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European Defence Industries' Sales Performance: A Benefit-Of-The-Doubt Based Comparative Analysis

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ABSTRACT
The Russian invasion of Ukraine has generated a new impetus towards an enhanced European defence pillar, while many EU members have announced significant increases in their respective defence budgets over the coming years. Expectedly, a large percentage of the capital and technological inputs required to support the efforts towards a common European defence and the increased defence needs of many EU members will be procured from the European Defence Technological and Industrial Base (EDTIB). The European defence companies are among the major suppliers of conventional arms in the world. Their cumulative share of world arms exports is the second largest globally. This paper uses a Benefit-of-the-Doubt (BoD) model via Data Envelopment Analysis (DEA) to comparatively evaluate the sales performance of major European defence industries vis-à-vis other major international arms producers. The sample used in the analysis contains 72 firms and spans the period 2016–2020. The findings indicate that on the whole US defence manufacturers have a dominant presence among the biggest global producers and outrank many major European companies. These findings offer valuable policy recommendations.

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Introduction

The Russian invasion of Ukraine acted as a stimulus that, apart from significant increases in defence procurement spending, seems to have further spurred efforts towards European defence cooperation. Perhaps, Chancellor Olaf Scholz's *Zeitenwende* speech[1] represents an encapsulation of this renewed impetus towards augmenting and enhancing the common defence and security pillar of the European Union. An objective that can be traced back well before the Maastricht Treaty (Hartley 2023a; Tardy 2018). The various scenarios and paths along which the common European defence project could proceed were examined in detail in the Reflection Paper on this theme by Mogherini and Katainen (2017).[2] Indeed, as noted by Cladi (2022), in recent years there has been a notable increase in initiatives to boost European defence and security cooperation. Such initiatives at the European level include the *Permanent Structured Cooperation* (PESCO), the *Defence and Security Procurement Directive* (DSDP), the *European Defence Fund* (EDF), the *European Defence Industrial Development Programme* (EDIDP) and of course the *European Defence Agency* established back in 2004. Expectedly, the drive towards a common European defence has attracted considerable attention in the extant literature with various aspects of it – strategic, political, economic, industrial – being the thematic focus of a steadily growing body of literature (*inter alia*: Calcara 2018, 2020b; Chappell, Exadaktylos, and And Petrov 2020; George and Sandler 2021; Haroche 2020; Håkansson 2021).

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A robust common European defence pillar requires significant capital equipment inputs to support the implementation of a common security and defence policy or for that matter to pursue a European strategic autonomy whereby EU member-states are able in the medium term to reduce their current military and security dependency on the USA To this effect, the European Defence Technological and Industrial Base (henceforth EDTIB) is expected to play a central role in the development, production and supply of the required technologies, weapons systems and defence equipment (Fiott 2023b; Hartley 2023b; Kollias and Tzeremes 2022; Zhang et al. 2022). This is acknowledged and stressed in Chancellor Scholz's *Zeitenwende* speech: '*. . . This is why it is so important . . . that we build the next generation of combat aircraft and tanks here in Europe together with European partners, and particularly France. . .*'. Clearly, this implies and in practice involves greater defence-industrial cooperation, joint development of defence and security technology and products, common procurement programs, strengthening the resilience of European defence industrial supply chains (Calcara 2020a; Kleczka et al. 2023; Vandercruysse, Du Bois, and Buts 2023). As noted by Kleczka et al. (2023), the actual implementation of the recently adopted EU Strategic Compass[3] that aims to strengthen the EU's security and defence policy by 2030 involves significant reliance on the EDTIB with the concomitant investments to enhance EU defence industrial supply chains and boost their resilience.

To this effect, policy initiatives such as PESCO, EDF, EDIDP aim at promoting networks of technological excellence, supplementing and amplifying national investment expenditures in the defence industrial sector, and support European defence producers engaged in joint development of state of-the-art products enhancing their competitiveness and stimulating innovation that potentially can also benefit the civilian sector through spill-overs (Haroche 2020; Håkansson 2021; Sabatino 2022). Nonetheless, as Hartley (2023a) notes, fundamental problems such as, for example, insufficient industrial collaboration, low levels of resource pooling between the EU members, technological gaps vis-à-vis the USA in key areas, defence market fragmentation continue to be present.

The national defence industries of the EU member-states are among the major suppliers of conventional arms in the world. Their cumulative share of world arms exports is the second largest after to the dominant US-based producers that rank first. Nevertheless, compared to their US counterparts, they lack the size needed to achieve the scale and learning economies required to support with industrial and technological inputs the ambitious drive towards a common EU defence pillar (Hartley 2023a). Using the renewed drive towards greater and deeper European defence industrial cooperation as an impetus, the present paper evaluates the sales performance of major European defence industries vis-à-vis other major international arms producers. To this effect, it applies a Data Envelopment Analysis (henceforth DEA) based model to construct a composite sales performance indicator. Specifically, this article applies a Benefit-of-the-Doubt (henceforth BoD) DEA window-based model. Generally, BoD models are used as optimization tools by the OECD for creating compound indicators. BoD and DEA modes have many common factors, for example, a particular structure of an input-oriented model with a single constant input. Moreover, BoD models are used by many studies in order to construct composite indicators. Examples of such composite indicators include the Human Development Index, the Quality of Life Indicator, the Internal Market Index, the Competitiveness Index, the Digital Access Indicator, the Technology Achievement Index, the Students' Evaluation of Teaching indicator, the Research Productivity Indicator, the Health System Performance Index, and the Environmental Performance Index. Moreover, BoD modeling is employed for decision-making issues, such as supplier selection, inventory classification, quality perception assessment, spatial efficiency or min-max strategy games (Karagiannis and Karagiannis 2018; Ravanos and Karagiannis 2022). Hence, combining both methodological frameworks, the approach adopted herein has several advantages. Firstly, using the DEA BoD model in order to combine sales performance sub-indicators into a single sales performance measure enables us to determine the weighting scheme of the sub-indicators endogenously. Essentially, this methodological approach allows for more flexibility, thus adapting to the units of measurement under evaluation. According to Cherchye, Moesen, and Van Puyenbroeck (2004) such a methodological treatment minimizes the potential weighting bias related to composite indicators. Secondly, the adaption of the DEA window-based setting allows us to evaluate panel data in a dynamic manner having a more robust measurement of the composite sales performance indicator (Asmild et al. 2004). Hence, better insights can be gained, and more robust inferences can be derived. The data used in the empirical estimations are drawn from SIPRI's database of the top 100 arms-producing companies in the world. The next section contains a brief comparative descriptive presentation of the European defence industry's importance in the international arms market. The methodology and the empirical findings are presented in section three, while section four concludes the paper.

The European Defence Industries: A Comparative Snapshot

The EDTIB, i.e. the aggregation of the national defence industries[4] of the EU member-states, is the second largest globally following the US defence industry that is by far the largest producer of weapons systems and military hardware. Of the top 100 arms-producing companies in SIPRI's 2020 ranking, seventeen (17) are EU27-based arms producers.[5] Their arms sales accounted for about 13.1% of the group's total and 15.2% of the total sales i.e. including civilian products. They include industrial giants such as Airbus, Dassault, Leonardo, Saab, ThyssenKrupp and Thales. A number of them are primarily or exclusively defence producers. Arms sales make up a very large share of their total annual turnover, as for instance the case is for MBDA and Naval Group, where arms sales account for 99% of the total sales, and Krauss-Maffei Wegmann, Nexter and Navantia with arms sales amounting to 95% of their turnover. For others, arms production and sales represent a smaller but nonetheless important share in their annual turnover such as for example Airbus (21%), Safran (24%), ThyssenKrupp (4,9%).

SIPRI's 2020 top 100 arms-producing companies list is dominated by US-based defence producers that occupy the first five places. Consequently, the global arms market is dominated by U.S. arms exports. Neuman (2010) points out, the global defence-industrial sector and the concentration that characterizes it very much mirrors the distribution and hierarchy of power in the world. Data drawn from SIPRI's Arms Transfers Database indicate that during 2000-21, US exports accounted for 33% of the total conventional arms market. The aggregate share of the EU27-based defence exporters amounts to 24.1%. If the UK's exports are included the share rises to 28.5% of the global total. Russia's share stands at 23.3% and China's at 4.3% for the same period.

As stressed by Kleczka (2020), the EDTIB faces a number of challenges, the most important one being its fragmentation along national lines. For example, the European armoured vehicle industry is such a case that despite considerable restructuring since the end of the Cold War it still exhibits a national-based fragmentation as observed by Kleczka and Jegers (2021). Weiss and Biermann (2022) argue that this fragmentation is mostly driven by sovereignty concerns and the desire by governments to exercise national control over what is considered to be an industrial sector of national strategic importance. In turn, this acts as a constraint for further integration of the EU-based defence industries, albeit EADS[6] stands out as an important exception to this rule that potentially could serve as a precedent for further integration. As has been stressed in the relevant literature, the current fragmentation along national lines of the EDTIB leads costly duplications that prevent European defence producers from reaping economies of scale and learning benefits, as well as bearing the increasing R&D costs associated with high technology weapon platforms and systems (*inter alia*: Hartley 2023a; Kleczka and Jegers 2020; Mogherini and Katainen 2017).

Neuman's (2010) observation mentioned above also holds true for the intra-EU hierarchy since the defence industries of France and Germany, the two countries considered to be the steam-engines of European integration, are by far the largest among the EU27 members. Their defence manufacturers emerge as the largest exporters of EU27 produced defence equipment and weapons systems. France's and Germany's aggregate share represents 60.7% of the total EU27 arms exports (33.1% and 27.7% respectively). Italy ranks third with a share of 10.4% followed by the Netherlands (8.6%), Spain (8.3%) and Sweden (6.3%). The cumulative share of the six largest arms exporters among the EU27 accounts for 94.3% of the total arms exports of European defence exporters (Table 1). It should be noted, however, that these shares include intra-EU27 exports (Kollias and Tzeremes 2022). On a global level, arms exports from the

Table 1. The major EU27 exporters 2000-21.

	EU27 % share	World % share
France	33.1%	8.0%
Germany	27.7%	6.7%
Italy	10.4%	2.5%
Netherlands	8.6%	2.1%
Spain	8.3%	2.0%
Sweden	6.3%	1.5%

French defence industry account for 8% of the global market and Germany's for 6.7% (Table 1). During 2000-21 they are ranked as the third and fourth largest exporters globally, followed by the UK (4.4%), China (4.3%), and Italy (2.5%).

In the section that follows, we examine the comparative sales performance of the main European defence companies that are included in SIPRI's top 100 arms-producers in the world using a DEA-based model to construct a composite sales performance indicator. Moreover, based on the BoD framework, we produce a DEA BoD model as used in the relative literature (Cherchye et al. 2007, 2007, 2008; Cherchye, Moesen, and Van Puyenbroeck 2004). Domínguez-Sánchez and Fonfría's (2022) note, amidst increasing competition in the international defence markets, the performance of defence companies is a significant issue, particularly in the case of EU27-based producers that are called upon to produce many of the required capital and technological inputs towards a common security and defence policy. It has been stressed in the relevant literature that the EU-based defence manufacturers are, in comparison to their US counterparts, 'too small' (Hartley 2023a). Their size differential disadvantage along with competition from emerging producers is further compounded by the duplication of research, development and production resources that results from the fragmentation along national lines (*inter alia*: Biermann and Weiss 2021; Bunde 2021; Kleczka and Jegers 2020; Mogherini and Katainen 2017; Weiss and Biermann 2022). All are factors that affect their standing in the global arms market and their relative performance. However, as Zhang et al. (2022) observe, given the anticipated significant increases in the European defence budgets and particularly in procurement spending, there are significant benefits that can ensue for the EDTIB. Moreover, such benefits could potentially spill over to the constellation of other enterprises that produce inputs used by the defence industry. Consequently, through spill-overs to the civilian sector, the EDTIB could have the potential to act as a stimulus to economic growth and technological progress.

Methodology and Empirical Findings

As already noted, the data used in the analysis that follows are drawn from SIPRI's top 100 arms-producers in the world database. Our sample contains balanced data of the largest firms operating of the international defense industry. It contains 72 firms and spans the period 2016–2020.[7] Encompassing panel data, the empirical investigation utilizes the DEA window-based model of Asmild et al. (2004) and Chen et al. (2022) and creates a window-based DEA BoD model. For the applied BoD DEA window-based model, we use two sales performance indicators in order to provide a unified dynamic comparative sales performance measure. Specifically, following Cherchye et al. (2007) we create two sub-sales performance indicators from firms' (i), 'arms sales' and the 'rest of sales' volumes based on the per year (t) 'distance to group leader' formula. This can be obtained as:

$$\%\,arm\ sales^{n}_{i,t} = \frac{arm\ sales_{i,t}}{arm\ sales^{max}_{t}} \times 100,\ \ \%\,rest\ of\ sales^{n}_{i,t} = \frac{rest\ of\ sales_{i,t}}{rest\ of\ sales^{max}_{t}} \times 100. \qquad (1)$$

Table 2 presents the descriptive statistics of the variables used. Moreover, 'arm sales' and the 'rest of sales' are displayed in millions of US dollars.[8] As it can be seen from Table 2 the sales volumes on average terms both for the two sub-indicators have increased over the examined period, this is also evident for the '% rest of sales' indicator. However, this is not the case for the '% arm sales' measure. Given that the percentage

Table 2. Descriptive statistics.

Year	statistic	Arm sales	Rest of sales	% arm sales	% rest of sales
2016	*mean*	5124.861	10990.111	12.613	9.144
	stdev	7062.504	20644.206	17.382	17.176
2017	*mean*	5306.944	10426.417	12.094	10.939
	stdev	7264.285	18069.043	16.555	18.958
2018	*mean*	5637.361	10913.667	11.928	11.746
	stdev	7911.798	18691.762	16.741	20.118
2019	*mean*	6102.778	10350.417	11.465	11.398
	stdev	8658.605	17476.911	16.266	19.246
2020	*mean*	6278.056	9014.542	10.785	12.512
	stdev	9142.524	14622.691	15.706	20.295

represents the per-year percentage of distance to group leader arms sales volumes, it is a first indication that the defense industry is dominated by a peer group of defense companies.

Let us consider N companies (DMUs-Decision making units) over T periods having $t = 1, \ldots, T$, having overall $N \times T$observations. A company has a $s-$dimensional composite performance indicator H as $h_t^n = \left(h_{1t}^n, h_{2t}^n, \ldots, h_{st}^n,\right)$. Then, based on Asmild et al. (2004) and Chen et al. (2022), we have a starting window , $1 \leq \varphi \leq$ T, having a window width $\beta, 1 \leq \beta \leq T - \beta$, denoted as φ_β, having $N \times \beta$ observations. Therefore, in its general form, the matrix of composite performance indicators can be represented as:

$$H_{\varphi_\beta} = \left(h_\varphi^1, h_\varphi^2, \ldots, h_\varphi^N, h_{\varphi+1}^1, h_{\varphi+1}^2, \ldots, h_{\varphi+1}^N, \ldots, h_{\varphi+\beta}^1, h_{\varphi+\beta}^2, \ldots, h_{\varphi+\beta}^N\right). \tag{2}$$

As a result, in its general form the DEA-based BoD model under window structure for the *ith* firm can be obtained as:

$$H_{\varphi_\beta t}^k = \frac{min}{\omega} \sum\nolimits_{j=1}^K \omega 1_{\varphi_\beta}^k, s.t. \sum\nolimits_{j=1}^K \omega H_{\varphi_\beta}^j - H_{\varphi_\beta t}^k \geq 0, \omega_n \geq 0 (n = 1, \ldots, N \times \beta). \tag{3}$$

In Equation (3) $H_{\varphi_\beta}^k$ is the composite sales performance indicator of the kth firm and ω represents the firm-specific weights. Equation (3) represents analogously a DEA input oriented widow-based model as described by Asmild et al. (2004). This can be represented as:

$$\%\, arm\ sales_{i,t}^n = \frac{arm\ sales_{i,t}}{arm\ sales_t^{max}} \times 100, \ \%\, rest\ of\ sales_{i,t}^n = \frac{rest\ of\ sales_{i,t}}{rest\ of\ sales_t^{max}} \times 100. \tag{4}$$

Therefore, Equation (4) is a CCR (Charnes, Cooper, and Rhodes 1978) input oriented DEA model having as inputs the value of one for all firms (i.e. $X = 1$) and as outputs the two sales percentages. In Equation (4) X represents the inputs and H the two sales percentages deemed as outputs. According to Lovell, Pastor, and Turner (1995) the inclusion of one as an input (equation 3) acts as a dummy input for all firms. Such an approach according to Lovell, Pastor, and Turner (1995) represents firms' pursue of several sales performance policy objectives, corresponding to two specific sales sub-indicators. However, as explicitly stated by Cherchye et al. (2007, 121) the model presented in (3) must be regarded only as a tool for aggregating the two sub-indicators of sales performance measures, without explicit reference to the actual inputs used by firms in order to achieve those sales performance measures. Cook and Kress (1994) assert that the constraint in (equation 3) acts as a scaling or bounding condition, whereas Cherchye et al (2007, 2007) highlight that the advantage of the DEA-based BoD measure against the traditional composite indicators is that it accounts also for the input-side with the inclusion of the dummy inputs.

Table 3 presents as an illustrative example of the sales performance indicator of five well-known companies operating in the defense industry. The choice of window can be varied based on the years under evaluation. To increase the robustness of our findings, based on Chen et al. (2022) we have chosen a 3-year window since we only have data for 5 years. The first window provides the sales performance

Table 3. Sales performance indicator.

Company	2016	2017	2018	2019	2020	
Lockheed Martin Corp.	1	1	1			First window
		1	1	1		Second window
			1	1	1	Third window
	1	**1**	**1**	**1**	**1**	**Mean**
General Electric	1	1	1			First window
		1	1	1		Second window
			1	1	1	Third window
	1	**1**	**1**	**1**	**1**	**Mean**
Boeing	0.952349	0.958676	1			First window
		0.958606	1	0.828368		Second window
			1	0.825625	0.697303	Third window
	0.952349	**0.958641**	**1**	**0.826997**	**0.697303**	**Mean**
Airbus Group	0.618711	0.666057	0.761401			First window
		0.666057	0.761401	0.805269		Second window
			0.762205	0.806264	0.686759	Third window
	0.618711	**0.666057**	**0.761669**	**0.805767**	**0.686759**	**Mean**
BAE Systems	0.560916	0.47835	0.448794			First window
		0.47835	0.448794	0.41781		Second window
			0.448794	0.41781	0.412644	Third window
	0.560916	**0.47835**	**0.448794**	**0.41781**	**0.412644**	**Mean**

indicator of the companies for 2016, 2017, and 2018. Similarly, the second window presents the indicator for the years 2017, 2018, and 2019 and the last (third) window for the years 2018, 2019, and 2020. Finally, the column-wise mean values of every year are presented having a dynamic evaluation of the companies' sales performance profile over the examined period. Moreover, in Table 3, values equal to one suggest top sales performance, whereas, values less than unit indicate lower sales performance levels. The best performance is exhibited by Lockheed Martin Corp. and General Electric (both values are equal to one) followed by Boeing, Airbus Group, and BAE Systems.

Table 4 presents on average terms overall the industry's mean sales performance levels over the examined period Our findings suggest that over the years industry's mean sales performance levels have been slightly increased from 0.18479 to 0.196832. Interestingly enough, the standard deviation values are very high, suggesting that we have high fluctuations among the companies, with a possible domination of few of them dominated the industry market.

Table 5 presents the mean grand mean of companies' windows mean sales performance levels, providing an overall ranking over the examined period. Our findings suggest that the industry is dominated by U.S.A.-based companies and especially by General Electric, Lockheed Martin Corp. and Boeing. It can be observed that the highest performance of the European companies is obtained by Airbus Group followed by ThyssenKrupp, BAE Systems, Thales, Safran, and Leonardo, the highest performance from the Asian companies is detected by NORINCO, AVIC, CSGC, Fujitsu, Mitsubishi Heavy Industries, CASIC, and CETC. As can be seen the lowest performance from European companies is depicted by Nexter, UkrOboronProm, Meggitt, PGZ, Babcock International Group, and Rheinmetall, the lowest performance from the United States companies is exhibited by Vectrus, Aerojet Rocketdyne, BWX Technologies, and Pacific Architects and Engineers, while the lowest performance from the Asian companies is exhibited by Bharat Electronics, LIG Nex1, IHI Corp., Indian Ordnance Factories, and ST Engineering. Overall, the detailed rankings of all the defence companies included in the sample of the preceding empirical analysis clearly suggest that the US defence producers have a dominant presence among the biggest global producers (Table 5).

Table 4. Industry's average sales performance levels.

	2016	2017	2018	2019	2020
Mean	0.18479	0.19367	0.199193	0.193991	0.196832
Std	0.230756	0.234206	0.244088	0.236551	0.242357

Table 5. Sales performance rankings.

Company	Country	Performance	Rank	Company	Country	Performance	Rank
General Electric	United States	1.000	1	MBDA	Trans-European	.077	36
Lockheed Martin Corp.	United States	1.000	1	Dassault Aviation Group	France	.075	37
Boeing	United States	.887	2	Elbit Systems	Israel	.072	38
Airbus Group	Trans-European	.708	3	Science Applications International Corp.	United States	.072	39
NORINCO	China	.688	4	Oshkosh Corp.	United States	.072	40
AVIC	China	.645	5	Tactical Missiles Corp.	Russia	.068	41
Northrop Grumman Corp.	United States	.537	6	Saab	Sweden	.065	42
General Dynamics Corp.	United States	.510	7	Sandia Corp. (Lockheed Martin U.S.A)	United States	.063	43
ThyssenKrupp	Germany	.475	8	CEA	France	.062	44
BAE Systems	United Kingdom	.464	9	Fincantieri	Italy	.062	45
CSGC	China	.418	10	Israel Aerospace Industries	Israel	.061	46
Honeywell International	United States	.386	11	United Engine Corp.	Russia	.061	47
Fujitsu	Japan	.381	12	Hindustan Aeronautics	India	.060	48
Mitsubishi Heavy Industries	Japan	.372	13	KBR	United States	.057	49
CASIC	China	.364	14	ST Engineering	Singapore	.054	50
CETC	China	.358	15	Rafael	Israel	.050	51
Bechtel Corp.	United States	.247	16	Serco Group	United Kingdom	.048	52
Thales	France	.230	17	Bell Helicopter Textron (Textron U.S.A)	United States	.048	53
Safran	France	.220	18	Russian Helicopters	Russia	.047	54
Leonardo	Italy	.218	19	TransDigm Group	United States	.043	55
L3 Technologies	United States	.215	20	Indian Ordnance Factories	India	.042	56
Rolls-Royce	United Kingdom	.185	21	KRET	Russia	.039	57
Fluor Corp.	United States	.184	22	ASELSAN	Turkey	.036	58
Almaz-Antey	Russia	.166	23	ManTech International Corp.	United States	.034	59
Huntington Ingalls Industries	United States	.151	24	Krauss-Maffei Wegmann	Germany	.032	60
Kawasaki Heavy Industries	Japan	.146	25	UralVagonZavod	Russia	.031	61
Textron	United States	.140	26	LIG Nex1	South Korea	.030	62
Leidos	United States	.131	27	Bharat Electronics	India	.030	63
IHI Corp.	Japan	.129	28	Pacific Architects and Engineers	United States	.030	64
Jacobs Engineering Group	United States	.129	29	BWX Technologies	United States	.029	65
United Aircraft Corp.	Russia	.113	30	Aerojet Rocketdyne	United States	.028	66
Booz Allen Hamilton	United States	.104	31	PGZ	Poland	.028	67
United Shipbuilding Corp.	Russia	.093	32	Meggitt	United Kingdom	.028	68
Rheinmetall	Germany	.089	33	Vectrus	United States	.026	69
Babcock International Group	United Kingdom	.082	34	UkrOboronProm	Ukraine	.025	70
CACI International	United States	.077	35	Nexter	France	.022	71

Concluding Remarks

In many respects, the Russian invasion of Ukraine in February 2022 represents a major historical turning point. As pointed out by Fiott (2023a) the invasion has upended the European security order. It has resulted in the biggest geopolitical crisis in Europe since the end of the Second World War and possibly has violently ended the post-bipolar era (*inter alia*: Biscop 2023; Bunde 2022; Farzanegan and Fischer 2022; George and Sandler 2022). As a result, many European states have announced significant increases in their defence budgets and are already implementing major weapons procurement programs. Furthermore, the invasion seems to have acted as a stimulus that further spurred efforts towards European defence cooperation. A quest dating back to the Maastricht Treaty and beyond (*inter alia*: Galbreath, Mawdsley, and Chappell 2019; Larivé 2014; Mogherini and Katainen 2017; Tardy 2018). Among other requisites, the pursuit of a common European defence pillar that will eventually lead to a reduction of European defence dependence on the U.S.A. and perhaps to greater European strategic autonomy requires significant capital inputs into the production of common European military capabilities (*inter alia*: Blauberger and Weiss 2013; Béraud-Sudreau and Pannier 2021; Kollias and Tzeremes 2022). The EDTIB will be called upon to develop, produce, and supply the required technologies, weapons systems, and defence equipment (*inter alia*: Bellais 2023; Fiott 2023b; Hartley 2023b; Vandercruysse, Du Bois, and Buts 2023). This was explicitly signaled in Chancellor Scholz's *Zeitenwende* speech. EU27 defence producers are among the major suppliers of conventional arms in the world ranking, second in total arms exports to the dominant US-based producers. During 2000-21 their total exports accounted for 24.1% of global arms exports. If the UK is included, this share rises to 28.5%.

Using a Benefit-of-the-Doubt (BoD) model via Data Envelopment Analysis (DEA), the preceding empirical analysis investigated the sales performance of major European defence industries vis-à-vis other major international arms producers. To the best of our knowledge, this theme has not been hitherto examined by the relevant literature. The data for the estimations were drawn from SIPRI's top 100 arms-producers in the world database. The findings reported above clearly indicate that on the whole US defence manufacturers have a dominant presence among the biggest global producers, outranking many major European companies. The significant and to a large extent unprecedented increase in the European defence budgets and particularly procurement spending will generate increases in the demand for EDTIB's products, leading to rises in their turnover and sales performance. This has the potential to serve as a stimulus for economic growth and technological progress, particularly considering the significance of EDTIB companies as a key component of the European industrial landscape. Recent initiatives such as EDF, EDIDP, and PESCO aim to bolster European companies involved in the production of defence and security-related products and technologies, thereby enhancing their competitiveness and fostering innovation that can also have positive effects on the civilian sector through spill-over. Existing literature has repeatedly highlighted the considerable economic benefits that can arise from a coordinated defence industrial policy, including the pooling of industrial and technological resources for joint development, production, and acquisition of weapons systems (*inter alia*: Biscop 2018; Calcara 2018, 2020b; Hartley 2003, 2008; Lambertini 2023; Sabatino 2022). Moreover, by promoting collaboration among European countries, it is possible to address competitiveness and capability gaps through joint ventures and technology sharing agreements. Strengthening partnerships with non-European countries can also enhance market research and facilitate the adoption of best practices. By fostering public and private investment in defence research and development, it becomes possible to drive innovation and technological advancements within European defence industries. Additionally, European countries require substantial capital equipment inputs to support the implementation of a common security and defence policy. This could involve establishing financial instruments to support defence industry innovation, as well as pursuing European strategic autonomy by creating collaborative research and development programs and initiatives that involve industry, academia, and research institutions, pooling resources and expertise for mutual benefit. These measures aim to gradually reduce the current military and security dependency of EU member states on the United States in the medium term. Through the implementation of these initiatives, active collaboration, and increased research and development investments, Europe can effectively stimulate economic growth, propel technological progress, and significantly enhance the competitiveness of its defence industries.

Notes

1. 'Zeitenwende/End of an era' speech at the Bundestag, 27 February 2022. Available here: https://www.bundesregierung.de/breg-en/news/policy-statement-by-olaf-scholz-chancellor-of-the-federal-republic-of-germany-and-member-of-the-german-bundestag–27-february–2022-in-berlin–2008378
2. Vice-President & High Representative of the Union for Foreign Affairs and Security Policy & Vice-President Jobs, Growth, Investment and Competitiveness, respectively when the reflection paper was published.
3. https://www.eeas.europa.eu/eeas/strategic-compass-security-and-defence–1_en
4. A recent and comprehensive survey of the domestic defence industries of many EU countries can be found in Hartley et al. (2020).
5. Including MBDA and Airbus listed as trans-European.
6. Airbus Group today.
7. Aerojet Rocketdyne, Airbus Group, Almaz-Antey, ASELSAN, AVIC, Babcock International Group, BAE Systems, Bechtel Corp., Bell Helicopter Textron (Textron U.S.A), Bharat Electronics, Boeing, Booz Allen Hamilton, BWX Technologies, CACI International, CASIC, CEA, CETC, CSGC, Dassault Aviation Group, Elbit Systems, Fincantieri, Fluor Corp., Fujitsu, General Dynamics Corp., General Electric, Hindustan Aeronautics, Honeywell International, Huntington Ingalls Industries, IHI Corp., Indian Ordnance Factories, Israel Aerospace Industries, Jacobs Engineering Group, Kawasaki Heavy Industries, KBR, Krauss-Maffei Wegmann, KRET, L3 Technologies, Leidos, Leonardo, LIG Nex1, Lockheed Martin Corp., ManTech International Corp., MBDA, Meggitt, Mitsubishi Heavy Industries, Nexter, NORINCO, Northrop Grumman Corp., Oshkosh Corp., Pacific Architects and Engineers, PGZ, Rafael, Rheinmetall, Rolls-Royce, Russian Helicopters, Saab, Safran, Sandia Corp. (Lockheed Martin U.S.A), Science Applications International Corp., Serco Group, ST Engineering, Tactical Missiles Corp., Textron, Thales, ThyssenKrupp, TransDigm Group, UkrOboronProm, United Aircraft Corp., United Engine Corp., United Shipbuilding Corp., UralVagonZavod, and Vectrus.
8. SIPRI provides only information of 'arms sales as a % of total sales'. The label 'rest of sales' is authors' label of firms' sales performance measure presenting the remaining percentage of firms total sales (i.e. the percentage other than firms' arms sales).

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