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Abstract

In the last ten years, military expenditures of NATO EU countries (according to NATO definitions and data) have increased by almost 50%, from €145 billion in 2014 to a budget forecast of €215 billion in 2023 (measured in constant 2015 prices). In this context, it is important to assess the economic consequences that the current increase in military spending is likely to have on Europe's economies. We focus on Germany, Italy and Spain, and we concentrate on arms acquisitions. The article investigates the economic effect of military expenditure on growth and employment and compares it to the impact that could emerge from a similar expenditure for education, health and the environment. We use an input-output methodology – already adopted by several studies - to assess the relevance of imports and of demand towards different sectors providing intermediate inputs. We assess the likely impact on output and jobs of one billion euros of extra spending in arms, and compare it to the outcomes of the same amount spent in education, health and the environment. Our findings show that for all countries non-military public expenditures have a greater impact on the economy and employment than spending for arms acquisition.

Keywords

Military expenditure, arms acquisition, input-output, economic impact, military jobs

JEL codes

C67, D57, H50, H56, Q50

1. Introduction

European countries are on a road to militarisation. In the last ten years, military expenditures of NATO EU countries (according to NATO definitions and data) have increased by almost 50%, from €145 billion in 2014 to a budget forecast of €215 billion in 2023 (measured in constant 2015 prices). This total is greater than the annual GDP of a country such as Portugal. With the war in Ukraine, 2023 outlays are expected to increase by almost 10% in real terms over the previous year. NATO EU countries as a whole now spend 1.8% of GDP on their militaries, close to the 2% target set by the US and NATO. [1]

In this context, it is important to assess the economic consequences that the current increase in military spending is likely to have on Europe's economies. In this article we focus on Germany, Italy and Spain, the three largest EU countries – excluding the nuclear power status of France – and we concentrate on arms acquisitions. Over a decade, Germany has increased its real military spending by 42%, Italy by 30%, Spain by 50%. In all countries, this expansion has been entirely due to higher acquisitions of arms and equipment. In 2023, arms expenditure in NATO EU countries reached €64.6 billion (+270% over a decade); Germany tripled its spending to €13 billion; Italy reached €5.9 billion; Spain €4.3 billion. EU imports of arms (based on data from SIPRI, the Stockholm International Peace Research Institute) have jumped, increasing by three times between 2018 and 2022. Half of all imports come from the US.

Such a rise in military expenditure and arms procurement contrasts starkly with the stagnation of EU economies. In the aggregate of NATO EU countries, between 2013 and 2023, real GDP has increased by 12% (just over 1% per year on average), total employment by 9%, and military expenditures by 46%, four times faster than national income. The picture in the area of new investment is even more dramatic: while capital formation has risen by 21%, arms acquisitions have increased by 168% – eight times as fast – in NATO EU countries. In Germany, Italy and Spain, the disparities in growth rates are broadly similar. Arms are absorbing a rapidly increasing proportion of the resources that countries devote to new production capabilities, new technologies, and new infrastructures.

At a time of concerns about public finances, such a rise in military spending comes at the expense of other types of public expenditures. In the aggregate of NATO EU countries, total government expenditures increased over a decade by 20% in real terms (about 2% per year on average). However, military expenditure expanded twice as fast, by 46%, as opposed to lower increases in education (+12%), environmental protection (+10%), health (+34%).

Arms procurement can be compared to the capital investment outlays of public expenditures. In NATO EU countries, the latter increased by 35% over a decade, but arms acquisition increased by 168%, almost five times as fast. Germany and Spain are broadly in line with EU patterns, while Italy shows a less dynamic growth in its expenditure, due to its public finance constraints.

In this article we investigate the economic effect of military expenditure on growth and employment and we compare it to the impact of public expenditures for education, health and the environment. We use an input-output methodology – already adopted by several studies - to assess the relevance of imports and of demand towards different sectors providing intermediate inputs. We can therefore assess the likely impact on output and jobs of one billion euros of extra spending in arms, and compare it to the outcomes of the same amount spent in education, health and the environment. Our findings show that for all countries non-military public expenditures have a greater impact on the economy and employment than spending for arms acquisition.

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The article is structured as follows. Section 2 assesses the state of the art on the economic impact of arms spending; section 3 presents data, patterns and the methodology used; section 4 shows the results and concludes.

2. The state of the art on the economic impact of military expenditure

Military expenditures are the outcome of the military system, national politics, and economic processes. They represent the quantity of economic resources that a country's government allocates to the national military system: the armed forces, the acquisition of armaments, military infrastructures, and the implementation of military operations.
Military expenditures are influenced by four main drivers (Nascia and Pianta 2009; Caruso 2017):

a. The military system plans spending programmes based on strategic priorities, taking security objectives, military alliances and external threats into account. An emphasis on military power can lead to arms races with other countries or alliances, resulting in growing military spending. Military bureaucracies may also demand greater resources for expanding their power.
b. In the political system, governments use the military as a foreign and security policy instrument. Other means for achieving security include regional political integration, international economic cooperation, diplomacy and trust-building, disarmament treaties, human rights protection, and development aid. By reducing the risk of international tensions and conflicts, such policies may reduce the prominence of the military system.
c. In the economic system, military expenditures are funded by tax revenue or government debt and compete with other public expenditures – for education, health, welfare, research, the environment, etc. Government policies define the relative importance of the military as opposed to other economic, social or environmental priorities. Different types of public expenditures support economic growth to varying degrees, and shape the trajectory and quality of a country's development.
d. Military expenditures create demand for products sold by companies – either private or public – and support research, development, production and exports of armaments. Profits in arms production are usually higher than average and a country's 'military industrial complex' – a definition coined by General Dwight Eisenhower in his farewell speech at the end of his US presidency – is a major force driving the growth of military expenditures.

The debate regarding the impact of military expenditures on growth and employment reflects their contradictory nature. On the one hand, military expenditure, like other public expenditures, may act as a stimulus to the economy by increasing public sector demand, in accordance with Keynesian principles. This may compensate for problems of underconsumption and stabilise business cycles. In the US, since the Second World War, military spending has included considerable resources for research and investment in new technologies that have contributed to the expansion of new economic activities (Baran and Sweezy 1968; Krell 1981; Dunne and Tian 2013).[2]
On the other hand, military spending reduces the resources available for consumption and productive investment. It absorbs a significant part of a country's limited capabilities in research, technology, human skills, capital accumulation and finance. In the case of the US, this has led to business practices that have inflated costs, prices and profits, and reduced efficiency (Melman, 1988). It has been argued that "in the United States military spending acts as a de facto industrial policy, and (...) the poor performance of the economy results from the distortions brought about by this reliance on military-led investment and innovation" (Markusen 1986: 496). Some scholars concluded that military

[2] Other studies suggesting a positive effect of military expenditure on growth include Benoit 1973; Zhang et al 2017; Hatemi-J et al 2018; Alptekin and Levine 2012. Dunne and Tian (2013, 2016) surveyed 168 studies analyising the effect on growth of military expenditures during and after the Cold War, finding a prevalence of negative effects.

expenditure has no impact or insignificant impact on economic growth (Maher and Zhao 2022). Several studies have shown that military expenditure has a negative impact on GDP growth (Dunne and Tian 2013, D'Agostino et al 2017, Ahad and Dar 2017), that it does not decrease unemployment (Smith and Dunne 1994), that diverts funds away from social expenditure (Lim 1983), that it is positively associated with inequality (Biscione and Caruso 2019) and that is harmful for economic growth (Phiri 2019). Another group of studies focused on the effect of military spending on health care. Ikegami & Wang (2023) carried out a study on 116 countries and concluded that military expenditure crowd out health care spending. Moreover they discovered that the crowding-out effect is higher in poor countries. Similarly Coutts et al. (2019) discovered a crowd-out effect of military expenditure on public goods, including health care.

Considering such differentiated findings, empirical studies on the economic effects of military spending have to be carried out in the specific context of countries and periods (Dunne and Smith 2020; Yesilyurt and Yesilyurt 2019). Dunne and Smith (2020) identified four possible combinations of growth and military expenditures according to geography and historical period, with an explicit consideration of the nature of external threats. The first case is characterised by low military expenditure and high growth (as in Germany and Japan after World War II, which faced a relatively low threat and benefited from technology transfer). The second case is that of high military expenditure and high growth (as observed in Taiwan and South Korea). The third type is characterised by low military expenditure and low growth (typified by Sub-Saharan Africa, characterized by several internal threats). The final case is the presence of high military expenditure and low growth (exemplified by the Soviet Union) in countries devoting a high share of output to the military at the detriment of other expenditures.

The strategic role that a country plays within a military alliance has a relevance, as it affects the composition of military expenditure (research and development, infrastructure, operation, equipment, and arms acquisition) and their specific effects on economic activities and jobs (Bove and Cavatorta 2012; Droff and Malizard 2019; Becker and Dunne 2023; Emmanouilidis 2024). Caruso and Di Domizio (2016) investigated the interdependence between US and European military spending and found that the expenditure of a panel of European countries was positively associated with US military spending.

Turning now to the analysis of emerging countries, the case of China has been studied by Ali and Dimitraki (2014) who showed that military expenditure varies with growth, decreasing when growth slows down, and resuming when growth is rapid. Similarly, Su et al. (2018) found a positive correlation between military expenditures and growth, indicating a bidirectional causal relationship. Studies conducted on South Africa and African states (Phiri 2019; Saba and Ngepha 2019) found instead that military expenditures have a negative impact on the growth of 35 African nations with high levels of inequality and fragility; they suggested that the outcome is associated with the presence of dysfunctional institutions, corruption, and lack of democracy, as well as with recurrent conflicts and famine crises.[3]

An additional perspective has pointed out that emphasising the military reduces the possibilities for alternative development trajectories. It may also have authoritarian effects on the nature of a country's institutions, political cultures, and society, with a possible erosion of democracy (Galtung 1985; Thorpe 2014).

Beyond exploring the general association between military expenditure and growth, economic analysis can offer tools that investigate more carefully the impact of arms spending. One methodology

[3] Moreover, results may depend on the econometric methodology used. Dunne and Smith (2020) tested different methods to analyze the same data for OECD countries, comparing a Solow-Swan neoclassical growth model with an exogenous saving rate, with a VAR approach (Vector Autoregressive Model), Granger causality tests, and a number of other methods. They concluded that results also depend on "various sample sizes, specifications, and estimation techniques" and the handling of heterogeneity that are used (Dunne and Smith 2020:612). In addition, unobserved common variables could affect both military expenditure and growth dynamics (Saeed, 2023:3) and problems of endogenity non linearity, lack of falsification measures could be relevant (D'Agostino, Dunne and Pieroni 2019).

is that of calculating fiscal multipliers, that is the macroeconomic expansionary effect of different types of public expenditure. Considering the US economy, Auerbach and Gorodnichenko (2012) found a positive multiplier effect of defense spending, that is generally higher than the one for consumption spending, but lower than the one for non-defense and investment expenditures. A similar result was found by Deleidi and Mazzucato (2021) who investigated US defense R&D spending as a proxy for "mission oriented" programmes. These approaches also find – consistently with Keynesian insights - that the multiplier is higher during periods of low growth or recessions than in periods of expansion (see also Auerbach at al. 2018; Arin et al., 2015; Fazzari et al. 2015; Deleidi et al. 2023).

In the case of Europe, Saccone et al. (2022), investigated the impact of public investment in 31 countries over the 1995–2019 period using the local projection method, finding a generally strong multiplier effect of aggregate spending on output. In the breakdown by type of public activities, they found that investment in education, public order and general public services have the highest multipliers, while defence investment turns out with a negative sign. This can be related to the specificity of military investment in recent years, and on the reliance on arms imports of Europe – differently from the US.

A specific method to assess the impact of military expenditure on output and growth is offered by the the input-output (I-O) approach. The analysis of structural interdependencies considers the economy as an interconnected system where we can calculate the requirements that the production of one good in a given industry has in terms of the inputs needed from all other industries. Such fixed relationships can be reported in a input-output matrix, allowing us to estimate the impact that an increase of production in one industry has on all other sectors; such effects can be calculated in terms of both output and employment. According to Pollin and Garriet-Peltier (2009:443) "The input-output model can accurately capture broad parameters of economic reality, including those relating to the question on which we are focusing, the relative employment effects of military versus non-military spending initiatives."

Wassily Leontief, the inventor of the input-output approach, carried out the first study of the economic impact of demilitarizing the US economy, showing that a shift of resources from the defense to non-defense sectors would have doubled the number of jobs (Leontief, 1961). Medoff (1993) used the input-output model of the U.S. economy to estimate the employment impact of different variables – consumption, private investment, state expenditure, military spending – finding that personal consumption and defense expenditures had the lowest effects on an indicator combining the number of jobs created and the level of wages and benefits.

Anderson et al. (1991) relied on a model – developed by the Employment Research Associates and Regional Economic Models Incorporated (REMI) - that integrates an input-output approach with other statistical techniques to estimate the relative employment effects of military versus alternative domestic spending. In a scenario of gradual reduction in military spending, starting with a cut of $35 billion in 1990 up to a $105 billion cut in 1994, they found that the U.S. economy would gain 477,000 additional jobs. In another study, Pollin and Garriet-Peltier (2007: 4) showed that "spending on personal consumption, health care, education, mass transit, and construction for home weatherization and infrastructure repair all create more jobs per $1 billion in expenditures relative to military spending." Similar conclusions were obtained by Peltier in additional studies (Peltier 2023).

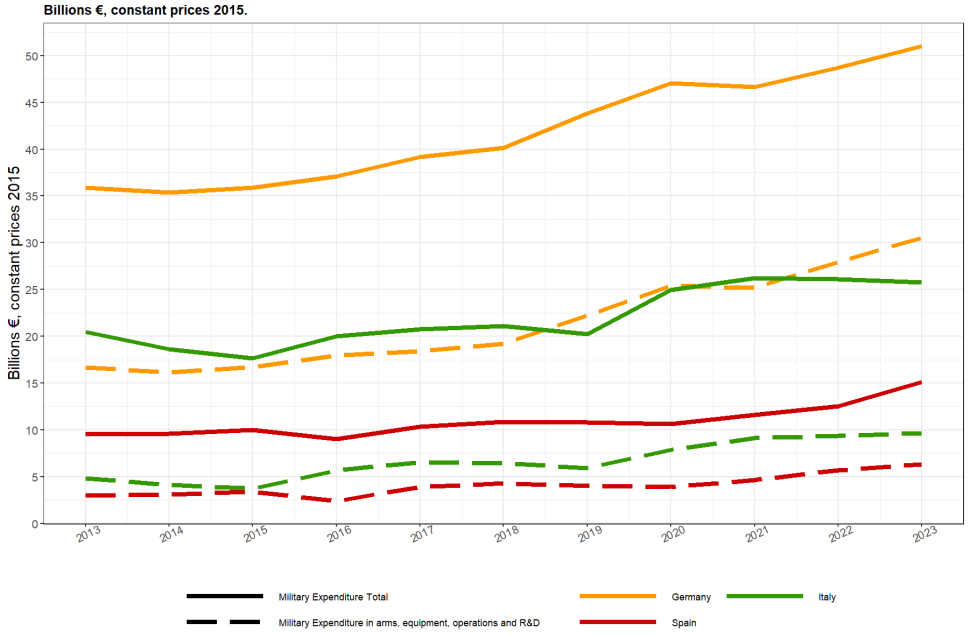
Input-output analysis refers to real quantities in the economy and is highly appropriate to assess the economic impact of military spending. At the same time, the I-O model is static, assumes the stability of technical coefficients, does not account for the presence of scale economies, nor for the effects of inflation and changes in relative prices. Most I-O studies have focused on the US – where the Bureau of Economic Analysis produces I-O matrixes including data for the defense sector – and less attention has been devoted to European countries (Scandizzo et al. 2015:40; Gentilucci 2010: 160-161). In order to contribute to fill this gap, in this article we will adopt the I-O approach to explore the economic and employment impact of arms spending in three major EU countries – Germany, Italy and Spain.

3. Military spending in Europe: data, patterns and methodology

Data

In this article we use NATO's definition of military expenditure and the available database. Data refer to budget allocations, and use NATO budgetary forecasts for 2022 and 2023. Details on definitions, sources, and data are provided in the Appendix.
Fig. 1 shows the evolution of total military expenditures and outlays for arms, equipment, operations and research for Germany, Italy and Spain. From 2013 to 2023, Germany increased military spending from €36 billion to €51 billion (+42%), Italy from €20 billion to €26 billion (+30%), Spain from €10 billion to €15 billion (+50%).[4] In all countries, the increase has been entirely accounted for by higher expenditures on arms and equipment. It should be pointed out that over this decade, Italy and Spain were experiencing difficult situations in their public finances with strict European constraints on government deficits and debt. In spite of this, military budgets and arms procurement were able to increase at an unprecedented pace, further reducing the space for social and environmental public expenditures.

Fig. 1. Total military expenditure and Military expenditure on arms, equipment, operations and R&D



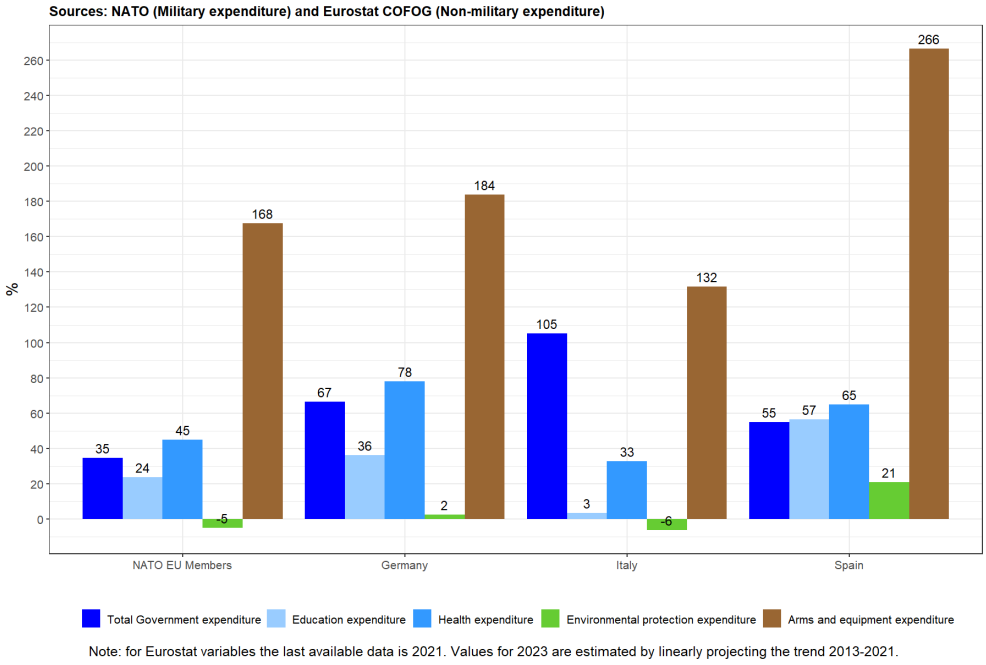
The growth in arms expenditures – whose share has doubled in all countries over a decade – is the most relevant common feature of European countries. Germany tripled its spending on arms and equipment from €4.5 billion in 2013 to €13 billion in 2023; Italy went from €2.5 billion to €5.9 billion; Spain raised its outlays from €1.2 billion to €4.3 billion. NATO EU countries as a whole increased their expenditures for arms and equipment from €24.1 billion in 2013 to €64.6 billion in 2023, with an increase of 267%.
An additional investigation can compare the investment dynamics of public expenditures. Arms procurement has the nature of capital investment as it is part of a country's gross fixed capital

[4] These NATO data differ from official government data, due to the inclusion of expenditures of a military nature that are present in other Ministries' budgets. For instance, German government data for military spending in 2013 is €32.8 billion, as opposed to €36 billion in the NATO data. See the Appendix for details.

formation. Eurostat COFOG data include information on capital expenditure in different functions of government, including the investment resources spent on building schools, hospitals, or water treatment facilities. This effectively indicates what type of future European governments envision: one where education, health or environmental protection are expanding, or a society with larger arms arsenals. Figure 2 provides the evidence on the percentage changes in real terms for the 2013-2023 period of such variables; 2023 arms expenditure data are NATO budgetary forecasts data; 2023 COFOG data are estimated with a linear projection of the 2013-2021 trend. A description of available data from Eurostat and COFOG is provided in the Appendix.

Fig. 2. Arms expenditures vs investment in the environment, education and health

Percentage change in real terms, 2013-2023



Note: for Eurostat variables the last available data is 2021. Values for 2023 are estimated by linearly projecting the trend 2013-2021.

In NATO EU countries, total government capital investment increased by 35% over the period, with education showing moderately lower (+24%) and health showing moderately higher (+45%) patterns; remarkably, investment in environmental protection fell in real terms by 5% during the decade. At the same time, arms procurement increased by 168%, around 4.8 times faster than total public investment.

Germany shows a comparable pattern here, with a 67% increase in public investment, similar to the expansion of health capital expenditures (+78%), while environmental investment is basically unchanged. In contrast, arms procurement has increased by 184%, almost three times the rate of government capital expenditure as a whole.

Italy's government finance crisis is clearly visible in public investment data; the 105% increase in total public capital outlays is entirely accounted for by increases in the most recent years, when EU funds for the Recovery Programme have become available. Investment in health has grown by 33%, investment in education is unchanged, there is a fall in environmental spending, while arms procurement increases by 132%.

In terms of total public expenditure, Spain presents a more balanced distribution of government investment across the different areas, with an overall increase of 55%, equally distributed to education and health; Spain is the only country with some growth in environmental investment (+21% over the decade). The exceptional growth of 266% in expenditures for arms and equipment is the result of the projected rapid increase in arms procurement in 2023.

Methodology

We assess the output and employment effects of increasing expenditure in arms production and compare them with the effects of increasing public capital expenditure in environmental protection, education, and health activities. Our analysis follows the input-output methodology implemented by Peltier (2017; 2019; 2023) and Garret-Peltier (2017).[5]

The input-output analysis allows us to estimate both the direct and the indirect effects resulting from any type of expenditure, given the actual patterns of flows of goods and services from each industry to all others. The direct effects are the output and employment increases within the same sector, whereas the indirect effects are the output and employment increases in the other sectors of the economy which provide intermediate inputs. We leave aside the demand effects of incomes and wages paid by a given industry, as consumption patterns by wage earners are likely to be similar for wages earned in any industry. Also, we do not consider the effects of foreign demand leading to increased national exports.

The input-output analysis is performed using data from the 2021 edition of OECD Inter-Country Input-Output (ICIO) Tables for Germany, Italy, and Spain and using data from the OECD Structural Analysis (STAN) Database (see the Appendix for details on I-O data). We start from the inter-country input-output data contained in the OECD-ICIO database. An inter-country input-output table is a representation of the flows of goods and services (in monetary values) across all countries' sectors in a given year. The rows of the table show the sales of the output of a country's sector to all domestic and foreign sectors. The columns show the intermediate demand of a country's sectors or the final demand for the output of all domestic and foreign sectors.

From the original table, we extracted three separate input-output matrices for Germany, Italy, and Spain. For each country, we then transformed the matrix of inter-industry monetary flows into a $n \times n$ matrix of technical coefficients of production $\boldsymbol{A}$, where n is the number of industries of the economy. Each entry of the matrix of technical coefficients is defined as follows:

$$a_{ij} = \frac{z_{ij}}{x_j}, \quad i,j = 1, \dots, n \tag{1}$$

where z_{ij} denotes the inter-industry sale from sector *i* to sector *j*, x_j denotes total output of sector *j*, and the technical coefficient a_{ij} shows the amount of input *i* that is required to produce one unit of output of sector *j*. Each entry of the matrix of the matrix of technical coefficients $\boldsymbol{A}$ then shows the amount of input produced by the industry in the row that is required to produce one unit of output in the industry in the column.

Making these steps, the input-output structure of the economy boils down to a $n \times n$ linear system. In matrix notation:

$$\boldsymbol{x} = \boldsymbol{A}\boldsymbol{x} + \boldsymbol{f} \tag{2}$$

where $\boldsymbol{x}$ is the $n \times 1$ vector of sectoral outputs and $\boldsymbol{f}$ is the $n \times 1$ vector of final demand.

The solution to the system is:

$$\boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{f} \tag{3}$$

where $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ is known as the "Leontief inverse" or the "total requirement" matrix. Each entry of the Leontief inverse matrix l_{ij} shows the increase in output in sector *i* generated by a €1 increase in expenditure for final output in sector *j*. The output multiplier for sector *j* (OM_j) is then calculated as the total of all sectoral output effects generated by a €1 increase in expenditure for final output in

[5] For an introduction to input-output analysis see Miller and Blair (2009).

sector *j* (i.e. the column sum for sector *j* of the Leontief inverse matrix):

$$OM_j = \sum_i l_{ij} \tag{4}$$

The sectors of the economy that we consider here include: a) the arms industry (see below for the way we estimate its data); b) the environmental protection industry, proxied with "Water supply, sewerage, waste management, and remediation activities" (E36-E39 sector of the NACE Rev. 2 classification); c) the education activities, "Education" (P sector); d) the health activities, proxied with the "Human health and social work activities" (Q sector). A description of data used for the input-output analysis is provided in the Appendix. For each of these industries, the output multiplier measures the effects on the economy as a whole of a €1 increase in demand for the final output of that industry.

As the OECD-ICIO Tables for European countries do not provide data for military expenditure and arms production, we estimate information on the 'arms industry' on the basis of the data provided by the US Bureau of Economic Analysis input-output tables for the US arms industry ("Federal national defense: Gross investment in equipment"). US data show that the three main suppliers of intermediate inputs for arms production are "Computer and electronic products" (that include military electronics), "Motor vehicles, bodies and trailers, and parts" (that include tanks and armoured vehicles), and "Other transportation equipment" (that include military aircraft and ships), which account for more than 90% of all inputs for arms production; their average shares of all defence investment in the US over the period 2018-2022 are 38.86%, 12.76%, and 48.38% respectively. We assume that the structure of the arms industry in Europe is the same as the US one; in particular, for Germany, Italy, and Spain, we consider the corresponding intermediate input suppliers in the NACE classification (i.e. "Computer, electronic and optical equipment", "Motor vehicles, trailers and semi-trailers", and "Other transport equipment") and assume that they contribute to the 'arms industry' in the same proportions as in the US.

The matching between the US classification and the European NACE Rev. 2 classification of the three main intermediate input suppliers, as well as the share of each sector in arms production, are summarized in Table 1.

Tab 1. The sectoral structure of arms production

US BEA classification	NACE Rev. 2 classification	Weights
Computer and electronic products	Manufacture of computer, electronic and optical products (C26)	0.3886
Motor vehicles, bodies and trailers, and parts	Manufacture of motor vehicles, trailers and semi-trailers (C29)	0.1276
Other transportation equipment	Manufacture of other transport equipment (C30)	0.4838

The assumptions above imply that the arms production sector can be considered as a linear combination of the "Computer, electronic and optical equipment", "Motor vehicles, trailers and semitrailers", and "Other transport equipment" industries, and output multipliers for arms production are equal to the weighted average of the multipliers of these three industries, with weights being equal to the shares of each intermediate input supplier in arms production.

This procedure makes it possible to calculate the overall output multiplier of investment expenditures in arms, environmental protection, education and health, defined in equation (4).

Part of the demand set in motion by investment expenditure – either for arms or for other activities - is directed to goods and services produced by other nations and imported by the domestic economy.

They contribute to increase output and employment in foreign countries and therefore they have to be excluded from the estimate of domestic output effects. We have therefore to calculate the percentage of imports of final capital goods. In the case of arms production, this was calculated from WMEAT and NATO data as the ratio of "Imports of arms (goods & services)" to "Defense expenditure in equipment". In the case of environmental protection, education, and health activities, it was calculated from OECD-ICIO data as the ratio of investment demand going to the corresponding foreign sectors to total investment demand.
The increase in public expenditure going to the domestic economy is then obtained by multiplying the initial increase in public expenditure by $1 - m$, where m is the propensity to import out of final investment demand for the sector being considered.
As we investigate the effects of *changes* in expenditure, in matrix notation, the output effects of a change in final demand directed to the domestic economy $\Delta \boldsymbol{f}$ are:

$$\Delta \boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1} \Delta \boldsymbol{f} \tag{5}$$

Using equation (5) – and building different vectors of change in final demand $\Delta \boldsymbol{f}$ – we obtain the domestic output effects of an increase in investment expenditure, in arms, environmental protection, education, and health activities.[6]
The final step of the analysis is to investigate the employment effects generated by such increases in expenditure. From the OECD STAN database we calculate for each sector the employment requirements (in full time equivalents, FTE) per million euros of output, in other words how many workers are needed to produce in one year an output of the value of one million euros. Finally, we transformed the Leontief inverse matrix into an employment requirement matrix $\boldsymbol{ER}$ as follows:

$$\boldsymbol{ER} = \boldsymbol{W}(\boldsymbol{I} - \boldsymbol{A})^{-1} \tag{6}$$

where $\boldsymbol{W}$ is the $n \times n$ diagonal matrix of labour/output ratios. Each entry of the employment requirement matrix er_{ij} shows the increase in the number of FTE employees in sector *i* as a result of a €1 increase in expenditure for final output in sector j.
The vector of total (i.e. both direct and indirect) employment effects of a change in final demand going to the domestic economy is obtained by post-multiplying the employment requirement matrix by the vector $\Delta \boldsymbol{f}$:

$$\Delta \boldsymbol{e} = \boldsymbol{ER} \Delta \boldsymbol{f} \tag{7}$$

Using equation (7) – and considering different vectors of change in final demand $\Delta \boldsymbol{f}$ – we can assess the employment effects of an increase in arms acquisition in comparison to public investment in environmental protection, education, and health.

4. Results

What are the output and employment effects of €1,000 million expenditure in arms as opposed to non-military alternatives in the economies of Germany, Italy and Spain? Table 2 provides the results

[6] For arms production, the vector $\Delta \boldsymbol{f}$ is generated using the weights presented in Table 1; for environmental protection, education, and health, the vector $\Delta \boldsymbol{f}$ is built by assuming that all increase in final demand is devoted to "Water supply, sewerage, waste management, and remediation activities", "Education", and "Human health and social work activities" respectively.

for the overall demand multiplier (domestic and foreign), for the share of imports and for the domestic output multiplier effect of each sector – the focus of our investigation.[7]

Table 2. Output multipliers for arms, environment, education, and health

Germany			
	Multiplier of final demand (domestic + final imports)	**Share of imports (%)**	**Multiplier of final demand for the national economy**
Arms	1.62	24.21	1.23
Environment*	1.77	2.52	1.72
Education	1.27	5.51	1.20
Health	1.38	4.29	1.32
Italy			
	Multiplier of final demand (domestic + final imports)	**Share of imports (%)**	**Multiplier of final demand for the national economy**
Arms	1.82	59.28	0.74
Environment*	1.91	2.33	1.87
Education	1.26	28.36	0.90
Health	1.56	3.53	1.51
Spain			
	Multiplier of final demand (domestic + final imports)	**Share of imports (%)**	**Multiplier of final demand for the national economy**
Arms	1.65	22.30	1.28
Environment*	1.83	6.39	1.72
Education	1.19	1.74	1.17
Health	1.39	5.13	1.32

Note: For arms production, the output multiplier is calculated as the weighted average of the output multipliers of the three main sectors in the structure of arms production, with weights shown in Table 1.
(*) = Water supply, sewerage, waste management, and remediation activities

The first column of Table 2 shows that arms procurement has a significant multiplier effect on both arms-producing sectors and supplying industries, in the domestic and foreign economies; a €1 increase in final demand generates €1.62 of output in Germany, €1.65 of output in Spain, and €1.82 of output in Italy. However, investment in environmental protection has a higher effect than arms in all three countries, with output multipliers ranging from 1.77 in Germany to 1.91 in Italy. Health has an intermediate effect – with output multipliers ranging from 1.38 in Germany to 1.56 in Italy – while education has the lowest multiplier, as it requires fewer intermediate inputs in goods and services from other industries, and is more labour intensive.
The second column of Table 2 shows the propensity to import in each sector; in all countries, the arms industry exhibits the highest percentages, ranging from 59% in Italy to 22% in Spain, while the other three sectors have shares of imports lower than 7% (with the only exception of the education expenditure in Italy).

[7] As already pointed out, the multiplier effect for arms expenditure is the weighted average of the values of the three component sectors of computers, motor vehicles, and other transport industries; for environmental protection is the value for the water supply, sewerage, waste management, and remediation activities; for education and health is the value of these industries.

The multiplier effects on the domestic economy are reported in column 3 of Table 2, showing the output effect of a €1 increase in expenditure in each of the sectors. In Germany the domestic effect of arms acquisition is 1.23, significantly lower than that of investment in environment and health, and similar to the one in education. In Italy the arms multiplier falls to 0.741, due to the high share of arms imports, the lowest value of all sectors. In Spain arms expenditure has an output effect of 1.284, lower than environment and health, and higher than education.

Table 3 presents for the three countries the detailed effects of a €1,000 expenditure on domestic output and employment, identifying in each sector the impact on the sector itself and on other industries. For Germany a €1,000 million expenditure in arms procurement sets in motion an increase in domestic output of €1,230 million, for two thirds in arms-producing industries. In Italy the resulting increase is €741 million only, 60% of which is in arms-producing industries. In Spain the impact is 1,284 million, similar to the German results. The high concentration of the effects within the industries that produce arms points out the limited expansionary effects that such expenditure has on the rest of the economy.

In addition, Table 3 shows the employment requirements (in FTE) per million euros of direct output in the industry concerned. The arms industry is highly capital-intensive and employs significantly fewer employees per unit of output than environment, education, and health activities, which are more labour-intensive.

The key result shown in Table 3 is the domestic employment effects of the initial €1,000 expenditure, broken down in the direct impact within the same industry and the indirect effects in the rest of the economy. A €1,000 expenditure in arms acquisition is associated to 3,800 additional jobs in Germany, 2,900 in Italy, and 6,000 in Spain, generally half in the arms-producing industry and half in the rest of the economy.

How do these results compare with the three alternative destinations of the original €1,000 million in public expenditure? Environmental protection, education, and health are all characterised by service activities in the domestic economy, with a much lower relevance of imports, less need for intermediate inputs, and a higher labour intensity. The multiplier effect in terms of output and employment for each of the three alternative public expenditures is generally greater than the economic effect of increased arms procurement, except for the output effects of education expenditure in Germany and Spain. In terms of output, the highest results are found for environmental protection, with an increased output of €1,723 million in Germany, €1,865 million in Italy, and €1,717 million in Spain. For education and health, the additional output ranges from €900 million to €1,508 million.

Looking at the impact in terms of additional employment, in Germany the original €1,000 million in public expenditure could lead to the creation of 6,200 new jobs in the environmental sector 10,700 jobs in education, and 13,000 jobs in health services. The employment impact of education and health is about three times the one resulting from arms spending, and is mainly concentrated within the sectors themselves.

In Italy, the new jobs created by a €1,000 million expenditure would range between 9,000 in environmental services to 10,900 in health services – three to four times higher than the employment impact of increased arms procurement; the share of the new jobs created within the industries ranges from 60% in environmental protection to 90% in education and health.

In Spain, the employment effect would range between 10,200 new jobs in the environment to 14,700 in education – two and a half times the number of jobs associated to arms procurement.

These results show that increasing arms expenditure has a significantly lower effect in terms of total additional jobs created in the domestic economy compared to the three alternative destinations of public expenditures - environmental protection, education, and health activities. The results for the three countries are broadly similar, with differences due to the relevance of arms imports and economic structures. In terms of the indirect effects - i.e. the additional jobs created in other industries through the supply chain – in all countries the highest results are found for environmental protection, which has the largest positive employment spillover effects in the rest of the economy.

Table 3. Output and employment effects of 1,000€ million expenditures for arms, environment, education, and health

Germany							
	Domestic output effects (millions €)			**Employment requirements (FTE) per million euros of direct output**	**Domestic employment (FTE) effects (thousands employees)**		
	Direct (1)	**Indirect (2)**	**Total (3)=(1)+(2)**		**Direct (1)**	**Indirect (2)**	**Total (3)=(1)+(2)**
Arms	831.24	399.34	1230.58	2.45	2.01	1.83	3.84
Environment*	1164.75	558.34	1723.09	3.15	3.67	2.53	6.20
Education	1032.60	167.77	1200.37	9.60	9.91	0.77	10.68
Health	998.96	325.24	1324.20	11.57	11.56	1.47	13.03
Italy							
	Domestic output effects (millions €)			**Employment requirements (FTE) per million euros of direct output**	**Domestic employment (FTE) effects (thousands employees)**		
	Direct (1)	**Indirect (2)**	**Total (3)=(1)+(2)**		**Direct (1)**	**Indirect (2)**	**Total (3)=(1)+(2)**
Arms	440.17	301.47	741.64	3.29	1.44	1.47	2.91
Environment*	1100.81	765.12	1865.93	4.81	5.30	3.70	9.00
Education	726.48	173.43	899.91	11.43	8.31	0.86	9.17
Health	1057.42	450.85	1508.28	8.26	8.74	2.18	10.92
Spain							
	Domestic output effects (millions €)			**Employment requirements (FTE) per million euros of direct output**	**Domestic employment (FTE) effects (thousands employees)**		
	Direct (1)	**Indirect (2)**	**Total (3)=(1)+(2)**		**Direct (1)**	**Indirect (2)**	**Total (3)=(1)+(2)**
Arms	837.74	446.87	1284.61	3.50	2.88	3.11	5.99
Environment*	1188.20	529.14	1717.33	5.49	6.52	3.65	10.17
Education	985.07	188.75	1173.82	13.64	13.43	1.29	14.73
Health	1003.40	312.18	1315.59	11.06	11.09	2.13	13.22

Note: For arms production, the employment requirements are calculated as the weighted average of the employment requirements of the three main sectors in the structure of arms production, with weights shown in Table 1. Direct output (employment) effects refer to output (employment) created within the three sectors.
(*) = Water supply, sewerage, waste management, and remediation activities

The results we have obtained for the scenarios of a €1,000 million additional expenditure could be used also in retrospect, assuming the stability of input-output coefficients and other relationships over time. In a context of constraints on public finance, the increase in arms expenditure has often come at the cost of cutting public spending in other areas. We consider now the last ten years - the period 2013-2023 for which descriptive evidence has been provided in Figures 1 and 2 – and estimate the cumulative increase in arms acquisitions that has taken place over the decade. Table 4 shows that, compared to the value of arms spending of 2013, in the following decade the cumulative amount spent is remarkable. Germany's tripling of arms expenditure in real terms equates to a cumulative amount of €22.5 billion that has been diverted from alternative uses. In Italy, the cumulative increase in arms expenditure amounts to €16.3 billion. In Spain, the amount of resources absorbed by arms acquisitions has been €10.6 billion.

The potential employment impact of such amounts of resources is documented in Table 4. The cumulative expenditure for arms has created a number of jobs/year (number of employment positions of the length of one year, in the decade) equal to 86,300 in Germany, 47,600 in Italy, and 63,300 in Spain. What would have happened if the same amounts had been spent in environmental protection? Table 4 shows that the number of jobs/year would have been 139,300 in Germany, 147,100 in Italy, and 107,500 in Spain. The positive effect on employment would have been even larger if the same amount of expenditure had been devoted to health activities; the potential number of jobs/year created by the same amounts of expenditure ranges from 139,000 in Spain to 293,000 in Germany. Similar data emerge for education.

Table 4. Additional new jobs resulting from the cumulative increase in expenditure (2013-2023)

	Germany	Italy	Spain
Cumulative increase in arms expenditure relative to 2013 (billions €)	22.46	16.34	10.57
Additional new jobs resulting from increased expenditure in 2013-2023 (thousand employees)			
Arms	86.27	47.55	63.32
Environment*	139.26	147.07	107.51
Education	239.94	149.78	155.69
Health	292.75	178.45	139.80

(*) = Water supply, sewerage, waste management, and remediation activities

The difference between the employment effects of increasing arms expenditure and those of the potential alternatives makes the costs of militarization evident in terms of missed job creation opportunities. In general, the potential employment gain offered by environmental protection, education and health ranges between two and more three times the job impact of arms production.

Our findings show that the current drive to increase European military expenditures has problematic economic consequences. In European countries characterised by constraints on public expenditures, policies that concentrate limited public resources in the military have negative outcomes in several regards. They result in larger imports of arms and high-tech components, mainly from the US; they lead to lower availability of public resources for environmental and social priorities; and they have a significantly lower effect in terms of domestic growth of output and employment compared to other potential destinations of public expenditures.

In quantitative terms, considering the performances of economic and employment growth, the findings show that increased military expenditures – associated with the prospect of a stronger European 'military-industrial complex' – may slow down Europe's development, compared to trajectories based on increased environmental and social expenditures. In terms of the quality of Europe's development, more expenditures on education, health and the environment bring improvements in wellbeing and sustainability that are even more important than the quantitative gains we may estimate.

References

Ahad, M. and A. Dar 2017. "Modelling the asymmetric impact of defence spending on economic growth." J*ournal of Economic and Administrative Sciences.* 33(2):131-149.

Alptekin, A. and P. Levine. 2012. "Military expenditure and economic growth: a meta-analysis." *European Journal of Political Economy* 28(4): 636–650. https://doi:10.1016/j.ejpoleco.2012.07.002.

Anderson, M. G. Bischak and M. Oden. 1991. "Converting the American Economy. The Economic Effects of an Alternative Security Policy." Lansing, MI: Employment research Associates.

Arin K. P., F. Koray, N. Spagnolo. 2015. "Fiscal multipliers in good times and bad times." *Journal of Macroeconomics* 44: 303-311.

Auerbach, A. J. And Y. Gorodnichenko 2012, "Measuring the Output Responses to Fiscal Policy." *American Economic Journal: Economic Policy* 4(2): 1-27.

Auerbach, A. J., Y. Gorodnichenko and D. Murphy, 2018, *Local Fiscal Multipliers and Fiscal Spillovers in the United States."* Paper for the 19th IMF Jacques Polak Annual Research Conference, November 1-2, 2018.

Aziz, N., and M. N. Asadullah. 2017. "Military Spending, Armed Conflict and Economic Growth in Developing Countries in the Post-Cold War Era." *Journal of Economic Studies* 44 (1): 47–68.

Baran, P. and P. Sweezy. 1968. *Monopoly Capital: An Essay on the American Economic and Social Order.* Harmondsworth: Penguin.

Becker, J. and J. P. Dunne. 2023. "Military Spending Composition and Economic Growth." *Defence and Peace Economics* 34(3): 259-271, April.

Benoit, E. 1973. *Defence and Economic Growth in Developing Countries*. Boston: Lexington.

Biscione, A. and Caruso, R. 2019. "Military Expenditures and Income Inequality Evidence from a Panel of Transition Countries (1990-2015)." Defence and Peace Economics 32:(1):46-67.doi: 10.1080/10242694.2019.1661218.

Bonaiuti C., P. Maranzano, M. Pianta and M. Stamegna. 2013. *Arming Europe. Military expenditures and their economic impact in Germany, Italy, and Spain*. Report for Greenpeace, November. https://www.greenpeace.org/static/planet4-italy-stateless/2023/11/d4d111bc-arming-europe.pdf.

Bove, V., and E. Cavatorta. 2012."From Conscription to Volunteers: Budget Shares in NATO Defence Spending." *Defence and Peace Economics* 23 (3): 273-288.

Caruso, R. 2017. *Economia della pace.* Bologna: Il Mulino.

Caruso, R., and M. Di Domizio. 2016. "Interdependence between US and European military spending: a panel cointegration analysis (1988-2013)." Applied economics Letters 23 (4): 302-305. hdoi:10.1080/13504851.2015.1071466] [http://hdl.handle.net/10807/115064.

Cavatorta, E., and R. P. Smith. 2017."Factor Models in Panels with Cross-sectional Dependence: An Application to the Extended SIPRI Military Expenditure Data." *Defence and Peace Economics* 28 (4): 437–456.

Coutts A, Daoud A, Fakih A, Marrouch W, Reinsberg B .2019. “Guns and butter? Military expenditure and health spending on the eve of the Arab Spring”. Defence and Peace Economics 30(2):227–237. https://doi.org/10.1080/10242694.2018.1497372.

D’Agostino, G., J. P. Dunne, and L. Pieroni. 2019. “Military Expenditure, Endogeneity and Economic Growth.” *Defence and Peace Economics* 30 (5): 509–524. doi.org/10.1080/10242694.2017.1422314

D’Agostino, G., J. P. Dunne, and L. Pieroni .2017. “Does military spending matter for long-run growth?.” *Defence and Peace Economics* 28 (4): 429–436.

Deleidi, M. and M. Mazzucato. 2021. “Directed innovation policies and the supermultiplier: An empirical assessment of mission-oriented policies in the US economy.” *Research Policy*, 50 (2). doi.org/10.1016/j.respol.2020.104151.

Deleidi, M., F. Lafrate, and E.S. Levrero. 2023. “Government investment fiscal multipliers: evidence from Euro-area countries.” *Macroeconic Dynamics* 27: 331-349.

D'Hernoncourt, J., M. Cordier and Hadley D. 2011. "Input-Output Multipliers – Specification sheet and supporting material, Spicosa project report." *Working Papers* hal-03233439, HAL.

Droff, J., and J. Malizard. 2019.“Qui porte le fardeau? Les coûts de la production de défense dans l’Union européenne.” *Revue francaise d’economie* XXXIV (3): 83–121.

Dunne J. P. 1990. “The political economy of military expenditure: an introduction.” *Cambridge Journal of Economics* (14): 395-404.

Dunne, J. P. 1986. “The Employment Consequences of Military Expenditure: a Comparative Assessment”. ILO Disarmament and Employment Programme, working paper no. 6. Geneva, International Labour Office.

Dunne, J. P. and R.P. Smith 2020. “Military Expenditure, Investment and Growth” *Defence and Peace Economics*, 31(6): 601-614. hpps://DOI: 10.1080/10242694.2019.1636182.

Dunne, J. P. and N. Tian. 2013. “Military Expenditure and Economic Growth: A Survey.” *Economics of Peace and Security Journal* 8 (1): 5–11. doi:10.15355/epsj.8.1.5.

Dunne, J.P. and R.P. Smith. 1984. “The economic consequences of reduced UK military expenditure.” *Cambridge Journal of Economics* 8 (3): 297–310, https://doi.org/10.1093/oxfordjournals.cje.a035552.

Dunne, P. and N. Tian. 2016. “Military expenditure and economic growth, 1960–2014”. *The Economics of Peace and Security Journal* 11(2):50–56.

Emmanouilidis K. 2024. "Military Spending and Economic Output: A Decomposition Analysis of the US Military Budget," *Defence and Peace Economics*. 35(2): 243-263,

Fazzari, S. M., J. Morley, and I. Panovska, 2015. "State-dependent effects of fiscal policy" *Studies in Nonlinear Dynamics & Econometrics*, 19 (3) 2015: 285-315. https://doi.org/10.1515/snde-2014-0022.

Galtung, J. 1985. *There Are Alternatives!*. Nottingham: Spokesman.

Garret-Peltier H. 2017. “Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model.” *Economic Modelling* 6: 439-447.

Garrett-Peltier H. & Pollin R. 2007. "The Employment Effects of Downsizing the U.S. Military."Working Papers wp152, Political Economy Research Institute, University of Massachusetts at Amherst. https://ideas.repec.org/p/uma/periwp/wp152.html

Gentilucci, E. 2010. “The military expenditure in the analysis of contemporaneous economists.” History, Philosophy and Sociology of Sciences. Université Panthéon-Sorbonne - Paris I, 2010. https://theses.hal.science/tel-00612338/document.

Hatemi-J, A., T. Chang, W. Y. Chen, F. L. Lin and R. Gupta. 2018. “Asymmetric causality between military expenditures and economic growth in top six defense spenders.” *Quality & Quantity* 52(3):1193–1207. https://doi.org/10.10 07/s11135-017-0512-9.

Ikegami M. & W. Z. Wang, 2023. "Does military expenditure crowd out health-care spending? Cross-country empirics," *Quality & Quantity: International Journal of Methodology*. 57(2): 1657-1672.
Krell, G. 1981. “Capitalism and armaments: business cycles and defense spending in the US 1945-1979.” *Journal of Peace Research* 18(3): 221-240.
Lanrui, L., Z.U. Rahman and S.I. Khattak 2022. “Asymmetric Effect of Military Expenditures on Economic Growth in Pakistan: A Nonlinear-ARDL Approach.” *Engineer Economics* (33) 3:316–32.https://doi.org/10.5755/j01.ee.33.3.28982
Leontief, W. & Hoffenberg, M. 1961. “The Economic Effects of Disarmament.” *Scientific American*, *204*(4): 47–55. http://www.jstor.org/stable/24937422
Leontief, W. 1986. *Input-Output Economics.* New York: Oxford University Press.
Lim, D. 1983. “Another look at growth and defense in less developed countries.” *Economic Development and Cultural Change* 31(2): 377–384. https://doi.org/10.1086/451326.
Maher M. and Zhao Y. .2022. “Do political instability and military expenditure undermine economic growth in Egypt? Evidence from the ARDL approach”. *Defence and Peace Economics* 33(8):956–979. doi.org/10.1080/10242694.2021.1943625.
Markusen A. 1986. "The Militarized Economy." *World Policy Journal* 3 (3): 495-516.
Medoff, J. L. 1993. “Smart Stimulus: More Good Jobs,” Washington, D.C.: Center for National Policy.
Melman S. 1988. *The Demilitarized Society: Disarmament and Conversion*. Montreal: Harvest House.
Menla, F. A. and O. Dimitraki. 2014. “Military spending and economic growth in China: a regime-switching analysis.” *Applied Economics*, 46:28, 3408-3420. Doi.10.1080/00036846.2014.929626
Miller, R. E. and P. D. Blair 2009. Input-Output Analysis: Foundations and Extensions. Cambridge: Cambridge University Press.
Nascia L. and M. Pianta 2009. “La spesa militare in Italia, 1948-2008.” In N. Labanca (ed.) *Le armi della Repubblica: dalla Liberazione a oggi*. Torino: Utet:177-208.
Peltier H. 2023 “We Get What We Pay For: The Cycle of Military Spending, Industry Power, and Economic Dependence.” *Costs of War,* Watson Institute, Brown University and Pardee Center, Boston University, 8 June 2023. file:///C:/Users/Chiara/Desktop/spese%20militari%20bibliografia/Peltier%202023%20-%20We%20Get%20What%20We%20Pay%20For%20-%20FINAL%20-%200608.pdf
Peltier, H. 2017. “Job Opportunity Cost of War.” Costs of War, Watson Institute, Brown University. https://watson.brown.edu/costsofwar/files/cow/imce/papers/2017/Job%20Opportunity%20Cost%20of% 20War%20-%20HGP%20-%20FINAL.pdf
Peltier, H. 2019. “War Spending and Lost Opportunities.” *Costs of War*, Watson Institute, Brown University.
https://watson.brown.edu/costsofwar/files/cow/imce/papers/2019/March%202019%20Job%20Opportun ity%20Cost%20of%20War.pdf.
Phiri, A. 2019 “Does Military Spending Nonlinearly Affect Economic Growth in South Africa?.” *Defence and Peace Economics* 30(4): 474-487. DOI: 10.1080/10242694.2017.1361272.
Pollin, R. and H. Garrett-Peltier. 2009. “The U.S. employment effects of military and domestic spending priorities.” *International Journal of Health Service.* 39(3):443-60. doi: 10.2190/HS.39.3.b. PMID: 19771950.
Saba, C. S. and N. Ngepah. 2019. “A cross-regional analysis of military expenditure, state fragility and economic growth in Africa.” *Quality & Quantity* 53(6): 2885-2915. https://doi.org/10.1007/s11135-019-00905-6.
Saccone, D., P. Della Posta, E. Marelli and M. Signorelli M. 2022. “Public investment multipliers by functions of government: An empirical analysis for European countries.” *Structural Change and Economic Dynamics (*60): 531-545.

Saeed, L. 2023. “The Impact of Military Expenditures on Economic Growth: A New Instrumental Variables Approach.” *Defence and Peace Economics.* doi: 10.1080/10242694.2023.2259651
Scandizzo, P., R. Nardone, and C. Ferrarese. 2015. “Impatto sul sistema economico italiano dei flussi di spesa corrente e di investimento del settore aerospaziale/difesa”. *Openeconomics.* https://www.researchgate.net/profile/Pasquale-Scandizzo/publication/338104028_IMPATTO_SUL_SISTEMA_ECONOMICO_ITALIANO_DEI_FLUSSI_DI_SPESA_CORRENTE_E_DI_INVESTIMENTO_DEL_SETTORE_AEROSPAZIODIFESA_DICEMBRE_2015/links/5dfe8692299bf10bc36ec4b9/IMPATTO-SUL-SISTEMA-ECONOMICO-ITALIANO-DEI-FLUSSI-DI-SPESA-CORRENTE-E-DI-INVESTIMENTO-DEL-SETTORE-AEROSPAZIO-DIFESA-DICEMBRE-2015.pdf
SIPRI (Stockholm International Peace Research Institute) (various years) *SIPRI Arms Transfers Database.* Https://armstrade.sipri.org/armstrade/page/values.php;
SIPRI (Stockholm International Peace Research Institute) (various years) *SIPRI Military Expenditure Database.* https://www.sipri.org/databases/milex.
Su, C., Xu, Y., H.L. Chang,O Lobont and Liu, Z. 2018. “Defence and Peace Economics Dynamic Causalities between Defense Expenditure and Economic Growth in China: Evidence from Rolling Granger Causality Test.” *Defence and Peace Economics*, 1–18. https://doi.org/10.1080/10242694.2018.1505583
Thorpe, R.U. 2014. *The American Warfare State: The Domestic Politics of Military Spending.* Chicago: The University of Chicago Press.
Yesilyurt, F., and M. E. Yesilyurt. 2019. “Meta-analysis, Military Expenditures and Growth.” *Journal of Peace Research* 56(3): 352–363.
Wang X., N. Hou & B. Chen. 2023. “Democracy, military expenditure and economic growth: A heterogeneous perspective.” *Defence and Peace Economics,* 34(8): 1039-1070. doi: 10.1080/10242694.2022.2126955
Zhang, Y, X. Liu, J. Xu and R. Wang. 2017. “Does military spending promote social welfare? A comparative analysis of the BRICS and G7 countries.” *Defence and Peace Economics 2*8(6): 686-702. doi: 10.1080/10242694.2016.1144899.

Appendix.
Dataset structure and sources

This Appendix provides information on the data presented in the main text. In particular, we discuss the institutional sources, the variables definition, and the methodology used to harmonize the dataset.

The list of countries considered in the paper includes Germany, Italy, Spain and NATO EU countries. The latter group is composed by Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain.

The period covered in the database is from 2008 to 2023. Data are mainly reported for the last decade, 2013-2023. The database we have produced is available on request for interested scholars.

The database has been constructed by combining data from three institutional sources:

- North Atlantic Treaty Organization (NATO) Defence Expenditure database (available at the link https://www.nato.int/cps/en/natohq/topics_49198.htm);
- Eurostat databases (Eurostat data warehouse and COFOG);
- World Military Expenditure and Arms Transfers (WMEAT) database (available at https://www.state.gov/world-military-expenditures-and-arms-transfers/).

NATO military expenditure variables

From the NATO database we gathered information about the military expenditure of countries at both the aggregate and sectoral levels. By sectoral, we mean the division of total defence expenditure into four principal breakdowns, that is, personnel, equipment and arms, infrastructures, and other expenditures.

The list of variables collected from NATO database 19 sal follows:

- Total military expenditure (million €, constant 2015 prices and millions in national currency, current prices), military expenditure per capita (thousand €, constant 2015 prices), military expenditure share of real GDP (0-100% of GDP), and military expenditure annual real change (% of year-to-year annual real change)
- Military personnel (thousand persons)
- Military expenditure breakdown: equipment, personnel, infrastructures and other expenditures (million €, constant 2015 prices and 0-100% of total defence expenditure).

NATO has adopted a common definition of defence expenditure since the early 1950s, which is agreed by all NATO Allies. It is regularly reviewed, most recently in early 2023. Defence expenditure is defined by NATO as payments made by a national government (excluding regional, local and municipal authorities) specifically to meet the needs of its armed forces, those of Allies or of the Alliance. Specifically, the NATO's military expenditure includes (but not limited to):

- Expenditure for the military component of mixed civilian-military activities, but only when the military component can be specifically accounted for or estimated. For example, these include airfields, meteorological services, aids to navigation, joint procurement services, research and development;
- Military and financial assistance by one Ally to another, specifically to support the defence efforts of the recipient, should be included in the defence expenditure of the donor nation and not in that of the recipient;
- R&D costs, in turn including expenditure for those projects that do not successfully lead to

production of equipment;
- Equipment expenditure includes major equipment expenditure and R&D devoted to major equipment;
- Payments for Armed Forces (e.g., land, maritime and air 20 salso20s well as joint formations) financed from within the Ministry of Defence budget. Armed Forces might also include parts of other forces such as Ministry of Interior troops, national police forces, coast guards etc. In such cases, expenditure is included only in proportion to the forces that are trained in military tactics, are equipped as a military force, can operate under direct military authority in deployed operations, and can, realistically, be deployed outside national territory in support of a military force. Expenditure on other forces financed through the budgets of ministries other than Ministry of Defence 20 salso included within the definition (below, we discuss more in detail the allocation of military expenditure from the national public budgets);
- Retirement pensions made directly by the government to retired military and civilian employees of military departments and for active personnel;
- Operations and maintenance expenditure, other R&D expenditure and expenditure not allocated to the above-mentioned categories;
- Maintenance and construction of NATO common infrastructures and national military construction.

Notice that, military expenditures are mainly included in the budget of the Ministry of Defence. However, other expenditures of a military nature can also be found in the budgets of the Prime Minister's Office, the Ministry of the Economy, the Ministry of Industry (arms development and procurement, support to military industries), the Ministry of Research (research and development for military applications) and other government departments. NATO's definition includes some, but not all, of these additional expenditures. In turn, Ministries of Defence's budgets generally include expenditures for domestic public security functions that are removed from the aggregate of military expenditures. One problem in assessing military budgets is that there is often a disparity between forecasts, budget allocations, and the actual expenditures that are documented ex-post; in many countries, there is a systematic increase as expenditures move along such a budgetary.

The available data from NATO ranges from the second half of '900 to 2023. However, as reported in the official documentation provided by NATO (CITE), values for 2022 and 2023 are budgetary estimates/forecasts computed by NATO itself.

To avoid any ambiguity, the fiscal year has been designated by the year which includes the highest number of months: e.g. 2022 represents the fiscal year 2022/2023 for Canada and United Kingdom, and the fiscal year 2021/2022 for the United States. Because of rounding, the total figures may differ from the sum of their components.

World Military Expenditure and Arms Transfer (WMEAT) variables

From the WMEAT 2021 report we gathered information about the trade (export and import) of arms (including both goods and services) for the considered European countries. Arms imports data are used to compute the net military expenditure as the difference between total expenditure and imports.

According to the WMEAT documentation (see pages 9 to 11 of WMEAT Report 2021), the reported values respect the NATO definition on military expenditure. By arms trade, WMEAT means the international transfer (under terms of grant, credit, barter, or cash) of military equipment and related services, including weapons of war, parts thereof, ammunition, support equipment, and other commodities designed for military use, as well as related services (see pages 12 and 13 of WMEAT Report 2021 for details on the voices included in the account).

Notice that, WMEAT data are only available from 2009 to 2019. Values for 2020, 2021 and 2022 were imputed by linearly interpolating the empirical relationship with the Trend Indicator Values (TIVs) provided by the Stockholm International Peace Research Institute (SIPRI) arms transfer database (available at https://armstrade.sipri.org/armstrade/page/values.php). Values for 2023 were imputed by linearly projecting the 2013-2022 temporal trend.

Eurostat economic and social variables

From Eurostat, we gathered information about relevant social and macroeconomic indicators connected to defence expenditure and military investments. In particular, we collected information about the economic level of countries, public expenditure at sectoral level, and demography.

The list of variables collected from Eurostat database is as follows:

- Gross Fixed Capital Formation and Gross Fixed Capital Formation in machinery and equipment and weapons systems (millions €, constant 2015 prices);
- Gross Domestic Product (million €, constant 2015 prices);
- GDP implicit deflator national currency base 2015 (index, year base = 2015);
- Total employment (thousand persons) using the national concept. It covers all persons engaged (employees and self-employed) in some productive activity (within the production boundary of the national accounts);
- Population (thousand persons) using the national concept on January 1st. It consists of all persons, nationals or foreigners, who are permanently settled in the economic territory of the country, even if they are temporarily absent from it, on a given date;

Notice that, at the time of writing, the last available year was 2022 for all the Eurostat variables. Values for 2023 are estimated as follows:

1. Population and Total employment: assumed to be equal to the values for 2022;
2. GDP annual growth rates: provided by the "Spring GDP growth estimates for 2023-2024" provided by Eurostat;
3. GDP values (total and per capita): computed by multiplying the estimate of the 2023 year-to-year GDP growth rate and the GDP values for 2022;
4. GDP implicit deflator: computed as the ratio between the 2023 total defence expenditure at current prices (provided by NATO) and the total defence expenditure at constant 2015 prices.

Eurostat General Government Expenditure by Function (COFOG) variables

The list of variables collected from Eurostat-COFOG database is as follows:

- Total general government (million €, constant 2015 prices): this is the sum of COFOG for general public services, defence, public order and safety, economic affairs, environmental protection, housing and community amenities, health, culture, education, and social protection;
- General public services (million €, constant 2015 prices): includes executive and legislative organs, financial and fiscal affairs, external affairs; foreign economic aid; general services; basic research; R&D related to general public services; general public services (other); public debt transactions, transfers of a general character between different levels of government;
- Environmental protection (million €, constant 2015 prices): includes waste management; water waste management; pollution abatement; protection of biodiversity and landscape; R&D related to environmental protection;
- Health (million €, constant 2015 prices): includes medical products, appliances and equipment; outpatient services; hospital services; public health services; R&D related to

health;
- Education (million €, constant 2015 prices): includes pre-primary, primary, secondary and tertiary education, post-secondary non-tertiary education, education non-definable by level, subsidiary services to education; R&D related to education.

Notice that, at the time of writing, for the Eurostat-COFOG variables, the last available data is 2021. Values for 2022 and 2023 are estimated by linearly projecting the 2013-2021 trend.

Input-Output Analysis

Inter-country input-output data were extracted from the 2021 edition of the OECD Inter-Country Input-Output (ICIO) Tables. Our reference year is 2018, which is the last available year in the 2021 edition of OECD ICIO Tables. As the arms production industry is not explicitly identified as a productive sector in the NACE Rev. 2 classification at the level of aggregation provided by the OECD-ICIO Tables, we reconstructed the sectoral structure of arms production for Germany, Italy, and Spain using the IO Accounts Data on "Federal national defense: Gross investment in equipment" from the US Bureau of Economic Analysis (BEA) (Use Tables, 71 Industries).
The percentage of imports of final capital goods for the arms production sector was calculated using WMEAT and NATO data.
Data on employees' total worked hours in 2018 were obtained from the OECD STructural ANalysis (STAN) Database. Where OECD STAN provides data on total worked hours for 2018 at a higher level of aggregation than OECD ICIO, but data are available at a lower level of aggregation for 2017, we extrapolated the missing data by using 2017 data; where 2017 data are not available at a lower level of aggregation, we extrapolated the missing data by using data on sectoral output for 2018.
We calculated FTE employment by dividing the total worked hours in each sector by the average hours worked in a year by a FTE employee. For Italy and Spain, the average hours worked in a year by a FTE employee was obtained by dividing total worked hours by the number of FTE employees, both provided by Istituto nazionale di statistica (ISTAT) and Instituto nacional de estadística (INE); for Germany, since Destatis does not provide these data at the aggregate level, we assumed that the average hours worked in a year by a FTE employee is equal to 1800 (corresponding to 45 working weeks of 40 hours each), in line with the Eurostat's imputation method for Annual work unit.