

Easterly (2002)

Chapter 3 Case of South Korea

Above-average economic growth in the region

South Korea has been evolved from a poor agricultural country to one of the most developed industrial economies in just four decades. According to Sungchul Chung (2011), it was the 1960s when South Korea first started an industrialization reforms. The background was not all flattering. It had a very small domestic market with very scarce resources and production base. Also, quite a large population to feed. However, after all the reforms, Korea presented an economic miracle. It is now the 13th largest economy worldwide. It is also a major trading country not only in Asia but across the globe. South Korea is the innovator in the technology areas such as automobiles, shipbuilding, telecommunication, liquid-crystal display (LCD), semiconductors and many more. It was the technological innovation that has brought about so-called "Korean Miracle".

South Korea has been demonstrating the above-average economic growth rate in its region. If we compare South Korea to its neighbors, who did not have an existential threat, we will see that South Korea has been growing much faster than they. Now, this does not mean that military threat can be the only stimulus to growth, we know that in East Asia there has been a famous Asian Tigers - four countries which grew extraordinarily fast. These are Hong Kong, Singapore, South Korea and Taiwan. We cannot compare South Korea and Taiwan to Hong Kong and Singapore because latter ones are city-states and their economy and politics vastly differ to normal size countries. Taiwan, on the other hand, has had impressive economic growth and also an intense threat from China. The characteristics which I described above are valid enough to disqualify three Asian Tigers for comparison with South Korea. This is why South Korea is compared to other relatively similar size countries which do not have major existential threats. These are Indonesia, Thailand, and Malaysia.

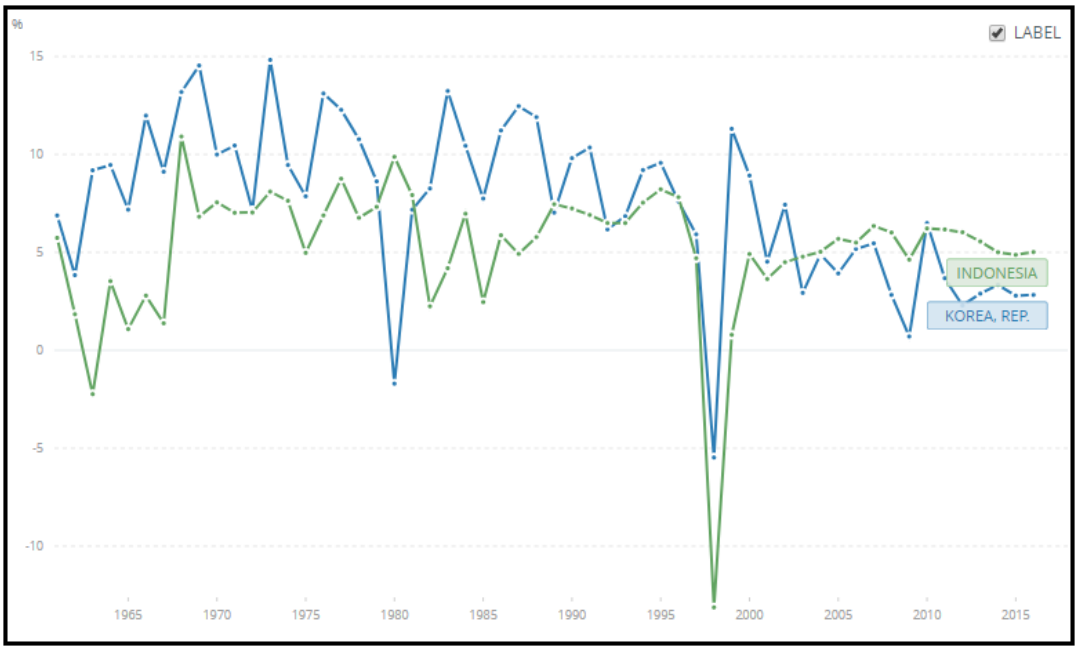
Table 2. above average growth rate in East Asia

Annual percentage growth rate of GDP Since 1961 (World Bank Data)

Year	South Korea	Indonesia	Thailand	Malaysia
Average	**7.503524057**	**5.2622368**	**6.314637996**	**6.05306**

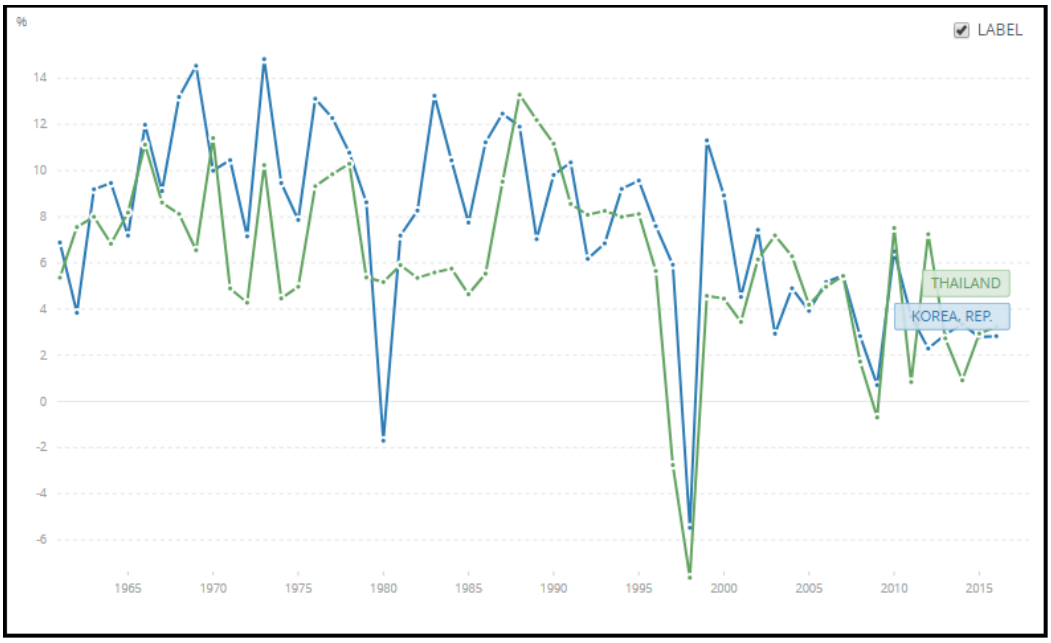
On table two we see that South Korea has grown at least one full point higher on average than its neighbors throughout half a century. Because “average” could trick us on such a long timescale graphs are provided to show that South Korea has been better off than its neighbors most of the times.

Table 3. Annual growth rate, comparison of South Korea and Indonesia. World Bank Data



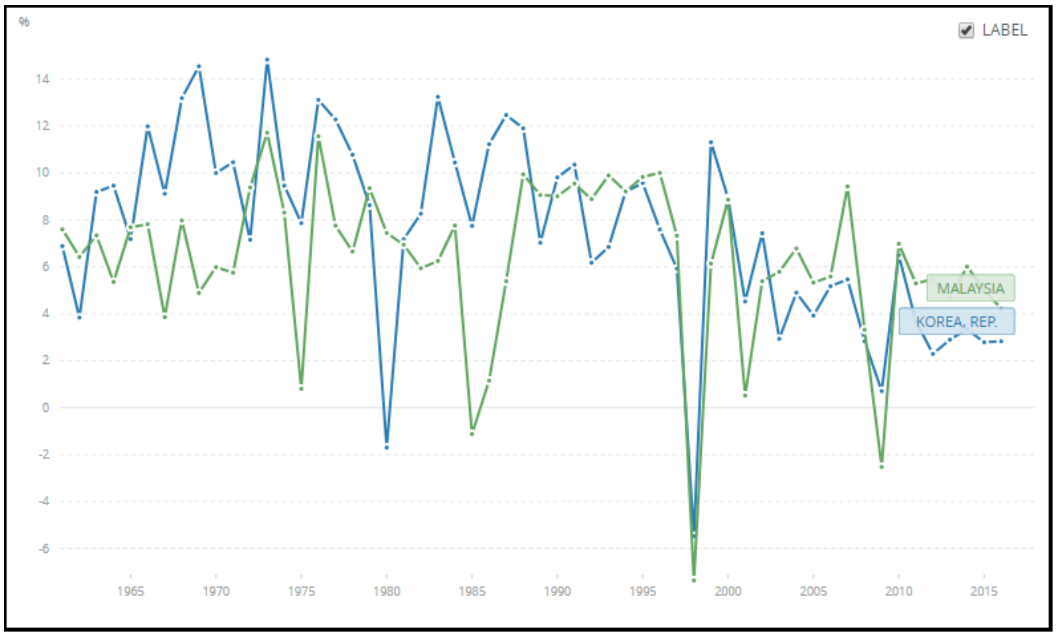
On table three we see that South Korea has been growing much faster than Indonesia almost every year since 1960.

Table 4. Annual growth rate, Comparison of South Korea and Thailand. World Bank



Even though Thailand has been doing relatively better than other two countries, South Korea has been growing faster than Thailand too.

Table 5. Annual growth rate, comparison of South Korea and Malaysia. World Bank Data.



And lastly, South Korea has been much more successful than Malaysia.

We see that South Korea had stronger incentives to grow faster than its neighbor and it did so.

Military tension: an overview of threat and pattern of defense spending

Since the end of Korean War and breakup of the country into south and north there has been continuous military tension. According to South Korea's defense ministry's report: "Defense White Papers," the security threat to the Republic of South Korea has been increasing since the Korean War ended. There have been some periods of stabilization, for instance in the 1990s, but the threat has become pressing again in the 21st century. There has been continuing and increasing local provocations by North Korea. The threat is posed by territorial disputes among the countries in Northeast Asia too. Overall, the security issues surrounding South Korea has been becoming more diverse, complicated and more intensified over the years. There is an immense threat posed by North Korea's nuclear tests, launches of missiles and multiple rocket launchers (MRLs). In addition to nuclear threats, North Korea has intensified the level of UAV (Unmanned aerial vehicle) infiltration and increased cyber attacks. (Defense White Paper 2014). The crisis has been intense during last few years. In 2017 there has been 20 nuclear tests, 20 missiles and one testing of a nuclear device. (Wood 2018) The dispute between young tyrant of North Korea and the president of U.S. has added up to existing tension. And it does not help that North Korea is already equipped with intercontinental ballistic missiles (ICBM) which can reach not only Seoul but Washington DC and London. North Korea and its hostile regime has affected many of its neighbors and especially South Korea and its policy for many years now. Let's look at defense spending and military industrialization the variables that obviously have been affected by North Korean Threat.

As we know, North Korea has had military advanteged over the South since the end of Korean War. The South has had a relative military weakness, but it was compensated by the U.S.-South Korean alliance and its security commitment. The U.S. did a good job being a deterrent force. However, North Korea started provocations against south anyway. Significant provocations started in 1968 when North Korea commandos raided South Korean presidential residence. After two days, USS Pueblo has been seized and 82 crew members were caught. In 1968 U.S. reconnaissance plane with 31 crew members was shot down by North Korea. These provocations had continued and increased over the years significantly (Nanto, n.d.). There has been diffusion of tension in the 1990s when North Korea entered the United Nations and announced the acceptance of International Atomic Energy Agency's nuclear inspections, but tension always came back like

in 2000s and increased significantly. However, there is not a formal peace treaty between the North and the South nor between the U.S. and North Korea yet not even when the leader of South and North Korea finally met.

According to Chung-in Moon and Sangkeun Lee (2009) It would have been expected that after the Korean war South Korea would allocate a large portion of its revenue in military expenditure but it did not happen so. South Korea's economy was not strong enough to support its defense incentives. Even the fund that was allocated to the defense was not coming from the budget directly. A big portion of the military expenditure was financed by the fund which was created from the supply of South Korean products and also services and was bought by American Army was based in South Korea. By that time the South Korean government had military forces of 600 000 however, because of its pure economic conditions it wouldn't handle maintaining the forces on its own. That's why it was vital for South Korea's security to maintain American support. U.S. aid reached 358 million dollars at the end of the 1950s. The assistance was three times larger than South Korea's own spending on the military. South Korea was heavily dependent on the U.S. weaponry, equipment and logistics. Only at the end of the 1960s South Korea was able to double its military spending. Even though there was post-war economic boom defense spending did not grow more than 4 to 4.5 percent as a percent of GNP. It was only 1970s when defense spending started to grow significantly and it was due to military provocations on North Korea. It is noteworthy that the threats coming from the North alone was not the stimulus for South to increase the defenses spending and build a defense industry. It was rapidly weakening U.S. commitment in securing South Korea. All the U.S. did in response to North Korea's provocations was verbal denunciation. This position which has resulted from the prolonged unpopular war in Vietnam pushed South Korea's government to seek self-reliance. This desire was more strengthened by "Nixon Doctrine ("Asian hands must shape the Asian future") through which the U.S. started to withdraw from the Far East's affairs. Nixon Doctrine was followed by withdrawing U.S. division from Korea in 1971." (Lee 1992: p18) "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. " (Lee 1992: p16) So South Korean government decided to rely on its own defense forces. That was when the military industrialization became a top priority in public policy. It should be mentioned that even though the U.S. lessened its effort to security commitment, the Carter Administration and its policies really promote South Korea's

incentives to build its own independent military industry. “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 19 co-production agreements as a palliative for the U.S withdrawal policy.” (Lee 1992: p19) Most importantly, the U.S. provided South Korea with technical data packages, manufacturing licenses and coproduction framework as part of security commitment. Huge amounts of investment went to heavy machinery, shipbuilding, metallurgy and electronic industries because these fields became strategic for the defense sector. “Almost 80 percent of investment in manufacturing during 1977-79 went to heavy industry and to finance these defense-related heavy industries, a National Investment Fund was created” (Lee 1992: p31).

Defense spending rose 51.2 percent from 1973 to 1974. In 1976 the increase reached 59 % of the previous defense budget, that’s far higher than the threshold of arms race. The thing is, other patterns (except excessive spending in military) weren’t pointing at arms race. South Korea was not following the militarization of North Korea, it was just concentrated on strengthening its own defense capabilities. By that time military spending accounted for 6 percent of Gross National Product (GNP). Most of the money went to industrialization but this number does not show exact expenditure that was in South Korea because all these actions were considered as “burden-sharing” with the U.S. Thus U.S. still helped South Korea’s security means financially. The rapid rise continued until 1983. The main goal of Park Chung-hee was to modernize and upgrade military equipment and that’s why his administration initiated first armed force modernization project which mainly focused on imposing defense tax. The second phase was more problematic because on the one hand, the burden-sharing agreement required South Korea to maintain defense spending of 6 percent as of GNP and on the other hand, IMF required South Korea to tighten its fiscal and monetary policy. Eventually, the IMF’s stabilization act cut the defense spending to 4.5 percent in 1984. As a result of democratization and the end of the Cold war, downsizing trend continued until the 2000s. However, the new government of Roh Moo-hyun wanted to be self-reliant in defense so he reversed the trend. Consequently, his administration increased defense spending to 2.72 % of GDP in 2007. The portion of defense spending in GDP became 15.5 %. This was the result of not only desire to be less dependent on U.S. military support as well as increased risk and

provocations from the side of North Korea. Now that we have seen how fast defense spending increased in the 1970s and the beginning of the 1980s we might assume that defense spending framework follows the pattern of the arms race.

"South leads the North only in three areas: the size of navy personnel (South, 68,000; North, 60,000), armored vehicles (South, 2,400; North, 2,100), and helicopters (South, 680; North, 310)" (Moon; Lee 2009: p83). It seems on the surface that North has all the advantages, but the South Korean government and the public does not seem to be concerned with a gap. This is because they know they have the advantage of cutting-edge technology sometimes even by global standards.

It must be emphasized that even though South Korea's defense spending is increasing and it is justified because the "constant threat" that comes from North Korea, South Korea does not respond to the military spending pattern of North Korea.

Governance: Industrialization and support for Science and Technology

In the theoretical part of the thesis, I emphasized Cowen's argument that military threats incentivize governments to make some basic decisions right. It was the case for South Korea, it did not have very strong institutions, but it achieved to build a very strong institutional base and implemented very pro-development policies. These policies and governance practices might haven't been of highest democratic standards first but after the basis was laid, then it opened up and transformed to the open-market economy and democratic political system. All of that happened in just 40 years.

In the 1960s there was no development of science and technology at all. South had only two public-funded institutions for research and high-tech development. "1) The National Defense Research and Development Institute founded after the Korean War and 2) Korea Atomic Energy Research Institute founded in 1959 with 5 000 researchers and engineers." (Chung 2011: p334). At the beginning of 1960s, public expenditure on R&D was 9, 5 million U.S. dollars. After fifty years South Korea is one of the front-runners in spending in R&D. "First Five-Year Economic Development Plan of 1962 included developing new technologies." (Chung 2011: p334) "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" (Lee 1992: p26). At that time Korea lacked

technological capabilities, so it temporarily relied on foreign sources for technologies. It is very important to emphasize that Korea's policy strategy was not only to promote inflow of foreign technologies but also "to digest, assimilate and improve" Chung (2011: p334) these transferred technologies.

In the 1970s, Korea's reforms targeted capital and technology-intensive industries because these were the bodies that implemented huge investment projects for the purpose of building machinery and chemical industries. Governments focus was also directed to heavy machinery industries. In order to support all of these industries South Korea created R&D institutions in the fields of heavy machinery and chemicals. For example: "the Korea Institute of Machinery and Metals (KIMM), the Electronics and Telecommunications Research Institute (ETRI), the Korea Research Institute of Chemical Technology (KRICT), the Korea Research Institute of Standards and Science (KRISS), the Korea Institute for Energy Research (KIER), the Korea Ocean R&D Institute (KORDI), etc. These research institutes worked with the private sector to build a technological foundation for industrial development." (Chung 2011: p336).

According to Chung (2011) while promoting Research and development in order to acquire blueprints for industrialization Korean government also started to develop the base for Science and Technology. The Science and Technology Promotion Act and the Science Education Act were adopted by the government in 1967. It was considered a legal base for further development policies towards promoting S&T. It was the same year when the government initiated the creation of the Korea Institute of Science and Technology (KIST). But it was not all, in 1968 government created new "Ministry of Science and Technology" which was the main responsible body for science and technology policy. In the next decade, governments adopted another law "Korea Advanced Institute of Sciences Act." It was the legal basis for founding the Korea Advance Institute of Sciences (KAIST). Then called KIST was the first Research and Development organization in a strict sense. Among many things, KIST brought U.S. graduate education system in Korea.

In the 1970s there were research organizations established which assisted industries in transferring blueprints revolutionizing them and fitting them to Korean business environment. In that stage of development these organizations did two main things: 1) they assisted companies to get new technologies and 2) they did not leave companies dependent on foreign technological assistance, they built domestic R&D capability, and they did it through attracting various established engineers and scientist from all over the world. Many of them were Koreans coming

back to their country. Investments were specifically allocated to defense-related research and development in 1971. Most importantly there was created the Agency of Defense Development (ADD). According to Lee (1992) it served as defense-related technical data center and assisted the private sectors defense research and development activities. It also provided foreign defense technology and took part in the development of defense products itself.

The government continued industrial development in the 80s too. It was necessary because technological demands of Korean industries were becoming more complex. South Korea was not getting technological know-how as a result of Foreign Direct Investment. FDI has restricted anyway, but in the 1980s the regulations have loosened as a requirement of International Monetary Fund (IMF). Deregulation did not result in huge inflows of FDI. In that circumstances, the government decided to strengthen its R&D capabilities in order to sustain the development. Since then investment in R&D has skyrocketed. " Korea's R&D investment, which stood at only 368.8 billion Won ($526 million, 0.81 % GDP) in 1981, rose to 10,878 billion Won ($13.5 billion, 2.8% of GNP) in 1996, to 13,848 billion Won ($12.2 billion, 2.7% of GDP) in 2000, and to 31,301.4 billion Won ($33.7 billion, 3.47% of GDP) in 2007." (Chung 2011: p340). Since the 1980s public funding for R&D rose sixty times. It is noteworthy how South Korea invest more in Research and Development than any country with the same or higher GDP.

South Korea has had remarkable achievements in international trade too. Started by 1970s Korea had export-oriented policies. Exports in the 1960s were only 41 million dollars, and in 1981 it was already 21, two billion.

"In 1977, Korea celebrated breaking the $10 billion export target and had doubled the total within four years." (Lee 1992: p27) According to Lee (1992) "since those successful years, arms export revenues have averaged 250 million dollars annually. However, when a government wants to expand sales, it might be followed by negative consequences which were market saturation and underutilization of defense-production capacity. In order to avoid these negative consequences, Shout Korea had to export military hardware actively." So it shifted from exporting soft good to conventional weapon systems and nowadays South Korea is one of the largest exporters in the developing world. South Korea achieved this even though it had challenges from the restrictions of the U.S. and other nations. In sum, military exports have a very beneficial effect on the overall economy.

The connection between military industrialization and economic growth

Lee (1992) says that it is often speculated that military industrialization is bad for economic growth in South Korea and the economy grew in spite of negative effects of an immense defense measures. He says that it is often argued that hyper military spending has a draining effect on the social welfare as well as the inflationary effect on the economy in developing countries. Even though South Korean defense industry had negative impacts on the economy, it cannot be said that it was negative overall and especially in the developing period of the country. According to Lee (1992) the defense industry has had both capital and technological spin-off effects which are implemented through capital and know-how investment in commercial sector. "The acquisition and dissemination of advanced technology serve as engines of growth for the entire national economy." (Lee 1992: p3)

It is true that defense sector might not be as productive as the civilian sector because defense sectors are not as competitive part of the economy as other commercial sectors. However, it is only fair to say that in South Korea defense spending is largely procurement of military logistic supplies, and it comes from defense industry that is owned by the South Korean government itself. So military spending and defense industry has been contributing to economic growth since it started.

Military Industrialization in South Korea started with manufacturing conventional weapon systems. Even though, South Korea started the business later than other countries it became fifth large conventional arms exporter in the developing world. It was the base of highly precise and high-quality weapons production. Nowadays it produces almost every kind of conventional weapon. "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 to 20 percent of the manufacturing labor force" (Lee 1992). Throughout industrialization advances South Korea was using more and more sophisticated technology, and it was a good sign that country was modernizing and not only the military sphere.

Developing countries which start producing arms do it for two economic reasons: 1) to grow their defense industry and 2) to reduce the costs of having weaponry imported from foreign countries. Industrialization of military sector helps the economy by updating and upgrading

technology and human capital; it makes the growing of other industries possible. Importing materials and know-how from developed countries is much cheaper than purchasing manufactured weapons. Saving also happens due to the lower cost of labor in the developing world.

Even though advantages that were mentioned above, defense sector industrialization had some negative effects on the South Korean economy in the beginning; As Lee (Lee 1992: p37) "argues defense industry undermined macroeconomic performance in the second part of the 1970s." It was due to immense investment in heavy and chemical industries in 1976 and 1979. The investment was unsuitable for the smaller size and financial capabilities of the market.

The huge investment in these areas created inefficiencies - a lot of money was wasted. It contributed to artificially overheating the economy. The inflation was growing rapidly from 19.5 percent to 35 percent in just two years at the end of the 1970s. Of course, there were other reasons of crisis in 1980 like oil price shock, real estate speculations and foreign-exchange shortage. But, defense's huge investments in the areas of heavy and chemical industries were one of the most important reasons that created economic difficulties in South Korea. Apart from macroeconomic problems these investments created microeconomic effects too. For instance: South Korea made private sector enter the defense industrialization because the government decided there was a need for heavy capital investments. It was more of a carrot- and stick policy, but these private firms did not really have many alternatives. As a result of 90 firms engaged in heavy and chemical industry. Carrots in this sense were subsidies, cheap long-term loans from the government and guaranteed procurement. Very soon it became apparent that subsidization also had negative sides. As soon as South Korea filled its conventional weapons need, the market started to shrink, and nine defense contractors in private sector went bankrupt. After the difficult period of 1980-84 defense industry started to bring about positive economic effects. The most important one for this thesis is spin-off effect of the defense industry.

Technological spill-over or spin-off is considered to be one of the ways that defense technological advancement effects overall national economy. According to Lee (1992), there was an extensive transfer of high technology from defense sphere to commercial sphere. He says that defense technology upgraded the state metallurgy communication, electronics and encouraged other fields to continue research and developments in these areas. Before extensive defense industrialization in 1970s research and development investment was not at all on the table of

policy-makers. It was after defense industrialization that government started to allocated money for R&D. For the first time in Korea's history it there was new R&D institutes that started to undertake basic long-term research projects.

Korean defense industry definitely had an immense effect on the national economy, and it was not simple, it consisted of both costs and benefits. On the negative side, fast industrialization brought macroeconomic constraints including foreign debt, inflation, increasing tax, overcapacity, the creation of military-industry complex, etc. However, industrialization brought physical and human capital formation, the growth of GNP arms import substation and most importantly technical spillovers. As Lee (1992: p99) emphasizes "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." In the end, he also suggests that investment in defense is not as complete wastes as many economists argue, but he also adds that it should be justified by national security rationales. He concludes that Korean defense investments contributed to national security as well as economic growth.

Industries now

South Korea's defense ministry produces yearly reports called defense white papers. In defense white paper for 2014 ministry explains how defense budget is spent the way that it spurs the economy. Ministry states that there are many ways how defense budget created economic effects that contribute to the national economy much more than the initial investment. The effects are categorized as: 1) the generation of national production, 2) creating new jobs and 3) creating added value. For example, in 2010 1 billion won invested in defense generated 1.68 billion won in production, created the effect of 12.3 new employment and had an added value of 780 million won. Ministry of defense presented a chart which showed industrial spillover effect of national defense expenditure in 2010.

In 2013 defense industry exported goods valued for 3.4 billion dollars which recorded accumulated amount of 10 billion dollars. The mean goods that defense industry exports are diversifying every year. For instance, in 2013 different kinds of ammunition, small arms, vessels, and aircraft were added to exports. The diversification and increase of these exports create numbers

of jobs, which builds a stable basis for the growth of defense industry. Defense industry exports also promote diplomatic and military exchange.

Most importantly, defense industry creates spillover effects in the development of science and technology. **It happens through transferring advanced technologies to the private sector.** (Defense white paper 2014) Every year there is an increased budget for carrying out creative national defense R&D. Defense-related R&D works on 27 projects. These projects include: creating advanced security systems, aimed at countering North Korea's local provocations which needed 1 trillion and 99.5 billion won; & trillion and 345.8 billion won was invested in the projects that created next-generation frigates, and fighters. These investments are due to the need of building elite military forces to ensure self-reliant readiness towards existing threats. R&D also achieved to build the Kill Chain and KAMD – counter deploying counter-battery detection radar. In 2015 and 2016 defense R&D was working on enhancing South Korea's military surveillance, reconnaissance and "command and control" capabilities. It achieved considerable success in improving maneuver and precision strike capabilities. In the future, R&D plans to strengthen naval capabilities in protecting sea lines of communication (SLOC). It is also planned to strengthen air power in acquiring long-distance operational capabilities.

It is planned to expand the investments to catch up defense science and technology capabilities of leading countries. It is the goal of the ministry of defense to strengthen the Agency for defense development the way that it becomes a world-class research institute. The government wants to ensure private sector's participation and contribution in the national defense research and development. It is going to be done through subsidies for the businesses in the defense industry. According to Ministry of Trade, Industry, and Energy, there was a plan confirmed in a national science committee. The plan is about the joint defense technology development which purports the rise of R&D budget "from 134.3 billion won (US$124.3 million) in 2017 to about 200 billion won by 2022." ("S. Korea to Expand Defense R&D Budget by 2022" n.d.)

Empirical findings

There are South Korean scholars who have studied the link between the defense industry and economic growth and some of them have found positive results, for instance: Ja Song (1990 cited in Lee 1992) has studied the link between the defense industry and civilian sector. He used a

descriptive methodology which was mainly based on statistics. According to him, the defense industry has an influence on three civilian sectors: 1) Defense's industry's impact on GNP growth rate; 2) creation of jobs in military sector and 3) spill-over effect of military innovations to the commercial sector. He found that there is a positive relationship between the defense industry and these three areas. However, the effects were quite weak in the spill-over area.

Sung Min (1987 cited in Lee 1992) has studied defense-related R&D and technological advances. He has used Solow's growth model (1957) to measure technological advances in six areas of industries. These are fire, vehicles, vessels, communication, aerospace, and ammunition. First, he calculated technological change index in these areas. He has found that defense technology has improved 240 times since the defense industrialization started. Then he took the data on how much money went to R&D as a percentage of the defense budget and regressed it against technological change index. This was the direct influence of R&D investment. He proved with a regression model that technology improves as defense R&D investment increases. According to his study, the vehicle sector scored the highest rate on technological advances. Communication and aerospace's areas also had very good advancements in technology. To sum up, "The sectors with the greatest absolute amount of government-funded R&D have the highest growth rates." (Lee 1992: p77) As said by Solow technological advancement allows industries to have bigger output with the same number of labor. It is commonly accepted that technological advances and breakthroughs are due to the systematic and high investment in research and development. According to Lee's interpretation of Min's regression results "defense R&D has a positive effect on technological advancement. The coefficients of the conventional sectors such as fire, vehicles, and vessels are larger than those of the aerospace and communications sector" (Lee 1992: p79). So, defense R&D had significant effect on the technological change index in 3 areas: "fire, vehicles, and vessels lesser impact was in aerospace and communication." (Lee 1992: p79) If the investment was higher in latter areas, it would develop faster too.

As I stated in the theoretical part of the thesis, technological change is the main engine that ensures sustained long-term growth which is proved by same Solow's growth theory. It does not need any more regression to prove that technological advances cause a sustained increase in output thus long-term growth in GDP. **So here is the logical chain: Military threat which led to military industrialization (as a side effect of the U.S. disengagement from security commitment) and obviously increased investment in the defense-related R&D had a direct**

effect on technological change, and because of Solow's growth model, we know that technological change and GDP growth rate have a positive corelation. Min's findings prove that technological progress in areas where military R&D was more financed helped growth of GDP. Most importantly to this thesis, it shows that there is a positive relationship between military tension all the way through GDP and GNP growth rate.

However, here is the finding os this thesis too. There was conducted correlation analysis between defense R&D and patents per year. It is not as the sophisticated analysis as Min's, but it shows a general trend.

Table 6. Defense Research and development and patent data

Correlation Analysis		
Year	Patent Applications, residents (World Bank)	Defense Research and Development in PPP Dollars (GBAORD OECD)
1999	55970	971.993
2000	72831	1030.792
2001	73714	937.248
2002	76570	1019.783
2003	90313	1010.148
2004	105250	965.278
2005	122188	1227.886
2006	125476	1347.961
2007	128701	1685.864
2008	127114	2022.125
2009	127316	2028.477
2010	131805	2163.289
2011	138034	2404.829
2012	148136	2780.964
2013	159978	2920.937
2014	164073	2753.5
2015	167275	2864.923
Correlation		**0.902090591**

In the table we see the amount of PPP dollars spend on defense research and development and patent applications per year. Defense R&D is measured in Purchasing Power Parity (PPP) dollars because it would be more comparable to Israel too. "Purchasing power parity (PPP) is an economic theory that compares different countries' currencies through a "basket of goods" approach. According to this concept, two currencies are in equilibrium or at par when a basket of goods (taking into account the exchange rate) is priced the same in both countries."(Investopedia" n.d.)

The result of the analysis is **0.902090591** which is a pretty significant correlation. Now, it does not prove causation and nor does not it guarantee that there is 100% link between this variables because we have data only for 16 years. However, empirical analysis conducted by scholars mentioned above gives us a reason to be optimistic about these results. Plus 0.9 is a pretty high indicator.

"Applying military technology to the civilian sector has become Israel's greatest source of wealth."

Benjamin Netanyahu - Israeli Prime Minister

(Rapaport, 1998).

Chapter 4 Case of Israel

The above-average growth rate in the region

Israel is one of the fastest growing economies in its region. It has shown even faster growth than its oil-rich neighbours. Israel has a "defense economics," which means that country's economy is characterized with high defense spending and externalities coming from a defense sector. According to Karl Derouen (2000) its economic growth can be described with five main phases between the years of 1953 – 1992. During the 1950s and 1960s Israel had a very steady growth rate between 9.7% and 11.2%. In the seventies growth rate was interrupted by a Yom Kippur war between Israel and Arab countries. Also there was the oil crisis which shocked the global economy. In the period of 1973 to 1980 growth rate was diminished to 3.2% on average. High pace of growth was lost until 1986. Starting from 1986 growth rate recovered and climbed to 4.4% on average. Fischer (1993cited in DeRouen 2000) points out that growth rates in Israel

never returned to previous figures after the oil prices jumped in 1970s and caused the worldwide energy shocks. Fischer also discussed Israel's huge defense burden and asserted that it started from the major conflicts in 1967 and 1973. Afterwards, the burden was doubled with the overall increase of government expenditures in social spending. Overall result of these events after 1970s was inflation and large deficit in the budget. However, U.S. aid was essential help to relieve defense burden. Some would say Israeli success is the result of a large amount of aid coming from the U.S. But, it would be taking Israel's economic miracle for granted if we consider the fact that aid is not all for growth. It makes country highly dependent on it and could easily end up trapped in a similar situation as "Dutch Disease". In order to clearly see effect of military tension on economic growth we should compare Israel to countries which do not have major existential threats. Such countries are Tunisia and Greece. None of them have a major threat coming from an external force.

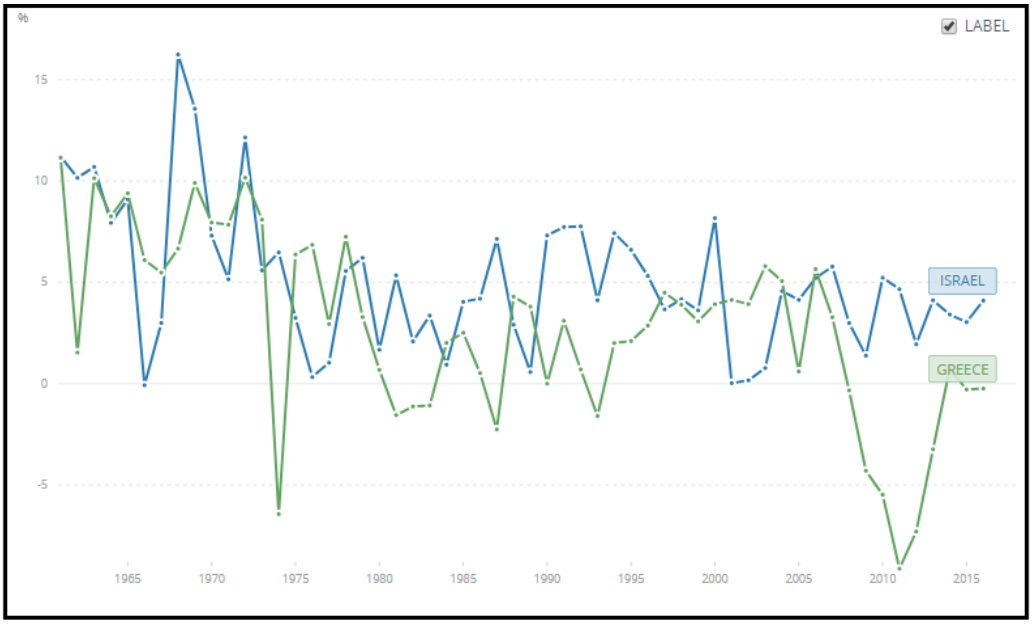
Table 7 Above-average growth in the East Asia

Annual percentage growth rate of GDP Since 1961 (World Bank Data)

	Israel	Tunisia	Greece
Average	**5.079276**	**4.590446**	**2.751293**

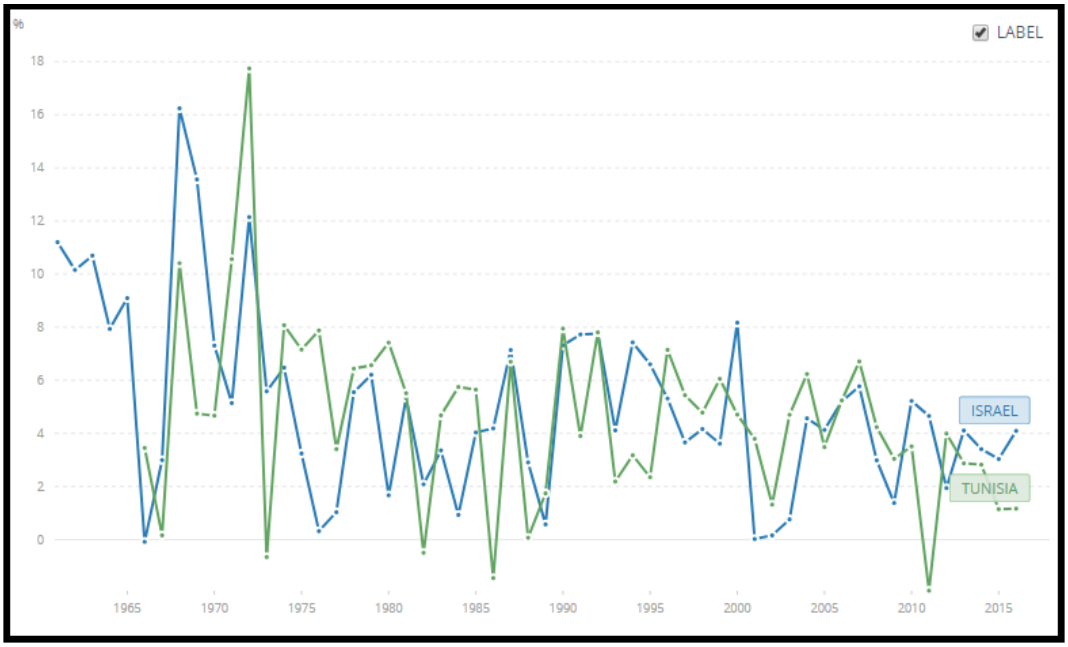
On Table seven we see that Israel has been growing faster than both countries.

Table 8 Growth rate of Israel and Greece (World Bank Data)



We see on this chart that Israel has been doing far better than Greece even though Greece as well has been receiving a large amount of aid. It is an illustration that aid is not all for growth and it can easily backfire.

Table 9. Growth rate of Israel and Tunisia. (World Bank Data)



Also, there is not much difference between Israel and Tunisia, but it is not surprising knowing that Tunisia has some oil and gas.

Military tension: an overview of provocations and pattern of defense spending

The creation of Israel caused huge controversies in the Middle East. The whole region perceived it as illegitimate act enforced by colonizers. Since its creation in 1948, Israel has been under existential threat. The geopolitical situation was very intense as long as Israel's Arab neighbor's aim was to fight against Israeli nation-state and eliminate it because to them - it was European colonial movement. Arab states: Egypt, Syria, Jordan, and Iraq declared war against Israel. The war caused fleeing of 700 000 Palestinian refugees. It did not help the situation - Palestinians are trying to return to their homes for decades which culminated in two uprisings called intifada in the 1980s and 2000s. There are several violent Palestinian groups which are backed by neighboring Arab states, Hamas is the main one which operates in Gaza strip. Several terrorist groups like Hezbollah target Israel too. In sum, to overcome existential threats from the neighborhood Israel had to become the strong state with an advanced economy. It definitely helped that Israel had a powerful military ally- the U.S. However, Israel's progress shouldn't be taken for granted. Its huge technological progress was caused by the necessity to become less dependent on U.S. on security matters.

Israel had very high military expenditure since its creation, however, because of rapid economic growth - expenditure has been becoming a smaller portion of GDP. It still is one of the highest spenders in the military. “Israel is one of the top ten countries in the world in terms of military expenditure as a share of GDP” (Broude, Deger, and Sen 2013: p12) According to Stockholm International Peace Research Institute (SIPRI) in recent 5 – 6 years military expenditure has been 13-14% of GDP (“SIPRI Military Expenditure Database | SIPRI” n.d.) which is different from World Bank Data. According to World Bank, military expenditure of Israel has been only 5% of GDP on average since 2011. (“Military Expenditure (% of GDP) | Data” n.d.)

Notwithstanding data it is clear that Israeli government has been spending a fair share of the budget on defense. The result has been impressive in the light of innovative production. Israel has shown considerable technological progress “especially in the small arms industry, lasers, radars, drones, Unmanned Aerial Vehicles (UAV), Unmanned Surface Vehicles (USV) and personal equipment. Israel is also the world leader in surface-bound equipment.” (“Defence Research and Development (R&D) in Israel: An Overview” 2016)

Israel is unique because it managed to emerge as a developed economy when it had such a huge military burden on its economy. Although, it should not be ignored that Israel had enormous support. “Given strict controls over public debt, conservative fiscal policy and the need for a low inflationary stable macroeconomy, Israel would have found it difficult to finance defense at a great cost to social welfare if it had not received quite massive military aid from the United States. “ (Broude, Deger, and Sen 2013: p40) However, the fact that in spite of a huge burden Israel achieved a rapid economic growth proves that growth is possible under high defense spending.

Israel has a high rank among developing countries on the defense industrialization and DIB. It means that overall macro-economy can be benefited from technological progress in the defense sector. Spin-offs from the defense industry can help with growing the whole economy. That happens when a country manages to have massive industrialization of the military.

Governance: industrialization, support for R & D

According to International Strategic and Security Studies Programme (ISSSP), (“Defence Research and Development (R&D) in Israel: An Overview” 2016), the industrialization in Israel has three main phases: First phase starts with the establishment of state and continues until the mid-1950s. During this period the task of Israel Defense industry was to produce light armory and

also ammunition. “The second phase starts after 1956 marked with Sinai Campaign, industry shifts to production under license, especially from French firms.”(Dvir and Tishler 2000: p35) Third and the most important phase starts in the 1960s and continues until today. “In the start of the third phase industry began to modify and improve weapon systems under license provided by other countries.” (Dvir and Tishler 2000: p35) Local industry started to develop modernized weapon systems based on the one bough from abroad. Let’s dig into the details of these phases.

So the defense industrial base in Israel was created in the 1920s, well before the establishment of Israel but after the official creation defense industry kicked in with its full strength. In 1948-1950s government led defense companies started the industrialization. Defense-related R&D was under the governmental attention from the beginning. This was due to the fact that Israel had very educated human capital which was capable of producing innovative military equipment. “In 1958, the military R&D units within the Ministry of Defense were organized as a separate unit called Rafael Advanced Defense Systems Ltd (or the Armaments Development Authority), which six decades later has become Israel’s central organization for defense systems production, technology, and research.” (Broude, Deger, and Sen 2013": p42) Meanwhile, Bedek another military company modified itself to Aerospace industry. It was very useful for the government considering Israel’s security threats and its need of airpower.

Even though there has been considerable progress in the first two phases, the third phase was the most significant. It was the Yom Kippur war in 1973 that increased the demand for the domestic military arms because Israel was under embargo of France. Also, it was restricted to buy sophisticated weaponry from the U.S. and Europe. That was when a fundamental change happened in defense industrialization. Israel’s enemies - Egypt and Syria were provided by powerful weapon systems by the Soviet Union. Israel, on the other hand, was pushed to develop its own domestic military production because of emergo and restrictions. In order to stay cost-effective, by that time, the domestic market was still small. However, that is why Israel’s military industry started to rely more on foreign markets. “Exports increased ten times since the 1970s until the mid-1980s. Israel, in its defense industrialization expansion, tried to develop the Lavi-fighter aircraft; it succeeded in producing unmanned airborne vehicles (UAVs) as well as creating air defense systems and communication satellites, which have dual usage - both for civilian as well as military purposes”(Broude, Deger, and Sen 2013: p43). That was the period when R&D started to work intensively in the fields of high-tech and manufacturing and spin-off effects of R&D was

enormous. The U.S. decided to closely examine Israel's military industry and its potential, and Central Intelligence Agency (CIA) made a research on it. Some of the parts of the research is still classified, but we can still access most of it.

According to CIA ("CIA-RDP83S00854R000100160002-7.Pdf" n.d.) Israel's defense industry has been wholly owned by the government. The industrialization was undertaken because of similar reasons as in South Korea. First of all, Israel wanted to be less dependent on foreign arms suppliers and secondly - to maintain a qualitative advantage over the weaponry of Arabs. Israel considers continuous modernization of its military industry as its national security issue. Often they depend on U.S. financial assistance to modernize their arms, but they would do it even if the aid was absent. Such kind of approach has a quite big burden on the economy. However, it was compensated partly with Israel's commitment to defense exports. In the 1980s they doubled their defense exports which consisted of "small arms, ammunition, communications and electronic equipment." ("CIA-RDP83S00854R000100160002-7.Pdf" n.d.) In the same period, militarization absorbed most of the resources of government and contributed to budget deficit, which was one of the main reasons of triple-digit inflation in the 1980s. Even with the U.S. assistance and increasing exports, this kind of "crowding out" from civilian sector resulted in lesser chances of sustained economic growth. It also tested countries' research and development capabilities.

The military industry included Israel Aircraft Industries (IAI), Israel Military Industries (IMI), Bet Shemesh Engines Limited, and Israel Shipyards. These industries accounted for most of the military equipment that is produced in Israel. Also, there are hundreds of private companies that are defense-related, and they are contractors and contributors to defense production.

CIA emphasizes that even though Israel was capable of producing a wide range of weaponry including sophisticated ones, it has been still dependent on the U.S imports because of "limited research and development capabilities" ("CIA-RDP83S00854R000100160002-7.Pdf" n.d.) P1). That is why Israel was trying to pull multibillion project of defense industry modernization in order to reduce dependency on the U.S. for finished military equipment. Most of Israel's inventory in the 1980s – aircraft, tanks, artillery, and other sophisticated weapons were supplied by the U.S.

Export of defense equipment was used to compensate rising costs of research and development. Because research and development was becoming a new priority of government. Even before, that education was always under attention.

Because Israel has geographical and demographical disadvantages in order to compensate it, the government had to invest its resources in technical education also. Since the beginning, Israel chose a human capital intensive growth strategy which was utilized in the top-notch education system and remarkable facilities of higher education. The consequence was very imressive. Israel has become one of the highest quality education provider. Israel's higher education institutes have highest rankings among the most developed countries. It can be easily proven that government places enormous importance on education- the numbers of scientists and technicians a country has is enormous. Israel has a high density of innovators as a proportion of its populations. With its rankings, it can easily compete and win over the European countries. "There are over 59 Israeli companies which are listed on NASDAQ, a number higher than the combined total of the United Kingdom (32), France (9) and Germany (10)" (Broude, Deger, and Sen 2013: p39).

Israel's huge investment in education resulted in Israel's technological superiority. Nowadays Israel is prominent in developing best high-tech innovative products in the military sector. Which benefits civilian sector too. Israel has had a leading role in developing aerospace naval and cyber systems. Leading role in the innovation of defense sector benefited Israel with gaining it valuable allies, strengthened its currency because of foreign exchange inflow and most importantly empowered Israeli Defense Forces (IDF), thus making the country more secure.

Nowadays Israel is the first country in the ranking of spending highest portion of GDP on R&D compared to other countries. Among the top ten countries is has the highest quality of R&D and innovations. Most money invested in R&D is distributed between academic and research institutions. In addition, government was not the pivotal player in developing R&D capabilities - the private sector was very active too. Defense companies and hi-tech industries "accounted for 37% of industrial product in 1965, which grew to 58% in 1985 and has currently reached close to 70%."("Defence Research and Development (R&D) in Israel: An Overview" 2016).

The connection between military tension and economic growth

So, we have seen that since its creation Israel has been under various military threats, which has resulted in large-scale industrialization. It needed two things: 1) large foreign markets because domestic was not enough for such an increased military production and 2) strong capabilities of domestic R&D so that Israel could produce sophisticated weaponry on its own. The first factor also helped to the innovation because Israel needed to export weaponry internationally, it put it on international competition. The international competition itself pushes for more incentives to innovate. So both factors helped the growth, exports on its own have obvious benefits because it is an output. Moreover, exports push for more development of R&D which creates innovation in technology. Technological progress in defense has spillover effects in civilian sectors by adaptation or learning by copying.

We know that nothing motivates the government to invest in R&D as multiple security risks. That is why the Israeli government has paid so much attention to defense R&D and hi-tech sectors. According to ("Defence Research and Development (R&D) in Israel: An Overview" 2016), Data from OECD and also SIPRI demonstrates how successful Israel has been in technological progress since the 1970s which is illustrated by the amount and types of the exports. Technological progress was the factor that compensated for Israel's disadvantages in geopolitical position, a small territory, lack of resources and population. The Israeli nation has dedicated its best human resources and billions of dollars to create military technologies that would shield it from hostile neighbors and conflictual minorities inside the country. As a result, investment in defense R&D stimulated the growth of not only defense industry but civilian too. This led to the emergence of the economically strong and technologically modernized prosperous country. Israeli people view defense R&D as a necessary investment for the future development of their country and a guarantor of their security.

Let's look closer how spin-off effect worked in Israel. First of all, it should be emphasized that positive effect of military R&D is not easily quantifiable. Modernization is a factor that is brought about by security-threatened government and society, but it is not easy to count it. Spin-offs are created through industrial linkages between different sectors. It happens when there is a utilization of dual-purpose research and development. Also "New industrial innovation at the frontiers of technology, as well as technological feedback from high-tech manufactures and dual-

use technical progress. The symbiotic relationship between the sophisticated defense industry and modern civilian manufactures is well-documented." (Broude, Deger, and Sen 2013: p48)

Spin-off specific to Israel is exceptionally developed high-technology sector, most educated and creative scientists and engineers. According to Broude, Deger, and Sen (2013), 75% of the weaponry that is produced by Israeli military industry is for export. Thus, major emphasis is on the innovative technologies in the military in order to hold the competition. There is a very good example how military know-how and top-notch scientists "spilled-over" in civilian sectors. In the 1980s when Israel was attempting to develop its own jet fighters – the Lavi, which did not succeed, because it was not cost beneficial. However, hundreds of scientists and engineers were hired in civilian sector who were released after Lavi-failure. These engineers had experience in computers, electronics, engineering and so on. That was the greatest boost for Israeli high-tech industry.

"The Israeli Ministry of Defence began promoting the conversion of the defense industry to civilian commerce in 1984 with the introduction of the R&D Encouragement Law." (Broude, Deger, and Sen 2013: p49) This law was very successful because defense industries started to launch commercial spin-offs which ended up outperforming military production.

Another very good example is Israel's former Prime Minister's – Netanyahu - statement. He said that "Israel is enjoying a "swords into silicon chips" trend (Rapaport, 1998 cited in DeRouen 2000). What he meant is that Israel is enjoying economic spinoffs and externalities of defense sector in private commercial sector. He goes on to describe the phenomenon and proves that military R&D had spill overs in commercial sector: there were virtual devices developed in defense sector for the purpose of training fighter pilots. Soon these virtual devices were used in surgeries. Israel became one of the leading states in healthcare. There is no doubt defense R&D had a role in that success. Another illustration is military engineers who retired from the army and creating robots to harvest fruits. Last but not least, there were remotely controlled planes that were used as surveillance cameras in Lebanese borders. Modernized and adapted versions of these planes ended up as traffic reporters, assistants to firefighters and surveillance tools of police.

In a well-recognized paper Barro (1991) (Cited in Broude, Deger, and Sen 2013) suggested that human capital and spending oriented on security are government investments that are most related to GDP growth. "The idea is that expenditures on education and defense are more like a

public investment rather than public consumption; in particular these expenditures are likely to affect private-sector productivity or property rights which matter for private investment" (Barro, 1991, citied in Broude, Deger, and Sen 2013). This is the expenditure framework which fits Israel perfectly. Education and defense are Israel's priorities. If we consider Barro's claim true, then it should be possible to prove with growth equation that there are high externalities from the military sector in Israel. Spill-over effects from the military-industrial complex into the civilian sector should be possible to quantify but there are not many empirical studies.

Empirical Finding

DeRouen (1995) (cited in DeRouen 2000) tested the relationship between military expenditure and economic growth in Israel in 1953-1988 period. He found out that military spending had a negative but not very significant effect on the economy since the war of 1967, but since the same year externalities of military spending started to have a positive effect on civilian output.

Looney & Winterford (1995) (cited in DeRouen 2000) also conducted a research on "guns and butter" relationship. They found that military spending increased the investment in the long run. They also claimed that there was no evidence whatsoever to prove that high military burden had a negative effect on growth. He added that military aid coming from the U.S. must have been the reason that economy was balanced.

Aizenman and Glick (Aizenman and Glick 2006 Cited in Broude, Deger, and Sen 2013) use the classic Solow growth model and estimate equation where military expenditure has an impact on GDP growth rate. They found that military burden has a negative impact, the threat *per se* also has a negative effect. But when the threat is coupled with military expenditure, they receive a positive outcome.

Broude, Deger, and Sen (2013) didn't find any significant positive correlation between the military spending and economic growth. On the contrary, with their mathematical model, they found that in Israel military spending has a negative but not very significant impact on GDP growth. They assume that spin-off effects don't have strong positive effect on growth. They also calculated the impact of technological progress on growth, and found that coefficient was positive but insignificant. Their findings are against Solow's growth theory – they deny the significance of innovation impact on growth rate and effects of defense spin-offs. They argue that all the scholars

who found a positive relationship between defense industrialization and economic growth used only supply-side models and ignored the demand side models. They claim, it is wrong because military expenditure doesn't only have supply-side effects. They rely on development literature which says that growth isn't a simple phenomenon and many interrelated factors help to achieve it. They also argue, that the role of the military expenditure should be evaluated not only with supply-side effects but as resource allocation. That's why they corrected this mistake and used both supply side and demand side models simultaneously. They used simultaneous equation model (SEM). To understand their model it is necessary to know what supply and demand side models are. Let's look closely what they mean.

Supply-side economics suggest that in production function supply creates the growth. The more you produce, higher growth you will have. Increase in supply is always followed by an increase in demand. This is more right wing thinking, and Solow's growth theory fits here. Demand-side economics imply that demand is the leading force of the economy. Increase in demand stimulates the growth, and one should be concerned with the increase of demand, because it will be followed by an increase in supply and overall growth. Now, supply-side effects of military industry are - increased number of products through increased efficiency of production. Defense R&D allows the industry to produce more product when labor and capital are fixed, thus in more efficient way. (Defense R&D creates better blueprints). The demand side of the military is related to Keynesian multiplier, defense industry employs more people gives them salaries, thus there is an increase in demand. Employees can go and buy more things and benefit other businesses. As it was mentioned in the theoretical background - it only works for a short-term growth. The Keynesian expansionist fiscal policy does not give a high rate of growth in a long run. The government cannot increase demand artificially for a long time. The high deficit in the budget for long-run causes extreme inflation. (Which was present in the case of Israel.) Borrowed money spend on military creates crowding out effects. It creates a dramatic rise in real interest rates which in return decreases economy's lending capacity, and businesses stop making capital investments. When business stops investment the result is underemployment. I think that DeRouen's (2000), Aizenman and Glick (2006), Looney & Winterford (1995)'s findings are more relevant for this thesis. They tested supply sides of the military industry and they found a positive relationship between these supply-side effect and growth rate. What Broude, Deger, and Sen (2013) were checking was Israel's military spending with demand-side effects too, what they got, (positive but

insignificant impact) is a compensation effect. Supply-side effect compensated for demand-side effects. Of course, U.S. military aid helps the compensation of demand-side effect in a short run too. But my opinion on U.S. aid in Israel is that it just creates another "Dutch Disease" effect there, and they would have been better off without it like South Korea was. The conclusion from Broude, Deger, and Sen (2013)'s empirical analysis would be that supply-side effects of the military industry are so significant that they compensate for demand-side effects of military burden which is also eased by U.S. aid.

When it comes to empirical finding of this thesis Israel isn't very generous with sharing how much it spends on defense R&D so instead, thesis looks at the data which shows how much Israel spends on Industrial Production and Technology. Paper implies that this data could be closest to defense R&D because the military industry is the biggest in Israel and there many evidence that they work a lot on military technology. Patent data, on the other hand, is for non-resident.

Table 10 Empirical Findings

Correlation Analysis		
Year	Patent Applications, non-residents World Bank Data	Industrial production and technology R&D GBAORD OECD
1993	2635	242.904
1994	2701	298.161
1995	3159	322.313
1996	2101	331.823
1997	1445	409.788
1998	3106	392.571
1999	3904	379.183
2000	5203	507.784
2001	5521	499.926
2002	5095	437.956
2003	4569	499.185
2004	4870	429.168
2005	5157	379.183
2006	6154	392.445
2007	6394	360.914
2008	6214	408.409
2009	5387	445.512
2010	5856	439.089
2011	5526	450.952
2012	5473	514.34

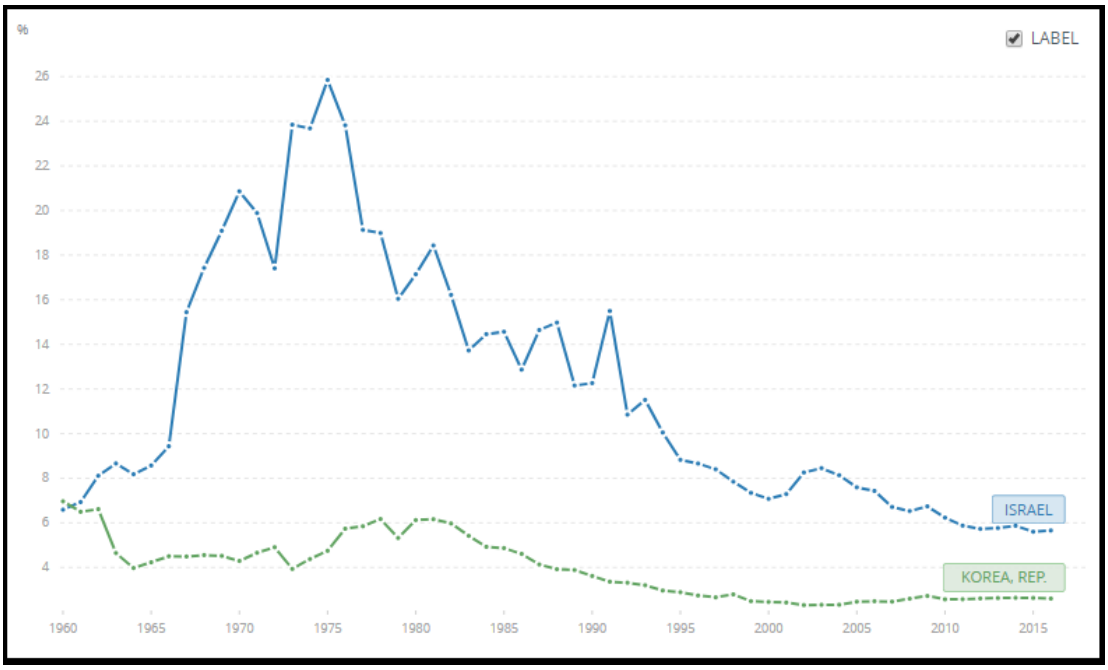
2013	4984	503.972
2014	5148	531.498
2015	5623	546.349
Correlation 0.552423		

On table 10 we see that correlation between patent data and expenditure on industrial production and technology R&D isn't significant. This finding couples with its insignificance, does not prove much about the relationship between R&D and innovation because information on defense R&D is classified.

Comparison of Two Cases and Conclusion

Military threats coming from neighbours of Israel and South Korea encouraged these countries to seek self-reliant defense posture. To that end, both countries industrialized their defense sector and achieved impressive advances in defense technology. As we have seen in this paper, there are many ways how defense industry can affect economic growth namely: 1) government produces a military product and then buys it and it has a direct effect on GNP. 2) It affects the economy because of industrial diversification. 3) There definitely is human capital development and employability in the defense sector. 4) There is, of course, international arms trade. But most importantly this thesis makes emphasis on defense technological advancement that has a spillover effect in commercial sectors.

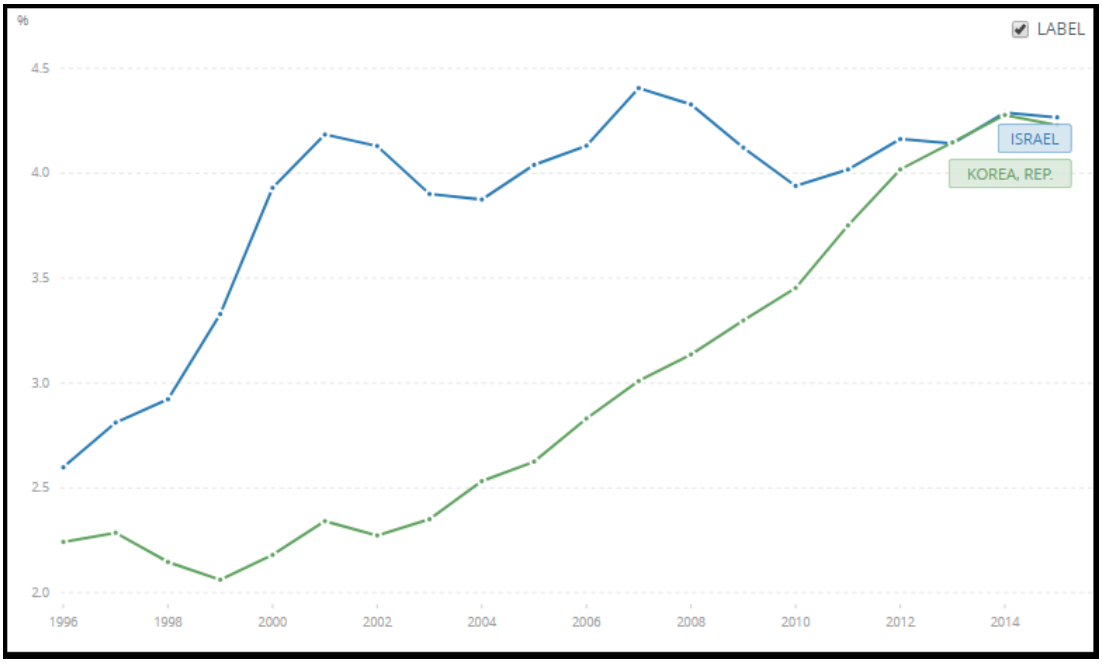
Table 11 Military expenditure (% of GDP) (World Bank Data)



On table 11 we see that Israel has been spending much more on military as a percentage of GDP than South Korea. It isn't surprising because Israel was fighting actual wars against its Arab neighbors especially in 1970s and it is reflected on the graph. South Korea, on the other hand, beside provocations and small confrontations has been relatively peacful. However, threat was real and South Korea as well as Israel was industrializing its military rapidly.

Both countries of this study invest a higher percentage of their GDP in R&D than any other country with similar or higher GDP. These countries started off with helping companies to acquire new technologies and they did not leave companies dependent on foreign technological assistance, they built domestic R&D capability, and they did it by attracting various established engineers and scientist from all over the world.

Table 12 Research and development expenditure (% of GDP) (World Bank Data)



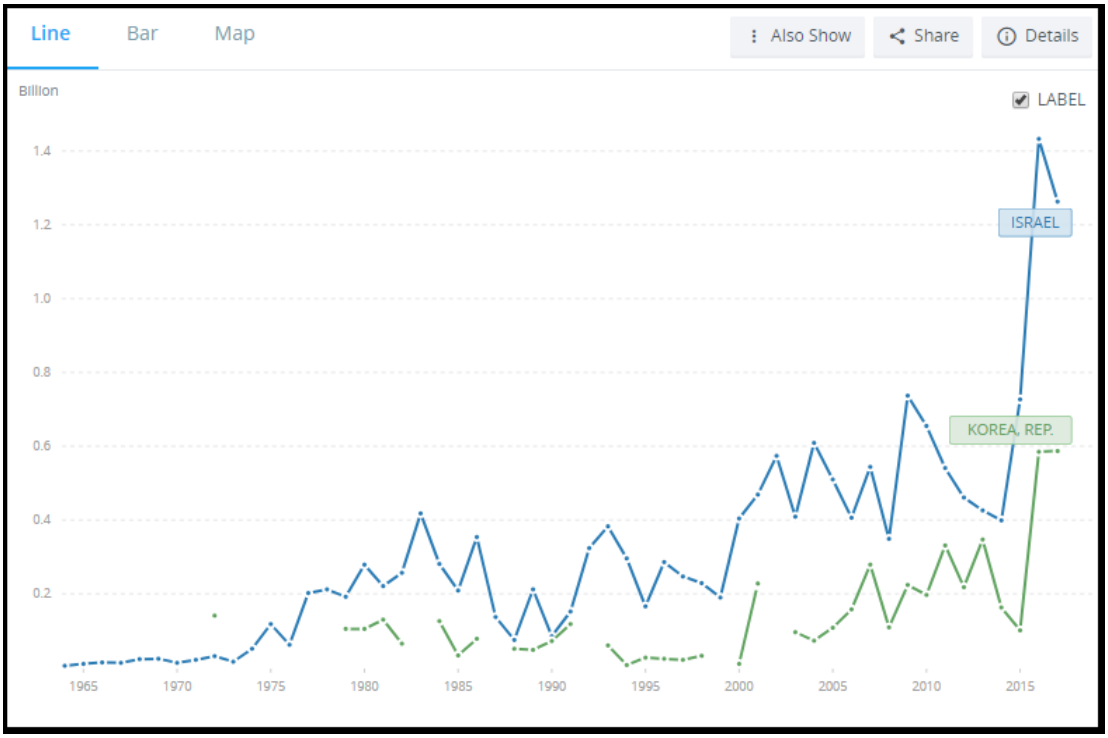
On table 12 we see that Israel has been spending much more on Research and Development than South Korea. Although Israel does not share how much it spend on military R&D but from the graph we see that its spending follows the pattern of escalations in the country. For example: in 2000 second Intifada started and in 2006 second Lebanon war. This gives us a reason to think that overall R&D in Israel is oriented on military even though it is not revealed.

Military threat which leads to military industrialization and produces output rather than only input. Evidently, increased investment in defense-related R&D has a direct effect on technological change, and because of Solow's growth model, we know that technological change and GDP growth rate have a positive correlation.

The research paper found out that in South Korea's defense R&D has a significant correlation to innovation indicator which is patent applications per year. Relying on these findings and findings of other scholars, this thesis suggests that there is considerable evidence to assume that military tension through defense R&D has an impact on growth rate.

Military R&D isn't the only factor that has a positive relationship to growth. Exports are pretty beneficial too. Plus it doubles the incentives to invest more in research and development. First of all, domestic market is not enough for huge military industry. It is not possible to sell all the output in domestic market that is way international market is needed. So, exports as output and direct benefit to economy, helps the innovation because when a country intends to export weaponry internationally, foreign market puts it on international competition. The international competition itself pushes for more incentives to innovate.

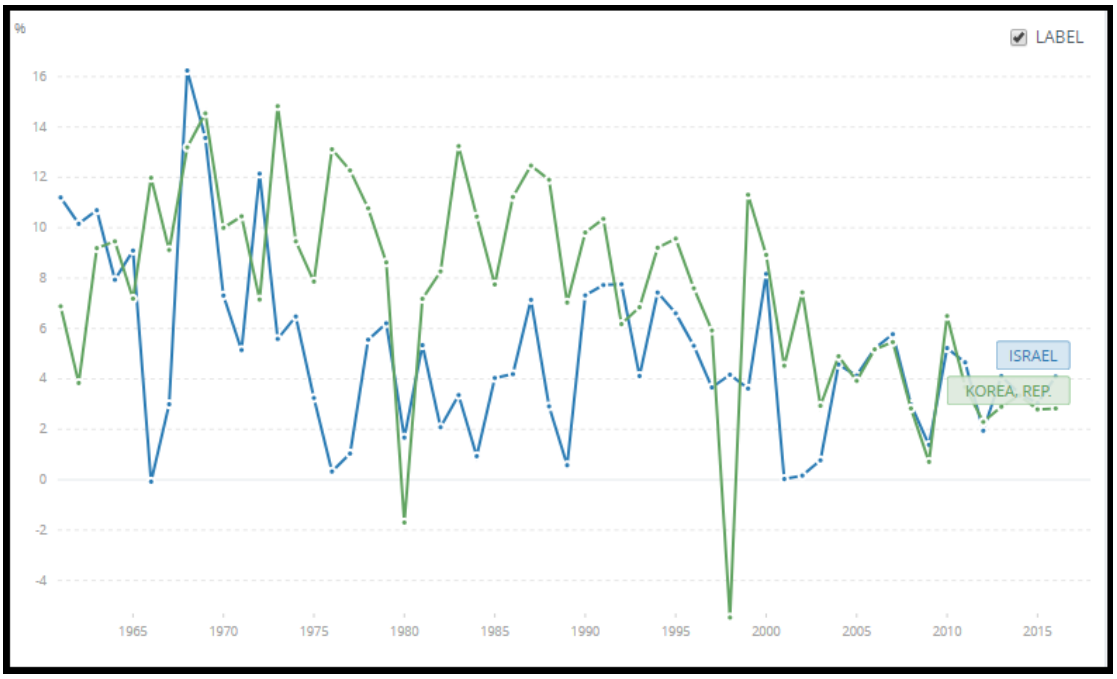
Table 13 Arms exports (SIPRI trend indicator values) (World Bank Data)



On table 13 we see that South Korea's data is fragment though it is clear that Korea has less exports but follows the patterns of Israel's arms exports.

Finally, let's look at the comparison of GDP growth rate.

Table 14 GDP growth (annual %) (World Bank Data)



On table 14 we see that South Korea has been much more successful in economic growth. The question is if technological progress is the core force to growth and both countries are prominent to be technologically most advance why was Israel growing slower when it was spending more of its money on R&D? Well, if we look closely to this graph we will see that Israel's economy had several shocks in the periods when it had wars. Meanwhile, South Korea was enjoying war-free environment while still threatened by North Korea and having incentives to grow fast.

Of course, with this analysis paper does not imply that military threat and technological advancement in military industry and its spillovers explain economic miracle of South Korea as a whole. It might not have had a decisive say in the overall economic performance, but it is still interesting to look at the growth patter from this perspective.

Empirical studies conducted on South Korea was more homogenous and it agreed that defense R&D had positive effect on growth. It was shown by the finding of this paper too. However, empirical findings of Israel were more controversial, some found that military R&D had positive impact on growth, but it was balanced by Broude, Deger, and Sen (2013) study which had more e sophisticated design, in the sense that it tested both supply side effects of military industry

as well as demand side effects. It is not fair to compare Broude, Deger, and Sen (2013) study to Korean studies because they too mostly tested supply side effects. However, I think that if it was possible to collect data on Israel's military R&D and tested with this papers framework, it would show less significant correlation than of South Korea's. Broude, Deger, and Sen (2013) findings still have to say much about supply side effects too.

In the beginning of the paper it was emphasized that threat has a positive impact on growth rate - war does not. The difference between Israel and South Korean military industries is that Israel has a much bigger demand-side effect of it (due to wars that it has been having) than the supply side ones. To sum up, military tension has a positive effect on economic growth through many factors but mainly though military R&D. It is evident in South Korea, and in Israel it would have been more significant if country didn't have so much wars which increased the demand side effects of military industrialization, namely crowding out effect.

*** * ***

In development literature, there is an inconsistency over what exactly causes rapid economic growth. There is a variety of opinions - starting with market liberalization, big inflow of FDI, support to education and healthcare and ending with good governance and development aid. This paper suggested an alternative approach, when it comes to development – William Easterly's motto - "People Respond to Incentives" is the right approach. None of the well-proven strategies will work if the incentives are not right. Market liberalization may not bring as good results as was expected - as it happened in Latin American countries after the Washington Consensus. FDI inflow might not be as successful as one would suggests, sometimes foreign investors might want to gain fast money - neither diversify economy nor bring know-how with them. Aid is the most controversial among others, it might stagnate the economy instead of helping it to achieve sustainable growth. Because giving aid to countries doesn't give them incentives to grow, it gives them incentives to expect more aid and become dependent on it. For growth - incentives matter the most.

I think that military tension can be one of those incentives. It makes governments to get some decision right – investing in science or industrialization. This paper examined economic effect of military industrialization in Israel and South Korea, and more specifically spin-off effects of defense research and development. These countries are the highest spenders in Research and Development as of percentage of GDP and bigger shares of these funding go to defense R&D (We

can't be sure about Israel). There was expected a relationship between such a high investment in R&D and high rate of growth. Expectations were met.

The research paper found out that in South Korea defense R&D has a significant correlation to innovation indicator which is patent applications per year. In Israel defense R&D data is classified which gives us a basis to think that their defense R&D is even higher than South Korea's. Data indicating the money spend in other fields of R&D do not have a significant correlation with innovation indicator in Israel. In sum, the thesis suggests that there is a considerable evidence to assume that military tension has an impact on growth rate. Also, in case of Israel, impact might be less because the positive impact that defense R&D has on growth compensated crowding out effects of overall military expenditure. Even though it is proven that military R&D has a positive effect on growth this thesis does not imply any policy suggestion concerning military industrialization and increasing funding for defense R&D. It only has an explanatory purpose. Moreover as Easterly (2002) mentioned it is not possible to explain what was the exact reason of East Asian "gang of four's" success. And it is definitely difficult to replicate it. Economic growth is a very complex phenomenon, and scholars haven't been able to identify exact recipe for it. It is easier to understand patterns of development rather than growth of GDP. It is more likely that nowadays economic growth can be reached much more effectively with the policies that are made for economic goals. As a takeout, thesis suggests that national defense industries shouldn't be promoted in order to accelerate economic growth. Even though it explains growth phenomenon partly, from a policy perspective, it should not be pursued. The positive side effects of defense industrialization are apparent in many cases, but it can have negative side effects too. As a matter of fact, it is always very hard to predict if benefits or supply side effect of defense expenditures will outweigh significantly the demand side effects and its costs. Pursuing military industrialization and investing in military R&D is even worse for the countries without military tensions. It must be said that high military expenditure and the military-industrial complex might contribute to creating one. Because there is a factor of security dilemma – when a country starts military industrialization and development of high technological weapons, its neighbors receive it as a threat and respond in a hostile manner. Risking security is far too high price for economic growth. Government's traditional responsibility is to ensure security first. There can be no sustainable economic growth without it.

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