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Abstract: This paper presents a macroeconomic impact assessment of the European Defence Fund (EDF) expenditure planned for the programming period 2021-2027. The analysis is carried out with the spatial dynamic computable general equilibrium model called RHOMOLO. According to this analysis, EDF investments can generate significant economic returns in terms of Gross Domestic Product (GDP) and employment. These economic benefits are long-lasting and are still significant ten years after the end of the programme, thanks to the productivity gains resulting from the R&D activities financed by the policy. Impact assessments such as the one presented here allow for continuous policy adjustment and ensure informed decision-making by evaluating potential economic outcomes, thereby increasing transparency and accountability to EU citizens and Member States.

Keywords: European Defence Fund, Macroeconomic impact assessment, Research and development, innovation, General equilibrium modelling.

JEL Codes: C68, O30, R13.

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Executive summary

The European Defence Fund (EDF) 2021-2027 is expected to generate significant long-term economic benefits, including increases in GDP and employment, according to a macroeconomic impact assessment using the RHOMOLO model. With a budget of €7.05 billion, the EDF aims to support collaborative defence research and development (R&D) and promote an innovative and competitive defence industrial base. The assessment shows that EDF investments can generate significant economic benefits even ten years after the end of the programme, thanks to the productivity gains resulting from the R&D activities funded by the policy.

The RHOMOLO model simulations indicate that the EDF will have a positive impact on EU GDP, with a maximum increase of 0.025% in 2030, corresponding to an increase of almost €3 billion and the creation of more than 30 thousand jobs across the EU. The cumulative EU GDP multiplier, which measures the return on investment, is expected to increase over time, reaching €4.5 for every €1 invested in the EDF by 2040.

The evaluation underlines the importance of the EDF in supporting economic growth and job creation in the EU, while stressing that the results should be interpreted with caution due to the limitations of the model and the assumptions made. The EDF is seen as a strategic catalyst for defence cooperation and industrial competitiveness, and its economic benefits are expected to last beyond the end of the programme. Overall, the evaluation provides valuable insights into the potential economic impact of the EDF and informs policy decisions on the allocation of resources to support defence R&D and capability development.

1. Introduction

This document presents a macroeconomic impact assessment of the European Defence Fund (EDF) 2021-2027, carried out using the spatial dynamic computable general equilibrium (CGE) model called RHOMOLO (Lecca et al., 2018). Economic impact assessments are crucial for the European Commission when developing policies such as the EDF, as they ensure informed decision-making by evaluating potential economic outcomes, thereby increasing transparency and accountability to the citizens of the European Union (EU) and to its Member States. These assessments facilitate efficient resource allocation and risk management, while also engaging stakeholders and building market confidence. By providing benchmarks for evaluation, they allow for continuous policy adjustment and confirm strategic alignment with broader EU objectives, ultimately contributing to the effectiveness and credibility of EU policies.

The EDF is an EU initiative to support collaborative defence research and development (R&D), and to promote an innovative and competitive defence industrial base. It was proposed by the European Commission in 2017 and became operational in 2021 (see Regulation (EU) 2021/697). The EDF has two main objectives:

- Supporting defence research: The fund provides grants for collaborative research on innovative defence technologies and products, from early-stage research to the development of prototype systems;
- Supporting the development of defence capabilities: The EDF supports collaborative projects for the subsequent development phases of defence products and technologies, including the design phase, prototype testing, qualification, and certification.

The budget for the EDF is part of the EU's long-term budget (Multiannual Financial Framework) for 2021-2027, with a proposed allocation of around €7 billion for the whole period. The fund is designed to leverage national investments in defence R&D and act as a catalyst for cross-border cooperation between companies and research organisations across the EU. The EDF is part of the wider European Defence Action Plan, which aims to strengthen the EU's strategic autonomy, improve its ability to protect its citizens, and boost the competitiveness of its defence industry.

The EDF aims to stimulate cooperation between Member States and reduce duplication of expenditure in the EU defence sector. EDF-funded projects must involve cross-border cooperation with at least three participants from three different Member States or associated countries. EDF grants can cover up to 100% of eligible costs, with additional incentives for both small and medium-sized enterprises (SMEs) and companies with a market capitalisation between that of an SME and that of a large company ("mid-caps"), as well as for projects linked to Permanent Structured Cooperation (PESCO - see Decision (CFSP) 2017/2315).

The EDF's annual work programs, divided into 34 thematic and horizontal categories, are aligned with the EU's Multiannual Financial Framework and the defence priorities set by Member States under the Common Security and Defence Policy (CSDP) and Capability Development Plan (CDP). The programme also takes into account NATO and regional priorities. Managed directly by the European Commission, or delegated where justified, the EDF prioritises projects across all military domains and key technologies to meet Member States' needs and target essential future capabilities. The programme agenda is developed in consultation with Member State representatives, the European Defence Agency (EDA), and the European External Action Service (EEAS).

The macroeconomic impact assessment presented in this document shows that EDF investments can generate economic returns in terms of Gross Domestic Product (GDP) and employment. These economic benefits are long-lasting and are still significant ten years after the end of the programme, thanks to the productivity gains resulting from the R&D activities financed by the policy.

Note that this assessment has some similarities with the impact assessment of the Horizon policy, which also deals with R&D investment (Christou et al., 2024a). However, there are differences in the simulation strategy that make the results different from those of the Horizon assessment, and we explain these when commenting on the results below.

The rest of the document is structured as follows. Section 2 presents the data used in the analysis. Section 3 briefly explains the model and the simulation strategy used to analyse the data with the spatial CGE model. Section 4 presents the results and section 5 concludes.

2. The EDF data used in the analysis

The EDF data used in this analysis were provided by the Directorate-General for Defence Industry and Space (DG DEFIS) and the main features are summarised here. The total amount spent in the European Union (EU) is €7,051.66 million for the programming period 2021-2027. The main activity funded by the EDF is research and development (R&D).

The time profile of the actual expenditure over the period is unknown at the time of writing (last quarter of 2024). A realistic time profile is based on the assumption that projects have started two years after the start of the programming period, i.e. in 2023, and that the last payments will be made in 2031 (see Table 1). This estimated payment profile projection is calculated assuming that projects start in January 2023, last around 3 years, and payments are made every 18 months with the following shares: 55%, 35%, and 10%).

Table 1. Time profile of the EDF expenditure 2021-2027 (€ million)

	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**
Payment profile			562.78	901.80	998.66	998.66	998.66	998.66	998.66	465.91	127.86

Source: DG DEFIS (July 2024).

Additional information provided by DG DEFIS shows that 92.7% of the funds are directed to the private sector (funding R&D activities in science and technology – M-N sector, in the NACE Rev. 2 classification, see also Table 2) and 7.3% to the public sector.

3. The model and the simulation strategy

3.1 The RHOMOLO model

RHOMOLO is a spatial dynamic CGE model routinely used for policy impact assessment and its mathematical description can be found in Lecca et al. (2018). The model covers all 235 NUTS 2 regions of the EU and disaggregates their economies into ten NACE Rev. 2 sectors. It has been recently used to assess the impact of Horizon Europe (Christou et al., 2024a), of the 2014-2027 Cohesion policy programmes (Christou et al., 2024b), of the Recovery and Resilience Facility (Barbero et al., 2024), and labour market measures related to the European Social Fund (Christou et al., 2023), among other things.

A full description of the model is beyond the scope of this document. Some of its main features are the following. The RHOMOLO model is calibrated using data organised in a multi-regional system of Social Accounting Matrices (SAMs) of the NUTS-2 regions of the EU27 (García-Rodríguez et al., 2025). SAMs are detailed, economy-wide datasets that represent all transactions between economic agents within a given time period. Extending Input-Output tables, SAMs cover the full circular flow of income, detailing the interactions between all agents in the economy. Often used to inform multi-sectoral CGE models (Mainar-Causapé et al., 2018), SAMs provide a nuanced picture of economic transactions and serve as a valuable tool for policy analysis.

Following the data availability of Eurostat regional accounts, the RHOMOLO sectors are shown in Table 2.

Table 2. Economic sectors in RHOMOLO (NACE Rev. 2 classification)

NACE Rev. 2 Code	**Definition**
A	Agriculture, forestry and fishing
B-E	Industry (except construction)
C	Manufacturing
F	Construction
G-I	Wholesale and retail trade, transport, accommodation and food service activities
J-K	Information and communication, Financial and insurance activities
L	Real estate activities
M_N	Professional, scientific and technical activities; administrative and support service activities
O-Q	Public administration, defence, education, human health and social work activities
R-U	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies

Source: García Rodríguez et al., 2025.

All regions are linked by trade and production factor flows. Trade is modelled following Armington (1969) and all regions are treated as small open economies. Households, governments and industries (sectors) consume domestically produced and imported goods and services. Myopic economic agents optimise within one year, and the model is solved recursively, year by year. For this particular exercise, the model was run assuming Dixit-Stiglitz monopolistic competition, capital mobility, and a labour market governed by a static wage curve.

3.2 The simulation strategy

The RHOMOLO simulations, the results of which are presented below (based on data provided to the JRC by DG DEFIS), should be read as the result of a shock of a total of €7,051.66 million spent over nine years (between 2023 and 2031 - see Table 1). The simulation results refer to 20 years of simulations (from 2021 to 2040), because R&D investment (such as the one studied here) has long-term effects that are worth analysing (even ten years after the end of the programming period). This is a scenario analysis: the model is calibrated with data for 2017 which is assumed to be the initial steady state of the economy, hereinafter referred to as the baseline (based on the work of García-Rodríguez et al., 2025). This is shocked with the policy intervention, and the results are presented as deviations from the baseline, and can therefore be read as the impact of the policy itself. In other words, the simulation allows for a 'what if' comparison of an initial state of the economy with a counterfactual scenario resulting from the introduction of a shock.

The EDF data were used as input for the RHOMOLO simulations and an effort was made to activate the economic channels most likely to be activated by the policy. As agreed between the JRC and DG DEFIS (in meetings between May and July 2024), the simulation strategy is as follows.

We simulated 92.7% of the funds as private investment by lowering the user cost of capital. The reduction in the exogenous part of the user cost of capital stimulates private investment and leads to a temporary increase in the stock of private capital (which depreciates at an annual rate of 15%). These R&D investments are assumed to generate a supply-side effect consisting of an increase in total factor productivity (TFP) in the science and technology sector (M-N). The elasticity governing the change in TFP due to the R&D investment ranges between 0.01 and 0.04 and depends positively on regional R&D intensity (measured as R&D expenditure as a percentage of GDP – source: Eurostat). The elasticity is in line with the existing evidence on the impact of R&D expenditure (Bronzini & Piselli, 2009; Männasoo et al., 2018; and Griffith et al., 2004). The increase in TFP is subject to an annual decay rate of 5%.

The remaining 7.3% of the funds was simulated as an increase in public investment. Public capital enters the model's production function as an unpaid factor, available to all firms but subject to congestion effects (Baxter and King, 1993; Fisher and Turnovsky, 1998); thus, this shock leads to an increase in the production of goods and services in the economy. The effects of the shock gradually disappear due to the depreciation of the public capital added by the intervention (the depreciation rate of public capital is 5%). The public capital elasticity of output with respect to public capital plays an important role in determining the results. We follow the existing literature by assigning a value of 0.08 in the EU. This value is conservative and lies between the 40th percentile and the median of the distribution of the estimated values as discussed in the meta-analysis of Bom & Ligthart (2014).

3.3 Limitations of the analysis

Firstly, RHOMOLO is primarily a model used for ex-ante evaluations, but it is also useful for interim evaluations such as the one presented here. The data used to feed the model relate to actual defence spending at the start of the evaluation period and projections for the second half of the period, so this is an interim evaluation in the sense that we are assessing the impact of past policy interventions. The scenario analysis capabilities of the model allow us to quantify the impact of these past investments, providing valuable insights into the efficiency and effectiveness of the EDF. It should be understood that the model does not measure the actual impact of the policy investment, but rather provides a hypothetical scenario of what might be expected. This means that the results should be interpreted as a possible outcome rather than a definitive prediction of the impact of the policy.

Second, the defence sector may differ from other sectors normally considered in RHOMOLO analyses in terms of its non-commercial, classified and non-market nature. However, the focus of the EDF on R&D investment allows some parallels to be drawn with other EU-funded R&D initiatives, such as the Horizon funds. The mechanisms driving the impact of R&D investment in the defence sector may not be entirely dissimilar to those in other sectors, particularly when considering the potential for knowledge spillovers, innovation and economic growth.

A third important limitation of the analysis is the assumption that interventions are financed by a non-distortionary lump sum contribution. In reality, policies such as the European Defence Fund are likely to be financed through distortionary taxes, which would reduce the macroeconomic impact of the policy. This assumption may lead to an overestimation of the potential benefits of the policy, as the model does not take into account the negative effects of taxation on economic activity.

Furthermore, the scenario analysis does not take into account the potential opportunity costs associated with the financing of the European Defence Fund. In other words, it does not take into account the fact that allocating funds to this policy may require reductions in budget allocations to other, alternative policies. This could have a significant impact, as the resources diverted to the EDF could have been used to support other policies that might have had a greater impact on the economy. By ignoring these potential trade-offs, the scenario analysis provides an incomplete picture of the overall impact of the policy, highlighting the need for a more comprehensive assessment that takes into account the broader budgetary context.

4. GDP Impact, Multipliers and Employment change

Table 3 shows the impact of the EDF investments on i) EU GDP expressed as % differences from the baseline; ii) the impact in EUR million per year (obtained by multiplying the % differences by EU GDP in 2021); iii) EU employment expressed as % differences from the baseline; iv) EU employment expressed as net new jobs created per year; v) the cumulative GDP impact in EUR million per year (note that the cumulative impact is the same as the annual impact in 2023, that is the first year in which the shock is applied); vi) the cumulative GDP multiplier, which indicates the EUR of GDP generated by each EUR invested in the policy (it is calculated as the cumulative change in GDP divided by the cumulative shock - monetary injection).

Table 3. EU GDP Impact and Multipliers

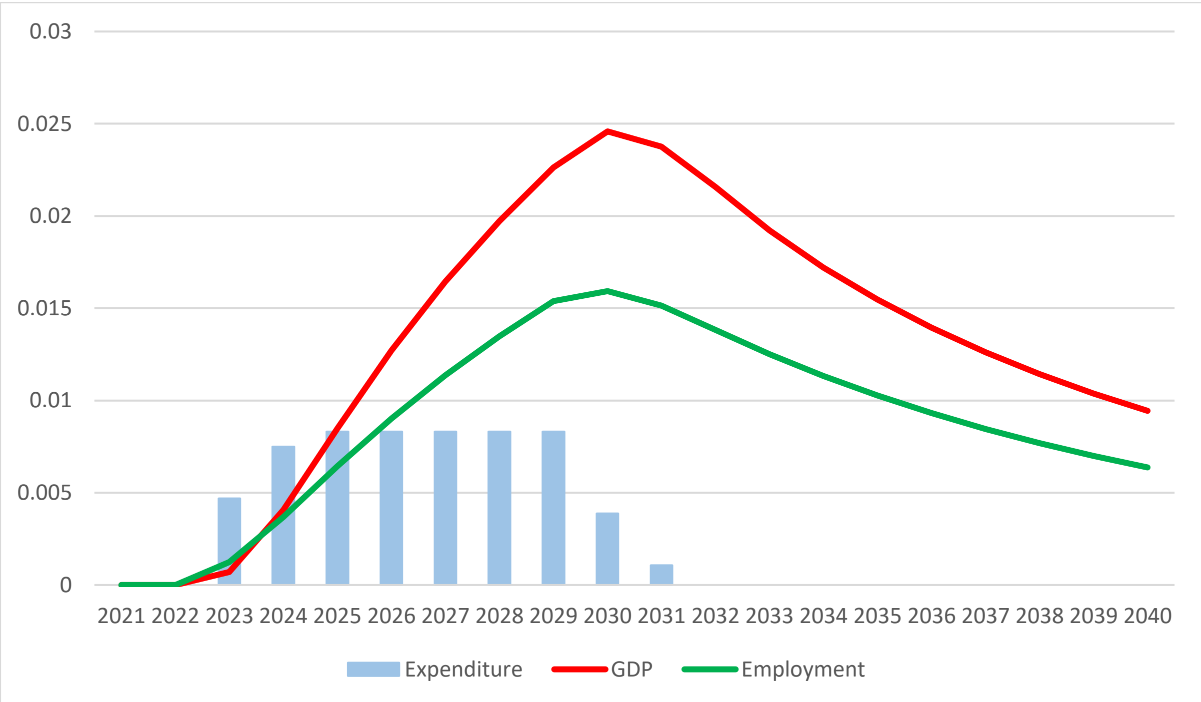
Year	EU GDP Impact (%)	GDP Impact (euro, million)	EU Employment Impact (%)	EU Employment (number of workers)	Cumulative GDP change (Million Euro)	EU GDP multiplier
2021	0	0	0	0	0	0
2022	0	0	0	0	0	0
2023	0.001	85	0.001	2,526	85	0.15
2024	0.004	488	0.004	7,485	573	0.39
2025	0.008	1,019	0.006	13,097	1,592	0.65
2026	0.013	1,529	0.009	18,366	3,121	0.90
2027	0.016	1,975	0.011	23,123	5,096	1.14
2028	0.020	2,369	0.013	27,418	7,465	1.37
2029	0.023	2,719	0.015	31,295	10,185	1.58
2030	0.025	2,954	0.016	32,413	13,139	1.90
2031	0.024	2,854	0.015	30,830	15,993	2.27
2032	0.022	2,592	0.014	28,147	18,585	2.64
2033	0.019	2,309	0.013	25,471	20,894	2.97
2034	0.017	2,068	0.011	23,064	22,962	3.26

2035	0.015	1,859	0.010	20,902	24,820	3.53
2036	0.014	1,676	0.009	18,959	26,496	3.76
2037	0.013	1,515	0.008	17,213	28,012	3.98
2038	0.011	1,373	0.008	15,643	29,385	4.18
2039	0.010	1,247	0.007	14,231	30,631	4.35
2040	0.009	1,134	0.006	12,958	31,765	4.51

Source: RHOMOLO simulations.

Figure 1 shows the impact of the EDF on GDP (red line) and on employment (green line) over time and the full shock (blue bars) expressed as a percentage of baseline GDP. After the planned projects from the policy reach completion from 2023 onwards, EU GDP changes are positive each year. The policy reaches a maximum impact of +0.025% increase in EU GDP in 2030 compared to the baseline scenario (without the policy), thanks to the combination of increased private and public investment and higher TFP. This corresponds to a maximum of +2,954 million in 2030 and the creation of +32,413 jobs across the EU, leading to an increase in EU employment of about +0.016%. The impact declines thereafter due to the investment depreciation and lack of demand side stimulus (it is assumed that there are no further public investment in defence R&D after those planned for the period 2021-2027).

Figure 1. GDP Impact (% deviations from baseline GDP) and EDF expenditure (% EU GDP)



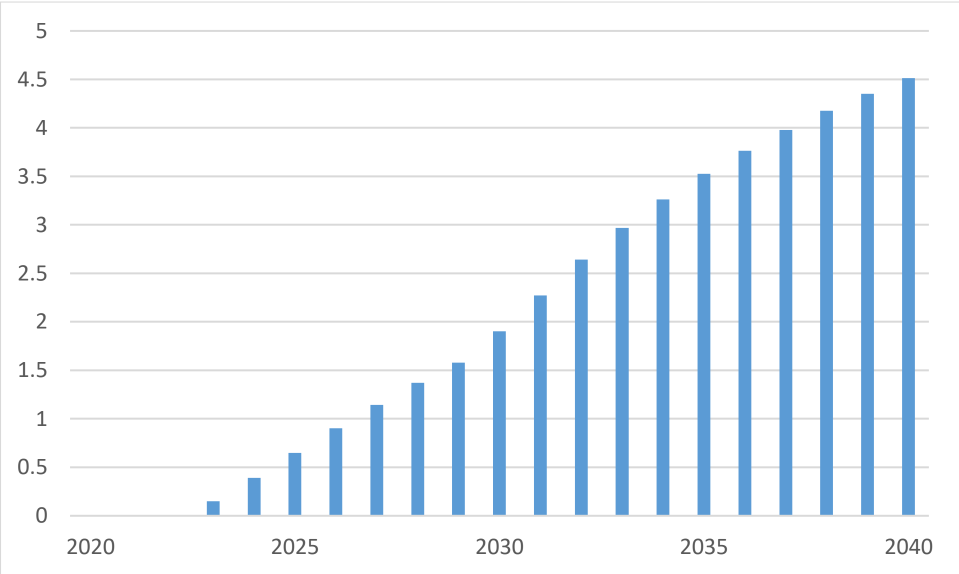
Source: RHOMOLO simulations.

Figure 2 shows the evolution of the cumulative EU GDP multiplier, which can be interpreted as a measure of the return on investment, expressed as the euros of GDP generated by each euro invested in the policy. The multiplier increases as projects get completed and, by 2040, a euro invested in the EDF is able to generate more than 4.5 euros in return.

This is similar to the results of the ex-post impact assessment of the Horizon policy carried out by Christou et al. (2024a), (in that case, the 17 year multiplier, comparable to the 2040 multiplier reported above, was 4.87 – see Table 4.1 of that paper), despite the following differences in the simulation strategy:

- The share of private versus public investment is 93% versus 7% (in the Horizon analysis it is 60% versus 40%);
- The TFP impact is concentrated in the science and technology sector (in the Horizon analysis it is spread across all sectors).

Figure 2. EU GDP Multiplier generated by the EDF investment



Source: RHOMOLO simulations.

5. Conclusions

The macroeconomic impact assessment of the EDF 2021-2027, carried out using the RHOMOLO model, is a critical exercise for the European Commission to understand the policy's broader economic implications. The EDF, with a budget of €7.05 billion, underpins the EU's strategic autonomy by funding joint defence R&D and capability development, promoting innovation, and enhancing the competitiveness of the EU defence industry.

The assessment reported here shows that EDF investments are likely to generate significant long-term economic returns, including increases in GDP and employment, which will persist even a decade after the programme due to productivity gains from R&D. These findings suggest that the EDF is not only a strategic catalyst for defence cooperation and industrial competitiveness but also a significant contributor to overall economic growth and job creation in the EU, reinforcing the value of such investments.

While economic modelling analyses are invaluable for policy impact assessment, they have several limitations. General equilibrium models (whether CGE such as RHOMOLO or other types) rely on a number of assumptions about market behaviour, technology, and the responsiveness of economic agents, that may not fully capture complex real-world dynamics or unanticipated events. They often require simplifications that may overlook nuanced interactions within the economy or between sectors. Data limitations can also limit the accuracy of these models, as they depend on the availability and quality of historical data, which may not reflect future conditions or structural changes. Additionally, the scope of these models is typically limited to quantifiable economic factors, which may underrepresent the social, environmental, or geopolitical impacts of policies. These limitations underline the need for a cautious interpretation of modelling results and the importance of complementing quantitative analyses with qualitative analysis to gain a full understanding of policy impacts.

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