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## The macroeconomic effects of defence spending: what impact beyond GDP?

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**Abstract**

This paper estimates the macroeconomic effects of defence spending for a panel of up to 27 EU member states over 1999–2025 using Panel Local Projections. We look beyond the output multiplier that dominates the literature to trace the price implications of defence spending and the demand-side channels through which effects operate. A key methodological contribution is a country-specific order-date adjustment for capital expenditure, constructed from the SIPRI Arms Transfers Database, which shifts the estimated (unitary) peak GDP multiplier from around year one to approximately year three to four. Under this specification, the HICP inflation response is higher and occurs earlier. Capital expenditure drives the positive output effects, whereas personnel and intermediate consumption generate stronger inflationary pressures per unit of fiscal impulse. Capital spending induces additional recurrent costs, standing at about 30 cents per euro spent over five years. Multipliers are also found to be substantially lower, on average, in high public debt regimes.

**Keywords:** Military Expenditure; Fiscal Multiplier; Local Projections; European Union; Spending Composition

**JEL Classification:** E31, E62, H54, H56

## Non-technical summary

European governments are rapidly increasing defence expenditure. Russia's full-scale invasion of Ukraine in February 2022 triggered immediate budgetary responses across EU member states, and the European Commission's *ReArm Europe Plan* initiative from March 2025 has elevated national and EU-wide defence ambitions to a structural priority. Understanding the macroeconomic consequences of this fiscal shift has become a priority not only for defence planners and fiscal authorities, but also for central banks: a sustained increase in public spending at this scale can increase inflation, shift trade balances, and interact with existing fiscal vulnerabilities in ways that go beyond real GDP.

This paper first provides a comprehensive empirical assessment of these macroeconomic effects, particularly inflation. We use a Panel Local Projection method, tracing how each variable of interest – real GDP, price dynamics, household consumption, net exports, and private investment – responds over a five-year horizon to an increase in defence spending, providing a richer picture of the fiscal transmission mechanism than estimates focused solely on output. Second, since our focus lies on European-wide effects, we use data for 27 EU member states from 1999 (and earlier) until 2025, thus drawing on more than two decades of variation in defence spending, while also providing an up-to-date EU assessment that covers the post-2022 build-up.

Finally, a central methodological contribution of our paper is the novel correction for a recording lag in European national accounts (the COFOG database, which classifies government expenditure by function). Under EU accounting rules, capital spending such as major weapons systems is recorded at *delivery*, not at *order*. For equipment that is often delivered several years after it is ordered, official data show a spending increase years after the actual fiscal decision. Using the Arms Transfers Database of the Stockholm International Peace Research Institute (SIPRI), we construct country-specific order-date adjustments for all 27 EU member states, with lags ranging from zero years (Malta) to four years (Germany, Italy, Sweden, and the Netherlands). Applying these adjustments shifts the estimated peak GDP response from year one to year three to four. At the same time, the inflation effect is larger and kicks in earlier. These are important differences for both budget planning and monetary policy assessment.

Turning to the size of estimates, a one percent of GDP increase in total defence spending generates a GDP multiplier of approximately unity at its peak, consistent with the broader government spending literature. Both multipliers lie below their respective peaks by the five-

year horizon – the unadjusted settling at around 0.3, the adjusted one higher, at around 0.6. On the price side, consumer prices (HICP) and the GDP deflator rise persistently, with the deflator response generally larger – reflecting that defence-specific cost pressures show up directly in government deflators, while HICP effects operate through indirect channels. In the adjusted specification, cumulative HICP inflation reaches about 1 percentage point by year one, peaks at about 1.4 percentage points in year three and remains at around 1.25 percentage points at the five-year horizon. The inflation effect also holds, with a smaller magnitude, when the sample ends in 2021, before the inflation surge.

The aggregate figures, however, conceal substantial differences across spending categories. Capital expenditure drives the GDP effects of defence spending, generating the largest and most persistent output multiplier. Personnel costs and intermediate consumption, by contrast, produce stronger inflationary pressure per euro of fiscal impulse but more limited output effects. Capital procurement also generates *recurrent costs*: each additional euro triggers approximately 30 cents of additional personnel and maintenance spending over five years, implying that the true fiscal cost of a procurement-heavy build-up substantially exceeds the initial capital appropriation.

The macroeconomic returns to defence spending also depend on fiscal space. EU member states differ widely in their public debt positions, and countries with high(er) public debt see substantially lower multipliers, although these estimates are imprecise.

The baseline results for total defence spending are robust to alternative lag lengths, detrending methods, and monetary policy controls, as well as to GDP weighting, leave-one-out country exclusion, winsorising outlier observations, excluding a small residual spending category, correcting for military donations to Ukraine, and measuring defence spending with the SIPRI (as opposed to COFOG) database. Yet, substantial uncertainty surrounds the estimates, in particular the size of GDP multipliers across various periods and country samples. For the past EU defence spending in our sample, the statistical significance tends to be stronger for higher price effects (mostly originating from personnel spending), negative net exports, and larger recurrent (personnel and maintenance) costs of capital procurement.

# 1 Introduction

Since Russia's full-scale invasion of Ukraine in February 2022, governments across the European Union have announced, and in many cases implemented, substantial increases in military expenditure, driven both by direct security concerns and by NATO commitments to higher defence targets. At the Hague summit in June 2025, NATO members agreed a new headline target of 5% of GDP by 2035, comprising at least 3.5% for core defence requirements and up to 1.5% for defence- and security-related investment such as infrastructure and industrial capacity. In parallel, the European Commission's *ReArm Europe Plan*, announced in March 2025, and the subsequent activation over the period 2025-28 of the national escape clause under the reformed EU fiscal framework have opened fiscal space for member states to act on these commitments. Policymakers, fiscal authorities and central banks therefore need to understand the macroeconomic effects of defence expenditure, on prices as well as on output, and the demand-side channels through which they operate.

The empirical literature on defence spending multipliers has predominantly focused on the United States, where large military buildups provide sharp and plausibly exogenous variation in government spending (Ramey and Shapiro, 1998; Ramey, 2011; Ramey and Zubairy, 2018). European evidence is more limited, but EU-specific estimates are emerging strongly. More fundamentally, the literature has focused almost exclusively on the real GDP response, leaving the inflationary consequences of defence spending far less studied.[1] This is a significant gap: from the perspective of monetary policy, the price effects of a large and sustained fiscal expansion in defence matter at least as much as the output effects.

The methodological backbone of the defence spending multiplier literature traces to Barro (1981) and received new impetus with the narrative identification approach of Ramey and Shapiro (1998), who exploit US military buildups as quasi-exogenous variation in government spending. Ramey and Zubairy (2018) combine the local projection method of Jordà (2005) with narrative shock identification and cumulative multiplier definitions, providing a comprehensive treatment of US government spending multipliers, including in periods of economic slack and near the zero lower bound. These contributions form the basis for our empirical approach.

[1] Price responses do feature in some recent work. For the EU27 sample, Furceri et al. (2026) find that consumer prices rise (shown in their figure 7), and Alloza et al. (2026) report price responses alongside GDP components for Spain, but these are typically a secondary result rather than an object of study, and we are not aware of a systematic investigation of price effects, including by spending category.

For defence spending specifically, the cross-country panel evidence in Sheremirov and Spirovska (2022) covers a broad sample of advanced and developing economies and finds multipliers in advanced economies roughly twice those in developing ones. More generally, state dependence in government spending multipliers has been studied by, among others, Auerbach and Gorodnichenko (2012), who find larger multipliers in times of economic slack, and Nickel and Tudyka (2014), who find that high public debt attenuates them. We adapt their empirical specifications for our debt-state analysis.

EU-specific evidence is expanding rapidly. García Serrador et al. (2025) estimate defence spending multipliers for the EU27 using local projections, with particular attention to spending composition and non-linearities across fiscal space and other regimes. Olejnik (2023) examines multipliers for NATO's eastern-flank countries over 1999–2021. For Spain, Alloza et al. (2026) construct a comprehensive series of defence procurement contracts timed at order placement rather than delivery, directly highlighting the timing problem we address systematically for all EU member states through the order-date adjustment. Most recently, two IMF contributions have analysed the topic. Furceri et al. (2026) use procurement data to estimate cumulative GDP multipliers ranging from around 1.3 at impact to close to 2 at the two-year horizon for a panel of EU27 countries, with multipliers larger where import intensity is low and fiscal space is ample. The April 2026 World Economic Outlook devotes a chapter to defence spending (International Monetary Fund, 2026), drawing on data for 164 countries since 1946. Following a peacetime defence spending boom, real output is more than 3% higher than in periods without a boom, with the gain materialising about two years after onset, and defence spending multipliers are close to 1 on average. Restricting the sample to NATO members gives similar, though less precisely estimated, multipliers, and model simulations calibrated to the planned EU build-up yield a medium-term multiplier of about 0.8. Appendix A.1 brings these and other US, cross-country and EU estimates together in a single figure, at short and medium horizons. They range from about zero to above two, with a median close to one, in line with our peak estimates.

Our central contribution to this literature is methodological. Under the European System of Accounts 2010 (ESA 2010), defence capital goods are recorded in national accounts at the time of delivery, not at the time of order. Major weapons systems, such as aircraft, naval vessels and armoured vehicles, are often delivered several years after they are ordered, creating a systematic misalignment between the timing of the fiscal decision and its appearance in the data. We address this by constructing country-specific order-date adjustments using the SIPRI Arms Transfers

Database (ATDB; Stockholm International Peace Research Institute, 2025), which records both order and delivery dates for all international transfers of major conventional weapons. Another contribution is to trace the macroeconomic effects of defence spending beyond output, particularly on inflation, and to do so separately for capital expenditure, personnel and intermediate consumption. We examine the demand-side channels through which these effects operate and document the recurrent costs that capital acquisitions induce. In line with other studies, we also estimate state-dependent multipliers, using government debt as a proxy for fiscal space.

Finally, our analysis covers up to 27 EU member states over 1999–2025, using Eurostat's Classification of the Functions of Government (COFOG). It thus includes the post-2022 build-up so far, providing an up-to-date EU-wide assessment. This matters because the build-up is fast by historical standards: in real terms, EU defence spending rose by about 10 per cent in 2024 alone, more than in any earlier year of our sample, and announced plans point to further increases.

Our main results are as follows. Aggregate defence spending generates a cumulative GDP multiplier of around unity at its peak, with the adjusted specification peaking later than the unadjusted one. Price effects are positive and significant, with GDP deflator growth generally rising more than HICP inflation. Capital expenditure is the primary source of GDP gains (but it also generates recurrent costs); personnel and intermediate consumption generate relatively stronger price effects per euro spent. Household consumption rises and net exports deteriorate, particularly in reaction to personnel and intermediate consumption spending. Fiscal space conditions the estimates: on average, high-debt countries see smaller output and price responses from increased defence spending.

The remainder of the paper is organised as follows. Section 2 describes the data, including the construction of the order-date adjustment. Section 3 presents the empirical model. Section 4 presents the results, encompassing the baseline impulse responses, the sub-category decomposition, the fiscal implications of capital procurement, and the debt-state analysis. Section 5 concludes.

## 2 Data

Three public sources measure defence spending for EU countries with sufficient historical depth: Eurostat's Classification of the Functions of Government (COFOG), the Stockholm International

Peace Research Institute (SIPRI), and NATO. We take COFOG as our baseline for two reasons. First, it is compiled under the European System of Accounts (ESA 2010), so it is measured on a consistent methodology across all 27 member states and is directly comparable with GDP and its components. Second, COFOG provides an economic decomposition of defence spending into gross fixed capital formation, compensation of employees, and intermediate consumption, on the same national-accounts definitions as the outcome variables, which underpins the spending-composition analysis at the heart of the paper.

All macroeconomic and fiscal data are drawn from Eurostat, with additional macro-financial series (e.g., short- and long-term nominal interest rates) taken mostly from AMECO and used only in robustness specifications. The estimation panel covers up to 27 EU member states over 1995–2025; for the 1999-start baseline it is close to balanced, the one material exception being Slovakia, whose COFOG defence series begins only in 2010. The dependent variable and the control set are described together with the empirical model in Section 3.

## 2.1 Defence Expenditure: Sources

We use Eurostat's annual government expenditure by COFOG function (`gov_10a_exp`), where GF02 denotes defence expenditure by the general government sector in current million euro.[2] We download five spending aggregates: total defence expenditure, gross fixed capital formation, compensation of employees, social benefits, and intermediate consumption. From these we construct: *personnel costs* as the sum of compensation of employees and social benefits and the order-date-adjusted series described in Section 2.3.

COFOG, SIPRI and NATO differ in two respects that matter for our analysis. The first is scope: SIPRI and NATO count military pensions as defence spending (García Serrador et al., 2025; North Atlantic Treaty Organisation, 2025; Rodríguez-Vives, 2026; Stockholm International Peace Research Institute, 2026), whereas the ESA 2010 definition underlying COFOG excludes them, together with some military schools and support for veterans (Olejnik, 2023). The second is timing: SIPRI and NATO record expenditure when payments are made, whereas COFOG,

[2] As 2025 COFOG defence data were largely unpublished at the time of data compilation (data downloaded on 28 April 2026), 2025 values are imputed by applying the 2024-to-2025 growth rate from Eurostat's more timely supplementary defence expenditure table (`gov_ev`) to the 2024 COFOG baseline. For five member states for which the supplementary table was also unavailable, the 2025 total defence observation remains missing. Appendix A.3 details the procedure and the resulting coverage. Excluding the imputed observations leaves the results for adjusted total defence spending unchanged, but raises the GDP multiplier for unadjusted total defence spending.

like the national accounts, records equipment when it is delivered (Olejnik, 2023; North Atlantic Treaty Organisation, 2025), a difference that motivates the order-date adjustment in Section 2.3. NATO data, moreover, cover only the 23 EU member states that belong to the alliance, excluding Austria, Cyprus, Ireland and Malta.

Figure 1 compares the three sources for each member state and for the EU27 aggregate. COFOG and SIPRI, which are available over the full period, share a common trajectory: a secular decline from the late 1990s through approximately 2014–2016, followed by a gradual recovery and, in many countries, a marked acceleration from 2022 onwards. Where NATO data are available (shown only for comparison) they broadly track SIPRI, though they run higher in the most recent years for several member states. COFOG is generally the lowest of the three, reflecting the differences in scope and accounting convention set out above. Cross-country heterogeneity is substantial, with a clear pattern of higher spending in countries geographically proximate to Russia's borders, particularly after 2014 and more sharply from 2022.

## 2.2 Composition of EU Defence Expenditure

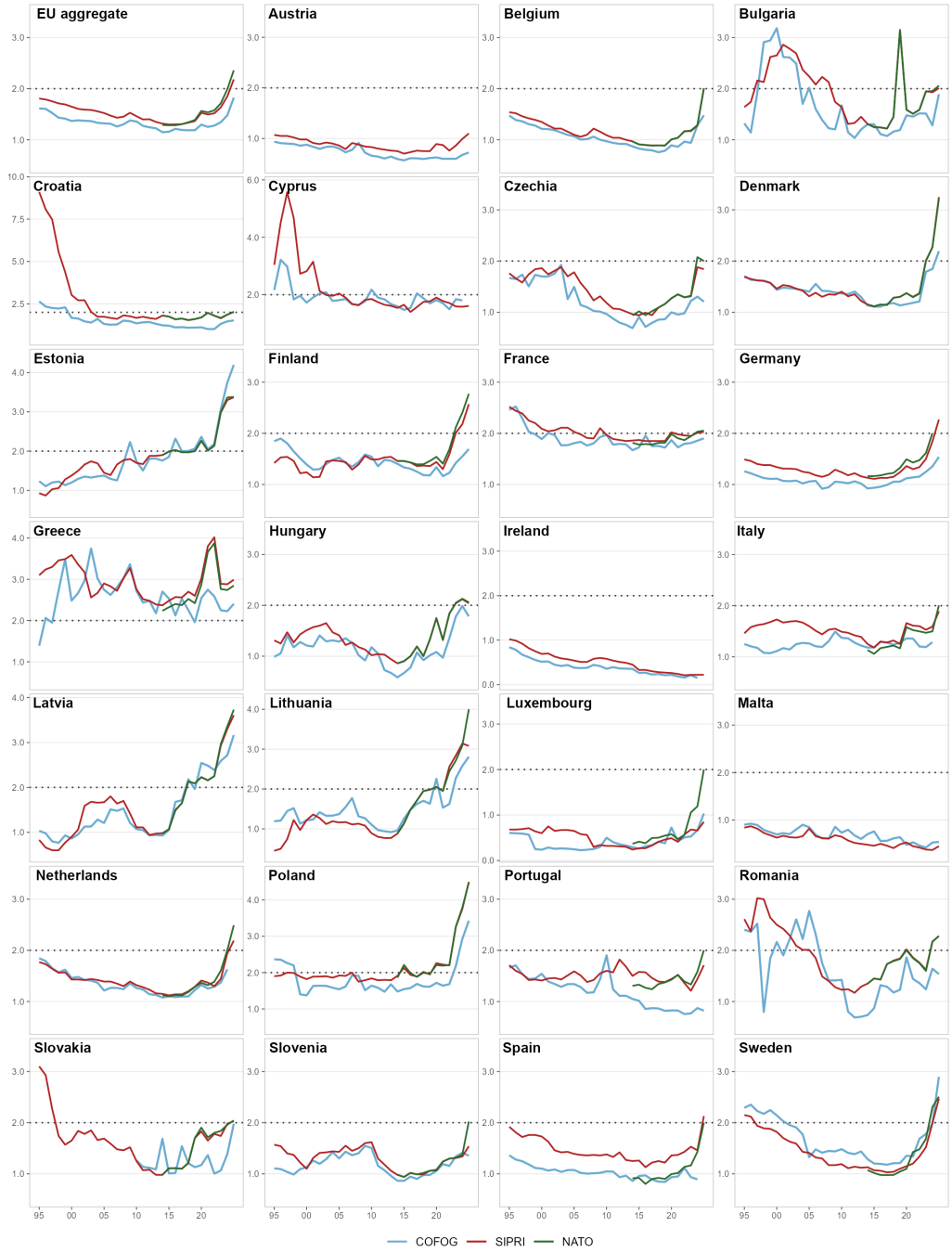
Figure 2 plots the composition of EU27 aggregate defence spending over 1995–2024 based on COFOG data. Personnel costs have consistently been the dominant component, accounting for roughly half of total spending over most of the sample. Intermediate consumption (operations and maintenance, such as fuel, spare parts and contracted services) represents approximately one quarter. Gross fixed capital formation, which includes the weapon systems and platforms that ESA 2010 classifies as fixed assets, such as warships, aircraft and armoured vehicles, has remained broadly stable at around one fifth throughout the period.[3] A residual category, mainly current transfers such as contributions to international organisations before 2022 and investment grants largely related to military aid since then, has been small historically (about 3 per cent of total spending over 1999–2021) but has grown markedly since Russia's invasion of Ukraine (about 9 per cent over 2022–2024).[4]

Although capital represents only around one fifth of total defence spending, Section 4 shows that it is the primary driver of output effects, which is why the timing with which it is recorded, the subject of the next subsection, matters.

[3] Single-use items such as ammunition, missiles and bombs are treated as military inventories rather than as fixed assets (Eurostat, 2013, para. 20.190; see also Rodríguez-Vives, 2026), and so are not part of the capital series used here.

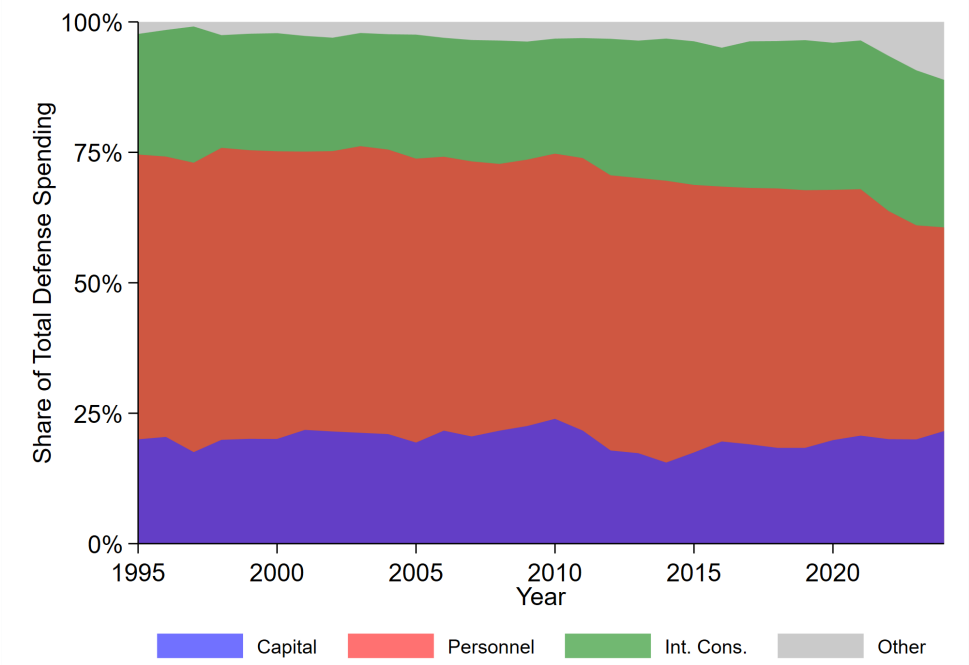
[4] Appendix A.5 details its composition and its role for the estimated responses.

**Figure 1: Defence Spending by Source and Country, 1995–2025**




*Notes:* Defence spending as a percentage of GDP from COFOG (blue), SIPRI (red) and NATO (green). The first panel shows the EU27 aggregate, computed as a GDP-weighted average of the member states; the remaining panels show individual member states. Note that the vertical scale differs across panels. The dotted line marks the 2% NATO guideline. NATO data are shown from 2014 onwards; figures for the two most recent years are estimates (North Atlantic Treaty Organisation, 2025). Sources: Eurostat COFOG, SIPRI, NATO.

**Figure 2: Composition of EU27 Defence Spending, 1995–2024**




*Notes:* Area chart showing shares of total defence expenditure: Capital/GFCF (blue), Personnel (red), Intermediate Consumption (green), Other (grey). EU27 aggregate. Source: Eurostat COFOG.

## 2.3 Order-Date Adjustment for Capital Expenditure

Under ESA 2010, military weapon systems are classified as fixed assets and recorded as gross fixed capital formation at the time of delivery, not at the time of order (Eurostat, 2013, paras. 20.190–20.191). Delivery is taken to occur when the military forces take possession of the equipment, and for heavy equipment that takes many years to build, such as large ships or submarines, the unfinished good remains work in progress in the producer's inventories, so no government expenditure is recorded while it is under construction (Eurostat, 2016, Section II.5). The progressive recording that applies to uncompleted buildings is explicitly not extended to such assets. The gap between fiscal decision and national accounts recording can therefore span several years; in the ATDB used below, for instance, the median time from order to delivery is three years for tanks and frigates and six years for submarines. This timing mismatch matters for local projections: the measured capital spending at time $t$ partly reflects order decisions made $k$ years earlier, where $k$ is the delivery lag, and treating delivery-date recording as the timing of the impulse will attribute output effects to the wrong period.

To address this, we construct a country-specific adjusted capital variable. For each EU member state, we estimate the median procurement delivery lag from the SIPRI Arms Transfers Database (Stockholm International Peace Research Institute, 2025), which records the order date and actual delivery year for all international transfers of major conventional weapons since 1950.[5] We restrict to capital-relevant armament categories (aircraft, ships, armoured vehicles and related systems)[6] and compute the median delivery lag across all qualifying transactions, pooling both import and export flows. We include export transactions because a country's exports of major weapons systems reflect the production and delivery cycle of its own defence industry, providing a proxy for the lead times of domestic procurement, which the ATDB does not otherwise record.

We restrict the computation to transactions from 1950 to 2010: the long window provides more observations per country, and truncating before the end of the data avoids a downward bias in the estimated lags. Appendix A.2 documents the construction and its sensitivity in full; Table A.2.1 reports the resulting lags for all 27 EU member states.

The resulting country-specific lags range from 0 years (Malta) to 4 years (Germany, Italy, the Netherlands, Sweden), with a cross-country median of 2 years. For a country with estimated lag $k$, let $g_{i,t}^{\text{cap}}$ denote capital defence spending recorded at time $t$ under delivery-date accounting. The order-date-timed capital variable is:

$$\tilde{g}_{i,t}^{\text{cap}} = g_{i,t+k}^{\text{cap}}$$

The adjusted total defence spending series replaces the unadjusted capital component:

$$\tilde{g}_{i,t}^{\text{total}} = g_{i,t}^{\text{total}} - g_{i,t}^{\text{cap}} + \tilde{g}_{i,t}^{\text{cap}}$$

Figure A.2.1 in Appendix A.2 plots the COFOG and adjusted total defence series for each member state.

We assess the sensitivity of the estimated lags to three alternative methodological choices: restricting to import flows only, restricting to confirmed (non-estimated) delivery dates, and using a recent subsample (1995–2010). The import-only alternative produces differences for eight

[5] SIPRI records actual delivery years (marking some as estimated where the precise date is uncertain), not contracted or expected delivery dates. This distinction is important: expected delivery times are forecasts that are revised as procurement proceeds, whereas actual deliveries reflect realised procurement timelines.

[6] Aircraft, ships, armoured vehicles, air-defence systems, engines, naval weapons, sensors, selected artillery systems and SIPRI's residual 'other' category.

countries of at most one year; the recent-subsample approach yields longer lags for major procurers, reflecting that more recent large-system programmes have longer production cycles than the post-WWII average. Re-estimating under these specifications produces impulse responses that track the baseline closely, except that the recent-subsample lags lower the GDP response; the later timing of the GDP peak and the price responses are unaffected.

# 3 Empirical Model

We estimate the dynamic macroeconomic effects of defence spending using the Panel Local Projection (LP) method of Jordà (2005), following the cumulative multiplier specification of Ramey and Zubairy (2018). For country $i$, period $t$, and projection horizon $h = 0, 1, \ldots, 5$ years (with the fiscal shock occurring at time zero), the estimating equation is:

$$\sum_{j=0}^{h} y_{i,t+j} = \alpha_i + \tau_t + \beta_h \sum_{j=0}^{h} d_{i,t+j} + \sum_{\ell=1}^{4} \boldsymbol{\gamma}_\ell' \mathbf{z}_{i,t-\ell} + \varepsilon_{i,t,h} \tag{1}$$

where $y_{i,t}$ is the outcome variable (GDP, household consumption, net exports, private investment, HICP inflation, or GDP deflator growth); $d_{i,t}$ is the defence spending variable of interest, either total defence, order-date-adjusted total defence, or one of the sub-categories (capital, personnel, intermediate consumption), normalised by lagged trend GDP; $\alpha_i$ are country fixed effects; $\tau_t$ are year fixed effects; $\mathbf{z}_{i,t-\ell}$ is a vector of controls; and $\varepsilon_{i,t,h}$ is the error term. A separate regression is estimated for each combination of horizon $h$, outcome $y$, and spending variable $d$. For the quantity outcomes, $\beta_h$ is the cumulative multiplier at horizon $h$; for the two price outcomes, it is the cumulative response in percentage points. Section 4.4 extends equation (1) to allow $\beta_h$ to vary with the debt state.

**Data and variable construction.** All outcome and control variables are built from Eurostat national accounts, government finance and price statistics. All nominal series, including defence spending, are converted to constant 2015 prices with the GDP deflator. Net exports are exports minus imports, and private investment is total gross fixed capital formation minus general government capital formation. The two price outcomes are the year-on-year percentage changes in the Harmonised Index of Consumer Prices (annual average, 2015 = 100) and in the GDP deflator (2015 = 100).

**Cumulative specification.** Following Ramey and Zubairy (2018), both sides of equation (1) contain cumulative sums from $t$ to $t+h$. In a standard LP the right-hand side contains only the contemporaneous shock $d_{i,t}$, so converting $\beta_h$ into an economically meaningful multiplier requires an auxiliary assumption about the persistence of the shock. Defence spending shocks are strongly persistent: a procurement contract, personnel expansion, or equipment programme generates spending over several subsequent years, and ignoring this would attribute the full cumulative output response to a single year's spending increment. Cumulative sums on both sides instead deliver the ratio of cumulative outcome change to cumulative spending change over $h$ years directly, with no persistence assumption.

**Fixed effects.** Country fixed effects absorb all time-invariant cross-country heterogeneity. Year fixed effects absorb common macroeconomic shocks and global time trends, ensuring that $\beta_h$ is identified from within-country variation in defence spending relative to the cross-country common trend.

**Controls.** Broadly in line with the literature (Ramey and Zubairy, 2018; García Serrador et al., 2025), the baseline control vector $\mathbf{z}_{i,t-\ell}$ comprises real trade volume (exports plus imports), non-defence government expenditure, government revenue, gross public debt, the real effective exchange rate, and the outcome and spending variables themselves. Trade volume accounts for the openness of the economy; the three fiscal variables control for the country's fiscal position and for financing effects through taxes or non-defence spending; the real effective exchange rate controls for competitiveness and exchange rate regimes; and the lags of the dependent variable and of the defence spending variable of interest capture dynamic effects. All controls enter with four lags.[7]

**Normalisation.** All quantity variables, namely the outcomes (GDP, household consumption, net exports, private investment), the defence spending measures and their sub-components, and the fiscal and trade controls, are measured in real (constant 2015-price) terms and expressed as shares of lagged trend GDP, following Ramey and Zubairy (2018); the two price outcomes enter as annual growth rates.[8] Lagged trend GDP is used rather than contemporaneous or actual GDP because it is predetermined at the time of any current-period spending decision, avoiding

[7] Figure A.5.2 reports robustness to this choice, comparing the baseline four-lag specification against two- and three-lag alternatives.

[8] The real effective exchange rate is the one control that is not a quantity and is therefore not normalised by trend GDP.

mechanical endogeneity. Trend GDP is estimated country by country as the fitted value from a fifth-order polynomial regression of log real GDP on a country-specific time index.[9]

**Identification.** We follow the standard identifying assumption in the literature that uses military spending to estimate fiscal effects (Barro, 1981; Ramey and Shapiro, 1998; Hall, 2009): conditional on the controls and fixed effects, within-country variation in defence spending is uncorrelated with unobserved current shocks to the outcome. The assumption rests on defence spending decisions being driven primarily by geopolitical considerations and alliance commitments rather than by domestic macroeconomic conditions.

**Inference.** Standard errors are clustered at the country level, robust to heteroskedasticity and to arbitrary serial correlation within countries, including that induced by the overlapping cumulative sums. Confidence bands are reported at the 68 per cent and 90 per cent levels, in line with recent work on defence spending multipliers (García Serrador et al., 2025; Furceri et al., 2026); the 68 per cent band follows longer-standing practice in the fiscal multiplier literature (Ramey, 2011).

# 4 Results

This section first presents the baseline responses to total and adjusted total defence spending (Section 4.1). It then examines the role of the spending composition (Section 4.2) and the recurrent costs induced by capital acquisitions (Section 4.3). Section 4.4 studies how the effects depend on fiscal space, and Section 4.5 summarises the robustness checks.

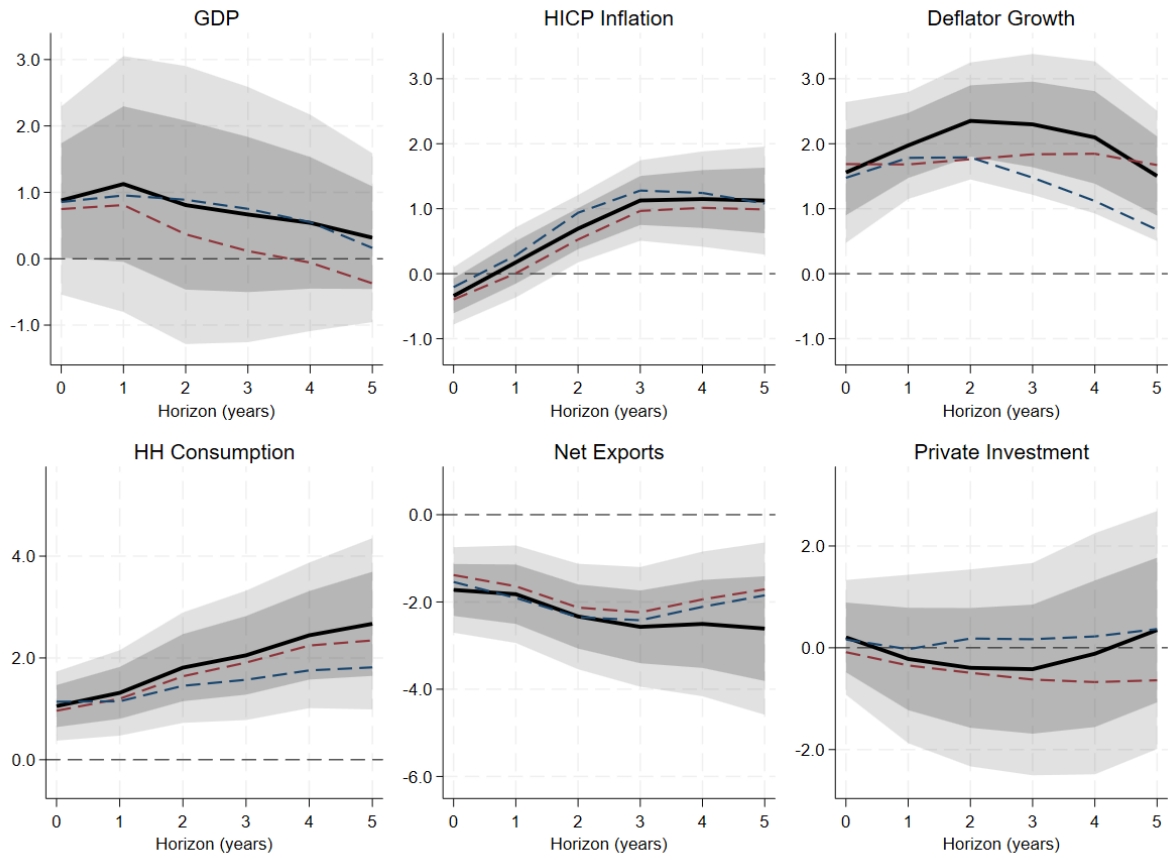
## 4.1 Baseline Results: Total and Adjusted Total Defence

We begin with the aggregate (unadjusted) COFOG total defence spending as the shock variable. Figure 3 presents the cumulative impulse responses for the full set of outcome variables: GDP, HICP inflation, and GDP deflator growth in the top row; household consumption, net exports, and private investment in the bottom row. The baseline 1999-start sample is shown in black with 68 and 90 per cent confidence bands; a longer sample starting in 1995 (maroon) and a more recent sample starting in 2004 (navy) are shown as point estimates (without confidence bands) to assess sample sensitivity.

[9] Figure A.5.3 reports robustness to this choice, comparing the baseline fifth-order polynomial detrend against fourth- and sixth-order alternatives and against contemporaneous trend GDP and lagged actual GDP normalisation.

The three windows are chosen to balance economic relevance against data coverage. The baseline begins in 1999, a period for which most countries are fully data-covered and marking the start of the common monetary-policy regime for 20 of the 27 countries in the sample by 2025. The longer window extends back to 1995, the earliest year for which harmonised national accounts and COFOG data are broadly available, maximising the time-series information at the cost of thinner early-sample coverage. The more recent window begins in 2004, the year of the large NATO enlargement in which Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia, and Slovenia joined the alliance, so that the estimation sample increasingly reflects member states facing broadly common alliance commitments; this focus, however, comes at the cost of a shorter sample.

**Figure 3: Baseline Results: Total Defence Spending**




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in total COFOG defence spending. Black + bands = Baseline (1999-2025); Maroon = (1995-2025); Navy = (2004-2025). Confidence bands: grey 68% and light grey 90%.

The cumulative GDP multiplier is approximately one on impact and remains around that level for the first two years, before moderating to around 0.3 at the five-year horizon. The response is broadly consistent across sample periods, though much lower as of year 2 in the extended period, and overall not statistically significant.[10] Among demand-side components, household consumption shows a strong positive response, consistent with a standard Keynesian income channel: defence spending raises incomes through direct employment and supply-chain activity, which in turn supports private consumption. Net exports respond negatively, reflecting the import-intensive nature of defence procurement in many EU member states. Finally, the private investment response is small and statistically indistinguishable from zero throughout the horizon.[11]

On the price side, both inflation measures rise persistently and are statistically significant, with the deflator response exceeding the HICP response throughout. Cumulative deflator growth is positive already on impact and peaks at approximately 2.4 percentage points at year two, moderating to around 1.5 percentage points by year five; cumulative HICP inflation is statistically significant from year two and builds to approximately 1.1 percentage points from year three onwards. This differential is economically interpretable: the GDP deflator directly captures price changes in domestically produced output, including the government consumption and investment deflators, which react to rising costs in the defence sector. The HICP, measuring consumer prices faced by households, is affected only through income and other indirect general-equilibrium channels.

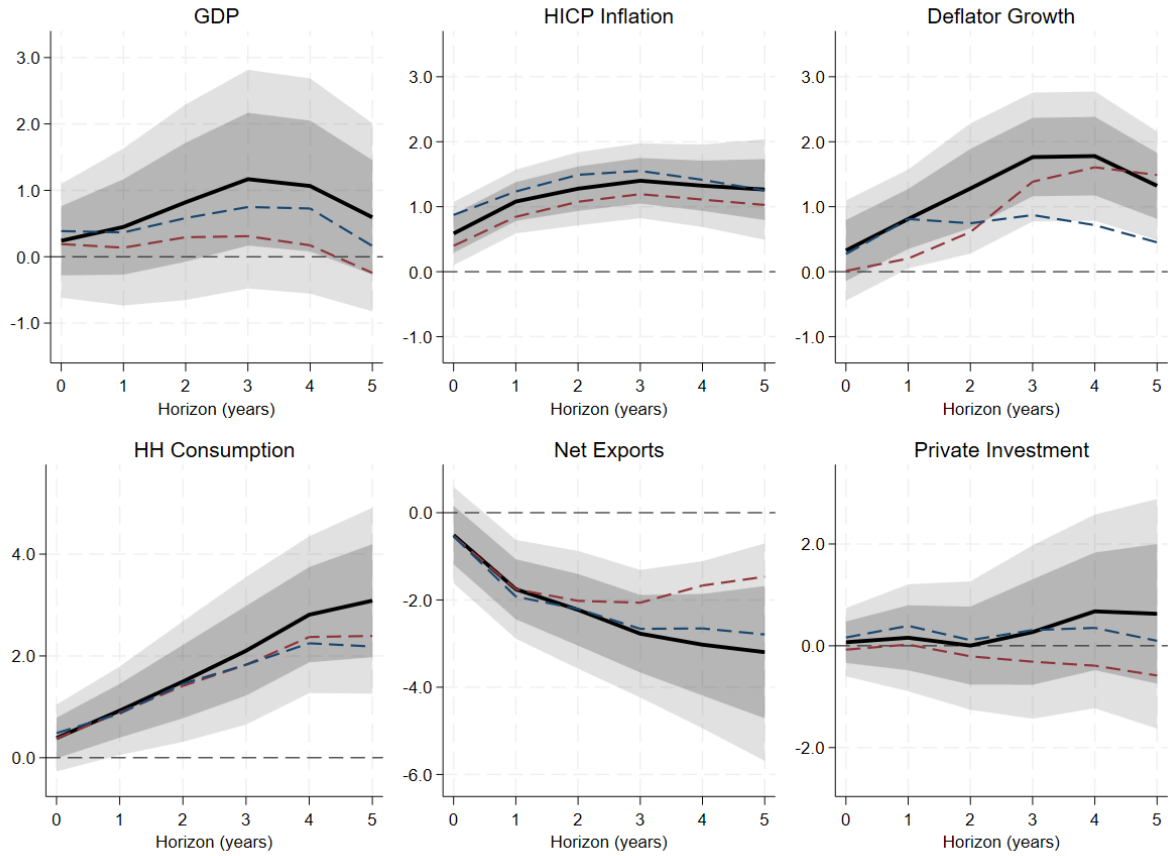
Figure 4 presents the corresponding results using the order-date-adjusted total defence spending variable.

The qualitative pattern is similar to the unadjusted case, but with a crucial difference in timing: the cumulative GDP multiplier rises more gradually under the adjusted specification, starting at approximately 0.25 on impact, and peaks at approximately unity at years three to four, roughly two years later than under the unadjusted specification, before moderating to around 0.6 at the five-year horizon. This shift is the direct consequence of moving capital spending from delivery-date to order-date timing. Under the unadjusted specification the shock

[10] Throughout, we describe an estimate as statistically significant when the 90 per cent band excludes zero.

[11] The demand-side panels show the private-sector components of GDP and, by construction, do not sum to output: the remainder consists of government consumption and government investment, which mechanically contain the defence impulse itself since defence spending is a subset of general government expenditure, together with smaller items such as changes in inventories and non-profit institutions' consumption. We therefore focus on the private components, whose response to the defence impulse is not definitional.

**Figure 4: Baseline Results: Adjusted Total Defence Spending**




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in order-date-adjusted total COFOG defence spending. Black + bands = Baseline (1999-2025); Maroon = (1995-2025); Navy = (2004-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

is dated at delivery, several years after the production it pays for. Output generated during that production period is therefore attributed to spending recorded at delivery, so the estimated response appears immediately and peaks early. Once the capital component is placed at order-date timing, the estimated peak GDP response shifts to a later horizon, consistent with the view that the economic activity generated by procurement orders takes time to materialise before the equipment is delivered.

Under the adjusted specification, the GDP response also fades less, remaining at about half its peak at the five-year horizon, against about a quarter under the unadjusted data.

In terms of prices, the positive HICP inflation effect occurs earlier and is somewhat higher throughout the horizon in the adjusted specification. Cumulative HICP inflation reaches about

1 percentage point by year one, peaks at about 1.4 percentage points in year three and remains at around 1.25 percentage points at the five-year horizon. The response is also statistically significant on impact (0.6 percentage points), but this should be regarded with caution: it depends on a small residual spending category, which since 2022 consists largely of military aid to Ukraine, and on the years since 2022 (Appendix A.5).[12] The inflation results also hold when the sample ends in 2021, before the inflation surge, with a smaller peak of about 1 percentage point in year three. The GDP deflator reaction broadly follows the output path in the adjusted specification: it is much lower at the beginning and peaks with a delay compared with the unadjusted setting at years 3–4. The peak effect (at close to 2 percentage points) is still higher than the HICP peak (although not for the most recent period starting in 2004, where HICP inflationary effects are substantially higher). With the data ending in 2021, the deflator response is virtually unchanged from year two and thus remains above the HICP response.

The adjustment also changes the estimation sample, because the forward leads used to construct the adjusted capital series are unavailable for the most recent observations. Appendix A.2 decomposes the difference between the two figures into a sample effect and a pure re-timing effect, confirming that the later peak reflects the re-timing of capital spending itself. The same decomposition shows that including the most recent observations lowers the estimated GDP multiplier substantially at every horizon: for unadjusted total defence the two-year cumulative multiplier falls from 1.8 on the matched sample to 0.8 once the final years are added, and the five-year multiplier from 0.7 to 0.3. This is consistent with the post-2022 build-up not yet having been followed by its full output response, although it may also reflect genuinely smaller multipliers in the current episode; the sample is as yet too short to separate the two. The HICP response is less sensitive: it is also lower in the first two years, but marginally higher from year three onwards, while the deflator response is lower throughout.

## 4.2 Impact of Defence Spending Composition

We next exploit the COFOG sub-category data to estimate separate multipliers for adjusted capital expenditure, personnel costs and intermediate consumption, which together account for about 97 per cent of total defence spending before 2022; the remaining residual category is discussed in Appendix A.5. We use the same regression setup as for the baseline results, with

[12] We thank an anonymous reviewer for drawing our attention to this point. The impact response is not statistically significant once the residual category is excluded, capital spending is corrected for military donations or the data end in 2021, whereas from year one the response remains statistically significant in all three cases.

each sub-category in turn as the spending variable. Figure 5 (Panels A–C) presents the results. This decomposition reveals that the aggregate multiplier conceals substantial heterogeneity in the macroeconomic character of different defence spending instruments.

**Adjusted capital expenditure** (Panel A). The GDP multiplier is notably large relative to the aggregate, consistent with the view that investment-type public spending carries a higher multiplier than current expenditure. Household consumption is almost unchanged up to year three and rises much less at the end of the horizon compared with the reaction to other components, particularly personnel spending. The private investment response is positive at medium horizons, consistent with possible demand-driven crowding-in in related industrial sectors, though this does not reach conventional levels of statistical significance. Net exports decline, reflecting capital-goods imports. Price effects are mostly positive but not significant at conventional levels, although the HICP response is significant at the 68 per cent level at horizons one to three.

Among the leave-one-out exercises we run, this is the only case where a single country materially affects the estimates. In Latvia a capital defence boost in 2005–07 was followed by an investment collapse in the global financial crisis with persistent effects. Excluding it raises the peak private investment response to 4.7 and the peak GDP multiplier to 2.8, both significant at the 90 per cent level (Appendix A.5). We retain the full-panel estimates throughout, but both the crowding-in and the output reading are stronger once that episode is set aside.

**Personnel expenditure** (Panel B). The dominant feature is a large positive response of household consumption: wages and salaries paid to military and civilian defence personnel flow directly into domestic household spending, producing a strong income channel. Net exports respond negatively throughout, significant at the 68 per cent level at every horizon but at the 90 per cent level only at year two. Price growth pressures are statistically significant and highest among the main defence components, reflecting upward pressure from consumer demand and higher wage costs. Private investment declines markedly and significantly, the largest such response among the spending categories, contributing to the weak GDP response of personnel spending. Why the displacement should be strongest for this category is not obvious to us and we leave it as an open question. Most important from a monetary policy perspective, the inflation effects are large and persistent. The very large effect on the GDP deflator growth on impact is rather puzzling; it may reflect, among other things, the direct channel of higher public wages affecting the government consumption deflator.

**Intermediate consumption** (Panel C). The GDP effect in the baseline is close to zero up to year 3 and increasing afterwards, but not statistically significant (the very large effects in the most recent sample are puzzling). Net exports impact is negative and builds up strongly both economically and statistically towards the end of the horizon, consistent with import leakage through operational inputs and military goods, such as ammunition, sourced abroad. Household consumption and private investment peak later in the horizon, albeit not significant at conventional levels. Inflation and GDP deflator growth effects are mostly positive, but less statistically significant than for the other components.

The central finding from this decomposition is that *capital expenditure is the primary driver of the GDP multiplier of defence spending*, while personnel and intermediate consumption generate relatively stronger inflationary pressure per unit of fiscal impulse. The price effects of defence spending, in other words, do not stem from capital: the HICP response to adjusted capital spending is small and not significant at the 90 per cent level, whereas the response to personnel spending reaches about 3 percentage points from year three onwards. The macroeconomic assessment of a defence build-up should therefore take its composition into account.

### 4.3 Capital Acquisitions and the Build-Up of Recurrent Defence Costs

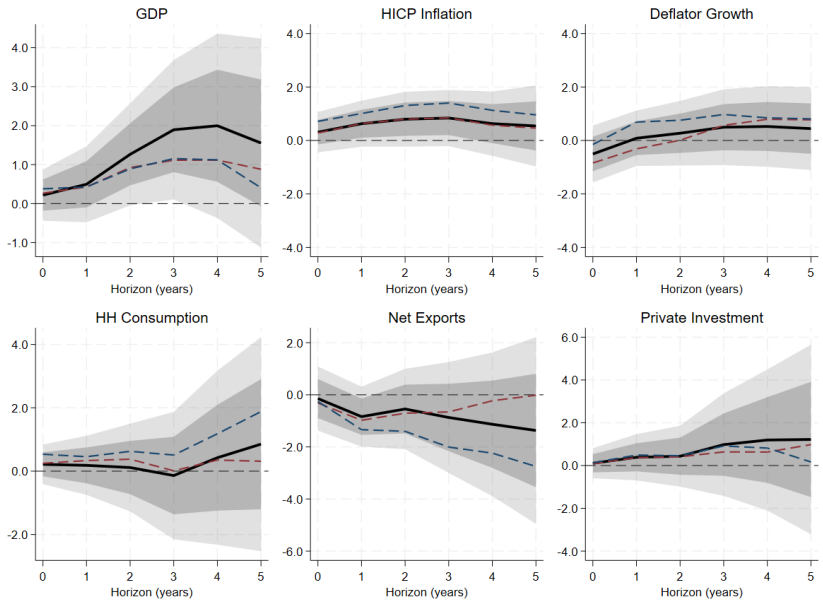
Figure 6 addresses the medium-term fiscal dynamics of defence capital investment: the extent to which capital acquisitions induce persistent increases in operating costs. The acquisition of major military equipment generates ongoing operational obligations: maintenance crews, spare parts, fuel, training. A government committing to a large capital acquisition programme therefore implicitly commits to a stream of future recurrent expenditure.

We estimate this linkage directly, using adjusted capital defence spending as the shock variable and personnel and intermediate consumption separately as the outcome variables.

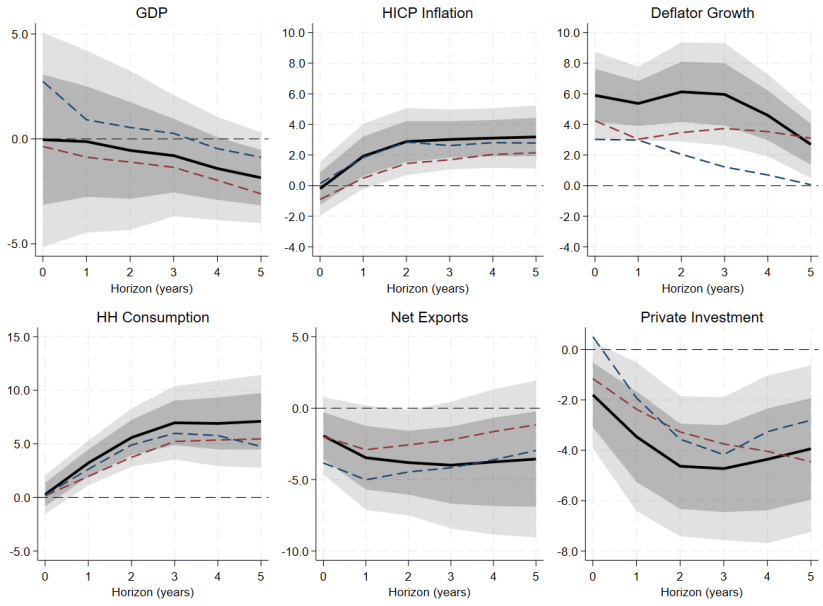
A shock to capital defence expenditure generates a positive and persistent increase in recurrent defence costs, accumulating over the five-year horizon and significant at the 90 per cent level from year four. Cumulating over five years, each additional euro of capital defence expenditure is estimated to generate approximately 0.3 euros of induced recurrent spending, a substantial fiscal tail. This finding has two implications. First, it provides a rationale for the cumulative LP specification: defence spending shocks are genuinely persistent, with capital decisions creating their own future spending trajectory. Second, it implies that the true medium-term fiscal cost of capital-intensive defence procurement exceeds the initial investment outlay by a meaningful

## Figure 5: Impact of Defence Spending Composition

**(A)** Effect of a 1% of trend GDP increase in adjusted capital defence spending



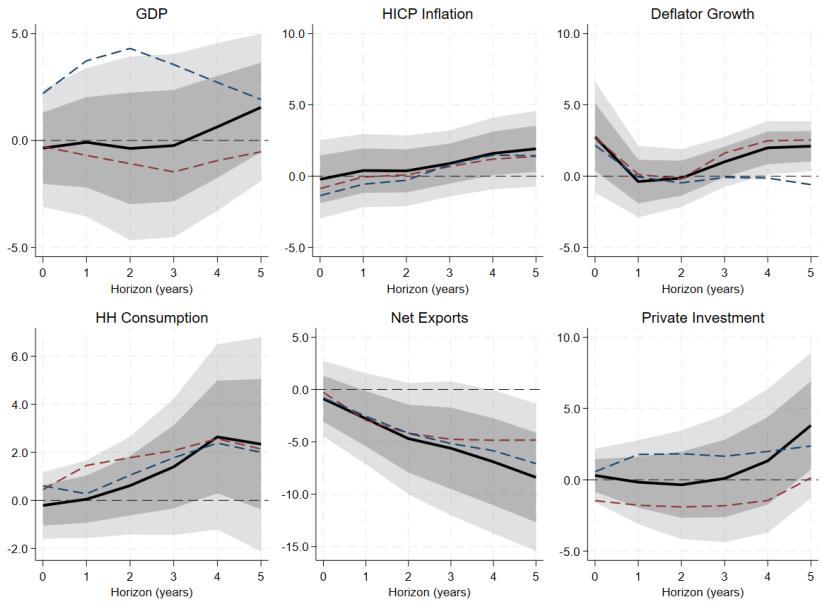

**(B)** Effect of a 1% of trend GDP increase in personnel spending




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in each defence spending sub-category. Black + bands = Baseline (1999-2025); Maroon = (1995-2025); Navy = (2004-2025). In Panel B, the samples end in 2024, as COFOG expenditure by economic category was available only up to 2024 at the time of data compilation. The order-date adjustment shortens the effective sample for adjusted capital at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

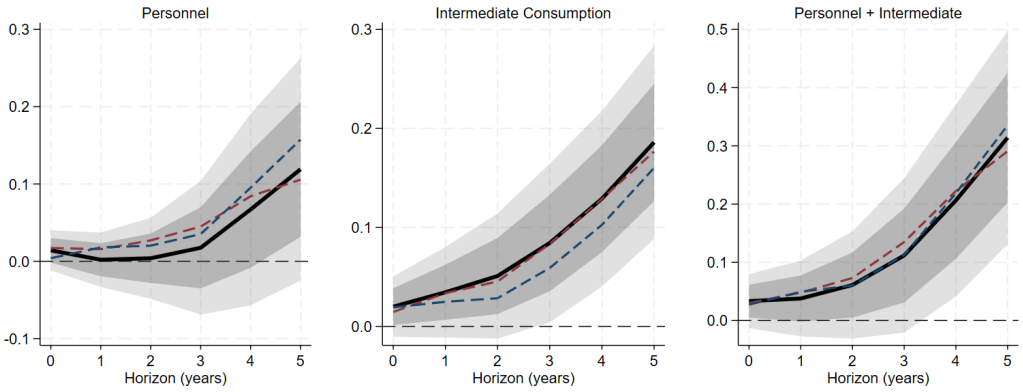
## Figure 5: Impact of Defence Spending Composition (continued)

**(C)** Effect of a 1% of trend GDP increase in intermediate consumption spending




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in each defence spending sub-category. Black + bands = Baseline (1999-2024); Maroon = (1995-2024); Navy = (2004-2024). COFOG expenditure by economic category was available only up to 2024 at the time of data compilation. Confidence bands: grey 68% and light grey 90%.

## Figure 6: Effect of Capital Defence Spending on Recurrent Defence Costs




*Notes:* Cumulative impulse responses of defence personnel expenditure, intermediate consumption, and their sum to a 1% of trend GDP increase in adjusted capital defence spending. Black + bands = Baseline (1999-2024); Maroon = (1995-2024); Navy = (2004-2024). The outcome variables are COFOG expenditure by economic category, which was available only up to 2024 at the time of data compilation. The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

margin. Budget plans that account only for the capital appropriation will therefore understate the future budgetary commitment.

### 4.4 State Dependence and Fiscal Space

The macroeconomic effectiveness of fiscal policy may depend on prevailing conditions. A dimension of particular relevance for the current EU context is the level of government indebtedness. High-debt and deficit countries face tighter constraints, such as higher borrowing costs, greater Ricardian anticipation of future consolidation by forward-looking households, and reduced policy credibility (Checherita-Westphal and Rother, 2012). The fiscal multiplier literature documents that high public debt levels attenuate multipliers (Nickel and Tudyka, 2014; Kirchner et al., 2010). Fiscal positions across EU member states are highly heterogeneous, and the fiscal space available to finance defence investment varies widely.

We test for state dependence by augmenting equation (1) with interactions between the spending variable and a state indicator based on the lagged debt-to-GDP ratio, estimating separate impulse responses for high- and low-debt regimes. Our baseline conditioning follows Auerbach and Gorodnichenko (2012): the high-debt weight is the logistic function $S_{i,t-1} = (1 + e^{-\gamma z_{i,t-1}})^{-1}$ with $\gamma = 1.5$, where $z_{i,t-1}$ is the standardised lagged debt-to-GDP ratio, so that the weight rises smoothly with indebtedness.

Formally, the state-dependent specification generalises equation (1) to:

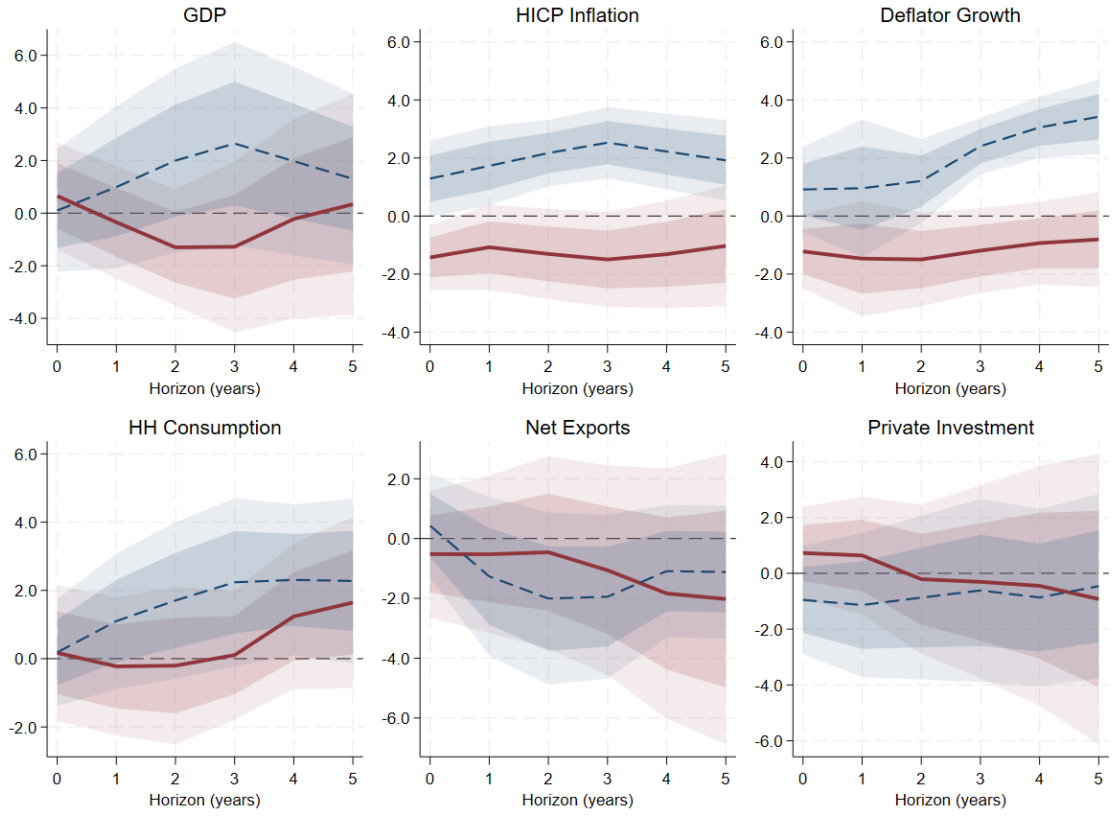
$$\begin{aligned}\sum_{j=0}^{h} y_{i,t+j} = \alpha_i + \tau_t + S_{i,t-1}\Big[\beta_h^H \sum_{j=0}^{h} d_{i,t+j} + \sum_{\ell=1}^{2} \boldsymbol{\gamma}_\ell^{H\prime} \mathbf{z}_{i,t-\ell}\Big] \\ + (1 - S_{i,t-1})\Big[\beta_h^L \sum_{j=0}^{h} d_{i,t+j} + \sum_{\ell=1}^{2} \boldsymbol{\gamma}_\ell^{L\prime} \mathbf{z}_{i,t-\ell}\Big] + \varepsilon_{i,t,h}\end{aligned} \tag{2}$$

where $S_{i,t-1}$ is the logistic high-debt weight defined above. All regressors other than the fixed effects are interacted with the state, so that $\beta_h^H$ and $\beta_h^L$ trace the cumulative response in the high- and low-debt regime respectively. To limit the proliferation of parameters, we use two rather than four lags in the state-dependent specifications.

Figure 7 presents the state-dependent impulse responses using adjusted total defence spending, with solid maroon lines denoting the high-debt state and dashed navy lines the low-debt state.

In the low-debt state, the GDP multiplier is positive throughout and peaks at about 2.6 in year three, above the unconditional baseline. In the high-debt state, by contrast, the GDP multiplier is substantially lower: it is positive on impact but negative from year one to year four, at around $-1.3$ in years two and three. Yet, the results are only weakly statistically significant. The effects on price dynamics are positive only in the low-debt state. The difference between the two states comes mainly through household consumption, which barely responds in the high-debt state until year three, consistent with the Ricardian channel discussed above. As a robustness check, we also define the high-debt state by discrete thresholds, as a lagged debt ratio above 60 or 90 per cent of GDP; these variants deliver a similar message in years one to three (Appendix A.4).

**Figure 7: State-Dependent Results: Smooth-Transition Debt Conditioning**




*Notes:* State-dependent cumulative impulse responses to a 1% of trend GDP increase in adjusted total defence spending, using the smooth logistic transition function with $\gamma = 1.5$, the value calibrated by Auerbach and Gorodnichenko (2012). Maroon (solid) with bands = high-debt state; Navy (dashed) with bands = low-debt state. Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands 68% and 90%.

### 4.5 Robustness

The core results are overall robust across several dimensions, as documented in Appendix A.5.

**SIPRI data.** SIPRI total defence spending is an independently constructed series built on a broader, cash-based perimeter. Re-estimating on it yields a GDP multiplier profile close to the COFOG baseline, though lower at the peak (about 0.7 against 1.1) (Figure A.5.1). The price responses remain statistically significant, positive and persistent, but their composition differs: under SIPRI the HICP response reaches approximately 1.1 percentage points and exceeds the deflator response. This most likely reflects SIPRI's broader coverage of defence-related spending outside the COFOG boundary, military pensions in particular, whose price effects fall relatively more on consumer prices than on the government-output deflator. The finding of material price effects is therefore robust to the choice of measure, while their incidence across the two price gauges depends on the spending perimeter.

**Lag order.** Re-estimating with two and three lags rather than the baseline four produces closely tracking impulse responses for both total and adjusted total defence (Figure A.5.2), confirming that results do not depend on the particular lag length chosen.

**Detrending and normalisation.** The baseline fifth-order polynomial detrend is compared against fourth- and sixth-order alternatives, as well as contemporaneous trend GDP and lagged actual GDP normalisation (Figure A.5.3). In 2 out of 4 alternatives, GDP multipliers are larger, while price effects are broadly unchanged. Apart from the small and insignificant private investment response, no variable changes sign. The relatively close agreement across all four variants and the baseline confirms that results are not driven by a particular detrending choice.

**Monetary and financial conditions vs. time fixed effects.** The baseline relies on year fixed effects to absorb common monetary policy variation. Replacing or augmenting these with shadow interest rate measures (Wu and Xia, 2016; Lemke and Vladu, 2017) or long- and short-term nominal interest rates leaves the sign and shape of the responses unchanged, with the specifications that retain year fixed effects sitting somewhat below those that replace them, particularly in the unadjusted defence spending specification (Figure A.5.4). All of these variants, including the baseline reproduced for comparison, are estimated on the common sample for which the interest rate series are available. That sample is shorter than the headline one and raises the estimated GDP multiplier throughout, so the exercise is informative about the treatment of common macroeconomic conditions rather than about the level of the multiplier.

**Weighting.** Baseline results are broadly replicated under GDP-weighted estimation, confirming that the findings are not mechanically driven by the equal-country weighting (Figure A.5.5). For inflation, such effects carry more relevance for the euro area common monetary policy (covering most countries in the sample). In this specification, the GDP-weighted output response builds more gradually, consistent with the longer procurement cycles of the largest economies, but reaches a similar magnitude by the end of the horizon. The HICP responses are close to the baseline, except that the response to total defence spending is somewhat higher in years 4–5, whereas the deflator response is higher for total and lower for adjusted total defence spending.

**Outliers.** Re-estimating on data winsorized at the pooled 1st and 99th percentiles produces closely tracking impulse responses (Figure A.5.6), confirming that the estimates are not driven by extreme observations.

**Country sample sensitivity.** A leave-one-out exercise re-estimates the baseline 27 times, excluding one member state at a time, and compares the estimated responses at the baseline peak horizon (Figure A.5.7). No single exclusion moves the estimated GDP, HICP inflation, or deflator growth response outside the 68 per cent confidence band of the baseline, indicating that the results are not driven by any individual country. Repeating the exercise for the effects of adjusted capital defence spending identifies one exception (Figure A.5.8): excluding Latvia raises both the private investment and the GDP response materially.

**Composition effects.** Excluding the small residual spending category, or correcting capital spending for military donations from existing stocks, which the order-date adjustment can otherwise distort, leaves the GDP response to adjusted total defence spending virtually unchanged. The HICP response remains statistically significant from year one, but not on impact (Figure A.5.9).

**Overall.** Across these checks, which concern total and adjusted total defence spending, the GDP and price responses keep their sign. The GDP multiplier does show some sensitivity to specification, most visibly to the detrending and normalisation choice, which rescales the output response. The price responses are broadly more stable.

# 5 Conclusions

This paper has estimated the macroeconomic effects of defence spending for the EU27, providing a comprehensive analysis that extends beyond the traditional GDP multiplier focus. Three main findings emerge.

First, the timing of the fiscal impulse matters. The order-date adjustment moves capital defence spending from delivery-date to order-date timing, using country-specific procurement lags from the SIPRI Arms Transfers Database. It shifts the estimated peak of the GDP multiplier from approximately the first year under the unadjusted specification to year three or four under the adjusted one. The level of the cumulative GDP multiplier at its peak is around unity in both specifications, but the temporal profile differs, and the multiplier remains higher at the five-year horizon under the adjustment (0.6 against 0.3), although the two estimates rest on samples that end in different years (Section 4.1). On the price side, consumer prices (HICP) and the GDP deflator rise persistently, with the deflator response generally larger, reflecting that defence-specific cost pressures show up directly in government deflators, while HICP effects operate more through indirect channels. The HICP inflation effect in the adjusted specification occurs earlier and is higher at every horizon than in the unadjusted setting. It peaks at about 1.4 percentage points in year three and is robust from year one, including when the sample ends in 2021, before the inflation surge, whereas the significant impact response is not. For both fiscal planning and monetary policy assessment, the distinction between a near-term and a three-to-five year response is substantively important.

Second, spending composition is decisive. Capital expenditure drives GDP effects while personnel and intermediate consumption, particularly personnel, generate stronger inflationary pressure per unit of fiscal impulse. Capital acquisition also induces persistent increases in maintenance and personnel costs of approximately 30 cents per euro over five years, implying that the medium-term fiscal cost of procurement programmes may substantially exceed the initial investment outlay. The recurrent-cost implications of capital defence spending commitments should be built into fiscal plans. To the extent that the current build-up is tilted towards capital spending, our estimates point to a larger output effect, albeit with a delay, and a smaller inflationary impact per euro than the historical spending mix.

Third, fiscal space conditions the macroeconomic returns to defence spending, with high(er)-debt EU member states exhibiting, ceteris paribus, lower GDP multipliers (and price increases)

than their low-debt counterparts, although these estimates are imprecise. The effect comes mainly through household consumption, whose response is markedly weaker in high-debt countries.

The baseline responses to total and adjusted total defence spending survive a range of specification checks: alternative lag lengths and detrending choices, explicit controls for the monetary policy stance and financial conditions, GDP weighting, the exclusion of individual member states, winsorisation of extreme observations, the exclusion of the residual spending category and the correction of capital spending for military donations. They also hold when defence spending is measured with the SIPRI series rather than COFOG, where the HICP inflation response is larger than the deflator growth response.

Several caveats apply. Our estimates reflect average historical relationships and may not fully capture non-linearities arising from the unprecedented speed and scale of the current build-up, including industrial capacity constraints, input price bottlenecks, and supply chain disruptions. Relatedly, including the most recent observations lowers the estimated GDP multiplier at every horizon; whether this reflects timing (consistent with a build-up whose output effects have not yet materialised in the data) or genuinely smaller multipliers in the current episode cannot yet be established. The analysis is based on the EU27 as a whole; country-level evidence would complement the panel estimates. While we use country fixed effects throughout to control for country-specific characteristics, a deeper analysis of the location of military equipment production and its spillover effects would bring substantial value added, particularly for the GDP effects. Finally, the interaction with monetary policy and specifically whether and how the output and inflationary effects of defence spending-induced fiscal expansions depend on the monetary policy reaction warrants further investigation.

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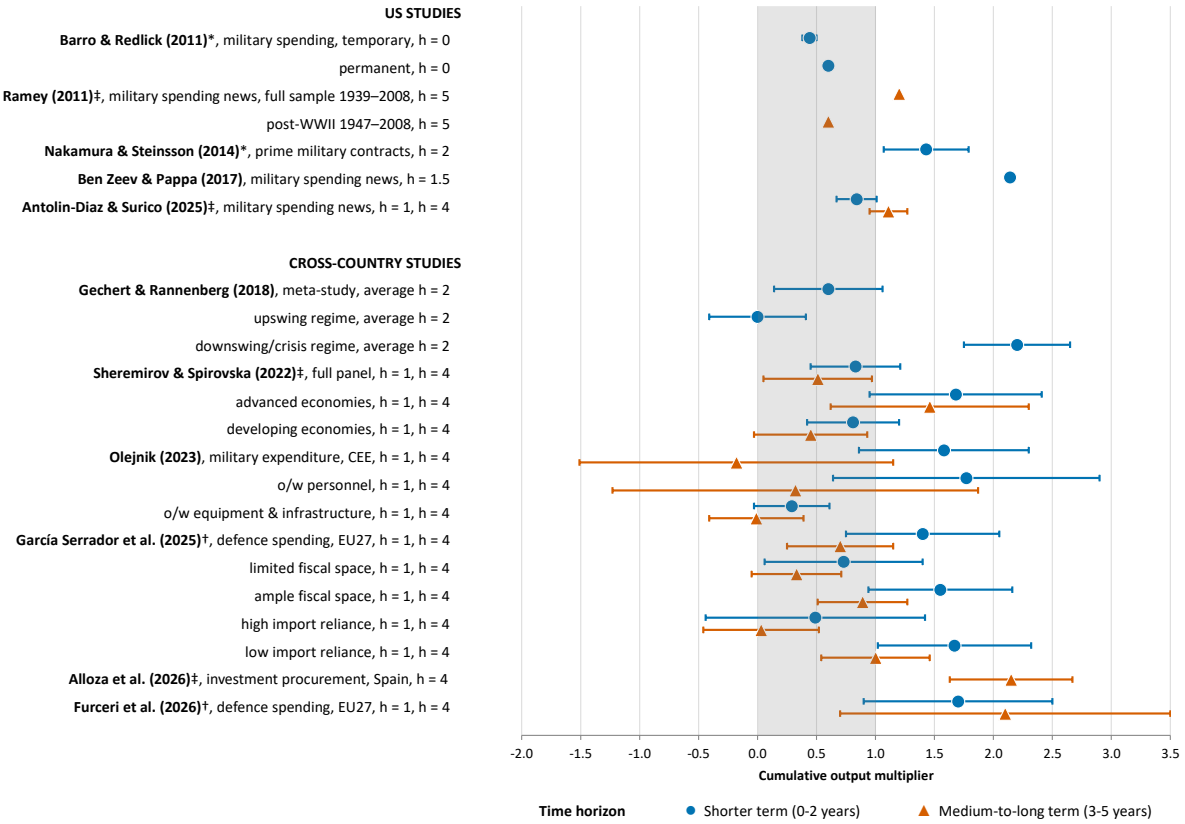
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# A Appendix

## A.1 Literature Review on Defence Spending Multipliers

Figure A.1.1 collects estimates of the output multiplier of military and defence spending from recent US and cross-country studies. For each study we plot the short-term (0–2 years) and, where available, the medium-to-long-term (3–5 years) estimate from the authors' preferred specification, favouring the centre of each range: one and four years.

**Figure A.1.1: Fiscal Multipliers of Military Spending in Recent Studies**




*Notes:* Markers are the point estimate from each study's preferred specification, with one-standard-deviation bands where available. Bands are not available for Ramey (2011), Ben Zeev and Pappa (2017) and the permanent estimate of Barro and Redlick (2011). $h$ is the horizon in years after the shock. Shading marks multipliers between zero and one, broadly the range implied by standard theoretical models.
The default concept is the cumulative increase in real GDP per unit increase in defence spending. (*) Barro and Redlick (2011) and Nakamura and Steinsson (2014) measure a change in a GDP growth rate rather than in the level of output; the latter is additionally a regional relative multiplier and so differences out the aggregate monetary policy response. (†) García Serrador et al. (2025) and Furceri et al. (2026) scale by trend GDP, as in this paper. (‡) Ramey (2011), Antolin-Diaz and Surico (2025), Sheremirov and Spirovska (2022) and Alloza et al. (2026) divide by the response of *total* government spending, using military variation only to identify the shock.

Studies differ in what the output response is scaled by. Most report the response per unit of *defence* spending, but Ramey (2011), Antolin-Diaz and Surico (2025), Sheremirov and Spirovska (2022) and Alloza et al. (2026) divide by the response of *total* government spending, using

military spending or military news only to identify the shock; these entries are marked (‡) and are therefore government spending multipliers identified from military variation rather than defence spending multipliers in the strict sense. A small number of studies measure the multiplier on a GDP growth rate rather than on the level of output, marked (*).

**US studies.** Barro and Redlick (2011) treat changes in US defence spending as driven by geopolitical factors exogenous to the business cycle and estimate, on annual data from 1939, contemporaneous multipliers on the per-capita real GDP growth rate of 0.44 for temporary expenditure and 0.60 for permanent expenditure, the latter combining the contemporaneous response with the effect of Ramey's defence news variable over the following years. Ramey (2011) identifies military spending shocks through a narrative news variable ordered first in a SVAR and computes multipliers as the integral of the impulse responses over the five years following the shock, obtaining 1.2 on the full 1939–2008 sample and 0.6 once World War II is excluded. Ramey attributes the gap to the financing mix: World War II spending was financed mostly by issuing debt whereas Korean War spending was financed in large part by tax increases, so that the WWII-inclusive sample involves less use of distortionary business taxation. Nakamura and Steinsson (2014) exploit cross-state variation in prime military contracts to estimate an open-economy *relative* multiplier of approximately 1.5 on the two-year growth rate of state output; as a regional estimate that differences out the aggregate monetary policy response and cross-regional spillovers, it is not directly comparable to aggregate time-series estimates. Ben Zeev and Pappa (2017) identify anticipated defence spending shocks in an SVAR as those that best explain movements in defence spending over a five-year horizon while remaining orthogonal to current defence spending, and report a cumulative output multiplier of 2.14 at the sixth quarter. Antolin-Diaz and Surico (2025) estimate a Bayesian VAR on a long US sample (1890Q1–2015Q4) with military news ordered first and find present-value multipliers above unity on impact that dip to about 0.8 after one year and recover to about 1.1 at four years. Their estimates then continue to rise well beyond the medium run, reaching about 2 fifteen years ahead, which the authors attribute to a shift of public spending towards research and development that raises productivity.

**Cross-country and EU evidence.** Gechert and Rannenberg (2018) synthesise the fiscal multiplier literature through meta-regression and, at the sample-average horizon of eight quarters, find a military spending multiplier of 0.60 in the average regime with pronounced state dependence: essentially zero in the upswing regime and 2.17 in the downswing or crisis regime, consistent with the broader view that multipliers rise when resources are underutilised.[13] Sheremirov and Spirovska (2022) estimate panel local projections for a large sample of advanced and developing countries over 1988–2013, instrumenting government spending with military spending, and obtain cumulative multipliers of 0.83 at one year and 0.51 at four, with substantial heterogeneity across development levels: 1.68 and 1.46 for advanced economies against 0.81 and 0.45 for developing ones. Olejnik (2023) estimates panel local projections for nine Central and Eastern European NATO members over 1999–2021 and finds effects that are distinctly short-lived: the cumulative multiplier is close to 0.6 on impact, peaks at roughly 1.6 one to two years after the shock, and is approximately zero and no longer statistically significant by the fourth year. Among the disaggregated categories, personnel expenditure carries the highest multiplier, while the estimates for equipment and infrastructure purchases are close to zero and statistically insignificant beyond impact. For the EU27, García Serrador et al. (2025) estimate panel local projections and find multipliers above unity in the first year that decline over the medium term; both fiscal space and import reliance condition the estimates in the expected direction, with markedly lower

[13] The military spending category comprises 73 estimates in their database.

multipliers under limited fiscal space and under high import reliance, consistent with stronger domestic demand retention when procurement is sourced locally. Furceri et al. (2026) obtain EU27 multipliers from procurement data that are positive and rising over the medium term, though with wide confidence bands. Finally, Alloza et al. (2026) use the universe of Spanish defence procurement contracts over three decades, dating the fiscal impulse at contract award rather than at delivery and thereby addressing the same order-versus-delivery misalignment that motivates our order-date adjustment. They report a cumulative multiplier of 2.15 at four years, with output effects that build up only gradually, become sizeable and then fade.[14]

## A.2 Delivery Lag Validation in the SIPRI Arms Transfers Database

In the baseline specification, the delivery lags are computed over transactions from 1950 to 2010. Using this full historical period provides more observations per country, especially for smaller EU members with sparse recent procurement, while truncating at 2010 avoids an end-of-sample bias: because the SIPRI data record only completed deliveries, orders placed close to the data cutoff with multi-year lead times are systematically absent, which would compress the estimated median lag if recent years were included.

Table A.2.1 reports the baseline country-specific delivery lags for all 27 EU member states.

Figure A.2.1 illustrates the effect of these lags country by country, plotting the COFOG and order-date-adjusted total defence spending series for each EU member state. For countries with long procurement cycles, such as Germany, Sweden and the Netherlands, the adjustment creates a visible difference between the two series, particularly during periods of active capital expansion. For countries with limited internationally-procured capital, such as Malta and Ireland, the two series are virtually identical.

The baseline delivery lags rest on three further methodological choices: which trade flows to use, whether to include delivery years that SIPRI flags as estimates, and which historical period to cover. Figure A.2.2 re-estimates the model with lags constructed under three alternatives, each shown as a point estimate against the baseline (black, with confidence bands), which uses the median over combined import and export flows for orders placed in 1950–2010, including estimated delivery years. *Import-only* (maroon) uses import flows only; *Confirmed-only* (navy) excludes estimated delivery years; and *Recent subsample* (teal) restricts the computation to 1995–2010 and to import flows, testing whether post-Cold War procurement cycles differ from the full historical record. The LP specification and sample period are otherwise unchanged.

Panel (A) presents results for adjusted total defence spending; Panel (B) for adjusted capital defence. For both spending measures, the import-only and confirmed-only lags produce responses that track the baseline closely. The recent-subsample lags, which are longer for the major procurers, lower the GDP response, to a peak of about 0.7 rather than 1.2 for adjusted total spending, while leaving the later timing of the GDP peak and the price responses broadly unchanged.

A related question is whether the differences between the adjusted and unadjusted results in the main text (Figures 3 and 4) reflect the re-timing of capital spending itself or the change in estimation sample that the adjustment induces: because the adjusted capital series is built from forward leads of future capital formation, the most recent observations, for which the required

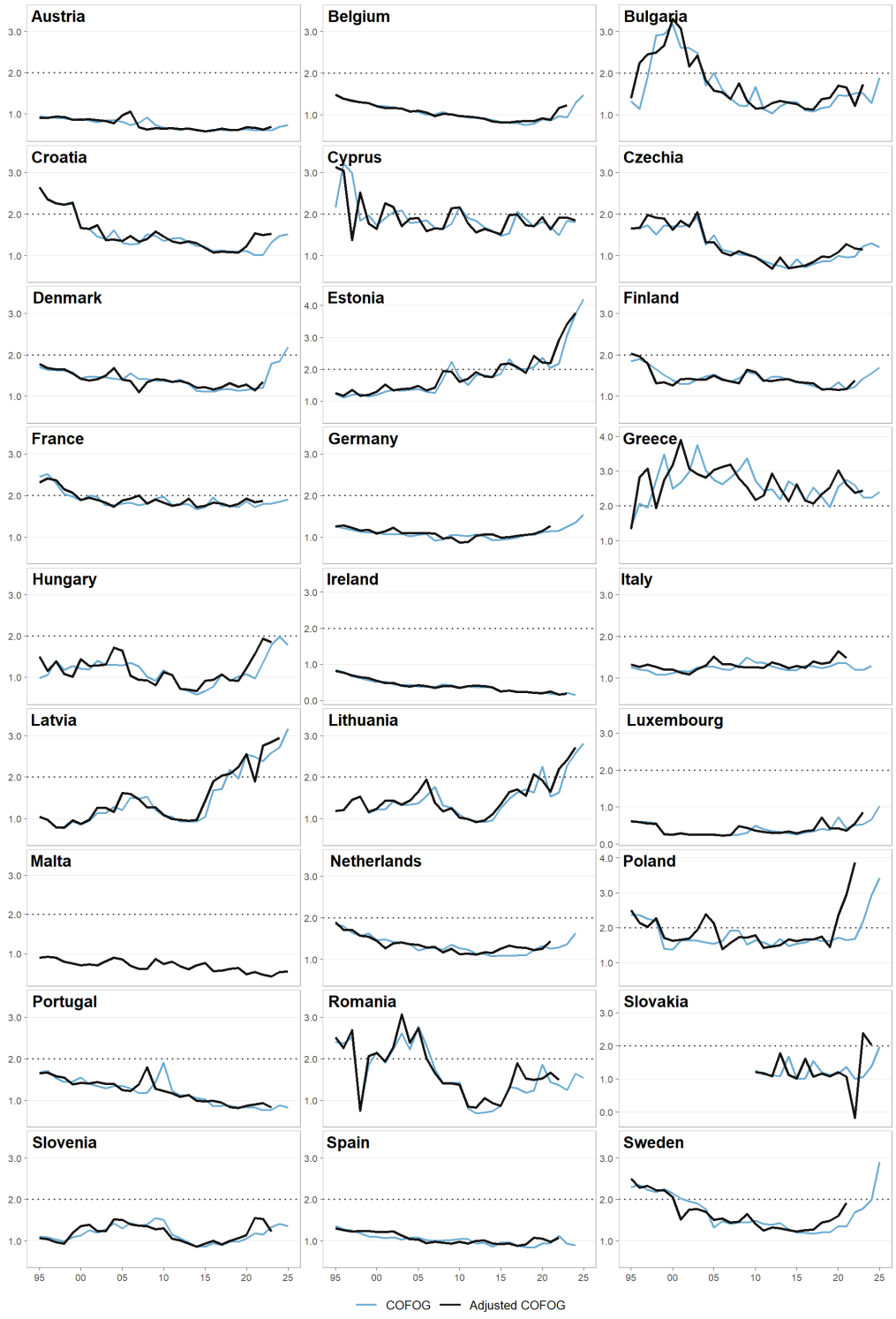
[14]We report only their medium-term estimate. Because defence investment enters national accounts upon delivery, the measured spending response is close to zero in the first years, so the cumulative multiplier is undefined or uninformatively large at short horizons and the authors do not report it. They also report a total multiplier, which scales by the spending response over the full horizon; we use the cumulative measure to remain consistent with the rest of the figure.

**Table A.2.1: Country-Specific Procurement Delivery Lags**

| Country | ISO | Median lag (years) | Mean lag (years) | SD (years) | Records ($N$) |
|---|---|---|---|---|---|
| Germany | DE | 4 | 5.3 | 5.6 | 2,784 |
| Italy | IT | 4 | 4.9 | 4.4 | 2,222 |
| Netherlands | NL | 4 | 4.5 | 3.6 | 1,458 |
| Sweden | SE | 4 | 5.0 | 4.7 | 1,020 |
| France | FR | 3 | 4.5 | 5.4 | 3,876 |
| Spain | ES | 3 | 3.9 | 3.8 | 1,005 |
| Poland | PL | 3 | 5.0 | 4.9 | 899 |
| Romania | RO | 3 | 4.8 | 4.5 | 558 |
| Denmark | DK | 3 | 3.4 | 2.6 | 416 |
| Finland | FI | 3 | 3.4 | 3.0 | 401 |
| Greece | EL | 2 | 3.1 | 3.2 | 773 |
| Belgium | BE | 2 | 3.3 | 3.5 | 461 |
| Bulgaria | BG | 2 | 2.6 | 3.3 | 430 |
| Portugal | PT | 2 | 2.5 | 3.0 | 371 |
| Austria | AT | 2 | 2.3 | 2.4 | 303 |
| Hungary | HU | 2 | 2.3 | 2.0 | 252 |
| Czech Republic | CZ | 2 | 3.7 | 5.4 | 165 |
| Ireland | IE | 2 | 2.1 | 1.5 | 105 |
| Slovenia | SI | 2 | 2.0 | 1.5 | 43 |
| Croatia | HR | 2 | 2.1 | 1.4 | 41 |
| Luxembourg | LU | 2 | 4.3 | 6.7 | 10 |
| Cyprus | CY | 1 | 1.8 | 1.6 | 88 |
| Slovakia | SK | 1 | 1.3 | 1.4 | 51 |
| Lithuania | LT | 1 | 1.1 | 1.3 | 45 |
| Estonia | EE | 1 | 1.5 | 1.6 | 44 |
| Latvia | LV | 1 | 1.6 | 1.6 | 38 |
| Malta | MT | 0 | 0.6 | 0.9 | 20 |

*Notes:* Country-specific procurement delivery lags from the SIPRI Arms Transfers Database, 1950–2010, pooling import and export transactions, restricted to GFCF-relevant armament categories (aircraft, ships, armoured vehicles, air-defence systems, engines, naval weapons, sensors, selected artillery systems and SIPRI's residual 'other' category). The lag applied in the adjustment is the (integer) median delivery time. The mean, standard deviation, and number of underlying delivery records, one per transaction and delivery year, ($N$) are reported for reference; the mean is right-skewed by occasional long-delayed deliveries and so exceeds the median for most countries.

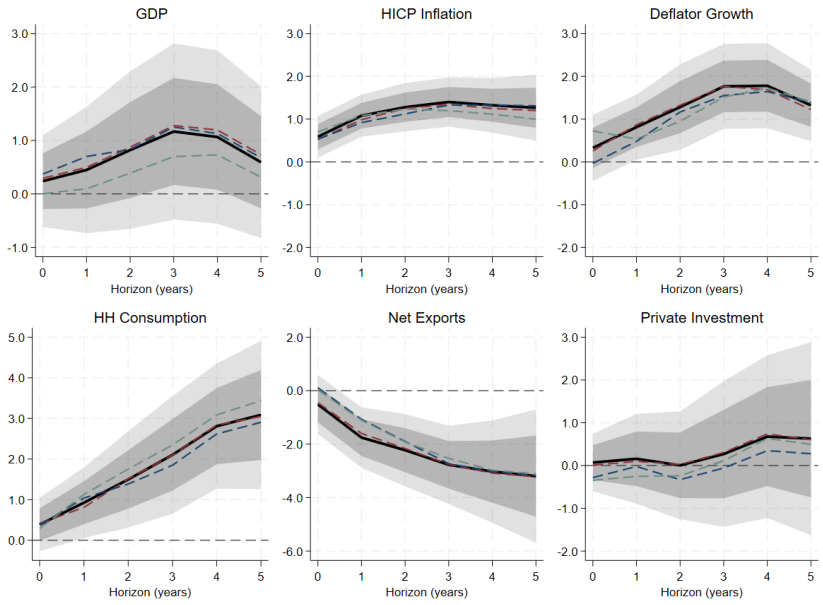
## Figure A.2.1: COFOG and Adjusted Total Defence Spending by Country



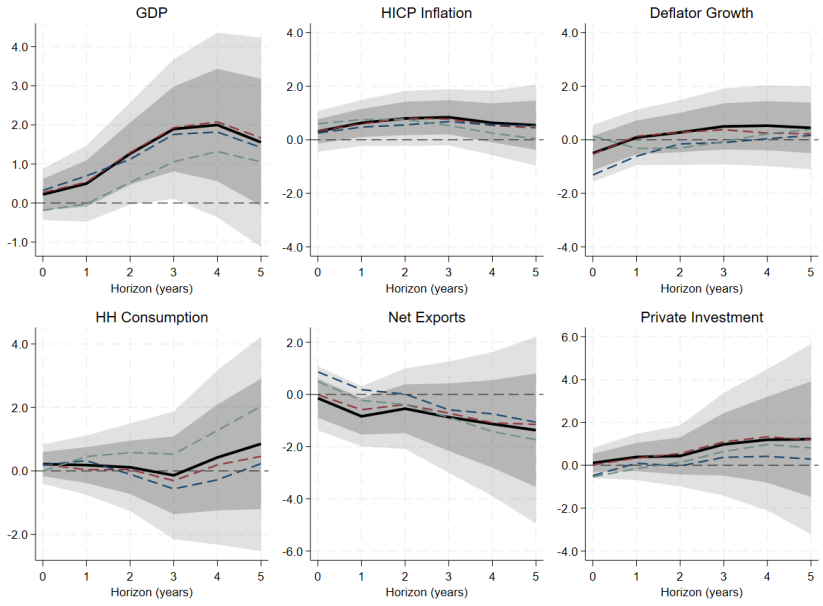

*Notes:* COFOG (blue) and order-date-adjusted COFOG (black) as % of GDP, 1995–2025. The adjustment moves capital spending from delivery-date to order-date timing using ATDB-derived country-specific lags. The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country).

## Figure A.2.2: Lag Adjustment Specification

**(A)** Effect of a 1% of trend GDP increase in adjusted total defence spending




**(B)** Effect of a 1% of trend GDP increase in adjusted capital defence spending



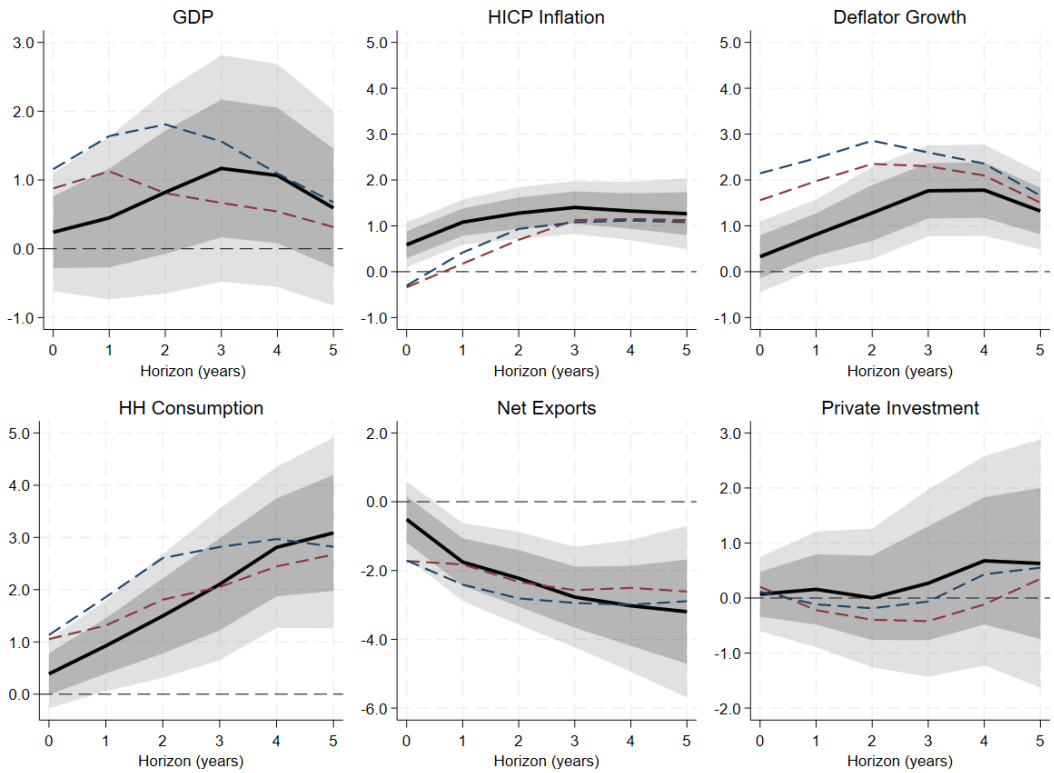

*Notes:* Baseline: Imports and exports including estimated delivery times 1950-2010 (black with bands), Import-only 1950-2010 (Maroon), Confirmed deliveries only 1950-2010 (Navy), Recent sample 1995-2010 (Teal). Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands, shown for the baseline only: grey 68% and light grey 90%.

leads are not yet observed, drop out of the estimation. Figure A.2.3 disentangles the two by comparing three specifications: unadjusted total defence on its full available sample (maroon - same line as per Figure 3 in the main text); unadjusted total defence on the matched sample, restricted to observations for which the adjusted measure exists (navy); and adjusted total defence on its available sample (black, with bands - same as Figure 4 in the main text).

The maroon–navy comparison isolates the pure sample effect. Holding the spending measure fixed, under the restricted, shorter sample (up to 2023 for the median country - navy), the output multiplier is substantially larger across all horizons than on the longer sample (maroon). This possibly reflects either that the most recent years of the build-up have brought a weaker output response than before, or that their full output effect has yet to materialise.

The navy–black comparison isolates the pure methodological adjustment effect on identical observations. Holding the sample fixed, the re-timing then reshapes the profile: the impact response falls from above unity to approximately 0.2 and the peak moves from years one–two to years three–four, while converging at year 5. The later and more gradual multiplier profile under the adjusted measure is therefore attributable to the re-timing of capital spending, not to the accompanying change in sample composition.

**Figure A.2.3: Adjustment Decomposition: Sample vs. Re-timing Effects**




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in defence spending. Black + bands = adjusted total defence, available sample; Maroon = total defence, full available sample; Navy = total defence, matched sample (observations for which the adjusted measure exists). Maroon vs. Navy isolates the sample effect; Navy vs. Black isolates the adjustment effect. Sample (1999-2025). Confidence bands: grey 68% and light grey 90%.

## A.3 2025 COFOG Imputation

Eurostat's detailed COFOG expenditure table (`gov_10a_exp`) lags budget outturns by one to two years. At the time of data compilation, we use Eurostat's more timely defence-specific table (`gov_ev`), published in the context of the excessive deficit procedure (EDP) and fiscal surveillance. This reports total government defence expenditure and defence gross fixed capital formation in current million euro for most countries and draws on the same national accounts perimeter as COFOG. As there are some differences in levels, we impute the 2025 values using the 2024-to-2025 growth rate of each series applied to the corresponding 2024 COFOG value. Total and capital expenditure are treated independently, and imputation is applied only where the COFOG value is missing.

The resulting 2025 coverage is as follows. Capital spending is available for all EU countries, but total defence expenditure remains missing for five countries (Cyprus, Spain, Ireland, Italy, and the Netherlands) for which the 2025 data required to compute the growth rate were unavailable. The 2025 observations of these five countries consequently drop out of the estimations involving total and adjusted total defence spending. Excluding the imputed observations is essentially equivalent to ending the estimation sample in 2024, as only Luxembourg had published 2025 data. For adjusted total defence spending this leaves the results unchanged, since the order-date adjustment already removes almost all 2025 observations. For unadjusted total defence spending, it raises the GDP multiplier from year two onwards, to about 1.4 at year two against 0.8 in the baseline, and somewhat raises the price responses, mainly in the first years, in line with the sample effect discussed in Section 4.1.

## A.4 State Dependence: Discrete Debt Thresholds

Section 4.4 reports the state-dependent results under the smooth logistic transition function. Figure A.4.1 reports the two discrete-threshold specifications, in which the high-debt state is an indicator for the lagged debt-to-GDP ratio exceeding 60%, the Maastricht Treaty reference value, or 90%, as found in the debt-and-growth literature (Reinhart and Rogoff, 2010; Checherita-Westphal and Rother, 2012). In equation (2), $S_{i,t-1} = \mathbb{1}\left[b_{i,t-1} > \bar{b}\right]$ with $\bar{b} \in \{60\%, 90\%\}$, where $b_{i,t-1}$ is the lagged debt-to-GDP ratio, and the discrete specifications additionally include the state indicator itself as a regressor. Both deliver a similar message to the smooth-transition specification in the main text in years one to three: the GDP multiplier and the price responses are larger in the low-debt state, while in the high-debt state both are close to zero or negative. With the exogenous thresholds, surprisingly, the GDP effects tend to be higher in the high debt regimes at the 5-year horizons and the prices tend to catch up, but the results are not statistically significant.

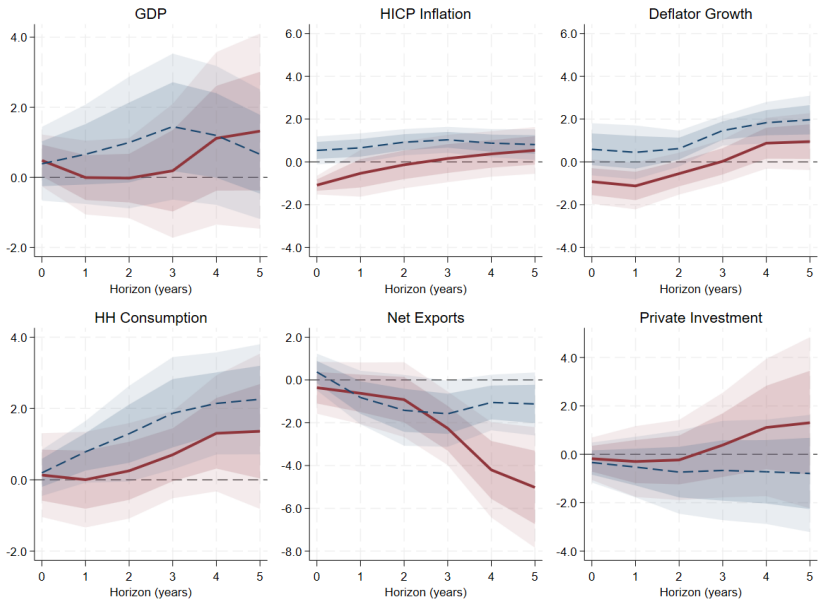
## A.5 Robustness

This section reports the robustness exercises summarised in Section 4.5.

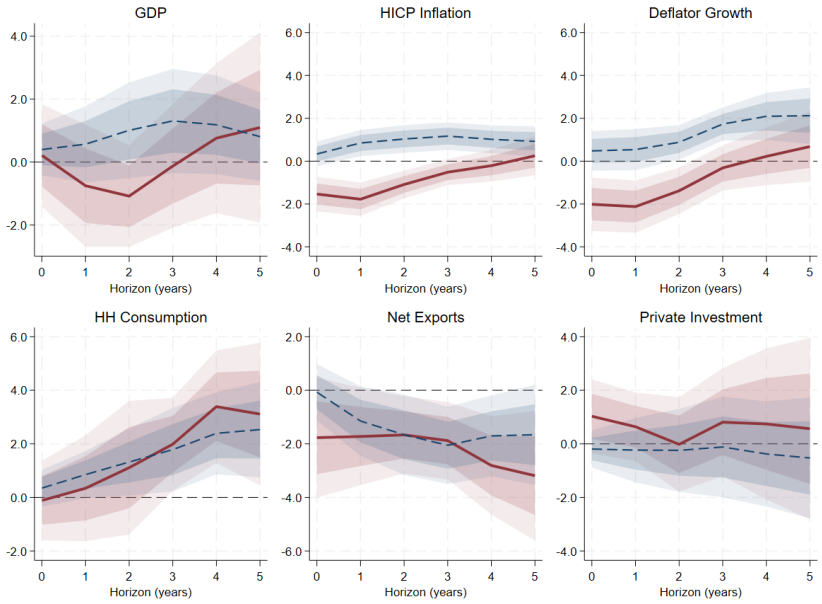
**SIPRI data** (Figure A.5.1). Our headline estimates use COFOG defence spending, but the SIPRI military expenditure series is an independent measure built on a different definition and collection methodology (mostly cash-based and more closely aligned with the NATO definition). It is available only for total defence spending and re-estimating part of our results with it serves as both a robustness check and a complementary source of evidence. Figure A.5.1 re-estimates the baseline for unadjusted total defence spending on the SIPRI series, which runs to 2025.

## Figure A.4.1: State-Dependent Results: Discrete Debt Thresholds

**(A)** Threshold at 60% of GDP




**(B)** Threshold at 90% of GDP




*Notes:* State-dependent cumulative impulse responses to a 1% of trend GDP increase in adjusted total defence spending. Maroon (solid) with bands = high-debt state; Navy (dashed) with bands = low-debt state. Sample (1999-2025). The smooth-transition version is shown in the main text (Figure 7). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands 68% and 90%.

The GDP multiplier profile is broadly consistent with the COFOG unadjusted baseline, though somewhat lower in size, especially at the peak value.

Under SIPRI, the HICP inflation response remains statistically significant. It peaks at about 1.1 percentage points, as for unadjusted COFOG spending, but sets in earlier, with a profile closer to that for adjusted COFOG spending. Differently from the COFOG specifications, the GDP deflator response is weaker - both statistically and economically - it is significant at the 90 per cent level only in years 4–5, lies between about 0.6 and 0.9 percentage points from year one onwards, and remains below the inflation response at all horizons. With data ending in 2021, however, the SIPRI deflator response is larger, peaking at about 1.4 percentage points in year two, and close to the HICP response at all horizons.

As in the COFOG baseline, the household consumption response is positive and the net export response negative, both statistically significant, and the private investment response is not statistically significant.

**Lag order** (Figure A.5.2). The baseline uses four lags of all regressors. Shorter lag specifications leave more within-variation for identification but may not fully absorb serial correlation in the outcome and spending series. We re-estimate with two and three lags and overlay the point estimates. The agreement across lag orders confirms that the results are neither driven by over-fitting from an unnecessarily long lag nor sensitive to residual serial correlation under a shorter specification. Quantitatively, the spread of the GDP response across the two-, three- and four-lag specifications is at most 0.2 percentage points for adjusted total and 0.3 for total defence spending, and that of the HICP inflation response at most 0.3. The deflator response is somewhat more sensitive, with spreads of up to 0.6 percentage points in year five, where the four-lag estimate lies below the others, but it remains positive and significant from year one at all lag orders.

**Polynomial order and normalisation** (Figure A.5.3). Two dimensions of sensitivity are assessed jointly. The first concerns the polynomial order used to extract trend GDP for detrending and normalisation: we compare fourth- and sixth-order polynomials against the baseline fifth-order specification. The second concerns the GDP denominator: we test contemporaneous trend GDP and lagged actual GDP as alternatives to lagged trend GDP used in the baseline. Because these choices affect scaling but not the qualitative shape of the response, close agreement across all five specifications provides reassurance that the results are not an artefact of a particular detrending or scaling convention. Of the three outcomes, the GDP multiplier is the most sensitive: its spread across the five specifications reaches about 1.7 percentage points at the three-year peak, driven mainly by the choice of normalisation denominator, which rescales the output response, whereas the HICP inflation and deflator growth responses vary by less than 0.35 percentage points at every horizon.

**Monetary and financial controls vs. time fixed effects** (Figure A.5.4). The baseline absorbs all common time-varying factors through year fixed effects, which may conflate fiscal and monetary impulses. Four alternatives are overlaid. Two specifications replace the year effects with a set of relevant time dummies and add either the Wu and Xia (2016) or the Lemke and Vladu (2017) euro area shadow rate as a continuous proxy for the monetary policy stance in the EMU countries. The time dummies cover 2009 (the trough of the global financial crisis), the period from 2014 onwards (Russian annexation of Crimea), 2020 (the pandemic), and the period from 2022 onwards (Russia's invasion of Ukraine and the energy and inflation surge). A third alternative retains year effects but adds the lagged long-term nominal interest rate. A fourth replaces year effects with the same episodic dummies and the short-term nominal interest rate. All specifications, including the baseline shown for comparison, are estimated on the common

sample of observations with non-missing values for both interest rate series. This restriction matters in its own right: it drops all of 2025, together with the early years for several member states that joined the EU after 1999 and a gap in the Estonian series (2011–2019), as well as Bulgaria's observations for 2022–2024. On this shorter sample the estimated GDP multiplier for total defence (unadjusted) is two to three and a half times its full-sample value, depending on the horizon. That is the same sample effect documented in Appendix A.2, whereby excluding the most recent years raises the measured multiplier. The specifications should therefore be compared with each other rather than with the headline estimates. Doing so, for total defence spending, the responses that retain year fixed effects sit below those that replace them with episodic dummies and a policy rate. Yet, in our preferred specification with adjusted total defence spending, the size of the GDP response is much less dispersed. For both spending measures, the specifications without year fixed effects yield a higher cumulative inflation response than the baseline in year 2 (about 2 percentage points), which converges to the baseline towards the end of the horizon. Apart from the insignificant private investment response to total defence spending, which turns marginally negative in year three when the long-term rate is added, no specification changes the sign of the estimated responses.

**GDP weighting** (Figure A.5.5). Panels A–B compare the equal-weighted EU27 baseline with a GDP-weighted EU27 specification, in which each observation is weighted by the country's share of EU27 GDP in that year. Weighting by economic size attenuates the influence of smaller member states. For inflation, such effects carry more relevance for the euro area common monetary policy (covering most countries in the sample). In this specification, the GDP-weighted output response builds more gradually, consistent with the longer procurement cycles of the largest economies, but reaches a similar magnitude by the end of the horizon. The HICP responses are close to the baseline, except that the response to total defence spending is somewhat higher in years 4–5, whereas the deflator response is higher for total and lower for adjusted total defence spending. The strong household consumption response is smaller under GDP weighting, as is the net export response to adjusted total defence spending, indicating that the effects in the baseline partly reflect smaller member states. Overall, the results confirm that the baseline findings are not mechanically driven by the equal-country weighting.

**Outlier robustness** (Figure A.5.6). To verify that the estimates are not driven by extreme observations we construct a version of the dataset in which the defence spending shocks and all outcome variables are winsorized at the pooled 1st and 99th percentiles. We leave the control variables unchanged and re-estimate the baseline specification. The winsorized responses track the baseline closely across all outcomes. The GDP response to total (unadjusted) defence spending is modestly attenuated at short horizons, by 0.3 percentage points at the one- to two-year horizon, consistent with a limited influence of large spending realisations. The adjusted total defence results are virtually unchanged. Extreme outliers therefore do not drive the baseline findings.

**Country sample sensitivity** (Figures A.5.7 and A.5.8). The panel pools 27 economies of very different size, and some member states combine small GDP with large and lumpy defence outlays, raising the question of whether the results depend on the presence of any individual country. We re-estimate the baseline 27 times, excluding one member state at a time, and compare the estimated response at the horizon at which the baseline response peaks ($h^*$, determined separately for each spending variable and outcome based on the baseline results). Evaluating all leave-one-out estimates at a common horizon ensures that differences reflect the composition of the panel rather than shifts in response timing. Across GDP, HICP inflation, and deflator growth, and for both total and adjusted total defence spending, every leave-one-out estimate

remains within the 68 per cent confidence band of the baseline. The exercise compares each re-estimated point estimate against the baseline bands. The largest movements in the GDP response arise from excluding Romania, Latvia, Estonia, Greece, or Lithuania, all smaller member states with comparatively volatile and large defence spending series. The single largest movement – from excluding Romania – shifts the peak GDP response by about one percentage point, and remains inside the baseline 68 per cent band. The price responses move less than the GDP response.

We repeat the exercise for the impact of adjusted capital defence spending across all six outcomes of Figure 5 (Figure A.5.8, Panel A). Among the 27 exclusions and six outcomes, only one moves the estimate outside the baseline 68 per cent confidence band: excluding Latvia shifts the private investment response by 3.4 percentage points, against 1.3 for the next largest exclusion. Panel B compares the full-panel impulse responses with those obtained when Latvia is dropped. At the five-year horizon the private investment response rises from 1.2 to 4.7 percentage points and becomes significant at the 90 per cent level, whereas the full-panel estimate is not significant at any conventional level. The GDP multiplier strengthens in step, from 2.0 to 2.8 at its four-year peak, where the full-panel estimate is significant only at the 68 per cent level.

Inspection of the Latvian series suggests why. Adjusted capital defence spending in Latvia rose from 0.2 to above 0.6 per cent of trend GDP between 2004 and 2006. Private investment peaked at 39 per cent of trend GDP in 2007 and collapsed to 13 per cent by 2010 in the global financial crisis. The estimate therefore treats a coincidence in timing as crowding out.

Household consumption and net exports also move, but both are imprecisely estimated at the five-year horizon before and after exclusion, and no other exclusion, for any outcome, takes the response outside the baseline 68 per cent band.

We do not adopt the exclusion as a preferred specification, but it lends support to the crowding-in channel we associate with capital procurement.

**Composition effects: the residual category and military donations** (Figure A.5.9 and Table A.5.1). Besides capital formation, personnel costs and intermediate consumption, total defence spending contains a residual category, which accounted for about 3 per cent of total defence spending over 1999–2021 and 9 per cent over 2022–2024. Before 2022, the residual consists mainly of other current transfers, such as contributions to international organisations (about 55 per cent of the residual), and of taxes and pension-entitlement adjustments (about 30 per cent). Since 2022, it is driven by investment grants (about half), largely related to military aid, and by other current transfers (about 30 per cent), which also include some military aid. Donations of weapons systems are recorded as investment grants and donations of ammunition and other military inventories as current international cooperation, part of other current transfers (Eurostat, 2024). As donations from existing stocks are offset within defence by the disposal of the donated assets, they leave total defence spending unaffected (Eurostat, 2026, para. 32); for weapons systems, however, the disposal is recorded as negative capital formation, so spending shifts from capital to the residual category.[15]

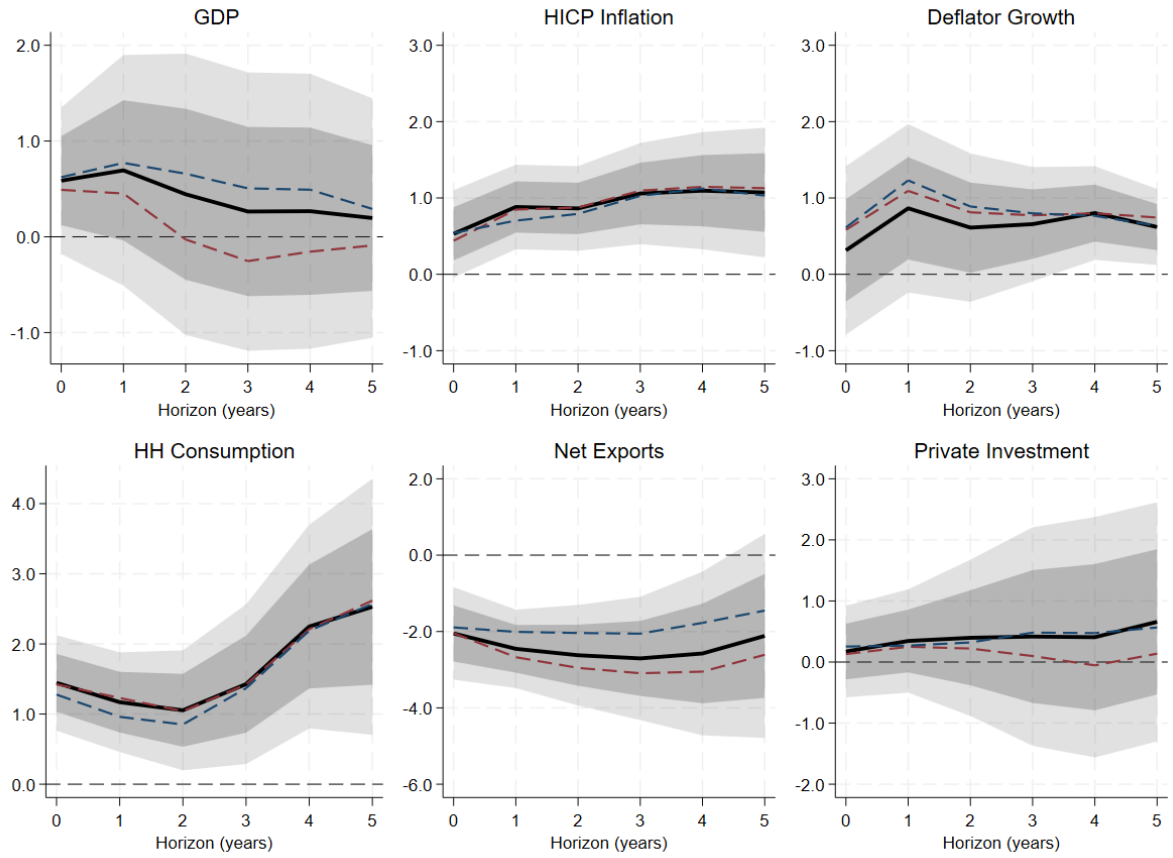
Donations also affect the order-date-adjusted series. The order-date adjustment shifts the disposal back by the delivery lag while the grant remains in the year of the donation, so donations can produce sharp swings in the adjusted series; in Slovakia, for instance, the adjusted series turns negative in 2022 (Figure A.2.1). We correct for this in the robustness checks by adding

[15]The remainder consists mainly of changes in inventories (about a tenth of the residual in both periods), which include ammunition and missiles, with small amounts of other capital transfers, subsidies, property income and net acquisitions of non-produced assets. Shares are EU27 sums from Eurostat `gov_10a_exp` (COFOG GF02, general government).

back to capital spending the investment grants reported in the same Eurostat table. Investment grants also include cash aid that the recipient uses to acquire military equipment (Eurostat, 2026, para. 42), as well as other grants not matched by a disposal. The corrected series is therefore an upper bound on capital spending before donations, while the recorded series is a lower bound.

Figure A.5.9 re-estimates the baseline responses to adjusted total defence spending (Figure 4), changing one element at a time: excluding the residual category, correcting capital spending for donations, and ending the data in 2021. The GDP response is virtually unchanged when the residual is excluded or donations are corrected, and larger when the data end in 2021, in line with the sample effect discussed in Section 4.1. The HICP impact response is not statistically significant in any of the three variants (between 0.2 and 0.4 percentage points, against 0.6 in the baseline; Table A.5.1). From year one, by contrast, the HICP response is statistically significant in all of them (with data ending in 2021, only at the 68 per cent level in year five): excluding the residual lowers it by about 0.2–0.3 percentage points and ending the data in 2021 by about 0.5, while the donation correction leaves it unchanged. The deflator response changes by at most 0.3 percentage points from year two. For adjusted capital alone (Figure 5, Panel A), the donation correction lowers the peak GDP multiplier from about 2.0 to 1.7.

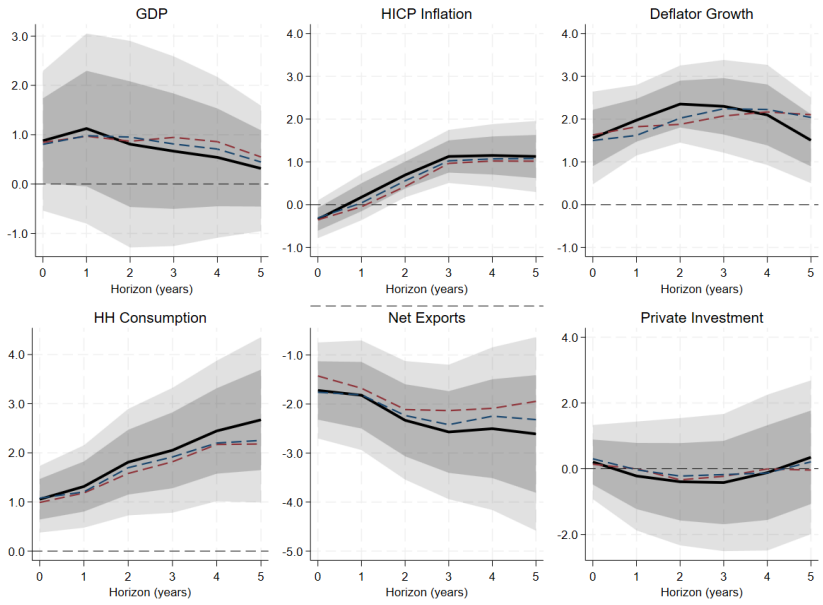
**Figure A.5.1: Robustness: SIPRI Total Defence Spending**



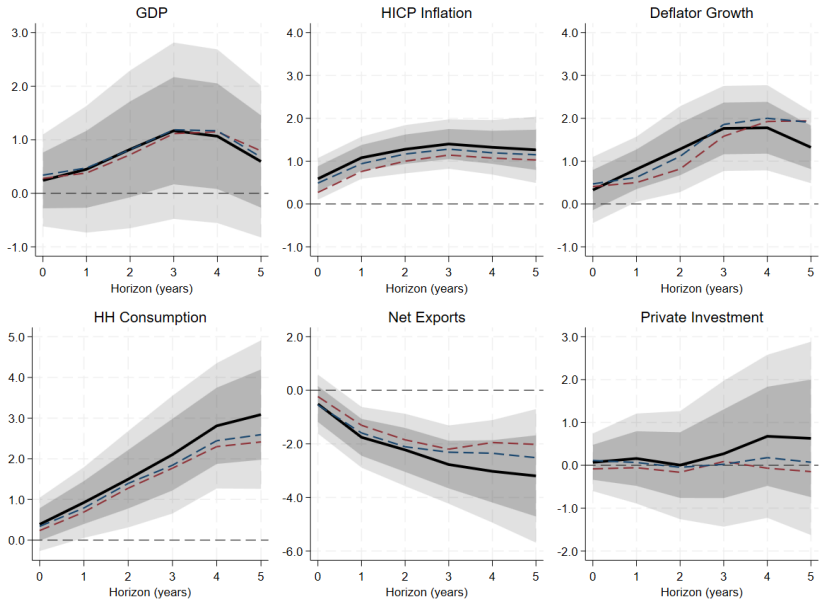

*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in total defence spending. Black + bands = Baseline (1999-2025); Maroon = (1995-2025); Navy = (2004-2025). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.2: Lag Order Robustness

**(A)** Effect of a 1% of trend GDP increase in total defence spending



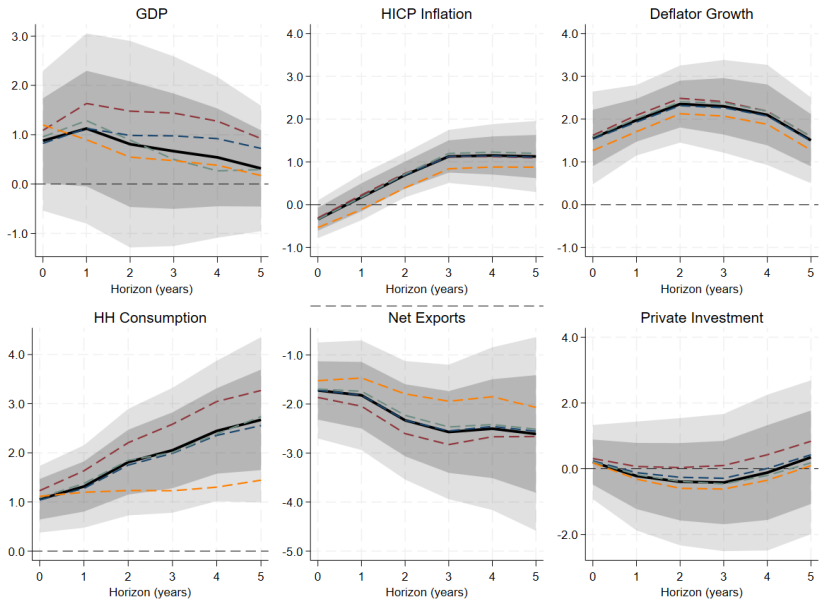

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



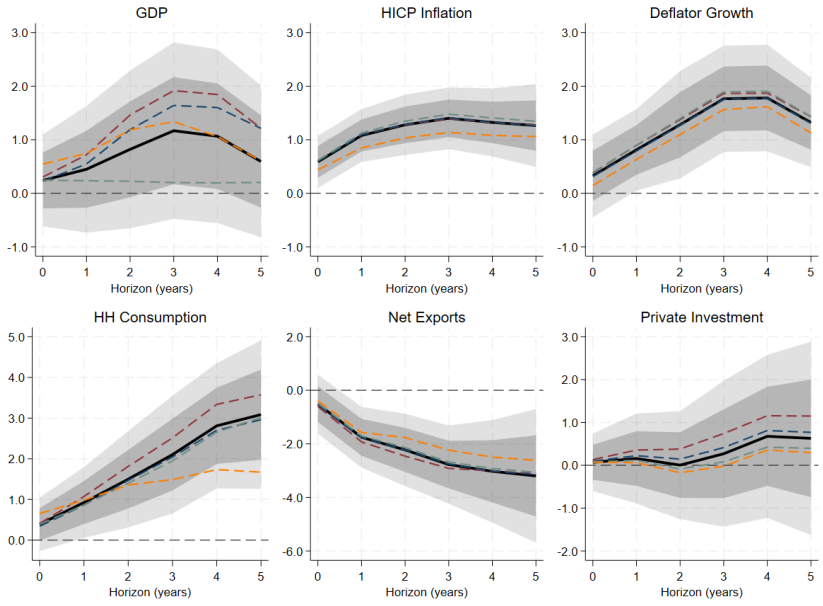

*Notes:* Black with bands = baseline (4 lags); Maroon = 2 lags; Navy = 3 lags. Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.3: Polynomial and Normalisation Robustness

**(A)** Effect of a 1% of trend GDP increase in total defence spending



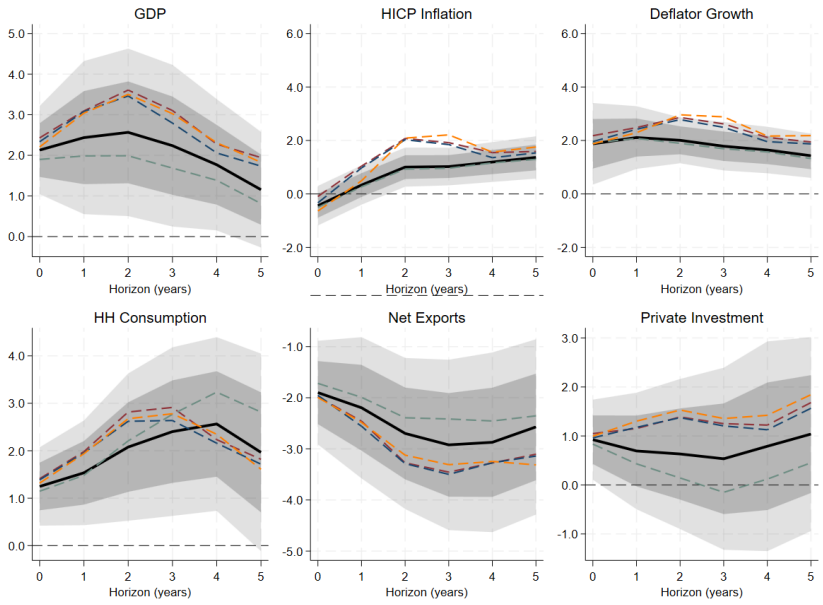

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



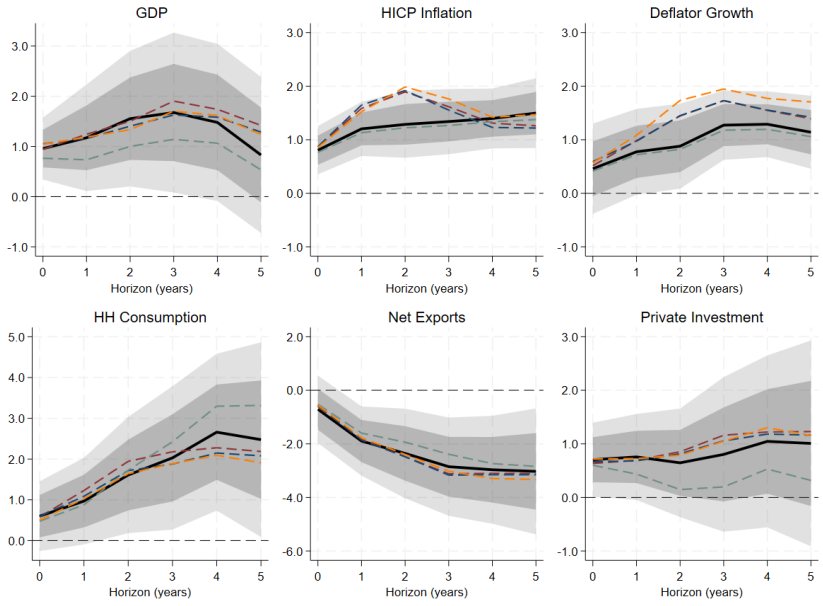

*Notes:* Black with bands = baseline (5th-order polynomial, lagged trend GDP); Maroon = 4th order; Navy = 6th order; Teal = contemporaneous trend GDP; Orange = lagged actual GDP. Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.4: Shadow Rate and Interest Rate Robustness

**(A)** Effect of a 1% of trend GDP increase in total defence spending



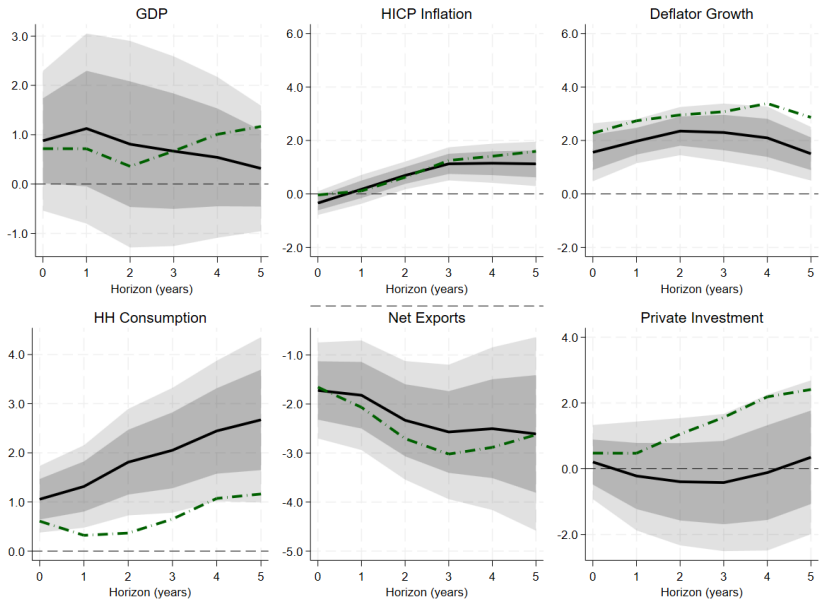

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



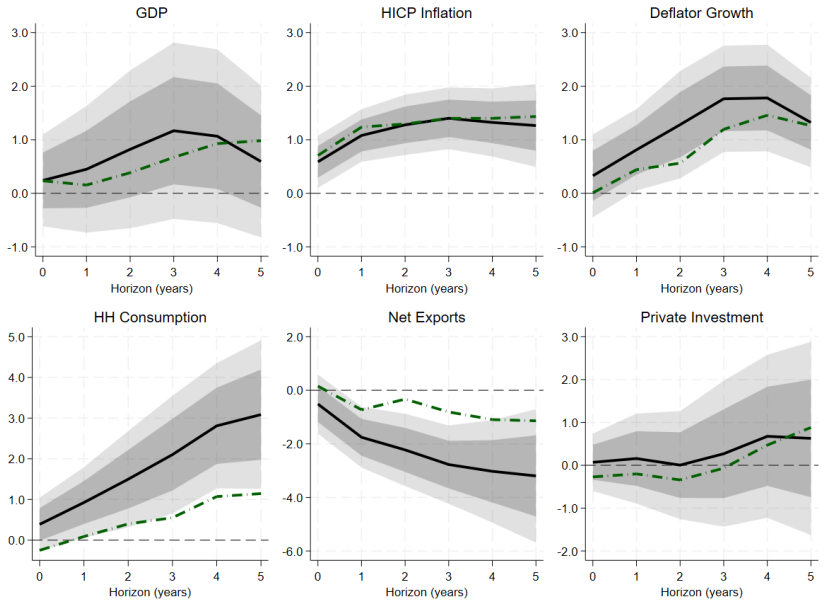

*Notes:* Black with bands = baseline, year fixed effects (FE); Maroon = Wu-Xia shadow rate (Wu and Xia, 2016), no year FE; Navy = Lemke-Vladu shadow rate (Lemke and Vladu, 2017), no year FE; Teal = year FE + long-term rate; Orange = short-term rate, no year FE. Common sample. The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.5: GDP Weighting

**(A)** Effect of a 1% of trend GDP increase in total defence spending



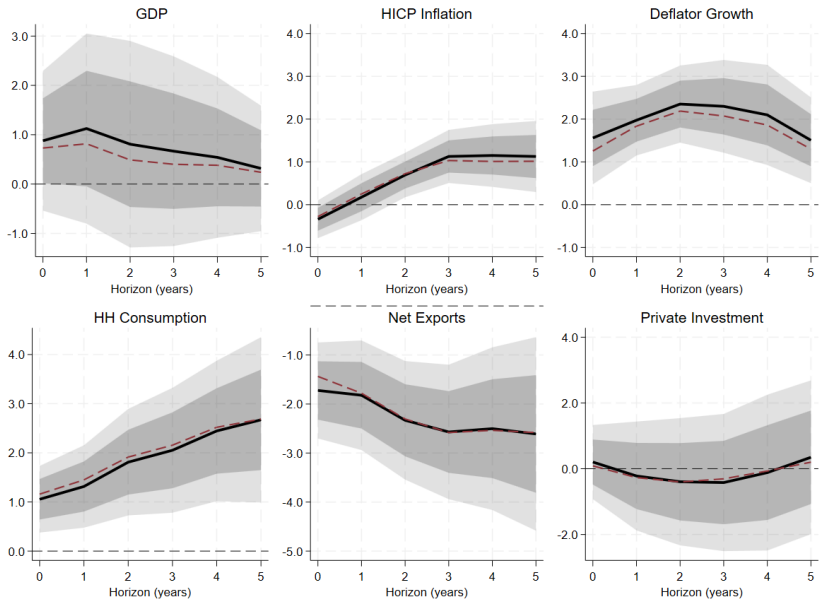

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



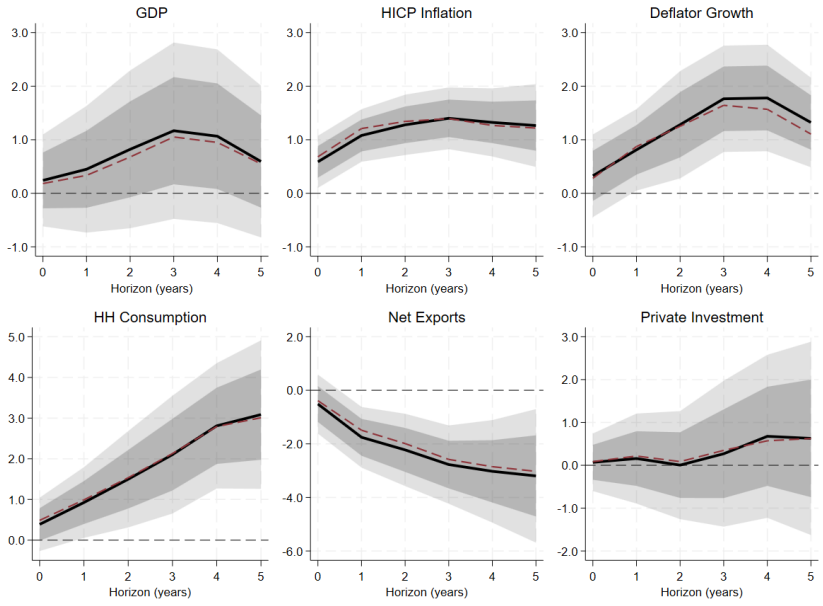

*Notes:* EU27 equal-weighted (black, with bands), EU27 GDP-weighted (green, dotted). GDP weights are each country's share of EU27 GDP in the given year. Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.6: Outlier Robustness: Winsorization

**(A)** Effect of a 1% of trend GDP increase in total defence spending



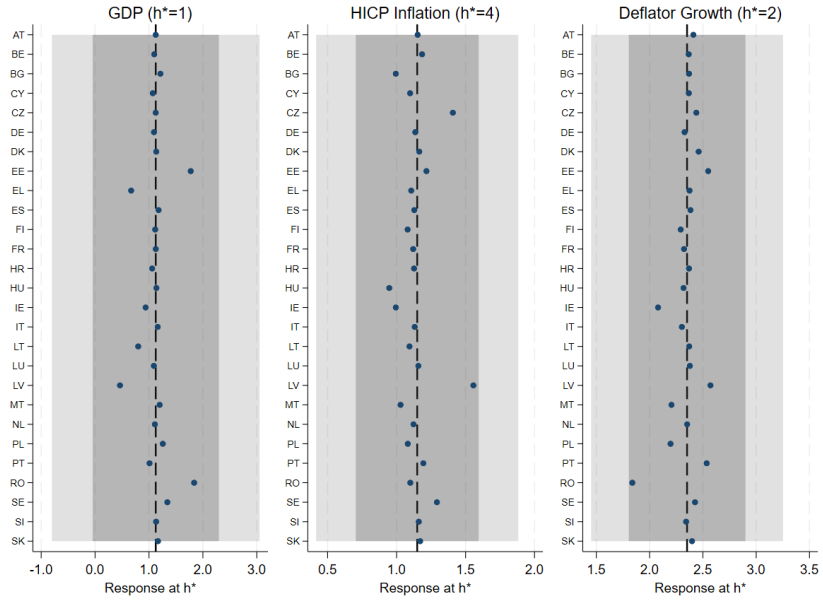

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



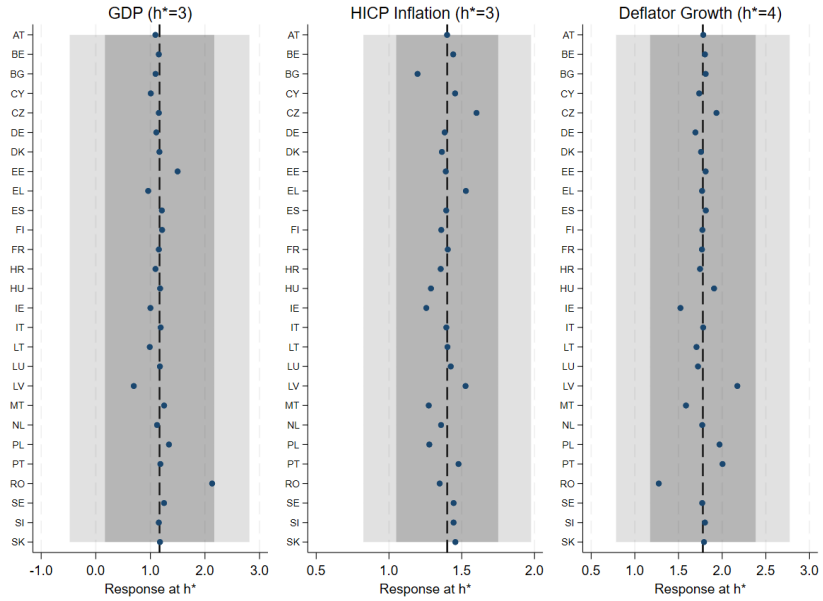

*Notes:* Black with bands = baseline; Maroon (dashed) = winsorized data, in which the defence spending shocks and all outcome variables are winsorized at the pooled 1st/99th percentiles (controls unchanged). Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: grey 68% and light grey 90%.

## Figure A.5.7: Country Sample Sensitivity: Leave-One-Out

**(A)** Effect of a 1% of trend GDP increase in total defence spending



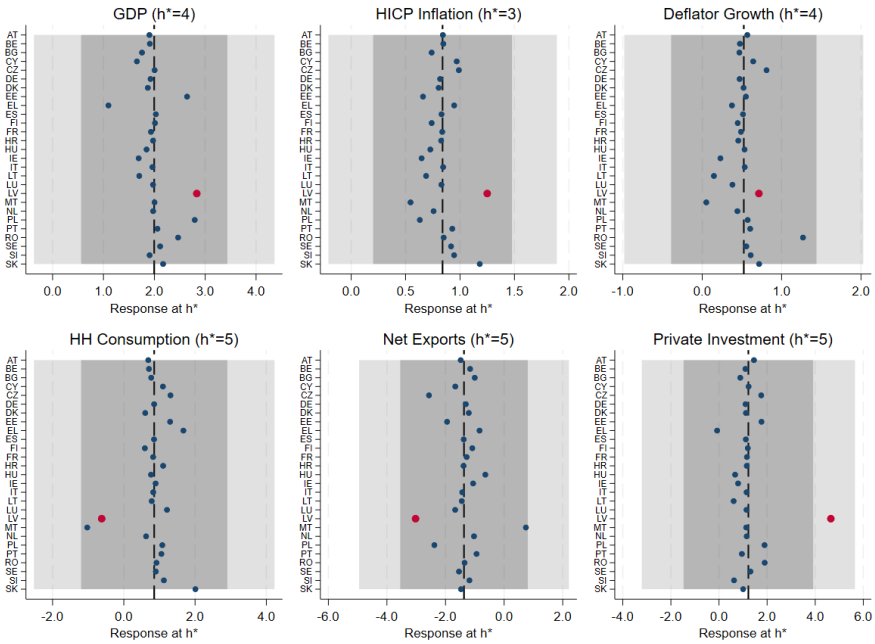

**(B)** Effect of a 1% of trend GDP increase in adjusted total defence spending



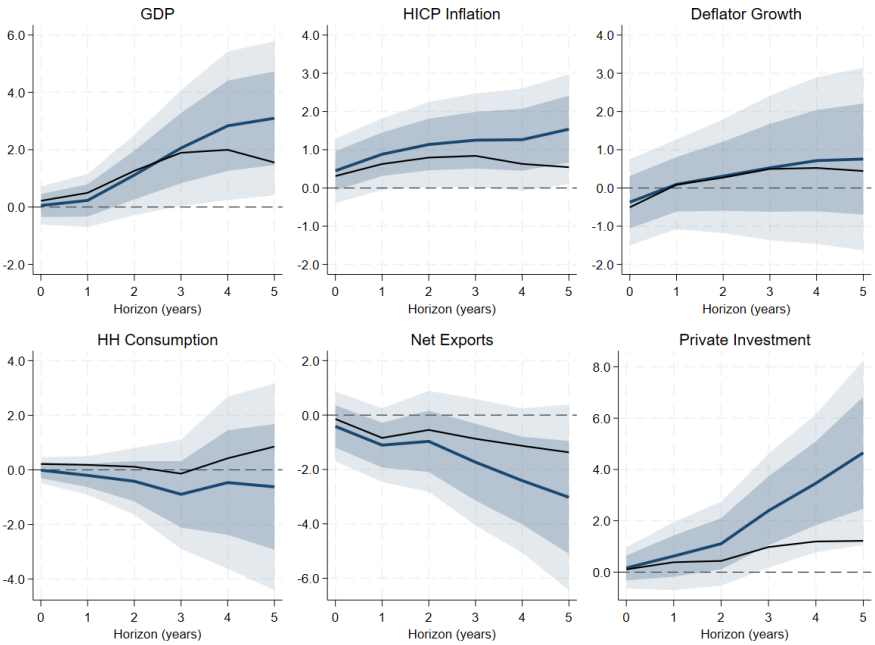

*Notes:* Leave-one-out estimates. Each dot shows the estimated response at the baseline peak horizon $h^*$ (reported in each panel title) when the indicated country is excluded from the panel. Dashed vertical line = baseline (all EU27) estimate at $h^*$; dark and light shaded bands = baseline 68% and 90% confidence intervals. $h^*$ is the horizon of the largest absolute baseline response for each outcome. Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country).

**Figure A.5.8: Influential Observations: Impact of the Adjusted Capital Defence Spending**

**(A)** Leave-one-out estimates at the baseline peak horizon

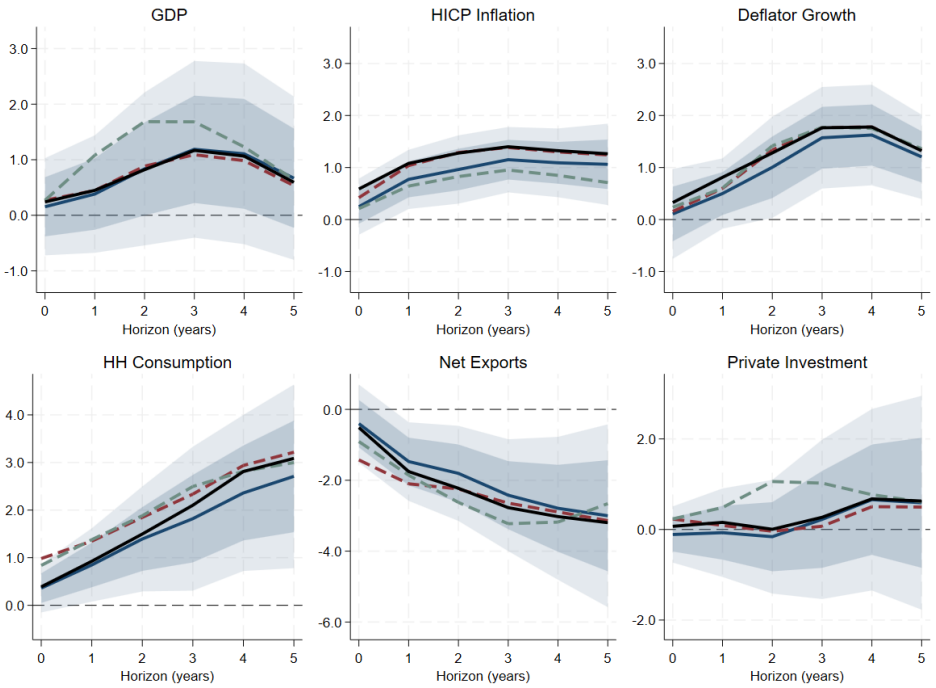



**(B)** Full panel versus excluding Latvia




*Notes:* Effect of a 1% of trend GDP increase in adjusted capital defence spending. Panel A: each dot shows the estimated response at the baseline peak horizon $h^*$ (reported in each panel title) when the indicated country is excluded from the panel; Latvia in red. Dashed vertical line = full-panel estimate at $h^*$. Panel B: navy line = excluding Latvia; black line = full panel (point estimate only). Sample (1999-2025). The order-date adjustment shortens the effective sample at the end by each country's procurement lag: 0–4 years (ending in 2023 for the median country). Confidence bands: 68% (dark) and 90% (light), shown around the full-panel estimate in Panel A (grey) and around the exclude-Latvia estimate in Panel B (blue).

**Figure A.5.9: Robustness: Residual Category, Military Donations and Data to 2021**




*Notes:* Cumulative impulse responses to a 1% of trend GDP increase in adjusted total defence spending, from 1999. Black (solid) = baseline specification in Figure 4; Navy (solid) with 68% (dark) and 90% (light) confidence bands = adjusted total defence spending excluding the residual category (data to 2024); Maroon (dashed) = adjusted total defence where capital spending is corrected for military donations; Teal (dashed) = data ending in 2021.

**Table A.5.1: Cumulative HICP Inflation Response: Baseline, Residual Category, Military Donations and Data to 2021**

| | Horizon (years) | | | | | |
|---|---|---|---|---|---|---|
| Specification | 0 | 1 | 2 | 3 | 4 | 5 |
| Baseline specification (Figure 4) | 0.59** | 1.08** | 1.28** | 1.40** | 1.32** | 1.26** |
| Excluding the residual category | 0.25 | 0.77** | 0.96** | 1.15** | 1.09** | 1.06** |
| Corrected for military donations | 0.42 | 1.04** | 1.29** | 1.39** | 1.30** | 1.24** |
| Data ending in 2021 | 0.21 | 0.64** | 0.83** | 0.95** | 0.85** | 0.71* |

*Notes:* Cumulative response of HICP inflation, in percentage points, to a 1% of trend GDP increase in adjusted total defence spending, from 1999. The specifications are those shown in Figure A.5.9. ** and * denote statistical significance at the 90% and 68% levels.

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