Arms, Alliances and Trade

Author: *George Timoney Ringström*
Supervisor: *Maria Persson*
Lund University
Faculty of Economics
Spring 2015

Abstract

With the use of arms trade data spanning the time period between 1992 and 2010, this thesis sets out to study what influence joining NATO has on a country's volume of arms export and its probability of exporting arms. An assessment is also made of how NATO members trade arms. The data is estimated with a set of different gravity models and by using linear regressions evaluating volume and logistic regressions evaluating probability. The study finds that joining NATO has a negative influence both on the volume of arms exported by a country and the probability of the country exporting arms. Both exporter and importer being a member of NATO has a positive influence on the volume of export. It does however decrease the probability of arms being exported.

Key words: NATO, Arms trade, Arm export, Swedish arms export, Gravity Model

Table of Contents

1   Introduction

The Swedish debate on whether to join NATO has lately intensified. At the same time another hot topic current to Swedish politics, the nation's arms export, has recently gained increased attention. For many years Sweden has been one of the largest arms exporters in the world. The arms industry of the country and a potential entrance into NATO both play significant roles in Swedish defense politics. This particular relationship gives grounds for closer examining what influence joining NATO has on the arms export of a country. More specifically the aim of this study is to investigate what impact joining NATO has on a country's volume of arms export as well as the probability of the country exporting arms. Furthermore the study will investigate the arms trade pattern of NATO members. To what countries do NATO members export arms, and from where do NATO members import arms? Is trade more probable and are export volumes larger within the alliance as supposed to outside of it?

By the use of extensive data from the Stockholm International Peace Research Institute (SIPRI) a quantitative study is conducted. A gravity model forms the basis of the econometric approach to the question. The results are thereafter examined and interpreted from a general perspective. In a final discussion the findings are also applied to Sweden in order to evaluate what impact joining NATO more specifically would have on the Swedish arms industry.

Section 2 continues by encompassing a description of the data, a review of the arms trade patterns of all NATO members and a brief background to the Swedish export of arms. Section 3 discloses information regarding previous research while section 4 gives a theoretical foundation to the study. Section 5 describes the method used to examine the data. This part elaborates on the use of the gravity model and variables of the model. Section 6 presents as well as discusses the results. In the final conclusion of section 7 the results are put into the context of the Swedish arms export. This means evaluating the results while attributing attention to the political, economic and strategic aspects of Sweden and its arms export. Section 7 also treats all remaining remarks on the work such as areas in need of improvement and suggestions for future research.

2   Background

2.1   Data

This study uses data found in the Arms Transfer Database of the Swedish Institute for Peace and Research (SIPRI). The database encompasses all trades of major conventional weapons over the period 1950-2014. The SIPRI Arms Transfer Database does not include any trades of small arms. More specifically the database is compiled by eleven subcategories to the overall one being major conventional weapons (MCW). These categories are the following: aircraft, air defense systems, anti-submarine warfare weapons, armored vehicles, artillery, engines (for military aircraft, combat ships and most armored vehicles), missiles, sensors, satellites and other MCWs (mainly turrets for armored vehicles and ships). The valuation of each arms trade is a volume measure. This means that the prices noted in the dataset are not the actual prices paid by the receivers, but based on trend indicator values. This is expected to give more consistent data that is more comparable over time. The dataset has in other research been endorsed for its accuracy and reliability. Åkerman and Seim do in their article on arms trade, which uses the same database, communicate the reassurance of the high quality of the dataset given to them directly from representatives at SIPRI. These representatives explain that "since the rules and surveillance relating to arms are so strict and since equipment of this nature and size is difficult to hide from observation, the arms trade not captured by the dataset is negligible" (Åkerman & Seim, 2014, p.537).

2.2   NATO and its trade of arms

With the end of World War II began a new era in global politics. In order to avoid future wars ripping apart the continent and to deter the advancement of the Soviet Union, ten Western European countries, The United States and Canada signed a treaty in 1949. What was originally but an alliance treaty in which all parties, as is famously stated in the fifth article of the treaty, "agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all (NATO, 1949)" soon started to evolve into a closer military and political cooperation. In the following decades the organization expanded with several new members joining. The map in figure 1 illustrates how NATO has grown over the years.

Figure 1. *The member states of NATO* (CFR, 2015)

NATO carries almost no military equipment of its own[1]. The alliance does instead work as a pooling system where members contribute with military equipment to the extent needed. This falls under a wider policy of interoperability, which by NATO itself is defined as, "the ability for Allies to act together coherently, effectively and efficiently." Furthermore it states that, "Interoperability does not require common military equipment. What is important is that the equipment can share common facilities, and is able to interact, connect and communicate, exchange data and services with other equipment (NATO, 2012)." These statements clearly indicate that the trade of military equipment is a domestic business pertaining to each member state itself. The alliance does have requirements on how much a member must spend on its military defense. The 2% of GDP is however a requirement few members actually fulfill (World Bank, 2014). Albeit not all members spend the full 2% that is required, they still allocate funds to their military defense. A portion of those funds is used to purchase arms. But from where are these arms purchased? And those who produce, to whom do they sell? The charts in figure 2 & 3 have been compiled using data from the SIPRI Arms trade database. Accumulating and sorting all trades of each NATO member for those years every particular

---

[1] The alliance itself only holds some radar aircraft systems (NATO, 2015)

[2] Although France abandoned the NATO-command between 1966 and 2009, it never officially left NATO and is thus in all calculations counted as a member of NATO since 1949.

[3] This list does not include India. The country is often cited as one of the biggest importers of Swedish arms in

member has been part of NATO carry out the calculations in figure 2 & 3[2]. Division has also been made for trades taking place with the same country both prior to and after that country joined NATO as well. An example of this would be Portugal's imports from Spain. All arms Portugal imported from Spain *prior* to 1982 (the year Spain joined NATO) are in the chart registered as *Imports from other countries,* while all imports from Spain *after* 1982 are registered as *Imports from NATO members.*

The pie charts in figure 2 show the accumulated import and export of arms carried out by NATO members since the creation of the alliance. The pie charts in figure 3 incorporate data from a much narrower spectrum of time. 1999 is the year in which the first former Warsaw Pact states (The Czech Republic, Poland and Hungary) joined NATO. Several other have later followed. The charts in figure 3 do in other words illustrate the accumulated import and export of arms carried out by NATO members since its eastern expansion started in 1999.
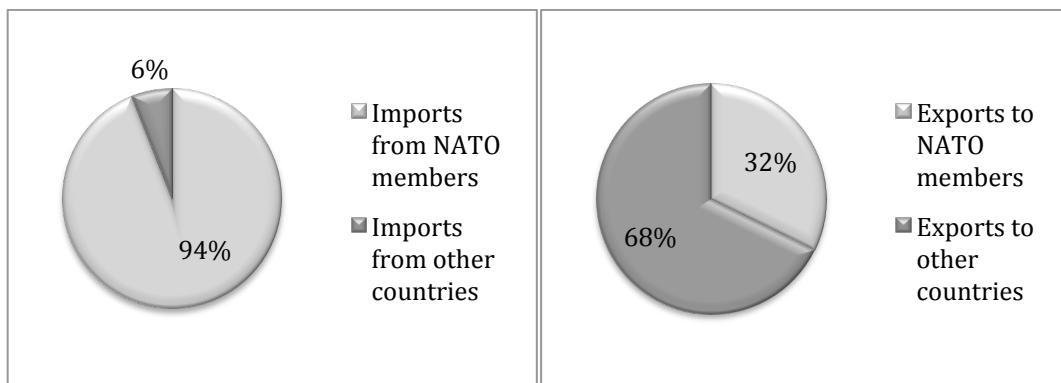

Figure 2. *Total NATO imports and exports of arms 1950-2014*
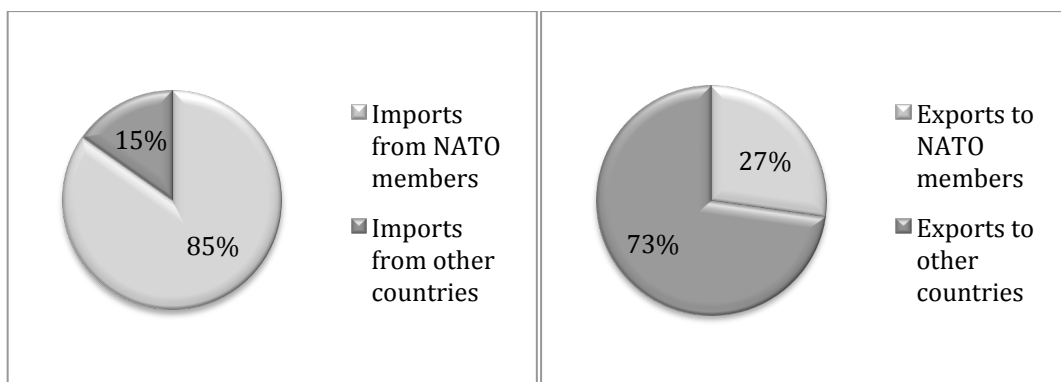

Figure 3. *Total NATO imports and exports of arms 1999-2014*

---

[2] Although France abandoned the NATO-command between 1966 and 2009, it never officially left NATO and is thus in all calculations counted as a member of NATO since 1949.

By looking at the charts it becomes evident that a large portion of arms imported by NATO members originates from other member states. In contrast stand the charts representing *export* of arms from NATO members. In these only about one third of all arms exported go to other NATO members. There seems to be a preference of *importing* arms from fellow members while seemingly no particular regard is taken to if an *importer* of arms is a NATO member or not. When comparing the imports and exports of NATO members for the two time periods measured, it is noticeable that imports from other countries more than double from 6% (1950-2014) to 15% (1999-2014). The share of arms exports to other countries also increases, albeit only with a slight 5% from 68% (1950-2014) to 72% (1992-2014). Both changes suggest an increasingly globalized arms trade network where importers and exporters are less clustered to allies. This finds support in the work of Åkerman and Seim that is discussed in the section of previous research. The large portion of arms exported from NATO members to non-members may seem remarkable. It does however receive some explanation in figure 4. The pie chart illustrates the largest exporters of arms in the world during the post-Cold War era. Members of NATO (bold) make out almost 67% of the global exports of arms. In other words it is quite logical that importers, regardless of whether they are NATO members or not, will be purchasing a fair share of their arms from NATO members. Similarly the large arms exporting NATO members meet a demand, and perhaps are in need of demand, that exceeds the accumulated demand of their allies. Consequently such a great portion of NATO member arms exports go to countries outside of the alliance.
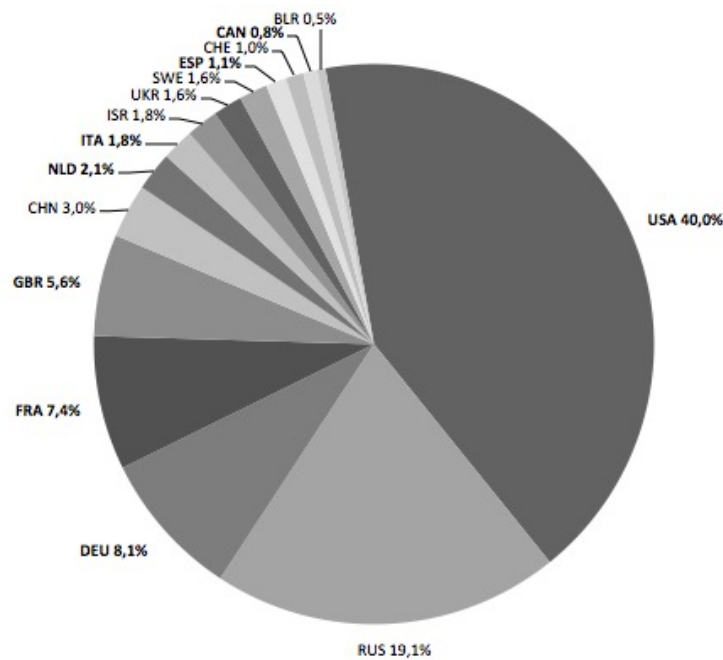

Figure 4. *The 15 largest exporters of arms, 1992-2014*

A closer examination of who these other countries are shows a large presence of allies to the United States. The largest importer of arms from NATO is South Korea at 7% of total NATO member exports. The country is a close regional ally of the United States. Saudi Arabia follows closely at second place with 6,6% of exports. Albeit not at all as close of an ally to the United States as South Korea, Saudi Arabia plays a central role in the military strategic presence of the United States in the Middle East. One way of exercising this presence is through arms trade (SUSRIS, 2010).
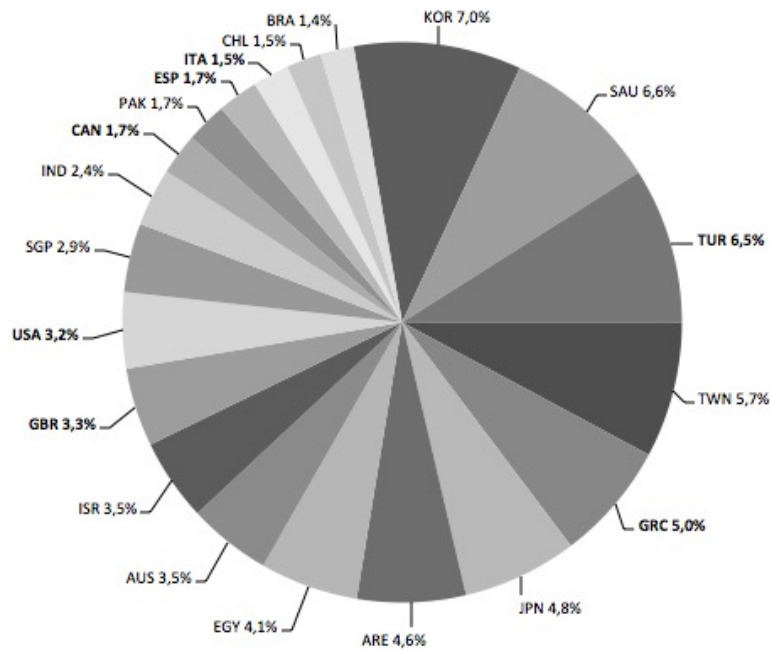

Figure 5. *The 20 largest importers of arms from NATO members, 1992-2014*

Japan is another noticeable ally of the United States that places high on the list of the largest importers of NATO member exported arms. Given the fact that the United States holds a central role within the alliance and makes out about 40% of global arms exports, it is quite logical that a large share of the arms being exported to countries outside of NATO by NATO members are closely tied to the United States.

The aim of this study is mainly, as aforementioned, to examine the impact that joining NATO has on the arms export volumes of a country. An indicative, yet simple, way of examining this is by looking at how arms export volumes have changed for those countries that have joined NATO since the end of the Cold War. The two graphs in figure 6 and 7 show the average volume of arms exported by all post-Cold War entrants. To avoid distortion of the graphs between the group entering NATO in 1999 and the group entering in 2004, these two have instead been divided. The volume on the y-axis is denoted in million US$ at 1990 constant prices while the x-axis values are years.
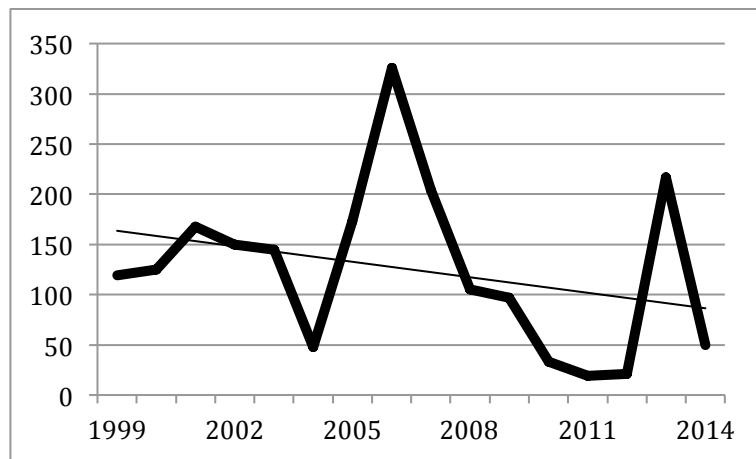
8

Figure 6. *Average annual volume of arms exports for NATO members who joined in 1999*
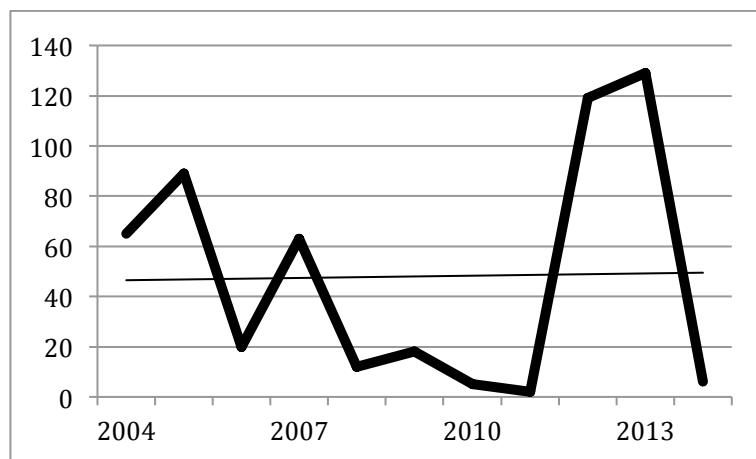

Figure 7. *Average annual volume of arms exports for NATO members who joined in 2004*

The trend for the 1999 group is quite a substantial decline in the export of arms since joining NATO. The group joining in 2004 experiences a very slight, positive trend. Arms trade deals tend to be a very lengthy and extensive process. This creates a certain degree of lag between the initiation of negotiations and an actual transaction. To smaller producers, like all those incorporated into the chart data, one large purchase may heavily affect the total volume of exports for that year. Both of these effects may blur the true image of the impact that joining NATO has had on the countries' arms export volumes. Nevertheless the overall impression of the two graphs leads to believe that joining NATO has a negative impact on a country's arms export volumes.

The likelihood of a country exporting arms can to some extent be reflected in the occurrence of individual exports of arms. The higher the current occurrence, the more likely the country is of exporting arms in the future. This can be briefly explained as a result of the extensive

initial costs of producing arms and the intricacies of sovereign state arms purchases. These create large entry barriers for new actors. Both of the observed groups have a negatively sloping trend line for the number of individual arms exports per year during the time period they have been NATO members. This indicates a decreased likelihood of exporting arms due to having joined NATO.
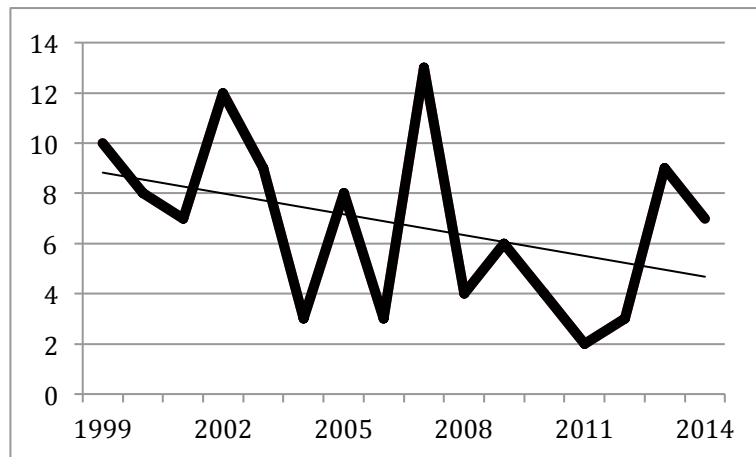
Figure 8. *Average annual number of arms exports for NATO members who joined in 1999*
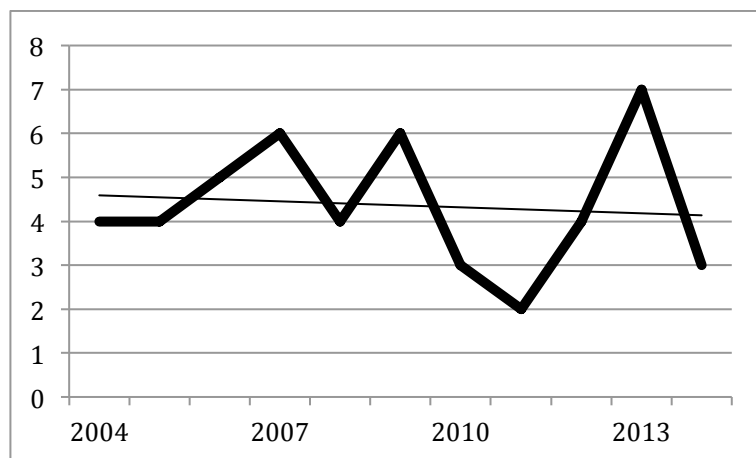
Figure 9. *Average annual number of arms exports for NATO members who joined in 2004*

The graphs are but simple observations of trends occurring within the arms export sector of a set of NATO members. They do however give an indication of what tendencies are to be expected in the econometric investigation.

2.3 The Swedish arms export

By entering the Cold War neutral, and remaining so throughout the whole course of it, Sweden saw it necessary that its military defense was as independent as its politics. Relying

on any other nation for the supply of military equipment was considered unreliable and to some extent in conflict with the established neutrality. As a result the arms industry received large funding and support from the government. With the end of the Cold War much of the incentive for high military spending evaporated.
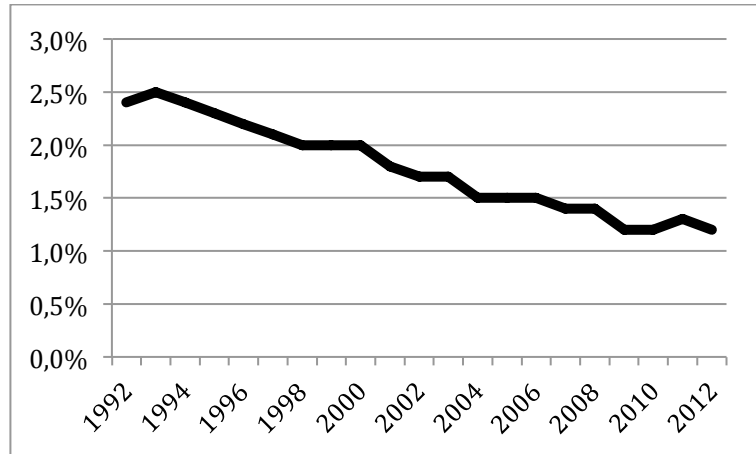
Figure 10. *Sweden's military expenditure as a percentage of GDP, 1992-2012*

(Försvarsmakten, 2014)

The constantly decreasing Swedish military expenditure should as a natural consequence have taken its toll on the Swedish arms industry. This does however not hold true. The diagram in figure 11 illustrates the value of Sweden's total export of arms for every year between 1992 and 2014. The export is denominated in US$ million at constant (1990) prices.
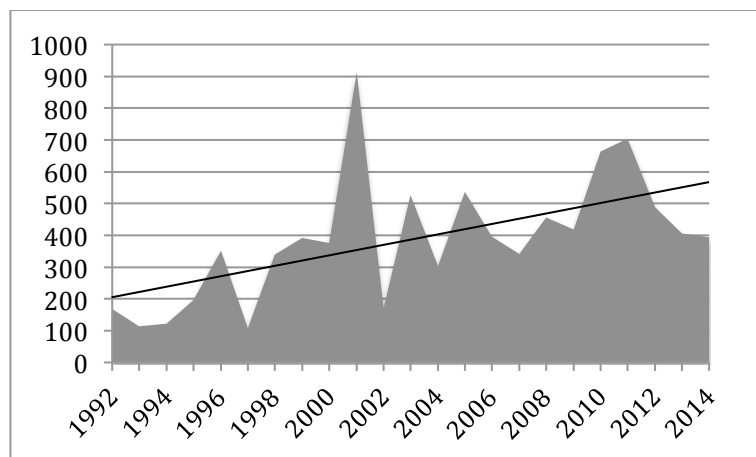
Figure 11. *Sweden's arms export 1992-2014*

The trend line clearly shows how the Swedish arms industry steadily has increased its exports since 1992. This has happened simultaneous to a trend of decreasing governmental spending on the very same industry. Combining the two facts, one can assume that as governmental

investments decreased, capital was instead injected into the industry through an increased export of arms. In other words: the arms export started to substitute Swedish military expenditure (Tuvestad, 2014). This is a good example of how the production costs of domestic arms are supported by arms export. Although the Swedish producers of arms are privately held companies, the Swedish arms export is no free market, open to any buyer or seller. The government does according to paragraph 6 in the law on military equipment (Sveriges Riksdag, 1992) wield absolute power in the decision of what countries Swedish companies may sell arms to. Figure 12 shows the countries to which Sweden has exported arms since 1992.
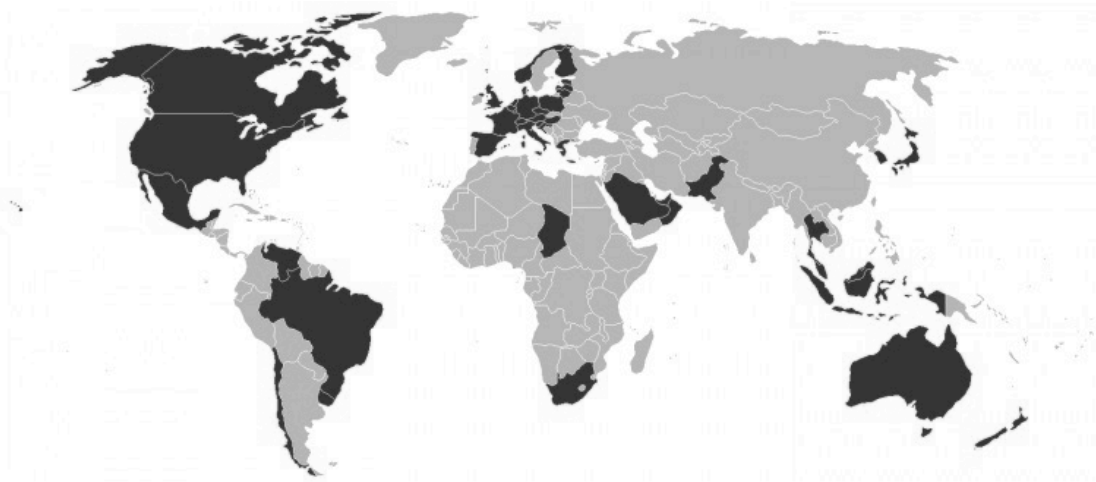
Figure 12. *Importers of Swedish arms, 1992-2014*

Importers include most of Europe, large parts of the Americas, parts of the Middle East as well as a handful of nations in South and East Asia, Oceania and Africa.

Figure 13. *The 20 largest importers of Swedish military equipment 1992-2014*[3]

The Swedish law states that the country only gives license to the export of arms as long as "there exists security and defense reasons and if it does not conflict with Sweden's foreign policy". Moreover all decisions regarding licensing of arms export have to follow the guidelines of the EU. These prohibit arms from being sold to countries that violate human rights and/or are involved in an armed conflict.

3 Previous research

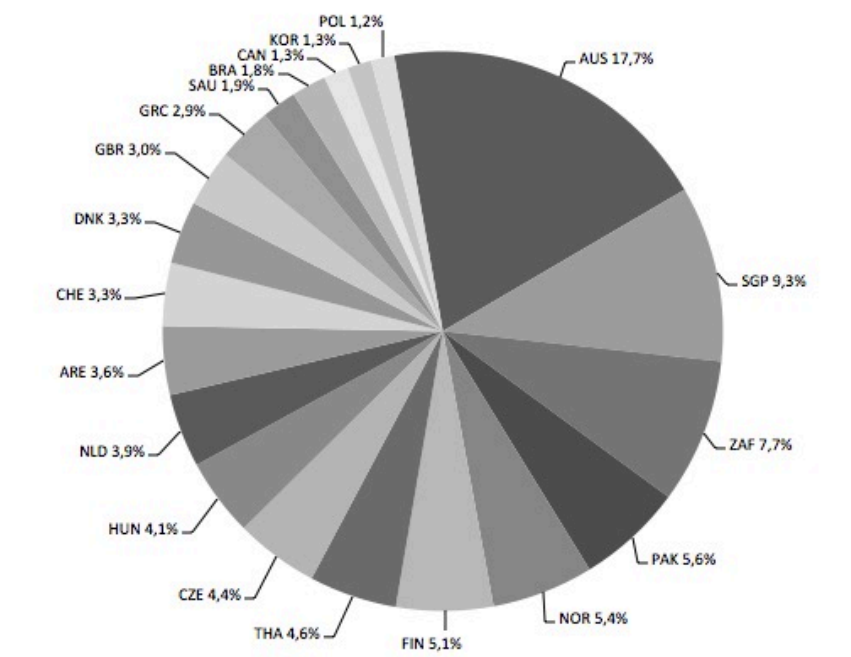Previous studies specifically addressing empirical observations made on the economic aspects of arms trade are somewhat scarce. It is suggested by García-Alonso and Levine (2007) that this is due to the complexity of the arms trade market as well as the difficulty of finding reliable and well defined data that captures all aspects of the market. As they point out in their work a large challenge to making any predictions about the market is the difficulty of quantifying national or regional security (alternatively insecurity) – a determining factor of demand.

What the writers consistently point out in their paper, and that cannot be stressed enough, is the many ways in which the arms trade market is fundamentally different from other markets. An explicit example of this is the skewed market preferences caused by the negative insecurity externality of arms. The more arms possessed by the world, the more insecure countries will feel. Consumers on the arms market may therefore enjoy *higher utility* from producer monopoly or the forming of cartels – something that would, in accordance with basic microeconomic theory, mean lowered output and increased prices. Exporters of arms are free to engage in any such formation since arms trade is exempt from WTO rules. In other words exporting countries may set any trade policies they find maximize their own objectives.

Much of this essay's empirical approach is based on the work of Åkerman and Seim (2014). Their extensive work examining the global arms trade network from 1950 until 2007 is a very suitable foundation. The two authors set out to investigate if countries tend to trade arms with other countries in their own political vicinity. More specifically they look at how countries with different polities trade arms. To their aid they also use the SIPRI arms trade database. In

---

[3] This list does not include India. The country is often cited as one of the biggest importers of Swedish arms in recent years. SIPRI's database (upon which the list is based) does however not include artillery under 100 mm caliber, support equipment, components and technology – some of which is what India purchased from Sweden. (Regeringen, 2013).

addition they use polity scores from the POLITY IV database hosted by the Center for Systematic Peace and George Mason University. Åkerman and Seim also look at how the global arms trade network has changed over time and document the key differences between the arms trade networks of NATO and the Warsaw-pact. In parts of the study they divide results into a Cold War and a post-Cold War section. This is to contrast the two against each other and see if the polity preferences of arms exporting governments are different between the two eras. The part of their article most significant to this study is their method of estimating differences in polity scores and their influence on arms exports. A similar gravity model is used. The independent variable of their equation is a dummy variable assuming the value 1 if country i exported arms to country j at point t in time and 0 otherwise. Essentially the same set of independent variables is used except the NATO variables that are specific to this study. All the variables are explained in the method section of the essay. Calculating the difference in polity score between the exporter and importer derives the relative polity score. The difference is then squared to achieve a positive value. This score is also modified to serve some of the other areas studied in their article. These are however not of relevance to this investigation. Their equation is regressed with a pooled OLS.

What Åkerman and Seim find is that the global arms trade network of the Cold War era had a clear division between East and West. These two sub-networks were quite centralized, the Warsaw Pact being the more centralized. In the post-Cold War era the global arms trade network has grown more clustered and decentralized. As for the polity preferences, a clear negative relationship between differences in polity and arms traded is noted for the Cold War era. The further apart two countries were in polity, the less likely they were of trading arms. The same relationship cannot be detected for the post-Cold War era. This is corroborated by their observations of the global arms trade network having grown more clustered in recent years.

4   Theory

Concerns for internal as well as external threats are what create the demand for arms. The threat of having to engage in an armed conflict is however not solemnly what drives the demand. The possession of arms also emits a general posture of power (Levine et al., 1997). A heavy possession of arms could therefore also be seen as a preventive measure. It is less likely to be involved in an armed conflict if antagonists evaluate an attack to be costly. A predicament faced by every nation though is the *security dilemma*. A scholar named J.H. Herz was first to use this term in 1950. Herz wrote that the security dilemma was "A structural notion in which the self-help attempts of states to look after their security needs tend,

regardless of intention, to lead to rising insecurity for others as each interprets its own measures as defensive and measures of others as potentially threatening (Herz, 1950)." The skewed microeconomic preferences brought up in the section of previous research addresses this matter. The research suggests that because the general existence of arms in the hands of one nation creates a negative utility for other nations, minimizing the existence of arms therefore optimizes the accumulated utility of the world. Consumers will hence prefer less of a supply at a higher cost, since this will decrease the risk of other nations possessing arms. Such a market is achieved through monopoly or oligopoly. The forces of such a market will as a result have larger exporters eventually outcompete smaller exporters.

Most countries need to import Major Conventional Weapons while a small group of countries has the capability of producing them. In their work Levine et al. (1997) create a Cobb-Douglas utility function that seeks to quantify an arms exporting country's perception of its own security. While their particular study aims at creating an equilibrium model for the global arms trade network, the utility function still serves to gain better understanding of some of the mechanism at force in this study.

1. $S = S_d^{1-\mu} S_r^{\mu}$

The function describes the national security (S) of an arms exporting nation. This security is defined by domestic security (S_d) and regional security (S_r). The exponent μ is the weight attached to regional security, assuming any value between 0 and 1. In the case of 0 the exporting country has no regard for repercussions in regional security due to its exports. Instead it exports on free market terms with the aim of maximizing profit. This is however not a very likely scenario. Many of the largest exporters are global dominant players. It is consequently in their interest not to export too much arms to any specific country or region. This could impair their own capability of intervening in a regional conflict. By joining NATO two things happen to the military strategic positioning of a country. Through the binding agreements of the alliance the country is assured of receiving military assistance. At the same time the country complies to share the defense burden carried by other, possibly, remote nations. In other words what the alliance effectively does is a pooling of national security, through sharing national defense. Putting this into the context of equation 1, joining the alliance means merging with a general NATO security.

2. $S_{NATO} = S_{d\_NATO}^{1-\mu} S_{r\_NATO}^{\mu}$

The total security of NATO is a cumulated value of all members' domestic and regional security. The reasons for bringing this up is to underline the fact that ones a country joins NATO it will start complying with much of the military strategic policies of the alliance. These policies could have other preferences for domestic security ($S_d^{1-\mu} \neq S_{d\_NATO}^{1-\mu}$) and regional security ($S_r^{\mu} \neq S_{r\_NATO}^{\mu}$). That could put constraints on the arms export policy of the joining country.

Every nation with an arms industry has, at least at some point in time, decided to create it due to defense reasons. A domestic supply of arms ensures a constant supply of arms even in the case of a conflict. But the more advanced the arms technology becomes, the more expensive the development costs are. This is most commonly what drives the initial decision of starting to export arms, an otherwise, on national level, not very desirable choice (due to the security dilemma). When a country joins NATO it aligns itself with a large percentage of the worlds arms producers. The risk of lacking arms in case of an intrastate conflict naturally decreases. This consequently diminishes a strong argument for the domestic production of arms, the result potentially being less domestic production and less export of arms from that country. It is moreover plausible that the country will receive beneficial offers on arms purchases from allies. To these allies exporting arms to other NATO members does not necessarily result in a negative externality (as would otherwise be the case). Exporting arms to an ally increases the military capability of the ally and adds to the accumulated capability of the alliance. Exports within NATO therefore ought to generate a positive externality to other members. Bolstering the national security of one member means bolstering the security of the entire alliance.

5   Method

The empirical study of the data has been conducted by using the gravity model. Jan Tinberg was in 1962 the first one to apply the gravity model to trade flow analysis. The name is an analogy with Newton's model on gravity. Both predict that the larger the mass of two objects and the closer they are located to each other, the more they gravitate towards each other. In terms of trade, gravitate does in the analogy signify volume of trade and mass is measured in GDP and GDP per capita. Larger economies situated closer to each other are thus predicted to trade more. Economic size was not accounted for neither in the Heckscher-Ohlin model nor the Ricardian model – two prominent models of international trade at the time of Tinberg's gravity model implementation. These did instead place focus on differences in technology and factor endowments respectively. The gravity model was initially criticized for lacking theoretical basis, but has over the years, with contributory theoretical amendments (such as

Anderson and van Wincoop's paper on relative trade costs (Anderson and van Wincoop, 2003)), evolved to become one of the most widely used and recognized models when assessing and forecasting different patterns of trade. The formal gravity model is expressed as follows:

3. $\ln M_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln GDPpc_{it} + \beta_4 \ln GDPpc_{jt} + \beta_5 \ln Dist_{ij} +$
    $\beta_6 Border_{ij} + \beta_7 Language_{ij} + \beta_8 Colony_{ij} + \varepsilon_{ijt}$

The model (as is the case in equation 3) is most often log-linearized. This means converting the equation into a linear equation by taking the natural logarithm of both sides. Several of the variables increase at an exponential rate. The conversion simplifies the use of the econometric method ordinary least squares (OLS) and does also in general render the results much easier to interpret. The equation can be broken down into dependent and independent variables as well as constants. $\ln M$ is the only dependent variable of the equation and represents the logarithmic value of exports from country i to country j at point t in time. β_0 is the constant at which the equation crosses the x-axis. $\ln GDP_{it}$ and $\ln GDP_{jt}$ are the logarithmic values of the GDP of the exporting and the importing country. $\ln GDPpc_{it}$ and $\ln GDPpc_{jt}$ are similar to the previous two variables, but with the difference of GDP now being presented as per capita. All of the four GDP-variables relate to the mass of the exporting and importing country. A greater economy has a greater accumulated demand for goods, meaning more goods will tend to be demanded from exporting country i. The higher the GDP per capita of the importer, the higher will also the average demand of each citizen be. This is a way of accounting for how rich the countries are and not simply the accumulated size of the economy, regardless of wealth. The GDP and GDP per capita of the exporter is a proxy for the demand on the goods sold by the country. Assuming high GDP and GDP per capita means the exporter has goods in high demand by the rest of the world, this should consequently increase export volumes. The theory predicts that the values of all the four variables will at increase also increase trade. This leads to the hypothesis for this study that all four variables relating to GDP will have positive coefficients, in other words a positive impact on trade.

$\ln Dist_{ij}$ is the logarithmic geographical distance between the exporter and the importer. In physics the gravitational pull of two bodies decreases simply due to the fact that they are further apart. Distance in the gravity model is however an expression for different trade barriers. These tend to become larger and larger the further two economies are from each other. Of course the mere distance plays a role. Shipping cost increase the farther two countries are from each other. But with distance other barriers such as culture, historical

heritage and linguistic differences tend to increase. $Border_{ij}$ is a dummy variable taking the value 1 if two countries share borders and 0 otherwise. The feature of sharing borders can be seen as an extension to the concept of distance. By sharing a border, two countries are not only very close to each other, but they even make physical contact. With this comes lower trade barriers as shipment costs decrease, the chance of historical and linguistic ties increase and citizens of the two countries are more likely to come in contact with products from the other country. They may even commonly cross the border for work or personal relations. All of these are factors that increase trade. $Language_{ij}$ is a dummy variable taking the value 1 if the same language is shared by the exporter and the importer, whilst 0 otherwise. Once more trade barriers are at target. Sharing the same language simplifies communication and will naturally increase the likelihood, thus also volume, of trade occurring. The comfort of calling somebody over the phone and negotiating in ones native language as suppose to English or another language is indisputable. $Colony_{ij}$ is quite a curious dummy variable that also relates to distance and trade barriers. Many colonies (current or historic) are by geographical distance located far from the colonizing country. Simply accounting for the distance variable would in this case therefore suggest less trade than is probably true. The cultural, many times linguistic and perhaps judicial ties binding a historic or current colony with its colonizer tend to decrease trade barriers that would otherwise have been present. The variable $Colony_{ij}$ (taking the value 1 if exporter and importer have a shared colonial past) accounts for these effects created by the colonial ties. The gravity model predicts that the less the distance between two countries, the more they will trade. A more refined way of saying it would be that the smaller the trade barriers, the more two countries trade. This leads to the hypothesis that the coefficients of $\ln Dist_{ij}$, $Border_{ij}$, $Language_{ij}$ and $Colony_{ij}$ will all have a positive value, hence a positive value on trade volume.

In order to assess the particular question posed by this study, the gravity model needs some alterations. In equation 3 the dependent variable was the logarithmic value of all exports from country i (exporter) to country j (importer) at point t (year) in time. Since this study investigates volumes of arms export, the dependent variable $\ln Armsexp_{ijt}$ in equation 4 is only the volume of arms exported from country i to country j at point t in time. This modified equation has also been equipped with an additional dummy variable. $NATO_{EXP}$ takes the value 1 if the exporting country is a member of NATO at poinst t in time and 0 if not. Since the dataset is comprised of observations of the same country pairs but for different years, a change of $NATO_{EXP}$ from 0 to 1 (the exporting country joins NATO) is expected to capture the impact that joining NATO has had on the arms export of the exporting country. The theoretical background discussed in the theory section suggests that by joining NATO many

of the primary incentives for maintaining a domestic arms industry evaporate. This does in consequence eliminate the, by the theory stated, primary reason for arms export – namely to spread the fixed cost needed to sustain a competitive domestic industry. The hypothesis is therefore that by joining NATO an arms producing country will decrease its exports.

μ_{ij} and λ_t represent the bilateral and time fixed effects used in the equation. These are given detailed attention further into the method section. ε_{ijt} is the error term.

4. $\ln Armsexp_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln GDPpc_{it} + \beta_4 \ln GDPpc_{jt} + \beta_5 \ln Dist_{ij} + \beta_6 Border_{ij} + \beta_7 Language_{ij} + \beta_8 Colony_{ij} + \beta_{10} Rel\_pol_{ijt} + \beta_{11} NATO_{EXP} + \mu_{ij} + \lambda_t + \varepsilon_{ijt}$

New to this equation is also the variable Rel_pol_{ijt}. It describes how far apart the polities are of exporting country i and importing country j. The relative polity score is estimated by using the   following   equation:

5. $Rel\_pol_{ijt} = (polity_{it} - polity_{jt})^2$

This variable is used to account for some of the preferences countries have of trading with other countries of the same or similar polity (Åkerman & Seim, 2014, p.541). Åkerman and Seim have in their work already concluded that similar polities have a positive impact on arms trade, giving strong reason to believe that the variable will have a positive coefficient also in this study.

The econometric study does not only investigate the impact that joining NATO has on the volumes of arms exported by a country. It also estimates the impact that joining NATO has on the very probability of the same country exporting arms. To estimate the impact that joining NATO has on the probability of a country exporting arms, the dependent variable $\ln Armsexp_{ijt}$ is switched to a dummy variable named $Dummy\_Armsexp_{ijt}$. This dummy variable takes the value 1 if trade occurred between country i and country j at point t in time. If not it equals zero. What this means is essentially having a dependent variable for each observation saying if "arms are exported" is a true or false claim. The probability of exporting arms is considered to be closely related to the volume a country exports. Since the arms industry is so costly and arms deals tend to be few and large as suppose to many and small, it is likely that the probability of arms export will follow the same pattern as the volume of arms export when a country joins NATO. Therefore the hypothesis is that the probability of exporting arms will decrease as a country joins NATO.

Additional estimations of volume impact and probability impact are also made, but now accounting for *both* the exporter and the importer being a member of NATO. When volume impact and probability impact is estimated with both the exporter and the importer being part of NATO, the dependent variables are the same as when only the exporter membership status is accounted for. The variable $NATO_{EXP}$ does however change. It is now switched to the dummy variable $NATO_{BOTH}$, which takes the value 1 if *both* exporter and importer is a member of NATO at point *t* in time and otherwise it 0 is. Observing how Dummy_$Armsexp_{ijt}$ and $NATO_{BOTH}$ relate to each other gives an estimate of how both the exporter and the importer being a NATO member influences the arms export frequency. From this an estimate of likelihood of arms export can be derived. The theory section brings up the security dilemma, namely that any country's possession of arms is a negative externality to all other countries. Exporters therefore ought to be reluctant of exporting weapons due to this negative externality. Joining NATO will however diminish some of the negative externality since some importers will now be part of the same alliance. That means exporting arms to allies is in effect an indirect way of improving the military defense of the exporter. In a way it can be considered removing part of a trade barrier. The hypothesis is therefore that both exporter and importer being part of NATO has a positive impact on the volume of arms export. Joining NATO does however decrease the incentives for a country to maintain a domestic arms industry and in consequence an arms export industry. Only the very largest of arms exporting NATO members continue with their arms production. Most NATO members will therefore not be exporting arms to each other, but rather import from the few large producers in the alliance. This leads to the hypothesis that both exporter and importer being part of NATO decreases the likelihood of arms export occurring.

The two types of regressions applied to the equations are ordinary least squares (OLS) and a logistic regression. The reason for using two different types of regressions are the natures of the dependent variables and the answers intended to be found in the results. OLS is a statistical technique that fits equations with dependent variables that have a continuous value. What OLS does is draw a line through the set of data points that minimizes the sum of squared distances to all the different data points. Simply speaking it is a way of constructing a line of best fit. By looking at the values the OLS regression assigns to the coefficients of variables $NATO_{EXP}$ and $NATO_{BOTH}$, a prediction can be made about what impact they have on the trajectory of the line, thus also the impact on the value assumed by the dependent arms export variable.

A binomial logistic regression better fits the equations expressing probability. These equations do not have a continuous value for their dependent variable. It is instead a dummy variable that equals 1 or 0 depending on whether arms are exported from i to j at point t in time (1 if true). The dependent variable of the equations is hence called binomial. A logistic regression can also be used on equations with dependent variables ranging other values than 0 and 1. These are called multinomial logistic regressions. This study only uses equations with a binomial dependent variable. Henceforth logistic regression therefore only refers to a binomial logistic regression.

So why use a logistic regression? Well, the OLS regression is linear and will project a line of best fit through the data points. But if the data points only hold the value 0 or 1, a straight line through the dataset would cross the line of points valued at 0 and the line of points valued at 1. The OLS would give a trajectory that can assume values beyond the scope of the dataset, which is impossible since the values reflect a yes/no question. Further confusion to the linear model is the fact that the residuals are not normally distributed, but clustered around 1 and 0. Using the logistic model adjusts for this and does instead create an approximated equation that converges towards 0 and 1 in the ends. Figure 14 gives a graphic viewing that clarifies the benefit of using the logistic model.
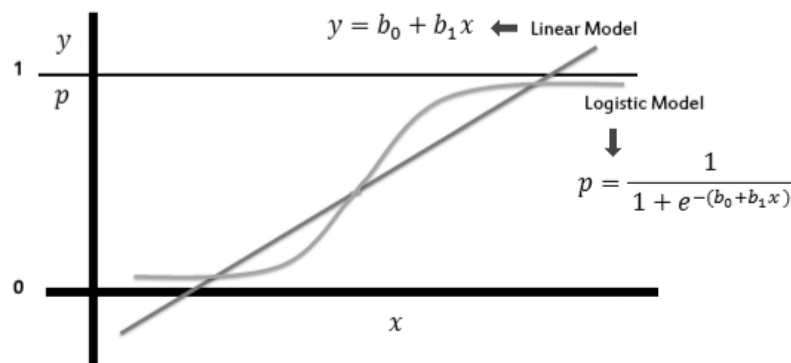
Figure 14. *Graphic illustration of a logistic and a linear regression with a binomial variable*

The equation of the logistic curve seen in the figure can be transformed back into a linear equation by taking its logarithm.

6. $ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = \beta_0 + \beta_1 x$

In difference to an ordinary linear equation, the dependent variable consists of a logged odds for the probability of the variable assuming one value ($\hat{p}$) divided by the probability of

assuming the other value $(1 - \hat{p})$. The coefficients estimated for each independent variable do not, as with the OLS, directly state what impact they have on the value of the dependent variable. Instead they state the impact they have on the logged odds of the independent variable being affirmative (equaling 1). So in the particular case of arms trade, the coefficients of $NATO_{EXP}$ and $NATO_{BOTH}$ in the logistic regression indicate how much more likely country i is of exporting arms to country j at point t in time if country i is a member of NATO ($NATO_{EXP}$) or if both are members of NATO ($NATO_{BOTH}$).

The data is so called panel data, meaning it measures a set of entities over time. In this case it observes the entity of country pairs and how arms are exported from i to j during a certain time period. Because of this a bilateral fixed effect (μ_{ij}) and a time fixed effect (λ_t) is added to all of the regressions. This allows for different groups of observations (in this case country-pairs and years) to have different intercepts. It functions as a control for unobserved time and bilateral effects. An otherwise lingering issue is the risk of omitting external effects, thus creating a bias in the data. An example of this could be a large financial crisis. Since the same entities are observed over time, the data would pick up a heavy drop in trade between countries. The risk could be of this coinciding with change in some other variable within the model. A crisis in 2004 could for example heavily have impacted world economy and resulted in a global slump in trade. Without a time fixed effect this slump in trade (including arms trade) could in the data set have been estimated as a result of joining NATO for those joining in 2004. Reality is however that this was an effect of the financial crisis and is not related to factors accounted for within the model. Yet without a time fixed effect, the model would include the large macroeconomic effects of the financial crisis and consequently distort the results. The bilateral fixed effect accounts for unobserved time-invariant differences for each country-pair. This captures the omitted variables that are specific to each pair and do not change over time. This could be proximity between the capitals or a presence of a geographical obstacle like mountains, which in the model just would be expressed as *border* and nothing else. Omitted variable bias is when a variable that should be accounted for is not.

In an effort to minimize the impact of some undesirable statistical effects, a robustness test is included in all of the regressions. There are several different tests used to ensure the statistics to be robust. In this case the Huber-White sandwich estimator has been used. It is a robust option for estimating standard errors. The robust standard errors generated by the test can deal with a collection of statistical concerns such as heteroskedasticity or that some observations exhibit large residuals, leverage or influence.

Complimentary sources merged to the data set of arms export come from different sources. Data on GDP and GDP per capita comes from Penn World Tables. Data on distance between countries, common language, common borders and common colonization history comes from Centre D'Etudes Prospectives et Informations Internationales (CEPIIs). The polity score data is retrieved from the POLITY IV database hosted by the Center for Systematic Peace and George Mason University.

The SIPRI arms trade database spans data from 1950 to 2014. The regressions are however run on data for the time period 1992 to 2010. Constraints in the dataset of GDP and GDP per capita is what rendered the years after 2010 not to be included in the dataset. The year 1992 is chosen as t=1 because it is the first year after the disintegration of the Soviet Union. This study aims at examining what impact joining NATO has on a country's arm export today. The arms trade pattern of the world has undergone large change since the Cold War. Figure 15 and 16 illustrate this change. The trade of today is much more clustered than it was during the Cold War. One reason for this is the clear bipolar character of world politics during the Cold War. Including years when the Soviet Union was still in existence would not be a true reflection of the trade pattern of today and would distort the results.

Fig. 15. *The global arms trade network, 1970-1974* (Åkerman & Seim, 2014)

Fig. 16. *The global arms trade network, 2000-2004* (Åkerman & Seim, 2014)

6   Results

The results from estimating volume of export with OLS and probability of export with a logit model are displayed in table 1. **Volume 1** includes an independent dummy variable accounting for whether the exporter is a member of NATO at the point of exports. **Volume 2** includes an independent dummy variable accounting for whether both exporter and importer is a member of NATO at the point of exports. **Probability 1** includes the same independent variables as **volume 1** but uses the binary dependent variable expressing export or no export. **Probability 2** has the same independent variables as **volume 2** and the same dependent variable as **probability 1**. The number of observations is significantly different between the volume and the probability results. This has in general rendered the results of probability a higher level of statistical significance.

Table 1. *Regression results*

Variable	Volume 1	Volume 2	Probability 1	Probability 2
lnGDP$_{it}$	0,289***	0,261***	0,796***	0,8***
	(0,000)	(0,000)	(0,000)	(0,000)
lnGDP$_{jt}$	0,28***	0,279***	0,445***	0,45***
	(0,000)	(0,000)	(0,000)	(0,000)
lnGDPpc$_{it}$	-0,225***	-0,276***	0,694***	0,696***
	(0,000)	(0,000)	(0,000)	(0,000)
lnGDPpc$_{jt}$	0,024	0,018	0,023	0,04***
	(0,247)	(0,397)	(0,122)	(0,008)
lnDist$_{ij}$	0,065*	0,088***	-0,44***	-0,485***
	(0,056)	(0,010)	(0,000)	(0,000)
Border$_{ij}$	0,121	0,148*	-0,068	-0,098
	(0,126)	(0,060)	(0,330)	(0,155)
Language$_{ij}$	-0,061	-0,042	0,02	-0,009
	(0,425)	(0,591)	(0,647)	(0,847)
Colony$_{ij}$	0,176*	0,156*	0,486***	0,474***
	(0,055)	(0,083)	(0,000)	(0,000)
Rel_pol$_{ijt}$	0,001***	0,001***	-0,002***	-0,002***
	(0,008)	(0,005)	(0,000)	(0,000)
NATO$_{EXP}$	-0,154***	-	-0,076**	-
	(0,001)	(-)	(0,021)	(-)
NATO$_{BOTH}$	-	0,111**	-	-0,337***
	(-)	(0,022)	(-)	(0,000)
Time effects	Yes	Yes	Yes	Yes
Bilateral effects	Yes	Yes	Yes	Yes
Observations	5824	5824	458 026	458 026
R2	0,165	-	0,164	-
Pseudo-R2	-	0,36	-	0,36

Notes: The P-value is noted within parenthesis below the corresponding coefficient value. The asterisks note significance at the following confidence levels: *** means significance at the 1% level, ** means significance at the 5% level and * means significance at the 10% level. Export volumes have been regressed with OLS while probability of export has been regressed with a logistic regression.

The results across all four regressions suggest that both the probability and volume of export increase with the increase of GDP and GDP per capita. This confirms the hypothesis. The only results diverging from this are the **volume 1 & 2** GDP per capita coefficients of the exporting country. These estimate a negative coefficient for the two variables. The probability of export increases with a decrease in distance between the exporter and importer. The

hypothesis is confirmed. The volume of export does on the contrary though, according to **volume 1 & 2**, have a positive relationship with distance. This means the farther away the exporter and importer are from each other, the greater the volumes of export, thus refuting the hypothesis. In **volume 1** this result is only significant at the 10% level, which is rather poor. The result in **volume 2** is however significant at the 1% level, which gives it much more credibility. A partial explanation to this could be the relatively remote location of the United States. The impact of the country is rather large on the data, given it accounts for about 40% of global arms exports. Neither border nor common language generates any results of significance. The results suggest that a colonial past does, in line with the hypothesis, increase both the volume and the probability of arms export. All the results for relative polity are significant at a 1% level but are negligible in impact.

Turning to the main variables of interest, results from **volume 1** and **probability 1** suggest that joining NATO will decrease the volume as well as the probability of a country's arms export. The results in **volume 1** are significant at the 1% level while the results in **probability 1** are significant at the 5% level. This gives both of the results much statistical credibility. These results confirm the hypothesis put forth in the method section and also give answer to the research question posed in the beginning of the essay. According to these results joining NATO has a negative impact on the volume of arms exported. The results furthermore suggest that a country becomes less likely of exporting arms due to joining NATO. As for the examination of the effects on arms export generated by both exporter and importer being part of NATO, these suggest an increase in volume yet a decrease in probability. This means that the volume of arms increases if both parties of an arms purchase are members of NATO. The same conditions do however decrease the very likelihood of that purchase occurring. These results all confirm the hypothesis; both exporter and importer being part of NATO does *increase* the volume of export yet *decreases* the probability of export.

7   Conclusion

This study investigates what effects joining NATO has on the arms export of a country. An analysis is also made of how NATO members export arms. More specifically the effect on arms exports is evaluated with the condition of both the exporting and importing nation being a member of NATO. These studies are carried out by applying a modified version of the gravity model to a set of arms trade data spanning the time period of 1992 to 2010. The results find that joining NATO has a negative impact both on the volume of a country's arms export and the probability of the country exporting arms at all. Both exporter and importer

being a member of NATO has a positive influence on the volume of arms exported, but decreases the likelihood of arms being exported.

To interpret the results attention is paid to the incentives behind sustaining an export of arms. The theories on arms trade state that a country maintains a domestic arms industry as a way of securing supplies to its military defense. But few countries, if any, has enough resources to meet the high fixed costs related to developing moderns arms. In order to spread these costs and make the industry affordable, arms are therefore exported. The trend in Swedish military spending and arms export is a clear example of this. By joining NATO much of the incentive to maintain a domestic arms industry does however vanish. A large portion of global arms exports originates from NATO members. These have incentives to export to other members since arming allies does in effect increase the military capability of the exporter itself. The alliance does therefore not only guarantee military assistance in the case of conflict, it also generates a much more stable supply of arms. The outcome is that joining NATO decreases both the volume and probability of exporting arms. This is in compliance with the results. The analysis on how NATO members trade arms with each other corroborate the findings on arms export changes when joining NATO.

The econometric results show that if both parties in an arms trade are members of NATO, the likelihood of exporting arms decreases. The volume of export does however increase if both parties in an arms trade are members of NATO. The oligopolistic nature of the NATO arms trade network is assumed to increases the value of those arms deals actually taking place. NATO has no official policy on the arms trade of its members. It does however have "a long-standing commitment to an active policy in arms-control, disarmament and non-proliferation (NATO, 2014)." The oligopolistic nature of the NATO arms trade network signifies that few actors have influence over the supply of arms within the alliance. These do also wield large influence over the global supply of arms. This could be considered desirable to the NATO policy makers. With few actors holding a firmer grip around the world supply of arms, it becomes easier to control it.

In light of the results and the subsequent discussion, what can be said about the prospects of the Swedish arms industry and arms export in the case of Sweden joining NATO? The primary question is whether it will prevail under the oligopolistic market forces of the alliance. The country counts as the 11th largest exporter of arms during the last 23 years and has a broad industrial infrastructure to support the industry. It is therefore more likely to benefit trade wise, than not to, by joining NATO. The lowered trade barriers with other members of the alliance ought to increase the demand for Swedish arms. It is difficult to

speculate in how Sweden joining NATO would affect importers of Swedish arms not belonging to the alliance. These volumes are therefore assumed unchanged. The overall market effect of Sweden joining NATO would therefore be an increase in exports. But the Swedish arms industry is at the mercy of the government. Its purchasers are all sovereign states, and its own state decides to whom it may export. Joining NATO therefore has to be evaluated from a policy perspective as well.

The military strategic neutrality and a secure supply of arms are consistently used as arguments for a continuation of the Swedish arms industry and arms export. But if Sweden joins NATO the concept of neutrality will disappear. It is also quite safe to assume that some of the top ten arms exporters of the world that are members of NATO will ensure a steady supply of arms to Sweden. This would subtract two heavy arguments supporting the existence of the country's arms industry and export. Political will to argue for a continued or increased arms export may consequently decrease. The question therefore boils down to the arms export policy Sweden chooses to adopt as a NATO member. Two heavy arguments supporting the export and industry, neutrality and supply, dissolve with the membership. Other forces are also at play though when it comes to the policymaking. Public opinion in favor of the arms industry and its export may, due to the loss of arguments, decrease. At the same time disarming the industry would render large economic disadvantages to some regions of the country. This could create public upset among parts of the population. Policymakers are likely to find themselves facing a dilemma similar to the current situation. Joining NATO would however weaken the cause for sustaining the Swedish industry and its export of arms.

This study has looked at panel data for the time period 1992-2014. During these years 12 countries joined NATO. This means the change in arms export has been possible to observe for these 12 countries. All of these 12 countries were historically part of the East during the Cold War. The selection may therefore not be very representative when assessing the expected effects on arms trade when joining NATO for western European countries like Sweden or Finland. Moreover most of the studied countries do not have a large arms export or any export at all. The export of a country with a large arms industry, such as Sweden, may behave differently when the country joins NATO. The range of observable countries could consequently be considered a shortcoming in the study. Although the results of the study would not reflect reality better did the data set range further back into time, extending the data forward in time would definitely give more precise results. It was in this study merely due to an unfortunate shortcoming of GDP-data that the years beyond 2010 could not be included.

References

Anderson & van Wincoop. (2003), Gravity With Gravitas: A Solution To The Border Puzzle. [Online] Available from: http://www.nber.org/papers/w8079.pdf. [Accessed 20th of May 2015]

Council on Foreign Relations. (2015) The North Atlantic Treaty Organization (NATO). [Online] Available from: http://www.cfr.org/nato/north-atlantic-treaty-organization-nato/p28287. [Accessed 25th of May 2015]

Försvarsmakten. (2014) Försvarets andel av BNP. [Online] Available from: http://www.forsvarsmakten.se/sv/om-myndigheten/ekonomisk-planering-och-redovisning/forsvarets-andel-av-bnp/. [Accessed 7th of April 2015]

García-Alonso, M. & Levine, P. (2007), Arms trade and arms races: A strategic analysis. *Handbook of defense economics.* p. 941-971. Vol. 2. Elsevier. [Online] Available from: https://www.kent.ac.uk/economics/documents/GES%20Background%20Documents/Defence/Garcia-Alonso&Levine%20Handbook.pdf. [Accessed 20th of April 2015]

Herz, J. (1950) Idealist Internationalism and the Security Dilemma, *World Politics* vol. 2, no. 2 (1950): 171–201, at pp. 157

Levine, P et al. (1997) The Arms Trade. *Economic Policy.* Vol. 12, No. 25 (Oct.,1997) pp. 335-370. [Online] Available from: http://www.jstor.org.ludwig.lub.lu.se/stable/pdf/1344683.pdf?acceptTC=true. [Accessed 22nd of May 2015]

NATO. (2014) Arms-control, disarmament and non-proliferation in NATO. [Online] Available from: http://www.nato.int/cps/en/natohq/topics_48895.htm. [Accessed 27th of May 2015]

NATO. (1949) The North Atlantic Treaty. Article 5. [Online] Available from: http://www.nato.int/cps/en/natolive/official_texts_17120.htm. [Accessed 8th of April 2015]

NATO. (2012) Interoperability – connecting NATO forces. [Online] Available from: http://www.nato.int/cps/nl/natohq/topics_84112.htm. [Accessed 15th of April 2015]

NATO. (2015) FAQ – Does NATO have its own armed forces? [Online] Available from: http://www.nato.int/cps/en/natohq/faq.htm#A11. [Accessed 15th of April 2015]

SIPRI. (2014) Arms Transfer Database. [Online] Available from: http://armstrade.sipri.org/armstrade/page/values.php. [Accessed 7th of April 2015]

SUSRIS. (2010) US-Saudi Security Cooperation, Impact of Arms Sales. [Online] Available from: http://susris.com/2010/09/17/us-saudi-security-cooperation-impact-of-arms-sales/. [Accessed 26th of May 2015]

Sveriges Riksdag. (1992) Lag (1992:1300) om krigsmaterial. Paragraph 1. [Online] Available from: http://www.riksdagen.se/sv/Dokument-Lagar/Lagar/Svenskforfattningssamling/Lag-19921300-om-krigsmateri_sfs-1992-1300/?bet=1992:1300. [Accessed 7th of April 2015]

Tuvestad, Sofia. (2014) Med sikte på vapenexport. pp. 16-17. [Online] Available from: http://www.fredsagenda2014.se/wp-content/uploads/2013/04/med-sikte-p%C3%A5-vapenexport.pdf. [Accessed 7th of April 2015]

World Bank. (2014) Military expenditure (% of GDP). [Online] Available from: http://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS. [Accessed 15th of April 2015]

Åkerman, A. & Seim, A.L. (2014) The global arms trade network 1950-2007. *Journal of comparative economics*. Vol. 42.