DE GRUYTER Peace Econ. Peace Sci. Pub. Pol. 2024; 30(4): 393–422

Marco Stamegna*, Chiara Bonaiuti, Paolo Maranzano and Mario Pianta

The Economic Impact of Arms Spending in Germany, Italy, and Spain

https://doi.org/10.1515/peps-2024-0019
Received March 23, 2024; accepted August 30, 2024; published online October 22, 2024

Abstract: In the last 10 years, military expenditures of NATO EU countries (according to NATO definitions and data) have increased by almost 50 %, from €145 billion in 2014 to €215 billion in 2023. 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 Classification: C67; D57; H50; H56; Q50

***Corresponding author: Marco Stamegna**, Post-Doc Researcher, Faculty of Political and Social Sciences, Scuola Normale Superiore, Florence, Italy, E-mail: marco.stamegna@sns.it. https://orcid.org/0009-0002-5547-7642
Chiara Bonaiuti, Researcher Associate, Jean Monnet Centre, Newcastle University, Newcastle upon Tyne, UK; and Researcher, Ires Toscana, Defence Economics Division, Florence, Italy, E-mail: chiara.bonaiuti@irestoscana.it
Paolo Maranzano, Researcher, Department of Economics, Management and Statistics (DEMS), University of Milano-Bicocca, Milano, Italy, E-mail: paolo.maranzano@unimib.it
Mario Pianta, Professor of Economic Policy, Faculty of Political and Social Sciences, Scuola Normale Superiore, Florence, Italy, E-mail: mario.pianta@sns.it

1 Introduction

European countries are on a road to militarisation. In the last 10 years, military expenditures of NATO EU countries (according to NATO definitions and data) have increased by almost 50 %, from €145 billion in 2014 to €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.

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. 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 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 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.

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; Section 5 concludes.

2 The State of the Art on the Economic Impact of Military Expenditure

Military expenditures are the outcome of the military and political strategies, 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.

Their military and political drivers include security and foreign policy objectives, military alliances and external threats.[1] 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, shaping a country's growth trajectory. Military expenditures create demand for arms and supplies produced by corporations and fund the research, development and exports of armaments. Profits in arms production are usually higher than average and a country's 'military industrial complex' is often a major force driving the growth of military expenditures (Caruso 2017; Nascia and Pianta 2009).

The debate regarding the impact of military expenditures on growth and employment reflects their contradictory nature – a potential to expand the economy on the one side, and on the other side, a subtraction of resources to consumption and investment.

On the one hand, the argument for a positive effect of military expenditure on output growth rests on the Keynesian principle of effective demand and the Marxian "underconsumption" problem. In this view, military expenditure may boost capacity utilization and profits, compensating for capitalism's tendency towards stagnation (Baran and Sweezy 1968). At the same time, military expenditure may also have positive supply-side effects by supporting R&D, contributing to the development of new technologies, enhancing the skills of the labour force, as in the case of the US

1 The relationships between security and military spending is beyond the scope of this article. However, an emphasis on military power can lead to arms races with other countries or alliances, resulting in growing military spending, with no improvement in security. Military bureaucracies 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 – generally play a key role in shaping defence policies (Dunne and Sköns 2010). At the same time, security can also be achieved with non-military means, including disarmament treaties, diplomacy and trust-building, regional political integration, economic cooperation, human rights protection, and development aid (Galtung 1985; Melman 1988).

since the Second World War (Dunne and Tian 2013; Dunne, Smith, and Willenbockel 2005; MacNair, Murdoch, and Sandler 1995).

On the other hand, for a given level of productive capacity, an increase in military expenditure may have negative effects on growth. On the demand side, there may be a crowding-out of productive investment and other types of public expenditure. On the supply side, military expenditures may absorb 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 (Markusen 1986; Melman 1988).

Authors in the Marxist tradition have pointed out the contradictory role of arms spending in world capitalism. Military expenditures are required for ensuring military superiority and hegemonic power but, at the same time, their expansion imposes substantial costs in terms of lower capital accumulation and slower economic growth as it diverts resources from productive uses (Smith 1977).

Empirical investigations have produced mixed results. Survey of studies of the impact of military spending have pointed out that findings are highly dependent on the theoretical approach, the nature of the countries analysed, the time horizon, and the methodology used (Cepparulo and Pasimeni 2024; Dunne 1996).

Dunne and Uye (2010), reviewing 103 studies, found that about 45 % of cross-country and case studies show an unclear association between military expenditure and economic growth; 39 % of cross-country studies and 35 % of case studies find a negative effect of military spending on economic growth, with only about 20 % finding a positive effect. Dunne and Tian (2013, 2016) updated the survey, including developing countries, and confirmed that it is more likely for the empirical evidence to show negative or at most no statistically significant effects of military expenditure. When focussing on post-cold war data, most cross-country studies show a negative impact of military spending on economic growth. Yesilyurt and Yesilyurt (2019) conducted a meta-analysis of empirical studies using the share of military expenditure on GDP as independent variable and found evidence of non-statistically significant effects. In their meta-analysis of 48 studies, Churchill and Yew (2018) supported the existence of a negative military expenditure-growth association. In their meta-analysis of 32 empirical studies, Alptekin and Levine (2012) found a positive effect of the share of military expenditure in GDP on economic growth for developed countries and an unclear association in developing countries and in the sample as a whole. Sandler and Hartley (1995) argued that works focussing only on supply-side effects tend to find positive or insignificant effects, while models allowing for crowding-out effects of investment on the demand side are more likely to find negative effects.

D'Agostino, Dunne, and Pieroni (2018) and Saeed (2023) addressed the endogeneity problem arising from reverse causality and concluded that an increase in military expenditure leads to a statistically significant reduction in GDP growth; the results are robust to the use of different instrumental variables, the application of different estimators, different time periods, and different cross-section compositions.

The prospects of disarmament opened up by the end of the Cold War gave rise to literature on the "peace dividend", i.e. the economic benefits of cuts in military expenditures (Gleditsch et al. 1996). Rather than looking at growth effects, this literature focused on the short-run output and employment effects of shifting public resources from the defence sector to alternative types of public spending (Dunne and Tian 2013; 2016). For the case of UK, Dunne and Smith (1984) found that a reduction of the share of military expenditure in GDP by 1.5 percentage points, matched by a proportional increase in the non-military components of public expenditure, would lead to a net employment increase of about 100,000 jobs; Barker, Dunne, and Smith (1991) showed that halving the military budget and relocating the released "peace dividend" to the civilian sectors would have resulted in significant output and employment increases.

The role of changing security threats and military alliances in shaping arms spending has been investigated by several studies. Dunne and Smith (2020) accounted for internal and external threats among the determinants of military expenditure and identify different possible configurations of the relationship between arms spending and growth according to world regions and historical periods. Caruso and Di Domizio (2016) found a positive association between US and European military spending, driven by the dynamics of the NATO alliance. The composition of military expenditure – armed forces, arms acquisition, etc. – may have an impact on aggregate growth (Becker and Dunne 2023) and is significantly affected by government ideology (Olejnik 2024) and by the strategic role of a country within a military alliance (Bove and Cavatorta 2012). The expansion of military expenditure is also positively associated with economic inequality (Biscione and Caruso 2019) and may contribute to authoritarian turns in a country's institutions, political culture, and society, with a possible erosion of democracy (Galtung 1985; Thorpe 2014).

A focus on the economic impact of different types of public expenditures has come from the literature on fiscal multipliers. For the case of the US, Auerbach and Gorodnichenko (2012) found a positive multiplier effect of defence spending, which is generally higher than that for consumption spending but lower than that for non-defence and investment expenditures. Deleidi and Mazzucato (2021) investigated US defence R&D spending as a proxy for "mission oriented" programmes, finding – consistently with Keynesian insights – that the multiplier is higher in periods of low growth or recessions than in periods of expansion (Arin, Koray, and

Spagnolo 2015; Auerbach, Gorodnichenko, and Murphy 2018; Deleidi, Lafrate, and Levrero 2023).

In the case of Europe, Saccone et al. (2022) assessed the impact of public nvestment in 31 countries over the 1995–2019 period using the local projection method and found a strong multiplier effect of aggregate spending on output. In the breakdown by type of public activities, they find 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 to Europe's reliance on arms imports.

A different method is offered by the input–output (I–O) approach, which looks at the intersectoral flows of goods and services of an economy. I–O tables provide information on the input requirements in a given industry and allow estimation of the output and employment impact that an increase in production in one industry has on all other sectors.

Wassily Leontief, the inventor of the input–output approach, carried out the first study on the economic impact of demilitarizing the US economy, showing that a shift of resources from the defence to non-defence sectors would have doubled the number of jobs (Leontief and Hoffenberg 1961). Medoff (1993) used the input–output model for the U.S. economy to estimate the employment impact of different variables – consumption, private investment, state expenditure, military spending – finding that personal consumption and defence expenditures have the lowest effects on jobs and wage increases. Anderson, Bischak, and Oden (1991) rely on an augmented model that integrates the I–O methodology with other statistical techniques. 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 find that the U.S. economy would gain 477,000 additional jobs. Pollin and Garriet-Peltier (2009) showed that spending $1 billion on personal consumption, health care, education, mass transit, and construction for home weatherization and infrastructure repair will all create more jobs than devoting the same amount of public resources to military spending. Peltier (2017, 2019, 2023) found similar results when considering other types of non-military expenditure (e.g. investment in wind and solar energy).

Input–output analysis refers to real quantities in the economy and is highly appropriate to assess the short-run economic impact of military and non-military spending.[2] Most I–O studies have focused on the US – where the Bureau of Economic

---

2 The standard I–O model has some limitations when used for forecasting and policy analysis: 1) it assumes fixed technical coefficients of production, ruling out the possibilities of input substitution, economies of scale, asymmetries in output responses over the business cycle, or endogenous changes in technology; 2) it does not consider supply-side constraints, which means it implicitly assumes that

Analysis produces I–O matrixes including data for the defence sector – and less attention has been devoted to European countries (Gentilucci 2010; Scandizzo, Nardone, and Ferrarese 2015). This article aims to fill this gap, using the I–O methodology to explore the economic impact of arms spending in three major EU countries – Germany, Italy and Spain.

3 Military Spending in Europe: Data, Patterns and Methodology

3.1 Data

NATO EU countries have significantly increased their levels of military expenditures over the last 10 years, both in absolute terms and as a share of GDP.[3] The increase in military expenditures has been associated with a decline in the share of personnel and a parallel increase in the share of arms and equipment (Becker et al. 2024; Bonaiuti et al. 2023).

Figure 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. 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 168 %.

---

demand multiplier effects can always be accommodated by excess capacity and unemployed labour; 3) it does not account for inflation and changes in relative prices. However, the I–O methodology provides a good approximation of the short-run effects of different policy interventions and is not affected by methodological issues that could bias estimates based on econometric models (e.g. endogeneity problems arising from reverse causality, omitted variables, etc.).

3 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.

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.

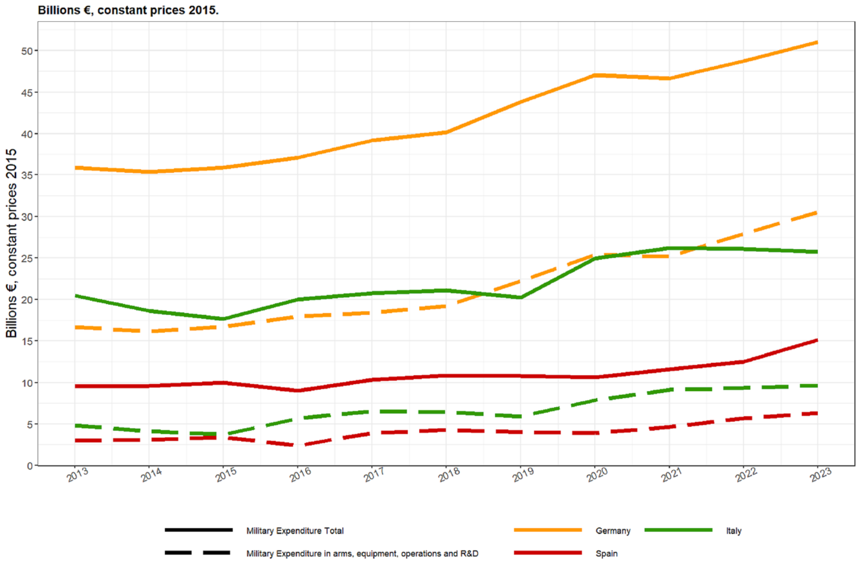

Figure 1: Total military expenditure and military expenditure on arms, equipment, operations and R&D.

In decade of slow economic growth, the increase in military expenditures has meant a rise in their share of GDP, as shown in Figure 2. For NATO EU countries, the percentage went from 1.4 % in 2013 to 1.8 % in 2023. In 2023, Germany was at 1.56 %, Italy at 1.45 % and Spain at 1.25 %. The US has long asked NATO EU countries to reach the 2 % of GDP target for military expenditures; after the start of the Ukraine war, Europe is getting close to such levels.

The international context for such patterns is provided by SIPRI data (based on a slightly different definition). From 2014 to 2022, military expenditures as a share of GDP decreased in the United States from 3.7 % to 3.4 %, in China from 1.7 % to 1.6 %, and in India from 2.5 % to 2.4 %, also due to their strong GDP growth over the decade. In Europe, Poland is the largest spender, moving from 1.9 % to 2.4 %, with a plan to reach 3 % in a few years; facing the war, Ukraine experienced a jump from 2.2 % to 33.5 % of GDP devoted to military activities.

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.

Arms procurement has the nature of capital investment as it is part of a country's gross fixed capital formation. An additional investigation can then

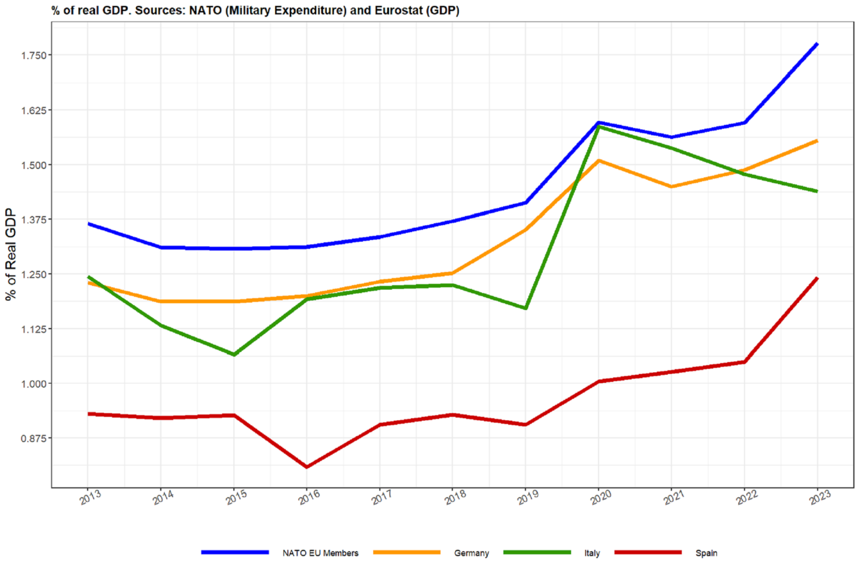

Figure 2: Military expenditure (percentage of GDP).

compare the investment dynamics in different areas of public expenditures. Figure 3 shows the percentage changes (in real terms) in public investment in arms acquisition, environmental protection, education, and health for the 2013–2023 period.[5]

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 %, 4.8 times faster than total public investment.

Germany shows a 67 % increase in public investment, similar to the expansion of health capital expenditures (+78 %), while environmental investment did not grow. 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

5 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. A description of available data from Eurostat and COFOG is provided in the Appendix.

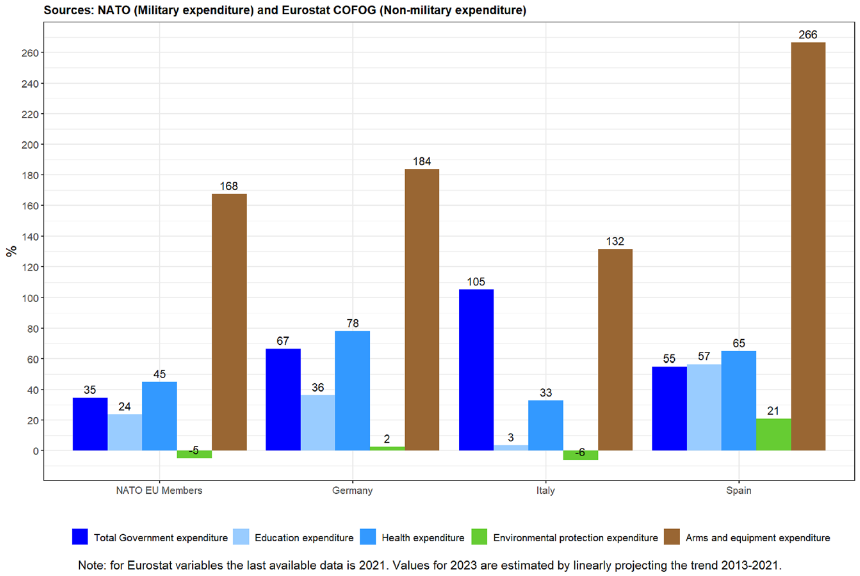

Figure 3: Arms expenditures versus investment in the environment, education and health percentage change in real terms, 2013–2023.

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 rapid increase in arms procurement in 2023.

The widespread problems with public finance and poor economic performances experienced by Europe in the last decade have shaped the context for difficult policy choices regarding public spending priorities. It is remarkable that all NATO EU countries – even those in greater economic difficulties, such as Italy and Spain – have allowed military expenditure and investment in arms procurement to take priority over environmental and social objectives. The increasing military orientation of European economies is likely to be problematic not only in terms of social quality and environmental sustainability but also in terms of its impact on economic and employment performance, that we assess in the next sections.[6]

3.2 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 Pollin and Garrett-Peltier (2009), Peltier (2017; 2019; 2023) and Garret-Peltier (2017).[7]

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.[8] We leave aside the induced effects, i.e. the demand effects of incomes and wages paid by a given industry generated by the different types of expenditure, 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. We start from the inter-country input–output data contained in the OECD-ICIO database. From the original table, we extracted three separate input–output matrices for Germany, Italy, and Spain.[9] For each country, we then transformed the matrix of inter-industry monetary flows into a $n \times n$ matrix of technical coefficients of production A, where n is

6 The environmental expenditures we consider (see definition in the Appendix) are confined to a rather narrow set of activities and do not consider the broader challenges related to climate change and to its disruptive economic impacts. If Europe's public expenditures give priority to arms acquisition and fail to devote adequate resources to climate change prevention and mitigation, the negative impact on growth and jobs is likely to be of major relevance (Fankhauser and Tol 2005; Roson and van der Mensbrugghe 2012).

7 For an introduction to input–output analysis see Miller and Blair (2009).

8 Our focus is on the backward-linkage effects, i.e. the economic impacts of an increase in demand for arms, environmental protection, education, and health services on the upstream sectors. As such activities are generally related to final public demand, we do not consider the forward-linkage effects. Our definitions of direct and indirect effects differ slightly from those commonly adopted in most I–O literature (e.g. Miller and Blair 2009).

9 See the Appendix and the Online Supplementary Material for details on I–O data.

the number of industries of the economy. Each entry of the matrix of technical coefficients is defined as follows:

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

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 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:

$$x = Ax + f \tag{2}$$

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

The solution to the system is:

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

where $(I–A)^{-1}$ 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 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

Table 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

input–output tables for the US arms industry ("Federal national defence: 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.

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 "Defence 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 Δf are:

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

Using Equation (5) – and building different vectors of change in final demand Δf – we obtain the domestic output effects of an increase in investment expenditure, in arms, environmental protection, education, and health activities.[10]

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 1 year an output of the value of one million euros. Finally, we transformed the Leontief inverse matrix into an employment requirement matrix ER as follows:

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

where 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 Δf:

10 For arms production, the vector Δf is generated using the weights presented in Table 1; for environmental protection, education, and health, the vector Δf 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.

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[a]	1.77	2.52	1.72
Education	1.27	5.51	1.20
Health	1.38	4.29	1.32
Italy			
Arms	1.82	59.28	0.74
Environment[a]	1.91	2.33	1.87
Education	1.26	28.36	0.90
Health	1.56	3.53	1.51
Spain			
Arms	1.65	22.30	1.28
Environment[a]	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. [a]Water supply, sewerage, waste management, and remediation activities.

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

Using Equation (7) – and considering different vectors of change in final demand Δf – 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 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.[11]

11 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 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).

The multiplier effects on the domestic economy is 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 0.74, due to the high share of arms imports, the lowest value of all sectors. In Spain arms expenditure has an output effect of 1.28, lower than environment and health, and higher than education.

Table 3 presents for the three countries the detailed effects of a €1,000 million 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 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 million expenditure, broken down in the direct impact within the same industry and the indirect effects in the rest of the economy. A €1,000 million 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.

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	1,230.58	2.45	2.01	1.83	3.84
Environment[a]	1,164.75	558.34	1,723.09	3.15	3.67	2.53	6.20
Education	1,032.60	167.77	1,200.37	9.60	9.91	0.77	10.68
Health	998.96	325.24	1,324.20	11.57	11.56	1.47	13.03
Italy							
Arms	440.17	301.47	741.64	3.29	1.44	1.47	2.91
Environment[a]	1,100.81	765.12	1,865.93	4.81	5.30	3.70	9.00
Education	726.48	173.43	899.91	11.43	8.31	0.86	9.17
Health	1,057.42	450.85	1,508.28	8.26	8.74	2.18	10.92
Spain							
Arms	837.74	446.87	1,284.61	3.50	2.88	3.11	5.99
Environment[a]	1,188.20	529.14	1,717.33	5.49	6.52	3.65	10.17
Education	985.07	188.75	1,173.82	13.64	13.43	1.29	14.73
Health	1,003.40	312.18	1,315.59	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. [a]Water supply, sewerage, waste management, and remediation activities.

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, €1,866 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.[12]

4.1 Sensitivity Analysis

How solid are the results we have obtained, and how sensitive are they to the methodology we have adopted? The multiplier effects of arms acquisition we calculated are linear combinations of the multiplier effects of the three main component sectors of arms industry: “Computer, electronic and optical equipment”, “Motor vehicles, trailers and semi-trailers”, and “Other transport equipment”. This implies that the results are sensitive to the weights assigned to each component sector. Additionally, the estimated domestic multiplier effects of investment in arms procurement, environmental protection, education, and health are highly dependent on each country’s and sector’s propensity to import out of final investment demand.

12 A limitation of standard I–O analysis is the use of average rather than marginal labour requirements to calculate the employment effects of increased expenditure. This approach does not account for the possibility that changes in final demand could affect the degree of labour intensity in the sector (Dunne 1986). Dunne and Smith (1984) and Barker, Dunne, and Smith (1991) compare the marginal and average employment effects of the peace dividend in the UK and find that the “average” calculation overestimates the net employment gains from a cut in military expenditure.

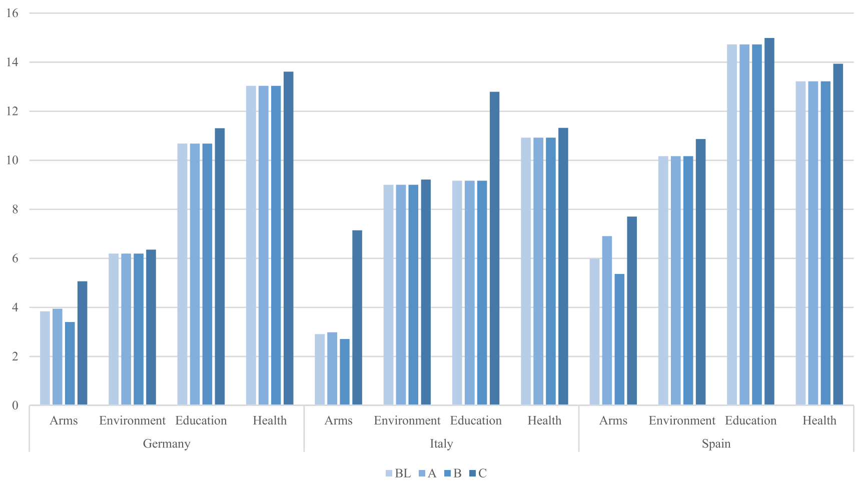

Figure 4: Employment effects of 1,000€ million expenditures (in thousands FTE employees).

Therefore, in order to assess the robustness of our findings, we conducted a sensitivity analysis by generating three scenarios (A, B, C), based on different assumptions, that can be compared with the baseline one (BL) leading to the results shown above.

In Scenario A, we assume that the arms industry is comprised entirely of the most labour-intensive industry (i.e. "Computer, electronic and optical equipment", which includes military electronics). Thus, the domestic output and employment effects of increasing arms expenditure in this scenario are determined entirely by the output multiplier of the "Computer, electronic and optical equipment" industry and the labour intensity of this sector and its intermediate input suppliers.

In Scenario B, we assume that the arms industry is comprised entirely of the least labour-intensive industry (i.e. "Motor vehicles, trailers and semi-trailers", which include tanks and armoured vehicles). Therefore, the economic impact of arms acquisition in this scenario is determined entirely by the output multiplier and the labour intensity of this sector and its intermediate input suppliers.

In Scenario C, the propensity to import out of final investment demand was set to 0 for all military and non-military expenditures. This scenario simulates that all final investment goods in the four sectors are produced domestically. Therefore, to calculate the output and employment effects of each type of expenditure, we used the multipliers of final demand provided in Table 2.

Figure 4 shows the employment effects of a €1,000 million expenditure in each sector for the baseline (BL) and the three alternative scenarios (A, B, C).

The sensitivity analysis demonstrates that our findings are robust to different weights for the sectoral structure of the arms industry and to different assumptions about the domestic content of military and non-military sectors. The new jobs created by a €1,000 million expenditure for arms acquisition would range between 3,400 and 5,100 in Germany, between 2,700 and 7,100 in Italy, and between 5,400 and 7,700 in Spain. In all three alternative scenarios, the employment impact of the same amount of increase in public investment in environmental protection, education, and health would be about 1.5–4 times greater than that in arms procurement. In the education and health sectors, the larger employment effects are due to higher labour intensity than in the arms industry. In the environmental protection, the larger employment effects are due to both higher labour intensity and a higher output multiplier than in the arms industry.[13]

4.2 The Employment Outcomes

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 10 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, 147,000 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

---

13 In all three alternative scenarios (A, B, C), the multiplier effects in terms of domestic output expansion for public investment in environmental protection exceed those of increased arms procurement. Thus, the sensitivity analysis confirms the findings of our baseline scenario. Detailed results for each simulation scenario are available upon request.

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[a]	139.26	147.07	107.51
Education	239.94	149.78	155.69
Health	292.75	178.45	139.80

[a]Water supply, sewerage, waste management, and remediation activities.

number of jobs/year created by the same amounts of expenditure ranges from 140,000 in Spain to 293,000 in Germany. Similar data emerge for education.

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 than three times the job impact of arms production.[14]

5 Conclusions

In the last decade, Europe has significantly increased its military expenditures, both in absolute terms and as a share of GDP, with a dramatic acceleration since the start of the war in Ukraine in 2022. In all NATO EU countries, this expansion has been driven by higher acquisitions of arms and equipment. At a time of economic stagnation and constraints on public finance, Europe's increased arms procurement is likely to reduce the space for social and environmental public investment.

In this article, we employed input–output analysis to estimate the economic and employment impacts of increasing expenditure in arms production in Germany, Italy, and Spain, comparing them with the effects of increasing public capital expenditure in environmental protection, education, and health services.

Our findings show that the current drive to increase European military expenditures has problematic economic consequences. Policies that concentrate

14 Numerical simulations built on the sensitivity analysis show that comparing the number of jobs/year created by the cumulative increase in arms procurement with the potential increase in jobs/year if the same amounts were spent on non-military alternatives reveals missed job creation opportunities ranging between 25,400 and 229,500 jobs/year in Germany, between 30,300 and 164,800 jobs/year in Italy, and between 26,000 and 101,700 in Spain. Detailed results for each simulation scenario are available upon request.

limited public resources in military activities 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.

According to our estimates, investment in environmental protection has greater multiplier effects in terms of domestic output than arms acquisition; in terms of domestic employment effects, investing in environmental protection, education, and health activities generate two to four times as many jobs as investing in arms acquisition. These estimates allowed us to compare the number of jobs created by the cumulative increase in arms expenditure in the period 2013–2023 with the potential employment gains if the same amounts of resources had been spent on non-military alternatives. Our calculations show that missed job creation opportunities range between 53,000 and 206,000 jobs/year in Germany, between 100,000 and 131,000 jobs/year in Italy, and between 44,000 and 92,000 jobs/year in Spain.

In quantitative terms, considering the performances of economic and employment growth, our 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.

Acknowledgements: The article is an extension of the research report '*Arming Europe. Military expenditures and their economic impact in Germany, Italy, and Spain*' we produced for Greenpeace (Bonaiuti et al. 2023). We thank Gianni Alioti, Sofia Basso, Raul Caruso, Guillem Colom Piella, Alexander Lurz, Jocelyn Mawdsley, Leopoldo Nascia, Pierdavide Pasotti, Quique Sánchez Ochoa, Javi Raboso, Francesco Vignarca for the discussions on the subject.

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, Roumania, 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 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 salsos 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 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 ‘900–2023’. 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 9–11 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 h each), in line with the Eurostat's imputation method for Annual work unit.

The input–output tables and FTE employment data for each country are provided in the online supplementary material.

References

Alptekin, A., and P. Levine. 2012. "Military Expenditure and Economic Growth: A Meta-Analysis." *European Journal of Political Economy* 28 (4): 636–50.

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

Arin, K. P., F. Koray, and N. Spagnolo. 2015. "Fiscal Multipliers in Good Times and Bad Times." *Journal of Macroeconomics* 44: 303–11.

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." In *Paper for the 19th IMF Jacques Polak Annual Research Conference, November 1–2, 2018*.

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

Barker, T., J. P. Dunne, and R. P. Smith. 1991. "Measuring the Peace Dividend in the United Kingdom." *Journal of Peace Research* 28 (4): 345–58.

Becker, J., and J. P. Dunne. 2023. "Military Spending Composition and Economic Growth." *Defence and Peace Economics* 34 (3): 259–71.

Becker, J., S. Benson, J. P. Dunne, and E. Malesky. 2024. "Disaggregated Defense Spending: Introduction to Data." *Journal of Peace Research* 00223433231215785, https://doi.org/10.1177/00223433231215785.

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

Bonaiuti, C., P. Maranzano, M. Pianta, and M. Stamegna. 2023. Arming Europe. Military Expenditures and Their Economic Impact in Germany, Italy, and Spain. Report for Greenpeace, November 2023. 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): 273–88.

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): 302–5.

Cepparulo, A., and P. Pasimeni. 2024. *Defence Spending in the European Union*. European Commission. Discussion Paper 199, April 10, 2024.

Churchill, S. A., and S. L. Yew. 2018. "The Effect of Military Expenditure on Growth: An Empirical Synthesis." *Empirical Economics* 55 (3): 1357–87.

D'Agostino, G., J. P. Dunne, and L. Pieroni. 2018. "Military Expenditure, Endogeneity and Economic Growth." *Defence and Peace Economics* 30 (5): 509–24.

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). https://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 (2): 331–49.

Dunne, J. P. 1986. "The Employment Consequences of Military Expenditure: A Comparative Assessment." In *ILO Disarmament and Employment Programme*, working paper no. 6. Geneva: International Labour Office.

Dunne, J. P. 1996. "Economic Effects of Military Expenditure in Developing Countries: A Survey." In *The Peace Dividend*, edited by N. P. Gleditsch, O. Bjerkholt, A. Cappelen, R. Smith, and J. P. Dunne, 439–64. Amsterdam: Elsevier.

Dunne, J. P., and E. Sköns. 2010. "Military Industrial Complex." In *The Global Arms Trade: A Handbook*, edited by A. Tan, 281–92. London: Routledge.

Dunne, J. P., and M. Uye. 2010. "Military Spending and Development." In *The Global Arms Trade: A Handbook*, edited by A. Tan, 293–305. London: Routledge.

Dunne, J. P., and N. Tian. 2013. "Military Expenditure and Economic Growth: A Survey." *The Economics of Peace and Security Journal* 8 (1): 5–11.

Dunne, J. P., and N. Tian. 2016. "Military Expenditure and Economic Growth, 1960–2014." *The Economics of Peace and Security Journal* 11 (2): 50–6.

Dunne, J. P., and R. P. Smith. 1984. "The Economic Consequences of Reduced UK Military Expenditure." *Cambridge Journal of Economics* 8 (3): 297–310.

Dunne, J. P., and R. P. Smith. 2020. "Military Expenditure, Investment and Growth." *Defence and Peace Economics* 31 (6): 601–14.

Dunne, J. P., R. P. Smith, and D. Willenbockel. 2005. "Models of Military Expenditure and Growth: A Critical Review." *Defence and Peace Economics* 16 (6): 449–60.

Fankhauser, S., and R. S. J. Tol. 2005. "On Climate Change and Economic Growth." *Resource and Energy Economics* 27 (1): 1–17.

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* 61: 439–47.

Gentilucci, E. 2010. "The Military Expenditure in the Analysis of Contemporaneous Economists." In *History, Philosophy and Sociology of Sciences*. Paris I: Université Panthéon-Sorbonne. https://theses.hal.science/tel-00612338/document.

Gleditsch, N. P., O. Bjerkholt, A. Cappelen, R. Smith, and J. P. Dunne, eds. 1996. *The Peace Dividend*. Amsterdam: Elsevier.

Leontief, W., and M. Hoffenberg. 1961. "The Economic Effects of Disarmament." *Scientific American* 204 (4): 47–55.

MacNair, E., C. Murdoch, and T. Sandler. 1995. "Growth and Defence: Pooled Estimates for the NATO Alliance, 1951–1988." *Southern Economic Journal* 61 (3): 846–60.

Markusen, A. 1986. "The Militarized Economy." *World Policy Journal* 3 (3): 495–516.

Medoff, J. L. 1993. *Smart Stimulus: More Good Jobs*. Washington: Center for National Policy.

Melman, S. 1988. *The Demilitarized Society: Disarmament and Conversion*. Montreal: Harvest House.

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 *Le armi della Repubblica: dalla Liberazione a oggi*, edited by N. Labanca, 177–208. Torino: Utet.

Olejnik, L. W. 2024. "Left-Wing Butter vs. Right-Wing Guns – Government Ideology and Disaggregated Military Expenditures." Discussion Paper NO. 24–26. ZEW Mannheim, May, 2024.
Peltier, H. 2017. "Job Opportunity Cost of War." In *Costs of War*. Providence, Rhode Island: Watson Institute, Brown University. May 24, 2017.
Peltier, H. 2019. "War Spending and Lost Opportunities." In *Costs of War*. Providence, Rhode Island: Watson Institute, Brown University.
Peltier, H. 2023. "We Get What We Pay For: The Cycle of Military Spending, Industry Power, and Economic Dependence." In *Costs of War*. Watson Institute, Brown University and Pardee Center, Boston University. June 8, 2023.
Pollin, R., and H. Garrett-Peltier. 2009. "The U.S. Employment Effects of Military and Domestic Spending Priorities." *International Journal of Health Services* 39 (3): 443–60.
Roson, R., and D. van der Mensbrugghe. 2012. "Climate Change and Economic Growth: Impacts and Interactions." *International Journal of Sustainable Economy* 4 (3): 270–85.
Saccone, D., P. Della Posta, E. Marelli, and M. Signorelli. 2022. "Public Investment Multipliers by Functions of Government: An Empirical Analysis for European Countries." *Structural Change and Economic Dynamics* 60: 531–45.
Saeed, L. 2023. "The Impact of Military Expenditures on Economic Growth: A New Instrumental Variables Approach." *Defence and Peace Economics* 1–16, https://doi.org/10.1080/10242694.2023.2259651.
Sandler, T., and K. Hartley. 1995. *The Economics of Defense*. Cambridge: Cambridge University Press.
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*. December 2015. 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). 2023. SIPRI Arms Transfers Database. https://doi.org/10.55163/SAFC1241.
SIPRI (Stockholm International Peace Research Institute) (various years). 2023. SIPRI Military Expenditure Database. https://doi.org/10.55163/CQGC9685.
Smith, R. P. 1977. "Military Expenditure and Capitalism." *Cambridge Journal of Economics* 1 (1): 61–76.
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): 35263.

Supplementary Material: This article contains supplementary material (https://doi.org/10.1515/peps-2024-0019).