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Macroeconomic Impacts of EU Defense Spending

Prepared by Davide Furceri, Pedro Juarros, Saurabh Mishra, Anh Dinh Minh Nguyen, Ana Sofia Pessoa, and Alexandre Sollaci

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ABSTRACT: Europe's defense spending is undergoing a historic shift. With NATO members expected to reach 2% of GDP and discussions underway to increase targets to 5% by 2035, this paper examines the possible macroeconomic consequences of such rearmament using two complementary approaches. First, using an annual panel dataset covering 27 EU countries over the period 1989–2023, we show that past national defense spending has stimulated economic activity in the short term, and entailed sizable cross-border spillovers. Importantly, we find that spending multipliers varied considerably across countries and over time: they tended to be larger when import intensity is low, fiscal space (captured by sovereign yields spread) is ample, and public investment efficiency is high. Second, a novel high-frequency dataset of monthly defense procurement contracts from Opentender, covering EU-27 countries from 2009 to 2023, allows for improved causal identification using fiscal news and instrumental variables based on European aggregate defense procurement and each country's geographic proximity to major adversaries. The estimates corroborate the positive effects of defense spending on output and show that equipment procurement has the strongest relative impact. Given the larger and more synchronized nature of the current European defense buildup relative to past national episodes in our sample, multipliers might fall below historical estimates, especially if monetary policy is not accommodative.

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WORKING PAPERS

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I. Introduction

The average level of military spending in Europe had been declining since the 1970s, although with significant cross-country heterogeneity (Figure 1). However, this trend has recently shifted. Between 2021 and 2024, defense outlays among European Union (EU) members' increased by about 30 percent, reaching 1.9 of the EU's GDP in 2024. Furthermore, defense spending is expected to continue rising , as all NATO allies are expected to meet or exceed the 2 percent of GDP spending target (NATO, August 2025). Discussions are also underway about raising the target further, with proposals for defense and security related spending to reach 5 percent of GDP by 2035.

These shifts represent a major change in the scale and direction of EU defense spending. Given their size and persistence, they are likely to carry significant macroeconomic consequences for a region already grappling with elevated debt. Against this backdrop, this paper aims to shed light on the following questions. First, what have been the macroeconomic effects of past increases of defense spending in EU countries? Second, what have been the transmission channels through which these effects operates? Third, do estimated defense multipliers vary with economic conditions and structural country characteristics? Fourth, given Europe's high degree of economic and security integration, how large have been cross-border spillovers from defense spending? Fifth, does the timing and frequency of high-frequency defense procurement awards reveal anticipation effects that shape macroeconomic responses? Finally, are there heterogeneous impacts depending on the type of defense procurement?

We use two complementary approaches and sets of data to address these questions. First, consistent with recent empirical literature, we leverage historical macroeconomic data on annual defense spending outlays—available for a large set of countries over more than three decades—to analyze aggregate effects, transmission channels, spillovers, and heterogeneity across countries. Second, we utilize granular monthly data on defense procurement obligations (fiscal news) to better identify causal effects, gain insights into the timing and anticipation of fiscal shocks, and assess how the impact of defense spending varies across components such as equipment, services, construction, and research and development.[1]

The first part of the analysis uses a country-level panel covering 27 EU countries from 1989 to 2023. Following Ramey and Zubairy (2018), we employ a local projection framework that regresses cumulative output (normalized by trend GDP) over several horizons on cumulative defense spending (also normalized by trend GDP), while controlling for a set of common macroeconomic variables. Under the assumption—examined further in the second part—that defense spending is exogenous to GDP shocks, the estimated coefficient on cumulative normalized defense spending indicates the fiscal multiplier for defense. The estimated short-term multipliers are statistically significant and above one; although estimates become less precise at longer horizons. The magnitudes align with recent for EU countries (Garcia-Serrador et al. 2025; Ben Zeev et al. 2025) as well as for the US states (Nakamura and Steinsson 2014). This suggests that defense spending had economically significant impact on GDP during the estimation period.

[1] Annual defense outlays and monthly procurement award notices differ in timing, measurement, and identification. Annual outlays reflect actual disbursements, including both consumption and investment, and are typically smoother, capturing the cumulative effect of defense spending over a longer horizon. In contrast, monthly procurement awards represent contractual obligations at the time of signing, not actual spending, and are more volatile and subject to timing mismatches between announcement and economic impact. That said, both approaches are complementary, offering alternative ways into looking the potential macro impact of defense spending.

To study the transmission channels, we examine responses of GDP components from both demand and supply perspectives. A 1 percent of GDP increase in defense spending raised government consumption by about 0.5 percent of GDP in the first year, reflecting the close link between defense outlays and overall government spending. More importantly, investment and private consumption also rise, pointing to an expansion of domestic absorption, consistent with multipliers above one. On the supply side, both capital and labor services responded positively, while effects on total factor productivity are confined to cyclical components and do not extend to trend TFP. In addition, we find consumer prices increase, suggesting that the positive demand effects are larger than positive supply effects.

To rationalize the positive response of consumption and investment and the multiplier above one, we examine the response of short-term nominal interest rates and real exchange rates, drawing on insights from by Christiano et al. (2011) and Miyamoto et al. (2018. The results suggest that, in our sample period, short-term interest rates tended to decline and real exchange rates depreciated following defense shocks, while real exchange rates depreciated. These patterns are consistent with many countries in the sample operating within a monetary union, where monetary policy may not have responded to individual national increases in defense spending—presumably because such increases did not significantly affect aggregate demand for the currency union. Moreover, monetary policy has often been accommodative, with policy rates in many European countries remaining at very low levels from the Global Financial Crisis in 2009 through the post-pandemic inflation surge in 2022.

Given the notable differences between the ongoing large and simultaneous increase in defense spending across European countries and the smaller, more national efforts of the past, not all results might translate to the current effort. For example, the multipliers relevant to the current defense buildup might be lower than historical estimates if monetary policy is less accommodative going forward.[2]

Defense spending multipliers are likely to vary systematically with economic conditions and structural characteristics across EU countries, as motivated by the existing literature, for instance, Corsetti et al. (2012), Ilzetzki et al. (2013), Coenen et al. (2012), and Auerbach and Gorodnichenko (2012). To investigate this, we focus on dimensions that are pertinent to the European context: import intensity, fiscal space (proxied by sovereign yield spreads), and public investment efficiency. Additionally, we examine whether responses differ between unexpected increases and cuts in defense outlays. Extending the baseline local-projection framework to allow for regime-dependent multipliers reveals that effects are considerably larger in environments characterized by low import intensity, ample fiscal space, and high public investment efficiency, while we find little evidence of systematic asymmetry between positive and negative shocks

Next, we analyze potential cross-border spillovers. We find that, for our sample period, a 1 percent GDP increase in domestic defense spending raised imports by about 2 percent of GDP, with roughly equal contributions from intra-EU and extra-EU trade. This points to potentially important cross-border spillovers. To quantify them, we construct a “spillover shock,” as the export-share-weighted average of defense spending changes among trading partners. We find that a 1 percent of GDP increase in partner-country defense spending raised domestic GDP by about 0.4 percent after one year, which corresponds to about one-quarter of the estimated domestic effect. In the context of a coordinated increase in national defense spending, some of these spillovers could be offsetting.

[2] See Nikola et al. (2025) for a discussion across different models assuming that monetary policy is active: the average multipliers across five considered models is 0.93, with three models indicating a multiplier great than 1 and two showing below 1.

In the second part of the paper, we draw on a novel disaggregated and high-frequency dataset constructed from defense procurement awarded contracts for EU-27 countries during the period 2009-2023. The data offers several advantages over annual expenditure series. First, the higher frequency allows for more credible identification since the timing of contracts is plausibly unrelated to business-cycle fluctuations. To address remaining endogeneity concerns (for example, the possibility that geopolitical risks drive both economic activity and defense spending), we use an instrumental variable approach, that combines aggregate European defense spending with country-specific geographic distance to major adversaries derived from military alliances and treaty networks.

A further advantage of procurement data is that they capture fiscal news rather than realized government spending. As emphasized by Ramey (2011) and Ramey and Zubairy (2018), forward-looking agents respond to information about future fiscal actions. Moreover, procurement obligations typically translate into actual payments only after a lag of three to four quarters (Briganti et al., 2025), meaning that identification using realized outlays is subject to anticipation, measurement, and implementation biases that depress multiplier estimates. Monthly procurement data align the timing of shocks with private-sector expectations, isolating unexpected and policy-relevant variation. The high-frequency nature of the data allows for the estimation of short-run dynamics that are not observable with annual data. Finally, the granularity of procurement records ensures that all included expenditures relate directly to defense, enabling analysis of heterogeneity across spending categories.

Our analysis shows that procurement shocks have positive effects on output. OLS estimates show cumulative multipliers that remain statistically significant after 12 months, reaching approximately 0.7 after two years and 0.8 after three years. Defense spending also induces a real effective exchange rate depreciation of about 0.4 percent at two years and 0.7 percent at three years, consistent with the behavior of fiscal shocks under accommodative monetary policy and, in some cases, fixed exchange-rate environments.[3] Instrumental variable estimates produce larger multipliers, with the cumulative multiplier reaching 1.5 at 12 months, closing matching the annual-data results.

Finally, the disaggregated procurement data allow for the examination of heterogeneous effects across categories. Based on the classification introduced by Directive 2009/81 of the European Parliament, spending is divided into construction, services, equipment, and research and development (R&D).The results indicate marked differences across these categories: equipment spending generates the largest multipliers, reaching 2.7 at 36 months, while services, construction, and R&D components also produce positive and statistically significant but more modest effects. These findings underscore the importance of procurement composition for macroeconomic outcomes.

Related Literature

This study contributes to literature on macroeconomic impacts of government spending in several important dimensions. Most existing studies use military spending as an instrument to identify the impact of government spending shocks (Ramey & Shapiro,1998; Ramey, 2011, 2016; Barro & Redlick, 2011; Nakamura & Steinsson, 2014; Antolin-Diaz & Surico, 2025, among others). Similarly, most of the current literature is focused on military spending in the United States, while evidence for a broader set of countries remains limited. In contrast, we

[3] The results are consistent with macro results and the literature on fiscal shocks under accommodative monetary policy and fixed exchange rate regimes (Coenen et al., 2012; Christiano et al., 2011; Ilzetzki et al., 2013; Miyamoto et al., 2018).

focus on the direct impact of military spending and estimate its effects over a large set of countries within Europe.[4]

In that respect, our paper is closest to Garcia-Serrador et al. (2025), Ben Zeev et al. (2025), and Ilzetzki (2025), who also compute defense multipliers in the EU. Specifically, Ilzetzki (2025) estimates that Europe-wide GDP growth will increase by 0.9 percentage point (reaching about 1.5%) if defense spending rises from 2% to 3.5% of GDP, implying a multiplier of about 0.6 to 1.[5] In contrast, Garcia-Serrador et al. (2025) estimates a dynamic fiscal multiplier for defense spending in the EU-27, finding that a 1 percent increase in trend-GDP defense outlays raises aggregate output by about 1.4 percent within one year, peaking at 1.6 percent after two years, with the multiplier more pronounced in deep downturns (exceeding 1.8) compared to expansions (about 0.8). Ben Zeev et al. (2025) estimate a Bayesian panel SVAR using annual data for 17 European economies over five decades, identifying defense news shocks via medium-run restrictions. They find that these shocks increase consumption, investment, employment, and output, with output multipliers around 2 for Europe and NATO members (three times larger than in the US), primarily driven by higher R&D spending and TFP growth—consistent with Antolin-Diaz & Surico (2025)'s findings on persistent effects of military spending biased toward public R&D in the US. Our baseline estimates for the cumulative defense multiplier peaks around 2, echoing Garcia-Serrador et al. (2025) and Ben Zeev et al. (2025).[6]

A potential factor explaining the differences between Europe-wide multipliers and country-specific multipliers within the EU is the role of exchange rates and common monetary policy. Many EU-27 countries share a common monetary policy (i.e., the eurozone) and operate under a fixed exchange rate regime. As documented in the literature (Ilzetzki, Mendoza, and Végh, 2013; Cacciatore et al., 2021, among others), spending multipliers tend to be larger—often exceeding one—in such contexts. This finding is also consistent with the evidence from Nakamura and Steinsson (2014), who show that fiscal multipliers at the US state level are larger than the aggregate national multiplier, reaching about 1.5.[7]

We extend this literature in three important ways. First, we look at the transmission channels through which the defense multiplier might affect the economy. Second, we provide systematic evidence on the heterogeneity of defense spending multipliers across economic and structural environments, particularly import intensity, financing conditions, and public investment efficiency —consistent with the state-dependent fiscal multiplier literature (Coenen et al., 2012; Ilzetzki et al., 2013; and Abiad et al., 2016, among others). Third, we quantify the cross-border spillovers generated by defense spending, which also contributes to the literature on the spillover effects of fiscal shocks (Auerbach and Gorodnichenko, 2013; Beetsma and Giuliodori, 2011).

[4] The literature on defense spending has grown rapidly in recent years, reflecting renewed geopolitical tensions and rising military outlays across advanced economies. While much of the recent work focuses on the macroeconomic effects of defense spending, the broader literature examines a wider range of related issues. For example, Benmelech and Monteiro (2025) study the effects of military spending on deterrence, while Antonova et al. (2025) analyze the factors shaping the effectiveness of military buildups.

[5] Ilzetzki's (2025) back-of-the-envelope calculations for a military multiplier between 0.6 and 1 implicitly assume historical U.S. defense multipliers—estimated at around two-thirds based on Ramey (2011) and Ramey and Zubairy (2018)—and that the ECB would respond to the expected coordinated military buildup, resulting in a moderate decline in private activity.

[6] These relatively large fiscal multipliers (above 1) are also in line with the results found by Canova and Pappa (2025), who study the recent increase in two EU structural funds. In their study, the estimated impact of a 1 percent increase in the European Social Fund (ESF) amounts to a cumulative increase of up to 4.4 percent in gross value-added growth after 3 years. Similarly, Abiad, Furceri and Topalova (2015) estimate public investment multipliers in advanced economies at about 1.4 in the medium term, using public investment forecast errors.

[7] Regarding the difference between US and EU spending multipliers, Figure 2 in Ilzetzki (2025) suggests a historically steeper relationship between military expenditure and GDP growth in the EU compared to the US.

One of the key innovations in this paper is that we construct a novel and high-frequency dataset on defense procurement for EU countries to analyze its impacts (see Cox et al., 2024 for a similar exercise in the US). Defense spending data in the EU is typically only available at the low-frequency, and with limited sectoral granularity. One important exception is Alloza et al. (forthcoming), who study the macroeconomic effects of defense procurement contracts in Spain. However, our paper is the first to use defense procurement spending to analyze its macro impacts in all countries withing the EU. Leveraging this novel dataset allows us to learn about the defense spending impacts at different horizons (particularly in the short run), and to explore potential heterogeneous effects across different components of defense procurement. A further advantage is that our approach uses fiscal news, captured by the timing of awarded contracts, which better aligns with private-sector expectations and isolates exogenous policy-relevant variation, improving identification compared to realized spending.

Finally, we explicitly address the potential endogeneity of defense spending for countries in Europe by employing a novel instrumental approach. In particular, we employ a shift–share instrumental-variables strategy (Nakamura and Steinsson, 2014; Nunn and Qian, 2014) in which we instrument defense procurement spending in an individual country using a combination of overall European spending (to capture aggregate trends) and each country's physical distance to a major adversary, identified through the distance between common military alliances and treaties between each pair of countries.

The remainder of this paper is organized as follows. Section II describes the macroeconomic impacts of defense spending—based on annual actual defense outlays—its transmission channel, potential heterogeneity, as well as trade spillover effects of defense spending shocks. Section III presents the monthly defense procurement obligations database, baseline results, instrumental variable strategy, with its robustness and heterogeneous effects by subcomponents. Section IV concludes.

II. Macroeconomic Effects and Transmission Channels

We begin the empirical analysis by examining the effect of military spending on GDP using local projection (LP) analysis (Jordà, 2005). This method has been advocated by Auerbach and Gorodnichenko (2013) and Romer and Romer (2017), among others, as a flexible alternative to vector autoregression or autoregressive distributed lag models, since it does not impose dynamic restrictions. The LP approach is better suited for estimating nonlinearities in the dynamic response—such as interactions between defense spending and country-specific characteristics in our context—and for incorporating multiple instruments, as we do later in the paper. In particular, we estimate the following model:

$$y_{i,t+h} = \beta_h g_{i,t}^m + \phi_h(L)x_{i,t} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \quad (1)$$

for $h = 0, 1, \dots, 5$. In the equation above, $y_{i,t+h}$ and $g_{i,t}^m$ are, respectively, normalized output and normalized government defense spending (i.e., as a ratio of the GDP trend); $x_{i,t}$ is a set of main covariates that follows Ramey and Zubairy (2018), Miyamoto et al. (2019), and Sheremirov and Spirovska (2022), including lags of defense spending, lags of normalized government consumption, lags of GDP, and an armed conflict index;[8] $\alpha_{i,h}$ are country fixed effects included to take into account differences in countries' average economic performance; and $\delta_{t,h}$ are time fixed effects, included to control for economic developments facing all countries in a given year. The GDP trend is estimated as a quadratic time polynomial, motivated by the annual frequency and relatively short sample period, similar to Sheremirov and Spirovska (2022).

We obtain direct estimates of the cumulative multiplier using the one-step approach proposed by Ramey and Zubairy (2018):

$$\sum_{k=0}^{h} \mathrm{y}_{\mathrm{i,t+k}} = \beta_h^c \sum_{k=0}^{h} g_{i,t+k}^m + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \quad (2)$$

where β_h^c denotes the cumulative defense-spending multiplier at an *h-year* horizon. Our sample consists of an unbalanced panel of the 27 EU countries during the period 1989-2023. Standard errors are clustered by country. Data for GDP and government consumption are taken from the United Nation's National Accounts Aggregates Database, while the military spending is taken from the Stockholm International Peace Research Institute (SIPRI).[9] The armed conflict index is from the UCDP/PRIO Armed Conflict Dataset and Miyamoto et al. (2019).[10]

Exogeneity of Defense Spending Shocks

Previous analyses, including Miyamoto et al. (2019), and Sheremirov and Spirovska (2022), treat defense spending as an instrument to identify government spending shocks. This identification strategy relies on two standard conditions: (1) military spending is uncorrelated with unobserved determinants of business cycles (the *exclusion criterion*), and (2) military spending shocks are strongly correlated with government spending (the *relevance criterion*). Since our primary focus is on the defense spending multipliers per se, the first condition is of direct importance.

The exogeneity of military spending has been utilized in a large number of studies, including Hall (2009), Barro and Redlick (2011), Ramey (2011) for the US, Miyamoto et al. (2019) and Sheremirov and Spirovska (2022) for the international samples, and García-Serrador et al. (2025) for EU. In addition, some argue that changes in defense spending are often large, suggesting that these changes are less likely to be driven by countercyclical reasons (Collier, 2006 and Miyamoto et al., 2019). We therefore follow this literature, assuming that military spending is exogenous to the state of the economy.

In addition, we conduct additional exercises to support the validity of the exogeneity of defense spending (Table 1). First, we examine whether defense spending is predictable based on lagged macroeconomic conditions. Specifically, we regress defense spending on lags of output and government consumption, while controlling for time and country fixed effects. Columns (1) and (2) report the results of specifications that include each predictor separately, while column (4) includes both variables jointly, together with the war indicator. Across specifications, the war indicator is the only statistically significant predictor of defense

[8] We use two lags in our baseline but also conduct robustness checks with 1 lag as in Miyamoto et al. (2019) and Sheremirov and Spirovska (2022) who also use annual data, as well as 3 lags.

[9] Compared to other sources of defense spending data, SIPRI has a longer times series. As noted in García-Serrador et al. (2025), while SIPRI's defense spending is slightly higher than the Eurostat's Classification of the Functions of Government, they exhibit very similar pattern and lead to similar results.

[10] See Annex A for the detailed list of data sources.

spending. By contrast, the coefficients on lagged output and government consumption are small in magnitude and statistically insignificant, suggesting that defense spending is not systematically driven by past economic conditions. This highlights the importance of controlling for the war indicator, as we do, to identify causal effects.

Second, we assess whether defense spending shocks are anticipated. To do so, we construct a proxy for the information set available at the end of year *t-1* regarding economic conditions in year *t*. This proxy is defined as the first principal component of October WEO projections of output growth, inflation, and government expenditure (as a percent of GDP) for year *t*, drawn from the IMF's WEO vintage database. If defense spending shocks are anticipated, they would be correlated with this forward-looking information measure. However, column (5) shows no statistically significant relationship between defense spending and the PCA-based anticipation measure, conditional on the baseline controls. This also suggests that defense spending shock is not correlated with the projected contemporaneous macroeconomic variables.

Third, we test whether defense spending shocks are correlated with other commonly used exogenous shocks. Specifically, we consider monetary policy shocks (Choi et al., 2024) and geopolitical risk shocks (Caldara and Iacoviello, 2022).[11] As shown in columns (6) and (7), neither measure is significantly associated with defense spending shocks once controls are included, indicating that our identified shocks are not capturing broader macroeconomic or geopolitical disturbances. Taken together, these results support the interpretation of the estimated defense spending shocks as plausibly exogenous, in the Ramey (2016)'s spirit.

Baseline Results

We now present our main results. Figure 2 shows impulse responses of defense spending and output to a defense spending shock of 1 percent of trend GDP. The shock leads to an increase in defense spending, which then fadeaway gradually thereafter (Figure 2, Panel A). Output also responds positively to the defense spending shock, increasing by about 1.3 percent in the same year as the shock, reaching the peak of 1.6 percent one year after the shock and then declining to zero from the second year onwards (Figure 2, Panel B). Output response is significant for two years. The dynamics of output response is in general consistent with the response to a government spending shock documented in Sheremirov and Spirovska (2022) for a panel of 129 countries.

The cumulative multiplier, estimated using Equation (2), captures the cumulative increase in output associated with a persistent rise in defense spending. It is approximately 1.3 on impact and rises to about 1.9 two years after the shocks (Figure 2, Panel C). The magnitude of the multiplier is similar to those found by Sheremirov and Spirovska (2022) for government consumption shock in an international panel of advanced economies as well as for a panel of NATO countries and to those of Nakamura and Steinsson (2014) for the US states.[12] These short-term multipliers are also broadly in line with García-Serrador et al. (2025) who also estimate the defense multiplier for the panel of EU countries in a local projection framework. Similarly, based on a Bayesian Panel SVAR, Ben Zeev et al. (2025) obtain a cumulative multiplier of defense news for Europe around 2 in the first 2 years. Over the medium term, the cumulative multiplier remains relatively stable, reflecting the fact that

[11] Geopolitical risk index is available for 12 EU countries from Caldara and Iacoviello (2022), therefor shrinking the samples significantly.

[12] We also find a multiplier above 1 for government consumption when using military spending as instrument to identify government consumption shock in the sample of EU countries, following Sheremirov and Spirovska (2022).

both defense spending and output responses gradually decline toward zero after reaching their peaks. This pattern is consistent with that of Ramey and Zubairy (2018) for the United States. In addition, Ben Zeev et al. (2025)'s estimated multiplier remains above 1.5 in year 4 since the shock. That said, confidence intervals widen at longer horizons, rendering the estimates less precise and statistically insignificant over the long term.[13]

Overall, our estimated multipliers are broadly consistent with recent findings on defense spending in for European countries and US states. Several factors may explain why these multipliers exceed one. First, as emphasized by García-Serrador et al. (2025), most countries in our sample operate within a currency union or effectively fixed-exchange-rate regime, which can amplify fiscal multipliers by limiting exchange rate adjustments and monetary policy offsets. Second, over our sample period (1989–2023), many countries experienced several major recessions—including the early 1990s downturn, the Global Financial Crisis, the sovereign debt crisis, the COVID-19 pandemic, and the post-pandemic energy shock—many of which coincided with accommodative monetary policy. To test the role of monetary policy accommodation, we examined the response of short-term interest rates and real exchange rates to defense shocks. The results, shown in Figure 3 (Panels A and B), support this hypothesis: short-term interest rates decline and the real exchange rate depreciates, or, at a minimum, there is no tightening of the monetary policy stance over the considered sample period. Third, much of the existing evidence on conservative estimates of government spending multipliers is based on U.S. data. Ben Zeev et al. (2025) show that the median fiscal multiplier in Europe is approximately three times larger than in the United States, with this gap persisting even at longer horizons.[14]

Robustness Checks

Our results are robust across a wide range of alternative specifications and sample definitions, as documented in Annexes B.2-B.3. The estimated defense spending multiplier remains statistically significant when we remove time-fixed effects to allow capturing common movements in defense spending across countries, following Auerbach and Gorodnichenko (2012), as well as global shocks. If anything, the multipliers tend to increase in magnitude. Controlling for revenue and public debt also leads to a similar multiplier. The findings are also robust to alternative lag structures, the inclusion of country-specific time trends, and leave-one-out exercises in which each country is sequentially excluded from the sample. We also obtain comparable results when restricting the sample to alternative subsets of EU countries (EU countries having borders with non-EU countries compared with the rest, as well as only EU member states joining from 2004)[15] as well as when considering different samples: pre-COVID sample as well as pre- and post-2006 (the middle sample), indicating

[13] By contrast, García-Serrador et al. (2025) find that the cumulative multiplier decays relatively quickly over the medium term, declining from a peak of about 1.6 in the first year after the shock to zero by the fifth year. Given that the impulse responses of output and defense spending are not reported separately, it is not clear to determine whether this faster decline reflects a more rapid fading of the output response (i.e., the numerator) or a more persistent increase in defense spending (i.e, the denominator). That said, our own long-term estimates are less precise and do not statistically reject the hypothesis that the cumulative multiplier converges to zero.

[14] We also modified Ramey and Zubairy (2018) to use defense news as instrument for federal defense spending, instead of government spending, over the 1947Q1-2015Q4 and find a 1-year multiplier of 1.2, 2-year multiplier of 0.8, and 4-year multiplier of 0.7, with Kleibergen–Paap rk Wald F statistic greater than 100 (Annex Table B.1). These estimates align with the multiplier of 0.7 at the 2- and 4-year horizons documented by Ben Zeev et al. (2025) for individual European countries, and with Ilzetzki's (2025) estimates of multipliers for the euro area, which range from approximately 0.6 to 1.

[15] EU border countries refer to countries that share borders with countries that are both non-EU and non-Schengen: Finland, Estonia, Latvia, Lithuania, Poland, Slovak Republic, Hungary, Romania, Bulgaria, Greece, and Croatia.

a multiplier above one, especially in the short run.[16] Finally, our results are robust to allowing for country-specific slopes on the global geopolitical risk measure of Caldara and Iacoviello (2022), as well as to alternative specifications that interact the leads and lags of global geopolitical risk with country fixed effects. This is expected and consistent with the exogeneity test. Also, including leads helps address concerns about anticipation effects associated with heightened geopolitical risk.

Transmission Mechanisms

How exactly does defense spending affect macroeconomic aggregates? Disentangling demand- and supply-side transmission channels separately is challenging because supply may respond endogenously to demand conditions and vice versa. In this section, we examine the responses of the respective components of GDP to learn about the potential mechanisms at play, extending the baseline specification in Equation (1) to investigate a broader set of outcome variables representing the sources of GDP from both a demand and a supply perspective. On the demand side, we consider government consumption, private consumption, and investment; on the supply side, we examine total factor productivity (TFP), as well as capital and labor services, all drawn from the Penn World Table (version 10.01).[17]

On the demand side, we find that government consumption increases by about 0.5 percent of trend GDP in response to a defense spending shock (Figure 4, Panel A). The positive but smaller than 1 response of government consumption is somewhat expected defense expenditures include both consumption and investment, with the former belonging to the government consumption. This is also consistent with earlier work using defense spending as an instrument for government consumption. More importantly, we document a crowd-in effect on private consumption, which rises by about 1 percent of trend GDP (Figure 4, Panel B). Investment also increases by a similar magnitude and displays greater persistence, consistent with the notion that defense spending increases capital as documented below (Figure 4, Panel C). These findings align with the positive impact of defense spending on consumption and investment found in Ben Zeev et al. (2025).[18] The fact that consumption and investment respond more strongly than government consumption is therefore fully consistent with this interpretation. Increase in domestic absorption leads to higher demand for (net) imports (Figure 4, Panels D-E), likely capturing both defense-related imports and broader non-defense imports stemming from higher aggregate demand, as discussed further below in the section of cross-border spillovers. Aggregating the responses of private consumption, investment, government consumption, and the net export leads to a similar response of GDP, indicating a consistency of our estimates.[19] Beetsma and Giuliodori (2011) also find that an increase in government purchases raises output, consumption and investment in the sample of EU countries. Overall, these results are consistent with our evidence that multipliers exceed one.

On the supply side, we see an expansion in capital services as defense spending—particularly its investment component—raises the stock of productive assets (Figure 5, Panel A). This result is consistent with Nekada and Ramey (2011) who show that government spending increases lead to a positive and long-lasting impact on

[16] Given the sample limitation to break into the pre- and post-2006 sample or the pre- and post-2009 sample, we use the dummy interaction approach as shown in Annex Figure B.3’s notes.

[17] For these extensions, in addition to the baseline set of controls, we also include two lags of the dependent variable into the set of control variables.

[18] Specifically, Ben Zeev et al. (2025) show that both consumption and investment rise immediately, with the largest response occurring on impact—even before defense spending itself reaches its peak—suggesting that households and firms adjust their behavior as soon as they learn about the increase in defense spending.

[19] This finding holds when using the baseline set of controls (i.e. lags of government consumption, defense spending, GDP, and an armed conflict index), therefore guaranteeing the consistency across controlled variables.

the real sectoral capital stock in a panel of 274 industries over the period 1960–2005. Labor services similarly increase, likely capturing higher employment and skill deployment in defense-linked sectors, as well as indirect effects through supply chains (Figure 5, Panel B), which is in line with the positive impact on employment documented in Nekada and Ramey (2011). Finally, similar to Ben Zeev et al. (2025), we find a positive response of TFP (Figure 5, Panel C). Nevertheless, given that the TFP is the residuals of the decomposition, which are likely subject to cyclical components, we further break it down into trend and cyclical components by using a quadratic time polynomial.[20] Our results indicate that the positive response of TFP is largely driven by cyclical components rather than by the long-run trend (Figure 6).

A useful way to gauge the relative importance of demand- versus supply-side forces is to examine the response of consumer prices to defense shocks. The results show that following a defense spending shock, the price level gradually rises and then plateaus at a higher level, indicating a level shift—albeit with increasingly imprecise estimates at longer horizons (Figure 7). This increase in consumer prices suggests that the expansion in aggregate demand associated with higher defense spending appears to outweigh any supply-side improvements, thereby exerting upward pressure on prices. The results are also consistent with the text-book notion that demand shocks have persistent effects on the price level but only temporary effect on the inflation rate.

Heterogeneity of Defense Multiplier

Do defense spending multipliers vary systematically with economic conditions and structural characteristics in EU countries? We address this question by focusing on three dimensions that are especially relevant for the defense multiplier: import intensity, financing conditions, and public investment efficiency. In addition, we examine whether the sign of defense spending shocks matters for the size of the multiplier.

To do so, we extend the baseline local-projection framework by interacting cumulative defense spending with $\mathrm{F_{I,t}}$ that captures the characteristic of state variable of interest $z_{i,t}$, or $\mathrm{F_{I,t}} = f\left(z_{i,t}\right)$. Formally, we estimate the following specification:

$$\sum_{k=0}^{h} \mathrm{y_{i,t+k}} = \mathrm{F_{i,t-1}}\left(\alpha_{\mathrm{S},0} + \beta_{\mathrm{S},h}^{c} \sum_{k=0}^{h} g_{i,t+k}^{m} + \phi_{\mathrm{S},h}(L)\boldsymbol{x}_{i,t-1}\right) + \left(1 - \mathrm{F_{i,t-1}}\right)\left(\alpha_{\mathrm{R},0} + \beta_{\mathrm{R},h}^{c} \sum_{k=0}^{h} g_{i,t+k}^{m} + \phi_{\mathrm{R},h}(L)\boldsymbol{x}_{i,t-1}\right) + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h}. \quad (3)$$

where the state variable $F_{I,t}$ allows the cumulative defense spending multiplier to differ across regimes. The coefficients $\beta_{\mathrm{S},h}^{c}$ and $\beta_{\mathrm{R},h}^{c}$ therefore trace out horizon-specific multipliers in the two different regimes: *S and R*, respectively. Regime S corresponds to low import intensity, favorable financing conditions (i.e., low spread), high public investment efficiency (i.e., low efficiency gap), depending on the state variable considered for each case respectively, while regime R captures the other states.

A popular approach to modeling $F_{I,t}$ is threshold-dependent, as motivated by Ramey and Zubairy (2018), in which $F_{I,t}$ takes a binary value depending on whether the underlying indicator $z_{i,t}$ crosses a predetermined threshold—either country-specific (z_i^*) or common across countries (z^*). The choice of threshold is critical and

[20] We obtain similar results with TFP trend from a HP filter decomposition.

depends on whether the analysis aims to exploit within-country variation, cross-country variation, or both.[21] This also means that $F_{I,t}$ can vary across countries ($F_{I,t} = F_i$) or vary jointly across countries and over time.

Our first state variable of interest is import intensity, which captures countries' relative exposure to import leakages. Import intensity exhibits a clear upward trend over time in most countries, with some countries have becoming relatively more (less) import-intensive and others less so (Annex Figure C.1). Meanwhile, public investment efficiency—proxied by investment efficiency gaps—and fiscal space—proxied by long-term sovereign bond yield spreads vis-à-vis the German long-term bond yield—exhibit substantial variation both across countries and over time (Annex Figure C.2-3).[22] Taken together, these patterns motivate a baseline specification in which the state variable varies jointly across countries and over time. This approach provides a flexible framework to capture transitions in economic conditions and structural characteristics within countries over a long sample period spanning several decades, from 1989 onward.

For each case, we choose the reference threshold z^* to be the sample average across country–year observations. Then $F_{I,t}$ is defined as:

$$F_{i,t} = \begin{cases} 1 & if\ z_{i,t} < z^* \\ 0 & otherwise \end{cases}$$

Under this definition, $F_{I,t} = 1$ corresponds to favorable conditions, namely low import intensity, low sovereign spreads, and high public investment efficiency (i.e., a low investment efficiency gap).[23]

Import intensity: Higher import leakage is generally expected to dampen fiscal multipliers by reducing the share of spending that translates into domestic demand (Barrell and others, 2012; Ilzetzki et al., 2013). We define the state variable $z_{i,t}$ as country-sepecific import as percent of GDP and set the threshold z^* to the sample mean across countries and time. Consistent with this mechanism, our empirical results indicate that defense spending multipliers are significantly lower in periods and countries with high import intensity. Specifically, the output multiplier one year after a defense spending increase is around 3 in low–import-intensity environments, compared with about 1 in high–import-intensity environments (Figure 8, Panel A).[24] Our results therefore support the findings of Beetsma and Giuliodori (2011) that the stimulating effect of government purchases is weaker for the more open EU economies.

Fiscal space and borrowing costs: Borrowing costs could be a key factor in shaping the macroeconomic impact of public spending by influencing fiscal space, and, thus, the extent of crowding out (Acalin et al., 2025). In countries facing higher borrowing costs, additional spending may raise debt-sustainability concerns and trigger higher risk premia, thereby attenuating the output response. As mentioned above, we proxy for borrowing costs using the long-term sovereign bond yield spreads vis-à-vis the German long-term bond yield. Our empirical results show that defense spending multipliers are smaller in high-spread environments. In contrast, when

[21] The focus on within-country dynamics usually applies to business cycle conditions or growth fluctuations. The cross-country variation is usually for the case with time-invariant characteristics, reflecting cross-sectional differences.

[22] The pair correlations for each country between these three variables are on average between -0.3 and 0.3, indicating their relatively distinctive nature.

[23] In Annex C, we present an alternative approach using the smooth transition approach as in Auerbach and Gorodnichenko (2012), which leads to similar findings.

[24] Our results remain robust when considering only cross-country variation (Annex Figure C.5), therefore separating EU sample into two groups: low import intensity (import-to-GDP below the threshold) versus high import intensity (import-to-GDP above the threshold).

sovereign spreads are low, defense spending shocks generate larger and more persistent output responses (Figure 8, Panel B).

Public investment efficiency: The effectiveness of public spending could also depend on the efficiency with which public investment is planned, executed, and implemented. In environments with higher efficiency, public investments are more likely to translate into productive capital, therefore leading to larger output gains (Abiad et al., 2016). We empirically test the influence of public investment efficiency on defense multipliers by using the recenetly developed database by IMF (2025), which estimates the efficiency gaps for for 174 countries between 1980 and 2023. Our results suggest that defense spending multipliers are significantly larger in countries and periods characterized by higher investment efficiency, with a multiplier of 3 in the first three years since the shock, compared to the multiplier of 1 under low investment efficiency (Figure 8, Panel C).

Sign of the shock: In addition to heterogeneity across economic conditions and structural characteristics, the macroeconomic effects of defense spending may also depend on the sign of the underlying shock. For instance, Hooker and Knetter (1997) argue that military cutbacks had larger effects than military buildups on US states. By contrast, Ben Zeev, Ramey, and Zubairy (2023), using the narrative military news series of Ramey and Zubairy (2019), find little evidence that fiscal multipliers differ by the sign of the shock.

While the narrative military news is useful for identifying positive versus negative fiscal innovations, such a measure is for a broad set of EU countries. To identify the sign of defense spending shocks in a consistent manner across countries, we first estimate defense spending on the set of control variables as in (1) as in Ben Zeev, Ramey, and Zubairy (2023):

$$g_{i,t}^{m} = \alpha_0 + \phi_h(L)x_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \tag{4}$$

and interpret the estimated residual $\hat{\varepsilon}_{i,t}^{m}$ as the unexpected component of defense spending, purged of predictable movements related to macroeconomic conditions and policy changes. Next, to examine whether the sign of the shock matters for output responses, we modify the baseline in equation (2) by replacing realized defense spending with the estimated shock:[25]

$$\sum_{k=0}^{h} \mathrm{y}_{\mathrm{i,t+k}} = \mathrm{F}_{\mathrm{i,t}}(\alpha_{\mathrm{S},0} + \beta_{\mathrm{S},h}^{c} \sum_{k=0}^{h} \hat{\varepsilon}_{i,t+k}^{m} + \phi_{\mathrm{S},h}(L)\boldsymbol{x}_{i,t-1}) + \left(1 - \mathrm{F}_{\mathrm{i,t-1}}\right)(\alpha_{\mathrm{R},0} + \beta_{\mathrm{R},h}^{c} \sum_{k=0}^{h} \hat{\varepsilon}_{i,t+k}^{m} + \phi_{\mathrm{R},h}(L)\boldsymbol{x}_{i,t-1}) + \alpha_0 + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h}. \tag{5}$$

where $F_{I,t}$, expressed in a contemporaneous manner, is now defined based on the sign of the estimated defense spending shock:

$$F_{i,t} = \begin{cases} 1 & if\ \hat{\varepsilon}_{i,t}^{m} < 0 \\ 0 & otherwise \end{cases}$$

Under this definition, regime *S* corresponds to negative (unexpected cuts) defense spending shocks, while regime *R* corresponds to positive (unexpected increases) shocks. The coefficients $\beta_{\mathrm{S},h}^{c}$ and $\beta_{\mathrm{R},h}^{c}$ captures their corresponding multipliers. We plot the difference between the two responses in Figure 9, which is neither

[25] This approach is convenient and flexible for identifying the defense spending shock of interest, as well as episodes associated with negative versus positive shocks. Nevertheless, it may raise the concern that the defense spending shock is derived from a linear model specification, while the multiplier is estimated using a nonlinear specification.

persistent over time nor statistically significant, suggesting limited evidence in support of systematic asymmetry between positive and negative defense spending shocks.

Cross-Border Spillovers

Given the high degree of economic integration and trade within the European Union, a natural question is whether defense spending generates cross-country spillovers, in particular through trade linkages. We address this question using two complementary approaches. First, we examine whether an increase in defense spending in an EU country leads, on average, to higher import demand from both intra-EU and extra-EU trading partners. Second, we assess whether defense spending in one EU country generates output spillovers in other EU countries through trade exposure to defense-related demand.

Defense Spending and Imports

Under the first approach, we use the same regression specification as in Equation (1) with import-related variables as dependent variables.[26] Our results indicate that a defense spending shock of 1 percent of trend GDP leads to an immediate increase in total imports of goods and services by about 2 percent of trend GDP (Figure 10, Panel A), providing direct evidence of international spillovers. We then decompose total imports into the intra-EU and extra-EU components. Because a comprehensive breakdown of total imports (covering both goods and services) is not available, we approximate this decomposition by using country-specific share of goods imports from EU partners using the IMF's Direction of Trade database.

Using this approach, we find that a defense spending shock of 1 percent of trend GDP increases both intra-EU and extra-EU imports by roughly 1 percent of trend GDP in each case, with both responses statistically significant (Figures 10, Panels B-C). These results underscore the relevance of trade linkages as a key channel through which defense spending can generate cross-border spillovers within the EU, consistent with evidence on fiscal spillover evidence documented in Auerbach and Gorodnichenko (2013) for a broad sample of OECD countries. Looking more closely at extra-EU trade, we find that imports increase both from the United States and from other non-EU countries, with a somewhat larger response for the latter (Figures 10, Panels D-E). This pattern reflects the fact that a substantial share of extra-EU imports originates from other advanced and emerging market economies. Specifically, about 5 percent of EU imports are from the United States, compared with 35 percent of imports from other countries.

The estimated increase in total imports reflects both the direct effect of higher defense spending and indirect effects operating through higher aggregate demand, as defense spending raises both consumption and investment. Given that there is no decomposition of total imports into defense versus non-defense components, we utilize the arms imports from SIPRI, measured in its unit of trend-indicator value (TIV), to investigate if there is a direct cross-border impact of defense spending. Specifically, we regress the log of arms imports on

[26] These import-related variables are also normalized by trend GDP.

defense spending following equation (1).[27] Our results show that arms imports increase by 50 percent following a defense spending shock of 1 percent of GDP, with significant responses for both intra-EU and extra-EU sources (Figure 11), reinforcing the interpretation that defense spending propagates internationally through military procurement and trade channels.

Output Spillovers via Trade

To estimate the magnitude of the cross-country spillovers, we follow Auerbach and Gorodnichenko (2013) and extend our baseline model to include a spillover shock that captures defense spending in EU trading partners. All other controls remain the same as our baseline above. Formally, we estimate the following local projection:

$$y_{i,t+h} = \gamma_h S_{i,t} + \beta_h g_{\mathrm{i},t}^m + \phi_h(L) x_{i,t} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \tag{6}$$

where the spillover shock $S_{i,t}$ is defined as:

$$S_{it} = \sum_{j \neq i} \frac{EXP_{ij}}{\sum_j EXP_{ij}} \frac{G_{jt}^m}{y_{jt}^*}.$$

where EXP_{ij} indicates intra EU exports from country *i* to country *j, and* $\frac{G_{jt}^m}{y_{jt}^*}$ is defense spending in country *j* expressed as a share of its trend GDP. F_{it} is a trade-weighted average of foreign defense spending. Intuitively, this construction captures the potential effect that defense spending in partner countries—directly through defense-related purchases and indirectly through higher aggregate demand—translates into higher imports from these trading partners, therefore boosting output growth in exporting countries.

Figure 12 depicts the estimated γ_h (panel A) and β_h (panel B), that is, the output response to the spillover shock and to the domestic defense spending shock, respectively. In panel A, we rescale the response by the average intra-EU export share of countries in the EU, implying that those with higher export share to the intra-EU trade would benefit more when other member states scale up defense spending.

First, we find that output response to the domestic defense spending shock (β_h) remains similar with the baseline, even when controlling for the trading-partner defense spending. This result corroborates our baseline findings and indicates that the estimated domestic effects are not driven by omitted foreign demand or correlated defense spending across EU countries.

Second, we find that the EU cross-country spillovers through the trade channel are statistically significant and economically meaningful in the first year following the shock. Specifically, a 1 percent GDP increase in defense spending in trading partners boosts domestic GDP, on average, by 0.2 percent on impact and 0.4 percent after 1 year. This corresponds to about 15 to 25 percent of the estimated impact of domestic shocks. We obtain similar results by using the median share to scale the response (Annex D). The magnitude of these spillovers is consistent with existing evidence for the EU. In particular, Beetsma and Giuliodori (2011) find that a one percent of GDP increase in government purchases in one EU country raises GDP in its trading partners by about 0.35 percent, a range comparable to our estimates. Similarly, EIB (2025) also emphasizes that spillovers between EU countries are significant.

[27] In addition to the baseline set of controls, we also include two lags of the (log of) arms import in the set of control variables.

III. The Impact of High-Frequency Defense Procurement Shocks

We now shift from the macro aggregates to using high-frequency defense procurement data to estimate the impacts of defense spending on output. The use of high-frequency defense procurement data offers several advantages over relying on aggregate defense spending figures. To begin, it strengthens our identification assumption: military procurement can reasonably be considered orthogonal to economic activity within a month, rather than only at the annual frequency employed in the first part of the paper and much of the existing literature. To alleviate any lingering endogeneity concerns (see below), we also estimate an instrumental variable approach that takes advantage of the correlation between a country's defense spending and the physical distance to a major military adversary.

Another important advantage of our empirical strategy is the reliance on *fiscal news* rather than realized government spending, consistent with the identification framework pioneered by Ramey (2011) and further developed by Ramey and Zubairy (2018). The key insight of this literature is that forward-looking economic agents adjust their behavior when information about future fiscal actions becomes available, not when expenditures are eventually executed. Briganti et al. (2025) document that new defense procurement obligations do not affect government spending until payment on delivery, which generally occurs three to four quarters after the procurement obligation. Consequently, identification based on actual outlays is vulnerable to anticipation effects, measurement lags, and the endogeneity of implementation timing, issues that downward bias standard estimates of fiscal multipliers.[28] By contrast, our measure of monthly awarded defense and security contracts captures the moment in which new information about future defense spending is, improving identification by isolating unexpected policy-relevant variation and better aligning the timing of shocks with private-sector expectations.

Using monthly data also allows us to estimate the impact of defense spending over much shorter horizons, particularly within a year, which is impossible to do with yearly data. Furthermore, by using detailed information from public procurement auctions, we can ensure that all spending we include in our sample is reliably related to defense. And finally, our disaggregated dataset provides high sectoral granularity which allows us to estimate the effect of different categories of defense spending.

Data Construction

To construct our dataset, we collaborated with Taiyo.AI, an AI platform that collects data from publicly available procurement contracts, to compile information on all monthly government procurement contracts in Europe. Our primary source for this initiative is Opentender, which provides data on procurement records for 35 jurisdictions in Europe (28 EU member states, Norway, the EU Institutions, Iceland, Switzerland, Georgia, Serbia, and North-Macedonia). These include the Tenders Electronic Daily (TED), the official journal of the European Union for public procurement, as well as national-level procurement portals. This multi-source

[28] Briganti et al. (2025) document that defense procurement contract obligations Granger-cause shocks to government spending identified via Cholesky decomposition but not defense news shocks. As a result, Cholesky shocks to government spending miss early inventory changes, leading to lower multiplier estimates compared to defense news shocks.

architecture ensures comprehensive coverage and enhances the reliability of the dataset, facilitating comparative analysis across jurisdictions and procurement categories.

In the EU, procurement-based fiscal news is especially suitable because defense contract awards must be publicly disclosed under harmonized procurement rules (e.g., Directive 2009/81/EC). These legal requirements create a consistent and transparent information release process, ensuring that contract announcements represent genuine news about future spending. Centralized databases such as Tenders Electronic Daily (TED) also reduce cross-country measurement error and reporting heterogeneity. Together, these institutional features make the EU an empirically advantageous setting for identifying fiscal news shocks from procurement data.

By extracting information from these records, we are able to construct a dataset at the contract level, which contains details on the timing of the award notice and its value, the identity of the buyer or the public agency leading the procurement process, and the procedural characteristics of the procurement itself. It also specifies the purpose of the contract, which identifies the type of product being acquired by the government (classified at the 8-digit level using the Common Procurement Vocabulary, CPV). The contract also indicates the place of performance, with geographic identifiers such as NUTS or postal codes, and provides seller or producer information, including name, postal address (NUTS), and nationality. Annex Figure E.1 shows an example of the information that can be found in our database.

To determine the "sector" of each contract, we leverage the CPV classification, which provides a unified system to standardize how contracting authorities describe procurement contracts in the EU. A total of 220 8-digit CPV codes related to defense and security spending have been identified using European Commission's Directive 2009/81 CPV list (reported in Table 43 of this document).[29] The CPV codes identified in Directive 2009/81 of the European Parliament classify defense and security-related spending into four main categories.

1. *Construction* encompasses military and security infrastructure projects, including the development of bases, facilities, and other physical assets.
2. *Equipment* refers to the procurement of weapons systems, vehicles, aircraft, naval vessels, electronics, and communication technologies essential for operational readiness.
3. *Services* includes a wide range of support activities such as training programs, simulation technologies, equipment maintenance, and hazardous material disposal, all of which are critical to sustaining defense capabilities.
4. *Research and Development (R&D)* captures expenditures related to military innovation, including the design and testing of new technologies and strategic systems.

This classification framework enables detailed analysis of procurement priorities and spending patterns across key functional areas of defense. Annex Figure E.2 illustrates some of the procurement categories captured in the dataset, ranging from construction work and IT services to pharmaceuticals, transport equipment, and cultural services, including defense and security products.

Our baseline approach allocates the full value of a defense contract obligation to the award date, regardless of its duration or payment schedule. This assumption is motivated by the goal of capturing defense news shocks,

[29] Evaluation of Directive 2009/81/EC on public procurement in the fields of defense and security.

unexpected fiscal information that influences private-sector expectations and economic behavior at the time of announcement (Ramey, 2011; Ramey and Zubairy, 2018). By aligning the shock with the award date, we strengthen identification by isolating the moment when new policy-relevant information enters the economy, consistent with the fiscal news literature. This timing reflects when agents update their expectations, which is critical for estimating the true dynamic response of output to defense spending.

Validity Checks and Summary Statistics

To verify that our data is representative of the aggregate patterns on defense spending, we perform several validity checks. First, Figure 13 (Panel A) shows that our total procurement data tracks official sources closely. Figure 13 (Panel B) shows that the procurement database for the year 2021 has a strong correlation with official European Commission figures, further validating its accuracy.

Following the aggregate trends, Figure 13 (Panel C) confirms that defense procurement as a share of GDP at annual frequency for the EU started to rise by 2016, reversing a long period of stability, and accelerated after 2022, reflecting renewed geopolitical risks and EU-wide commitments to strengthen defense capabilities. Figure 13 (Panel D) displays some of the monthly and cross-country variations that underpin our analysis. Looking at the defense procurement patterns in Estonia and France, we can see the “lumpy” nature of this type of spending, and in particular how different countries disperse their procurement over time (with Estonia concentrating expenses in big impulses, while France appears to have a more uniform distribution of contracts over time).

Figure 13 (Panel E) breaks down total EU procurement spending into its main components over time. While construction consistently represents the largest shares, the other components remain relevant at 30-40 percent of total expenses each year. Finally, Figure 13 (Panel F) breaks down the France and Estonia examples into each of their main components, showing that the composition of spending can also vary substantially across EU member states.

Estimating the Defense Multipliers

In this section, we estimate the impact of defense procurement spending on the overall economy. We again apply the local projection methodology to estimate cumulative multipliers:

$$\sum_{k=0}^{h} y_{i,t+k} = \beta_h^c \sum_{k=0}^{h} g_{i,t+k}^m + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \quad (7)$$

for $h = 0, 1, \ldots, 36$. Our dependent variable is the cumulative sum over monthly real GDP, constructed using information on industrial production and economic sentiment indicator in a state-space setting as in Stock and Watson (2010) (see Annex F), normalized by trend RGDP as in Ramey and Zubairy (2018).

We regress output on cumulative defense procurement spending, normalized by trend RGDP to measure the cumulative defense spending multiplier. We control for 4 lags of defense procurement, total government procurement and dependent variable (normalized by trend GDP).[30] Under the assumption that monthly defense procurement spending is exogenous to variation in total output, the coefficient β_h^c measures the cumulative impact of defense spending on output for each horizon h. Our sample period is 2009:m1 to 2023:m12 and includes the EU-27 countries. Robust heteroskedasticity and autocorrelation consistent (HAC) standard errors are used.

To ensure robustness and mitigate the influence of extreme observations, we exclude outliers based on economically meaningful thresholds. Specifically, we drop any month in which (i) defense procurement or total procurement exceeds 5 percent of annual GDP; (ii) monthly defense procurement as a share of trend real GDP above 12.5 percent, following the rationale in Auerbach, Gorodnichenko, and Murphy (2019), who drop outliers where annual Department of Defense procurement above 150 percent of a CBSA's GDP; and (iii) monthly total procurement as a share of trend real GDP exceeds 50 percent. These criteria target implausibly large procurement spikes that could distort impulse responses and inference. Importantly, all reported results maintain sample consistency: the same set of observations is used across all horizons (h = 0,…,36), ensuring comparability and avoiding horizon-specific sample variation.

Our findings are shown in Figure 14, where the solid lines show the magnitude of the coefficients, and the dotted lines are the 68% and 90% confidence intervales constructed using robust HAC standard errors. The cumulative fiscal multiplier remains statistically significant after 12 months and is approximately 0.7 at 2-years (24 months) and about 0.8 after 3-years (36 months). A similar exercise (after replacing the dependent variable) shows that a 1 percent increase in defense spending leads to a cumulative real depreciation of the effective exchange rate of about 0.4 percent relative to trend at 2-year horizon and 0.7 percent at 3-year horizon. This impact is consistent with Miyamoto et al. (2019), who find that REER depreciates after government spending shocks because accommodative monetary policy lowers interest rates (reducing domestic interest rate differentials relative to foreign rates), and makes domestic assets less attractive. This leads to capital outflows and currency depreciation, especially when fiscal expansions boost demand and imports, widening trade deficits.

Endogeneity

While it is common to view defense spendings as an exogenous shock to the government's fiscal stance, we must consider the possibility that the decision to spend on defense is also endogenous to the business cycle, especially within the context of a military and political union. One possibility is that smaller countries, aware of the fact that they will likely receive support from larger neighbors in the event of a conflict, may choose to increase their own spending during more convenient times, leading to a biased estimate of the spending multiplier. A similar concern is that countries within the EU must adhere to fiscal rules, which may create constraints on the amount of spending they are able to make. As result, countries may favor periods of higher growth (when the fiscal balance improves and therefore the fiscal constraints are relaxed) to increase expenditure on defense. Another possibility is that countries increase defenses spending during periods of heightened geopolitical risks, which are often associated with weaker economic conditions. This implies that the direction of the bias stemming from endogeneity is not clear *a priori.*

To address these endogeneity concerns, we employ a shift–share instrumental-variables strategy in which each country's predicted defense procurement is constructed as the interaction between an aggregate EU-wide

[30] Trend GDP is estimated as a fourth-degree polynomial for the logarithm of real GDP from 1995:m1-2023:12, excluding the COVID-19 period (2020:m3-2021:m12).

shift and a country-specific exposure share (Nakamura and Steinsson, 2014; Nunn and Qian, 2014). The shift component is given by total EU-27 defense and security procurement (normalized by the EU trend GDP) to capture common geopolitical shocks that influence overall European defense priorities but are plausibly exogenous to any individual country's contract awards.[31] The key identification assumption is that the country-specific shares, based on predetermined geographical characteristics such as geodesic distance to Russia and land borders with non-EU, non-NATO members, are unrelated to contemporaneous government policies or economic conditions. This ensures that the cross-sectional variation in exposure is exogenous and not driven by political choices. Similarly, the aggregate EU-wide shift reflects overall defense procurement dynamics, where an increase in total EU's procurement does not occur because Germany or Poland faces a recession. This combination of an exogenous shift and predetermined shares provide the basis for credible identification. While both the global EU shift and country shares can reasonably be assumed exogenous to popular support for the government, recent research shows that validity of Bartik-like instruments requires only one component to be exogenous (Goldsmith-Pinkham et al., 2020; Borusyak et al., 2022). In addition, global factors potentially correlated with EU spending are absorbed by time fixed effects, while country-specific factors correlated with country-specific shares are accounted for by country fixed effects.

We use two exposure shares reflecting distinct dimensions of geopolitical vulnerability. First, we use geographical (geodesic) population-weighted distance to Russia for each EU-27 country as our main exposure share. Russia is selected as the reference adversary based on an independent measure of geopolitical alignment derived from the Alliance Treaty Obligations and Provisions (ATOP) project.[32] The ATOP dataset compiles countries' formal alliance treaty obligations and, building on this information, provides "portfolio similarity" measures that summarize how similar two countries' sets of formal treaty commitments are (see Signorino and Ritter, 1999). Using this treaty portfolio similarity metric in the pre-estimation period (1999-2008),[33] Russia emerges as the country that is geopolitically farthest from the EU-27 among non-EU-non-NATO members, motivating our focus on exposure to Russia while keeping the instrument share grounded in predetermined geography rather than contemporaneous political or economic conditions. Second, we include a dummy equal to one if a country shares a land border with any non-EU, non-NATO members, such as Russia, Belarus, Ukraine, Moldova, North Macedonia, Montenegro, Bosnia, Kosovo or Serbia, as of 2015.[34] This indicator captures the possibility that the "threat frontier" through which conflict can enter NATO territory is not limited to Russia alone but also includes adjacent non-allied states. Interacting these exposure measures with aggregate EU-wide procurement produces instruments that vary across countries for reasons unrelated to domestic economic fluctuations, but strongly correlated with the perceived strategic environment, thereby strengthening identification. Therefore, the term $\sum_{k=0}^{h} g_{i,t+k}^{m}$ in (2) is instrumented by:

$$shock_{i,t}^{ru} = \mathrm{s}_{\mathrm{i,ru}} \frac{\sum_{\mathrm{i}=1}^{27} \mathrm{g}_{\mathrm{I,t}}^{\mathrm{m}}}{\sum_{\mathrm{i}=1}^{27} \hat{\mathrm{y}}_{\mathrm{I,t}}} \quad ; shock_{i,t}^{bor} = \mathrm{s}_{\mathrm{i,border}} \frac{\sum_{\mathrm{i}=1}^{27} \mathrm{g}_{\mathrm{I,t}}^{\mathrm{m}}}{\sum_{\mathrm{i}=1}^{27} \hat{\mathrm{y}}_{\mathrm{I,t}}} \tag{8}$$

[31] Table 2 shows each country's share of the total variation in EU-27 defense and security procurement, with France accounting for about 20%. Annex Figure G.1, Panel E demonstrates that the results remain robust even when France is excluded from the analysis.

[32] See Chiba et al. (2015).

[33] ATOP distance starts in 1990 and changes over time. When the sample period is adjusted to 1990-2008, Russia remains the farthest geopolitically.

[34] Switzerland is excluded because, despite being a non-EU and non-NATO country, it is considered neutral and does not pose a potential military threat to EU-27 countries.

with *ru* being the (normalized) distance to Russia, and *border* is a dummy if the country *i* shared land border with any non-EU, non-NATO member, and $\frac{\sum_{i=1}^{27} g_{i,t}^{m}}{\sum_{i=1}^{27} \hat{y}_{i,t}}$ is the total EU-27 defense and security procurement, normalized by EU-27 trend GDP.

Overall, our IV estimation is as follows:

$$\sum_{k=0}^{h} y_{i,t+k} = \beta_h^c \sum_{k=0}^{h} \widehat{g_{i,t+k}^{m}} + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \quad (9)$$

with,

$$\sum_{k=0}^{h} \widehat{g_{i,t+k}^{m}} = shock_{i,t}^{ru} + shock_{i,t}^{bor} + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \vartheta_{i,t+h} \quad (10)$$

Figure 15 provides visual evidence supporting the relevance of our instruments: countries that are geographically closer to Russia and those sharing a land border with non-EU, non-NATO members exhibit, on average, higher defense procurement spending as a share of GDP. Importantly, this cross-sectional pattern is consistent with variation driven by exogenous geopolitical exposure rather than contemporaneous macroeconomic conditions.

More formally, Table 3 shows that for all specifications, the first-stage results indicate that the instruments are both relevant and statistically significant. We report the Kleibergen–Paap rk Wald F statistic, which is the standard measure of instrument strength in the presence of heteroskedasticity.[35] In our setting, where two instruments are used for a single endogenous regressor, the Kleibergen–Paap F statistic captures whether the instruments jointly explain sufficient variation in the endogenous variable to avoid weak-instrument bias. Across horizons, the statistic consistently exceeds the conventional threshold of 10, including on impact and at key horizons such as 24, and 36 months, supporting identification and reliable inference. Importantly, the Hansen J overidentification test is not rejected at any horizon, which supports the validity of the exclusion restriction. This outcome suggests that the instruments are jointly consistent with the structural model and are not correlated with the error term, reinforcing the assumption that the identifying variation comes from exogenous sources rather than omitted factors. Together, strong first-stage relevance and the absence of overidentification concerns provide confidence in the robustness of our IV strategy.

In addition, we include as a control the global geopolitical risk index from Caldara and Iacoviello (2022), which varies over time, interacted with the two country-specific exposure shares. This adjustment addresses the concern that global geopolitical shocks, such as major conflicts or international crises, could simultaneously influence European procurement decisions and domestic macroeconomic outcomes, thereby confounding our estimates. By interacting the global risk measure with the exposure shares, we allow the effect of worldwide geopolitical tensions to differ across countries according to their strategic vulnerability, capturing heterogeneous spillovers that might otherwise bias the instrument. This ensures that the identifying variation in our shift–share instrument reflects EU-specific procurement shocks rather than broader global risk dynamics, strengthening the credibility of our exclusion restriction and mitigating omitted-variable bias.

Figure 16 presents our IV estimates, where solid lines depict point estimates and dotted lines represent 68% and 90% confidence intervals based on robust HAC standard errors. The results reinforce the exogeneity of our

[35] This statistic tests the null hypothesis that the instruments are weak and provides a robust alternative to the conventional Cragg–Donald F statistic.

instrument: cumulative fiscal multipliers obtained via IV are more than twice as large as those from OLS, underscoring the importance of addressing endogeneity. Specifically, the cumulative multiplier reaches about 1.5 at the 12-month horizon, approximately 1.7 at two years, and around 1.9 after three years, both statistically significant at the 90% level.[36] These magnitudes suggest a substantial and persistent effect of defense spending on output. In addition, a 1 percent increase in defense spending leads to a cumulative real depreciation of the effective exchange rate of roughly 4 percent relative to trend at the two- and three-year horizons, highlighting the broader macroeconomic implications of defense procurement shocks. By comparison, OLS estimates yield much smaller multipliers, suggesting a downward bias from reverse causality and omitted-variable concerns.

Robustness Checks

Our findings are robust to a range of alternative specifications designed to address potential concerns about model dependence and omitted-variable bias. Annex Figure H.1 presents the results. First, we vary the number of lags included in the local projection framework to ensure that dynamic responses are not driven by horizon length assumptions. Second, we re-estimate the models with and without time fixed effects, which allows us to test whether controlling for global movements in defense spending materially affects the results; the stability of coefficients across these specifications suggests that our estimates are not confounded by common shocks. Third, we perform a leave-one-out analysis by sequentially removing each country from the sample, which addresses concerns that results might be driven by a single influential observation. Finally, we restrict the sample to the 2009–2019 period, excluding the COVID-19 recession and the geopolitical shock associated with Russia's invasion of Ukraine in 2022; the persistence of our findings in this alternative window underscores that they are not driven by extraordinary global events. Collectively, these checks reinforce the robustness and credibility of our results identification strategy.

Heterogeneous Impacts by Spending Category

Finally, we use our granular data to examine whether the impacts of defense spending depend on the composition of the expenditure. To capture heterogeneity in defense spending, we exploit CPV codes to classify monthly defense procurement into four sub-components: construction, services, equipment, and R&D. Given that these sub-component spendings tend to overlap and are correlated with each other, we follow Alesina et al. (2015) and create four mutually exclusive dummies, each equal to one if the corresponding sub-component represents the largest share of defense procurement in that month. Including all four dummies in the same regression allows us to identify which type of procurement dominates during a given episode and estimate their relative macroeconomic effects of defense packages within a unified framework. This approach has two key benefits: (i) it avoids multicollinearity because the dummies are mutually exclusive by construction, and (ii) it provides a clear benchmark for comparing the relative impact of different defense procurement packages without running separate models.

[36] We show in Annex G that when using a robust inference to weak instruments–based on the conditional likelihood ratio (CLR) test proposed by Finlay and Magnusson (2009)–the confidence intervals increase, as expected, but remains in close range with the baseline CIs, therefore supporting our identification.

As described above, we exploit the contracts' CPV codes to decompose defense and security packages into the four sub-components: construction, services, equipment, and R&D. Therefore, the modified baseline specification is as follows:

$$y_{i,t+h}^{c} = \beta_h^{equ} d_{i,t}^{equ} g_{i,t+h}^{c,m} + \beta_h^{con} d_{i,t}^{con} g_{i,t+h}^{c,m} + \beta_h^{ser} d_{i,t}^{ser} g_{i,t+h}^{c,m} + \beta_h^{r\&d} d_{i,t}^{r\&d} g_{i,t+h}^{c,m} + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h} \quad (11)$$

where $g_{i,t+h}^{c,m}$ and $y_{i,t+h}^{c}$ are the cumulative defense procurement and the cumulative real GDP, both normalized by trend GDP

$$g_{i,t+h}^{c,m} = \sum_{k=0}^{h} g_{i,t+k}^{m}, \qquad y_{i,t+h}^{c} = \sum_{k=0}^{h} y_{i,t+i}.$$

and $d_{i,t}^{equ}$, $d_{i,t}^{con}$, $d_{i,t}^{ser}$, $d_{i,t}^{r\&d}$ are dummy indicators which have value of 1 if equipment, construction, service, and R&D is largest in the defense procurement package, respectively. Consequently, the corresponding slope coefficients indicate the relative strength of defense procurement sub-components.

Between 2009 and 2023, the composition of defense procurement shifted notably. Figure 17 shows the sectoral heterogeneity and changes over time of subcomponents. Construction consistently held the largest share, averaging nearly 70%, but its dominance declined from a peak of 80% in 2011 to around 55% by 2023. Meanwhile, services and R&D gradually increased their shares, particularly after 2020, with R&D reaching about 20% and services rising to 12–15%. Equipment remained the smallest component throughout but has increased recently. This evolving composition is central to the modified baseline regression, which uses mutually exclusive dummies to identify the leading subcomponent each month. The variation in subcomponent shares over time enhances the regression's ability to capture heterogeneous effects, allowing for a more nuanced understanding of how different types of procurement influence macroeconomic outcomes.

Figure 18 summarizes the OLS cumulative GDP responses to a 1 percent of GDP increase in defense procurement, distinguishing between these four components. The results indicate relative heterogeneous macroeconomic effects across spending types, reflecting different demand and supply-side channels. Equipment bias spending packages (Panel A) delivers the largest relative medium-term multipliers, reaching about 2.7 at 36 months. This aligns with Ramey and Shapiro (1998), who show that defense buildups strongly stimulate equipment-intensive industries, durables and capital goods, with broad spillovers across sectors. These effects likely stem from forward linkages in supply chains and higher capital accumulation, which enhance productivity.

Services procurement packages (Panel B) yield relatively smaller multipliers, around 1 after 24 months and 1.2 after three years. Construction-biased packages exhibit even relative lower effects, but are strongly statistically significant, with multipliers near 0.6 at 36 months. Construction is typically labor-intensive, geographically concentrated, and less prone to sectoral spillovers or long-term productivity gains (Panel C). Finally, R&D-related defense spending packages (Panel D) produces moderate but positive relative effects, with a cumulative multiplier near 1.0 at the 36-month horizon. These gains likely reflect innovation linkages and productivity spillovers. While magnitudes are modest, estimates are statistically significant at the 68% level, suggesting potential longer-run benefits from defense-related innovation investments.

Figure 19 shows that the results are similar when we implement our IV strategy.[37] Compared to the aggregate multiplier of roughly 1.9 at 36 months, equipment spending stands out as the dominant driver of output effects, while other components contribute more modestly.

IV. Conclusion

Europe's sharp rise in defense spending marks a structural shift in fiscal priorities with significant macroeconomic implications. Our analysis shows that increased defense outlays generate positive effects on output. In addition, we find that intra-EU spillovers through trade are both positive and economically meaningful, indicating that changes in defense spending in one country can influence economic outcomes elsewhere in the region.

Given the notable differences between the ongoing large and simultaneous increase in defense spending across European countries and the smaller, more national efforts during the 1989–2023 sample period on which our empirical analysis is based, not all results may fully translate to the current effort. For example, the multipliers relevant to the current coordinated defense buildup might be lower than historical estimates if monetary policy is less accommodative.

We also document significant heterogeneity in defense multipliers and document factors that affect their size. Multipliers tend to be larger in environments characterized by low import intensity, fiscal space, and high public investment efficiency. These findings suggest that structural characteristics play an important role in shaping the macroeconomic impact of defense spending. For example, when fiscal space is limited and borrowing costs are high, the estimated multiplier is smaller and could lead to a significant increase in public debt. Similarly, higher import intensity is associated with greater leakage of spending abroad, suggesting that countries with strong domestic production capabilities or deeper intra-EU supply-chain integration are better positioned to benefit from increases in regional defense spending. Importantly countries with high public investment efficiency are able to translate defense spending more effectively into higher output, productivity, and employment.

Using high-frequency data on defense procurement contract awards, the analysis uncovers robust short-run effects on both output and exchange rates, with equipment procurement yielding the largest multipliers. These findings highlight the importance of procurement composition and timing in shaping macroeconomic outcomes. Future research could explore several venues. On possibility is to explore alternative classifications of defense spending, including automated contract parsing using large language models and keyword-based techniques. Another is to examine the implications of allocating expenditures uniformly over the duration of contracts rather than assigning the full impact at the award date as in our baseline, which may help distinguish between

[37] The key difference from the aggregate IV estimation is that, for subcomponents, we interact each of the four mutually exclusive dummies (construction, services, equipment, and R&D) with our two shift–share instruments. This creates eight instruments instead of two, allowing us to isolate variation in defense spending episodes dominated by a specific category rather than overall procurement. The endogenous variable becomes the cumulative change in defense procurement interacted with the relevant dummy, so identification now comes from exogenous EU-wide shifts combined with predetermined geographic shares, conditional on which component is dominant. This design lets us compare macroeconomic effects across procurement types within one specification while preserving the same logic of exogeneity as the aggregate IV.

anticipated and unanticipated defense shocks, and provide insight into how expectations influence the timing and magnitude of fiscal multipliers. Incorporating supplier-level information could shed light on the geographic and sectoral distribution of spillovers. Additional work could exploit cross-sectional variation using buyer-location and place-of-performance data across Europe to better understand regional patterns. Finally, jointly identifying shocks to defense and non-defense spending would allow a comparison of their respective multipliers.

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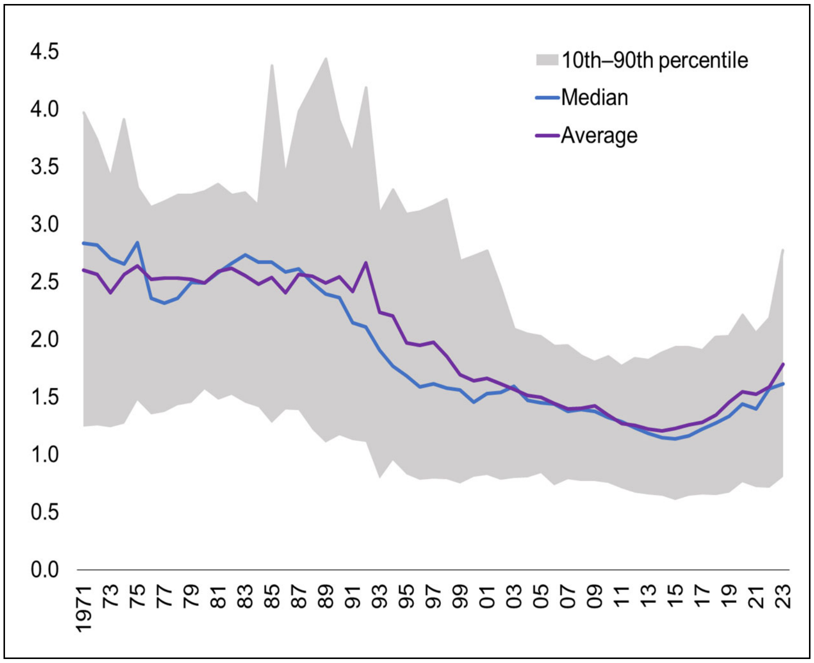
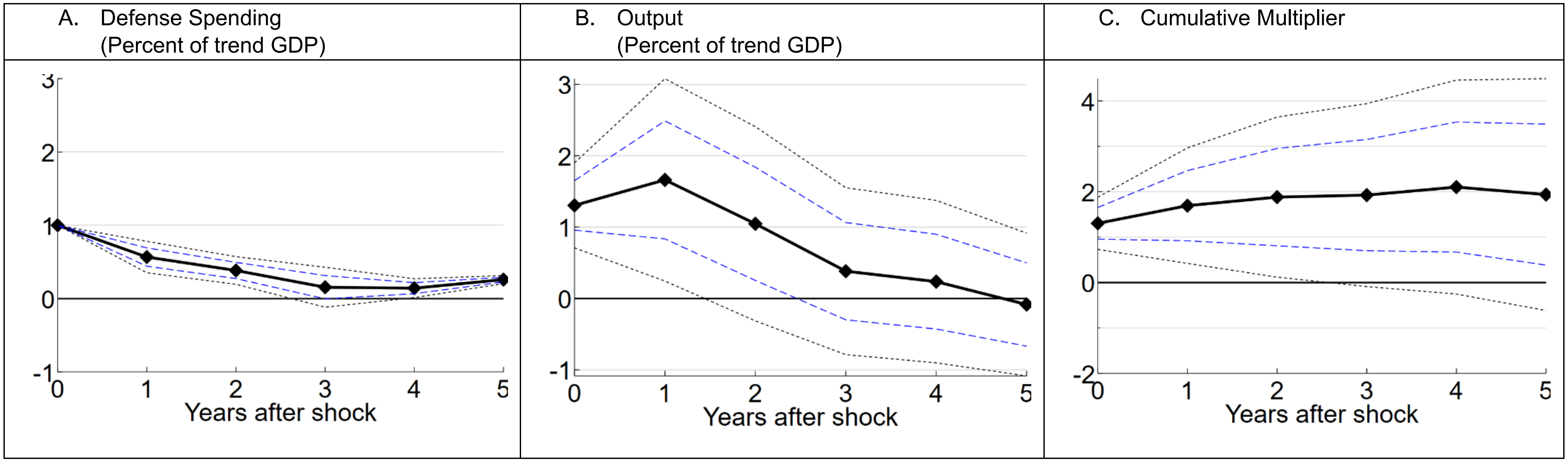
Figures

Figure 1. Military Spending in EU 1973-2023
(Percent of GDP)



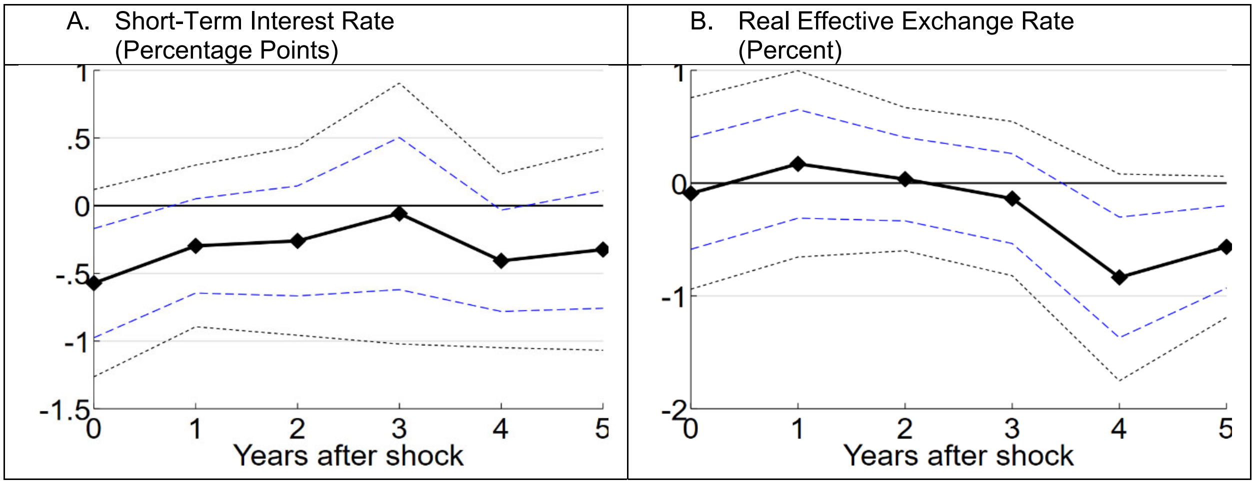
Source: SIPRI.

Figure 2. Response to a 1 Percent of Trend GDP Increase in Defense Spending



Note: Panels A and B: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Panel C is the cumulative multiplier estimated based on Equation (2). Standard errors are clustered by country. Dashed blue lines indicate 68% confidence intervals; dashed black lines indicate 90% confidence intervals.

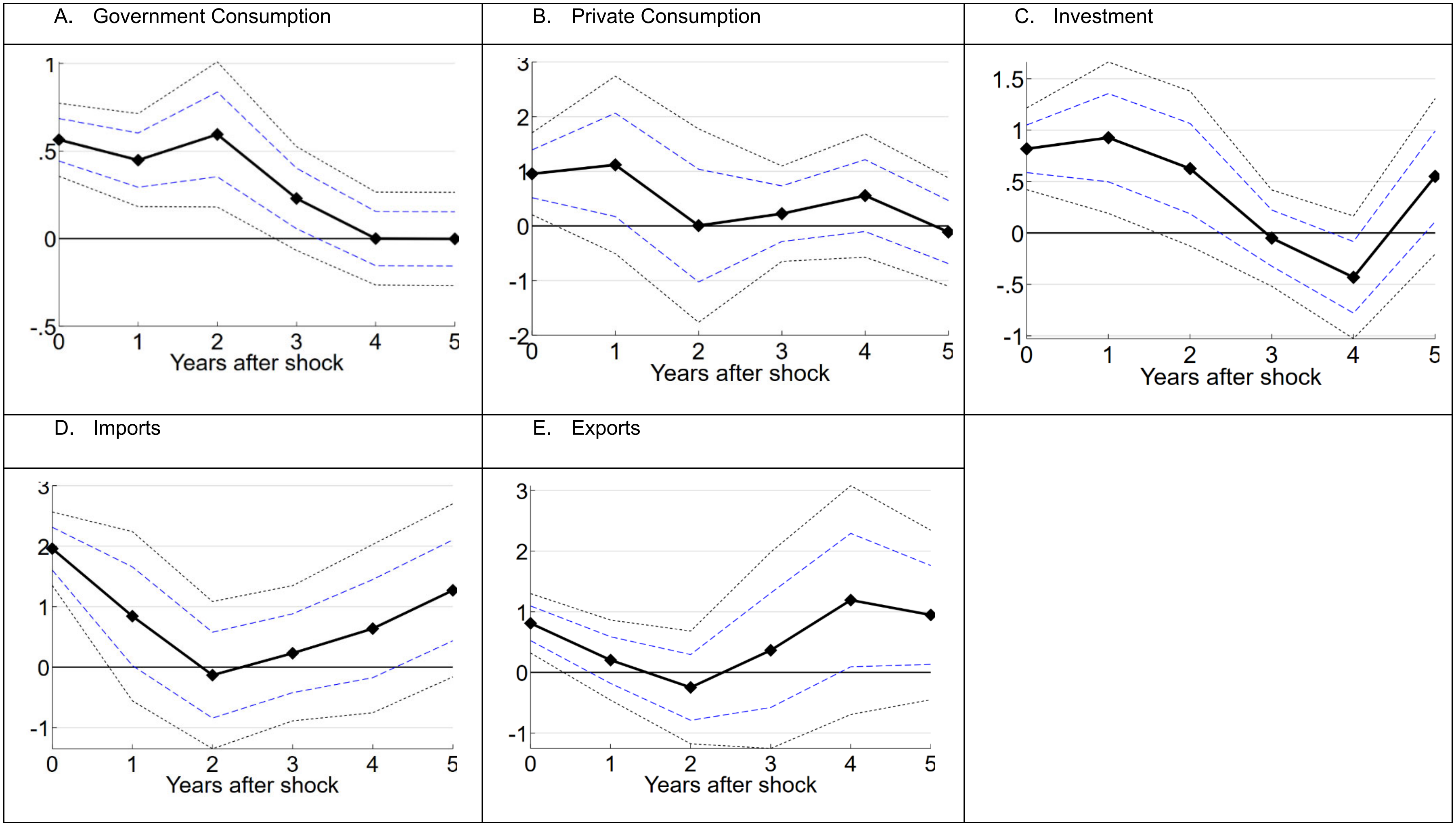
Figure 3: Response of Short-Term Interest Rate and Real Effective Exchange Rate to a 1 Percent of Trend GDP Increase in Defense Spending



Note: This extends the baseline specification in Equation (1) to regress short term interest rate (Panel A) and Real effective exchange rate (Panel B), while also controlling for its own lags in addition to the baseline set of controls. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 4: Responses of Demand Components to a 1 Percent of Trend GDP Increase in Defense Spending

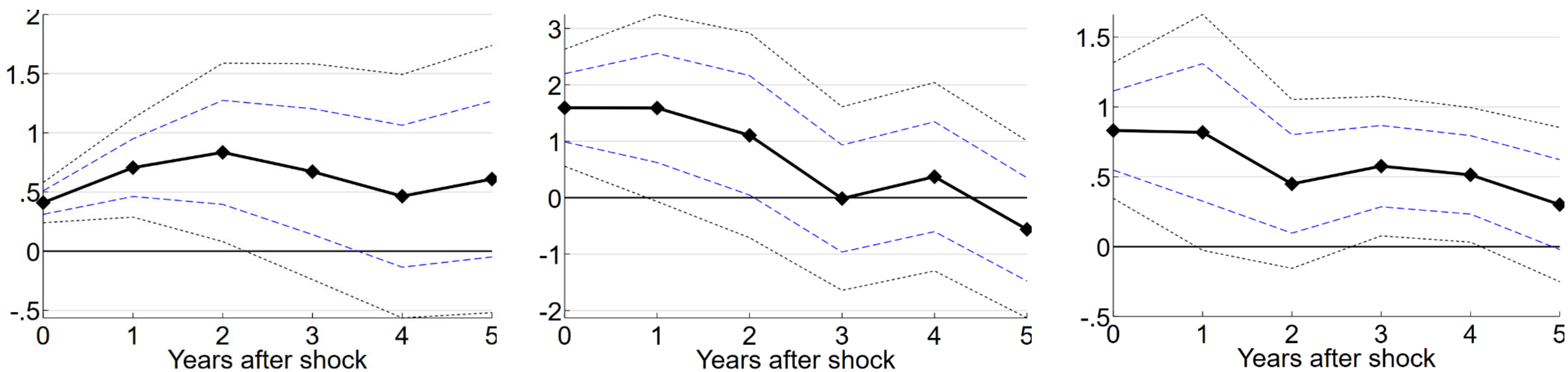
(Percent of trend GDP)



Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 5. Responses of Supply Components
(Percent)

A. Capital Service B. Labor Service Supply C. Total Factor Productivity

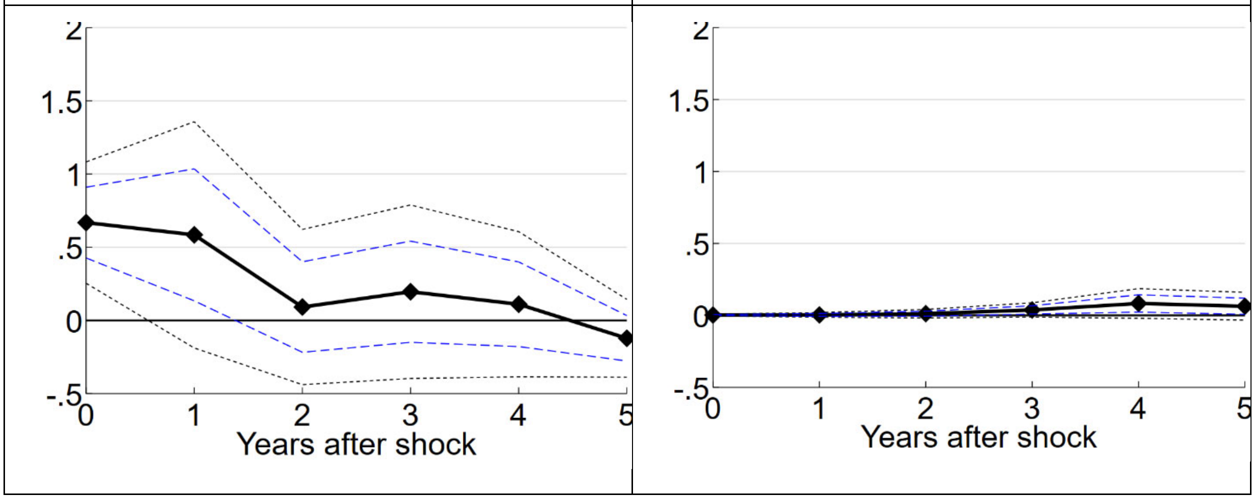


Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 6. Response of TFP Components

(Percent)

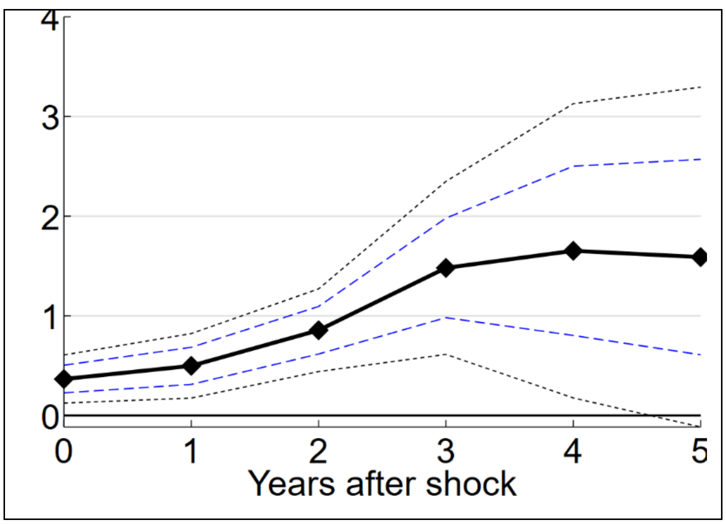
A. TFP Cyclical Component	B. TFP Trend Component



Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals. TFP trend is estimated from estimated from a quadratic polynomial trend.

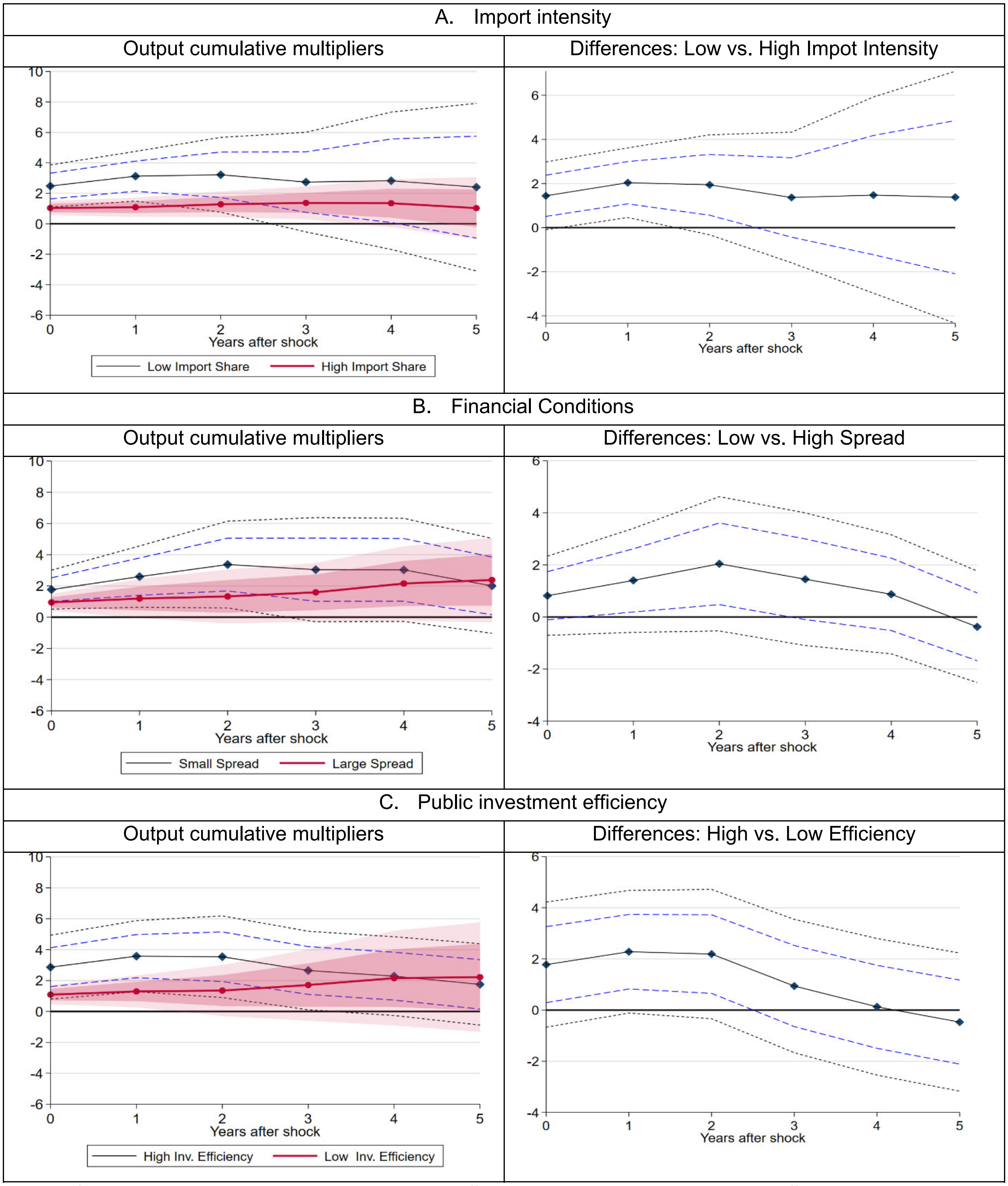
Figure 7: Response of Price

(Percent)



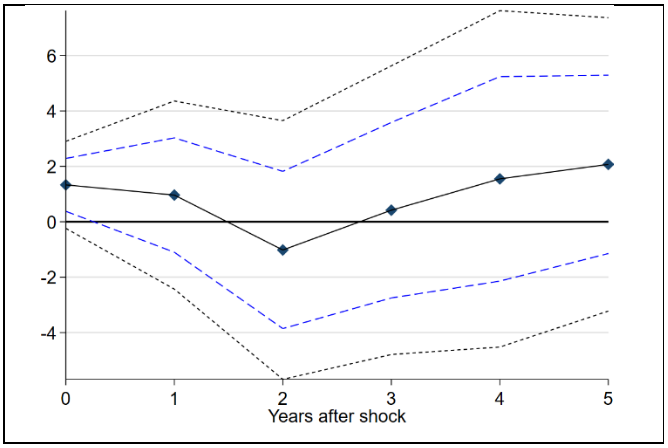
Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals. Given the sizable changes of prices at the beginning of the sample, particularly in Emerging EU, we first winsorize inflation to limit the influence of outliers and build a new price index based on the winsorized inflation series. We then regress the log of price index following Equation (1), while also controlling for its own lags in addition to the baseline set of controls.

Figure 8. Heterogeneity of Defense Multiplier
(Threshold approach)



Notes: Left chart shows the cumulatiev multiplier under two different environemnts. Right chart shows differences between the "blue" and "red" lines on the corresponding left charts. Blue lines indicate 68% confidence intervals and black lines 90% confidence intervals. The darker/lighter shaded area in the left chart describes the 68/90 percent confidence intervals for the correposnding state.

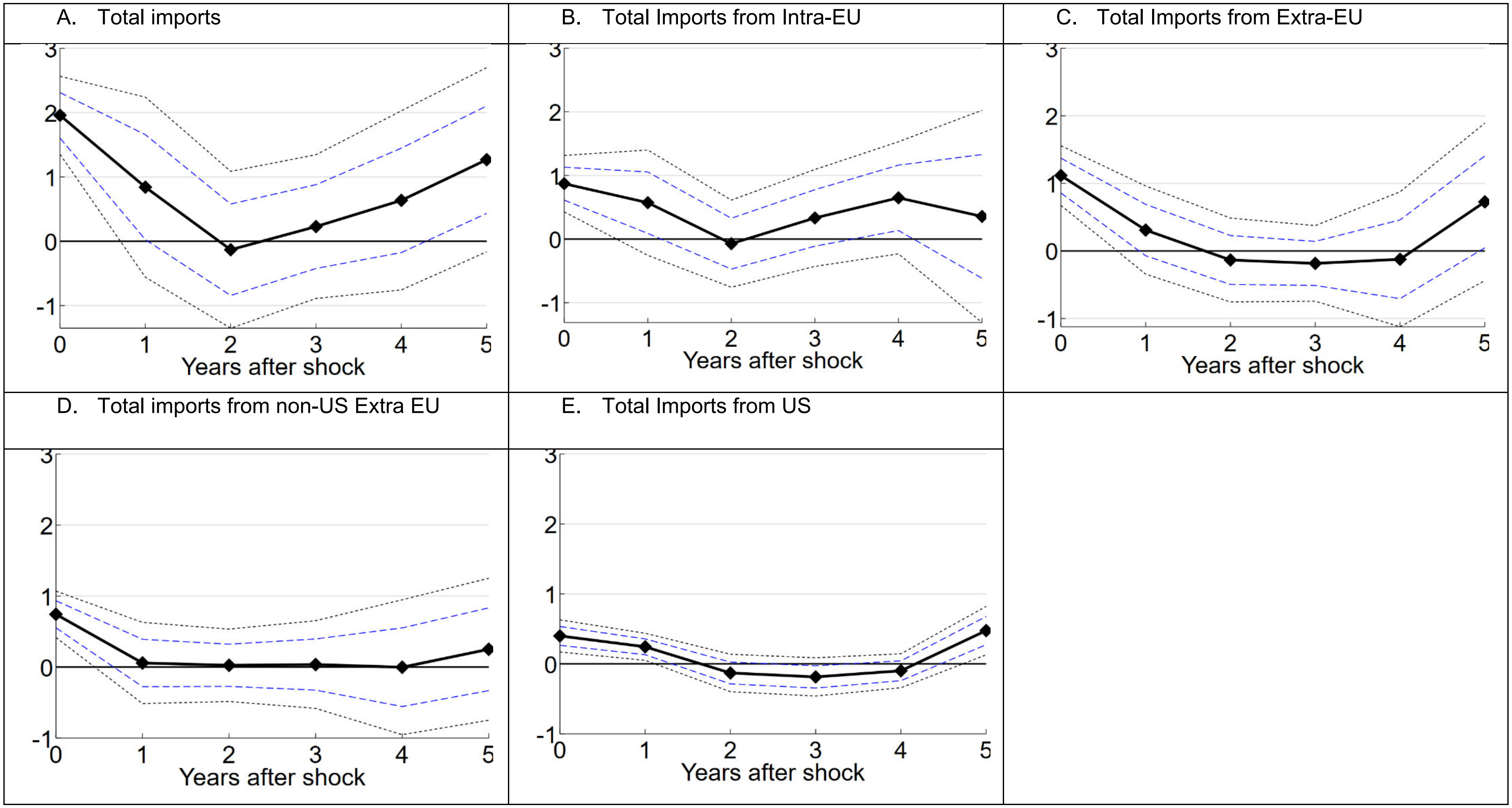
Figure 9: Differences Between Cumulative Multipliers of Negative Shocks and Positive Shocks



Notes: Figure shows differences between the teh cumulative multipliers of negative shocks versus that of positive shocks. The bounds are 68 percent and 90 percent confidence intervals, respectively.

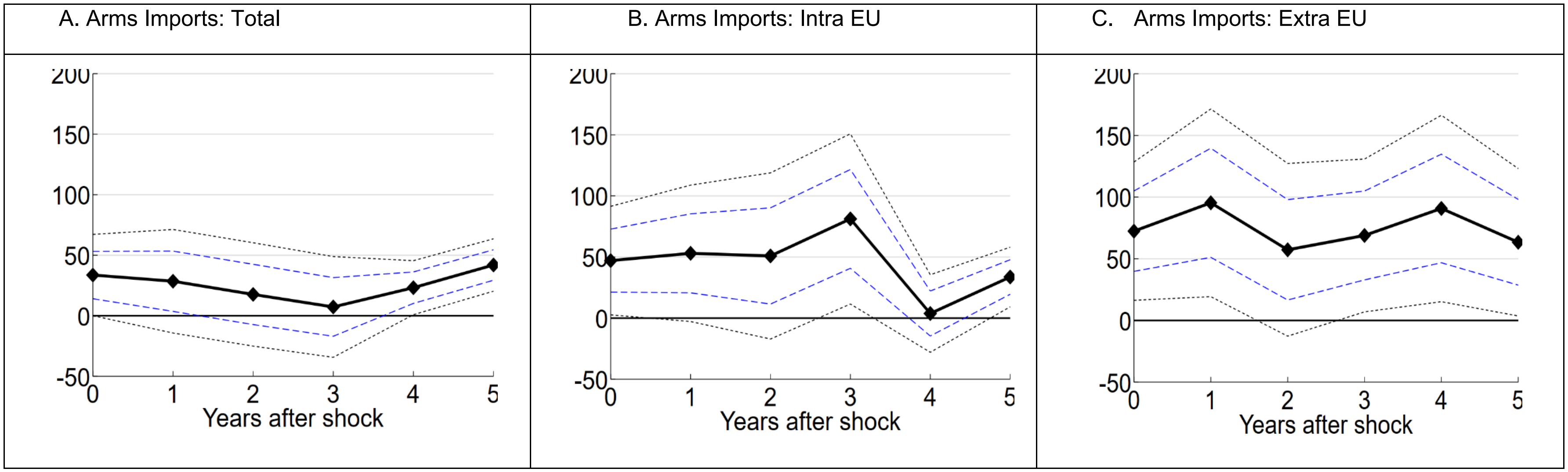
Figure 10. Responses of Imports

(Percent of trend GDP)



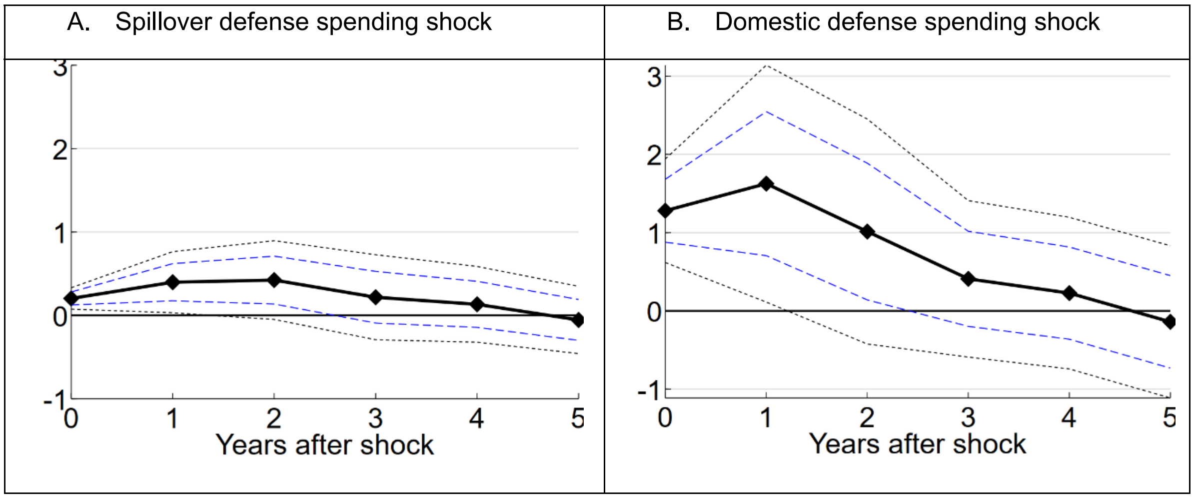
Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 11. Impulse Responses of Arms Imports to a Defense Spending Shock
(Percent)



Note: Responses to a positive defense spending shock of 1 percent of GDP in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

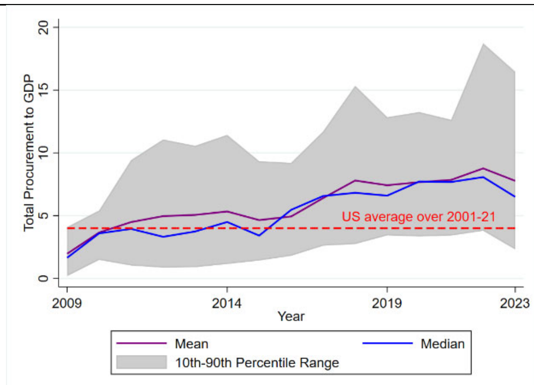
Figure 12. Responses of GDP to Defense Spending Shock in Trading Partner Versus Domestic Shock
(Percent of trend GDP)



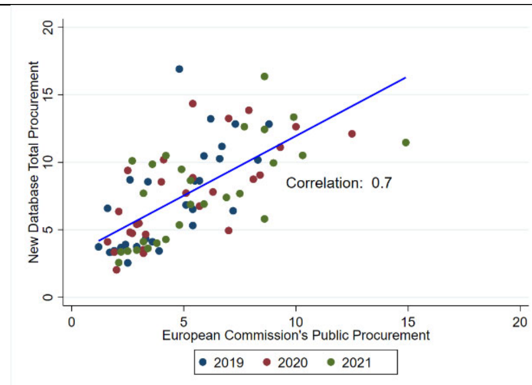
Note: Left chart: Responses to a positive military spending shock of 1 percent of trading partner GDP in a panel of 27 EU countries. The response is rescaled by rescaled by average export share. Right chart: Response to domestic defense spending shock (1 percent of domestic GDP).

Figure 13. OpenTender Procurement Database vs Official Aggregates

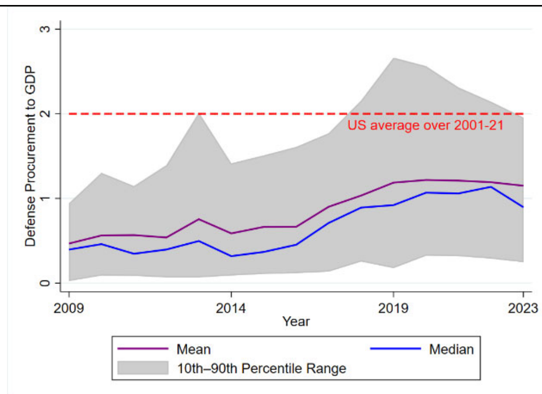
A. EU's Total Procurement (% of GDP)



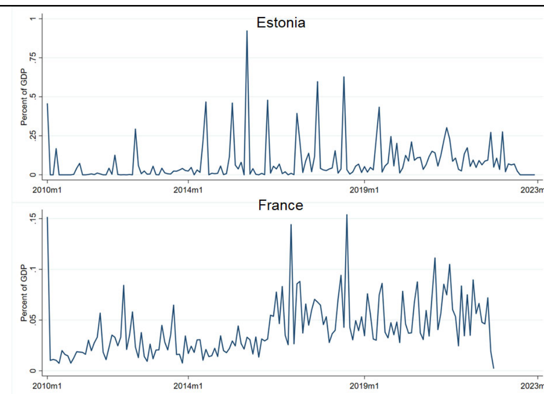
B. Comparison: Our sample vs EC's (2019 – 2021)



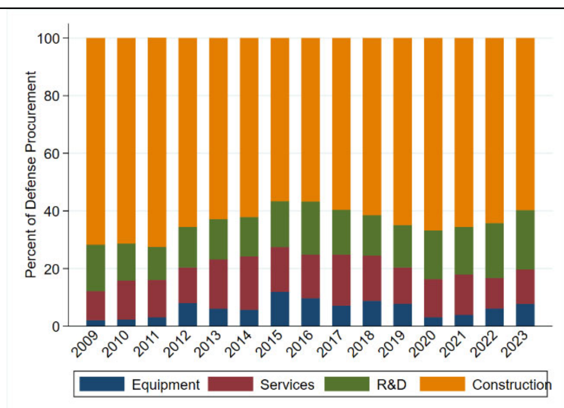
C. EU's Defense Procurement (% of GDP)



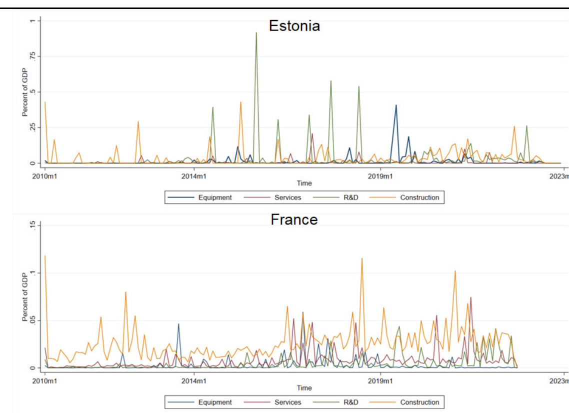
D. Monthly's Defense Procurement: Selected Countries



E. Defense and Security Procurement by Subcomponents



F. Defense and Security Procurement by Subcomponents: Selected countries

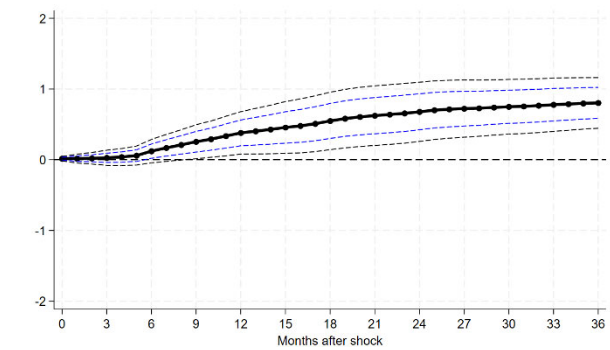


Source: Taiyo and European Commission and Staff estimate.

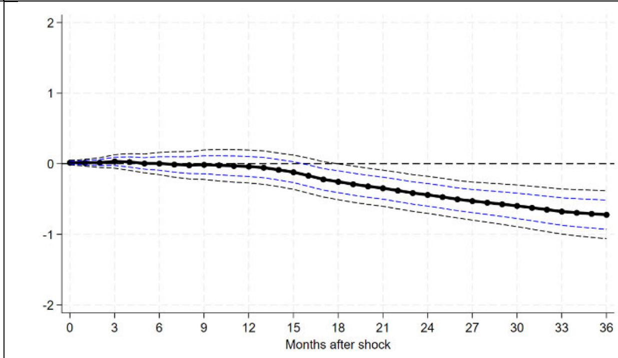
Note: To define defense and security procurement we follow EU Common Procurement Vocabulary, adopted by Regulation EC No. 213/2008 and Taiyo. The US averages are based on Cox et al. (2024).

Figure 14. Defense and Security Procurement: OLS Results

A. GDP

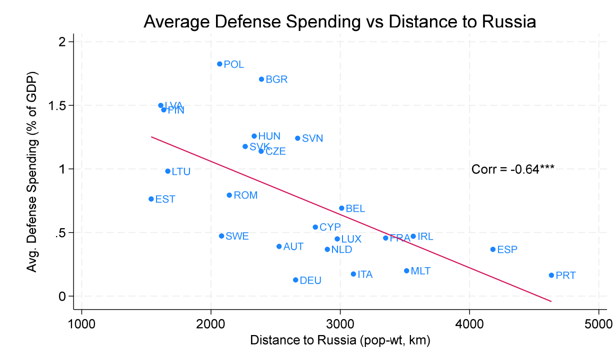
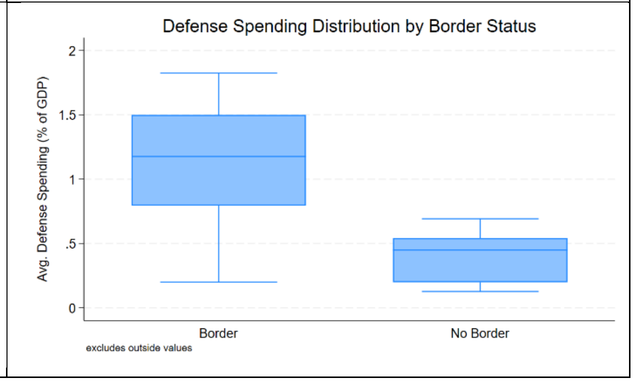


B. REER



Note: This figure presents baseline OLS estimates from Equation (8), showing the dynamic cumulative response to a defense and security procurement shock of 1 percent of trend GDP for EU-27 countries. Panel A displays the cumulative response of normalized GDP; Panel B shows the cumulative normalized response of the REER (real effective exchange rate, where a negative value indicates depreciation). Standard errors are robust (HAC). Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

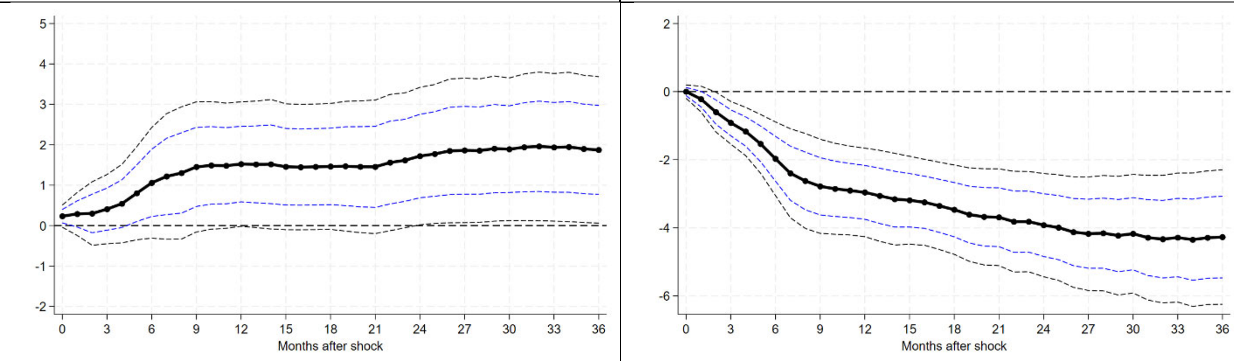
Figure 15. Relevance of Instruments

A. IV1: Distance to Russia	B. IV2: Non-EU-non-NATO member Border
	

Note: This table demonstrates the relevance of the instruments defined in Equation (8). Panels A and B assess whether the instruments are relevant (correlated with procurement). Panel A shows each EU-27 country's population-weighted average distance to Russia (km) and average defense and security procurement as a share of trend GDP. Panel B presents average defense and security procurement as a share of trend GDP, grouped by whether the country borders a non-EU, non-NATO member (indicator = 1 if yes).

Figure 16. Defense and Security Procurement: IV Results

A. GDP | B. REER

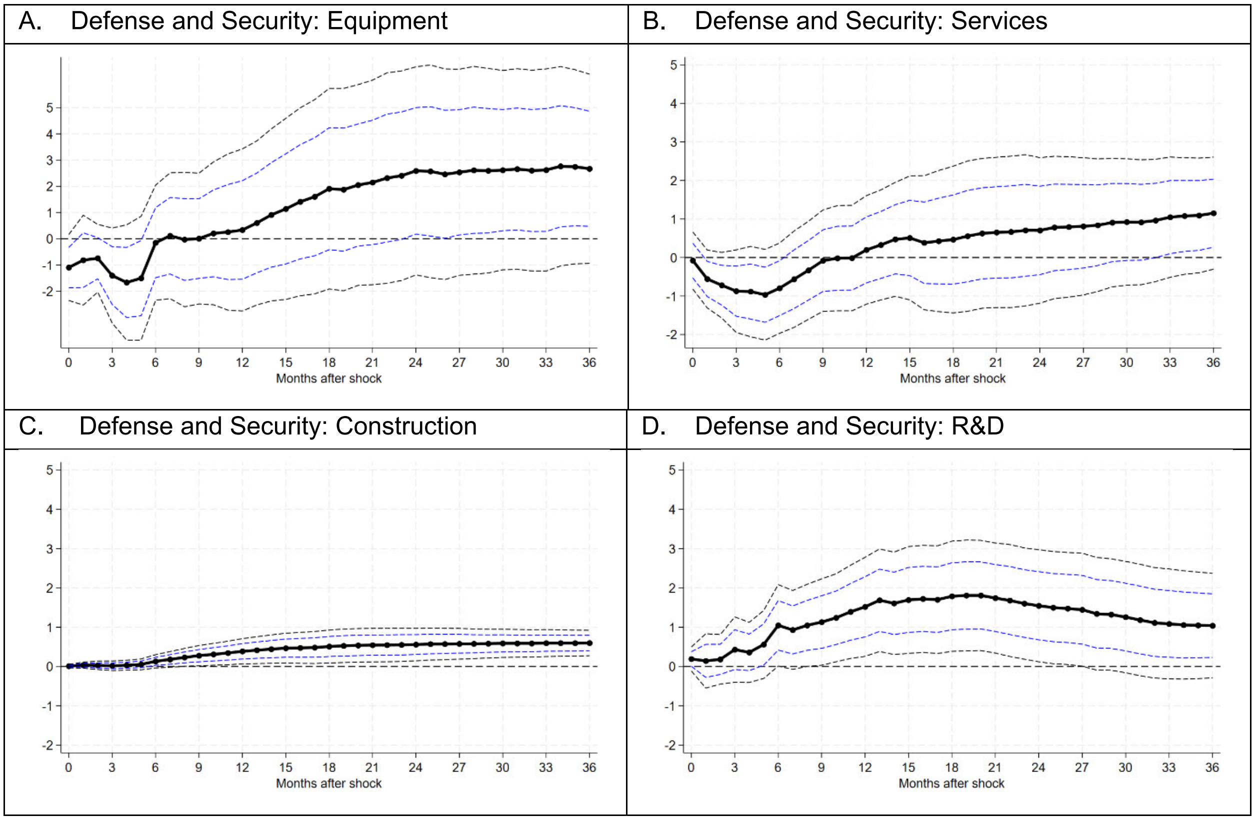


Note: This figure presents baseline IV estimates from Equation (9) and (10) using the instruments defined in Equation (8), showing the dynamic cumulative response to a defense and security procurement shock of 1 percent of trend GDP for EU-27 countries. Panel A displays the cumulative response of normalized GDP; Panel B shows the cumulative normalized response of the REER (real effective exchange rate, where a negative value indicates depreciation). Standard errors are robust HAC (4). Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 17. Evolution Over Time of Subcomponents of Defense and Security Procurement Packages

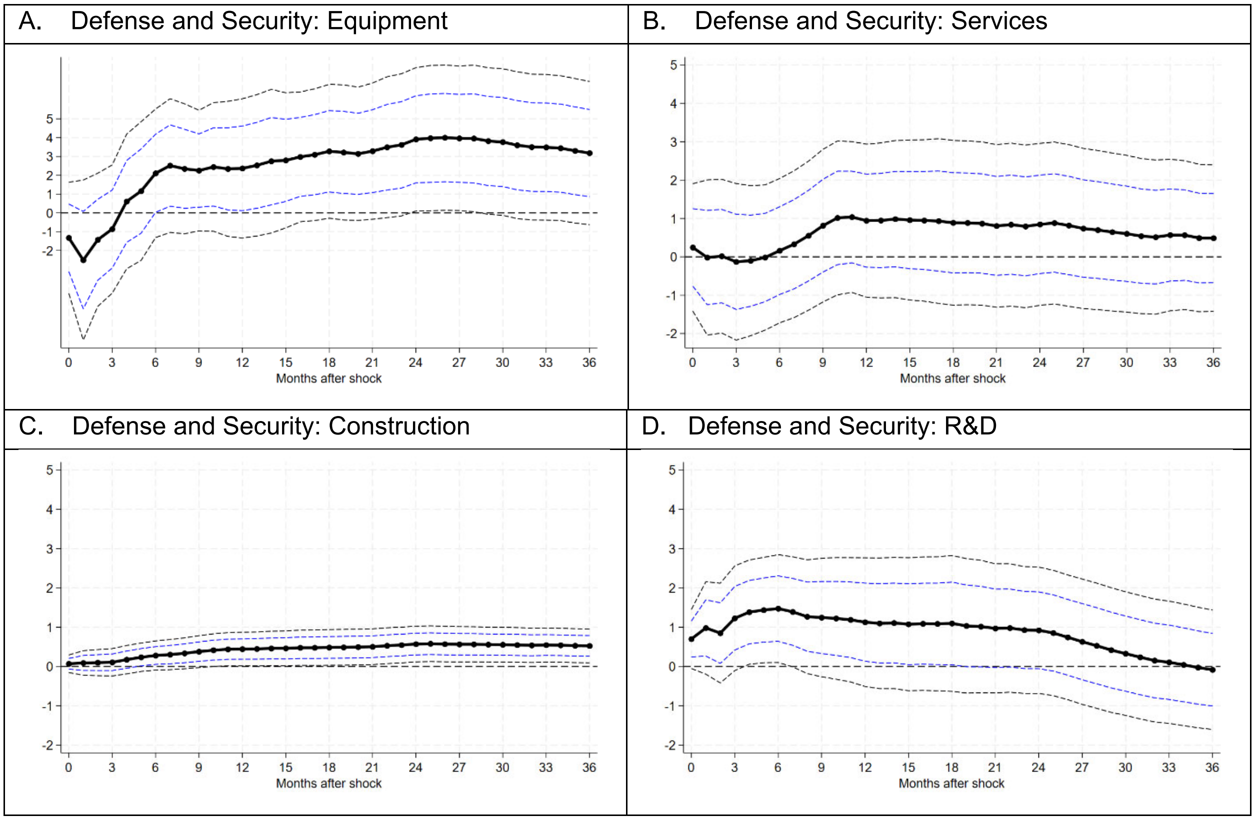
Note: This chart shows, for each month in our sample, the average share of EU-27 countries where a specific defense and security procurement subcomponent, Equipment, Services, Construction, or R&D, is dominant. This is, the average over $d_{i,t}^{equ}$, $d_{i,t}^{con}$, $d_{i,t}^{ser}$, $d_{i,t}^{r\&d}$ equal to 1 across countries for each point in time. Construction consistently has the highest average dominance across countries, while Equipment, Services, and R&D remain less prevalent. The chart highlights sectoral heterogeneity and shifts in procurement focus over time.

Figure 18. Heterogeneity by Defense and Security Procurement Subcomponents: OLS Results



Note: This figure presents OLS estimates from Equation (11), showing the dynamic cumulative response of GDP to a subcomponent defense and security procurement shock of 1 percent of trend GDP for EU-27 countries. Panel A displays the cumulative response of normalized GDP to an equipment dominated defense and security procurement package shock ($d_{i,t}^{equ}$=1); Panel B shows the cumulative response of normalized GDP to a service dominated defense and security procurement package shock ($d_{i,t}^{ser}$=1); Panel C shows the cumulative response of normalized GDP to a construction dominated defense and security procurement package shock ($d_{i,t}^{con}$=1); and Panel D shows the cumulative response of normalized GDP to an R&D dominated defense and security procurement package shock ($d_{i,t}^{r\&d}$=1). Standard errors are robust HAC (4). Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Figure 19. Heterogeneity by Defense and Security Procurement Subcomponents: IV Results



Note: This figure presents IV estimates from Equation (11), showing the dynamic cumulative response of GDP to a subcomponent defense and security procurement shock of 1 percent of trend GDP for EU-27 countries. The main difference from the aggregate IV is that, for subcomponents, each of the four category dummies (construction, services, equipment, R&D) is interacted with the two shift–share instruments, defined in Equation (3), creating eight instruments. This isolates shocks dominated by a specific procurement type. Panel A displays the cumulative response of normalized GDP to an equipment dominated defense and security procurement package shock ($d_{i,t}^{equ}$=1); Panel B shows the cumulative response of normalized GDP to a service dominated defense and security procurement package shock ($d_{i,t}^{ser}$=1); Panel C shows the cumulative response of normalized GDP to a construction dominated defense and security procurement package shock ($d_{i,t}^{con}$=1); and Panel D shows the cumulative response of normalized GDP to an R&D dominated defense and security procurement package shock ($d_{i,t}^{r\&d}$=1). Standard errors are robust HAC (4). Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Tables

Table 1. Exogeneity Test of Defense Spending

Specifications	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Output (-1)	0.005 (0.018)			0.017 (0.012)			
Output (-2)	0.003 (0.008)			-0.006 (0.006)			
Government consumption (-1)		-0.045 (0.052)		-0.067 (0.058)			
Government consumption (-2)		0.014 (0.034)		0.043 (0.035)			
Armed conflict index			0.036* (0.018)	0.056*** (0.001)			
PCA					-0.000 (0.000)		
Geopolitical Risk						0.001 (0.001)	
Monetary Policy Shocks							-0.000 (0.000)

Note: This table presents estimates from the regression of military spending. All specifications control for country and time fixed effects. Standard errors clustered by country are in parentheses. Geopolitical risk is available for 12 EU countries from Caldara and Iacoviello (2022). PCA: principal component, i.e. the first component, of output growth, inflation, and gov expenditure as percent of GDP at year t, projected in October previous year from the WEO vintage database. The monetary policy shock is from Choi et al. (2024). ***p<0.01, **p<0.05, *p<0.1

Table 2. Country Contribution to Total EU Defense and Security

Country	Mean	P50	P25	P75	SD
Austria	2.4	1.5	0.7	2.9	3.9
Belgium	4.8	3.5	2.3	5.5	4.1
Bulgaria	2.3	1.5	1.0	2.4	3.2
Croatia	0.5	0.3	0.1	0.6	0.6
Cyprus	0.1	0.0	0.0	0.2	0.3
Czech Republic	5.0	4.0	2.6	5.6	3.9
Denmark	6.9	6.1	3.8	8.8	4.1
Estonia	0.4	0.1	0.0	0.3	0.8
Finland	6.3	5.5	3.5	8.1	4.9
France	19.6	17.1	14.1	24.1	9.0
Germany	6.4	5.2	3.4	8.2	4.6
Greece	0.6	0.3	0.1	0.7	0.9
Hungary	2.5	1.7	1.1	3.1	2.4
Ireland	2.0	0.8	0.3	2.1	3.6
Italy	5.2	3.3	1.6	7.2	5.8
Latvia	0.9	0.6	0.2	1.0	1.2
Lithuania	0.7	0.2	0.1	0.7	1.2
Luxembourg	0.5	0.2	0.0	0.5	0.9
Malta	0.0	0.0	0.0	0.0	0.2
Netherlands	4.7	3.0	1.6	5.6	5.4
Poland	13.6	11.5	7.6	16.0	9.6
Portugal	0.6	0.3	0.1	0.6	1.2
Romania	2.7	1.9	1.1	3.1	3.0
Slovakia	1.8	1.1	0.7	2.3	1.7
Slovenia	0.8	0.6	0.2	1.1	1.1
Spain	5.9	5.2	3.3	7.0	4.5
Sweden	3.0	2.2	1.0	3.9	2.9

Note: This Table shows each EU-27 country’s contribution to total EU-27 Defense and security procurement spending.

Table 3. First Stage Statistics

Horizon	Cragg-Donald Wald F-statistic	Kleibergen-Paap rk Wald F	Over-identification Hansen J p-value
h = 0	28.28	10.68	0.90
h = 1	16.93	10.16	0.64
h = 2	13.85	7.58	0.45
h = 3	17.96	7.15	0.38
h = 4	20.28	7.20	0.48
h = 5	18.83	6.75	0.51
h = 6	16.39	5.71	0.53
h = 7	14.90	5.06	0.55
h = 8	15.77	5.42	0.58
h = 9	18.10	6.37	0.55
h = 10	21.46	7.39	0.53
h = 11	25.45	8.50	0.52
h = 12	28.71	9.00	0.55
h = 13	30.81	9.47	0.51
h = 14	32.83	9.99	0.57
h = 15	36.70	11.07	0.48
h = 16	39.58	10.82	0.49
h = 17	41.18	10.44	0.45
h = 18	42.40	10.68	0.39
h = 19	41.78	11.01	0.38
h = 20	42.07	11.08	0.36
h = 21	43.57	11.84	0.37
h = 22	42.64	11.69	0.35
h = 23	44.68	12.65	0.34
h = 24	43.90	12.38	0.34
h = 25	43.41	12.27	0.34
h = 26	41.39	11.75	0.36
h = 27	41.22	11.79	0.36
h = 28	42.27	12.31	0.35
h = 29	41.54	12.21	0.34
h = 30	42.80	13.25	0.30
h = 31	40.22	12.81	0.28
h = 32	39.11	12.63	0.26
h = 33	39.52	13.00	0.23
h = 34	37.91	12.76	0.20
h = 35	38.52	13.44	0.17
h = 36	38.73	13.72	0.16

Note: This Table first-stage statistics for instrument strength (Cragg-Donald and Kleibergen-Paap rk Wald statistics) and the Hansen J p-value for overidentification (testing instrument validity) for Equation (10).

Annex A. Data Sources

Part 1: Analysis with Annual Data

Variable	**Source**
Real GDP	United Nation's National Accounts Aggregates Database
Real Government Consumption	United Nation's National Accounts Aggregates Database
Military Spending (as percent of GDP)	Stockholm International Peace Research Institute (SIPRI)
Arms Conflict Index	Miyamoto et al. (2019), but extended using data from UCDP/PRIO
Import	United Nation's National Accounts Aggregates Database
Real Private Consumption	United Nation's National Accounts Aggregates Database
Real Investment	United Nation's National Accounts Aggregates Database
Capital Service	Penn World Table (version 10.01)
Labor Service Supply	Penn World Table (version 10.01)
Total Factor Productivity	Penn World Table (version 10.01)
Long term sovereign bond yield	Haver
Short term interest rate	OECD, Haver
Investment efficiency gap	IMF (2025)
Bilateral trade	IMF's Direction of Trade
Revenue as percent of GDP	IMF WEO database
Debt as percent of GDP	IMF WEO database
Geopolitical Risk	Caldara and Iacovello (2022)
Monetary policy shock	Choi et al. (2024)

Part 2: Analysis with High-Frequency Data

Variable	**Source**
Defense and Security procurement	Opentender
Total Procurement	Opentender
Industrial production (excluding Construction)	Haver
Industrial production - Manufacturing	Haver
Economic sentiment indicator	Haver
REER	Bank for International Settlements (BIS)
Geopolitical risk index	Caldara and Iacovello (2022)
Distance to Russia (pop-wt, km)	GeoDistance Database (CEPII)
Shared borders with non-EU, non-NATO members	GeoDistance Database (CEPII)
Geopolitical alliance	Alliance Treaty Obligations and Provisions (ATOP)
Quarterly GDP	Haver
Quarterly GDP deflator	Haver
HICP	Haver

Annex B. Additional Results and Robustness Checks: Defense Spending Multiplier

Annex Table B.1: Extending Ramey and Zubairy (2018)

Using the same model specification as in Ramey and Zubairy (2018):

a) Replication of Ramey and Zubairy (2018): Full sample 1889Q1-2015Q4, using the defense spending news Defense news to be the instrument for government consumption

	Multiplier	Kleibergen–Paap rk Wald F statistic (first-stage strength)
1 year	0.706*** (0.130)	16.93
2 year	0.664*** (0.067)	19.39
4 year	0.713*** (0.044)	11.22

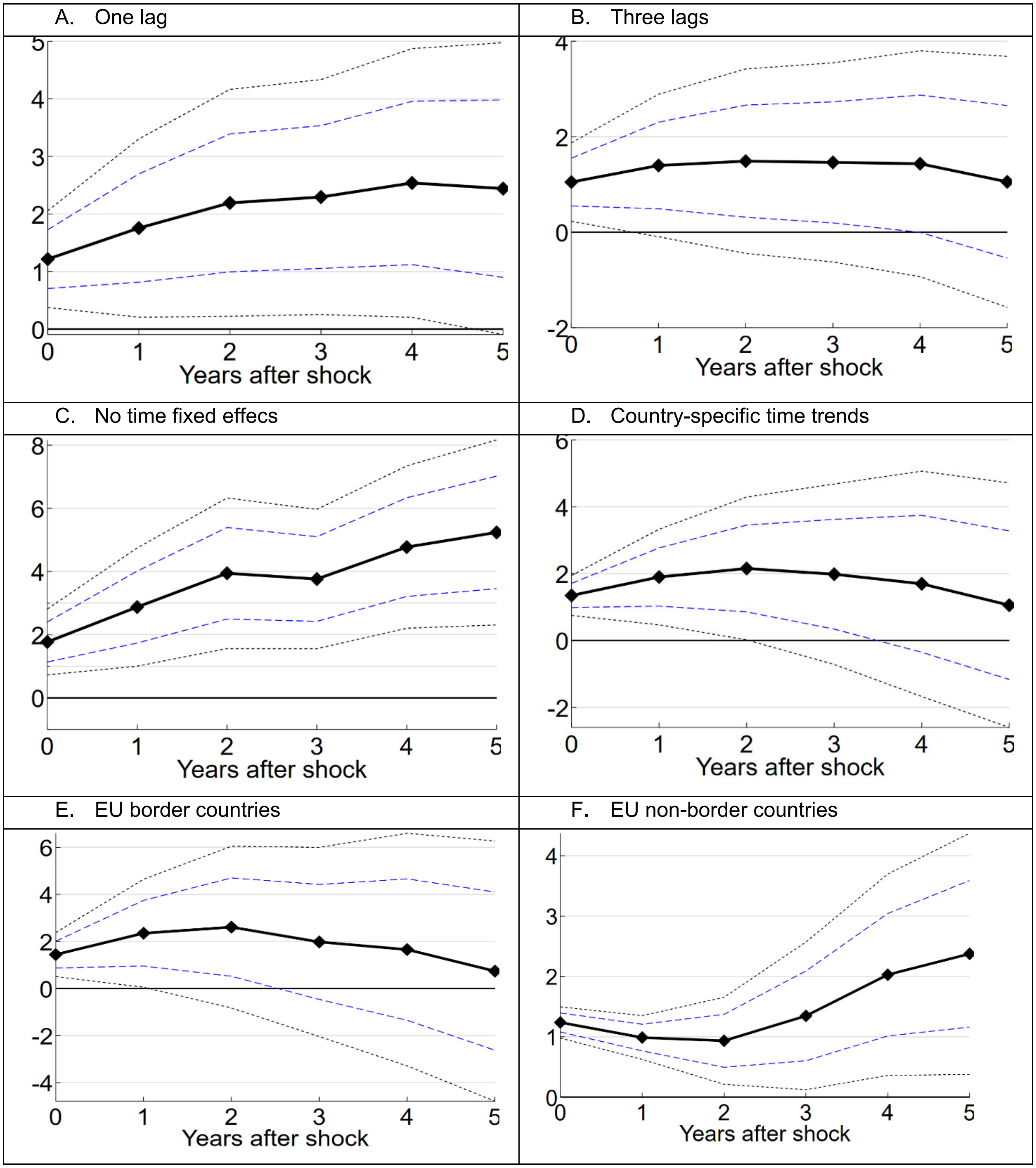
b) Similar to a but using the post-WWII sample 1947Q1-2015Q4

	Multiplier	Kleibergen–Paap rk Wald F statistic (first-stage strength)
1 year	1.418*** (0.302)	47.33
2 year	0.723*** (0.153)	197.31
4 year	0.505*** (0.163)	87.11

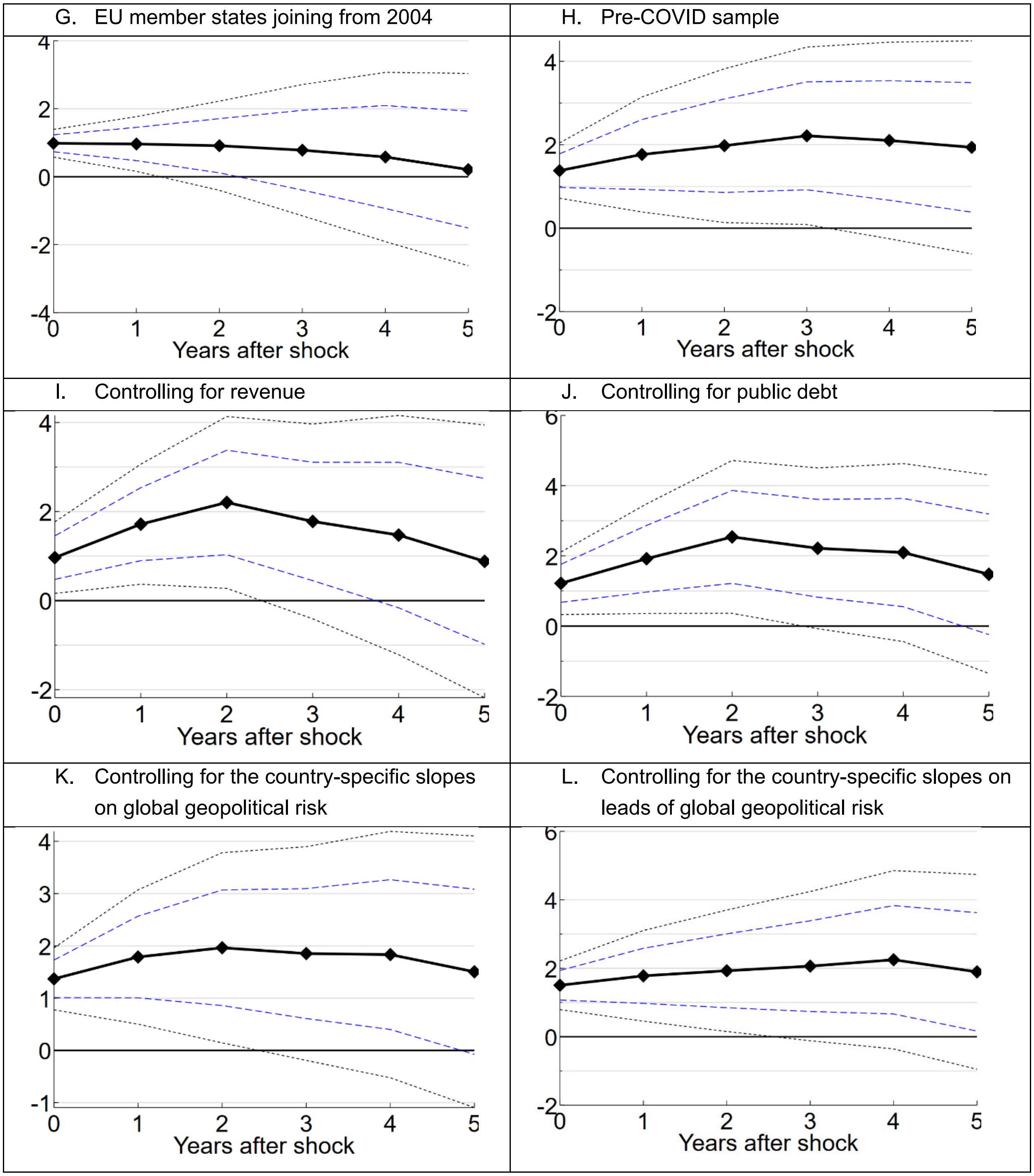
c) Extension to use defense spending news as instrument for federal defense spending outlay over the sample: 1947Q1-2015Q4:

	Multiplier	Kleibergen–Paap rk Wald F statistic (first-stage strength)
1 year	1.151*** (0.235)	374.85
2 year	0.812*** (0.176)	504.94
4 year	0.685*** (0.197)	123.89

Annex Figure B.2: Sensitivity of Cumulative Multiplier

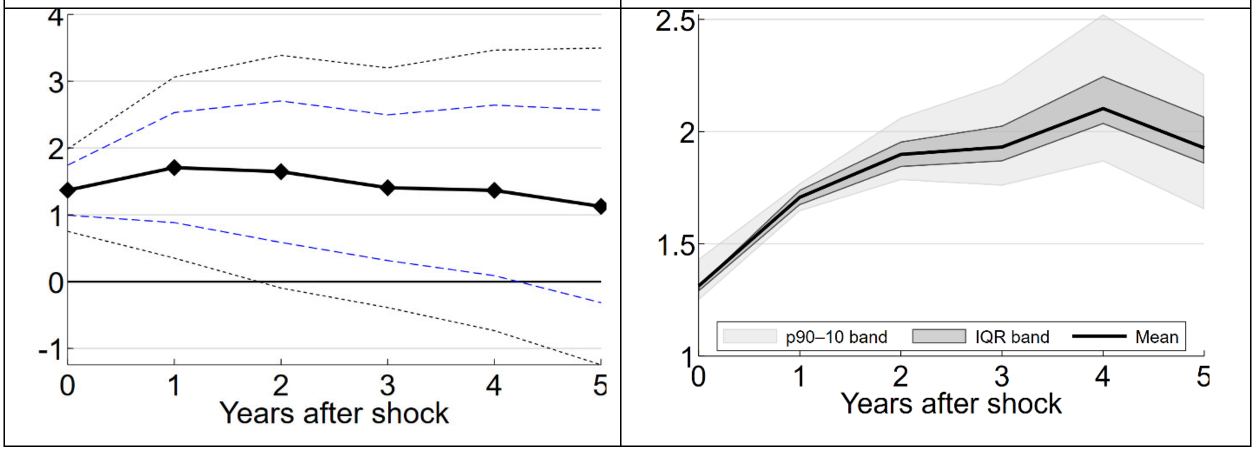


Annex Figure B.2: Sensitivity of Cumulative Multiplier (cont)



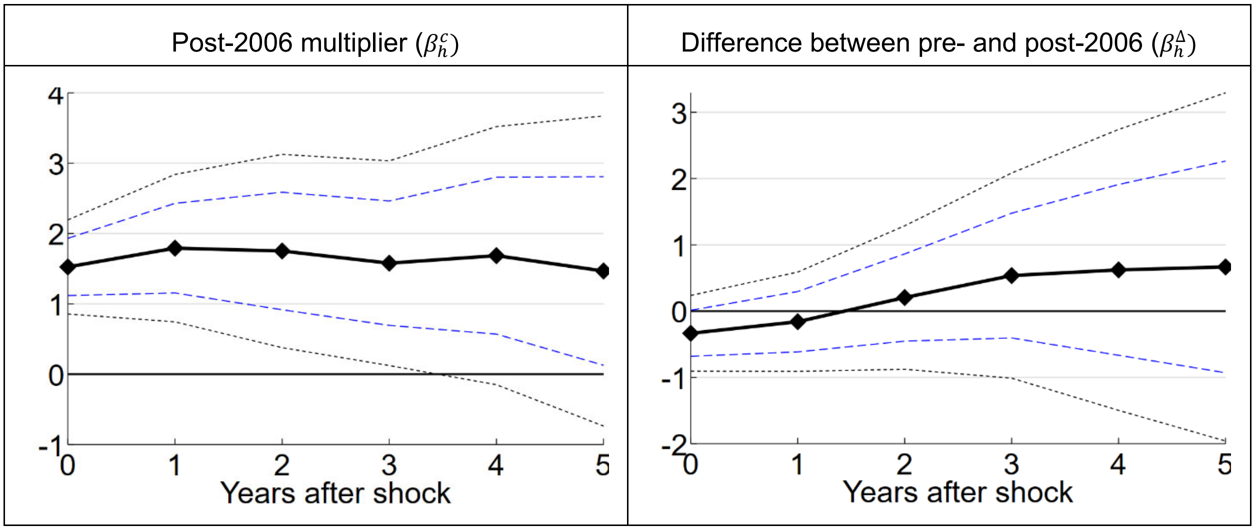
Annex Figure B.2: Sensitivity of Cumulative Multiplier (cont)

M. Controlling for the country-specific slopes on lags of global geopolitical risk	N. Excluding one country at a time: point estimates



Notes: Figure presents the cumulative multiplier estimated based on Equation (2) in a panel of 27 EU countries. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals. Panel D: The country-specific trend is included in Equation (2). Panel E: Border countries refer to countries that share borders with countries that are both non-EU and non-Schengen: Finland, Estonia, Latvia, Lithuania, Poland, Slovak Republic, Hungary, Romania, Bulgaria, Greece, and Croatia. Panel F: EU countries excluding border countries. Panel G: EU countries joining from 2004. Panels I and J: Controlling for the lags of normalized revenue and debt (as percent of trend GDP), respectively. Panel K-M: Allowing for the interaction between Caldara and Iacoviello (2022)'s global geopolitical risk (GPR) and country fixed effect: contemporaneous GPR (panel K), two leads of GPR (panel L) and two lags of GPR (Panel M). Panel N: Point estimates of cumulative multipliers when the baseline sample excludes one country at a time.

Annex Figure B.3: Addition Exercises on Sensitivity of Cumulative Multiplier with Different Samples



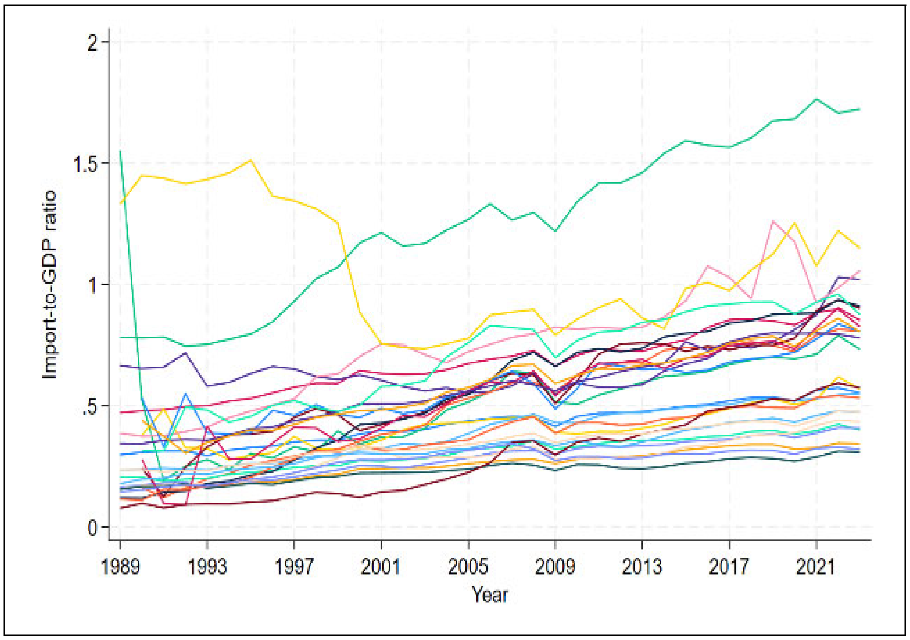
Note: The model specification is modified as:

$$\sum_{k=0}^{h} \mathrm{y}_{\mathrm{i,t+k}} = \beta_h^{c1} \sum_{k=0}^{h} g_{i,t+k}^{m} + \beta_h^{\Delta} D_{i,t} \sum\nolimits_{k=0}^{h} g_{i,t+k}^{m} + \phi_h(L)\boldsymbol{x}_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \varepsilon_{i,t+h}$$

where $D_{i,t} = 1$ if year <2006. Standard errors are clustered by country. Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

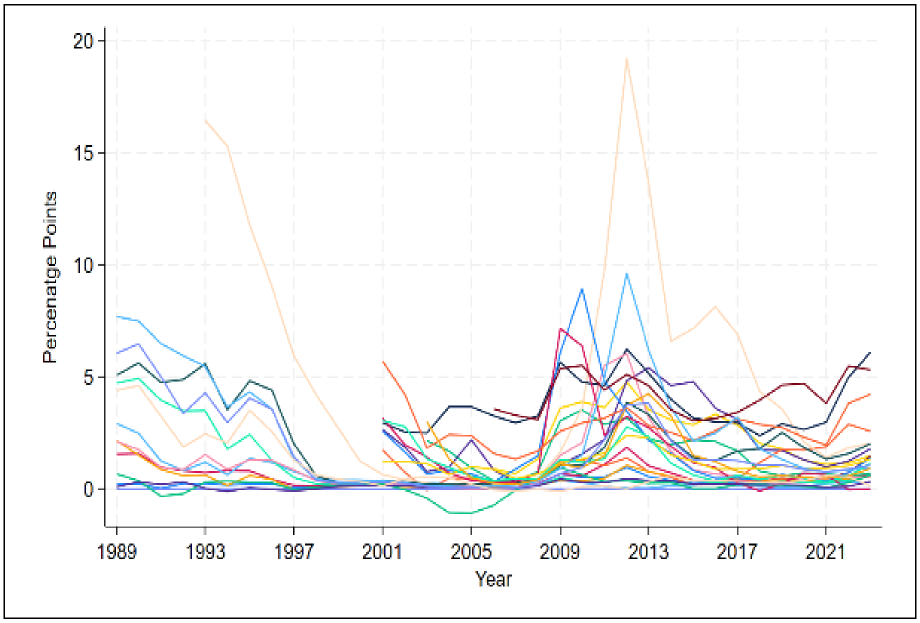
Annex C. Heterogeneity of Defense Spending

Annex Figure C.1: Import to GDP Ratio across 27 EU countries



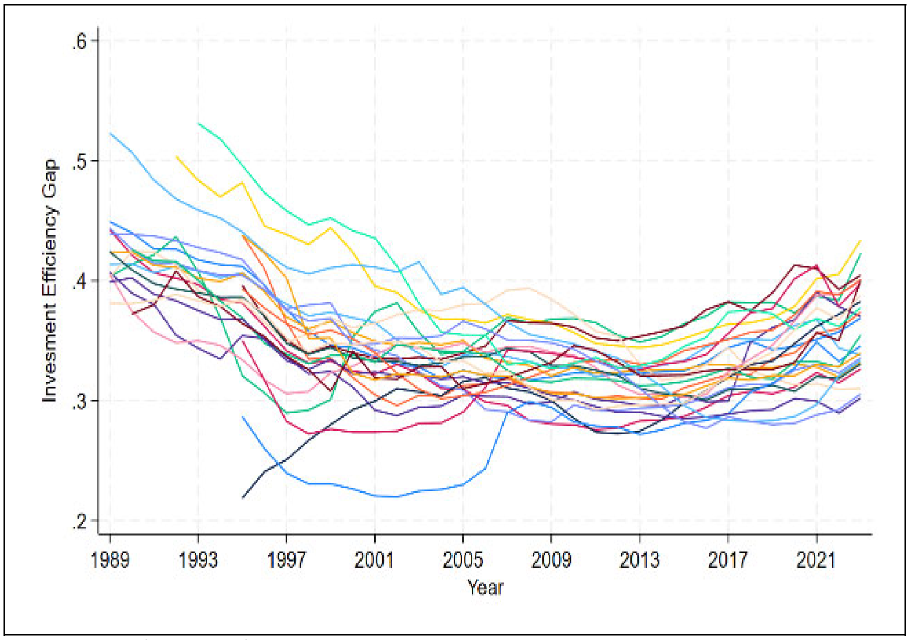
Sources: UN National Accounts - Analysis of Main Aggregates.

Annex Figure C.2: Long-term sovereign yield spreads
(Percentage Points)



Sources: Haver.
Notes: Sovereign bond spreads are computed as yield differentials relative to the German Bund at long maturities.

Annex Figure C.3: Investment Efficiency Gaps

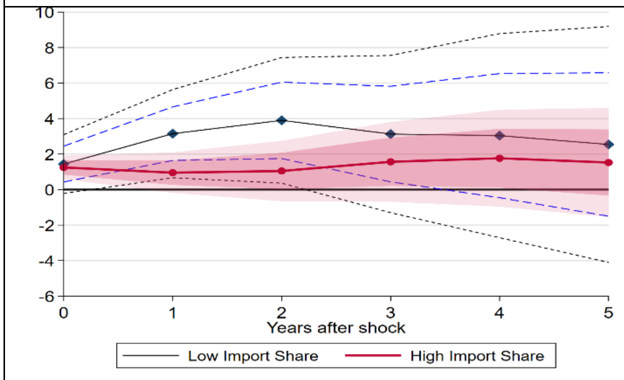


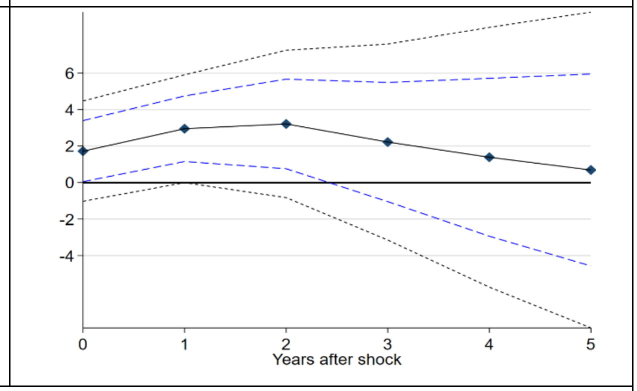
Sources: October Fiscal Monitor (IMF, 2025).
Note: Higher investment efficiency gap indicates a lower efficiency.

Annex Figure C.4: Heterogeneity of defense multiplier
(Smooth Transition, Gamma=3)

A. Import intensity

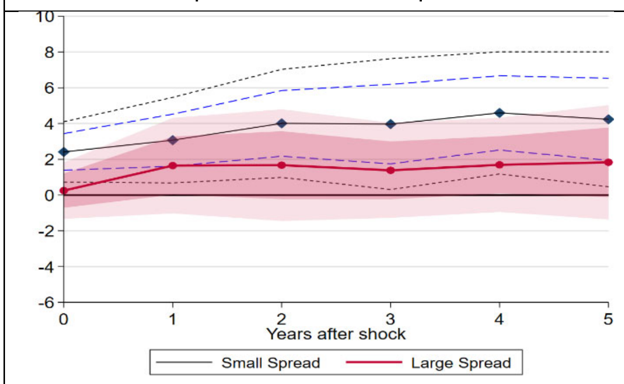
Output cumulative multipliers	Differences: Low vs. High Import Intensity

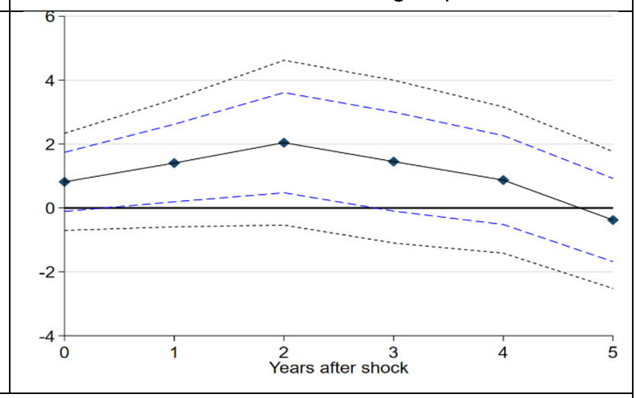




B. Financial Conditions

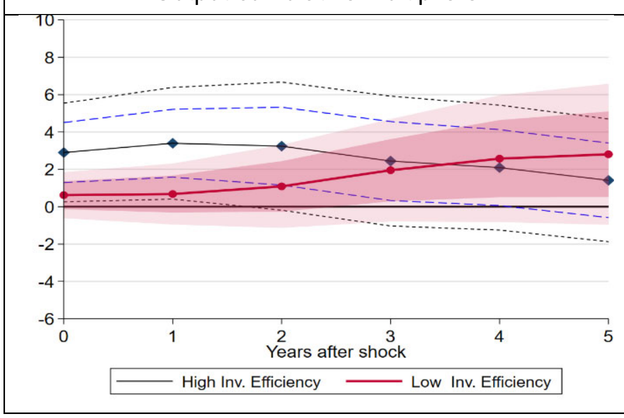
Output cumulative multipliers	Differences: Low vs. High Spread

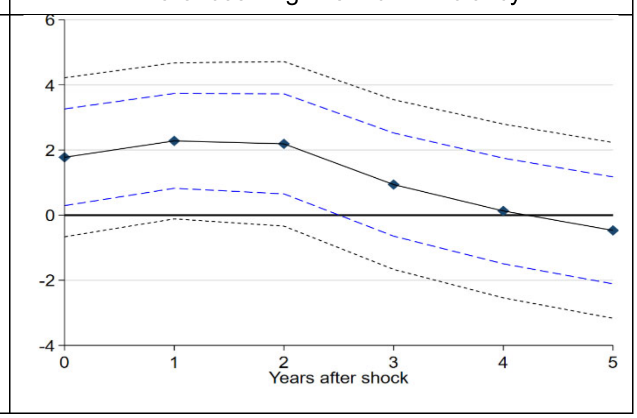




C. Public investment efficiency

Output cumulative multipliers	Differences: High vs. Low Efficiency

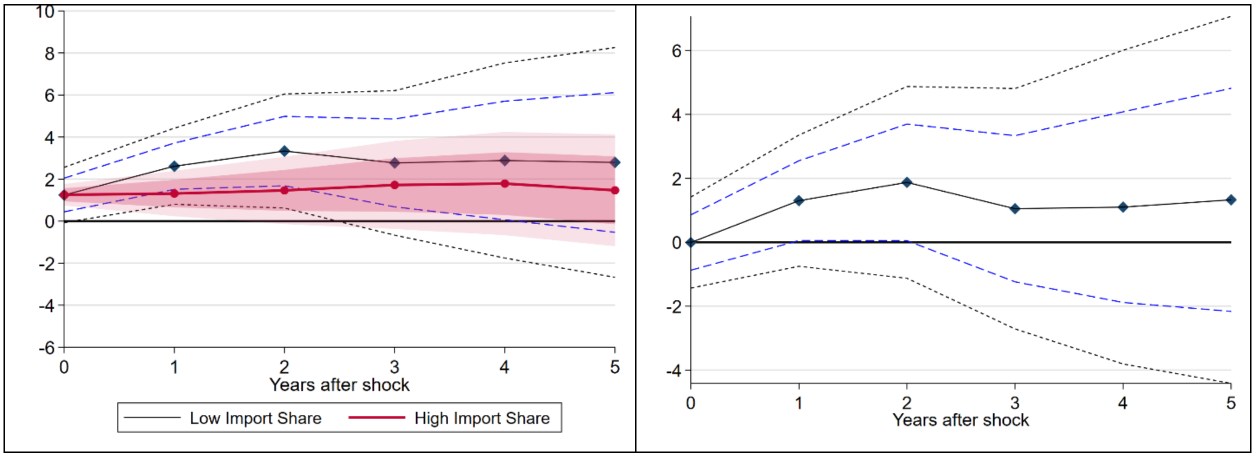




Notes: Left chart shows the cumulatiev multiplier under two different environemnts. Right chart shows differences between the "blue" and "red" lines on the corresponding left charts. Blue lines indicate 68% confidence intervals and black lines 90% confidence intervals. The darker/lighter shaded area in the left chart describes the 68/90 percent confidence intervals for the correposnding state.

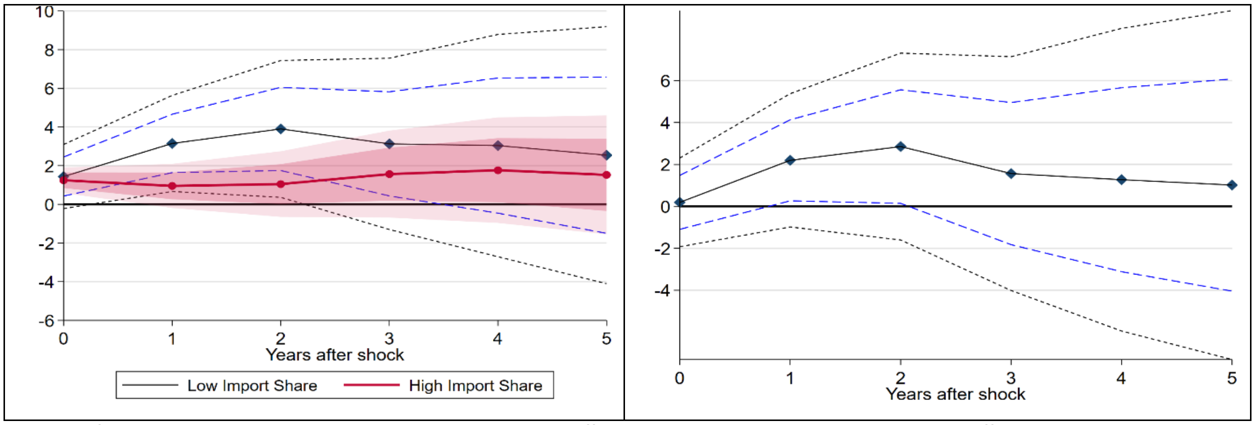
Annex Figure C.5: Heterogeneity of defense multiplier- Import Cross Country Variation

Threshold



Notes: Left chart shows the cumulatiev multiplier under two different environemnts. Right chart shows differences between the “blue” and “red” lines on the corresponding left charts. Blue lines indicate 68% confidence intervals and black lines 90% confidence intervals. The darker/lighter shaded area in the left chart describes the 68/90 percent confidence intervals for the correposnding state.

Smooth Transition, Gamma=3



Notes: Left chart shows the cumulatiev multiplier under two different environemnts. Right chart shows differences between the “blue” and “red” lines on the corresponding left charts. Blue lines indicate 68% confidence intervals and black lines 90% confidence intervals. The darker/lighter shaded area in the left chart describes the 68/90 percent confidence intervals for the correposnding state.

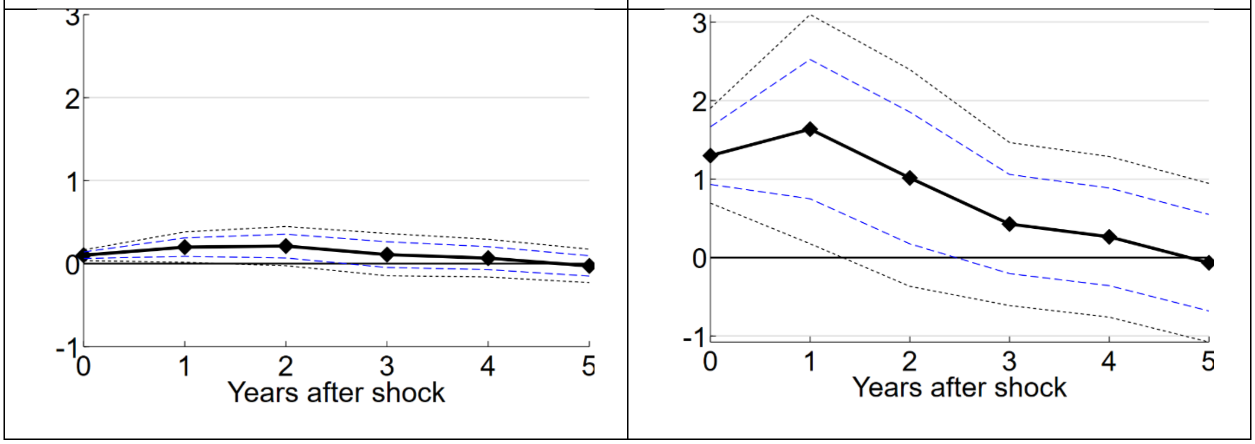
Annex D. Spillovers of Defense Spending Shocks

Annex Figure D.1: Responses of GDP to defense spending shock in trading partner versus domestic shock

(Percent of trend GDP)

A. Spillover defense spending shock

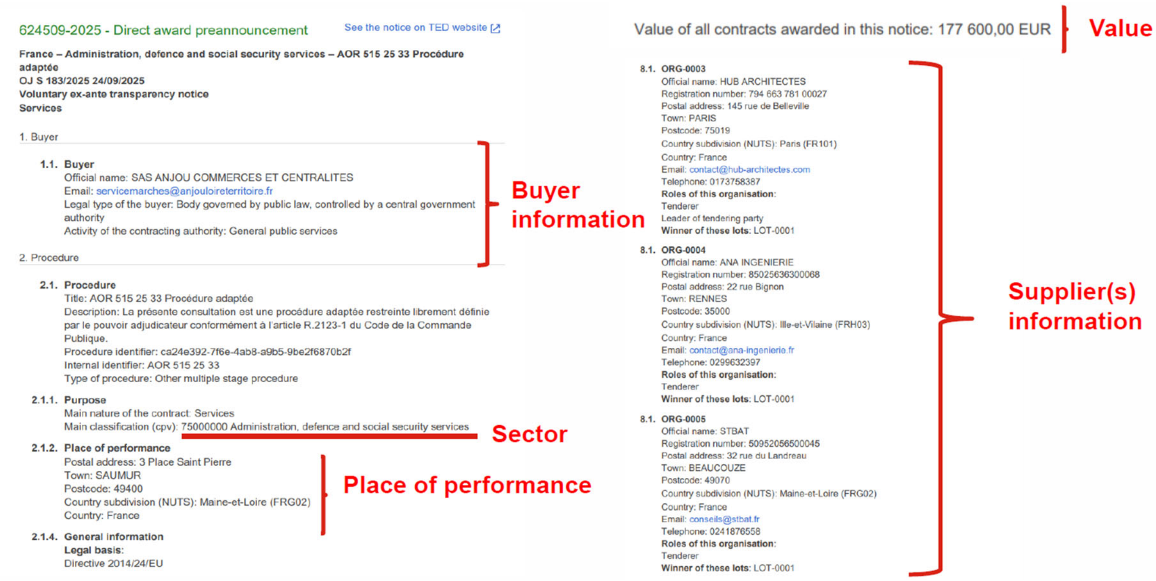
B. Domestic defense spending shock



Note: Left chart: Responses to a positive military spending shock of 1 percent of trading partner GDP in a panel of 27 EU countries. The response is rescaled by rescaled by median export share. Right chart: Response to domestic defense spending shock (1 percent of domestic GDP).

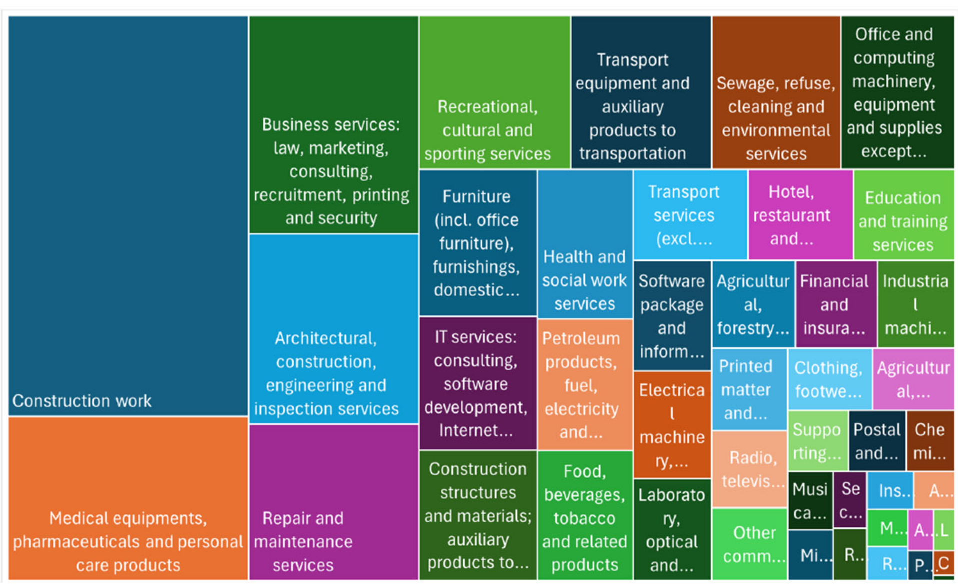
Annex E. OpenTender Monthly Procurement Database

Annex Figure E.1. Sample Contract Information



Note: This chart shows a sample procurement contract in TED and the type of information that can be extracted from the database. The contract specifies the award timing and value, identifies the buyer or public agency, and describes the procurement procedure. It states the contract's purpose, classifies the product using CPV, and indicates the place of performance with geographic codes (NUTS or postal). Seller details, including name, address, and nationality, are also provided.

Annex Figure E.2. Procurement contracts have granular sector level data



Source: Opentender.eu.

Note: This chart shows a sector overview of procurement contracts for 2023, highlighting the diversity of procurement categories in the dataset, from construction and IT services to pharmaceuticals, transport equipment, cultural services, and defense.

Annex F. Monthly GDP Construction

The monthly real GDP series is interpolated from quarterly real GDP using two monthly indicators: industrial production and the economic sentiment indicator. This approach follows the methodology proposed by Stock and Watson (2010).

Specifically, quarterly GDP values (Q_t) are linked to monthly values (q_{it}) using the identity:

$$Q_t = (q_{1t} + q_{2t} + q_{3t}) / 3 \quad \text{(F1)}$$

Both Q_t and q_{it} are trending variables. Let V_t and v_{it} denote the trends for Q_t and q_{it}, respectively. Define:

$$\hat{Q}_t = Q_t / V_t$$

$$\hat{q}_{i,t} = q_{it} / v_{it}$$

Then Equation (F1) can be rewritten as:

$$\hat{Q}_t = \frac{1}{3V_t} \times [v_{3t}\ v_{2t}\ v_{1t}] \times \begin{bmatrix} \hat{q}_{3,t} \\ \hat{q}_{2,t} \\ \hat{q}_{1,t} \end{bmatrix} \quad \text{(F2)}$$

Let X_{it} denote a set of observed (de-trended) monthly indicators: industrial production and the economic sentiment indicator. Then we model $\hat{q}_{i,t}$ as:

$$\hat{q}_{i,t} = \beta_0 + B \times X_{it} + u_{it} \quad \text{(F3)}$$

Where the residual term follows:

$$u_{it} = \rho \times u_{it-1} + \varepsilon_{it}, \text{ with } \varepsilon_{it} \sim N(0, \sigma_\varepsilon^2) \quad \text{(F4)}$$

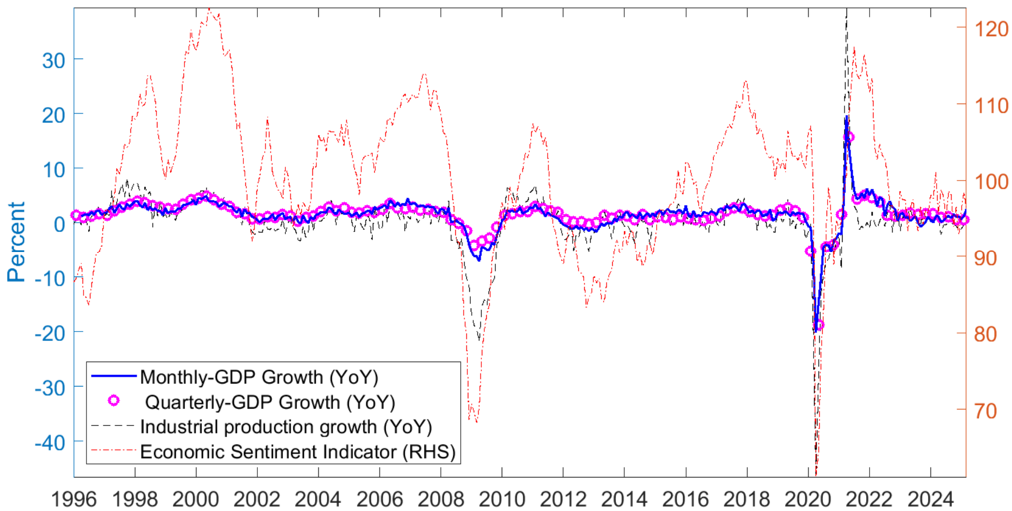
Following Stock and Watson (2010), the quarterly trend V_t is estimated using a cubic trend, while the monthly trend v_{it} is derived via cubic spline interpolation from V_t. Equations (F2), (F3) and (F4) form a linear state-space model, with Equation (2) being the measurement equation and Equation (F3) and (F4) being the transitions equations. Hence, the system includes one observable variable and four state variables.

Conditional on V_t and v_{it}, we estimate parameters β_0, B, ρ, σ_ε^2, and initial state values using maximum a posteriori estimation. The estimation uses quarterly real GDP and two detrended monthly indicators: industrial production and the economic sentiment indicator. We apply a similar procedure to construct the monthly GDP deflator, using monthly inflation data. Using the monthly estimated real GDP and GDP deflator, we obtain an estimate of monthly nominal GDP.

For the prior distributions, we assume a normal distribution for β_0 and B, with mean and standard deviation obtained from an OLS estimation of (detrended) monthly GDP, which is constructed from a simple spline data interpolation, on a constant term and industrial production and the economic sentiment indicator. For ρ, a beta distribution is used with a mean of 0.5 and a standard deviation of 0.2. The initial state variables [$\hat{q}_{3,0}$, $\hat{q}_{3,0}$, $\hat{q}_{3,0}$] share the same prior distribution with a mean of 1 and a standard deviation of 0.2, while being bounded between 0.8 and 1.2. The prior distribution for u_0 is a normal distribution with a mean of 0 and a standard deviation of 1. Lastly, the prior distribution for σ_ε^2 is an inverse gamma 2 distribution with a mean of 0.01 and an infinite standard deviation.

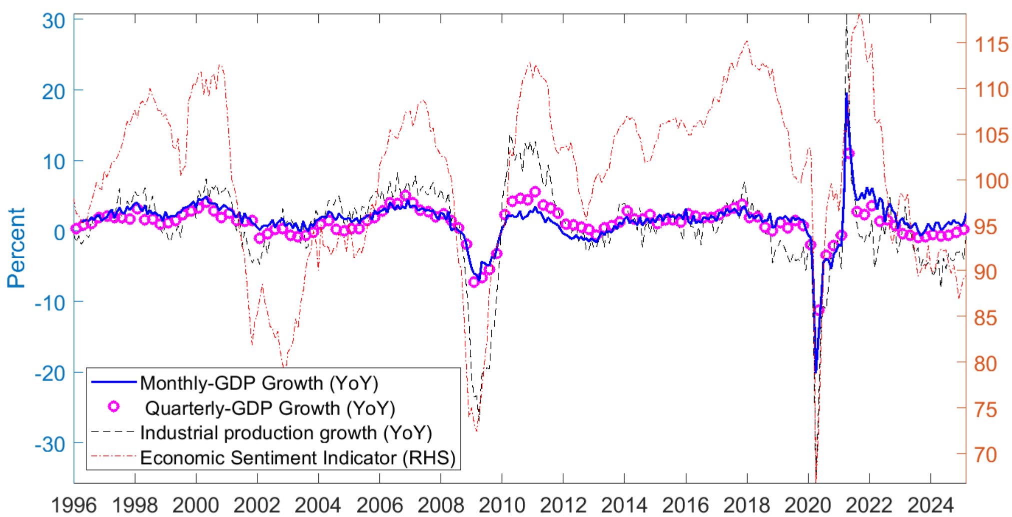
For illustration, Annex Figures F.1-F.2 show the estimates for France and Germany.

Annex Figure F.1. France: Constructed Monthly GDP Series



Note: Figure shows the year-on-year growth of the constructed monthly real GDP series together with the year-on-year growth of quarterly-GDP-series, the year-on-year growth of the industrial production, and the economic sentiment indicator (right axis).

Annex Figure F.2. Germany: Constructed Monthly GDP Series

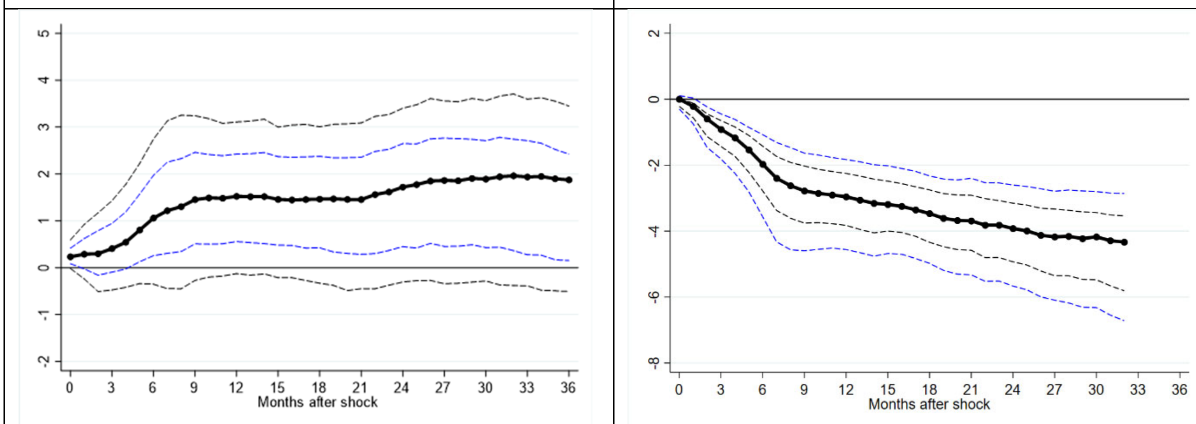


Note: Figure shows the year-on-year growth of the constructed monthly real GDP series together with the year-on-year growth of quarterly-GDP-series, the year-on-year growth of the industrial production, and the economic sentiment indicator (right axis).

Annex G. Robust Inference with Weak Instruments

Annex Figure H.1. Weak-Instrument Robust Inference

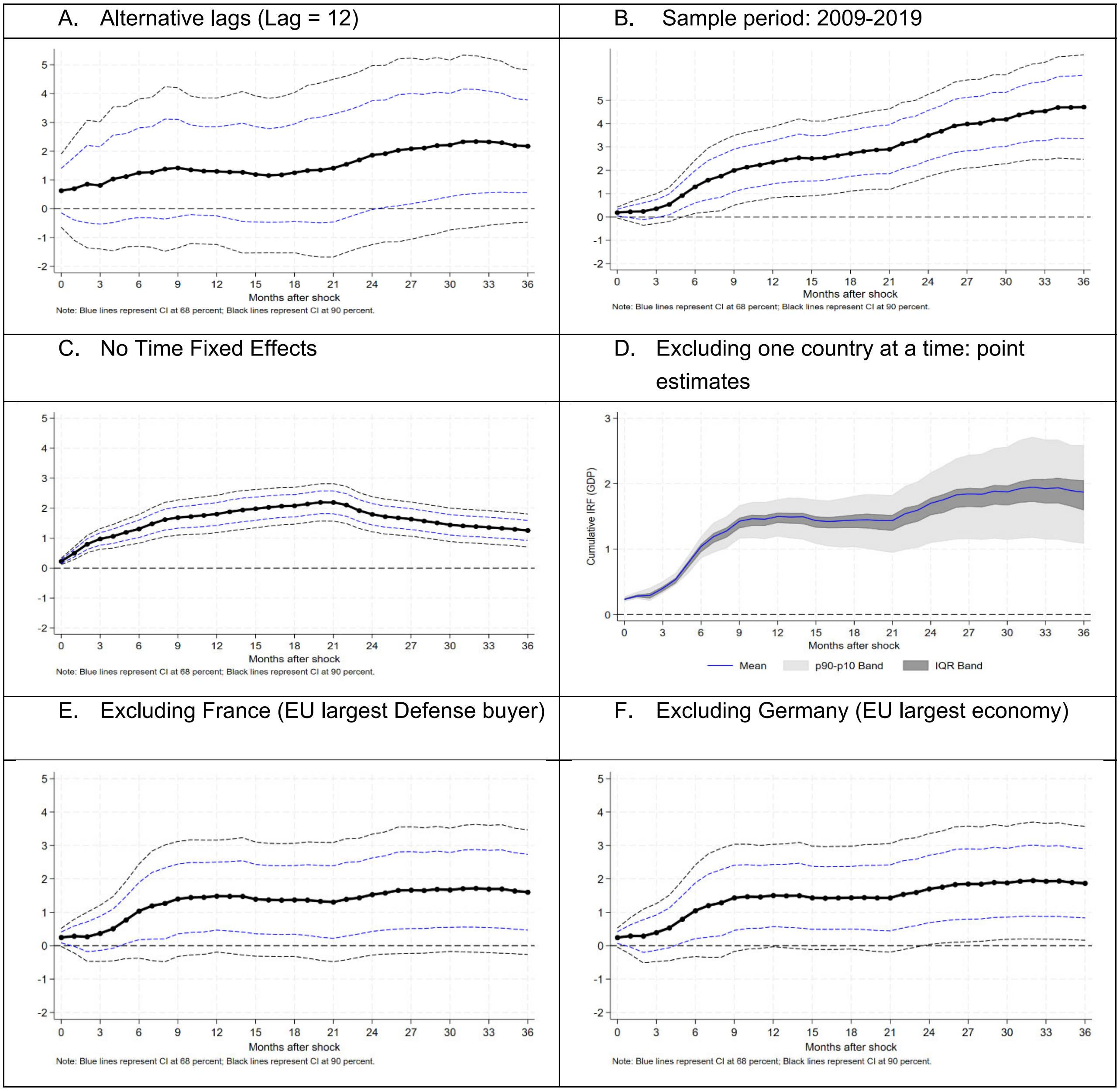
A. GDP B. REER



Note: This figure presents baseline IV estimates from Equation (9) and (10) using the instruments defined in Equation (8), showing the dynamic cumulative response to a defense and security procurement shock of 1 percent of trend GDP for EU-27 countries, with confidence intervals based on conditional likelihood ratio (CLR) test proposed by Finlay and Magnusson (2009) which are robust to weak instrument. Panel A displays the cumulative response of normalized GDP; Panel B shows the cumulative normalized response of the REER (real effective exchange rate, where a negative value indicates depreciation). Blue lines indicate 68% confidence intervals; black lines indicate 90% confidence intervals.

Annex H. Defense and Security Procurement – Robustness

Annex Figure G.1. Robustness test



Note: Figure shows different robustness check to our baseline from estimating Equation (8) and (9), with instruments defined in (7). Panel A add further lags to the specification (lag=12); Panel B restricts the sample to 2009-2019 to avoid COVID-19 period and the 2022 Russian invasion of Ukraine; Panel C does not include time fixed effects; Panel D shows point estimates cumulative multipliers when the baseline excludes one country at a time; Panel E shows the baseline results excluding France, the largest EU-27 buyer of defense and security procurement; and lastly, Panel F shows the baseline results excluding Germany, the largest economy in the EU-27.

PUBLICATIONS

Macroeconomic Impacts of EU Defense Spending
Working Paper No. WP/2026/053