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THE PROBLEM OF FREE RIDING IN NATO OVER THE PERIOD OF 2006 – 2016 AND ITS IMPLICATIONS FOR FISCAL POLICY

Bachelor thesis

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I hereby declare that I compiled this thesis independently, using only the listed resources and literature.

Jitka Richterova

In Prague, 12.05.2017

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BACHELOR THESIS TOPIC

Author of thesis: **Jitka Richterová**

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Topic: **The Problem of Free Riding in NATO in the period of 2006 – 2016 and its implications for fiscal policy**

Guides to writing a thesis:

1. Aim:
   The aim of the thesis is to (1) identify and describe the problem of free riding within the North Atlantic Treaty Organisation as well as to prove that such a problem is occurring and (2) analyse defence expenditures of member states in the period of 2006 – 2016.

2. Significance, relevance and use of the topic:
   In an inter-connected, globalised world where resources are shared and alliances are made, it is also important to share the economic burdens of these. The ongoing inequality of contributions of member states to the North Atlantic Treaty Organisation's budget and missions is an ongoing topic for burden sharing debates. This economically called problem of free riding becomes even more of a current issues with the turbulent changes in international politics such as the Brexit, the election of Donald Trump as the new president of the United States and the ongoing crisis in the Middle East and Russian threat. All of these cause both economic and political shocks and shifts in the dynamics of NATO expenditures and negotiations. With these events it is even more important to revisit the burden sharing debates and examine the problem from economic perspective and attempt to offer recommendations.
   The burden sharing debates are ongoing for the past decades however nowadays they are becoming even more important for both internal NATO researchers and external analysts. There is a need for NATO to go beyond diplomatic burden sharing debates and look at possible solutions. With these comes the challenge and relevance of economic research that should attempt to offer additional explanations based on economic analysis of the problem. The thesis also aims to provide a material for the ongoing burden sharing and free riding debates that are currently among the priorities for NATO based on the most current issues and political shifts and especially given the limited number of research concentrating on economic solutions to the problem of free riding applied on NATO specifically.
   In 2006 NATO set a criterion for defence spending on 2% of GDP. This part of NATO's burden sharing strategy closely impacts the long term strategy of budget, expenditures and fiscal policy of the member states. Thus the topic of free riding in NATO based on analysing defence expenditures and its deviations from the 2% criteria across the member states is closely relating to fiscal policy. The results of analysing the defence expenditures from an economic point of view have direct implications for defence spending either as set by the alliance or as individual recommendations to the member states. Hence the possible outcome and recommendations of the thesis will directly involve and impact fiscal policy and budget.
3. Characteristics of theoretical part:
   The thesis draws on principal sources on the topic such as Free Riding by Tuck, several publications on defence economics and NATO burden sharing by Sandler and Hartley as well as books on solutions to free riding like Optimal Allocation of Goods by Groves and Ledyard, the Parial Equilibrium Approach by Green, Kohlbeg and Lafont or the New Mechanism to Free Riding Problem (2008) by Hajek and Sanghavi.
   In theoretical part the thesis is mostly concerned about the economic theory of alliances, burden sharing debates in NATO and problem of free riding within the Alliance. The thesis proves by graphical and quantitative analysis of primary data that there is a problem of free riding in NATO and continues by attempts to apply economic solution based on own calculations and the aforementioned principal sources.
   The theories and definitions the thesis works with are the problem of free riding which occurs when "public goods (in this case collective defence is viewed as pure public good) provide an incentive for a nation to "free-ride" when it knows that other nations will provide sufficient alliance defence for its needs" (Montolio, Gnzález, 2014). And burden sharing, which refers to sharing the "burden" of costs and expenditures borne by the nations involved in the international peacekeeping body tat provides benefits of collective defence (Sandler, Hartley, 2007).
4. Characteristics of practical part:
   The thesis uses quantitative, statistical and econometric tools to indicate and analyse the problem of free riding in NATO based on analysis of defence expenditures of member states in period 2006 – 2016 based on the data from primary sources such as OECD, SIPRI, NATO
5. Key Words:
   NATO, Free Riding Problem, Burden Sharing, Public Sector Economics, Defence Economics

Length of thesis: 45

Selected bibliography:

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Abstract

The purpose of this thesis is to examine the problem of free riding in NATO with regards to fulfilling the criteria of defence expenditures as well as econometric analysis and interpretation of the defence expenditures of the member states in the period of 2006 – 2016. Using spearman correlation test, this thesis finds a significant positive correlation between GDP of member states and their defence expenditures. Explanatory variables include main economic indicators such as GDP, GNI, share of GDP devoted to defence expenditures, average annual change in defence expenditures, etc. Main findings include the conclusion that there is a significant level of free riding in the North Atlantic Treaty Organisation and that larger member states indeed bear the larger burden. Furthermore, based on having lower average defence expenditures than NATO in the examined period, the thesis labels nineteen of the member states as free riding, given that their defence expenditures are below the NATO average. After examining and analysing free riding in NATO the thesis also highlights the implications and recommendations for fiscal policy.

Key words: NATO, free riding, burden sharing, defence expenditures
JEL classification: E62, D74, H2, H56, H61

Abstrakt

Cílem této práce je identifikovat a popsat problém černého pasažéra v Severoatlantické alianci na základě kritéria výdajů na obranu. Práce k dosažení cíle používá ekonometrické nástroje a analyzuje širokou škálu dostupných dat. Pomocí spearmanova korelačního testu sleduje tato práce srovnání jednotlivých států Aliance a prokazuje významnou pozitivní závislost mezi velikostí HDP (a alternativně HND) státu a břemenem nákladů jednotlivých členů Aliance. Vysvětlující proměnné zahrnují zejména HDP, HND, výdaje na obranu jako podíl HDP, meziroční změny výdajů na obranu v období 2006 – 2016 a další. Mezi hlavní závěry práce patří argumenty podporující tvrzení, že v Alianci je významná úroveň černého pasažérství a větší členksé státy skutečně nesou disproporciálně větší břemeno nákladů. Dále, vzhledem k výsledkům analýzy srovnání zemí, tato práce označuje devatenáct členských států za černé pasažéry. Po prozkumání a zanalyzování problému černého pasažéra v NATO tato práce také obsahuje interpretace výsledků, důsledky a doporučení pro fiskální politiku.

Klíčová slova: NATO, problém černého pasažéra, výdaje na obranu státu
JEL klasifikace: E62, D74, H2, H56, H61

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List of Abbreviations

BMVg - Bundesministerium der Verteidigung

Cont. – continued

DoD – Department of Defence

EU – European Union

EUR - euros

GDP – Gross Domestic Product

GNI – Gross National Income

HQ – Headquarters

MAD – Mutual Assured Destruction

NATO – North Atlantic Treaty Alliance

NAC – North Atlantic Council

NSIP – NATO Security Investment Programme

OCO – Overseas Contingency Operations

OZ – Olson Zeckhauser Model

SIPRI – Stockholm International Peace Research Institute

US, USA – United States of America

USD – American dollars

UK – United Kingdom

UN – United Nations

Introduction

In 1990's NATO underwent a transition for which it was not prepared. The fall of the Berlin wall marked the end of the traditional threat from the East. On the other hand, new threats and challenges were almost simultaneously arising, new military technologies were discovered and new member states accepted. Such radical changes and challenges led to unavoidable debates on the new purpose of NATO as well as burden sharing and defence expenditures debates. The challenges naturally resulted in NATO's researchers examining the situation and trying to find a solution deriving from theories of public goods.

In 2004, NATO accepted seven new member states[1] as a part of second post-Cold War expansion. Consequently, alongside the decreasing trend of defence expenditures and the sudden expansion of the Alliance, at the end of the Cold War, NATO found itself in a need to set a new criterion to make the share of burden more equal. This need resulted in today's well known and largely discussed 2% criterion.[2]

Today the situation of NATO is not so different, the turbulent political shifts together with challenging economic situation remind the Allies of an old and not entirely resolved dispute over the fair share of burden. Several old threats are vanishing, new threats and challenges are arising. Let us mention, for example, the re-emergence of the Russian Federation representing the threat from the East, the Islamic State from the South and the tactic of hybrid warfare (Richterova, 2015) all resulting in the need for new comprehensive defence approach and more complex perception of defence and security. NATO is once again having debates on the purpose of the alliance, further enlargement, new technology and approaches used for defence and security and the arising burden sharing debates.

The United States of America have had traditionally a special strategic position within the Alliance. Ever since its creation, the States have stood in its centre and acted as a large protective umbrella for many European countries. Since the beginning of the Alliance, the disproportion of defence expenditures was visible. The United States have always had higher military expenditures in terms of percentage of GDP and have remained relatively stable over the past decades in the US, whereas in Europe, there is a noticeable trend of decrease of military spending that could almost be labelled as a trend of disarmament. These trends

[1] On 29 March NATO accepted 7 former SSSR states: Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia as the second round of post-Cold war enlargement

[2] According to this criterion, all member states should spend 2% of their GDP on defence

caused the disproportion of sharing the economic burden of the Alliance to become more apparent and the gap between states bigger. The diplomatic representation of the United States has been pointing this fact out for many year and appealing on Europe to concentrate more on defence and not rely on the protection and strategic alliance with the United States. However, what has been slowly diplomatically suggested over the past few decades is now being articulated loudly and more clearly than ever before. The contemporary dramatic change in the rhetoric of US diplomats and the new president, Donald Trump, signals, that a lot could change and the US might abandon its position of traditional protective ally of Europe. And thus Europe might stand on the tipping point and be forced to start rely less on the United States and do more for its protection otherwise it may soon find itself in a difficult position of weakened security.

The paragraphs above illustrate the relevance and importance of the topic with regard to current economic and political situation in Europe and Northern America. The debates on free riding are a common topic of both diplomats and media, however, the debates often result in accusations between Europe and USA and smaller and larger Allies of free riding. This thesis attempts to clarify the problem of free riding and offer conclusions on which countries can be labelled as free riding by providing theoretical framework and analysis of defence expenditures and free riding based on pure public goods theory and the OZ model between the years 2006 and 2016. The thesis sets two hypotheses: hypothesis (1) there is a significant level of free riding within the Alliance; and hypothesis (2) small allies are freeriding on larger Allies.

The thesis is organised as follows: Chapter 1 explains and defines the most important terms and definitions. Chapter 2 describes the data and methods used in this thesis. Chapter 3 outlines the basics of the economic theory of peacekeeping alliances, explaining some of the most basic assumptions of why countries join military alliances such as NATO and outlining several benefits from membership as well as offering implications for NATO. Chapter 4 is dedicated to explaining the functioning, categories and criteria of NATO funding which is considered relevant for further analysis of the problem of unequal distribution of the contributions to NATO public good by individual member states. Chapter 5 discusses the problem of not unified defence budgets across the member states. Furthermore, it provides description of the definition of defence expenditures by the Alliance as well as detailed list of items accountable as defence expenditures by the unified system as developed and used by NATO. As a demonstration of the problem of various systems of defence budgets which

can easily lead to misinterpretation of free riding, the chapter also discusses the differences on comparison of defence budgets of the USA and Germany. Chapter 6 is dedicated to free riding. It describes the two main theories of defence as public good and the joint product representation theory. It also includes the OZ model upon which is largely based the analytical part of the thesis. It also indicates burden sharing criteria and free riding measures as well as brief discussion of problems of several of the criteria and subjectivity of interpretation of free riding. And finally, this chapter also briefly suggests tools for reducing free riding which are divided between economic and diplomatic tools. Chapter 7 is the analytical part of the thesis and analyses NATO defence expenditures and free riding problem using econometric tools including the spearman correlation test which examines the relationship between wealth of a nation, represented by GDP or GNI, and the share of the burden a nation bears. And lastly, chapter 8 describes the most important implications and recommendations for fiscal policy. Apart from suggesting expansionary fiscal policy, the chapter also discusses possible ways of how member states can finance the desired increase in defence expenditures.

1. Terminology and Definitions

Prior to developing theoretical framework and constructing econometric models, it is vital to define and clarify the terms and definitions and explain how they are treated in the thesis. As the thesis discusses free riding in terms of defence expenditures, it is crucial to describe its definition. The term *defence expenditures*[3] is a broad one, generally, it may seem obvious, that every cost related to military or defence could follow under this term. However, this is not always the case and, especially in media but also in various supranational bodies, defence expenditures are viewed and treated as defence budget of a nation. However, as the thesis shows in chapter 5. such definition is narrow and omits several defence expenditures that are not included in national military budgets. Other ways of working with defence expenditures rely heavily on reporting of sovereign nations to international bodies, such as the United Nations, SIPRI or NATO. Although the SIPRI definition on defence expenditures is based on NATO guidelines. For the purpose of the thesis and with regard to the data used, the paper works with defence expenditures as defined by NATO unified criteria, further specified in chapter 4. It is vital for the thesis to work with the NATO defence expenditures definition, given that all data analysed in in the thesis is taken from official NATO resources. The data in several cases largely differ from the data reported by individual member states' governments or other international bodies, including UN, SIPRI, OECD or World Bank. Furthermore, as the analytical part of the thesis analyses free riding based on the contributions to NATO Common Funding and based on their defence expenditures as a share of GDP, it is necessary to apply the data and definitions precisely in the same form as NATO. Exceptions and further specification are available in chapter 2. on data and methodology.

Another term closely related to the problem of free riding, based on defence expenditures and contributions to NATO funding, is b*urden sharing*. This term refers to fairness of proportion of costs that a nation shares on the public good in question within the Alliance. As one of the leading researchers on NATO public and defence economics, Hartley described it; "*NATO burden sharing debates are about what is and what ought to be. They*

[3] The thesis also occasionally uses the terms defence or military spending; those terms are treated as synonyms.

are about the actual contribution of each nation to collective alliance defence and the fairness of each state's contribution."[4]

And lastly, the term *free riding* itself according to OECD definition "*occurs when one firm (or individual) benefits from the actions and efforts of another without paying or sharing the costs*."[5] For the purposes of the thesis, free riding will occur if a NATO member state will benefit from the provided public good, defence, without equivalently sharing the burden. Free riding and burden sharing are for the purposes of the thesis perceived as two sides of the same problem and will be henceforth treated as one problem given that burden sharing examines the fairness of contributions,[6] and similarly, free riding occurs when a nation enjoys benefit without equivalently paying for them, implying an unfair situation of clearly not contributing the fair share for the benefit it enjoys. Thus it is possible to treat those two concepts as two sides of the same problem given that they are both concerned with the same issue of appropriate or fair distribution of costs between the Allies.

[4] HARTLEY, Keith. STATE BUDGET IN A CHANGING ECONOMIC AND SECURITY ENVIRONMENT. NATO [online]. 1998 [cit. 2017-04-25]. Dostupné z: http://www.nato.int/docu/colloq/1998/13-hartley.pdf

[5] KHENAMI, R.S. a D.M. SHAPIRO. *Glossary of Industrial Organisation Economics and Competition Law*. Directorate for Financial, Fiscal and Enterprise Affairs, OECD, 1993.

[6] Fairness in this context is derived from the proportion of costs shared, as for example in the case of NATO Common Funding or in the form of devoting the appropriate amount of budget to defence expenditures, as in the case of the 2% criterion.

2. Data and Methodology

Generally, the data used in this thesis is taken from NATO official reports. Exceptions to this is chapter 4. regarding national defence budgets where the data is not only from NATO but also from available national sources, concretely the Government of the United States and the Government of the Federal Republic of Germany. Furthermore, for comparisons, the chapter also contains data from SIPRI.

In chapter 7.2.1. the cost sharing indexes are valid from January 2016 until December 2017. The data used in NATO Common Funding analysis, concretely the Gross National Income data is from another primary source, the World Bank. The Gross National Income as well as the GNI per capita data are from 2015 and are based on current US dollars.

In table 6., the defence expenditures as percentage of GDP, the data is based on NATO provided information. The data is expected to be slightly distorted given that the data from 2010 until 2016 are based on 2010 prices, the data of 2016 is NATO's most current estimate and the data of 2006 – 2010 is based on current prices of the respective years. This leads to small distortion in the econometrical results, however, the distortion in data are not expected to be big enough to critically influence the empirical results.

Regarding appendix 1 which describes average annual real change of defence expenditures in percentage of GDP, the data of 2006 are estimated and based on current prices, flowingly, between 2007 and 2008 are based on 2005 prices, they include non-deployable elements of Other Forces for most countries apart from Greece, Hungary, Portugal, Turkey and Italy. From 2006 they are calculated with a new accounting methodology as set by NATO and do not include pensions. From 2009 defence expenditures do not include Gendarmerie. Moreover, data do not include military pensions for UK and US. From 2009 to 2016 the data is based on 2010 prices, the data of 2016 is NATO's most current estimate.

The thesis uses several different methods, chapter 5.2. demonstrates the differences of defence spending systems and definitions based on case study analysis and comparison between NATO unified system and the defence budget of Germany and the United States of America. Chapter 5.4.4 on subjectivity of interpreting free riding uses the method of practical demonstration. The analytical part uses general econometric and statistical methods and tests the correlation between an ally's GDP (or GNI) and defence expenditures using the Spearman correlation coefficient to test correlation between two rankings. (Olson, Zeckhauser, 1966.) Spearman correlation is a non-parametric test that determines correlation between two ordinal variables. The requirements for the Spearman correlation are such that

the two variables are measured on a continuous or ordinal scale. As all requirements are fulfilled, it is possible for the analytical part of the analysis to use the test. The Spearman correlation was chosen due to the fact that it does not require normal distribution of the variables unlike, for example, the widely used Pearson's correlation test. (Wooldridge, 2009.)

3. Economic Theory of Peacekeeping Alliances

The North Atlantic Treaty Organisation was created on April 4, 1949 in Washington. The creation of the Alliance had several reasons, one of them being the increasing threat posed by the expanding Soviet Union. NATO's aims included creating counter force to the Soviet expansion and protect its member states. Lord Ismay, NATO's first Secretary General expressed and summed up the purposes in his famous quote: "*to keep the Russians out, the Americans in, and the Germans down.*"[7]

NATO, however, had more aims and benefits to offer to its members. The membership in the Alliance has always been and still remains purely voluntary. States are expected to join and remain members as long as the membership is beneficial, speaking in economic terms, as long as benefits exceed costs. The membership is expected to remain beneficial as long as the Alliance offers protection and opportunity to lower defence costs compared to non-membership. Given the characteristics of public goods, it is clear that a nation's total costs on defence are lower when in an Alliance compared to non-membership. If a nation is not a member, it will have to pay the full costs of defence, based on its preferences and the demand for the good. On the other hand, member states have lower costs on defence given that part of their demand is covered by the common defence infrastructure offered by the Alliance. (Olson, Zeckhauser, 1966).

Despite the fact that there is no measure available to determine the exact amount of benefits that a state receives from membership compared to costs, several researches have outlined many benefits that states are enjoying, starting from increased cooperation, lower defence costs and even include increase in foreign investment to name an example (Gowa, Mansfield, 2004).

The traditional benefits that a member state can expect from joining a military alliance are generally identified as deterrence, protection and damage limitation, those are considered to be the direct benefits.

Other categories and benefits include:

- direct - deterrence, protection and damage limitation;
- indirect - trade and investment;[8]

[7] *NATO: North Atlantic Treaty Organisation* [online]. [cit. 2017-05-09]. Dostupné z: http://www.nato.int

[8] Empirical research found observable increase in foreign investment for member states based on increased trust and perceived security of the environment (Mansfield, Bronson, 1991) as well as empirical evidence of increased trade between allies compared to non-allies (Long, Leeds, 2001).

- material, such as lowered defence costs and increased investments;
- non-material, such as higher security and protection.

On the other hand, the costs of membership include mainly contributions of member states to NATO's Funding. The concrete items and regulations of the funding are further discussed in chapter 4.

The economic theory of alliances is important given that it provides useful explanations for the dynamics and understanding of burden sharing, mostly outlined in the economic models of military alliances. These models provide several conclusions for unequal burden sharing. Firstly, based on their own self-interests, larger states will spend bigger share of their budget on defence than smaller states. Secondly, it is natural that small allies are relying on protection of the larger allies. And thirdly, as further expansion and accepting new member states does not diminish benefits of already existing members, there is no need restrict the size of an alliance (Sandler, Hartley, 1999).

An important conclusion for economic policy that economic theory of alliances provides is that the more the particular defence outputs are private to a state or are directly benefiting it, the more likely they will be financed by the directly benefiting nation, in which case free riding is not expected.

4. NATO Funding

In order to understand the problem of free riding in NATO, it is important to comprehend how the NATO Funding and the contributions of Allies function. This chapter describes the system of NATO funding with its categories, requirements and contributions, including its sources. Apart from requiring all member states to fulfil certain defence expenditures criteria, that are well known, NATO also requires the members to make both direct and indirect contributions to NATO budget. Those other contributions are often omitted in modern media articles that are concerned with free riding despite the fact that they are equally as important as the well-known and by far not perfect 2% criterion.

4.1. Indirect Contributions

Indirect, or in other words national contributions are such contributions that often come on a voluntary basis and make up for the largest part of budget.

4.1.1. NATO Operations

In case of a unanimous affirmative decision on NATO's participation in an operation as taken by the North Atlantic Council (NAC) states may on a voluntary basis decide whether or not to participate in the respective mission.[9] Although Allies may or may not contribute to operations, they have agreed on common funding for the deployment of the NATO part of NATO lead operations.

4.1.2. Defence Investment

In 2006, after another round of NATO enlargement, NATO member states agreed by unanimous vote to commit 2% of their GDP on defence spending. This measure was not only taken as a measure against the ongoing free riding debates and complaints of the United States on their unfair share of the burden, but also as a sign of political will to bear the fair share of defence burden.

Member states confirmed this commitment during the NATO Summit in Wales, where Allies reassured each other on the continuing validity of the 2% criterion and set a deadline for meeting it by 2020. (NATO, 2014.)

[9] Unless it is an Article 5 collective defence, in which case participation of all states is expected.

4.1.3. Major Equipment Spending

Just as in the case of defence expenditures, the particular allocation of the defence budget to smaller categories is a state's sovereign decision. Although defence spending as a share of GDP is a useful and major indicator, because it lacks any data on efficiency of the spending, the Allies decided to also include a requirement stating that at least 20% of national defence budget should be devoted to major equipment. This criterion is also used as an indicator of modernisation of military. (NATO, 2017.)

4.2. Direct Contributions

Direct contributions are used for the purposes of financing such requirements of the Alliance that do not fall under the responsibility of any member but represent the interest of all 28 and hence should be borne collectively, for example, NATO air defence. Whether the Alliance will use common or joint funding or trust funds depends primarily on the level of interoperability, integration, affordability at national level, potential for economics of scale and complexity of systems involved.

4.2.1. Common Funding

The principle of common funding works by setting a cost-sharing formula that the Allies have to agree on and is based on Gross National Income, as a share of defence budget.
This type of Alliance funding is used for financing NATO's principal budgets which are:

- the civil budget which is used to fund NATO HQ costs;
- the military budget used for integrated Command Structure;
- and NATO Security Investment Programme (NSIP) used for funding military capabilities.

The expenses of the civil budget cover personnel expenses, operation costs and capital and programme expenditure of the International Staff at NAT HQ and its resources are drawn from the budgets of ministries of foreign affairs of the sovereign member states. For 2017 the civil budget accounts for 234.4 million EUR. Expenses of military budget include operating and maintenance costs of the NATO Command Structure and it is financed from the ministries of defence of member states. The NSIP programme finances major construction command and control system investments that are beyond nationally covered requirements of individual member states. It also assists NATO Strategic Command by

providing facilities such as air defence information system, fuel system, critical airfield, etc. This programme is also financed by ministries od defence of individual member states.
The countries which are members of the Resource Policy and Planning Board discuss whether to apply the principle of common funding after a need for expenditures is identified based on fulfilling the criteria of serving the interest of all member states. (NATO, 2017.)

4.2.2. Joint Funding

Joint funding is multinational type of funding in a structured form operated and formed according to the terms of agreed character. Countries that are participating are asked with identifying requirements, priorities as well as the concrete funding arrangements, however, the Alliance provides political and financial oversight and oversees visibility and transparency of the arrangements. Joint funding is typically used to fund various NATO agencies, the concrete cost shares and other arrangements differ based on a specific requirement. (NATO, 2017.)

4.2.3. Trust Funds

The last form of funding are trust funds, which are used to fund certain projects on a basis of ad hoc financing system, donations or sharing arrangements.
The aforementioned categories of the NATO budget, their sources and what they cover are summarized in following table 1.

Table 1: NATO Budget Summary, Source: NATO and author

NATO Budget		
Direct Funding	**Covers**	**Source of Finance**
Common Funding		
Civil Budget	NATO HQ Costs	Ministries of Foreign Affairs
Military Budget	Integrated Command Structure	Ministries of Defence
NSIP	Military Capabilities	Ministries of Defence
Joint Funding	NATO Agencies	National defence budget of participating countries
Trust Funds	Ad hoc projects	States national defence budget
Indirect Funding		
NATO Operations	Operations of NAC	Voluntary bases, Ministries of Defence
Defence Investment	2% of GDP	States national defence budget
Major Equipment Spending	20% of national defence budget	States national defence budget

5. Defence Budgets

National defence and security spending is divided between several different bodies and agencies within each member state. The concrete amount and allocation of defence expenditures varies greatly, depending on the concrete preferences of a nation, military determinants in play but also in the different system of approving defence and military budget and different national bodies concerned. In international alliances, the comparison of defence expenditures becomes even more complicated given the reliance of the organisations on national reporting. Although NATO is among the more reliable sources of comparison of defence expenditures given its use of unified system, there are still reservations. Despite a slight progress and adjustments in recent years, NATO's data on defence expenditures of individual member states in most cases works with the data provided by each member state which is mostly based on the budget for Ministry of Defence or respective defence and military body. (NATO, 2017.) (UN, 2002.)

5.1. Differences in Definitions of Defence Spending

NATO has a set of categories that are accounted as defence spending, see table 2, however the concrete numbers remain to be largely distorted as they are based on each country's different system of assigning defence expenditures within different bodies and agencies.

Moreover, the amount spent itself does not speak to other attributes of the expenditures. Let us say that country A spends above 2% share of GDP on defence, but 50% of it is expenditures account for pensions, veterans and insurance, while country B spends 1.3% share of GDP on defence, however it contributes to missions with troops and soft power or humanitarian assistance and largely invests into combat-effective armed forces as well as research in military technology. The simple label of country B as a free rider based on not adhering to the 2% criterion seems unfair and illogical.

It is important to remember that analysing free riding in NATO will necessarily result in different conclusions and results based on the criteria and explanatory variables chosen as well as based on which items will be included in nations' defence expenditures. Although the thesis works with unified data on defence expenditures, as provided by NATO, it remains debatable whether or not NATO should introduce new unified system which would include more items, mostly related to security, given the necessary broader concept on defence and security deriving from the newly re-emerging hybrid warfare and the need for a comprehensive defence approach.

5.2. Case Study: Comparison of Defence Expenditures: NATO, USA, Germany

As mentioned above, when it comes to comparing defence expenditures, several factors need to be considered. Most importantly, the different systems of sovereign nations of allocating and approving defence expenditures and their reporting to international bodies. The United Nations has been developing a unified system for reporting and accounting defence expenditures since 1975. Most of NATO member states do report their defence expenditures to the UN, however this system is largely based by the numbers reported by nations on what is included in the Ministry of Defence budget. Being aware of this problem, NATO has developed its own set of defence expenditures reporting which is regarded as one of the most reliable sources as it does not rely solely on reporting defence expenditures based on budget of Ministry of Defence (or equivalent). Other systems include for example the data from SIPRI which has developed its system using the NATO guidelines and is largely based on the NATO system, although the data provided by NATO and SIPRI differ. (UN, 2002.) (SIPRI, 2016.) This can be easily demonstrated on the example on the United States and Germany where according to NATO data, defence expenditures of USA are 641, 253 and for Germany, it is 39,813. (NATO, 2016.) According to SIPRI, USA defence expenditures are 596 and Germany's 39.4. All data is for 2015 and in billions of USD using market exchange rates. (SIPRI, 2016.) It is noticeable, that while in the case of Germany, the data are quite similar, in case of the United States, there is a significant difference where according to NATO unified system, the defence expenditures of USA are 42.253 billion USD and 7.6% higher.

5.2.1. NATO

When it comes to defence expenditures, NATO recognises three main categories:

(1) pensions and personnel expenses;

(2) research, development and procurement;

(3) and operations and maintenance. (NATO, 2017.)

According to NATO, the definition of defence expenditures is as follows: "Payments made by a national government specifically to meet the needs of its armed forces or those of Allies[10]" (NATO, 2017).

As seen in table 2., which displays the breakdown of NATO accountable defence expenditures, NATO recognises the basic categories, similarly to those identified above: (1) operating costs; (2) procurement and construction and (3) research and development. The notable subcategories include (1.1) military personnel; (1.2) civilian personnel; (1.3) pensions; (1.4.) operations and maintenance; (2.1) major equipment; (2.2) national military construction; (2.3.) NATO common infrastructure; (3.1) research and development devoted to major equipment and (3.2) other research and development.

NATO takes most of the information on individual member states' defence expenditures from their respective ministries of defence. Those being: (a) armed forces: land, maritime, air forces; (b) joint formations: administration and command, special operations force, medical service, logistics command, etc.; (c) other forces: Ministry of Interior Troops, border guards, national police forces, customs, gendarmerie, carabinierie, coast guards, etc. and (d) additional forces expenditures although financed by a different ministry should also be included.

Furthermore, it is notable that NATO also counts with pensions paid to both military and civilian personnel. It also includes expenditures on peacekeeping and humanitarian operations, mixed civilian-military activities but also war damage payments and civil defence expenditures (only to the extent of the country's net contribution). (NATO, 2017.)

Even though NATO defence expenditures reporting has made a large progress, it is suntil necessary to remember, that the larger share of the expenditures is suntil heavily relying on (a) national reporting and (b) based on the ministry of defence budgets of individual member states.

[10] Information on Defence Expenditures. *NATO* [online]. 2017 [cit. 2017-04-25]. Dostupné z: http://www.nato.int/cps/en/natohq/topics_49198.htm

Table 2: NATO Defence Budget Unified Accounting System, source: NATO and author

NATO
1. Operating Costs
1.1. Military Personnel
1.1.1. Pay and Allowances
1.1.2. Employer's Contribution to Retirement Funds
1.1.3. Others
1.2. Civilian Personnel
1.2.1. Pay and Allowances
1.2.2. Employer's Contribution to Retirement Funds
1.3. Pensions
1.3.1. Paid to Military Retirees
1.3.1. Paid to Civilian Retirees
1.4. Operations and Maintenance
1.4.1. Ammunition and Explosives (excluding nuclear)
1.4.2. Petroleum Products
1.4.3. Spare Parts
1.4.4. Other Equipment and Supplies
1.4.5. Rents
1.4.6. Other Operations and Maintenance
2. Procurement and Construction
2.1. Major Equipment
2.1.1. Missile Systems
2.1.2. Missiles (Conventional Weapons)
2.1.3. Nuclear Weapons
2.1.4. Aircraft
2.1.5. Aruntilery
2.1.6. Combat Vehicles
2.1.7. Engineering Equipment
2.1.8. Weapons and Small Arms
2.1.9. Transport Vehicles
2.1.10. Ships and Harbour Craft
2.1.11. Electronic and Communication Equipment
2.2. National Military Construction
2.3. NATO Common Infrastructure
2.3.1. Expenditure as Host Country
2.3.2. Payments to Other Countries
2.3.3. Receipts from Other Countries
2.3.4. Land and Utilities
3. Research and Development
3.1. Devoted to Major Equipment
3.2. Other
4. Other Expenditures
4.1. Total
4.2. Statistical Discrepancy
4.3. Adjusted Total

5.2.2. United States of America Defence Budget

The United States has stood in the centre of the Alliance ever since its creation as it has also always been the biggest spender on military and defence, both in total numbers and as a share of GDP. The military expenditures of the United States are spread between various ministries. It covers (a) the base budget of the Department of Defence (DoD) which includes most regular military expenditures; (b) Department of Energy which covers mostly US nuclear arsenal expenditures; (c) Department of State spending on foreign military aid; (d) Overseas Contingency Operations (OCO) spending on foreign missions and operations and (e) other government departments. (SIPRI, 2016.)

The Department of Defence (DoD) accounts for the largest amount of defence expenditure of the United States. The department further breaks its budget into the following categories:

- Department of Defence Discretionary Base Budget;
- Overseas Contingency Operations (OCO);
- Opportunity, Growth and Security Initiative.

The DoD Defence Budget (2017) according to the proposal of president Trump also includes: (1) funds for protecting the military retirement, (2) funds for TRICARE and family-focused reforms, (3) funding overseas initiatives as a part of the OCO, including counter terrorism efforts in Iraq, Syria and Afghanistan and counter ISIL operation as well as countering Russian aggression, Asia-Pacific security interests and Iran; (4) Recovering Readiness and Optimising Force Structure and (5) growth opportunities.

The United States of America, unlike the majority of the European Allies, includes overseas operations and missions into its military budget, causing it to be largely higher. The data on US defence spending that NATO provides are also highly alleviated by the defence spending that are purely in national interest of the United States, such as the expenditures on security guarantees to South Korea and Japan. The whole OCO budget for 2017 is $58.8 billion, which represents over 11% of the whole DoD budget which totals $582.7 billion. Hence if a comparison of defence spending is made solely based on the budgets of Ministry of Defence, the numbers of the USA are highly distorted compared to the European Ministries that do not incorporate operations and missions into their military and defence budgets. On the other hand, USA has another $175.9 billion of defence expenditures spread in other bodies. That is over 30% increase compared to the DoD which would be omitted.

Other bodies involved with defence expenditures in the United States are for example the Department of Veteran Affairs, the Department of State, Homeland Security, Department of Justice: FBI and Cybersecurity and Department of Energy: National Nuclear Security Administration. (Amadeo, 2017.)

Table 3: Defence Expenditures, USA, source: USA Government and author

United States of America
Included in Department of Defence (DoD) Budget
1. DoD Base Budget
1.1. Defence Budget
1.1 Military Personnel
1.1.2. Operations and Maintenance
1.1.3. Procurement
1.1.4. Research and Development
1.1.5. Revolving and Management Funds
1.1.6. Military Construction
1.1.7. Family Housing
1.2. Opportunities and Growth
1.3. Administrative Costs
2. Oversees Contingency Operations (OCO)
Not Included in Department of Defence Budget
1.Department of Veteran Affairs
2.The State Department
3.Homeland Security
4.Department of Justice: FBI and Cybersecurity
5.Department of Energy: National Nuclear Security Administration

5.2.3. The Federal Republic of Germany Defence Budget

Germany is one of Europe's leading nations, yet it is perhaps most often targeted in burden sharing debates given that its defence expenditures remains significantly below the targeted 2% of GDP. The average of Germany's defence expenditures between 2006 – 2016 is 1.28%, that is not only below the 2% criterion but also below NATO average for the same period of time, 1.54% and ranks Germany among the bottom 10 countries (see figure 7). The Federal Ministry of Defence, or the Bundesministerium der Verteidigung (BMVg) and armed forces, Bundeswehr, budget includes similar main categories to the ones identified by NATO. It consists mostly of (1) operating costs which are divided into (1.1.) military personnel and (1.2.) operations and maintenance and (2) military investments, consisting of (2.1.) procurement, (2.2) research and (2.3.) development and infrastructure.

Compared to most other countries, the budget of the Federal Ministry of Defence does not include pensions for former military personnel, military aid to NATO Allies, NATO Civilian

Budget contributions, budget of Defence Commissioner, military jurisdiction and military family housing. Additionally, it does not include costs for missions and operations. Those are often approved ad hoc and sometimes financed from the Ministry of Foreign Affairs or other government bodies. For example, the Kosovo mission was financed from special budget plan called General Financial Administration. For breakdown of the BMVg budget see table 4. (Bundeswehr, 2016.) (Merrath, 2000.)

As table 4 also indicates, the BMVg budget also does not include several items that are accountable in NATO unified system as defence expenditures. If taking into account only budgets of Ministry of Defence as the only source of defence expenditures, then the data for Germany would be budget up to 20% lower than NATO provided numbers. (Merrath, 2000.) Germany's diplomatic representation points out these differences for many years now and criticises the superficial system of comparing countries' defence expenditures and contributions mostly based on the 2% criterion. German ministers of defence, for example Rudolf Scharping in 2000, belong among the diplomats who suggests broader concept of defence expenditures which would take into account other expenditures related to stability and security. (Scharping, 2000.) By contrast if such a broader view on defence expenditures would be applied and other expenses on security and stability were included, Germany's defence expenditures could be increased, for example, by additional 30 billion EUR a year that it spends on refugees. (Bundeswehr Statistics, 2016.)

Table 4: Federal Republic of Germany Defence Budget, source: Bundeswehr, Merrath, 2000 and author

Federal Republic of Germany
Federal Ministry of Defence - Bundesministerium der Verteidigung (BMVg)
1. Operating Costs
1.1. Military Personnel
1.1.1. Command Staff of Armed Forces
1.1.1.1. Army
1.1.1.2. Navy
1.1.1.3. Air Force
1.1.1.4. Bundeswehr Joint Medical Service
1.1.1.5. Joint Support Service and Military Counter Intelligence Centre
1.1.2. Civil Organisation
1.1.2.1. Centre for Military History and Social Sciences of the Bundeswehr
1.1.2.2. Bundeswehr Administration and Military Recruitment
1.1.2.3. Armament and Information Technology
1.1.2.4. Judicature
1.1.2.5. Military Chaplaincy
1.2. Operations and Maintenance
2. Military Investments
2.1. Procurement

2.2. Research
2.3. Development and Infrastructure
Not Included in BMVg Budget
1. Former Military Personnel Funding
2. Peacekeeping Missions
3. Military Aid to NATO Allies
4. NATO Civilian Budget Contributions
5. Defence Commissioner Budget
6. Military Jurisdiction
7. Military Family Housing

6. Free Riding

As outlined above in chapter 1., free riding occurs when one individual, firm or a state enjoys benefits of a public good without paying an equivalent share of costs. The following chapters describe theories of free riding, based on the distinction of pure and non-pure public goods as well as describe issues such as setting a burden sharing criteria and measures for free riding. Finally, the chapter also provides a brief overview of suggestions on how to reduce free riding.

The debate of free riding is closely related to whether defence and peacekeeping is a public good. If defence indeed is pure public good, then the benefits resulting from it must be both non-rival and non-excludable. Defence benefits can be classified as non-rival given that a consumption of defence of one ally does not decrease the opportunity for a consumption for another ally from the same unit. Likewise, the defence benefits are non-excludable as the deployment of defence mechanisms benefits other allies. Once the mechanism is deployed its defence abilities are not depending on the number of allies. Additional condition for non-excludability of the public good in question is whether it can or cannot be withheld by the provider at an affordable cost. (Sandler, 2000.)

Furthermore, defence can be considered both pure and impure public good, where according to the Handbook of Defence Economics (Sandler, Harltey, 2007.) defence has impure character of public goods and peacekeeping activities are pure public good. (Khanna et al. 1988.) (Bobrow and Boyer, 1997.)

6.1. Theories of Free Riding

The following chapter outlines the possible theories and approaches to the problem of free riding and mentions few of the most relevant models to this thesis. The chapter mentions the commonly used theory of public goods as well as alternative models, such as the joint product representation of alliance.

6.1.1. Public Goods Theory

Treating defence as a purely public good results into several implications, the most important being that defence burdens are expected to be shared unevenly, based on the assumption that the largest member states would lose the most should an attack occur. Thus, the large allies are generally spending more on defence which allows small member states to spend less and benefit from the defence efforts employed by the large allies. (Sandler, Murdoch, 2000.)

The pure public goods theory presents several conclusions: (i) the defence efforts of one member state are perfect substitutes to the defence efforts of a different member state;
(ii) defence spending is anticipated to be allocated in a not optimal manner, each member state will make its defence expense decisions based on marginal benefits to marginal costs analysis; (iii) due to the absence of rivalry and the increase of general benefit for all member states with expanding the alliance it would be beneficial from the economic point of view to continue with enlargement; and (iv) there should be strong cooperation ties between the allies to encourage giving up part of autonomy over defence expenditures decision in favour of the Alliance decision body.

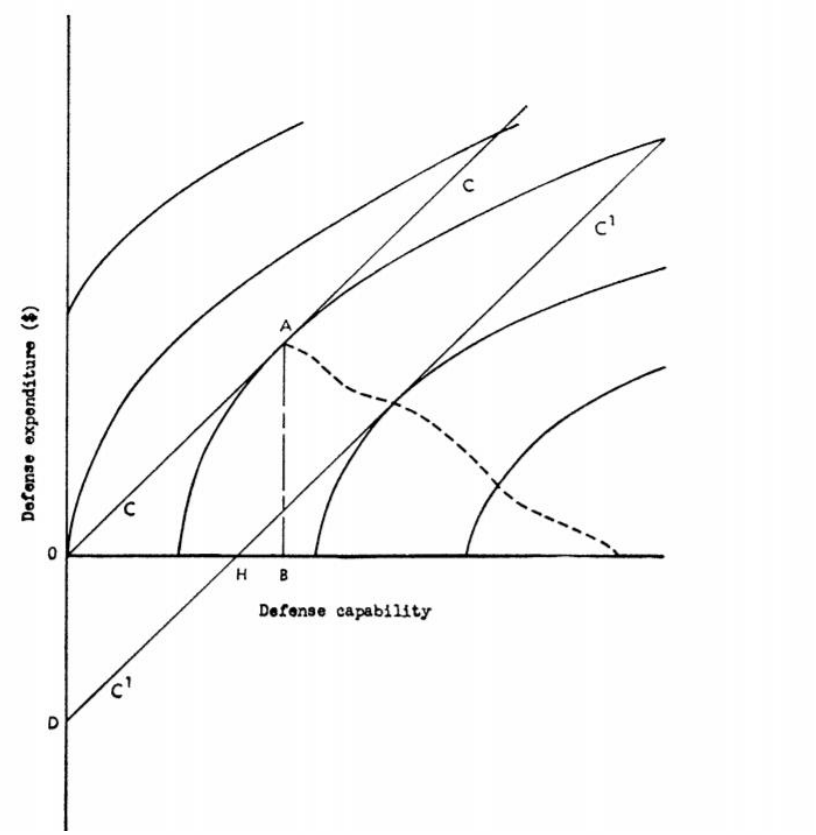
6.1.1.1. Olson Zeckhauser Model

The Olson Zeckhauser (henceforth OZ) model was developed as early as in 1966 and revisited and empirically tested by several researches throughout several decades. It is one of the first models upon which most of contemporary theories of economic alliances and models of free riding solutions are based and has been empirically tested several times. Many of those researches are mentioned in this thesis, notably Sandler and Forbes (1980), Murdoch and Sandler (1984, 1990) or Weber, Wiesmeth (1991).
Given that the OZ model is based on pure public goods approach, it does not provide a general theory of alliance behaviour, however, it remains one of the vital points in the discussion of economic solutions to the problem of free riding in military alliances with important theoretical and practical implications. The theory emphasises, as already mentioned, that it is a natural outcome that nations placing higher value on defence and deterrence will end up bearing a disproportionate share of the burden.
The vital assumption of the model is linearity of production cost functions. Those functions are also assumed to be the same for all allies. Despite the obvious unlikeliness of such situation, the authors argue that the general conclusion deduced from the model should not be altered by cross-country marginal costs variations. Recent researches have shown that this assumption leads the model to the conclusion that disproportionate cost sharing is no longer inevitable. Although nowadays it is considered a distortion, making the model less realistic, based on empirical tests this was quite a realistic and valid implication in the time of its development.[11] (Olson, Zeckhauser, 1966.)

[11] During the first 15 years of NATO, the contributions were quite equal, the differences between countries and their comparative advantages, weapons procurement policies and contracts were small.

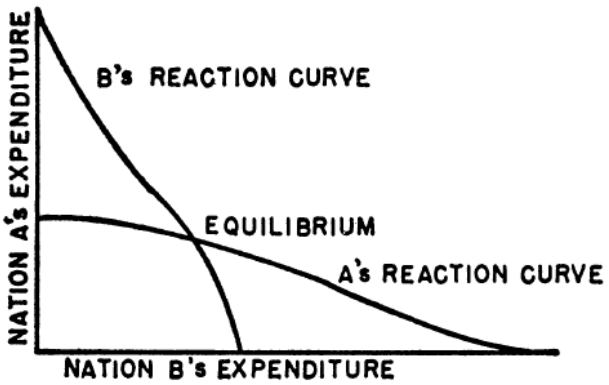
The model is based on the assumptions of (i) suboptimal allocation of defence efforts and (ii) larger members devote larger percentage of their income to defence than smaller members. Additionally, when an alliance is considering whether to accept a new member, or how many members it should have, it must consider the value that the state places on the particular public good in question, in this case defence and deterrence. Such values can be easily shown and represented by in indifference map, such as the one in figure 1 below. This presented indifference map is turned upside down and cut off at the present income line, where defence capability is on the horizontal axis and valued positively and defence spending is on vertical axis and valued negatively. The cost curves are, as was already said, assumed to be linear for simplicity. If A nation was not a member of an alliance it would obtain $|OB|$ amount of defence, found by drawing a cost curve from the point of origin and reaching point A where the cost curve is tangent to the highest obtainable indifference curve. In an alliance, a particular country's spending will be influenced by other countries' spending, the adjusted cost curve is obtained by shifting cost curve C down beneath origin, alongside the vertical axis. The distance between the origin and the juncture of C1 and vertical axis can then represent defence expenditures of allied nations. Hence if a nation's ally spends $|OD|$ on defence and they have the same cost curves, then the amount of defence received without any cost equals to $|OH|$ which is also a direct equivalent to an increase in income of $|OD|$. This interpretation of the model leads to an important conclusion: the more defence the alliance provides, the less will a country likely spend on defence.

Figure 1: Indifference Map of defence valued by states (Olson, Zeckhauser, 1966)



Furthermore, the model demonstrates the already mentioned conclusion that the larger allies will bear a disproportionate burden in figure 2. The figure shows reaction curves for 2 country model which can be generalised for any N countries, where equilibrium of defence expenditures provided by country A and B is at the intersection point of the two reaction curves. The resulting equilibrium output will equal the isolation output of the country with highest isolation output. Thus, its share of costs will exceed the share of benefits it will enjoy.

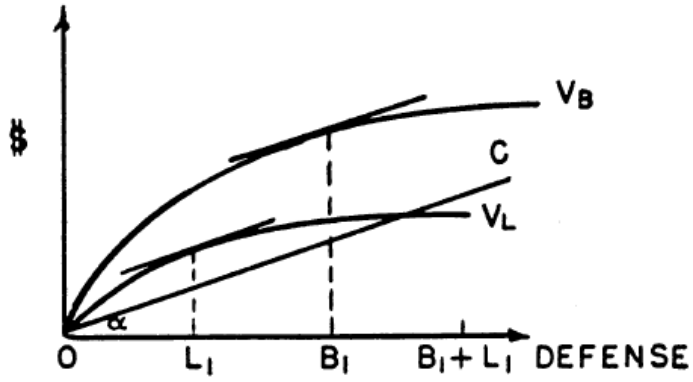
Figure 2: Reaction Curves of two countries defence expenditures (Olson, Zeckhauser, 1966)



Additionally, not only is the distribution of cost burdens unequal according to the OZ model, but it reaches its equilibria only when the large nation pays the high cost equal to what it would pay if there was no alliance, and the small nation bears zero of the cost. This is demonstrated with the help of income effect in figure 3. The larger nation has valuation curve V_B which is higher and steeper in order to reflect the higher value it puts on defence. The smaller nation has valuation curve V_L. The costs are represented by the linear curve C which is the same for both nations based on the assumptions of the model. Situation A, when nations would not be members of an alliance, the larger nations would demand B_1 and smaller nations L_1 units of defence. Situation B, when nations are assumed to be members of alliance, they would together demand B_1+L_1 units of defence however this results into a situation where both nations value marginal unit less than its marginal cost. Hence the larger nation will decrease its demand to the point B_1 where the two nations in alliance reach their equilibrium. But since point B_1 satisfies smaller allies demand of L_1 and is already fully provided by larger ally, it will have no incentive to share any burden at all.

The OZ model concludes, that the distribution of bearing costs among allies will always be suboptimal as long as each additional defence unit will have positive value for the allies. The reason is demonstrated by the following equation (1) which is valid for linear cost functions that are identical for all members where MRS is marginal rate of substitution of money for

Figure 3: Evaluation Curves (Olson, Zeckhauser, 1966)



the good and MC is marginal cost.

$$MRS_1 = MRS_2 = MRS_3 = MRS_N = MC \quad (1)$$

The allocation of cost burdens would be optimal only if the total sum of all marginal rates of substitutions would be equal to the total marginal costs, as shown in equation (2).

$$MRS_1 + MRS_2 + MRS_3 + MRS_N = MC \quad (2)$$

The model concludes that the second situation is not reachable. Nations would achieve a pareto optimal situation only if each nation's additional benefits equalled its marginal costs and hence the costs were shared in the same proportion as the benefits.

Olson and Zeckhauser ran several empirical tests based on spearman's correlation coefficients, all of the four hypothesis they have tested have supported the conclusions of their model. (Olson, Zeckhauser, 1966.)

Given the limitations of the model, such as linear and identical cost functions of the states, several modifications of the model were developed. For example, Weber and Wiesmeth developed a modified model fulfilling all assumptions, but using non-identical and linear functions. The model also works with quasi-egalitarian allocations that can cope with the inefficiency problem commonly associated with the Nash equilibria solution. (Weber, Wiesmeth, 1991.) They were not the first to use a partial equilibria approach to the free riding problem. It was first described and used by Kohlberg, Green and Laffoni in 1975. (Kohlberg, Green, Laffoni, 1975.)

6.1.2. Joint Product Representation of Alliance

This theory was being developed from 1960s on, as an alternative to the mainstream public goods theory. Researchers decided to offer this alternative given the noticeable reservations of public goods theory. In 1960s, several of the implications of the pure public goods model did not hold (Russett, 1970), so the leading researchers created the joint product model which works with multiple different outputs that are resulting from defence alliance and that differ in the level of publicness. Concretely, the model works apart from the traditional deterrence, damage limitation and protection also with private benefits in the form of ally-specific outputs. The model also incorporates the complementarity or substitutability of the produced defence outputs upon which the ally's response to defence spillovers are dependent.

The model is built upon deriving the traditional benefits into categories of outputs that benefit all the allies and hence represent either pure or impure characteristics of a public good, and the outputs that are counted into common sources even though they yield an output in the form of sole private benefit. The different categories of NATO provided public good with regard to their characteristics are, according to the joint product representation model, as follows:

- deterrence – pure public benefit;
- damage limitation – impure public benefit;

- protection – impure public benefit. (Sandler, Murdoch, 2000.)

The model hence recognises two kinds of output; Z_i, the Alliance wide public good and X_i, pure public good. In general, the model assumes both Z_i and X_i to be increasing concave functions of military output q. (Sandler, Murdoch, 1984.)

The implications and conclusions resulting from the model of joint product representation are different to the ones from the pure public goods model. First and foremost, depending on the ratio of excludable benefits, member states must assure their own protection and defence, regardless of whether it is a large or small ally. If the ratio is high, it diminishes the importance of the theory of exploitation of the large allies by the small allies, given that there is a large number of excludable and private benefits, hence the burden sharing is then expected to be spread more equally based on the assumption that small allies cannot rely on the protective umbrella of the large allies and have to support their own defence.

Second, markets and club arrangements can promote revelation of preference given the presence of excludable benefits. Uncovered preferences may lead to closer proximity and higher equality of marginal benefits and marginal costs, leading to higher efficiency and optimality. Thus, the theory of joint product in case of high ratio of private benefits offers a solution to reducing free riding. Third, when there are alliance size restrictions, forces thinning is expected, hence large allies with large borders are required to contribute with more conventional forces in order to counter this externality. Fourth, when the ratio of excludable benefits is large, the activities aiming at increasing interconnection and cooperation within the alliance do not have to be of a large extent. And lastly, fifth, the equality between benefits that a given member state receives and the burden it bares is the bigger, the larger the ratio is. (Sandler, Murdoch, 2000.)

6.2. Setting a Burden Sharing Criteria

Burden sharing criteria can be set according to the following principles:

(1) ability to pay principle;

(2) benefit principle.

The ability to pay principle typically includes a nation's level of GNI or GDP, assessing contribution to collective defence based on annual force planning exercise,[12] conscriptions per capita and other contributions. The benefit principle sets the criteria according to the

[12] e.g. NATO before 2006

distribution of benefits with regard to preferences of individual member states for the given commodity. Those different, at times called burden-sharing regimes, have the purpose of ensuring appropriate contributions, states upholding to international commitments, institutionalising cooperation and strengthening policy interdependence. (Chalmers, 2001.)

The ongoing long term burden sharing rebates are based mostly on defence expenditures as a share of GDP and on over reliance of European Allies on the United States. The USA spends more than half of what all the other allies account for. On the other hand, the European Allies argue by their presence of strategic troops in European and other strategically important bases. It is also important not to overlook other factors involved such as the alternative measures mentioned in chapter 6.3.2. For example, Europe, as a whole, is the biggest investor when it comes to international aid.

NATO currently uses a combination of eleven metrics which measure both military outputs and financial inputs. The criteria include the known 2% of GDP criteria as well as 20% of defence spending devoted to major equipment and research and development. Furthermore, NATO monitors the percentage of member state's deployable forces that are sustainable and on expeditionary operations as well as evaluation of implementing the national capability targets as set by NATO's defence planning process. Moreover, no Ally can be demanded to provide over 50% of individual capabilities as set in national targets. Lastly, a set of actual contributions that include percentage of deployable land forces, airframes, effectively deployed vessels on operations, extend of fulfilling assigned staff positions in NATO Command Structure and NATO Force Structure Headquarters and contributions to NATO Response Force. (NATO, 2017.)

6.3. Measuring Free Riding

Two questions are relevant while measuring free riding and burden sharing. Firstly, and most importantly, the necessity of choosing the right indicator for the measure itself and secondly, the correct evaluation and interpretation. Because there is currently no best measuring variable, it is considered to be the best to measure various different indicators simultaneously, followed by their further analysis and comparison. (Sandler, Hartley, 1999.)

The criticality of the correct choice of measurement indicator is possible to demonstrate on the example of how the different choice of an indicator leads to two opposite conclusions. If the defence expenditures indicator is chosen, either as total amount or percentage of GDP, then it is possible to come to the conclusion that Europe is free riding on the United States

of America, and smaller states are free riding on larger Allies. If, however, the soft power s chosen, broader definition of security investment or military presence in Europe, then it is possible to conclude that the United States of America is actually free riding on Europe. (Moravcsik, 2016.)

The choice of appropriate measures varies depending on the choice of burden sharing criteria and the concrete assumed model in question (pure public good or joint product representation. This thesis assumes the OZ pure public goods model and the ability to pay criteria of GDP and GNI as well as the 2% defence investment criterion.

When measuring free riding there are several quantitative and qualitative variables that need to be taken into account. Examples of the most commonly used variables are listed and discussed in this chapter. Moreover, it is vital to choose the appropriate indicator upon which the nations level of free riding will be judged and compared. Such indicators are very difficult to come up with, most often it is not one single indicator but several different ones brought and evaluated together given the complexity and complication of assessing free riding in an international peacekeeping body. A useful tool for measuring free riding is choosing a ranking within several indicators and comparing the states. The average ranking from all chosen indicators and categories can serve as a useful overall measure of free riding. (Sandler, Hartley, 1999.)

6.3.1. Basic Measures

The most basic and commonly used measure, when it comes to measuring free riding to begin with, is the ratio of defence spending to GDP of a nation, defence spending as a total amount and defence spending per capita.

- share of GDP devoted to military expenditures;
- military expenditures per capita;
- military manpower per capita.

Based on the average ranking of a country, according to Sandler and Hartley, it is possible to label countries as free riding when their ranking is below average and total for NATO (and/or Europe). (Sandler, Hartley 1999.)

Another basic tool for analysing the burden sharing gap can be based on trends in average standard deviation and annual change analysis, this thesis analyses those in chapter 7.2.2.

In most cases those indicators are not used alone given their ability to reflect only a small portion of the defence, military and security efforts. (Sandler, Murdoch, 2000.)

6.3.2. Alternative Measures

Alternative measures are on the other hand based on personnel numbers and commonly also on the ability to pay criteria. Commonly used alternative measures include mostly:

- total number of armed forces personnel;
- number of armed forces personnel per capita;
- share of defence spending on equipment;
- share of defence spending on research and development;
- arms trade, as a total number or as a share of NATO total;
- peacekeeping contribution and burden can be included as a part of burden sharing assessment given that following the fall of Berlin Wall, NATO set a role as an Alliance to act as a peacekeeper, hence the different expenditures of states on international and peacekeeping aid have to be considered;[13][14]
- foreign aid, i.e. economic, development air or aid with peacekeeping purposes and implications;
    i. European countries spend three times as much as USA to overseas aid. (Chalmers, 2001.) But are dependent on US military forces and often physical presence in European military bases or conflicts. (Kosovo, Yugoslavia)
    ii. Investment contribution to European integration as a part of making outside borders of NATO more secure (Chalmers, 2001.)
- balance of arms exports and imports, although trade is expected to be beneficial for both parties at low costs, so this is not direct burden;
- analysis of comparison of defence share expenses of GDP and per capita income.

6.3.3. Subjectivity of Free Riding Measures Interpretation – a Practical Demonstration

The ongoing pressure from the side of American diplomacy on European representation lies in the argument of European Allies constantly paying less than the 2% criterion and relying too much on the support of American military forces. The resulting interpretation that

[13] When ranked, Turkey and Greece have traditionally one of the highest defence expenditures burden ranks but in contrast the lowest peacekeeping burden. The highest peacekeeping burdens are borne by Norway, France, Italy, UK, Canada and USA, with the exception of Norway, those are also the leading countries in defence expenditures.

[14] Correlation between size of GDP overall and peacekeeping burden, is expected and confirmed by empirical tests with resulting coefficient 0.455. (Khanna, Sandler, 1997)

Europe is free riding on America and hence has to increase its military spending seems logical on the first sight, however it is only interpretation of one indicator.

A very good practical example on the subjectivity of interpreting and analysing free riding is exchange of arguments and points of view in recent essays, published 2016, written by respected researchers Andrew Moravcsik and Stefano Solesanto, both having an opposite opinion. Andrew Moravcsik, respected Princeton professor, outlines in his recent essay, not only does Europe already pay its fair share of the burden, it contributes even more than that. The current 2% measure is inadequate and without sufficient corresponding value given that it reflects solely the defence expenditures of states and disrespects various other, possibly more important factors such as but not limited to geo-economic and institutional instruments and infrastructure which in most cases the United States do not possess nonetheless needs. From this perspective, it can be concluded that America is actually free riding on Europe.

Furthermore, US military commitment and presence in Europe is notably small, only about 5% of total US active duty personnel, argues Moravcsik. Where Europe spends $250 billion on defence, United States expenditure on NATO reassurance programme and aid to Ukraine account for $1400 million in 2016 and $3.4 million in 2017.Out of these expenses $800 million goes to Ukraine. By contrast Europe, though declined military assistance spends $9 billion on economics assistance to Ukraine, that means more than 10 times as much. And lastly, most significant argument highlights the fact that interpretation of Europe as a free rider based on not adhering to the 2% criterion is misleading given its narrow conception of defence instead of broader inclusion of national security and expenditures directed on various expenses counted under comprehensive approach on new security and defence strategy.

Moravcsik also mentions Europe's domination in spending on world development and economic aid accounting for over 2/3 of all world expenses. What more is often omitted by the US diplomacy is Europe's heavy investments in European Union integration which is as an institution contributes to peace on the continent and larger negotiation power.

And finally, it is Europe that bears by far most of the both explicit and implicit costs of countering Russia, including the hidden costs cause by the imposed economic sanctions. (Moravcsik, 2016.)

The subjectivity and difficulty of analysing the free riding issue is further shown in contrasting essay written by Stefan Soesanto as a reaction on Moravcsiks arguments. (Soesanto, 2016.) Soesanto opens by a powerful statement pointing out that Moravcsiks

claim that United States military presence in Europe is only 5% and presents his argument that under different contextual data, although the overall presence may not be high, when taken to the total presence of US military troops abroad, the presence in Europe goes up to 43%. He then continues by outlining that comparing the US and Europe's budget contribution to Ukraine aid is based on false dichotomy given that by a category of budget they are similar, however in reality those two articles severely differ.

When it comes to evaluating solely defence expenditures, instead of taking into account broader security spending, Soesanto answers that different governments treat the terms 'defence, military and security' differently thus it is very difficult to draw the unified line between what counts and what does not upon which states' contributions could be judged. In the end, Soesanto emphasises that although the 2% criterion is arbitrary, it does have its purpose and the fact that Europe is investing elsewhere does not make up for the shortcomings in military expenditures that are weakening the defence strength of European nations.

In conclusion, Soesanto's counter-argument essay and the exchange of the arguments itself does not disprove Moravcsik, nonetheless it demonstrates the power of context and perspective while evaluating the problem of free riding, thus it is important to keep in mind when choosing and analysing free riding measures that even statistics is not simply black and white and interpretation matters greatly.

6.4. Reducing Free Riding

This chapter contains suggestions and tools on how to reduce free riding. The tools are divided between economic and diplomatic, economic tools concentrating more on providing solutions to free riding and diplomatic are reflecting more the burden sharing dimension.

6.4.1. Economic Tools

The economic solutions are such that stand on economic models and use economic tools, such as pareto optimum allocation of goods, Lindahl allocations, cost-benefit analysis and resulting benefit taxation, tobin tax or partial equilibria approaches as well as models that work with game theory, mostly using the Nash equilibrium.

6.4.1.1. Pareto Optimum

A pareto optimal situation is such, where none of the parties involved may reach an improvement without harming the other party. A pareto optimal situation is one of the

possible economic solutions to problems of distribution of public goods. However, despite having ways how to analyse whether a particular situation does or does not represent a pareto optimal situation, there is little to no tools when it comes to reaching a pareto optimal situation. Thus researchers are left with analysing the pareto (sub)optimality of a particular situation and recommend a measure that could lead to a pareto improvement.

For example, Sandler and Murdoch empirically tested whether the Allies display more a Nash-Cournot behaviour or Lindahl one. The Nash-Cournot model is assuming a homogenous product and several firms choosing their amount of production according to profit maximising decisions in simultaneous game. The equilibrium of such situation is called Nash-Cournot. (OECD, 1993.) Lindahl behaviour on the other hand, assumes allocation according to marginal benefits of utility derived from an additional unit of the public good in question. (Stiglitz, 2004.) The empirical results concluded that, there is more Nash-Cournot behaviour among the Allies, although neither of the models were followed strictly, it is rather the dominance of Nash-Cournot behaviour. (Sandler, Murdoch, 1990.)

6.4.1.2. Benefit Taxation

Using the benefit taxation is one of popular ways of solving the problems associated with public goods, such as free riding. However, given the impure characteristics of defence as public good, and sovereign countries being the targeted subjects, the application of benefit taxation is more complicated than when individuals are concerned. With regard to the OZ model that the thesis mostly works with, its authors, Olson and Zeckhauser, point out, that the natural outcome of larger countries paying larger share of the costs and the resulting cost distribution would significantly differ in the scenario of taxes based on the benefit each country receives and hence admit the possible solution or reduction of the free riding problem within the Alliance. Other researchers, such as Groves, started to also suggest the use of appropriate tax subsidies in 1970s, the possible outcomes of which were tested for example by Green, Kohlberg and Laffont in 1975 by using the partial equilibria approach.

In order to use benefit taxation, it is necessary to know the preferences of the public good provided as valued by each member state, which is however quite unlikely in real world. Nonetheless, the model shows, using the statistical properties of total revenues, that if willingness to pay distribution is symmetric, then the probability of reaching a pareto optimal situation is very high. (Green, Kohlberg, Laffont 1975.)

Another possible tool on setting the appropriate benefit taxation is by using the economic tool of cost-benefit analysis, which is, once again, practically impossible to carry out due to the problems with (a) identifying all associated costs and benefits with defence and mostly (b) measuring and quantifying such costs and benefits.

Despite the significant progress in analysing the costs and benefits of public goods such as defence and several empirical evidence, it would be very difficult for the Allies to adopt this tool of reducing free riding.

6.4.2. Diplomatic Tools

Another possible solution for decreasing the level of free riding is a more indirect and diplomatic, rather than the economic solutions presented in the chapters above. This solution should include higher interconnection, increased cooperation and links between the allies accompanied by an increased number of supranational treaties, institutionalisation as well as a system of sanctions and penalties should the criteria be disregarded.

While several of those ways have already been tested within the United Nations allies, their application on the North Atlantic Alliance would likely face several problems.

(1) Specific problem of unanimous approval decision making process effective within the NAC, member states are not expected to approve sanctions
(2) The higher the institutionalisation the higher are transaction costs associated (Chalmers, 2001.)
(3) Little bargaining power of the larger nations over the smaller nations in order to persuade them to increase the contributions. (Weber, Wiesmeth, 1991.)

An ideal solution for NATO should be one of the economic solutions accompanied by the diplomatic manner, in its optimal balanced level upon which the Allies would agree and where benefits would be higher or equal to the costs of its implementation.

7. Econometric Analysis of NATO Defence Expenditures

The analytical part analyses the defence expenditures of NATO member states not only with respect to the defence investment and burden sharing criteria, but also using other statistical tools. It also tests the hypothesis as set in the beginning of this paper and offers several interpretations and possible implications of the results.

7.1. Aim and Methodology

The aim of the analytical part is to provide a complex analysis of defence expenditures of NATO member states using data from 2006 to 2016. This 10 years long time horizon was chosen not only for data significance and in order to analyse the development and relevant changes and trends, but also given that 2006 was the year of implementing new and unified defence spending criteria, among them perhaps the most relevant 2% defence investment criterion.

Secondly, after general statistical analysis of the data, the thesis aims to analyse free riding within the Alliance, using the pure public goods approach based on the empirical evidence methods first used in the OZ model, as described in chapter 6.1.1. and as largely adopted and still used by later analysis of the leading researchers of free riding, Sandler, Hartley or Murdoch. The correlation analysis is done using the spearman, non-parametrical correlation test given that there is no guarantee of parametrical distribution of the data and so the analysis uses the ordinal variables in the means of ranking. (Wooldridge, 2009.)

For the purpose of the thesis and for simplicity, the assumptions of the analytical part are taking into consideration only the official burden sharing measures as set by NATO, the cost share coefficient of Common Funding and the Defence Investment criterion of 2%. Other factors and alternative measures are not taken into account.

7.2. Analysis

This part of the analytical part is the analysis itself of NATO Common Funding and defence expenditures of NATO member states. It also includes analysis of the overall ranking, based on average of GNI, Common Funding contributions and defence expenditures rankings as well as the spearman correlation tests.

7.2.1. NATO Common Funding

The first part of the analysis concentrates on NATO Common Funding that has been described in chapter 4. above. It further describes the dynamics of the contributions and analysis their fairness with regard to comparison of the share on total GNI and share on total costs a nation pays as well as the spearman correlation test.

7.2.1.1. Cost Share Analysis

The following table 5 displays the cost shares indexes based on Gross National Income as agreed upon that are valid for the period of time from 1st of January 2016 until 31st of December 2017. It is apparent from the first sight that there is a big variation between the cost shares borne by individual member states as the indexes are highly unequal. The reason behind this inequality is the different ability to pay that varies across countries. For the Common funding cost indexes NATO chose to use Gross National Income as a determinant of the different abilities to pay.

In the ranking column, it can be seen that the United States, Germany, France, United Kingdom and Italy are the countries with highest indexes. Those first five states, as mentioned above are also the top 5 in ranking of total Gross National Income as we can see in the column of GNI ranking. Moreover, if we extend the analysis and look at the top 10 states according to cost shares, their concrete ranking varies, however, as with the top 5 states, they are also the top 10 states by in GNI ranking. From the following table, it is clear, that the indexes ranking approximately follows the GNI ranking.

However, the size of the cost burden is disproportional, as we can see from figure 4, over 65% of the common funding is borne by the first five states. This fact may seem unfair and supporting the theory of large scale opportunity for free riding within the Alliance on the first sight, until we have a look at how much those first five states account for in Gross National Income share. Those same countries: United States, Germany, United Kingdom, France and Italy alone account for 78.91% of NATO's total Gross National Income, compared to baring the burden of only 65.6879. This can be interpreted as NATO's recent increased efforts to reduce the opportunities for free riding and equalise the burden sharing. However, it is also necessary to look not only at the rankings but also at other comparisons. Where the distribution of cost share indexes appears to be quite fair based on the GNI and cost index ranking comparison, when we shift our attention to the comparison of the percentage of burden borne as assigned by the cost index with the percentage of individual member states on NATO's total GNI, we can notice several differences.

Similarly to previous analysis, by the first look on the coefficients, it may seem like the United States of America pays an unequally large share. However, if we have a look at the share of total GNI per country, we can clearly see that the USA accounts for more than 48% of total NATO GNI, nonetheless funds only 22% of NATO Common Funding Budget. This can be interpreted as a result of ongoing pressure from the side of US diplomacy, for the last

8 years mainly president Obama and appeal on European countries to bear more of the cost burden. Such trend is not only expected to continue, but with the newly elected president Trump, several analysts assume to get bigger. In March 2017, Angela Merkel together with the German diplomatic representation announced unexpected and significant increase of the defence budget. The reason behind this sudden increase was precisely the appeal of president Obama.[15]

Table 5: NATO Common Funding, Source: NATO and the author

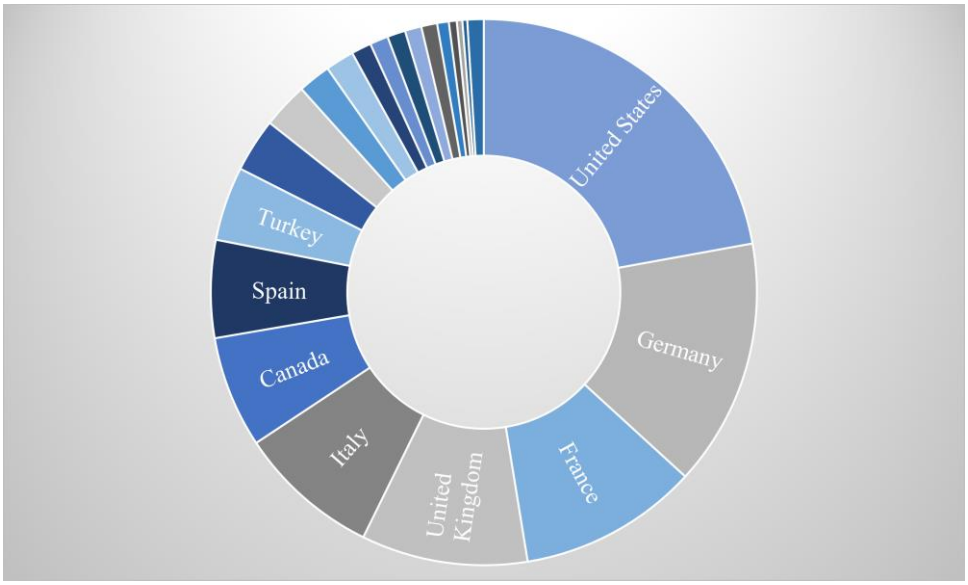
State	Index	Ranking	GNI*	% Share on Total GNI	GNI ranking
Albania	0.0837	27	12,355.63	0.03	28
Belgium	1.9336	11	499,449.12	1.35	11
Bulgaria	0.3262	20	53,693.79	0.14	20
Canada	6.6092	6	1,704,230.86	4.60	6
Croatia	0.2893	21	53,651.82	0.14	21
Czech Republic	0.9389	17	191,359.17	0.52	16
Denmark	1.1829	13	332,327.13	0.90	13
Estonia	0.1085	26	24,084.15	0.06	26
France	10.634	3	2,708,477.52	7.30	4
Germany	14.65	2	3,739,792.30	10.08	2
Greece	1.0874	14	219,898.04	0.59	14
Hungary	0.6911	18	127,821.04	0.34	18
Iceland	0.0519	28	16,587.26	0.04	27
Italy	8.4109	5	1,995,026.81	5.38	5
Latvia	0.149	24	29,641.54	0.08	25
Lithuania	0.2281	22	43,485.92	0.12	24
Luxembourg	0.1399	25	43,867.53	0.12	23
Netherlands	3.1804	9	827,558.66	2.23	8
Norway	1.6993	12	487,048.18	1.31	12
Poland	2.7117	10	506,768.92	1.37	10
Portugal	0.9798	16	212,490.23	0.57	15
Romania	1.0726	15	188,424.39	0.51	17
Slovak Republic	0.4681	19	95,305.15	0.26	19
Slovenia	0.2122	23	45,793.56	0.12	22
Spain	5.7804	7	1,324,464.92	3.57	7
Turkey	4.3879	8	782,795.99	2.11	9
United Kingdom	9.8485	4	2,826,572.88	7.62	3
United States	22.145	1	17,994,146.04	48.52	1
NATO Total	100	//	37,087,118.55	100.00	//

* Based on World Bank 2015 data of GNI in current US $

**based on World Bank 2015 data of GNI per capita in current US $

[15] http://www.dw.com/en/merkel-germany-to-heavily-increase-bundeswehr-budget/a-36054268

Figure 4: NATO Common Funding Cost Shares, Source: NATO and the author



7.2.1.2. Correlation Analysis

The following hypothesis tests whether there is a significant positive correlation between a member states GNI and the cost share of common funding that the Alliance set. Given that as explained in chapter 4.2.1. the Alliance set the cost share coefficients based on the ability to pay criteria for which they chose gross national income, the correlation coefficient is expected to be very high. The following hypothesis is tested:

H1: There is a significant positive correlation between the size of a nation's gross national income and the cost share burden of NATO Common Funding as set by the Alliance. This hypothesis will be tested against:

H0: There will be no significant positive correlation between the variables specified in H1.

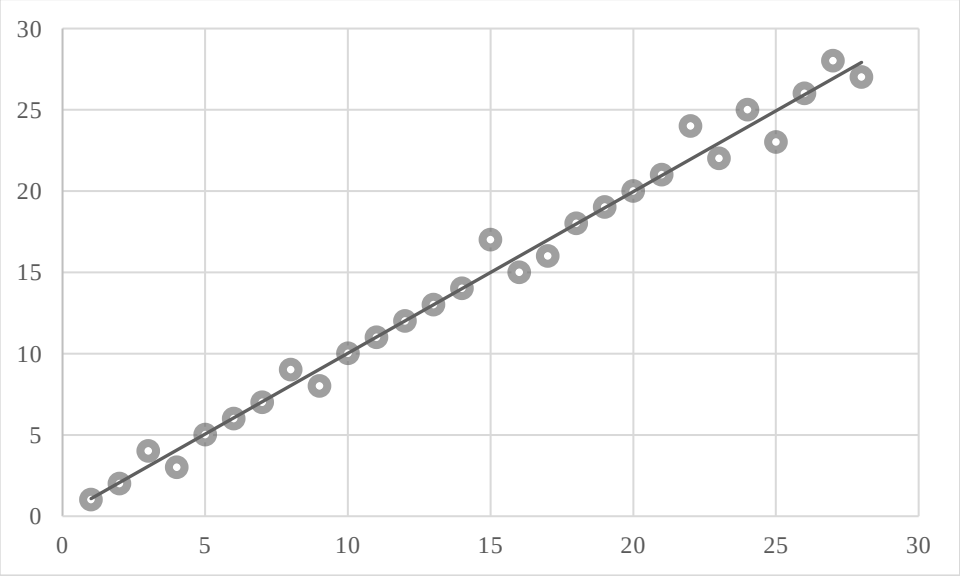
The spearman correlation test found very strong, almost perfect, positive linear correlation of 0.994 therefore, on the level of significance, we reject H0 and accept H1.

The empirical correlation test verifies the expected result of almost perfect relationship between the ranking of member states in GNI and in the share of common funding burden they bear. Given that the burden sharing criteria was set with regard to the ability to pay criteria, represented by a country's GNI, it is expected that larger ally's bear a larger burden. Therefore, even though the empirical test may have concluded that small member states are free riding on larger member states, this interpretation has obvious limits.

The Common Funding cost shares are a target of many debates as it represents a typical image on the distribution of costs within the Alliance. Based purely on GNI, the distribution

of costs is mostly a pure mirror of distribution of wealth of the member states. The exception being the United States of America which bears a disproportionate burden compared to its economic weight in NATO.

Figure 5: Correlation between GNI and Cost Share Coefficient



7.2.2. NATO Defence Investment

This chapter analyses NATO defence investment, part 1 concentrates on analysing the defence expenditures with statistical analysis and aims to interpret the trends as seen in the figures and graphs based on the table 3. Part two tests the hypothesis as set in the beginning of the thesis.

7.2.2.1. Defence Expenditures Analysis

The analysis of NATO defence expenditures is summarized in table 6, below, shows the data and analysis of defence expenditures as percentage of GDP between the years 2006 and 2016 by state. In the first columns we can see the military defence expenditures as percentage of GDP by state and by year, as available data from NATO. Furthermore, the table shows average defence expenditures as percentage of GDP between 2006 and 2016 for every member state separately, as well as total NATO average by year. The table also shows the ordinal ranking of member states by defence expenditures as percentage of GDP, from largest to smallest. These data are used for the spearman correlation test below. Additionally, the table provides average deviation of the defence spending between 2006 and 2016, in order to show which nations had relatively stable military expenditures and which nations underwent significant changes. Perhaps surprisingly, the highest average deviation of 0.44

has the USA, followed by Bulgaria, 0.41 and Slovenia and Latvia, both 0.25. By contrast the lowest average deviations and hence relatively stable military expenditures have Norway, 0.04, Germany and Luxemburg, both 0.06 or Portugal, 0.07.

The next column shows average annual change in defence expenditures as percentage of GDP between 2006 and 2016. The highest average annual change has Estonia, with 6.42 and Lithuania, 6.30, followed by Poland with 4.83. The lowest numbers belong to Italy, -5.52, Croatia, -4.96 and Greece, -2.73. The NATO average change is only 0.10, which though low, is at least a positive number. Moreover, the table also provides average deviation of annual change, based on own calculations and data provided by NATO. The highest numbers go as expected again to Latvia and Lithuania, 14.12 and 13.24, respectively and Bulgaria with 8.12. Lowest numbers are represented again by Norway, 1.91 and France, 2.30, closely followed by Germany, 2.32. The NATO average is 3.02.

As an alternative to average, the table also provides the statistics of mean, for both individual member states and by individual years. The total NATO mean is 1.50, compared to 1.54 average. The table also shows the number of member states above the 2% defence investment criteria by year. And lastly, the table displays variation and standard deviation as a sum of all countries by year. The average variation of NATO between 2006 and 2016 is 0.47 and the standard deviation is 0.69.

Table 6: NATO Defence Expenditures, % of GDP development and analysis, source: NATO and the author

State	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	Average	Overall Ranking	Average Deviation	Average Annual Change	Average Annual Change Deviation	Mean
Albania	//	//	//	1.52	1.56	1.53	1.49	1.41	1.34	1.16	1.21	1.40	**13**	0.12	-1.19	4.65	1.45
Belgium	1.10	1.20	1.10	1.16	1.08	1.05	1.05	1.01	0.97	0.91	0.85	1.04	**24**	0.08	-0.68	4.09	1.05
Bulgaria	2.40	2.40	2.60	1.75	1.67	1.33	1.35	1.46	1.32	1.29	1.35	1.72	**8**	0.41	-1.53	8.52	1.46
Canada	1.20	1.30	1.30	1.39	1.16	1.23	1.10	0.99	1.02	0.98	0.99	1.15	**22**	0.12	0.78	6.74	1.16
Croatia	//	//	//	1.62	1.54	1.60	1.53	1.47	1.41	1.37	1.23	1.47	**10**	0.10	-4.96	3.22	1.50
Czech Republic	1.80	1.40	1.40	1.52	1.29	1.07	1.06	1.03	0.96	1.06	1.04	1.24	**20**	0.22	-1.66	6.81	1.07
Denmark	1.40	1.30	1.30	1.34	1.41	1.30	1.34	1.23	1.16	1.14	1.17	1.28	**16**	0.08	-0.31	5.13	1.30
Estonia	1.60	1.70	1.90	1.80	1.70	1.68	1.89	1.90	1.94	2.07	2.16	1.85	**7**	0.14	6.42	7.15	1.89
France	2.40	2.40	2.30	2.02	1.96	1.87	1.87	1.86	1.84	1.80	1.78	2.01	**4**	0.20	-1.99	2.30	1.87
Germany	1.30	1.30	1.30	1.39	1.35	1.28	1.31	1.23	1.19	1.19	1.19	1.28	**18**	0.06	0.40	2.32	1.30
Greece	3.00	2.70	2.80	3.08	2.64	2.38	2.29	2.22	2.22	2.38	2.38	2.55	**2**	0.26	-2.73	7.85	2.38
Hungary	1.20	1.30	1.20	1.14	1.04	1.05	1.04	0.95	0.87	0.94	1.01	1.07	**23**	0.10	-2.45	6.70	1.04
Italy	1.70	1.30	1.30	1.42	1.35	1.30	1.24	1.20	1.09	1.02	1.11	1.28	**17**	0.13	-5.52	5.55	1.30
Latvia	1.50	1.50	1.70	1.21	1.06	1.02	0.89	0.93	0.94	1.04	1.45	1.20	**21**	0.25	4.43	14.12	1.06
Lithuania	1.20	1.20	1.10	1.07	0.88	0.79	0.76	0.76	0.88	1.14	1.49	1.03	**26**	0.19	6.30	13.24	1.07
Luxemburg	0.60	0.60	0.40	0.40	0.47	0.39	0.38	0.38	0.39	0.43	0.44	0.44	**27**	0.06	0.58	10.24	0.40
Netherlands	1.50	1.50	1.40	1.42	1.34	1.25	1.23	1.16	1.15	1.16	1.17	1.30	**14**	0.12	-0.93	2.66	1.25
Norway	1.50	1.50	1.30	1.54	1.52	1.51	1.47	1.48	1.51	1.47	1.54	1.49	**9**	0.04	1.54	1.91	1.50
Poland	1.90	1.80	1.90	1.71	1.77	1.72	1.74	1.72	1.85	2.23	2.00	1.85	**6**	0.12	4.87	7.19	1.80
Portugal	1.60	1.40	1.50	1.53	1.49	1.49	1.41	1.44	1.30	1.32	1.38	1.44	**11**	0.07	-1.29	4.52	1.44
Romania	2.00	1.50	1.50	1.33	1.24	1.28	1.22	1.28	1.35	1.45	1.48	1.42	**12**	0.15	0.85	7.37	1.35
Slovak Republic	1.70	1.50	1.50	1.52	1.27	1.09	1.10	0.99	0.99	1.14	1.16	1.27	**19**	0.21	0.70	6.81	1.16
Slovenia	1.70	1.50	1.50	1.59	1.61	1.30	1.18	1.06	0.98	0.94	0.94	1.30	**15**	0.25	-1.74	7.11	1.30
Spain	1.20	1.20	1.20	1.13	1.03	0.94	1.04	0.92	0.91	0.92	0.91	1.04	**25**	0.11	-1.13	5.72	1.03
Turkey	3.00	1.80	1.80	2.06	1.93	1.76	1.76	1.75	1.70	1.67	1.56	1.89	**5**	0.24	0.72	3.82	1.76
United Kingdom	2.30	2.40	2.20	2.51	2.51	2.42	2.20	2.30	2.20	2.09	2.21	2.30	**3**	0.12	0.53	4.09	2.30

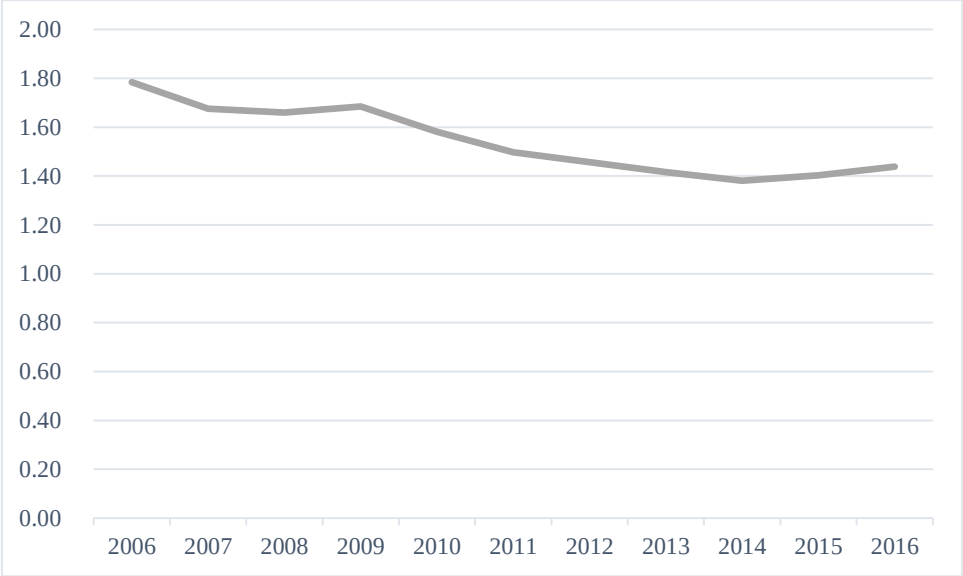
United States	3.80	4.20	4.00	5.29	4.81	4.77	4.42	4.09	3.78	3.59	3.61	4.21	**1**	0.44	-0.09	4.95	4.09
NATO average	1.78	1.68	1.66	1.68	1.58	1.50	1.46	1.42	1.38	1.40	1.44	1.54	//	0.12	0.10	3.02	1.50
N° of countries below average	16	17	16	19	18	17	17	16	18	18	16	19	//	//	//	//	//
N° of countries above 2%	7	5	5	5	3	3	3	3	3	5	5	4.27	//	//	//	//	//
NATO mean	1.60	1.50	1.50	1.52	1.41	1.30	1.31	1.23	1.19	1.16	1.23	1.30	//	//	//	//	//
Variation	0.34	0.50	0.50	0.76	0.63	0.62	0.53	0.48	0.42	0.40	0.39	0.47	//	//	//	//	//
Standard Deviation	0.71	0.70	0.71	0.87	0.79	0.79	0.73	0.69	0.65	0.63	0.62	0.69	//	//	//	//	//

// - not applicable

* the data for 2016 are the most current available estimate

Based on table 6, the evolution of average NATO defence expenditures as percentage of GDP from 2006 to 2016 is shown on the following figure 6. We may observe continual decrease from the year 2006 until 2007, stagnation from then until 2009. After that the decrease is sharper, from 1.68 in 2009 until reaching its minimum of 1.38% in 2014. Since then the expenditures increase again, until reaching 1.44% in 2016. Despite this increasing trend, the 2016 average defence expenditures did not reach the level of 2012, let alone any previous years.

Figure 6: NATO Average Defence Expenditures, percentage of GDP, 2006 - 2016, source: NATO and author



The following figure 7 is based on table 6 and displays NATO average defence expenditures as percentage of GDP, split by country and as average of the period 2006 – 2016. We can notice in the figure, that over the 10-year long period the only countries fulfilling the 2% criterion are France, with 2.01%, Greece with 2.55%, the United Kingdom with 2.3% and the United States with 4.21%. The average of the whole alliance is significantly below the targeted 2% with 1.54%, the mean being even less, 1.3%. The ongoing overall declining trend of military expenditures is likely driven by austerity dominated fiscal policies of Western democracies caused by the economic crisis.

Figure 7: NATO Average Defence Expenditures, percentage of GDP, 2006 – 2016, Source: NATO and author

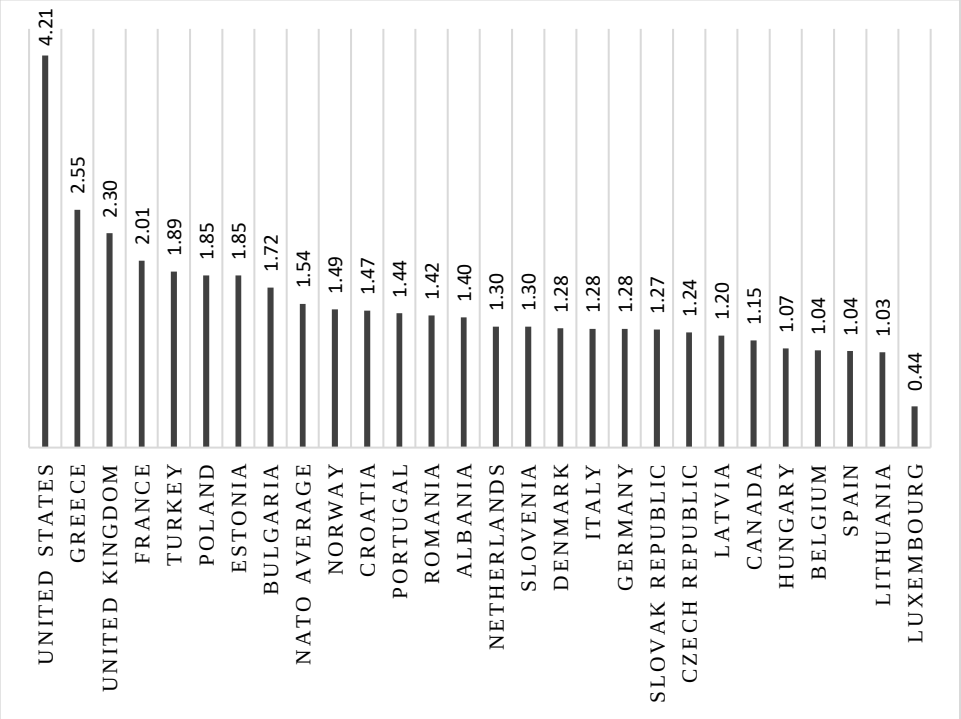


Figure 8 below is based on the table 6 above and demonstrates the evolution of the number of member states that fulfill the 2% investment criterion over the years 2006 – 2016. The trendline in the graph clearly shows the declining overall trend which is the opposite of the goal and commitments of the Alliance. This may be interpreted mostly as the result of the economic crisis, beginning of 2009. This is noticeable from the graph in the sharp decrease of the number of countries from 5 in 2009 to 3 in the subsequent year, 2010. The increase back to the level before the crisis did not happen earlier than 2015, which is also thought to be the year when European economies started to recover from the crisis.

Figure 8: Number of Countries Spending above 2%, 2006 – 2016, Source: NATO and author

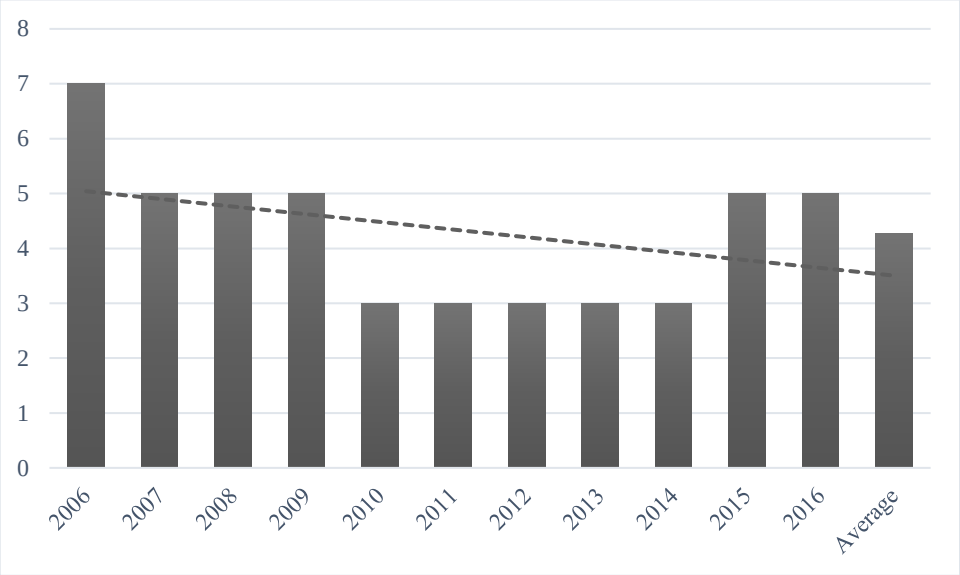


Figure 9 shows the evolution of real annual change in defence expenditures as average of NATO member states from 2006 - 2016 based on the table in appendix 1. Notable is the continued increase from the year 2006 to 2008, although with a slowing rate of increase. The biggest decrease in expenditures was in 2009, -4.71, since then, although less significant, the decrease continues until 2013. The first sign of increase is in 2014, with a symbolic 0.11%. However, in the subsequent years the increase quite sharp with 4.98% in 2015 and 5.37% in 2016. Most of the fluctuations are thought to be following setting the criteria in 2006 and the beginning willingness of governments to increase military expenditures, followed by a decrease caused by the economic crisis in 2009 and repeated increase after the end of the crisis and with more visible threats from the South and the East.

Figure 9: NATO Average Annual Real Change, 2006 - 2016, Source: NATO and author

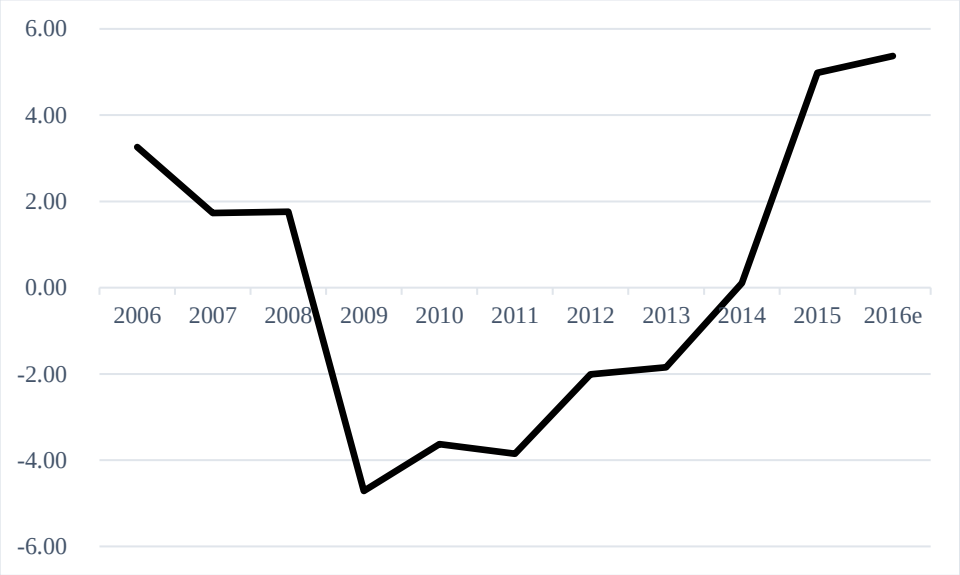


Figure 10 displays the standard deviation of defence expenditures as percentage of GDP as average of all member states, by years 2006 – 2016. The data are based on calculations available in table 6. This figure complements the previous table by demonstrating, that although the overall defence expenditures of the alliance decreased during the economic crisis, there were also major differences between the fiscal policies of individual member states and their respective approaches to changing military budget during economic crisis. The visible trend is that the standard average deviation is decreasing over the years 2006 – 2016. Moreover, we may observe that while before and after crisis, in the periods of 2006 – 2008 and 2012 – 2016, the deviation remained roughly on the same level, with minimal fluctuations, during the years of crisis, 2009 – 2011, the differences between the member states were noticeably higher and rose from the previous 0.7-0.71 to 0.87 in 2009 and decreased back to 0.73 in 2012 and below in the subsequent years, until reaching its minimum of 0.62 in 2016.

Figure 10: NATO Average Standard Deviation of percentage of GDP devoted to defence, 2006 - 2016, Source: NATO and author

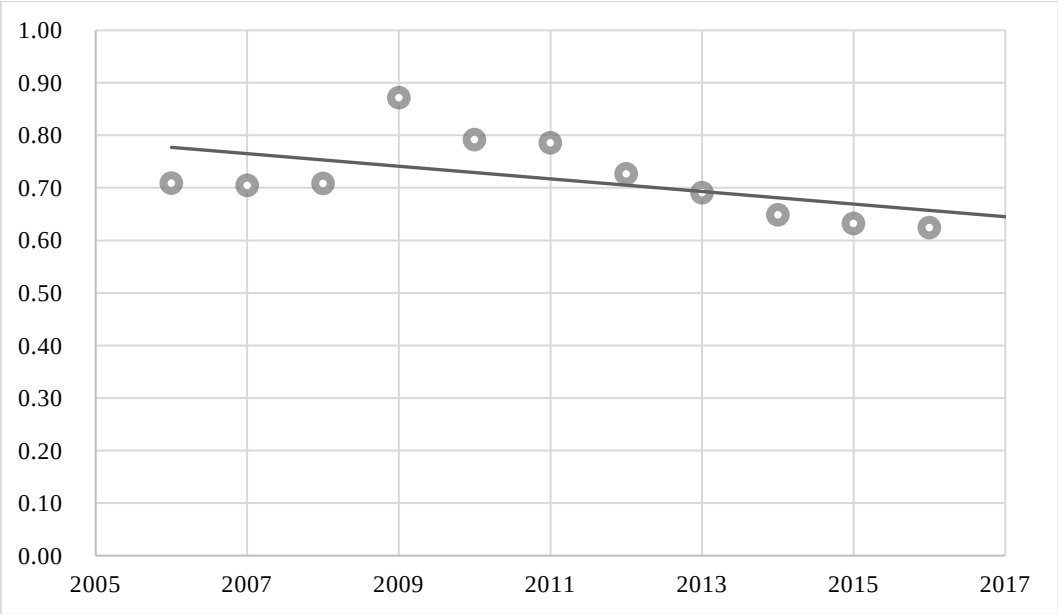


Figure 11 shows the annual real change of defence expenditures as percentage of GDP devoted to defence, as average of 2006 – 2016. Notable fact is the visible significant increase of defence expenditures of the Baltic States: Estonia, 6.42%, Latvia, 4.43% and Lithuania, 6.3% and Poland, 4.87%. Despite this trend, all of these countries remain below the targeted 2%, as shows figure 7 and table 6. By contrast, the largest decrease in military expenditures over the past ten years has Croatia, -4.96% and Italy, -5.52%.

Figure 11: Annual Real Change by Country as Average of 2006 - 2016, Source: NATO and author

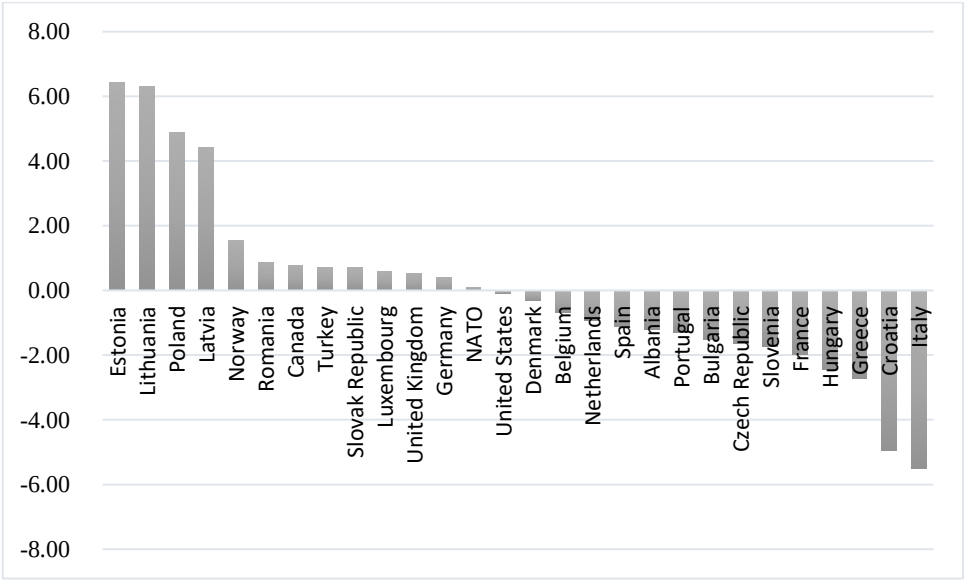
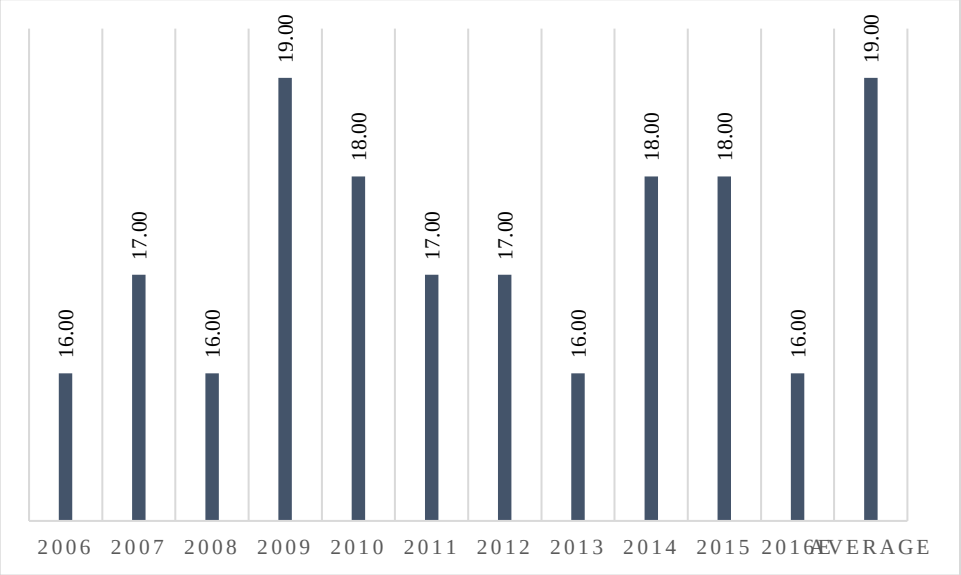


Figure 12 shows the number of countries with lower defence expenditures as a share of GDP than the NATO average for each of the years 2006 – 2016 respectively. The last column labeled as ‘average’ works with the average of defence expenditures of NATO between the

years 2006 and 2016 as well as average of the countries in this period of time that are then compared together. When comparing the individual years, it is important to note that for the years 2006, 2007 and 2008 NATO had two less member states, as Albania and Croatia joined in 2009. From the charter below, it is clear that the highest number of countries below the average was 19 in 2009 which is also the same value for the average. The lowest number was in 2013 and 2016, with 16 countries not reaching to the average.

Figure 12: N° of countries below NATO average defence expenditures as a share of GDP, source: NATO and author



7.2.2.2. Correlation Analysis

This chapter of the analytical part test the correlation between chosen basic measures of free riding, such as a nation's defence expenditures as a share of GDP and its GNI or GDP.

The following hypothesis are tested:

H2: There is a significant positive correlation between the size of a nation's gross national income and the percentage of gross domestic product it devotes to military expenditures within members of NATO. This hypothesis will be tested against:

H0: There will be no significant positive correlation between the variables specified in H2.

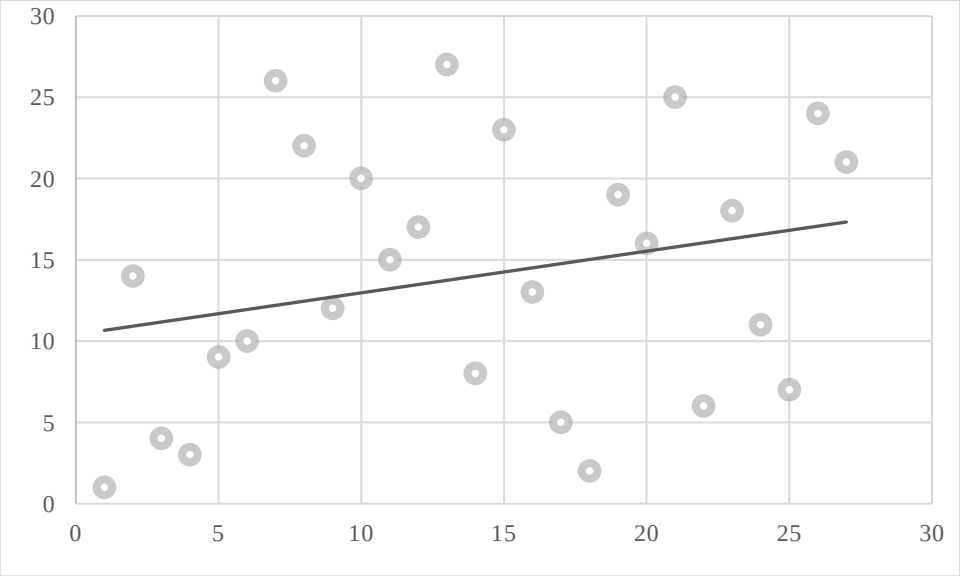
And alternatively hypothesis H3 which uses GDP instead of GNI given that defence expenditures as a share of GDP are often compared precisely with GDP.

H3: There is a significant positive correlation between the size of a nation's gross domestic product and the percentage of gross domestic product it devotes to military expenditures within members of NATO. This hypothesis will be tested against:

H0: There will be no significant positive correlation between the variables specified in H3.

The spearman correlation between member states' share of GDP devoted to defence expenditures as average between 2006 and 2016 and their GNI 2015 values is 0.3 The same correlation between same defence expenditures but using GDP as average between 2009[16] and 2016 is weaker, concretely 0.26. Based on level of significance being 0.05 for one-tailed non-parametric spearman correlation test, we reject H0 and accept H3. (Olson, Zeckhauser, 1966.) (Wooldridge, 2009.)

Figure 13: Correlation Analysis of GDP and defence expenditures. Source: NATO and author



7.2.3.Ranking Analysis

This chapter provides an analysis of free riding and defence expenditures based on all aforementioned rankings and further works with them as average. Table 7 below shows GDP, GNI, defence expenditures as percentage of GDP and Common Funding cost share coefficients, next to rankings for all member states. The last column, based on the method mentioned in chapter 6.3. on measuring free riding, calculates the average ranking for all member states based on GNI, defence expenditures as percentage of GDP and Common Funding cost share coefficients and divides member states in three clusters based on their average ranking. Country ranking is largely sensitive to the choice of indicator. For example,

[16] The GDP average is only taken between years 2009 and 2016 instead of 2006 and 2016 given that NATO does not provide information on the country's GDP from 2006 to 2008. Using data from other sources was considered, however as they significantly differed the thesis rather uses only smaller dataset in order to avoid data distortion.

Germany is ranked between 2 and 18, Canada ranked between 6 and 22, Italy between 5 and 17 or Belgium between 11 and 24, to name a few examples with big variation. Contrasting to those nations are not surprisingly the United States which ranks first in all chosen indicators.

Table 8 below summarises the results of table 7 and organises NATO member states into three clusters based on their average ranking. Furthermore, the table also shows the variations between the countries in clusters in terms of defence expenditures as a share of GDP and Common Funding cost share coefficients by showing the highest and lowest value for the cluster. Lastly, based on labelling countries as free riding if their defence expenditures as a share of GDP are lower than NATO average, the table also names such labelled countries for each cluster.

Cluster 1 includes USA, France, UK, Turkey, Germany, Poland, Norway, Greece and Canada. With variation in defence expenditures between 4.21 - 1.1 and 22.1 - 1.08 for cost shares. Not surprisingly, the lowest number of free riding nations is in cluster 1 with Canada, Germany and Norway. Cluster 2 contains Portugal, Denmark, Romania, Belgium, Netherlands, Bulgaria, Italy, Latvia and Croatia. The variation for defence expenditures and cost shares are 1.72 – 1.04 and 8.4 – 0.1 respectively. As free riding were labelled all countries from this cluster, except from Bulgaria and Romania. Cluster 3 includes Czech Republic, Spain, Slovak Republic, Slovenia, Estonia, Hungary, Albania, Lithuania and Luxembourg with variations of defence expenditures and cost shares between 1.85 - 0.44 and 5.7 - 0.08 respectively. As free riding were labelled all countries from cluster 3 except from Estonia.

Table 7: NATO Rankings, source: NATO and author

State	Average % of GDP spent on defence (2006 - 2016)	Ranking	GNI	GNI Ranking	GDP	GDP Ranking	Cost Share Index (Common Funding)	Cost Share Ranking	Average Ranking (Defence expenditures, GNI, Cost share Index)
Albania	1.40	**13**	12,355.63	28	12.63	**27**	0.0837	**27**	**22.67**
Belgium	1.04	**24**	499,449.12	11	493.97	**11**	1.9336	**11**	**15.33**
Bulgaria	1.72	**8**	53,693.79	20	51.75	**22**	0.3262	**20**	**16.00**
Canada	1.15	**22**	1,704,230.86	6	1707.34	**6**	6.6092	**6**	**11.33**
Croatia	1.47	**10**	53,651.82	21	58.83	**20**	0.2893	**21**	**17.33**
Czech Republic	1.24	**20**	191,359.17	16	212.17	**16**	0.9389	**17**	**17.67**
Denmark	1.28	**16**	332,327.13	13	324.31	**13**	1.1829	**13**	**14.00**
Estonia	1.85	**7**	24,084.15	26	21.77	**26**	0.1085	**26**	**19.67**
France	2.01	**4**	2,708,477.52	4	2708.00	**3**	10.6339	**3**	**3.67**
Germany	1.28	**18**	3,739,792.30	2	3552.64	**2**	14.65	**2**	**7.33**
Greece	2.55	**2**	219,898.04	14	264.96	**14**	1.0874	**14**	**10.00**
Hungary	1.07	**23**	127,821.04	18	134.64	**18**	0.6911	**18**	**19.67**
Italy	1.28	**17**	16,587.26	27	2077.87	**5**	8.4109	**5**	**16.33**
Latvia	1.20	**21**	1,995,026.81	5	26.49	**25**	0.149	**24**	**16.67**
Lithuania	1.03	**26**	29,641.54	25	41.22	**24**	0.2281	**22**	**24.33**
Luxembourg	0.44	**27**	43,485.92	24	55.71	**21**	0.1399	**25**	**25.33**
Netherlands	1.30	**14**	43,867.53	23	846.88	**8**	3.1804	**9**	**15.33**
Norway	1.49	**9**	827,558.66	8	446.92	**12**	1.6993	**12**	**9.67**
Poland	1.85	**6**	487,048.18	12	516.57	**10**	2.7117	**10**	**9.33**
Portugal	1.44	**11**	506,768.92	10	229.23	**15**	0.9798	**16**	**12.33**
Romania	1.42	**12**	212,490.23	15	177.85	**17**	1.0726	**15**	**14.00**
Slovak Republic	1.27	**19**	188,424.39	17	94.30	**19**	0.4681	**19**	**18.33**
Slovenia	1.30	**15**	95,305.15	19	48.08	**23**	0.2122	**23**	**19.00**

Spain	1.04	**25**	45,793.56	22	1409.06	**7**	5.7804	**7**	**18.00**
Turkey	1.89	**5**	1,324,464.92	7	821.88	**9**	4.3879	**8**	**6.67**
United Kingdom	2.30	**3**	782,795.99	9	2526.74	**4**	9.8485	**4**	**5.33**
United States	4.21	**1**	2,826,572.88	3	15704.14	**1**	22.1446	**1**	**1.67**
NATO average	0.00	//	707,147.13	//	1667.54	//	//	//	//

// not applicable

Table 8: NATO Clusters comparison based on average ranking, source: NATO and author

Cluster	Countries	Average Ranking	Defence Expenditures as % of GDP (highest-lowest in cluster)	Cost Share Indexes (highest-lowest in cluster)	Free Riding
Cluster 1	USA, France, UK, Turkey, Germany, Poland, Norway, Greece, Canada	1 - 11.33	4.21 - 1.15	22.1 - 1.08	Canada, Germany, Norway
Cluster 2	Portugal, Denmark, Romania, Belgium, Netherlands, Bulgaria, Italy, Latvia, Croatia	12.33 - 17.33	1.72 - 1.04	8.4 - 0.1	Belgium, Croatia, Denmark, Netherlands, Latvia, Italy, Portugal
Cluster 3	Czech Republic, Spain, Slovak Republic, Slovenia, Estonia, Hungary, Albania, Lithuania, Luxembourg	17.67 - 25.33	1.85 - 0.44	5.7 - 0.08	Albania, Czech Republic, Hungary, Lithuania, Luxembourg, Slovak Republic, Slovenia, Spain

7.3. Main Findings and Implications

Spearman correlation test found significant positive correlation in all cases therefore, we therefore rejected H0 and accept H1 and H2 (and alternatively H3). In the beginning this thesis set two hypotheses, (1) there is a significant level of free riding within the Alliance; and (2) smaller Allies are free riding on larger Allie. Based on the empirical analysis built on the pure public goods model and counting only with the 2% investment criterion and common funding cost shares, the thesis confirms all aforementioned hypotheses.

Both hypothesis 1 and 2 appear to be supported by the data and the correlation tests.

Hypothesis 1 is confirmed given that based on the average ranking of a country, it is possible to label countries as free riding when their ranking is below average and total for NATO. (Sandler, Hartley 1999.) NATO average defence expenditures as a share of GDP over the period of 2006 and 2016 is 1.54, based on table 6, it this thesis labels the following 19 countries with lower average defence expenditures between 2006 and 2016 as free riding: Albania, Belgium, Canada, Croatia, Czech Republic, Denmark, Germany, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Portugal, Romania, Slovak Republic, Slovenia, Spain.

Hypothesis 2 is also confirmed given the existence of significant positive correlation between GDP and defence expenditure which indicates that rich allies carry a disproportional burden of defence expenditures. (Sandler, Murdoch, 2000.)

The empirical results confirm the hypothesis of the thesis hence, based on the strong positive correlation, we may conclude that smaller allies are free riding on larger allies over the period of 2006 to 2016.

Based on the pure public goods theory and the OZ model, an in accordance with its conclusions, the analysis and empirical tests results in the very same conclusion. The allocation of goods in NATO is suboptimal, the failure to reach optimal distribution may partly be explained by the fact that each nation has to pay full cost of any additional benefit, however it enjoys only a fraction of such provided public good. This leads to an incentive for members to stop spending on defence and contribute to the collective good long before reaching the pareto optimal situation.

Although based on the model, it is possible to conclude that there is a significant level of free riding within the Alliance, we must not forget the assumptions made for the simplicity of the model and analysis. Any interpretations ought to be made with bearing in mind that it

takes into account only the 2% criterion and the set cost shares, it is therefore inappropriate to assume this conclusion of freeriding as general and apply it on free riding in NATO in general. NATO's burden sharing debates need to have a broader view on the criteria and measurements of free riding and in order to make a general conclusion, there is a need for a complex analysis of all variables concerned and bearing in mind that the public good provided by NATO is not a pure public good as the OZ model assumes.

It is also possible, that higher defence expenditures of the larger allies lead to an incentive for the smaller allies to stop increasing their military expenditures and rely on the protection of the larger allies, such implication falls within the natural incentive that the disproportionate burden of both smaller and larger nations is in fact rooted from their national interests. Such situation could be changed not only through policy changes, but also through institutional changes with an appropriate impact on defence expenditures incentives. These interpretations are also in accordance with the OZ model implications.

The fact that smaller allies are concluded to be free riding on the larger allies is not only in accordance with the OZ model but could also be interpreted as likelier given that if one member state starts to free ride, it provides higher incentive for other smaller allies to follow. In the cases of unique increase of military expenditures by Poland, Lithuania, Latvia and Estonia, a likely factor is their direct proximity to the threat itself, posed by the Russian Federation accompanied by the current general mood that nations may no longer rely on the protective umbrella of not only the traditional larger allies, but also the support from America and that they should take initiative for their own protection themselves. This interpretation follows the conclusion of the Joint Product Representation model.

8. Implications for Fiscal Policy and Further Recommendations

In September 2014, NATO representatives met in Wales, United Kingdom to discuss several of the Alliance issues and the ongoing burden sharing debates were no exception. The members agreed on the validity of the 2% criteria as well as the 20% spending on major equipment and research and development. Furthermore, it has been agreed that states who do not fulfil the aforementioned criteria will aim to reach them within a decade given that the widening gap between allies could lead to weakening of the overall defence capabilities of the Alliance. (NATO, 2017.) Despite this agreement, the diplomatic representatives were overall mostly expressing non-willingness of increasing taxation, burden, expenditures and setting further criteria, which makes it even more difficult for NATO to make progress and to make the necessary changes in order to reduce free riding.

Above all, it is vital that member states adhere to their commitments and show willingness and effort in the area of defence and security. Given the affirmation of the commitment that countries have made during the NATO Summit in Wales, all member states have to reach the 2% defence investment by 2025. This is a credible commitment that countries have to count with and gradually keep increasing defence expenditures until the criterion is reached. Thus, the most explicit recommendation for the governments of the member states being expansive fiscal policy with regard to not only military expenditures, but also other expenditures not explicitly included in the military budget but necessary for security and for comprehensive defence approach. Those being for example, but not limited to: cyber-power, fight against disinformation campaign, research and education investments, security infrastructure (professional guidance, stakeholder engagement and providing information for public), critical infrastructure (energy, electricity and emergency infrastructure, security of banking and financial system transportation). (Richterova, 2015.) (Cederberg, 2015.)

Furthermore, if the joint product representation model holds, then countries may no longer rely on the protective umbrella of the larger nations. This may currently hold not only empirically, as predicted by the model, but also given the rhetoric and signals that the United States headed by president Trump send. Important implication for nations and their economic and fiscal policy being such that given the increased threat nations and their citizens currently feel from the refugee crisis and Russia, and under the assumption that they cannot rely on protection of larger nations, it is within the direct interest of both the citizens

and government of smaller and European nations, labelled as free riding, to increase their military and security expenditures. Another fact supporting this thesis is the example of Poland and the Baltic States: Lithuania, Latvia, Estonia but also Germany.

Both Poland and the Baltics have heavily increased military spending in the last several years, accompanied by an increase in security investment and other measures, such as the introduction of mandatory military service or initiatives against disinformation campaigns. Although the trend is continual, larger change can be also traced down to the Ukraine crisis which magnified the threat of the Russian Federation.

Germany increased its military spending not only because of the refugee crisis but also under the pressure of the U.S. diplomacy. As Angela Merkel said herself "In the 21st century, we won't be getting as much help as we got in the 20th. We need to greatly increase the Bundeswehr budget to get from 1.2 to 2 percent." (Reuters, 2016.)

Lastly, increasing military spending is traditionally associated more with right-wing political parties, however, the current trend in most of the member states is the domination of government by left-wing parties. This factor might be another one to play a role in the non-willingness of European members to increase military expenditures. Although, given the current security threats, citizens are likely to be more willing to support such governments, that would guarantee security which creates a more favourable environment for politicians to increase military spending and reach the 2% criterion.

Furthermore, countries may finance the increase of military spending either by shifting the finance from different ministries and agencies, by borrowing from public and issuing bonds or borrowing from other international bodies, other means can also include financing through revenue or increase taxes. However, bearing in mind one of the goals of fiscal policy, concretely, the balanced budget surplus, it is recommended to use rather financing through revenues or by shifting the resources from other ministries.

Aside from solely increasing defence expenditures, the member states should also actively strive for unified costs procurements and open competition on government defence related purchases so that the best company from all the member states is chosen and the costs were the lowest while maintaining the quality standards of NATO and preference of the member state. Contrary to this strategy, if a member state prefers choosing a company from its respective countries as a protective policy, it often means higher costs and contributes to disproportionate distribution of costs of the same items and hence is economically inefficient.

Another prominent issue of reducing the burden sharing disproportional distribution is the issue of credible commitment among the Allies. In order to implement one of the tools and criteria, all allies would have to unanimously approve it. Such scenario is unlikely given the ongoing not so favourable economic situation of the member states, most of which already have large governmental debts and little willingness of the domestic diplomatic representation to further increase the military expenditures.

Aside from reducing free riding through an appropriate combination of above suggested economic and diplomatic solutions, NATO should also consider some of the tools of financing global public goods, such as:

- international financial incentives;
- incremental cost payments or compensations;
- international regulation;
- direct spending on intergovernmental service facilities;
- user fees and charges for global services.

Additionally, in case of the need to redefine the scale of defence expenditures that NATO requires the member states to reach, another of the useful guidelines that economic policy provides is a theory which states that the expenditures required could be as high as the cost of buying an insurance for peace from NATO. In such cases, the cost of insurance member states would pay is lower than the cost of maintaining separate national forces, hence is suntil expected to be economically advantageous.

Further important implications are based on the suboptimal distribution. Since this pareto suboptimal situation is natural but there are several ways of its reduction, it is possible to suggest such policy changes, that would lead to a pareto improvement of all involved parties. (Sandler, Harley, 2007.)

In order to reduce free riding, NATO could use a combination of available measures instead of only ability to pay criteria, it could also use the cost benefit analysis to determine certain degree of benefit taxation or marginal cost sharing schemes, all of which would lead to a reduction of the disproportionality. (Olson, Zeckhauser, 1966.) Seigile (2005) suggests such taxation policy that incorporates both ability to pay and benefit principle so that both the wealth and preferences are regarded. For example, a country that is relatively wealthy and benefits from a peace mission will be a target for financing and/or peace duties, while less wealthy nations will be requested to provide assistance of other kind based on the assumption that they benefit from such a mission but cannot afford it.

It is clear, that for sensible burden sharing debates, it is necessary to look not only on the 2% investment criteria, but further incorporate also stationing of troops in the strategically key areas, economic aid investment, EU integration investments and other alternative measure. Another reason why NATO should adopt a broader perspective on defence and security expenditures is the increased occurrence of hybrid warfare tactics that NATO has to face and the resulting need for a flexible comprehensive defence approach that integrates general preparedness and investments in security that are typically parts of the budget of various different ministries and not typically perceived as defence and military expenditures.

9. Conclusion

This thesis attempted to identify, describe and analyse the problem of free riding in the North Atlantic Treaty Organisation between 2006 and 2016, using econometric tools and spearman correlation test. The thesis first described the concept of economic theory of alliances, afterwards outlined the function of NATO funding as well as defence budget using a case study comparison between the United States and Germany. Afterwards the thesis turned to the problem of free riding itself, describing the theories of free riding, setting a burden sharing criteria, measuring free riding as well as suggesting tools for reducing free riding. The analytical part offered analysis of NATO Common Funding and Defence Investment using econometric tools and spearman correlation coefficient to test the two hypotheses set in the beginning of the paper and finally it also offered analysis and interpretation of rankings with regard to various indicators. Based on the results, the thesis confirmed both hypotheses and labelled 19 countries as free riding. The last chapter offered several important implications and recommendations for fiscal policy.

The thesis resulted in several conclusions and implications based on the practical analysis. The distribution of burden sharing in NATO remains unequal and suboptimal. There is a significant level of free riding in NATO and larger nations remain bearing larger share of costs. However, the results of whether, and to what extent, there is free riding in NATO significantly differ based on what is taken as the measure for free riding. This study works with the 2% criterion and common funding cost shares, however there is a need for NATO to look beyond those criteria and consider a broader concept on what is included in defence and security spending especially given the recent migrant crisis, military soft power, and current emphasis on comprehensive defence approach.

It is natural, that allies will be unequal whether it is in defence spending, economic aid, investment on refugees and security, disinformation campaign and others. The question for current burden sharing remains to be how much of the aspects, spending, procurement and contracts NATO wants to unify. Economics provides a clear conclusion, that unification, for example in weapon procurement, cost saving technologies and standardisation or even centralised production of the public goods commodity would lead to more equal marginal costs for defence goods and could lead to more optimal distribution of cost sharing. However, it is unlikely that NATO would adopt such measures given that a unanimous vote is necessary in order to approve such measures. Nations are currently sceptical about the political integration, norms and regulations that the European Union enforces on them, it is

then unlikely, that all member states would vote in favour of such measures and further criteria.

Further research is needed, and were it not for the limitation of space and time of this thesis, it would be desirable to include more variables in both the correlation test and the overall ranking analysis, especially including several of the alternative measuring variables of free riding, where it is likely that the deviations in ranking would be even greater and the division into clusters the more so interesting. Furthermore, it would be desirable to analyse the situation also based on the joint product representation model as well as label countries as free riding not only based on defence expenditures.

The future of NATO burden sharing and free riding debates will largely depend on whether NATO and the diplomatic representations involved, will recognise the deviation from 2% as the sole measure of free riding and insist on the criterion or whether NATO will acknowledge and incorporate other measures. An optimal solution for NATO is not only revisiting the models of free riding and choosing additional criteria and taking into account also various different measures of free riding, but also implementing the combination of economic and diplomatic solutions that should be such upon which allies would agree and where the benefits would be higher or equal to the transaction costs and the costs of its implementation.

Appendixes

Appendix 1: Average Annual Real Change of defence expenditures, is percentage of GDP, source: NATO and author

State	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016e	Average Annual Real Change	Average Deviation
Albania	//	//	//	-4.58	6.54	0.55	-1.32	-4.23	-2.83	-11.62	7.95	-1.19	4.65
Belgium	2.80	7.90	9.00	-5.82	-3.70	-1.68	0.10	-3.11	-3.09	-4.57	-5.30	-0.68	4.09
Bulgaria	0.40	16.10	1.30	-21.22	-4.59	-18.90	1.54	9.58	-8.27	1.02	6.21	-1.53	8.52
Canada	3.90	9.30	5.30	5.88	-14.25	9.71	-9.50	-7.51	5.14	-2.70	3.33	0.78	6.74
Croatia	//	//	//	-11.12	-6.38	3.53	-6.44	-4.93	-4.61	-0.95	-8.80	-4.96	3.22
Czech Republic	3.40	-8.80	0.90	10.17	-13.58	-14.92	-2.17	-3.11	-4.82	14.43	0.29	-1.66	6.81
Denmark	8.90	-3.50	3.80	-6.00	6.53	-6.81	3.12	-8.32	-4.37	-1.05	4.32	-0.31	5.13
Estonia	9.70	29.10	2.70	-13.79	-2.91	6.11	18.21	2.26	4.82	7.95	6.50	6.42	7.15
France	-0.40	-0.80	-2.00	-13.70	-0.94	-2.95	0.56	0.00	-1.08	-1.21	0.64	-1.99	2.30
Germany	-1.70	0.80	4.80	2.30	1.44	-1.90	2.90	-6.31	-1.26	1.22	2.08	0.40	2.32
Greece	3.80	-0.60	9.80	3.36	-18.94	-17.97	-10.81	-6.41	0.72	7.06	-0.07	-2.73	7.85
Hungary	-14.80	4.30	-4.80	-12.08	-8.01	3.09	-2.84	-6.67	-4.81	10.32	9.33	-2.45	6.70
Italy	-13.00	-22.50	4.30	-5.68	-3.73	-3.18	-6.82	-5.10	-9.81	-5.82	10.63	-5.52	5.55
Latvia	27.90	7.20	0.60	-31.82	-15.80	2.31	-9.51	8.31	3.11	14.08	42.31	4.43	14.12
Lithuania	11.40	8.10	-0.20	-17.54	-16.85	-4.28	-0.89	4.71	18.99	31.72	34.13	6.30	13.24
Luxembourg	0.40	2.60	-32.90	-2.57	25.03	-14.63	-3.72	3.02	7.15	16.23	5.75	0.58	10.24
Netherlands	1.50	1.10	-1.30	1.36	-4.22	-4.90	-2.84	-5.98	0.19	2.63	2.27	-0.93	2.66
Norway	0.50	3.20	0.10	3.65	-1.08	0.47	0.40	1.57	4.32	-1.65	5.45	1.54	1.91
Poland	6.30	9.60	-12.10	9.37	7.34	2.05	2.69	-0.05	11.42	24.76	-7.80	4.87	7.19
Portugal	-4.70	-6.80	3.20	5.03	-1.35	-1.45	-9.56	1.51	-8.74	3.01	5.68	-1.29	4.52
Romania	4.10	-11.40	3.10	-14.30	-7.31	4.48	-4.13	8.36	8.60	11.42	6.47	0.85	7.37

Slovak Republic	6.30	2.80	4.20	-1.74	-12.02	-12.23	2.31	-8.63	3.24	18.66	4.85	0.70	6.81
Slovenia	19.10	0.00	7.40	-1.73	2.38	-18.77	-11.90	-10.52	-4.76	-1.85	1.46	-1.74	7.11
Spain	5.50	2.80	2.00	-4.63	-8.87	-9.66	7.59	-12.81	0.53	4.54	0.62	-1.13	5.72
Turkey	5.60	-12.30	8.80	-0.74	2.54	-1.11	2.36	3.66	-0.04	2.33	-3.23	0.72	3.82
United Kingdom	-3.90	4.90	4.60	-1.40	1.38	-1.67	-8.23	6.80	-1.61	-2.52	7.44	0.53	4.09
United States	-1.50	0.13	21.40	2.07	-6.68	0.74	-5.45	-6.04	-5.22	-2.88	2.49	-0.09	4.95
NATO	3.26	1.73	1.76	-4.71	-3.63	-3.85	-2.01	-1.85	0.11	4.98	5.37	0.10	3.02

Appendix 2: Real GDP, source: NATO and author* **

State	2009	2010	2011	2012	2013	2014	2015	2016	Average	Ranking
Albania	12.00	12.00	12.00	12.00	13.00	13.00	13.00	14.00	12.63	**27**
Belgium	471	484	492	493	493	500	507	513	493.97	**11**
Bulgaria	50	50	51	51	52	52	54	55	51.75	**22**
Canada	1,565	1,613	1,664	1,693	1,731	1,773	1,794	1,824	1707.34	**6**
Croatia	61	60	59	58	58	57	58	59	58.83	**20**
Czech Republic	202	207	211	209	208	212	221	226	212.17	**16**
Denmark	315	320	324	323	322	327	330	334	324.31	**13**
Estonia	19	20	21	22	22	23	23	24	21.77	**26**
France	2,596	2,647	2,702	2,707	2,725	2,729	2,761	2,798	2708.00	**3**
Germany	3,283	3,417	3,542	3,556	3,567	3,624	3,685	3,746	3552.64	**2**
Greece	317	299	272	252	244	246	245	245	264.96	**14**
Hungary	129	130	132	130	133	137	142	144	134.64	**18**
Italy	2,090	2,125	2,137	2,077	2,041	2,034	2,049	2,070	2077.87	**5**
Latvia	25	24	25	26	27	28	28	29	26.49	**25**
Lithuania	37	37	39	41	42	44	44	46	41.22	**24**
Luxembourg	50	52	54	53	56	58	61	63	55.71	**21**
Netherlands	825	836	850	841	837	846	862	877	846.88	**8**
Norway	426	429	433	445	449	459	466	469	446.92	**12**
Poland	462	479	503	511	518	535	554	571	516.57	**10**
Portugal	234	238	234	225	222	224	227	230	229.23	**15**
Romania	169	168	170	171	177	182	189	197	177.85	**17**
Slovak Republic	85	89	92	93	95	97	100	103	94.30	**19**
Slovenia	47	48	48	47	47	48	49	50	48.08	**23**
Spain	1,431	1,432	1,417	1,380	1,357	1,376	1,420	1,460	1409.06	**7**
Turkey	670	731	795	812	846	872	907	942	821.88	**9**

United Kingdom	2,367	2,403	2,450	2,479	2,533	2,605	2,666	2,711	2526.74	**4**
United States	14,595	14,964	15,204	15,542	15,774	16,157	16,549	16,849	15704.14	**1**
NATO Average	1,205	1,234	1,257	1,269	1,281	1,306	1,334	1,357	1,280	

* billions of US dollars

** 2010 prices

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