BUCK FOR THE BANG?

ABNORMAL RETURNS IN RESPONSE TO ARMS DONATION ANNOUNCEMENTS DURING THE RUSSO-UKRAINIAN WAR

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Abstract:

This paper examines defense industry stock market reactions to governmental announcements to donate weapons to Ukraine in response to the Russian invasion 2022. We use daily stock return and donation announcement data and employ event study methodology to establish abnormal returns among a select number of defense industry firms. Our results indicate that announcements of arms donations generally do not explain variation in abnormal returns and that the explanatory value is low and insignificant. We also examine if the unique dynamics of the defense industry lead to a *proximity relationship*, i.e., that stock market reactions are stronger for announcements from the countries that are home to the select companies. While such a relationship is insignificant, our estimates indicate that markets react more strongly to such announcements. Our study relates to previous research on market reactions to difficult-to-interpret information, such as government announcements, and market reactions to war-related information. Our results conclude that markets do not react significantly to arms donation announcements in general. However, such information would suggest that future firm earnings would increase and that markets should respond in kind.

Keywords:

Event study, abnormal returns, defense industry, difficult-to-interpret information, Russo-Ukrainian war

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1. Introduction

1.1. Aim of study

In February 2022, Russia launched a full-scale military invasion of Ukraine. Although at war with each other since Russia's annexation of Crimea in 2014, the intensity of the conflict escalated into a full confrontation on February 24th, 2022. Initially, this resulted in swift economic and political sanctions against Russia from the international community. However, soon after the eruption of the conflict, many countries also chose to support the Ukrainian war effort directly by donating weapons and military equipment. Compared to the expected and uncontroversial financial and humanitarian support, contributing arms to a country at war was a new and drastic measure for many European countries.

Our paper uses the idea that a public announcement from a government to donate weapons causes an immediate worsening of military capabilities and a need for new weapons to replenish the arsenal. Naturally, this can potentially result in increased earnings for the defense industry. At the firm level however, the many uncertainties around this make it difficult to interpret the donation announcement. To assess whether the donation leads to higher earnings, an investor needs to know if the donated weapons were usable, if they are going to be replaced, by what they potentially might be replaced with, when such replacement might happen, which company might get such an order and at what price. While a donation of weapons signals the industry that orders will rise, investors can only make so much of the information at the firm level, which is why the markets' reactions are uncertain. In analyzing these uncertainties, we are inspired by the framework established by Pástor and Veronesi (2012), which study how equity markets react to governmental policy announcements and the uncertainty of translating a political announcement into firm earnings or valuation projections.

In response to the Russian invasion, equity markets reacted extensively within the defense industry and in general. While interpreting the information about the invasion and war developments is equally tricky as interpreting arms donation announcements, the former is not the aim of this paper. It is, however, essential to remember that investors might have foreseen future arms donation announcements when interpreting the invasion announcement. This leads us to wonder to what extent investors anticipated the arms donation announcements and to what extent the arms donation announcements provided the markets with new information. Since the Russian invasion, until July 31st, 2023, 273 announcements (at least) of military equipment and weapons donations to Ukraine have been made on (at least) 169 unique days (Trebesch, Antezza, Bushnell, Bomprezzi, Frank, Frank, Franz, Schramm, Weiser, Kharitonov, Kumar, Rebinskaya, and Schade, 2023).

In making inferences about the donation announcements as a group, we are inspired by the multiple-event study approach established by Shapiro, Switzer, and Mastroianni (2011). This paper seeks to establish how defense industry equity markets reacted to these announcements and if such reactions were significant. We therefore study how stock markets, home to a set of the largest defense companies, react on days with arms donation announcements compared to days without. We also seek to establish if such reactions are more prevalent in response to announcements from the countries' home to a select set of companies than announcements in general, i.e., if there is a *proximity relationship*. More specifically, the paper aims to answer the following research questions:

I. *Did defense industry equity markets show significant abnormal returns in response to arms donation announcements?*
II. *Is the relationship between arms donation announcements and abnormal returns stronger for announcements from countries in which defense industry companies are listed than for all countries, i.e., is there a proximity relationship?*

1.2. Research design

To make causal inference about the impact of arms donation announcements on defense industry equity markets, the ideal setting would be to perform a randomized control trial to see if investors price the studied stocks differently with a donation announcement than without, all else equal. As this experiment is not feasible, we find the abnormal return of the studied stocks and try to isolate the variation that the donation announcement can explain. Ideally, this would be done using intraday stock return data and detailed timing data of announcement, for example, by employing difference-in-difference or regression discontinuity methodology. Lacking critical data, we instead answer the research questions using classic event-study methodology as established by Fama, Fisher, Jensen, and Roll (1969), Brown and Warner (1985), MacKinlay (1997), and Busse and Green (2002) among others. As we seek to make inferences regarding a set of events rather than an individual event, the methodology differs somewhat but is, in principle, a series of repeated classical event studies. As stated above, we are inspired by the works of Pástor and Veronesi (2012) and Shapiro et al. (2011) in designing our study.

We benchmark the stock returns against a proxy for the market portfolio, the *S&P 500*, and compare the resulting abnormal returns, the share of firms showing positive abnormal returns, and the share of days with significantly positive abnormal returns at the group level for different sets of days. We also employ linear regression models where we regress the abnormal return measures on a dummy variable for announcements: using global announcements or only those originating in the companies' *home* countries. In doing so, we control for seasonality and weekday effect as well as for the proximity in time to the beginning of the war and cumulative number of announcements. We use publicly available daily stock return data for listed defense industry companies. We use a public dataset of support given to Ukraine compiled as the *Ukraine Support Tracker* (Trebesch et al., 2023). In our baseline scenario, we study the subset of the 50 largest listed defense companies in the U.S. and Europe for the first three months after the invasion. We replicate our study and compare our results to scenarios where we study subsets of firms from the 100 largest companies, with and without certain Asian countries (59 and 50 firms, respectively). In all three scenarios, we extend the three months studied in the baseline scenario to six months after the invasion and for the entire period covered by our support dataset (until 2023-07-31, roughly 18 months), respectively. While the support dataset is extensive, we only use data on the principal categorization of donation packages and announcement dates. To establish the potential *proximity relationship* between announcements from the companies' countries of listing and the abnormal returns, we specifically study the reaction within the countries home to the examined defense companies.

1.3. Results

Our study indicates that defense industry equity markets do not generally show abnormal reactions to arms donation announcements. However, our results suggest that the studied markets in which the defense industry companies are based react more strongly to announcements from their *home* countries' governments, indicating a *proximity relationship*. This is potentially an effect of the unique market dynamics typical of the defense industry. We reach these conclusions by noting that abnormal returns on average are not higher or significantly different from zero on days with announcements than on days without. However, the results are ambiguous upon considering different approaches to the research questions and additional measures of abnormal returns. Further, we note that while abnormal returns are not significantly different from zero when comparing days with and without *home announcements*, the results indicate a difference between the two groups. Although results are ambiguous, we find that average abnormal returns are higher, the share of firms showing positive abnormal returns is higher, just as the share of significant abnormal returns (overall and independent of sign) is higher for days with *home announcements* than without. However, considering both announcements in *home* countries and in general, the significance of results is a major vice in our study, with only a tiny share of figures considered showing statistical significance. While our analytical approach hints at some categorical differences between groups of dates, we find that the variation attributable to these factors, after employing relevant controls in our linear regression approach, is minimal. In general, results obtained using our baseline scenario are confirmed by extension scenarios, including larger sets of days and firms considered. We find that the results obtained using short event windows are robust to resampling, while those using longer event windows generally are not.

1.4. Literature review

This paper has two distinct focal points: equity markets' reactions to public difficult-to-interpret information and equity markets' reactions to news related to war and conflict. Although connected to the war, our paper aims to look at the donation announcements of countries not engaged in the war and how they might cause defense industry equity markets to react. Still, the effects of the war and conflict developments cannot be excluded from the markets' reactions during the war. As for the general setting, our study is close to McDonald and Kendall (1994), which studied the effects of unpredictable political events involving military actions on 16 U.S. defense firm stocks. The events studied are such that they directly relate to involvement in military force by the United States, the former Soviet Union, and their allies. They found statistically significant results showing that the defense firms' stock prices increased after the relevant events. Regarding methodology, Shapiro et al. (2011), which examines the effect of war-and-peace-related events on defense stocks, has been a valuable source of inspiration for research design. They studied over 60 firms using the Market Model with GARCH (1,1) error estimation to estimate abnormal returns. Their study examines a wide array of events and announcements, not only the outbreak of war and the making of peace. They found that positive abnormal returns follow war-related announcements, whereas negative abnormal returns follow peace-related announcements. Furthermore, we have taken inspiration from their multiple-event study framework, enabling us to make inferences from a set of events rather than individual events. Although inspired by their work, our paper excludes the effects of war development and instead focuses on the donation announcement of countries exogenous to the conflict.

Mitchell and Mulherin (1994) outline the basic framework for markets' reactions to public announcements. They studied the relationship between Dow Jones & Co. news announcements and stock market activity variables such as trading volume and returns. They found that such a relationship exists and that the volume of such announcements and stock market activity are directly related. Further, they discovered that firm-specific announcements had a more significant effect than announcements regarding macroeconomic news. More recently, Pástor and Veronesi (2012) studied how changes in government policy affect stock market prices and returns. Most importantly, their analysis includes the uncertainty surrounding government policy announcements: political uncertainty and implication uncertainty. They find that policy announcements, on average, cause stock prices to fall. They also find that the extent of the stock price effect is related to the level of uncertainty. Their study of *implication uncertainty* of policy announcements is very similar to the uncertainty we seek to examine concerning arms donation announcements.

The main contribution of our paper is to analyze market reactions to arms donation announcements, which essentially are a new type of difficult-to-interpret information as most Western nations have been reluctant to send weapons and equipment to war-waging countries before the Russian invasion of Ukraine. Although armed conflicts have always existed, publicly disclosed donations of weapons to a country at war is a new feature in many respects. Our paper, therefore, seeks to establish if and how markets react to this specific type of announcement. On a similar note, we aim to specifically analyze the *implication uncertainty* of announcements, as established by Pástor and Veronesi (2012), as we exclusively examine public announcements of certain decisions and deliverables. Thus, as there is no *political uncertainty* to be considered by markets, investors need only focus on the implication uncertainty of the announcement and interpret how the implication might affect firm earnings. Further, we set out to examine the structures and dynamics of the defense industry. Although historically an industry with strong national ties and a high political involvement in procurement processes, the (European) defense industry has been idle for the past three decades. As domestic production capabilities are small to non-existent in many countries, previous industry dynamics might need to change. Lastly, our paper contributes by analyzing new and recent data, examining announcement data that is merely a few months old. In addition, the studied conflict is current and ongoing, with little published literature available.

1.5. Structure of paper

This paper will begin with a theoretical overview and institutional background (Section 2, *Background*), where we discuss the dynamics within the defense industry and how the Russo-Ukrainian war developed before and during the examined period. This section will be followed by a description of the data employed in our study and which filtering decisions have been made (Section 3, *Data*). The fourth section presents the chosen methodology (Section 4, *Methodology*). After this, we present and analyze empirical results and discuss what conclusions can be made (Section 5, *Analysis*). In this section, we suggest some possible future research topics in response to our findings. In the final section (Section 6, *Robustness*), we describe the measures taken to test and ensure the robustness of the results.

2. Background

2.1. The Russo-Ukrainian war

The Russian invasion of Ukraine on 2022-02-24 marked the beginning of a new phase of the Russo-Ukrainian war. While the conflict began with the Russian annexation of Crimea in 2014, the conflict has been comparatively idle in intensity during 2015-2021. However, in the winter of 2021/2022, Russia began a series of large-scale exercises near Ukraine. After having deployed extensive military capabilities so close to the Ukrainian border, Russia eventually invaded Ukraine with full force on February 24th. Although the increased military activity was observed in the weeks before the invasion, the rapid increase in scale and intensity of the conflict took many by surprise. The invasion not only resulted in severe political and economic sanctions against Russia from the EU and the U.S. but also worsened the security conditions in all of Europe. Essentially, the invasion of Ukraine reset the level of economic integration between Russia and Europe to that of the Cold War. While Russia did undertake economic and political liberalization efforts after the fall of the Soviet Union in 1991, much of the development has been reversed since Vladimir Putin’s 2007 speech at the Munich Security Conference. Since then, the Russo-Georgian War of 2008, the Russian attempted intervention in Ukraine’s signing of the *EU-Ukraine Association Agreement* in 2014, and subsequently the beginning of the Russo-Ukrainian war (later that year), have worsened relationships and security conditions between Russia and the Western world. Still, the invasion of 2022 marks a new era for European security policy with the return of war to Europe. The full extent of the policy implications of the invasion is likely yet to come.

The security implications of the invasion are considered severe by many. Primarily, a full-fletched war is taking place in a country that neighbors four EU and NATO countries. Secondly, Russia has shown its will and capability to use military force to reach geopolitical goals not only in the short term while maintaining deniability but also in the long term and doing so in the open. Furthermore, virtually all European countries and the United States have pledged support to Ukraine, a country at war, and committed substantial financial, humanitarian, and military support to the Ukrainian war effort. Although Russian military capabilities for other operations are more limited since the invasion, a Russian victory would not only result in a changed geopolitical scene and a shift in the power balance between East and West but also significantly worsen the security situation for all European countries should Russian military assets be in closer proximity. Finally, the invasion marks the end of a period that has lasted for three decades, during which most European countries have decreased their defense spending, arsenals, and arms production, resulting in a rapid increase in defense spending across Europe.

2.2. Defense industry overview

Parallel with the rise and fall of hopes of Russian democratization, Europe has experienced continuously increasing integration and seen gradual democratization and integration of many former USSR and East-bloc republics, many of which have been members of NATO and the EU for the better part of the current millennia. During this period, defense spending has been lower than before, and the primary objective of European armed forces has been to conduct overseas peacekeeping missions rather than maintaining territorial defense at home. Worsened security conditions have, however, led to a shift from an international focus to a national defense perspective for European armed forces while drastically increasing defense spending (Svendsen & Bergmann, 2023).

One important implication of the prioritizations and lower defense spending during the past three decades is developing and manufacturing land warfare equipment and weapons. Although technological advances have been made and the defense industry has adapted to the new world order, large-scale heavy equipment production has virtually ceased, making ordering such equipment difficult as countries seek to expand their armies. For example, the production possibilities of main battle tanks and heavy howitzers are virtually non-existent in Europe, where defense industry executives have called for binding orders and production capability investments from governments (Kayali et al., 2023). One notable political action considering the production capacity issue is the EU action to support ammunition production ("ASAP"), adopted to ensure the production capacity of critical ammunition within the union (European Commission, 2023).

The defense industry is characterized by a high degree of protectionism and loyalty to domestic companies and those of one's allies. For strategic purposes, a nation, or a group of nations within an alliance (e.g., NATO), requires a defense industry of such width as to be able to supply its armed forces. Unless allied, acquiring weapons and defense systems from another country is uncommon as it would strengthen the purchaser's strategic position, potentially to the producer's detriment in the event of conflict.

Significant economies of scale also characterize the industry due to large investments and fixed costs in organizing production, incentivizing consolidation of production to a few companies or locations. Much like the civilian aerospace industry, this has resulted in a few large companies, each controlling large market shares. The consolidated production organization also results in large, thus attractive, employment opportunities within a single location. For various reasons, individual countries care greatly about the location of production facilities. Therefore, employment opportunities and spillover effects are implicitly or explicitly considered when awarding defense contracts, often resulting in a strong preference for domestic industries.

This concept is called *the military-industrial complex*, attributed to former U.S. President Eisenhower. For the reasons listed above, governments have a strong interest in the organization of the defense industry, resulting in a large share of state-owned and state-controlled companies. (Gholz, 2011)

Significant investments associated with arms production result in defense contracts exclusively involving the pre-ordering of equipment with deliveries several years in the future. Often, governments negotiate specific terms around the location of production, which allows foreign companies to compete with domestic companies as the positive effects on employment are retained within the purchasing country. Hence, defense companies rarely have equipment or weapons in inventory ready to sell. In times of surging demand but low production capabilities, this leads to additional uncertainty regarding delivery times and pricing.

2.3. Military Support to Ukraine

Military support to Ukraine has taken various forms, including grants, equipment, training, and weapons. For many nations, contributing arms to a country at war for purposes other than internationally sanctioned peacekeeping was unthinkable just a couple of years ago. This changed in response to the Russian invasion, and at the time of writing (December 2023), the military support given to Ukraine is valued at close to €100 billion (Trebesch et al., 2023). However, apart from the donations yielding results on the Ukrainian battlefields, they raise questions about arsenals and their replenishment within the donating countries. As a result, there is high uncertainty as to how defense industry equity markets react to donation announcements.

Coming out of roughly three decades of comparatively low military spending (*SIPRI Military Expenditure Database*, 2023), the worsened security conditions have resulted in rapid increases in national defense budgets in Europe (*SIPRI: World Military Expenditure Reaches New Record High as European Spending Surges*, 2023). The armed forces of these nations will expand, and they will generally switch focus from international missions to their traditional objective: territorial defense (Svendsen & Bergmann, 2023). In combination, demand for weapons and military equipment has skyrocketed during the past years, which defense industry shareholders have duly appreciated (Financial Times, 2023). Still, the announcements of arms donations since the invasion of February 2022 are examples of new information to which markets need to react.

3. Data

3.1. Ideal dataset

To make inferences on the impact of arms donation announcements on defense industry equity markets, we would ideally study stock return data on the intraday level. Additionally, we would ideally find a quantitative measure of the importance of a donation package, e.g., the dollar value of donated equipment or an estimated order value of the corresponding replacements. The ideal announcement data would also include detailed information about how and when the announcement was made, e.g., through what media and at what hour or minute. Using this data, one possible approach would be to use difference-in-difference or regression discontinuity methodology to examine the immediate market reactions to the announcement. Thus, most other confounding events that influence stock returns would be excluded as the announcement likely would be the dominant source of new information relevant to the market at the time.

While intraday stock return data is publicly available or feasibly obtainable, we have not accessed or compiled detailed data on the time aspect of announcements. Instead, we resort to date-level (daily) data on announcements as presented in the *Ukraine Support Tracker* (Trebesch et al., 2023). Without announcement data with corresponding quality, return data on the intraday level provides little additional information. Hence, we resort to daily stock return data, which is also publicly available at greater ease of access.

As for a quantitative measure of the importance of donations, more fundamental issues than data collection and compilation are at play. While the support dataset employed has tried to do just this, it is not apparent what the estimated value of a support package implies for the examined companies. Except for the dataset's incomplete valuation variables, the main concern is accounting for the likelihood of replacement and the market price of the goods in question. The first aspect considers that many weapons and equipment donated are obsolete, no longer in production, or replaced by other, better options. One example is old equipment kept in reserve from a previous generation because it was unnecessary to get rid of altogether, such as Swedish helmets and protective vests. Another example is equipment which is so old that there is no existing market for new products of its kind. The second aspect considers that while the support package might be of great value to the Ukrainian war effort, its market price might be meager. Estimating an approximate replacement value that accounts for these factors would be ideal but is not feasible. While estimates of the values of support packages exist, we have instead chosen to study how equity markets react to donation announcements in their simplest form.

3.2. Data selection

3.2.1. Defense companies' stock returns

We examine daily publicly available stock data (Yahoo Finance) for a set of the largest defense companies in the world. In determining this set, restrictions have been made for practical reasons. We have chosen to rank and select companies based on their 2021 arms sales figures using the SIPRI list of the 100 largest defense companies (*SIPRI Arms Industry Database*, 2023). In our baseline scenario, we limit our study to the 50 largest companies thereof. From these firms, we exclude Russian, Chinese, and Indian companies (12 companies) for conflict-of-interest reasons. Additionally, Israeli companies (three companies) have been excluded from the list as Israel has not provided any military support and has explicitly prohibited its defense industry from selling weapons to Ukraine. Because of the weak links between Japanese and South Korean defense companies and European armed forces, the Japanese and South Korean companies (2 companies) are also excluded. Lastly, as we aim to establish the equity markets' reaction to donation announcements, we exclude the non-listed companies (7 companies) remaining on the list. With these exclusions, 26 companies from six countries (USA, UK, France, Italy, Sweden, Germany) remain. The companies with their 2021 arms sales figure are presented in the appendix (Table 10).

In addition to the baseline scenario, we also extend our analysis to study the entire scope of the SIPRI dataset, i.e., the 100 largest companies. In doing so, we construct two lists of firms: one including Asian countries and one excluding them. While still excluding Russian, Chinese, and Indian companies (16 companies) as well as Israeli companies (three companies), for reasons stated above, in both cases, we retain Japanese, Singaporean, and South Korean companies in one of them. While one Taiwanese company is on the list, it is excluded for not being listed. As in the previous, we lastly exclude all non-listed companies still considered. For the case including Asian companies, this excludes 21 additional companies, resulting in 59 remaining companies. For the case excluding Asian companies, the nine companies from Japan, Singapore, and South Korea are excluded initially. Subsequently, the non-listed companies are excluded from the remaining list (21 companies). The case excluding Asian companies (except Turkish) thus contains 50 companies. The extension cases are mainly used to compare results for different datasets and check the robustness of results to data selection choices. When applicable, these are presented in the appendix as discussed in the *Analysis* (Section 5) and *Robustness* (Section 6) sections.

3.2.2. Support and donation announcement data

As the main focal point of this paper is to study the impact of arms donation announcements, our support data is of paramount importance. To exhaustively collect data on military support given to Ukraine, we examine the *Ukraine Support Tracker* dataset, compiled by the Institute for the World Economy (Kiel), (Trebesch et al., 2023). The dataset provides detailed insights into the support packages' value, category, and status, allowing us to limit the analyzed support to donations of military equipment and weapons. We exclusively use the 13th release of the Ukraine Support Tracker, which includes support packages announced between 2022-01-24 and 2023-07-31, published in September 2023.

In total, the dataset includes 2,279 support elements grouped in 892 support packages. We begin by limiting the dataset in terms of category. The categories defined are military, financial, and humanitarian aid. Eliminating financial and humanitarian (as well as uncategorized entries), 1,582 entries of military support remain (362 packages). The dataset also defines subcategories of military support: “Assistance”, “Equipment”, “European Peace Facility”, “Funding for Weapon Acquisition Program”, “Grant”, “Military Equipment”, “Training”, “Training and Equipment”, “Weapons”, “Weapons and Assistance”, “Weapons and equipment”, “Weapons, equipment, and assistance”. As we seek to establish equity markets’ reaction to donations of weapons and equipment currently inventoried in the donating countries, we exclude all subcategories except “Weapons”, “Weapons and equipment”, and “Military Equipment”. In doing so, we retain 1500 entries (303 packages).

Having established which entries to examine, we seek to establish on which days the packages above have been announced. We begin by excluding entries that lack a valid date. Examples are entries with uncertain announcement days, missing values, or marked “until” a specific date. This limitation excludes 261 entries (affects 30 packages). One additional entry is excluded due to an obvious data error (date during 2024). This leaves 1238 entries in 281 packages. To exclude the impact of the invasion on equity markets, we also exclude all entries announced on or before the date of the invasion, i.e., before 2022-02-25. This excludes 28 additional entries (8 packages). Net of exclusions, we retain 1210 entries (273 packages). These are made on a set of 215 days. However, although one package typically contains only entries announced on one specific day, there are exceptions to the rule. While impractical, we do not alter the package numbering from the original setup. Instead, we only count the first date if several dates are given for a particular package. Excluding these date multiples leaves 169 unique days on which announcements have been made.

The 273 packages (announced on 169 unique days), with package ID, country of origin, and date of announcement, are presented in the appendix (Table 11).

3.2.3. Proximity relationship data

We also constructed a date series of announcement days within the *home* countries to make inferences about the effect of announcements from countries in which the examined countries are listed on the stock portfolio (*proximity relationship*). In the baseline scenario, these countries are the U.S., U.K., France, Italy, Germany, and Sweden. Based on the result presented previously, we exclude all packages that do not originate from the countries above, leaving 52 packages (made on 44 unique days).

3.2.4. Announcement dummy variables

The data selection process for the support data enables us to match data on announcements with abnormal return data. This way, we can explain variation in abnormal returns with a binary (dummy) variable on whether an announcement was made. Correspondingly, we construct a dummy variable for whether an announcement was made in the examined companies' *home* countries for a given day.

As we study a portfolio of stocks listed in several countries, we face the issue of unsynchronized trading calendars, i.e., all markets examined are not always open simultaneously, for example, due to differences in observance of public holidays. As companies in the United States dominate the list of examined companies, we base our date series on the days the U.S. markets were open. This automatically excludes regular weekends, which are synchronized across markets, but also excludes U.S. federal holidays, although they are not necessarily observed abroad.

As some dates in our sets of selected packages occur on bank holidays and weekends (days on which the U.S. markets were not open), we need to adjust so that the information provided on these days will impact markets first on a later date. We have adjusted for regular weekends but no other U.S. banking holidays to do this. This means that if an announcement in either set occurred on a weekend, we have denoted the following Monday as the announcement day instead. Having made these adjustments, we have two sets of dummy variables with 161 (*all announcements*) and 42 (*home announcements* only) days, respectively, denoted as announcement days of their respective kind. These sets of dummy variables with our general date series (U.S. banking days) are presented in the appendix (Table 12).

3.3. Abnormal return data

In line with classical financial event study methodology, we seek to analyze abnormal returns of the examined stocks. In doing so, we employ a series of measures described and defined in the subsequent section (Section 4, *Methodology*).

In obtaining this data, we use the daily stock returns according to the selection criteria described above. We also use daily return data for the S&P500 index, which we use as our benchmark in the following. As previously stated, we only examine data provided on U.S. trading days. To obtain the abnormal returns according to model specifications described in the subsequent section, we use a web-based R-package called *EventStudyTools* (Wolf, Schimmer, Levchenko, and Müller, 2014). While all model specifications and the research design are our own products, we would gratefully like to acknowledge the importance of the R-package and programming resources employed in our calculations. We have calculated four abnormal return measures for each day through a repeated series of event studies of all U.S. trading days between 2022-02-25 and 2023-07-31. This series of calculations has, in turn, been repeated for all three sets of companies, as explained in the section above on the selection of defense companies' return data.

For the baseline case, including data from the first three months after the invasion for a set of 26 firms among the 50 largest defense companies, summary statistics are presented in the table below (Table 1):

Table 1: Summary statistics for abnormal return data (using four event windows) for the baseline scenario.

	Average	Median	Min	Max	SD	n_1 (Firms)	n_2 (Obs.)
AAR	0.190%	0.115%	-2.430%	6.280%	1.223%	26	64
CAAR (-1,1)	0.550%	0.290%	-3.320%	9.760%	2.352%	26	64
CAAR (-3,3)	1.052%	0.350%	-3.610%	10.450%	3.328%	26	64
CAAR (-5,5)	1.438%	0.775%	-4.720%	11.110%	3.991%	26	64

4. Methodology

To answer the research questions, we employ event study methodology as established by Fama et al. (1969) and developed by (among others) MacKinlay (1997) and Busse and Green (2002). Essentially, we perform a series of event studies for all U.S. trading days since the Russian invasion until July 31st, 2023. In doing this, we obtain a measure of the abnormal returns of the examined stocks benchmarked against a general index. We then analyze the calculated abnormal return measures through linear regressions and by examining the results for different groups of days, depending on whether arms donations were announced.

As expressed in the first research question (below), we attempt to establish if and to what extent there were abnormal returns among a select set of defense companies in response to governmental announcements to donate weapons and military equipment to Ukraine.

I. *Did defense industry equity markets show significant abnormal returns in response to arms donation announcements?*

More specifically, we answer this question by answering three sub-questions:

i. *Are daily abnormal returns among the largest defense companies significantly higher on days with arms donation announcements than on days without?*
ii. *Is the share of daily abnormal returns, which are significantly positive, higher on days with arms donation announcements than on days without?*
iii. *Is the share of firms presenting abnormal returns higher on days with arms donation announcements than on days without?*

As expressed in the second research question (below), we also seek to establish if the relationship between arms donation announcements and abnormal returns in the defense industry is more substantial for announcements from the examined firms' *home* countries, called a *proximity relationship*. As the defense industry is characterized by unique dynamics with a high degree of governmental interest in the organization of the industry as well as a high degree of promotion of one's defense industry for strategic purposes, we seek to establish if investors react stronger to announcements from countries in which the defense companies examined have their primary listing.

II. *Is the relationship between arms donation announcements and abnormal returns stronger for announcements from countries in which defense industry companies are listed than for all countries, i.e., is there a proximity relationship?*

More specifically, we answer this question by examining if the relationships established in sub-questions *i-iii* are stronger for *home announcement* days than announcement days in general.

We express this as follows:

iv. *Are the relationships expressed in i-iii stronger for days with arms donation announcements in the countries where the examined companies are listed (home) compared to days with arms donation announcements anywhere in the world (proximity relationship)?*

To answer the first research sub-question (*i*), we compare the average AAR and CAAR for the respective groups of days. We also employ a linear regression of the announcement dummy variable on the abnormal return series. In doing so, we employ controls for seasonality and weekday effects, as well as the novelty of the ongoing war and arms donation phenomenon, to account for the markets' expectations of future donations. To answer the second (*ii*) and third (*iii*) research questions, we compare AR and CAR values for the individual firms and summarize the results to analyze differences between the respective groups of dates. As for the fourth (*iv*) research question, we reiterate the analysis above for a subset of announcement dates (*home announcements*) and compare it with the results obtained from the analysis of all announcement days.

Our baseline scenario only examines the first three months after the Russian invasion, i.e., until 2022-05-25. We then extend our analysis to cover the first six months and the entirety of the dataset, i.e., up until 2022-08-25 and 2023-07-31, respectively. This is because we are mainly interested in how equity markets reacted to the donation announcements while the information type was still a novelty and an example of difficult-to-interpret information. While we expect that investors will better foresee future announcements after the initial three months, we compare our findings with the extended scenarios to find evidence for this.

4.1. Abnormal returns

In constructing our event study framework, we use the Market Model (MM) with GARCH (1,1) error estimation, established by Engle (1982) and developed by Bollerslev (1986). Although the securities we analyze are based in different countries and are part of different national equity markets, we benchmark all returns against the U.S. *S&P 500* index to get a common framework. As most companies examined are based in the U.S., and the value of aid (weapons and equipment) given by the U.S. (€42.1 billion) is nearly as large as all other such aid (€52.8 billion) (Trebesch et al., 2023), the *S&P 500* gives, in our opinion, the best possible fit.

4.1.1. Abnormal return measures

We define abnormal return ($AR_{i,t}$) as the difference between the actual stock return ($R_{i,t}$) and the expected return ($\alpha_i + \beta_i R_{m,t}$). The expected return is, in turn, calculated based on the relationship between the stock in question and a chosen reference index and the actual return of the latter ($R_{m,t}$).

The relationship between a stock and its reference index is expressed through the parameters α_i and β_i, which are estimated using historical return data for 120 days ending ten days before the event studied, as suggested by MacKinlay (1997).

The abnormal return for a single stock can hence be expressed as:

$$AR_{i,t} = R_{i,t} - (\alpha_i + \beta_i R_{m,t})$$

When considering several firms for the same event, we also define average abnormal return (AAR) as the arithmetic average of the abnormal returns of the firms considered. This can be compared to the abnormal return of an equally weighted portfolio of the considered companies. The average abnormal return for a group of firms can hence be expressed as:

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{i,t}$$

As events can both last and impact markets for a longer period than a trading day, we define the cumulative abnormal return (CAR) as the sum of abnormal returns over the chosen event window. The event window is expressed as a starting date (t_1) and end date (t_2) with respect to the event day. The event day is expressed as (0), while the event window beginning three days before and ending three days after the event is expressed as (-3,3). The cumulative abnormal return can hence be expressed as:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{i,t}$$

Like the previous, we also define the cumulative average abnormal return (CAAR) as the average cumulative abnormal returns (CAR) for a given event window for a group of firms considered. The relationship between the CAAR and the CAR for a given event window corresponds to the relationship between the AAR and the AR for a given event day. Hence, the cumulative abnormal return can be expressed as:

$$CAAR_t = \frac{1}{N}\sum_{i=1}^{N} CAR_i(t_1, t_2)$$

As acknowledged previously, we use software developed by *EventStudyTools* (Wolf et al., 2014) to calculate the AR, AAR, CAR, and CAAR values described above. In doing so, we have employed the same definitions of these measures described by the software providers (Wolf et al., 2022).

4.1.2. Event study setup

We perform an event study for each trading day in the examined time frame for four different event windows. In the empirical analysis, we make a comparison between these measures, as in Shapiro et al. (2011): (-5,5), (-3,3), (-1,1), and (0). When analyzing the broader windows (-5, 5), (-3, 3), and (-1, 1), we examine the cumulative average abnormal return (CAAR). In contrast, we examine the average abnormal return (AAR) of the respective event days when analyzing the narrower time frame (0). The CAAR measures are traditionally used to determine if there has been, and if so, account for, any information leakage before the event and if the market has reversed its reaction on the days following the event. Although many of our examined events overlap, the CAAR can serve as a comparison and robustness check of the AAR.

4.1.3. Statistical t-tests

To determine the statistical significance of the results, we use the Generalized Rank T-test, established by Kolari & Pynnönen (2011). Using this non-parametric test, we need not make any distribution assumptions. Furthermore, the test controls for cross-sectional and serial correlation of returns and any event-induced volatility. In our linear regression approach (described below), we instead use a regular T-test to determine statistical significance. We systematically employ a 5 % significance level to determine the statistical significance of our results.

4.2. Analytical approach

4.2.1. Differences across groups

As we study many similar events and try to make inferences from the announcements categorically, we compile the results of the individual event studies by computing average CAAR and average AAR for all the banking days (on which the U.S. markets were open) between 2022-02-25 and 2023-07-31. Using this data, we analyze how different categories of announcements explain variation in returns. In this process, we analyze averages for all days recorded in the dataset (161 days) and all days with announcements in the six countries that are home to large defense companies (U.S., U.K., France, Italy, Sweden, and Germany) (42 days). We also compute a percentage of days when the abnormal returns were significant according to the Generalized Rank T-test. Furthermore, we examine the average share of firms showing positive AR or CAR values for each group of days.

4.2.2. Linear regression model

A more insightful approach to analyze the abnormal returns calculated is to regress (OLS) a dummy variable for either announcements in the world or the subset of countries on our time series of AAR and CAAR measures. We let α_i denote our dependent variable i.e., one of the following abnormal return measures for a specific trading day i: AAR (0), CAAR (-1,1), CAAR (-3,3), or CAAR (-5,5). Our independent variable is a dummy variable for whether there is an arms donation announcement recorded on the day i or not (anywhere in the world), called $AADummy_i$.

We then control for the time passed since the invasion on 2022-02-24 for each day i, $DaysSinceInvasion_i$, and the cumulative number of announcements until that day (i), $CumulativeAnnouncements_i$. In addition, we control for month and weekday variation, using a total of 15 dummy variables. One of the main contributions of this paper to the literature is the study of a novel type of difficult-to-interpret information. However, this feature eventually also becomes *old news*. Because the efficient market hypothesis implies that investors price future earnings according to all publicly available information, this suggests that investors also foresee future donation announcements. As the phenomenon becomes more common, investors will likely become better at expecting future announcements. This will, in turn, cause the market reactions to decrease. To mitigate this, we chose to account for both the proximity in time to the start of the invasion and the cumulative number of announcements. The two final groups of control variables are commonly employed in financial research to account for known effects on returns within stock markets.

Our regression model with controls can thus be expressed as:

$$\begin{aligned}\alpha_i = \beta_1 AADummy_i + \beta_2 DaysSinceInvasion_i + \beta_3 CumulativeAnnouncements_i \\ + \beta_4 Monday_i + \beta_5 Tuesday_i + \beta_6 Wednesday_i + \beta_7 Thursday_i \\ + \beta_8 January_i + \beta_9 February_i + \beta_{10} March_i + \beta_{11} April_i + \beta_{12} May_i \\ + \beta_{13} June_i + \beta_{14} July_i + \beta_{15} August_i + \beta_{16} September_i \\ + \beta_{17} October_i + \beta_{18} November_i + \varepsilon_i\end{aligned}$$

We obtain a similar expression by replicating the regression model above but changing the independent variable (announcement dummy) only to record announcements from the countries where the studied companies have their primary listing, so-called *home* countries. Here, the independent variable is expressed as $HADummy_i$. The regression model can then be expressed as:

$$\begin{aligned}\alpha_i = \beta_1 HADummy_i + \beta_2 DaysSinceInvasion_i + \beta_3 CumulativeAnnouncements_i \\ + \beta_4 Monday_i + \beta_5 Tuesday_i + \beta_6 Wednesday_i + \beta_7 Thursday_i \\ + \beta_8 January_i + \beta_9 February_i + \beta_{10} March_i + \beta_{11} April_i + \beta_{12} May_i \\ + \beta_{13} June_i + \beta_{14} July_i + \beta_{15} August_i + \beta_{16} September_i \\ + \beta_{17} October_i + \beta_{18} November_i + \varepsilon_i\end{aligned}$$

4.3. Design flaws

Scrutinizing the above, the study has two crucial design flaws. First, the sample size (baseline scenario) of companies is small: only 26 companies. While these 26 companies account for 58% of the arms sales of the 100 largest companies, the securities' inherent idiosyncrasy will impact the event study results. Second, the generous categorization of announcement days leads to a large share of the total trading days being classified as announcement days. Essentially, this also means that the announcements themselves cannot be examined separately and that the data includes a lot of “noise”, leading to omitted variable bias.

The small sample size has both practical and econometric problems. As for practical issues, we consider the fact that the sample mainly includes large companies where marginal changes in prospective orders likely will not affect the companies’ valuation. Furthermore, many of the sampled companies’ revenues stem from aerospace products such as airplanes and aerial weapons systems (e.g., missiles and robots). The fact that virtually no air force systems have been donated to Ukraine and that doing so has been an openly debated topic means that these companies should not react as strongly as companies whose main revenues stem from land warfare weapons and equipment. Regarding econometric issues, the small sample size mainly results in larger standard errors (we consistently use regular standard errors), increasing the threshold of results to be considered statistically significant. This makes the results more conservative and restricts our ability to make causal inferences from the results. As for the significance measure, the Generalized Rank T-test is nonparametric and does not require any normality distribution assumptions. Thus, the significance measure should have adequate validity.

The omitted variable bias is a more fundamental concern that directly conflicts with the assumption that no other events occur during the event window, which is required to use conventional event study methodology. The study does not in any way account for the conflict developments, countries’ security conditions, realized arms sales, political initiatives, or other conflict eruptions during the examined period. Likely, these omitted variables would explain some of the variation in the defense industry's abnormal returns. To increase the validity of the results, these factors should be controlled for. However, quantifying political and military developments is a difficult feat. Also, there likely have been countless occurrences of firm-specific information reaching the markets for which neither has been controlled. When interpreting the results, it should be remembered that arms donation announcements cannot explain all variation in abnormal returns. Instead, it is the aim of the study to examine if they significantly explain some variation, and to which degree they do.

Furthermore, as the research questions inquire whether there is an abnormal reaction on announcement days, we essentially try to explain all variation in abnormality using a binary argument. This is unrealistic, especially as many trading days (days examined) are also announcement days. By design, a dummy variable will not be able to explain all variation in market reactions over time.

In the baseline scenario, we examine 64 trading days. During 42 (66 %) of these days, there have been announcements, 13 (20 %) of which were in the *home* countries. This is in comparison to the six-month extension scenario with 127 trading days, 67 (53 %) announcement days, of which 16 (13 %) were in the *home* countries, and the entire dataset, with 358 trading days, 161 (45 %) announcement days of which 42 (12 %) in the *home* countries.

To assess the effect donation announcements have on defense industry equity markets, a more appropriate approach would be to analyze the effect of the importance, size, or volume of announcements on abnormal reactions. This would allow us to explain the variation in market reactions using one or several independent variables, which likely would yield a higher explanatory value. However, quantifying the importance, size, or even estimated value is difficult due to fundamental valuation issues and, in our case, omitted data in the available datasets. While attempts to make such estimates of both importance and value have been made in the *Ukraine Support Tracker* dataset, the data is unfortunately incomplete with respect to this (Trebesch et al., 2023).

5. Analysis

5.1. Empirical results

5.1.1. Linear regression approach

The table below (Table 2) presents results from a linear regression for four different abnormal return measures. The model uses a dummy variable to establish whether a recorded donation announcement occurred on that day. This independent variable is regressed on the respective abnormal return measure while controlling for weekday and seasonality effects, the number of previous announcements, and the days that have passed since the invasion. The AAR and CAAR estimates are all non-significantly different from zero. This indicates that abnormal returns are neither significantly higher nor significantly lower on days with recorded donation announcements than on days without.

Table 2: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any), controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.199%	0.420%	0.732%	0.625%
Upper 95% CI	*0.357%*	*1.393%*	*1.995%*	*2.273%*
Lower 95% CI	*-0.756%*	*-0.553%*	*-0.531%*	*-1.022%*
SE	0.284%	0.496%	0.644%	0.841%
P-value	0.49	0.40	0.26	0.46

As presented in Tables 13 and 14 (appendix), we also run the same model presented in Table 2 over longer periods (six months and entire time series). While three out of eight abnormal return measures in these models show a positive significant effect, the results are still ambiguous. Thus, there is no general support in either scenario for the alternative hypothesis that the regression coefficient is positive and significant at the 5% level. Comparing these results with models that examine a set of 50 of the top 100 largest defense industry companies, both with and without Asian companies (see Section 3, *Data*), according to the setup above, we find additional support for what has been stated previously. As in the baseline scenario, no abnormal return measures show a significantly positive regression coefficient (Tables 15-17, appendix).

The following table (Table 3) presents results from a similar model to the above. Here, we replace the dummy variable for announcements in general with a dummy variable for *home announcements*. In doing so, we seek to draw conclusions about a potential *proximity relationship*.

Table 3: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries), controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.230%	0.560%	0.504%	-0.186%
Upper 95% CI	*0.972%*	*1.781%*	*2.134%*	*1.919%*
Lower 95% CI	*-0.512%*	*-0.661%*	*-1.125%*	*-2.290%*
SE	0.379%	0.623%	0.832%	1.074%
P-value	0.55	0.37	0.55	0.86

Also in this case, none of the abnormal return measures are significantly different from zero. This indicates that on days with recorded donation announcements in the *home* countries of the 26 selected companies, abnormal returns are neither significantly higher nor significantly lower than on days without. Thus, no statistically significant conclusions can be drawn regarding the strength of these relative differences. Comparing the point estimates between Tables 2 and 3, we see that the AAR coefficient examining *home announcements* is positive, while the corresponding figure for announcements in general is negative. While insignificant, this suggests some *proximity relationship*, although its extent cannot be ascertained. We observe similar results as in the previous case when extending the study to longer periods (six months and entire series) as well as when expanding the list of companies. These results are presented in Tables 18-19 and 20-22 (appendix). As previously, some abnormal return measures show a significantly positive regression coefficient for the *home announcement* dummy. Still, most coefficients are not significantly different from zero, and results are ambiguous due to the lack of significance and variation in the sign of point estimates. All considered, we conclude that while no effect can be established with the required certainty, we observe more positive estimates when observing *home announcements'* effect on abnormal returns than for announcements in general. This indicates that there possibly is some *proximity relationship*.

5.1.2. Categorical comparison approach (sign focus)

Proceeding with analyzing differences in aggregate data grouped on account of announcement type, we attempt to draw general conclusions from examining the results directly. While the regression models in the previous apply rigorous control measures to exclude variation attributable to other phenomena, the following approach is more liberal. Here, we compare the average AAR and CAAR values for different groups of dates and the average number of firms showing positive and negative AR/CAR values (Tables 4 and 5).

Table 4: Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for three categories of observations (all days, days with announcements (any), days without announcements).

	Average AAR/CAAR	**Average n_1**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0.19%	25.97	13.94	12.03	All days
CAAR (-1,1)	*0.55%*	*25.97*	*13.52*	*12.45*	-||-
CAAR (-3,3)	*1.05%*	*25.97*	*13.59*	*12.38*	-||-
CAAR (-5,5)	*1.44%*	*25.97*	*14.08*	*11.89*	-||-
AAR	0.20%	26.00	13.50	12.50	Days with any announcement
CAAR (-1,1)	*0.72%*	*26.00*	*13.81*	*12.19*	-||-
CAAR (-3,3)	*1.28%*	*26.00*	*13.93*	*12.07*	-||-
CAAR (-5,5)	*1.64%*	*26.00*	*14.33*	*11.67*	-||-
AAR	0.18%	25.91	14.77	11.14	Days without any announcement
CAAR (-1,1)	*0.23%*	*25.91*	*12.95*	*12.95*	-||-
CAAR (-3,3)	*0.61%*	*25.91*	*12.95*	*12.95*	-||-
CAAR (-5,5)	*1.05%*	*25.91*	*13.59*	*12.32*	-||-
Diff AAR (All)	0.02%	0.09	-1.27	1.36	Difference between days **with** and **without** any announcements

The results above show that while the AARs are positive on days with announcements, they are almost equally large on days without. Considering that about half the examined trading days are announcement days, the observed abnormal returns for the entire sample show an average of the two. We consider the difference between the categorical averages negligible. This suggests that the group of days with donation announcements does not show higher average abnormal returns than days without. Considering the regression results, this confirms our previous conclusions. While the AAR values show little differences, the CAAR values tell another story, showing higher abnormal returns for announcement days than days without. As in the previous, we conclude that results are ambiguous. However, when analyzing days with *home announcements* compared to days without, we do observe an effect. Results corresponding to those above are presented in the table below (Table 5).

Table 5: Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for three categories of observations (all days, days with *home announcements*, days without *home announcements*).

	Average AAR/CAAR	Average n_1	Average Pos firms	Average Neg firms	Description
AAR	0,19%	25,97	13,94	12,03	**All** days
CAAR (-1,1)	*0,55%*	*25,97*	*13,52*	*12,45*	-||-
CAAR (-3,3)	*1,05%*	*25,97*	*13,59*	*12,38*	-||-
CAAR (-5,5)	*1,44%*	*25,97*	*14,08*	*11,89*	-||-
AAR	0.71%	26.00	14.46	11.54	Days **with** home announcement
CAAR (-1,1)	*1.54%*	*26.00*	*14.23*	*11.77*	-||-
CAAR (-3,3)	*1.83%*	*26.00*	*14.85*	*11.15*	-||-
CAAR (-5,5)	*1.58%*	*26.00*	*14.00*	*12.00*	-||-
AAR	0.06%	25.96	13.80	12.16	Days **without** home announcement
CAAR (-1,1)	*0.30%*	*25.96*	*13.33*	*12.63*	-||-
CAAR (-3,3)	*0.85%*	*25.96*	*13.27*	*12.69*	-||-
CAAR (-5,5)	*1.40%*	*25.96*	*14.10*	*11.86*	-||-
Diff AAR (Home)	0.66%	0.04	0.66	-0.62	Difference between days **with and without home** announcements

From the results above, we see a clear difference between the groups of dates. While we note that the sample size is very small (only 13 *home announcements* considered), this supports our previous findings that the data suggests some *proximity relationship*. What is said about the AAR values is, in all cases, supported by the corresponding CAAR values. This contradicts the previous ambiguity of results, further supporting the suggestion of a *proximity relationship*. Both tables above present the average number of firms considered (n_1). This is to show that the calendar synchronization issue described previously has a minimal effect on the data analysis.

Contributing further ambiguity, the share of firms showing positive abnormal returns is larger for non-announcement days than announcement days (Table 4). Correspondingly, the share of firms showing negative abnormal returns is smaller for non-announcement days than for announcement days. This further supports our conclusion that announcements, in general, do not have a clear impact on abnormal returns, neither positive nor negative. However, in the second table (Table 5), we see confirmation of our previous suggestions of a *proximity relationship*. As can be seen from the table, the average share of firms showing positive abnormal returns (AR/CAR) is higher on days with *home announcements* than on days without.

Comparing these results to the extension scenarios, the picture painted above is confirmed. Examining the longer periods (six months, entire time series), we find support for the partial conclusions above, as seen in Tables 23 and 24 (appendix). Essentially, abnormal returns are slightly higher for days with announcements compared to other sets of days, and there is generally a notable difference between abnormal returns on days with *home announcements* compared to days without *home announcements*. It is worth noting that average AAR/CAAR values in Tables 23 and 24 are generally closer to zero compared to Table 4, and for longer periods, the difference from zero decreases. This is natural and can be explained by the fact that markets increasingly expect future announcements when they subsequently become more common practice. This is one of our motives for controlling for both days since the invasion and the cumulative number of announcements, which we do in our regression models (presented previously). While some minor differences exist between the scenarios, including a larger set of firms (both with and without Asian companies) and the baseline scenario, these results concur with the conclusions drawn from the baseline scenario (presented above). Support for this statement can be found in Tables 25 – 27 (appendix).

5.1.3. Categorical comparison approach (significance)

In addition to the categorical comparison of average abnormal returns (AAR/CAAR) and the average share of firms showing positive abnormal returns (AR/CAR), we continue the analytical approach with a categorical comparison of the sign and significance of the results presented. While the regression model approach is more insightful as to the significance, a crude comparison of the share of days with significant (specifically significantly positive) average abnormal returns (AAR/CAAR) gives insights into the distribution of important events (according to the markets) across groups of days. Baseline scenario data on the significance and sign of the measures above is presented below in Tables 6 and 7 (corresponding structure to the tables above). While we use a regular T-test to establish significance in the regression approach, we analyze the more conservative and appropriate Generalized Rank T-test in the categorical comparison approach. These are calculated while obtaining the abnormal returns as previously described (see Section 4, *Methodology*)

Table 6: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for three categories of observations (All days, days with *any announcement*, and days without *any announcement*), with categorical differences (percentage points). *Generalized Rank T-test.*

	% Pos.[1]	**% Sign.**[2]	**% Pos. & Sign.**[3]	**% Neg. & Sign.**[4]	**Description**
AAR	55%	9%	6%	3%	**All** days
CAAR (-1,1)	*58%*	*11%*	*8%*	*3%*	-||-
CAAR (-3,3)	*56%*	*5%*	*3%*	*2%*	-||-
CAAR (-5,5)	*58%*	*3%*	*3%*	*0%*	-||-
AAR	52%	12%	7%	5%	Days **with** any announcement
CAAR (-1,1)	*57%*	*10%*	*5%*	*5%*	-||-
CAAR (-3,3)	*55%*	*5%*	*2%*	*2%*	-||-
CAAR (-5,5)	*57%*	*2%*	*2%*	*0%*	-||-
AAR	59%	5%	5%	0%	Days **without** any announcement
CAAR (-1,1)	*59%*	*14%*	*14%*	*0%*	-||-
CAAR (-3,3)	*59%*	*5%*	*5%*	*0%*	-||-
CAAR (-5,5)	*59%*	*5%*	*5%*	*0%*	-||-
Diff AAR (Any)	-7%	7%	3%	5%	Difference between days **with** and **without** any announcements

1) Percent of observations (days) with a positive AAR/CAAR value
2) Percent of observations (days) with a significant (5%) AAR/CAAR value
3) Percent of observations (days) with a significant positive AAR/CAAR value
4) Percent of observations (days) with a significant negative AAR/CAAR value

From the table above (Table 6), we again see that there is no coherent support for the suggestion that announcements generally impact abnormal returns positively. Overall, announcement days show a lower share of positive average abnormal returns (AAR/CAAR). However, the group shows a slightly higher share of significant returns, both overall and independent of the sign. The ambiguity presented herein confirms previous suggestions. We also conclude that only a tiny fraction of results is significant.

Table 7: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for three categories of observations (All days, days with *home announcement*, and days without *home announcement*), with categorical differences (percentage points). *Generalized Rank T-test.*

	% Pos.[1]	**% Sign.**[2]	**% Pos. & Sign.**[3]	**% Neg. & Sign.**[4]	**Description**
AAR	55%	9%	6%	3%	**All** days
CAAR (-1,1)	*58%*	*11%*	*8%*	*3%*	-||-
CAAR (-3,3)	*56%*	*5%*	*3%*	*2%*	-||-
CAAR (-5,5)	*58%*	*3%*	*3%*	*0%*	-||-
AAR	62%	31%	23%	8%	Days **with** home announcement
CAAR (-1,1)	*54%*	*8%*	*8%*	*0%*	-||-
CAAR (-3,3)	*62%*	*8%*	*8%*	*0%*	-||-
CAAR (-5,5)	*46%*	*0%*	*0%*	*0%*	-||-
AAR	53%	4%	2%	2%	Days **without** home announcement
CAAR (-1,1)	*59%*	*12%*	*8%*	*4%*	-||-
CAAR (-3,3)	*55%*	*4%*	*2%*	*2%*	-||-
CAAR (-5,5)	*61%*	*4%*	*4%*	*0%*	-||-
Diff AAR (Home)	9%	27%	21%	6%	Difference between days **with** and **without** home announcements

1) Percent of observations (days) with a positive AAR/CAAR value
2) Percent of observations (days) with a significant (5%) AAR/CAAR value
3) Percent of observations (days) with a significant positive AAR/CAAR value
4) Percent of observations (days) with a significant negative AAR/CAAR value

As partially concluded from the regression analysis and categorical comparison approach, we find support for a *proximity relationship* also using this approach. In the table above (Table 7), we see that the group of *home announcement* days shows a higher share of days with positive average abnormal returns (AAR) and a higher share of days with significant results, both overall and independent of the sign.

While the CAAR values generally support what the AAR values suggest, some exceptions exist. Due to the lack of robustness (see Section 6, *Robustness*), our conclusions are not impacted by this more than by recognizing some ambiguity of the results. While the higher share of days with significantly negative abnormal returns contradicts the suggestion that markets home to defense industry companies react stronger and more positively to their *home* countries' announcements than others', the difference is small. More importantly, the shares of days with significant and significantly positive abnormal returns are notably higher. This supports the suggestion that *home announcement*s cause a more positive reaction and that such a reaction is stronger independent of sign.

As in the previous, the comparison with the extension scenarios concurs with what has been said above. Results corresponding to those above (Tables 6 and 7), using the extended time frames (six months, entire time series), are presented in the appendix (Tables 28 and 29). These results support the suggestion of a *proximity relationship* even more, as the share of days with significantly negative abnormal returns is lower for *home announcement* days than other days. As for the extension scenarios considering a larger set of firms, there are no noteworthy differences compared to the above (Tables 30-32, appendix).

The issue of statistical significance is illustrated in the figures below (Figures 1 & 2). From these, we learn that the 5% significance level generally leads to quite large margins of error, such that most observations cannot be said to be significantly different from zero.

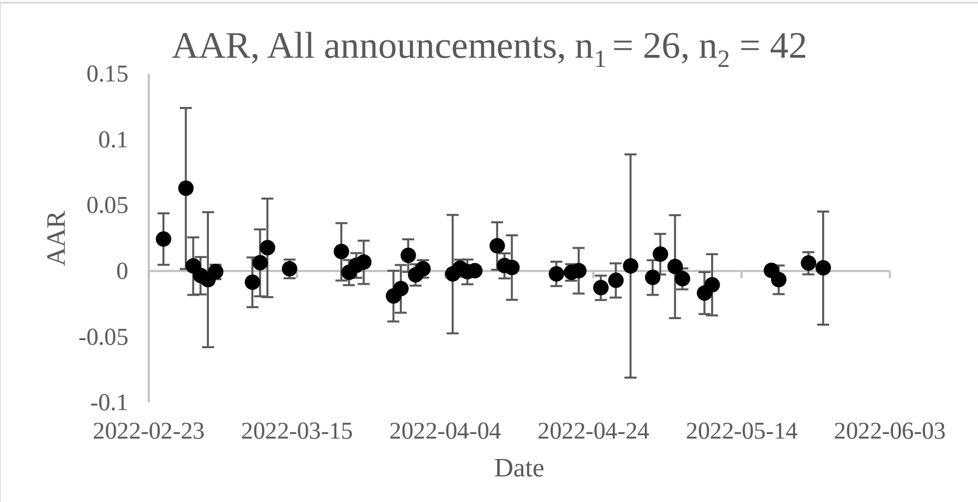

Figure 1: AAR for all announcement days with 95% confidence intervals. *Generalized Rank T-test*. n_1: Number of firms in sample, n_2: Number of events (days) in sample.

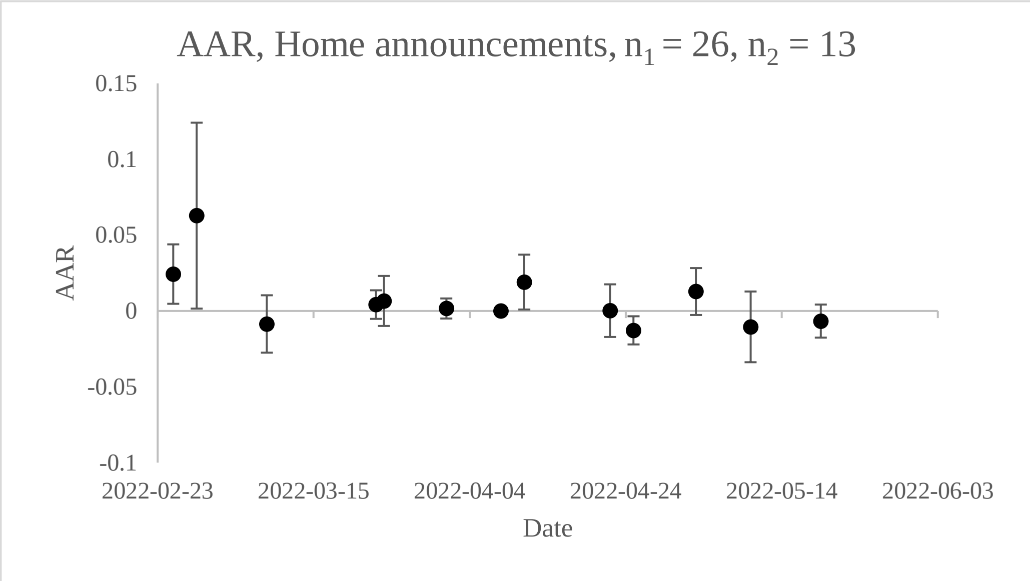

Figure 2: AAR for home-announcement days with 95% confidence intervals. *Generalized Rank T-test*. n_1: Number of firms in sample, n_2: Number of events (days) in sample.

As can be understood from the figures above, the results are ambiguous. To draw conclusions from the observations, we therefore resort to the methods previously described to summarize the results. However, the inherent uncertainties and ambiguities should not be hidden.

5.2. Discussion

Overall, our study does not find significant evidence that abnormal returns on *announcement days* are larger than on days without such announcements. Although we find some abnormal returns, they are scarce and not significant enough to find statistically significant evidence for the suggestion that abnormal returns are higher on such days. However, we find support for a *proximity relationship* by examining *home announcements*. These results are less ambiguous and generally show notable differences and positive regression coefficients, although they lack statistical significance. Our study also incorporates methods to ensure that these results are robust to resampling. This means that no significant relationship exists when testing randomly sampled announcement and *home announcement* days on the regressions. The permutation test in support of this is found in Section 6, *Robustness*.

Ambiguity, as well as low significance of results, is still a major flaw of our results. This implies that it is difficult to confidently credit abnormal returns to the occurrence of donation announcements, both for announcements in general and for *home announcements*.

Similar studies, such as that of Shapiro et al. (2011), found that (with some ambiguity) there is evidence that suggests that defense companies generate abnormal returns in response to war-related news. This differs from our results, which cannot make such a conclusion confidently. Ambiguity of the results, as well as low significance levels, affect this. Some possible explanations for these differences in results may relate to the type of announcement studied. Widening the perspective, we do not find significant results supporting abnormal returns in response to the events studied, which is not very common in the published literature.

To conclude, we cannot establish a statistically significant relationship between defense companies' abnormal returns and the occurrence of arms donation announcements. Neither can we establish such a relationship between the abnormal returns of defense companies and the occurrence of donation announcements in their *home* countries. However, we observe a difference between abnormal returns when comparing the two sets (announcements in general as opposed to *home announcements*), indicating the existence of a *proximity relationship*. Results are still ambiguous and insignificant, questioning the validity of what is suggested above.

5.3. Extension of study

To make causal inferences about the effect of arms donation announcements on the defense industry equity markets' reactions, other measures of market reactions, such as abnormal volume and abnormal volatility, should also be considered. Therefore, one possible extension of the study is to reiterate the analysis above with abnormal volume and volatility measures as a complement to abnormal returns. As the study aims to determine the degree of equity markets' reactions to donation announcements, we do not only seek to know the price at which the market valued the new information but also to know the degree to which the information was new, led to new interpretations of previous information, as well as the degree to which markets had already priced in the arms donations. In answering this, employing the above methods to volume and return volatility data would be of great value.

In describing our ideal dataset (Section 3, *Data*) we also suggest that the study feasibly could be extended by using more highly enriched data. Provided data on detailed timing of announcements can be collected, employing similar methods as used in this paper for intraday stock return data and intraday event windows, one could replicate the event study approach used in this paper. However, using either a difference-in-difference or regression discontinuity approach would be preferable with access to such data. This would likely correct many of the design flaws in the setup of our study.

While we in this paper study the impact of arms donation announcements without consideration of their importance to the market, a more insightful approach to understanding how markets react to this type of information would be to control for just this. By either using a dollar estimate of the packages' value or a qualitative measure (importance grade) as a control, the explanatory value could potentially increase. Qualitative measures could for example include analysis of news reports or be based on defense industry expert opinions.

Lastly, the study could be extended to make other considerations around the sample of companies examined. By including more companies, some endogeneity issues could be mitigated. Further, by value-weighting the AAR and CAAR measures according to market capitalization, arms sales (total), or arms sales of land warfare equipment specifically, these aggregate measures would better describe the abnormal reaction of the defense industry equity markets overall.

6. Robustness

As presented in the empirical analysis above, we run two multiple linear regression models to estimate the effect of our constructed dummy variables for announcement days on abnormal returns (for each abnormal return measure). In doing so, we also employ a series of controls to exclude a set of supposed sources of variation. To check the validity of our results, we perform a series of placebo tests, or a permutation test, where we resample dates randomly from the period examined in equal proportion of dates as above (placebo test). We then performed 1000 resampling iterations for each placebo test (permutation test). In doing this, we check if abnormal returns observed in our set of announcement days differ from those observed on a random set of days. From the tables below (Tables 8 & 9), we can conclude that only a small fraction of iterations (of the 1000 resampling iterations made) show a significant and positive coefficient estimate, meaning that the results above are not entirely due to chance. We can also conclude that the average estimates of the random date samples are very close to zero, indicating that only a small portion of the variation in abnormal returns is due to chance.

Table 8: Permutation test results of 1000 iterations of placebo tests for OLS regression models of a dummy variable of announcements (*any*) regressed on four abnormal return measures.

	AAR	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)
Estimate	0.005%	-0.033%	0.022%	0.013%
% Significant positive	3%	2%	3%	3%

Table 9: Permutation test results of 1000 iterations of placebo tests for OLS regression models of a dummy variable of announcements (*home*) regressed on four abnormal return measures.

	AAR	CAAR (-1,1)	CAAR (-3,3)	CAAR (-5,5)
Estimate	-0.014%	0.007%	0.001%	0.011%
% Significant positive	4%	2%	2%	3%

The purpose of the placebo and permutation tests is to establish if the results observed in the previous are due to chance (noise). To establish the likelihood of the results mainly including noise, we analyze the distribution of coefficients in the placebo tests through the figures below. The first figure (Figure 3) shows the distribution of coefficients for the regression model with a dummy variable of announcements in general as the independent variable. In contrast, the second figure (Figure 4) shows the distribution of coefficients for the corresponding model for *home announcements*. In each case, the figure shows the coefficient distribution of models run using the AAR measure of abnormal returns. The corresponding figures for tests, as in the first figure for the three CAAR measures, can be found in the appendix (Figures 5-7). Correspondingly, the additional figures for the second figure below can also be found in the appendix (Figures 8-10). As in the previous, the models are run on data from our baseline scenario (first three months, 26 firms among the 50 largest defense companies).

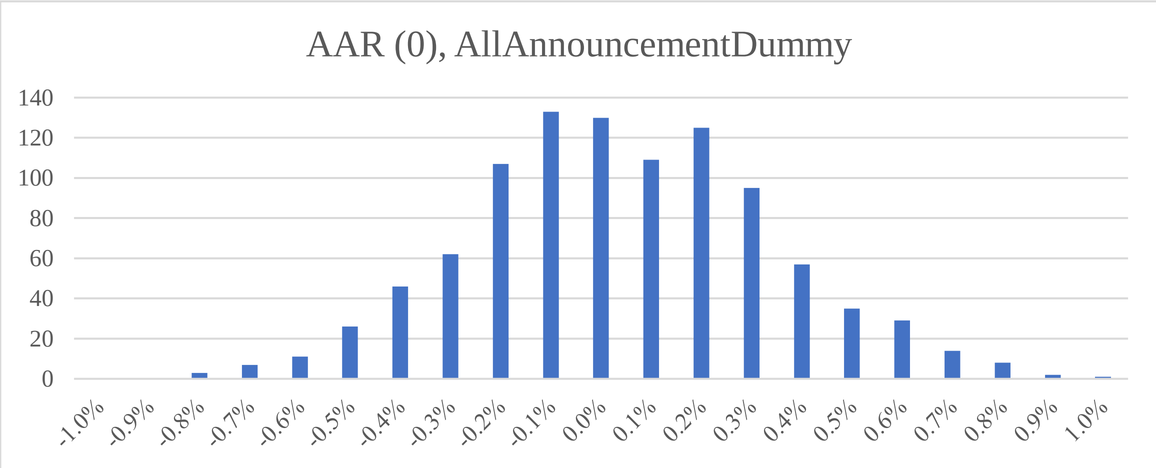

Figure 3: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (any) is regressed on abnormal returns using the AAR measure.

As seen above, the coefficient values are approximately normally distributed around zero. This implies that the results contain little noise compared to a distribution with a larger share of coefficients in the tails of the distribution function. In turn, this implies that the results presented are robust and are not simply due to chance. The distribution figures for the CAAR-based models, which consider event windows of between three and eleven days, will tell another story, as shown in Figures 5-7 (appendix). This discrepancy likely exists because of the wide event windows, measuring the cumulative abnormal returns, having little variation. This causes the resampling to have little effect as the abnormal returns recorded for each event considers returns from several days around this. This suggests that the CAAR measures are not robust to resampling and that the usefulness of these measures is limited and questionable.

However, because the primary purpose of using them in this paper is to compare them with the AAR results, this does not alter the previous analysis or conclusions. Also, the method of having several measures of abnormal returns increases comparability with previous event study literature.

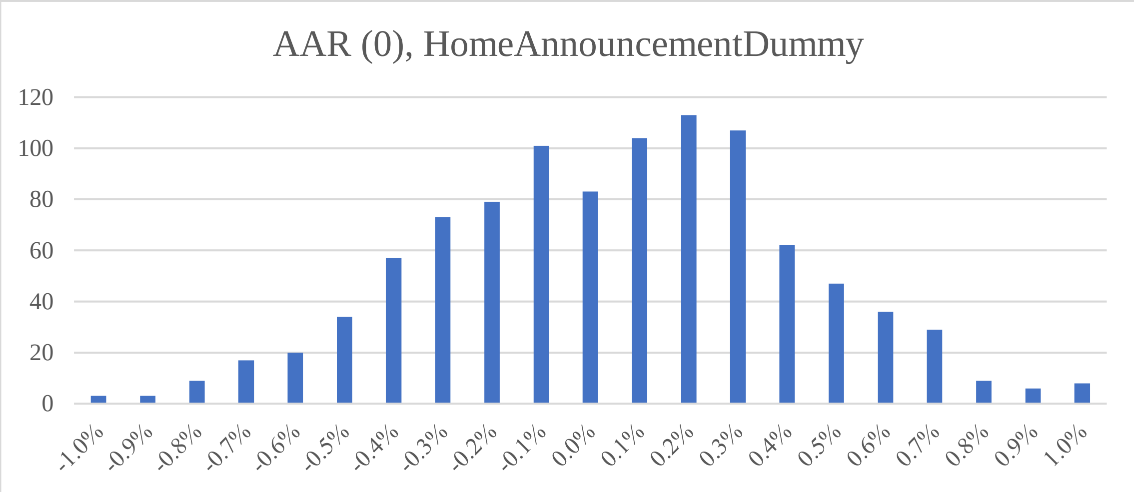

Figure 4: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (home) is regressed on abnormal returns using the AAR measure.

While a similar argument for robustness can be made for Figure 4 (above) as for Figure 3 (previous), we note that the distribution curve assumes a flatter shape and that observations are more prevalent in the tails. However, the distribution function still assumes a close-to-normal distribution shape and is centered around zero. Also in this case, are these suggestions contradicting what is suggested by the distribution figures of the CAAR measures. These are presented in the appendix (Figures 8-10).

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Appendix

AI-Disclosure

For the purposes of this paper, we have used artificial intelligence and machine learning tools in the following ways:

1. R-code improvement and error diagnostics, using *ChatGPT* (3.5) provided by OpenAI.
2. Grammatical checks and spelling corrections, using *Grammarly* provided by Grammarly Inc.

Tables

Table 10: The 100 largest defense companies ranked by 2021 arms sales (million USD) according to SIPRI Arms Industry Database (2023), firm name, country of origin, 2021 arms sales figure, whether the company is listed or not (or not at all considered in our study, marked with hyphen), whether the company is included in our baseline dataset or not, and symbol used to acquire stock return data (ticker).

Rank	**Company**	**Country**	**Arms Sales (Mn USD, 2021)**	**Listed (Y/N/-)**	**Baseline (Y/N)**	**Symbol**
1	Lockheed Martin Corp.	United States	60340	Y	Y	LMT
2	Raytheon Technologies	United States	41850	Y	Y	RTX
3	Boeing	United States	33420	Y	Y	BA
4	Northrop Grumman Corp.	United States	29880	Y	Y	NOC
5	General Dynamics Corp.	United States	26390	Y	Y	GD
6	BAE Systems	United Kingdom	26020	Y	Y	BA.L
7	NORINCO	China	21570	-	N	
8	AVIC	China	20110	-	N	
9	CASC	China	19100	-	N	
10	CETC	China	14990	-	N	
11	CASIC	China	14520	-	N	
12	Leonardo	Italy	13870	Y	Y	LDO.MI

13	L3Harris Technologies	United States	13360	Y	Y	LHX
14	CSSC	China	11130	-	N	
15	Airbus	Trans-European	10850	Y	Y	AIR.PA
16	Thales	France	9770	Y	Y	HO.PA
17	Huntington Ingalls Industries	United States	8570	Y	Y	HII
18	Leidos	United States	8030	Y	Y	LDOS
19	Dassault Aviation Group	France	6250	Y	Y	AM.PA
20	CSGC	China	5910	-	N	
21	Peraton	United States	5810	N	N	
22	Booz Allen Hamilton	United States	5600	Y	Y	BAH
23	Honeywell International	United States	5150	Y	Y	HON
24	Safran	France	5050	Y	Y	SAF.PA
25	Amentum	United States	5020	N	N	
26	Rolls-Royce	United Kingdom	4970	Y	Y	RR.L
27	MBDA	Trans-European	4960	N	N	
28	Elbit Systems	Israel	4750	-	N	
29	Naval Group	France	4740	N	N	
30	United Aircraft Corp.	Russia	4450	-	N	
31	Rheinmetall	Germany	4450	Y	Y	RHM.DE
32	CACI International	United States	4330	Y	Y	CACI
33	General Electric	United States	4140	Y	Y	GE
34	Saab	Sweden	4090	Y	Y	SAAB-B.ST
35	Mitsubishi Heavy Industries	Japan	4060	Y	N	7011.T
36	United Shipbuilding Corp.	Russia	4020	-	N	
37	Tactical Missiles Corp.	Russia	3990	-	N	
38	Israel Aerospace Industries	Israel	3870	-	N	

39	Science Applications International Corp.	United States	3550	Y	Y	SAIC
40	KBR	United States	3530	Y	Y	KBR
41	Textron	United States	3350	Y	Y	TXT
42	Hindustan Aeronautics	India	3300	-	N	
43	Babcock International Group	United Kingdom	3100	Y	Y	BAB.L
44	KNDS	Trans-European	3030	N	N	
45	Rafael	Israel	3010	-	N	
46	Fincantieri	Italy	2980	Y	Y	FCT.MI
47	CEA	France	2940	N	N	
48	United Engine Corp.	Russia	2910	-	N	
49	General Atomics	United States	2810	N	N	
50	Hanwha Aerospace	South Korea	2550	Y	N	012450.KS
51	Oshkosh Corp.	United States	2530	Y	N	OSK
52	Bechtel Corp.	United States	2470	N	N	
53	TransDigm Group	United States	2400	Y	N	TDG
54	Kawasaki Heavy Industries	Japan	2400	Y	N	7012.T
55	ThyssenKrupp	Germany	2390	Y	N	TKA.DE
56	ASELSAN	Türkiye	2160	Y	N	ALSELS.IS
57	ST Engineering	Singapore	2160	Y	N	S63.SI
58	ManTech International Corp.	United States	2080	N	N	
59	Jacobs Engineering Group	United States	2040	Y	N	J
60	NCSIST	Taiwan	1970	N	N	
61	Serco Group	United Kingdom	1870	Y	N	SRP.L
62	Sierra Nevada Corp.	United States	1860	N	N	
63	Bharat Electronics	India	1830	-	N	
64	CNNC	China	1810	-	N	

65	Korea Aerospace Industries	South Korea	1800	Y	N	047810.KS
66	BWX Technologies	United States	1650	Y	N	BWXT
67	Teledyne Technologies	United States	1640	Y	N	TDY
68	Vectrus	United States	1630	N	N	
69	Hensoldt	Germany	1610	Y	N	HAG.DE
70	Eaton	United States	1600	Y	N	ETN
71	LIG Nex1	South Korea	1590	Y	N	079550.KS
72	QinetiQ	United Kingdom	1510	Y	N	QQ.L
73	Aerojet Rocketdyne	United States	1470	N	N	
74	Fluor Corp.	United States	1430	Y	N	FLR
75	Parsons Corp.	United States	1430	Y	N	PSN
76	PGZ	Poland	1430	N	N	
77	Fujitsu	Japan	1410	Y	N	6702.T
78	Curtiss-Wright Corp.	United States	1380	Y	N	CW
79	UkrOboronProm	Ukraine	1330	N	N	
80	CAE	Canada	1280	Y	N	CAE
81	Moog	United States	1250	Y	N	MOG-A
82	Hanwha Corp.	South Korea	1240	Y	N	000880.KS
83	UralVagonZavod	Russia	1200	-	N	
84	Turkish Aerospace	Türkiye	1200	N	N	
85	Russian Helicopters	Russia	1200	-	N	
86	Amphenol Corp.	United States	1200	Y	N	APH
87	Melrose Industries	United Kingdom	1190	Y	N	MRO.L
88	Kongsberg Gruppen	Norway	1170	Y	N	KOG.OL
89	IHI Corp.	Japan	1160	Y	N	7013.T
90	Ball Corp.	United States	1090	Y	N	BALL

91	Navantia	Spain	1080	N	N	
92	The Aerospace Corp.	United States	1030	N	N	
93	Pacific Architects and Engineers	United States	980	N	N	
94	ViaSat	United States	980	Y	N	VSAT
95	Mercury Systems	United States	960	Y	N	MRCY
96	Howmet Aerospace	United States	950	Y	N	HWM
97	Austal	Australia	940	Y	N	ASB.AX
98	Ultra Electronics Group	United Kingdom	920	N	N	
99	Diehl	Germany	870	N	N	
100	Meggitt	United Kingdom	850	N	N	

Table 11: Packages considered according to selection criteria from the Ukraine Support Tracker 13th release (Trebesch et al., 2023), with package ID, donating country, and recorded announcement date.

ID	Country	Date
ATM1	Austria	2022-03-13
AUM1	Australia	2022-03-01
AUM10	Australia	2022-10-25
AUM11	Australia	2023-02-24
AUM12	Australia	2023-06-26
AUM2	Australia	2022-03-20
AUM3	Australia	2022-03-31
AUM4	Australia	2022-04-08
AUM5	Australia	2022-04-08
AUM6	Australia	2022-04-27
AUM7	Australia	2022-05-19
AUM8	Australia	2022-07-04
BEM1	Belgium	2022-02-26
BEM10	Belgium	2022-12-16
BEM11	Belgium	2023-01-27
BEM12	Belgium	2023-03-16
BEM13	Belgium	2023-05-12
BEM14	Belgium	2023-06-16
BEM2	Belgium	2022-03-22
BEM3	Belgium	2022-05-06
BEM4	Belgium	2022-07-15
BEM5	Belgium	2022-08-25
BEM6	Belgium	2022-09-16
BEM7	Belgium	2022-09-17
BEM8	Belgium	2022-10-28
BEM9	Belgium	2022-11-25
BGM1	Bulgaria	2022-04-07
BGM3	Bulgaria	2022-12-09
BGM4	Bulgaria	2023-07-13

CAM10	Canada	2022-03-03
CAM11	Canada	2022-03-09
CAM12	Canada	2022-10-12
CAM13	Canada	2022-11-14
CAM14	Canada	2022-11-14
CAM15	Canada	2022-11-16
CAM16	Canada	2023-01-18
CAM17	Canada	2023-01-27
CAM18	Canada	2023-02-24
CAM19	Canada	2023-02-24
CAM20	Canada	2023-03-15
CAM21	Canada	2023-04-11
CAM22	Canada	2023-04-21
CAM23	Canada	2023-04-21
CAM24	Canada	2023-05-25
CAM25	Canada	2023-06-10
CAM26	Canada	2023-07-13
CAM6	Canada	2022-02-27
CAM7	Canada	2022-02-28
CAM8	Canada	2022-03-01
CAM9	Canada	2022-03-03
CZM1	Czech Republic	2022-02-26
CZM11	Czech Republic	2022-03-30
CZM12	Czech Republic	2022-04-05
CZM13	Czech Republic	2022-04-05
CZM14	Czech Republic	2022-04-06
CZM16	Czech Republic	2022-05-23
CZM17	Czech Republic	2022-05-29
CZM18	Czech Republic	2022-10-05
CZM19	Czech Republic	2022-10-19
CZM2	Czech Republic	2022-02-26
CZM20	Czech Republic	2022-11-04
CZM22	Czech Republic	2023-01-09

CZM23	Czech Republic	2023-02-23
CZM24	Czech Republic	2023-02-23
CZM25	Czech Republic	2023-02-23
CZM26	Czech Republic	2023-04-05
CZM27	Czech Republic	2023-05-10
CZM28	Czech Republic	2023-06-27
CZM3	Czech Republic	2022-02-27
CZM30	Czech Republic	2023-06-27
CZM31	Czech Republic	2023-06-27
CZM32	Czech Republic	2023-06-27
CZM33	Czech Republic	2023-06-27
CZM34	Czech Republic	2023-07-07
CZM35	Czech Republic	2023-07-07
CZM36	Czech Republic	2023-07-07
CZM4	Czech Republic	2022-03-03
CZM5	Czech Republic	2022-03-09
CZM6	Czech Republic	2022-03-09
CZM7	Czech Republic	2022-03-10
DEM1	Germany	2023-07-11
DEM2	Germany	2023-07-11
DEM3	Germany	2022-10-02
DKM1	Denmark	2022-04-21
DKM10	Denmark	2023-05-02
DKM11	Denmark	2023-05-02
DKM12	Denmark	2023-05-02
DKM7	Denmark	2023-01-07
DKM8	Denmark	2023-05-02
DKM9	Denmark	2023-05-02
DMK7	Denmark	2023-01-19
EEM10	Estonia	2023-02-26
EEM11	Estonia	2023-03-16
EEM12	Estonia	2023-04-20
EEM13	Estonia	2023-06-22

EEM14	Estonia	2023-06-22
EEM3	Estonia	2022-04-06
EEM4	Estonia	2022-08-18
EEM5	Estonia	2022-08-18
EEM6	Estonia	2022-10-07
EEM7	Estonia	2022-12-01
EEM8	Estonia	2022-12-22
EEM9	Estonia	2023-01-19
ELM2	Greece	2022-05-26
ELM3	Greece	2022-09-18
ELM4	Greece	2023-02-14
ELM5	Greece	2023-04-06
ESM1	Spain	2022-03-02
ESM10	Spain	2022-10-06
ESM11	Spain	2022-10-13
ESM12	Spain	2022-11-02
ESM14	Spain	2023-01-25
ESM15	Spain	2023-02-01
ESM16	Spain	2023-05-25
ESM2	Spain	2022-03-11
ESM3	Spain	2022-03-29
ESM4	Spain	2022-04-21
ESM5	Spain	2022-06-05
ESM6	Spain	2022-06-28
ESM8	Spain	2022-07-12
ESM9	Spain	2022-08-24
FIM1	Finland	2022-02-27
FIM10	Finland	2023-02-23
FIM11	Finland	2023-03-23
FIM12	Finland	2023-04-21
FIM13	Finland	2023-05-25
FIM14	Finland	2023-07-06
FIM2	Finland	2022-05-05

FIM3	Finland	2022-06-10
FIM4	Finland	2022-09-01
FIM7	Finland	2022-11-17
FIM8	Finland	2022-12-22
FIM9	Finland	2023-01-20
FRM1	France	2022-04-23
FRM10	France	2023-05-15
FRM11	France	2023-07-11
FRM2	France	2022-06-30
FRM3	France	2022-10-07
FRM4	France	2022-11-18
FRM5	France	2022-12-12
FRM6	France	2023-01-04
FRM7	France	2023-01-05
FRM8	France	2023-02-03
FRM9	France	2023-03-28
HRM1	Croatia	2022-02-28
HRM2	Croatia	2022-11-16
HRM3	Croatia	2022-12-21
HRM4	Croatia	2023-02-23
ISM3	Iceland	2022-12-21
ISM6	Iceland	2023-05-15
ISM7	Iceland	2023-05-23
ISM9	Iceland	2023-06-16
ITM1	Italy	2022-02-28
ITM10	Italy	2023-04-16
ITM11	Italy	2023-05-30
ITM2	Italy	2022-04-22
ITM3	Italy	2022-05-10
ITM4	Italy	2022-07-27
ITM5	Italy	2022-10-17
ITM7	Italy	2023-01-13
ITM8	Italy	2023-02-15

JPM1	Japan	2022-03-04
JPM2	Japan	2022-04-19
JPM3	Japan	2022-08-04
JPM4	Japan	2023-03-30
KOM1	South Korea	2022-03-01
KOM2	South Korea	2022-04-13
KOM3	South Korea	2022-05-26
LTM10	Lithuania	2022-10-11
LTM13	Lithuania	2022-12-04
LTM15	Lithuania	2023-01-19
LTM16	Lithuania	2023-01-23
LTM17	Lithuania	2023-03-16
LTM18	Lithuania	2023-04-05
LTM19	Lithuania	2023-06-28
LTM2	Lithuania	2022-03-23
LTM20	Lithuania	2023-07-18
LTM21	Lithuania	2023-07-24
LTM22	Lithuania	2023-07-24
LTM23	Lithuania	2023-07-24
LTM3	Lithuania	2022-04-21
LTM4	Lithuania	2022-05-25
LTM5	Lithuania	2022-07-10
LTM6	Lithuania	2022-07-20
LTM7	Lithuania	2022-07-28
LTM8	Lithuania	2022-09-07
LUM1	Luxembourg	2022-02-28
LUM2	Luxembourg	2022-03-28
LUM5	Luxembourg	2023-02-15
LUM6	Luxembourg	2023-02-15
LUM7	Luxembourg	2023-06-16
LVM3	Latvia	2022-08-15
LVM4	Latvia	2022-08-15
LVM5	Latvia	2023-01-18

LVM6	Latvia	2023-04-21
NLM1	Netherlands	2022-02-26
NLM11	Netherlands	2023-02-07
NLM2	Netherlands	2022-04-19
NLM3	Netherlands	2022-06-16
NLM4	Netherlands	2022-06-28
NOM1	Norway	2022-02-28
NOM3	Norway	2022-10-02
NOM4	Norway	2023-02-14
NOM5	Norway	2023-02-16
NOM6	Norway	2023-02-16
NOM7	Norway	2023-02-16
NOM8	Norway	2023-02-16
NZM1	New Zealand	2022-03-21
NZM4	New Zealand	2022-04-11
NZM6	New Zealand	2022-05-23
PLM2	Poland	2022-04-29
PLM3	Poland	2022-07-25
PLM4	Poland	2022-12-13
PLM5	Poland	2023-01-27
PLM6	Poland	2023-01-27
PLM7	Poland	2023-03-16
PLM8	Poland	2023-05-24
PTM1	Portugal	2022-02-26
PTM10	Portugal	2023-04-22
PTM2	Portugal	2022-04-12
PTM3	Portugal	2022-04-30
PTM4	Portugal	2022-05-08
PTM5	Portugal	2022-05-18
PTM7	Portugal	2022-10-14
PTM8	Portugal	2023-01-20
PTM9	Portugal	2023-02-02
ROM1	Romania	2022-02-27

ROM2	Romania	2022-04-19
SEM1	Sweden	2022-02-27
SEM10	Sweden	2023-01-19
SEM11	Sweden	2023-01-10
SEM4	Sweden	2022-06-02
SEM8	Sweden	2022-08-28
SEM9	Sweden	2022-11-16
SIM2	Slovenia	2022-06-16
SIM3	Slovenia	2022-07-29
SIM4	Slovenia	2022-09-20
SIM6	Slovenia	2023-04-20
SKM11	Slovakia	2023-02-27
SKM12	Slovakia	2023-03-17
SKM13	Slovakia	2023-04-17
SKM14	Slovakia	2023-06-07
SKM2	Slovakia	2022-02-27
SKM3	Slovakia	2022-02-26
SKM4	Slovakia	2022-03-03
SKM6	Slovakia	2022-04-08
SKM7	Slovakia	2022-06-16
SKM8	Slovakia	2022-08-23
SKM9	Slovakia	2022-12-12
TRM2	Turkey	2022-08-22
UKM10	United Kingdom	2022-06-30
UKM11	United Kingdom	2022-10-13
UKM12	United Kingdom	2022-10-13
UKM13	United Kingdom	2022-11-09
UKM14	United Kingdom	2022-11-19
UKM15	United Kingdom	2022-11-23
UKM16	United Kingdom	2023-01-14
UKM2	United Kingdom	2022-03-09
UKM3	United Kingdom	2022-03-09
UKM4	United Kingdom	2022-03-23

UKM5	United Kingdom	2022-03-24
UKM6	United Kingdom	2022-04-08
UKM7	United Kingdom	2022-04-09
UKM8	United Kingdom	2022-05-19
UKM9	United Kingdom	2022-05-03
USM1	United States	2022-02-25
USM10	United States	2022-12-06
USM11	United States	2022-12-06
USM2	United States	2022-04-25
USM3	United States	2022-04-01
USM7	United States	2022-09-30
USM8	United States	2022-12-06
USM9	United States	2022-09-30

Table 12: Series of dates considered in the entire series with constructed dummy variables of announcements (any) and home announcements.

Date	**DUMMY ALL**	**DUMMY HOME**
2022-02-24	0	0
2022-02-25	1	1
2022-02-28	1	1
2022-03-01	1	0
2022-03-02	1	0
2022-03-03	1	0
2022-03-04	1	0
2022-03-07	0	0
2022-03-08	0	0
2022-03-09	1	1
2022-03-10	1	0
2022-03-11	1	0
2022-03-14	1	0
2022-03-15	0	0
2022-03-16	0	0
2022-03-17	0	0
2022-03-18	0	0
2022-03-21	1	0
2022-03-22	1	0
2022-03-23	1	1
2022-03-24	1	1
2022-03-25	0	0
2022-03-28	1	0
2022-03-29	1	0
2022-03-30	1	0
2022-03-31	1	0
2022-04-01	1	1
2022-04-04	0	0
2022-04-05	1	0
2022-04-06	1	0

2022-04-07	1	0
2022-04-08	1	1
2022-04-11	1	1
2022-04-12	1	0
2022-04-13	1	0
2022-04-14	0	0
2022-04-18	0	0
2022-04-19	1	0
2022-04-20	0	0
2022-04-21	1	0
2022-04-22	1	1
2022-04-25	1	1
2022-04-26	0	0
2022-04-27	1	0
2022-04-28	0	0
2022-04-29	1	0
2022-05-02	1	0
2022-05-03	1	1
2022-05-04	0	0
2022-05-05	1	0
2022-05-06	1	0
2022-05-09	1	0
2022-05-10	1	1
2022-05-11	0	0
2022-05-12	0	0
2022-05-13	0	0
2022-05-16	0	0
2022-05-17	0	0
2022-05-18	1	0
2022-05-19	1	1
2022-05-20	0	0
2022-05-23	1	0
2022-05-24	0	0

2022-05-25	1	0
2022-05-26	1	0
2022-05-27	0	0
2022-05-31	1	0
2022-06-01	0	0
2022-06-02	1	1
2022-06-03	0	0
2022-06-06	1	0
2022-06-07	0	0
2022-06-08	0	0
2022-06-09	0	0
2022-06-10	1	0
2022-06-13	0	0
2022-06-14	0	0
2022-06-15	0	0
2022-06-16	1	0
2022-06-17	0	0
2022-06-21	0	0
2022-06-22	0	0
2022-06-23	0	0
2022-06-24	0	0
2022-06-27	0	0
2022-06-28	1	0
2022-06-29	0	0
2022-06-30	1	1
2022-07-01	0	0
2022-07-05	1	0
2022-07-06	0	0
2022-07-07	0	0
2022-07-08	0	0
2022-07-11	1	0
2022-07-12	1	0
2022-07-13	0	0

2022-07-14	0	0
2022-07-15	1	0
2022-07-18	0	0
2022-07-19	0	0
2022-07-20	1	0
2022-07-21	0	0
2022-07-22	0	0
2022-07-25	1	0
2022-07-26	0	0
2022-07-27	1	1
2022-07-28	1	0
2022-07-29	1	0
2022-08-01	0	0
2022-08-02	0	0
2022-08-03	0	0
2022-08-04	1	0
2022-08-05	0	0
2022-08-08	0	0
2022-08-09	0	0
2022-08-10	0	0
2022-08-11	1	0
2022-08-12	0	0
2022-08-15	1	0
2022-08-16	0	0
2022-08-17	0	0
2022-08-18	1	0
2022-08-19	0	0
2022-08-22	1	0
2022-08-23	1	0
2022-08-24	1	0
2022-08-25	1	0
2022-08-26	0	0
2022-08-29	1	1

2022-08-30	0	0
2022-08-31	0	0
2022-09-01	1	0
2022-09-02	0	0
2022-09-06	0	0
2022-09-07	1	0
2022-09-08	0	0
2022-09-09	0	0
2022-09-12	0	0
2022-09-13	0	0
2022-09-14	0	0
2022-09-15	0	0
2022-09-16	1	0
2022-09-19	1	0
2022-09-20	1	0
2022-09-21	0	0
2022-09-22	0	0
2022-09-23	0	0
2022-09-26	0	0
2022-09-27	0	0
2022-09-28	0	0
2022-09-29	0	0
2022-09-30	1	1
2022-10-03	1	1
2022-10-04	0	0
2022-10-05	1	0
2022-10-06	1	0
2022-10-07	1	1
2022-10-10	0	0
2022-10-11	1	0
2022-10-12	1	0
2022-10-13	1	1
2022-10-14	1	0

2022-10-17	1	1
2022-10-18	0	0
2022-10-19	1	0
2022-10-20	0	0
2022-10-21	0	0
2022-10-24	0	0
2022-10-25	1	0
2022-10-26	0	0
2022-10-27	0	0
2022-10-28	1	0
2022-10-31	0	0
2022-11-01	0	0
2022-11-02	1	0
2022-11-03	0	0
2022-11-04	1	0
2022-11-07	0	0
2022-11-08	0	0
2022-11-09	1	1
2022-11-10	0	0
2022-11-11	0	0
2022-11-14	1	0
2022-11-15	0	0
2022-11-16	1	1
2022-11-17	1	0
2022-11-18	1	1
2022-11-21	1	1
2022-11-22	0	0
2022-11-23	1	1
2022-11-25	1	0
2022-11-28	0	0
2022-11-29	0	0
2022-11-30	0	0
2022-12-01	1	0

2022-12-02	0	0
2022-12-05	1	0
2022-12-06	1	1
2022-12-07	0	0
2022-12-08	0	0
2022-12-09	1	0
2022-12-12	1	1
2022-12-13	1	0
2022-12-14	0	0
2022-12-15	0	0
2022-12-16	1	0
2022-12-19	0	0
2022-12-20	0	0
2022-12-21	1	0
2022-12-22	1	0
2022-12-23	1	0
2022-12-27	0	0
2022-12-28	0	0
2022-12-29	0	0
2022-12-30	0	0
2023-01-03	0	0
2023-01-04	1	1
2023-01-05	1	1
2023-01-06	0	0
2023-01-09	1	0
2023-01-10	1	1
2023-01-11	0	0
2023-01-12	0	0
2023-01-13	1	1
2023-01-17	1	1
2023-01-18	1	0
2023-01-19	1	1
2023-01-20	1	0

2023-01-23	1	0
2023-01-24	0	0
2023-01-25	1	0
2023-01-26	0	0
2023-01-27	1	0
2023-01-30	0	0
2023-01-31	0	0
2023-02-01	1	0
2023-02-02	1	0
2023-02-03	1	1
2023-02-06	0	0
2023-02-07	0	0
2023-02-08	0	0
2023-02-09	0	0
2023-02-10	0	0
2023-02-13	0	0
2023-02-14	1	0
2023-02-15	1	1
2023-02-16	1	0
2023-02-17	0	0
2023-02-21	0	0
2023-02-22	0	0
2023-02-23	1	0
2023-02-24	1	0
2023-02-27	1	0
2023-02-28	0	0
2023-03-01	0	0
2023-03-02	0	0
2023-03-03	0	0
2023-03-06	0	0
2023-03-07	0	0
2023-03-08	0	0
2023-03-09	0	0

2023-03-10	0	0
2023-03-13	0	0
2023-03-14	0	0
2023-03-15	1	0
2023-03-16	1	0
2023-03-17	1	0
2023-03-20	0	0
2023-03-21	0	0
2023-03-22	0	0
2023-03-23	1	0
2023-03-24	0	0
2023-03-27	0	0
2023-03-28	1	1
2023-03-29	0	0
2023-03-30	1	0
2023-03-31	0	0
2023-04-03	0	0
2023-04-04	0	0
2023-04-05	1	0
2023-04-06	1	0
2023-04-10	0	0
2023-04-11	1	0
2023-04-12	0	0
2023-04-13	0	0
2023-04-14	0	0
2023-04-17	1	1
2023-04-18	0	0
2023-04-19	0	0
2023-04-20	1	0
2023-04-21	1	0
2023-04-24	1	0
2023-04-25	0	0
2023-04-26	0	0

2023-04-27	0	0
2023-04-28	0	0
2023-05-01	0	0
2023-05-02	1	0
2023-05-03	0	0
2023-05-04	0	0
2023-05-05	0	0
2023-05-08	0	0
2023-05-09	0	0
2023-05-10	1	0
2023-05-11	0	0
2023-05-12	1	0
2023-05-15	1	1
2023-05-16	0	0
2023-05-17	0	0
2023-05-18	0	0
2023-05-19	0	0
2023-05-22	0	0
2023-05-23	1	0
2023-05-24	1	0
2023-05-25	1	0
2023-05-26	0	0
2023-05-30	1	1
2023-05-31	0	0
2023-06-01	0	0
2023-06-02	0	0
2023-06-05	0	0
2023-06-06	0	0
2023-06-07	1	0
2023-06-08	0	0
2023-06-09	0	0
2023-06-12	1	0
2023-06-13	0	0

2023-06-14	0	0
2023-06-15	0	0
2023-06-16	1	0
2023-06-20	0	0
2023-06-21	0	0
2023-06-22	1	0
2023-06-23	0	0
2023-06-26	1	0
2023-06-27	1	0
2023-06-28	1	0
2023-06-29	0	0
2023-06-30	0	0
2023-07-03	0	0
2023-07-05	0	0
2023-07-06	1	0
2023-07-07	1	0
2023-07-10	0	0
2023-07-11	1	1
2023-07-12	0	0
2023-07-13	1	0
2023-07-14	0	0
2023-07-17	0	0
2023-07-18	1	0
2023-07-19	0	0
2023-07-20	0	0
2023-07-21	0	0
2023-07-24	1	0
2023-07-25	0	0
2023-07-26	0	0
2023-07-27	0	0
2023-07-28	0	0

<u>Table 13:</u> Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any) over a six-month period, controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.079%	0.538%	0.810%	0.468%
Upper 95% CI	0.281%	1.094%	1.561%	1.420%
Lower 95% CI	-0.440%	-0.018%	0.059%	-0.484%
SE	0.184%	0.284%	0.383%	0.486%
P-value	0.67	0.06	0.04	0.34

<u>Table 14:</u> Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any) over the entire time series. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.130%	0.059%	0.421%	0.267%
Upper 95% CI	0.066%	0.386%	0.857%	0.789%
Lower 95% CI	-0.325%	-0.268%	-0.016%	-0.256%
SE	0.100%	0.167%	0.223%	0.267%
P-value	0.19	0.72	0.06	0.32

<u>Table 15:</u> Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any) over a three-month period for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.242%	0.172%	0.470%	0.245%
Upper 95% CI	0.220%	1.068%	1.717%	1.911%
Lower 95% CI	-0.704%	-0.724%	-0.777%	-1.421%
SE	0.236%	0.457%	0.636%	0.850%
P-value	0.31	0.71	0.46	0.77

Table 16: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any) over a six-month period for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.079%	0.899%	0.824%	0.183%
Upper 95% CI	0.895%	1.988%	2.020%	1.494%
Lower 95% CI	-1.054%	-0.189%	-0.371%	-1.128%
SE	0.497%	0.555%	0.610%	0.669%
P-value	0.87	0.11	0.18	0.78

Table 17: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (any) over the entire time series for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	-0.083%	0.342%	0.389%	0.086%
Upper 95% CI	0.270%	0.773%	0.891%	0.643%
Lower 95% CI	-0.436%	-0.088%	-0.112%	-0.471%
SE	0.180%	0.220%	0.256%	0.284%
P-value	0.64	0.12	0.13	0.76

Table 18: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries) over a six-month period. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.306%	0.920%	0.992%	0.288%
Upper 95% CI	0.862%	1.760%	2.147%	1.736%
Lower 95% CI	-0.249%	0.081%	-0.163%	-1.160%
SE	0.283%	0.428%	0.589%	0.739%
P-value	0.28	0.03	0.09	0.70

Table 19: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries) over the entire time series. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.392%	0.435%	0.132%	-0.280%
Upper 95% CI	0.693%	0.943%	0.820%	0.535%
Lower 95% CI	0.092%	-0.072%	-0.556%	-1.096%
SE	0.153%	0.259%	0.351%	0.416%
P-value	0.01	0.09	0.71	0.50

Table 20: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries) over a three-month period for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.089%	0.343%	0.179%	-0.476%
Upper 95% CI	0.707%	1.469%	1.773%	1.634%
Lower 95% CI	-0.528%	-0.783%	-1.416%	-2.585%
SE	0.315%	0.575%	0.813%	1.076%
P-value	0.78	0.55	0.83	0.66

Table 21: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries) over a six-month period for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.188%	0.668%	0.835%	0.184%
Upper 95% CI	1.692%	2.351%	2.659%	2.182%
Lower 95% CI	-1.316%	-1.016%	-0.989%	-1.814%
SE	0.767%	0.859%	0.931%	1.020%
P-value	0.81	0.44	0.37	0.86

Table 22: Results from OLS regression of four AAR and CAAR (daily) on a dummy variable of announcements (home countries) over the entire time series for 50 of the top 100 largest defense companies excluding Asia. Controlled for number of previous announcements, number of days since the invasion, weekday, and seasonality (monthly). *T-test.*

	AAR	**CAAR (-1,1)**	**CAAR (-3,3)**	**CAAR (-5,5)**
Estimate	0.369%	0.537%	0.195%	-0.050%
Upper 95% CI	0.914%	1.202%	0.970%	0.804%
Lower 95% CI	-0.177%	-0.128%	-0.580%	-0.904%
SE	0.278%	0.339%	0.396%	0.436%
P-value	0.19	0.11	0.62	0.91

<u>Table 23:</u> Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for five categories of observations with categorical differences (percentage points), for a six-month period.

	Average AAR/CAAR	**Average N**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0,07%	25,98	13,44	12,54	**All** days
CAAR (-1,1)	*0,17%*	*25,98*	*13,09*	*12,89*	-||-
CAAR (-3,3)	*0,27%*	*25,98*	*12,75*	*13,23*	-||-
CAAR (-5,5)	*0,27%*	*25,98*	*12,67*	*13,31*	-||-
AAR	0,06%	26,00	13,13	12,87	Days **with** any announcement
CAAR (-1,1)	*0,69%*	*26,00*	*13,60*	*12,40*	-||-
CAAR (-3,3)	*0,81%*	*26,00*	*13,54*	*12,46*	-||-
CAAR (-5,5)	*0,70%*	*26,00*	*13,12*	*12,88*	-||-
AAR	0,07%	25,95	13,78	12,17	Days **without** any announcement
CAAR (-1,1)	*-0,40%*	*25,95*	*12,52*	*13,43*	-||-
CAAR (-3,3)	*-0,33%*	*25,95*	*11,87*	*14,08*	-||-
CAAR (-5,5)	*-0,20%*	*25,95*	*12,17*	*13,78*	-||-
AAR	0,62%	26,00	14,44	11,56	Days **with** home announcement
CAAR (-1,1)	*1,42%*	*26,00*	*14,81*	*11,19*	-||-
CAAR (-3,3)	*1,64%*	*26,00*	*15,19*	*10,81*	-||-
CAAR (-5,5)	*1,29%*	*26,00*	*13,75*	*12,25*	-||-
AAR	-0,01%	25,97	13,30	12,68	Days **without** home announcement
CAAR (-1,1)	*-0,01%*	*25,97*	*12,84*	*13,14*	-||-
CAAR (-3,3)	*0,07%*	*25,97*	*12,40*	*13,58*	-||-
CAAR (-5,5)	*0,13%*	*25,97*	*12,51*	*13,46*	-||-
Diff AAR (All)	-0,02%	0,05	-0,65	0,70	Difference between days **with and without any** announcements
Diff AAR (Home)	0,63%	0,03	1,14	-1,11	Difference between days **with and without home** announcements

<u>Table 24:</u> Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for five categories of observations with categorical differences (percentage points), for the entire time series.

	Average AAR/CAAR	**Average N**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0,03%	25,96	13,28	12,68	**All** days
CAAR (-1,1)	*0,09%*	*25,96*	*13,10*	*12,86*	-||-
CAAR (-3,3)	*0,16%*	*25,96*	*12,94*	*13,01*	-||-
CAAR (-5,5)	*0,21%*	*25,96*	*12,75*	*13,21*	-||-
AAR	0,00%	25,97	12,91	13,06	Days **with** any announcement
CAAR (-1,1)	*0,33%*	*25,97*	*13,18*	*12,79*	-||-
CAAR (-3,3)	*0,53%*	*25,97*	*13,75*	*12,22*	-||-
CAAR (-5,5)	*0,51%*	*25,97*	*13,30*	*12,66*	-||-
AAR	0,06%	25,95	13,58	12,37	Days **without** any announcement
CAAR (-1,1)	*-0,10%*	*25,95*	*13,03*	*12,92*	-||-
CAAR (-3,3)	*-0,15%*	*25,95*	*12,29*	*13,66*	-||-
CAAR (-5,5)	*-0,04%*	*25,95*	*12,29*	*13,66*	-||-
AAR	0,47%	26,00	15,10	10,90	Days **with** home announcement
CAAR (-1,1)	*0,77%*	*26,00*	*14,50*	*11,50*	-||-
CAAR (-3,3)	*0,68%*	*26,00*	*14,60*	*11,40*	-||-
CAAR (-5,5)	*0,68%*	*26,00*	*13,43*	*12,57*	-||-
AAR	-0,02%	25,95	13,04	12,91	Days **without** home announcement
CAAR (-1,1)	*0,00%*	*25,95*	*12,91*	*13,04*	-||-
CAAR (-3,3)	*0,09%*	*25,95*	*12,72*	*13,23*	-||-
CAAR (-5,5)	*0,14%*	*25,95*	*12,66*	*13,30*	-||-
Diff AAR (All)	-0,07%	0,02	-0,68	0,70	Difference between days **with and without any** announcements
Diff AAR (Home)	0,49%	0,05	2,06	-2,01	Difference between days **with and without home** announcements

<u>Table 25:</u> Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for five categories of observations with categorical differences (percentage points), for a three-month period and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section.

	Average AAR/CAAR	**Average N**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0,17%	49,92	26,41	23,52	**All** days
CAAR (-1,1)	*0,49%*	*49,92*	*26,78*	*23,14*	-||-
CAAR (-3,3)	*0,94%*	*49,92*	*26,50*	*23,42*	-||-
CAAR (-5,5)	*1,29%*	*49,92*	*27,33*	*22,59*	-||-
AAR	0,15%	49,95	25,90	24,05	Days **with** any announcement
CAAR (-1,1)	*0,58%*	*49,95*	*27,17*	*22,79*	-||-
CAAR (-3,3)	*1,08%*	*49,95*	*26,55*	*23,40*	-||-
CAAR (-5,5)	*1,36%*	*49,95*	*27,05*	*22,90*	-||-
AAR	0,20%	49,86	27,36	22,50	Days **without** any announcement
CAAR (-1,1)	*0,34%*	*49,86*	*26,05*	*23,82*	-||-
CAAR (-3,3)	*0,68%*	*49,86*	*26,41*	*23,45*	-||-
CAAR (-5,5)	*1,17%*	*49,86*	*27,86*	*22,00*	-||-
AAR	0,53%	50,00	26,92	23,08	Days **with** home announcement
CAAR (-1,1)	*1,23%*	*50,00*	*27,69*	*22,31*	-||-
CAAR (-3,3)	*1,50%*	*50,00*	*27,85*	*22,15*	-||-
CAAR (-5,5)	*1,22%*	*50,00*	*26,46*	*23,54*	-||-
AAR	0,07%	49,90	26,27	23,63	Days **without** home announcement
CAAR (-1,1)	*0,31%*	*49,90*	*26,55*	*23,35*	-||-
CAAR (-3,3)	*0,80%*	*49,90*	*26,16*	*23,75*	-||-
CAAR (-5,5)	*1,31%*	*49,90*	*27,55*	*22,35*	-||-
Diff AAR (All)	-0,05%	0,09	-1,46	1,55	Difference between days **with and without any** announcements
Diff AAR (Home)	0,45%	0,10	0,65	-0,55	Difference between days **with and without home** announcements

Table 26: Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for five categories of observations with categorical differences (percentage points), for a six-month period and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section.

	Average AAR/CAAR	**Average N**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0,05%	49,91	25,78	24,13	**All** days
CAAR (-1,1)	*0,14%*	*49,91*	*25,46*	*24,45*	-||-
CAAR (-3,3)	*0,21%*	*49,91*	*24,78*	*25,13*	-||-
CAAR (-5,5)	*0,19%*	*49,91*	*24,63*	*25,28*	-||-
AAR	0,05%	49,96	25,72	24,24	Days **with** any announcement
CAAR (-1,1)	*0,62%*	*49,96*	*26,66*	*23,30*	-||-
CAAR (-3,3)	*0,71%*	*49,96*	*26,09*	*23,87*	-||-
CAAR (-5,5)	*0,59%*	*49,96*	*25,28*	*24,67*	-||-
AAR	0,06%	49,87	25,85	24,02	Days **without** any announcement
CAAR (-1,1)	*-0,39%*	*49,87*	*24,13*	*25,73*	-||-
CAAR (-3,3)	*-0,35%*	*49,87*	*23,32*	*26,55*	-||-
CAAR (-5,5)	*-0,27%*	*49,87*	*23,90*	*25,97*	-||-
AAR	0,49%	50,00	27,31	22,69	Days **with** home announcement
CAAR (-1,1)	*1,17%*	*50,00*	*28,69*	*21,31*	-||-
CAAR (-3,3)	*1,46%*	*50,00*	*28,56*	*21,44*	-||-
CAAR (-5,5)	*1,07%*	*50,00*	*26,19*	*23,81*	-||-
AAR	-0,01%	49,90	25,56	24,34	Days **without** home announcement
CAAR (-1,1)	*-0,01%*	*49,90*	*25,00*	*24,90*	-||-
CAAR (-3,3)	*0,03%*	*49,90*	*24,23*	*25,67*	-||-
CAAR (-5,5)	*0,06%*	*49,90*	*24,41*	*25,50*	-||-
Diff AAR (All)	-0,01%	0,09	-0,13	0,22	Difference between days **with and without any** announcements
Diff AAR (Home)	0,51%	0,10	1,75	-1,65	Difference between days **with and without home** announcements

Table 27: Average AAR/CAAR (daily, %), average number of firms in sample, average number of firms reporting positive and negative AR/CAR respectively, for five categories of observations with categorical differences (percentage points), for the entire time series and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section.

	Average AAR/CAAR	**Average N**	**Average Pos firms**	**Average Neg firms**	**Description**
AAR	0,02%	49,90	25,36	24,54	**All** days
CAAR (-1,1)	*0,06%*	*49,90*	*25,18*	*24,72*	-||-
CAAR (-3,3)	*0,10%*	*49,90*	*24,89*	*25,02*	-||-
CAAR (-5,5)	*0,12%*	*49,90*	*24,72*	*25,18*	-||-
AAR	0,00%	49,91	25,29	24,61	Days **with** any announcement
CAAR (-1,1)	*0,30%*	*49,91*	*25,89*	*24,02*	-||-
CAAR (-3,3)	*0,44%*	*49,91*	*26,10*	*23,81*	-||-
CAAR (-5,5)	*0,38%*	*49,91*	*25,35*	*24,55*	-||-
AAR	0,03%	49,90	25,42	24,48	Days **without** any announcement
CAAR (-1,1)	*-0,13%*	*49,90*	*24,60*	*25,30*	-||-
CAAR (-3,3)	*-0,17%*	*49,90*	*23,89*	*26,01*	-||-
CAAR (-5,5)	*-0,08%*	*49,90*	*24,20*	*25,70*	-||-
AAR	0,41%	49,95	28,67	21,29	Days **with** home announcement
CAAR (-1,1)	*0,70%*	*49,95*	*27,93*	*22,02*	-||-
CAAR (-3,3)	*0,64%*	*49,95*	*26,93*	*23,02*	-||-
CAAR (-5,5)	*0,63%*	*49,95*	*25,60*	*24,36*	-||-
AAR	-0,04%	49,90	24,92	24,97	Days **without** home announcement
CAAR (-1,1)	*-0,02%*	*49,90*	*24,81*	*25,08*	-||-
CAAR (-3,3)	*0,03%*	*49,90*	*24,61*	*25,28*	-||-
CAAR (-5,5)	*0,06%*	*49,90*	*24,60*	*25,29*	-||-
Diff AAR (All)	-0,03%	0,01	-0,12	0,13	Difference between days **with and without any** announcements
Diff AAR (Home)	0,44%	0,06	3,75	-3,69	Difference between days **with and without home** announcements

Table 28: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for five categories of observations, with categorical differences (percentage points), for a six-month period. *Generalized Rank T test.*

	% Pos.[1]	**% Sign.[2]**	**% Pos. & Sign.[3]**	**% Neg. & Sign.[4]**	**Description**
AAR	54%	11%	5%	6%	**All** days
CAAR (-1,1)	*51%*	*14%*	*8%*	*6%*	-||-
CAAR (-3,3)	*46%*	*5%*	*2%*	*3%*	-||-
CAAR (-5,5)	*43%*	*4%*	*2%*	*2%*	-||-
AAR	52%	12%	4%	7%	Days **with** any announcement
CAAR (-1,1)	*52%*	*12%*	*6%*	*6%*	-||-
CAAR (-3,3)	*54%*	*4%*	*1%*	*3%*	-||-
CAAR (-5,5)	*45%*	*3%*	*3%*	*0%*	-||-
AAR	57%	10%	5%	5%	Days **without** any announcement
CAAR (-1,1)	*50%*	*17%*	*10%*	*7%*	-||-
CAAR (-3,3)	*38%*	*5%*	*2%*	*3%*	-||-
CAAR (-5,5)	*40%*	*5%*	*2%*	*3%*	-||-
AAR	63%	25%	19%	6%	Days **with** home announcement
CAAR (-1,1)	*56%*	*13%*	*13%*	*0%*	-||-
CAAR (-3,3)	*63%*	*6%*	*6%*	*0%*	-||-
CAAR (-5,5)	*44%*	*0%*	*0%*	*0%*	-||-
AAR	53%	9%	3%	6%	Days **without** home announcement
CAAR (-1,1)	*50%*	*14%*	*7%*	*7%*	-||-
CAAR (-3,3)	*44%*	*5%*	*1%*	*4%*	-||-
CAAR (-5,5)	*42%*	*5%*	*3%*	*2%*	-||-
Diff AAR (All)	-4%	2%	-1%	2%	Difference between days **with and without any** announcements
Diff AAR (Home)	9%	16%	16%	0%	Difference between days **with and without home** announcements

1) Percent of observations (days) with a positive AAR/CAAR value
2) Percent of observations (days) with a significant (5%) AAR/CAAR value
3) Percent of observations (days) with a significant positive AAR/CAAR value
4) Percent of observations (days) with a significant negative AAR/CAAR value

Table 29: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for five categories of observations, with categorical differences (percentage points) for the entire time series. *Generalized Rank T test.*

	% Pos.[1]	**% Sign.**[2]	**% Pos. & Sign.**[3]	**% Neg. & Sign.**[4]	**Description**
AAR	55%	13%	6%	7%	**All** days
CAAR (-1,1)	*51%*	*14%*	*7%*	*7%*	-||-
CAAR (-3,3)	*51%*	*14%*	*5%*	*9%*	-||-
CAAR (-5,5)	*46%*	*10%*	*5%*	*5%*	-||-
AAR	51%	14%	7%	7%	Days **with** any announcement
CAAR (-1,1)	*51%*	*12%*	*6%*	*6%*	-||-
CAAR (-3,3)	*56%*	*12%*	*6%*	*6%*	-||-
CAAR (-5,5)	*47%*	*7%*	*6%*	*1%*	-||-
AAR	58%	12%	6%	6%	Days **without** any announcement
CAAR (-1,1)	*51%*	*15%*	*8%*	*8%*	-||-
CAAR (-3,3)	*46%*	*16%*	*5%*	*11%*	-||-
CAAR (-5,5)	*46%*	*13%*	*5%*	*8%*	-||-
AAR	67%	19%	17%	2%	Days **with** home announcement
CAAR (-1,1)	*60%*	*17%*	*12%*	*5%*	-||-
CAAR (-3,3)	*52%*	*10%*	*7%*	*2%*	-||-
CAAR (-5,5)	*48%*	*7%*	*7%*	*0%*	-||-
AAR	53%	12%	5%	7%	Days **without** home announcement
CAAR (-1,1)	*50%*	*13%*	*6%*	*7%*	-||-
CAAR (-3,3)	*50%*	*15%*	*5%*	*9%*	-||-
CAAR (-5,5)	*46%*	*11%*	*5%*	*6%*	-||-
Diff AAR (All)	-7%	2%	1%	1%	Difference between days **with and without any** announcements
Diff AAR (Home)	14%	7%	12%	-5%	Difference between days **with and without home** announcements

1) Percent of observations (days) with a positive AAR/CAAR value
2) Percent of observations (days) with a significant (5%) AAR/CAAR value
3) Percent of observations (days) with a significant positive AAR/CAAR value
4) Percent of observations (days) with a significant negative AAR/CAAR value

<u>Table 30:</u> Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for five categories of observations, with categorical differences (percentage points), for a three-month period and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section. *Generalized Rank T test.*

	% Pos.	**% Sign.**	**% Pos. & Sign.**	**% Neg. & Sign.**	**Description**
AAR	56%	8%	5%	3%	**All** days
CAAR (-1,1)	*58%*	*5%*	*3%*	*2%*	-||-
CAAR (-3,3)	*52%*	*5%*	*5%*	*0%*	-||-
CAAR (-5,5)	*56%*	*3%*	*3%*	*0%*	-||-
AAR	52%	10%	5%	5%	Days **with** any announcement
CAAR (-1,1)	*57%*	*2%*	*0%*	*2%*	-||-
CAAR (-3,3)	*48%*	*5%*	*5%*	*0%*	-||-
CAAR (-5,5)	*55%*	*2%*	*2%*	*0%*	-||-
AAR	64%	5%	5%	0%	Days **without** any announcement
CAAR (-1,1)	*59%*	*9%*	*9%*	*0%*	-||-
CAAR (-3,3)	*59%*	*5%*	*5%*	*0%*	-||-
CAAR (-5,5)	*59%*	*5%*	*5%*	*0%*	-||-
AAR	62%	23%	15%	8%	Days **with** home announcement
CAAR (-1,1)	*54%*	*0%*	*0%*	*0%*	-||-
CAAR (-3,3)	*46%*	*8%*	*8%*	*0%*	-||-
CAAR (-5,5)	*46%*	*0%*	*0%*	*0%*	-||-
AAR	55%	4%	2%	2%	Days **without** home announcement
CAAR (-1,1)	*59%*	*6%*	*4%*	*2%*	-||-
CAAR (-3,3)	*53%*	*4%*	*4%*	*0%*	-||-
CAAR (-5,5)	*59%*	*4%*	*4%*	*0%*	-||-
Diff AAR (All)	-11%	5%	0%	5%	Difference between days **with and without any** announcements
Diff AAR (Home)	7%	19%	13%	6%	Difference between days **with and without home** announcements

Table 31: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for five categories of observations, with categorical differences (percentage points), for a six-month period and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section. *Generalized Rank T test.*

	% Pos.	**% Sign.**	**% Pos. & Sign.**	**% Neg. & Sign.**	**Description**
AAR	57%	10%	4%	6%	**All** days
CAAR (-1,1)	*51%*	*9%*	*5%*	*4%*	-||-
CAAR (-3,3)	*44%*	*8%*	*3%*	*5%*	-||-
CAAR (-5,5)	*44%*	*6%*	*2%*	*4%*	-||-
AAR	55%	12%	4%	7%	Days **with** any announcement
CAAR (-1,1)	*55%*	*6%*	*3%*	*3%*	-||-
CAAR (-3,3)	*48%*	*7%*	*4%*	*3%*	-||-
CAAR (-5,5)	*45%*	*4%*	*3%*	*1%*	-||-
AAR	60%	8%	3%	5%	Days **without** any announcement
CAAR (-1,1)	*47%*	*12%*	*7%*	*5%*	-||-
CAAR (-3,3)	*40%*	*8%*	*2%*	*7%*	-||-
CAAR (-5,5)	*43%*	*8%*	*2%*	*7%*	-||-
AAR	63%	25%	19%	6%	Days **with** home announcement
CAAR (-1,1)	*56%*	*6%*	*6%*	*0%*	-||-
CAAR (-3,3)	*50%*	*13%*	*13%*	*0%*	-||-
CAAR (-5,5)	*44%*	*0%*	*0%*	*0%*	-||-
AAR	57%	8%	2%	6%	Days **without** home announcement
CAAR (-1,1)	*50%*	*9%*	*5%*	*5%*	-||-
CAAR (-3,3)	*43%*	*7%*	*2%*	*5%*	-||-
CAAR (-5,5)	*44%*	*7%*	*3%*	*5%*	-||-
Diff AAR (All)	-5%	4%	1%	2%	Difference between days **with and without any** announcements
Diff AAR (Home)	6%	17%	17%	0%	Difference between days **with and without home** announcements

Table 32: Distribution (%) of observations (daily AAR/CAAR values) with respect to sign and significance (5%) for five categories of observations, with categorical differences (percentage points), for the entire time series and for a set of 50 of the top 100 largest defense industry companies excluding Asian companies, limited according to the data section. *Generalized Rank T test.*

	% Pos.	% Sign.	% Pos. & Sign.	% Neg. & Sign.	Description
AAR	52%	10%	4%	6%	**All** days
CAAR (-1,1)	*50%*	*11%*	*6%*	*5%*	-||-
CAAR (-3,3)	*48%*	*11%*	*6%*	*5%*	-||-
CAAR (-5,5)	*45%*	*11%*	*7%*	*5%*	-||-
AAR	52%	11%	4%	7%	Days **with** any announcement
CAAR (-1,1)	*53%*	*11%*	*6%*	*5%*	-||-
CAAR (-3,3)	*48%*	*12%*	*7%*	*5%*	-||-
CAAR (-5,5)	*45%*	*11%*	*8%*	*3%*	-||-
AAR	52%	10%	5%	5%	Days **without** any announcement
CAAR (-1,1)	*48%*	*12%*	*7%*	*6%*	-||-
CAAR (-3,3)	*47%*	*11%*	*6%*	*6%*	-||-
CAAR (-5,5)	*45%*	*12%*	*6%*	*6%*	-||-
AAR	67%	17%	14%	2%	Days **with** home announcement
CAAR (-1,1)	*60%*	*12%*	*10%*	*2%*	-||-
CAAR (-3,3)	*48%*	*10%*	*7%*	*2%*	-||-
CAAR (-5,5)	*45%*	*7%*	*7%*	*0%*	-||-
AAR	50%	9%	3%	6%	Days **without** home announcement
CAAR (-1,1)	*49%*	*11%*	*6%*	*6%*	-||-
CAAR (-3,3)	*48%*	*12%*	*6%*	*6%*	-||-
CAAR (-5,5)	*45%*	*12%*	*7%*	*5%*	-||-
Diff AAR (All)	0%	2%	0%	2%	Difference between days **with and without any** announcements
Diff AAR (Home)	16%	7%	11%	-4%	Difference between days **with and without home** announcements

Figures

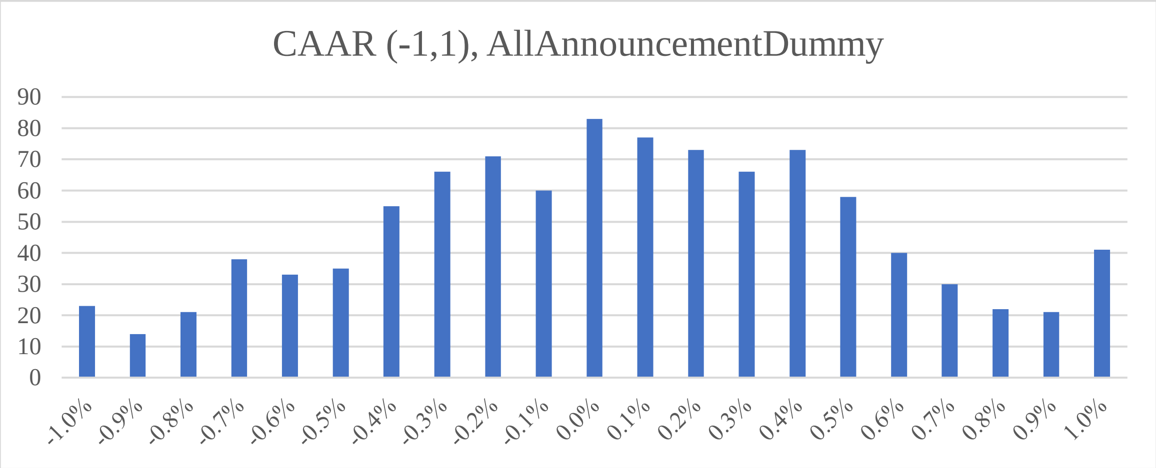

Figure 5: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (any) is regressed on abnormal returns using the CAAR (-1,1) measure.

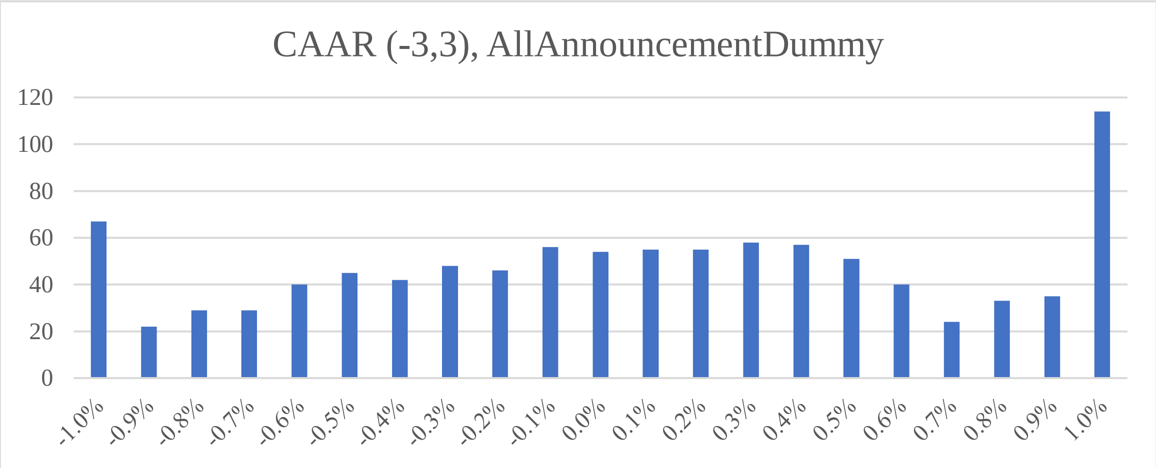

Figure 6: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (any) is regressed on abnormal returns using the CAAR (-3,3) measure.

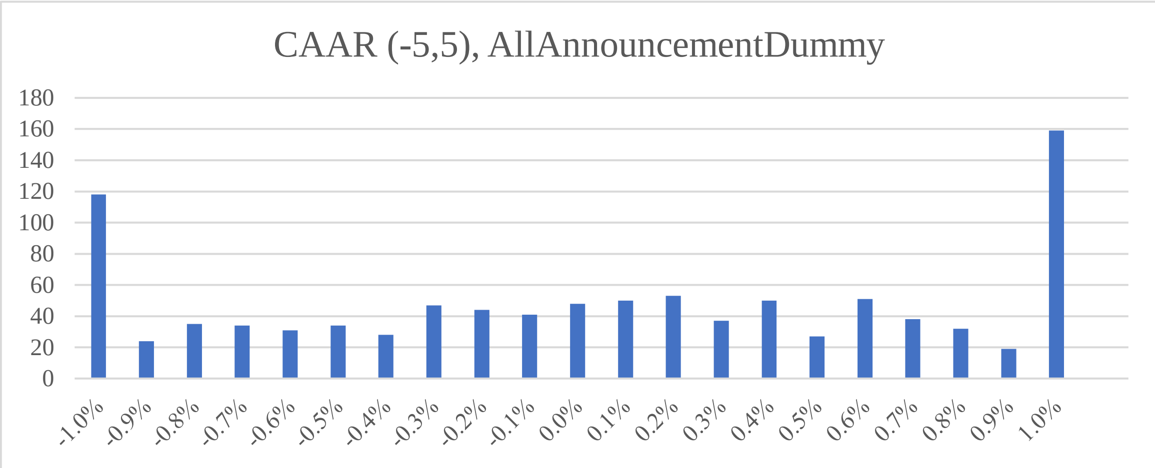

Figure 7: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (any) is regressed on abnormal returns using the CAAR (-5,5) measure.

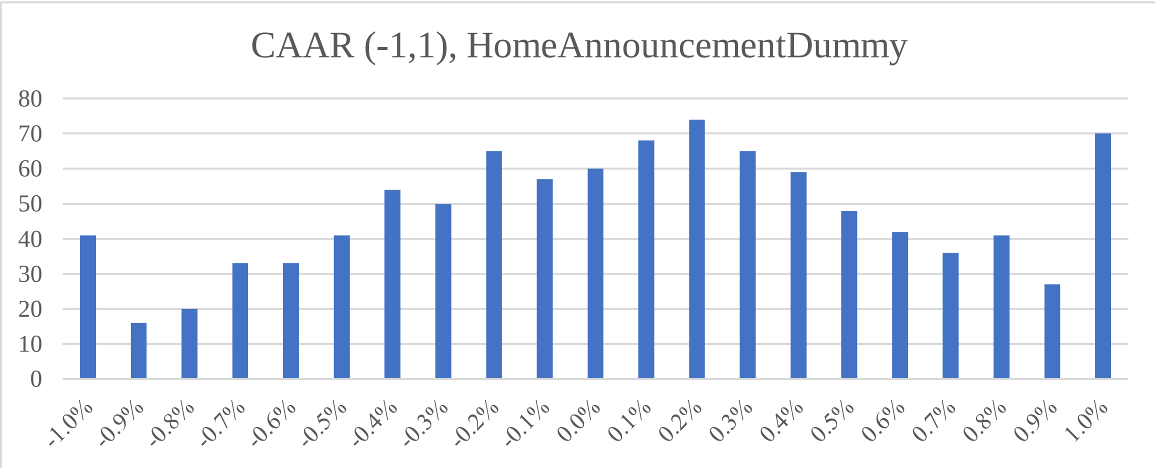

Figure 8: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (home) is regressed on abnormal returns using the CAAR (-1,1) measure.

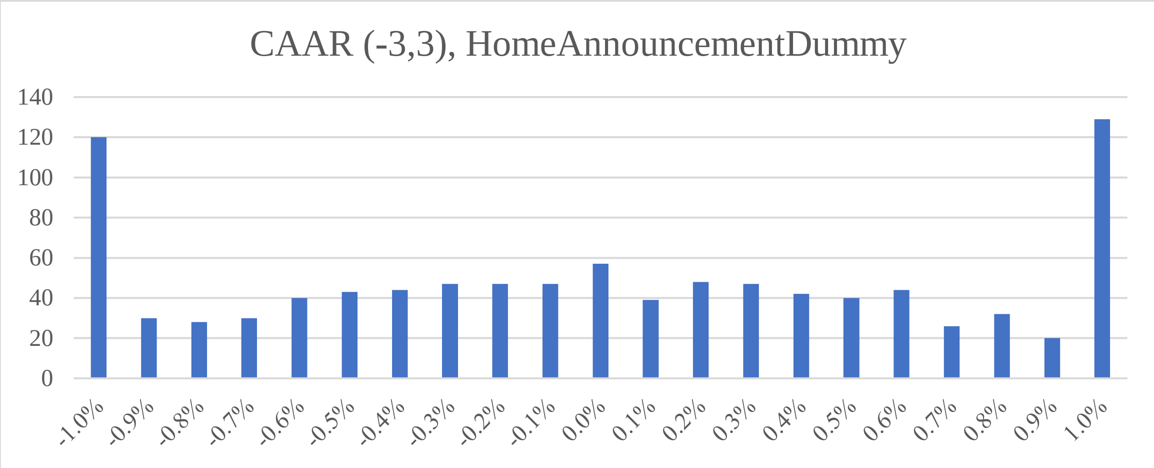

Figure 9: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (home) is regressed on abnormal returns using the CAAR (-3,3) measure.

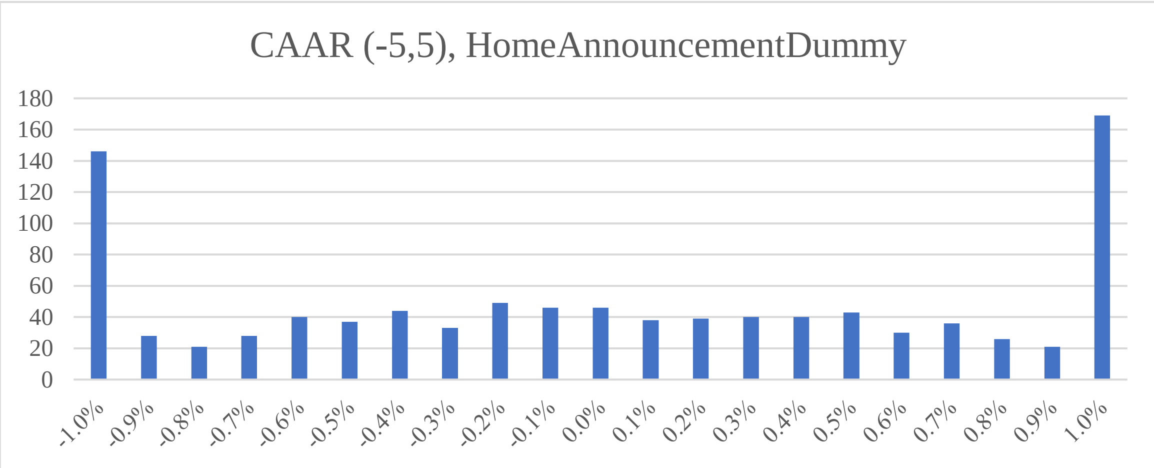

Figure 10: Distribution of coefficients of 1000 iterations of placebo test of linear regression model where a dummy variable for announcements (home) is regressed on abnormal returns using the CAAR (-5,5) measure.