The Macroeconomic Effects of Defence Expenditure: Evidence from Spain

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Abstract

We estimate the macroeconomic effects of defence expenditure using a novel dataset covering the universe of defence procurement contracts in Spain over 30 years. Our defence procurement data overcomes identification challenges posed by implementation lags inherent in traditional government spending, as contracts are awarded years before production begins and spending is recorded in government national accounts only upon delivery. Using local projections, we find that GDP effects take time to materialise, become sizeable, but remain transitory. That is, while defence investment has relevant economic consequences, these are bound to occur in the medium run insofar as the spending process is hindered by implementation lags. A DSGE model calibrated to our empirical setting yields two main findings. First, reducing implementation lags to US levels would meaningfully frontload macroeconomic effects. Second, defence spending delivers more transient and smaller long-run effects than general public investment projects.

Keywords: defence, fiscal policy, multipliers, local projections.

JEL classification: C32, E32, E62, H56.

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1 Introduction

Recent geopolitical tensions have brought defence expenditure back to the forefront of policy debates. The war in Ukraine, strategic tensions in the Indo-Pacific, and growing global militarisation have led NATO and EU member states to significantly revise their defence commitments. NATO has reinforced its 2% of GDP benchmark while encouraging even higher targets that amount to 5% of GDP, and the EU's ReArm Europe plan proposes unlocking up to €800 billion in defence spending over four years (European Commission, 2025b).[1] Despite this renewed interest, empirical evidence on the economic consequences of military spending remains scarce. In this paper, we contribute to filling this gap.

The long life-cycle of large military purchases implies that there are important implementation lags associated with defence spending, which we schematically represent in Figure 1. These implementation lags pose a significant challenge for identifying the economic impact of defence expenditure (Ramey, 2011). First, important lags may arise between contract announcement and production—a "time-to-spend" feature that creates anticipation effects if not properly addressed. Second, the statistical treatment of military investments means spending is recorded in government national accounts (NA) only upon delivery, creating a "time-to-delivery" lag that may extend years beyond the start of production.[2] This "time-to-delivery" reflects both the production period ("time-to-build") and potential delays between project completion and its registration in national accounts, a "time-to-register" lag (Briganti et al., 2026). Consequently, empirical strategies relying on national accounts data risk missing a substantial part of defence expenditure's economic impact.

We overcome these identification challenges by constructing a novel dataset of the universe of defence procurement contracts in Spain. To the best of our knowledge, this is the first comprehensive defence procurement dataset assembled for a European economy. The data collection process involved compiling, curating, and, in many cases, digitising procurement records to create a structured database of defence contracts spanning more than 30 years. This data collection effort allows us to precisely identify the timing of defence contract awards, thereby bypassing the "time-to-spend" and "time-to-delivery" features that complicate empirical identification.

We first use our dataset to characterize the life-cycle of military purchases, illustrating the need to use procurement data to correctly identify the effects of defence spending. First,

[1]See NATO Hague Summit Declaration: https://www.nato.int/cps/en/natohq/official_texts_236705.htm

[2]Throughout this article, government national accounts refer to the official statistics for the General Government sector as defined by the European System of Accounts (ESA 2010). These accounts include defence-related expenditure classified under the official *Classification of the Functions of Government* (COFOG).

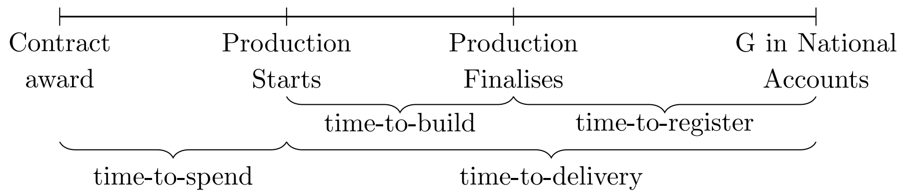


Figure 1: The life cycle of large military investment purchases.

drawing from the information contained in specific contracts, we document that defence spending is indeed shaped by important time-to-spend lags. Namely, looking at major military contracts, we find delays between contract award and first production that range from one to five years. That is, "news" of military spending occurs well before production starts to take place. Second, we also find that there is a long time span until delivery, and hence recording in government NA, which in some cases can take more than a decade. Therefore, government spending in NA is likely to miss the ramp-up process of production until delivery. We also summarize implementation lags of military purchases more formally through a correlation map between procurement contracts and government spending in national accounts, as in Briganti et al. (2026). This statistic shows that procurement anticipates government spending in national accounts well in advance, with the peak occurring between four and five years.

Government defence spending is not a single homogeneous good but consists of a composite of different items, as in the case of more general government spending (Cox et al., 2024). In the case of defence, a breakdown between investment and consumption goods is of particular relevance given that large military buildups (as those underlying the policy discussions outlined in the first paragraph of this introduction) are predominantly characterised by investment rather than by more routine consumption items, such as fuel or wages of military personnel.[3] Given its economic and policy relevance, we therefore decompose defence spending into investment-related and consumption-related contracts using the description of contracts and official documents, and henceforth focus on investment-related contracts as our main measure of defence spending.[4]

We then estimate the effects of defence contract awards on macroeconomic outcomes at quarterly frequency by means of local projections (Jordà, 2005). Following Ramey (2011) and Ramey and Zubairy (2018), causal inference hinges on the assumption that current economic conditions do not affect the awarding of defence contracts in that quarter, a substantially

[3] See (European Commission, 2025a) for the importance of investment-related spending in the context of the current debate on EU defence strategy.

[4] Because investment-related contracts represent a substantial share of defence procurement, we confirm that our main results remain unchanged when using total defence contracts instead of the investment-only subset.

weaker requirement than if we were to use raw government national accounts data given that our defence spending measure bypasses the timing issues highlighted above. The orthogonality of defence procurement to current economic conditions at quarterly frequency is likely to hold in our dataset, and even more so for investment-related contracts, given that these contracts are the result of strategic planning from the Ministry of Defence deciding to embark on large and complex defence projects that may take several years to conclude.

Our empirical estimates indicate that the impact of defence spending shocks—proxied by defence contract awards—on output is delayed, becomes substantial over time, but remains temporary.[5] Namely, the response of GDP to the shock is not statistically different from zero during roughly the first two and a half years. Such a response would be consistent with the time-to-spend feature discussed above. Then, output increases progressively with a peak that occurs four years after the shock, with this effect gradually declining the year after the peak. The response of government spending (as measured in national accounts) to the defence spending shock is also informative of the long implementation lags: it increases sluggishly with a peak that occurs nearly two years after the peak response of output, an empirical finding that would be consistent with the register-upon-delivery feature previously discussed.[6]

The timing issues associated with military spending render the estimation of fiscal multipliers non-trivial. Substantial delays in government spending responses (as recorded in national accounts) mean that standard cumulative fiscal multipliers (Mountford and Uhlig, 2009) are undefined or uninformatively large during the initial years. We instead propose to use the horizon-h *total multiplier*, which measures the cumulative euro increase in GDP at horizon h per euro invested in defence spending over the entire horizon H. Unlike the cumulative multiplier—which considers spending only up to horizon h—the total multiplier accounts for all investment over the full horizon. Following Ramey and Zubairy (2018), we show how this statistic can be estimated within a instrumental variables setting.[7]

Our empirical estimates indicate that total fiscal multipliers can be sizeable, but they take time to materialize. Specifically, multipliers remain close to zero during the first two years—reflecting time-to-spend constraints—before peaking at values slightly above unity between years four and six. Therefore, these findings indicate that while defence investment has relevant economic consequences, these are bound to occur in the medium run insofar as

[5] We demonstrate that our results hold in an extensive battery of robustness checks, including the number of lags, set of controls, and sample selection.

[6] We also document that the responses of GDP components (private consumption and investment and net exports) as well as prices align well with the estimated dynamics of aggregate output. Additionally, we also estimate a particularly pronounced increase in manufacturing production and prices, as could be expected from the sectoral composition of defence spending.

[7] Note that, by construction, both multipliers coincide at the final horizon H.

the spending process is hindered by implementation lags.

We further sustain our main empirical analysis with official procurement data from the European Union (EU), contained in the Supplement of the Official Journal of the EU. Unlike our dataset, the EU procurement data only provide a partial view of overall defence spending as it is severely censored in terms of the contracts recorded and does not allow for a breakdown into investment- and consumption-related defence contracts.[8] As such, available EU procurement data are far less representative than our dataset and hence less well suited for a precise assessment of the economic effects of defence spending. Notwithstanding this, we demonstrate that the main dynamics of GDP and government spending following an EU-defence contract award shock align well with our evidence based on Spanish data. Additionally, this analysis allows to document that the economic impact of defence spending is only significant when based on domestic contractors.

In the second part of the paper, we consider our empirical findings in light of theory through the lenses of a DSGE model calibrated to Spain and the Rest of the Euro Area. The framework that we consider resembles our empirical setting insofar as it is a two-country New Keynesian model of a monetary union. The model further features a rich fiscal block together with Ricardian and hand-to-mouth agents – a feature that has been deemed relevant to capture the macroeconomic effects of fiscal stimulus (Galí et al., 2007; Auclert et al., 2024).

We extend the model of (Stähler and Thomas, 2012) to incorporate the time-to-spend and the time-to-delivery features of defence spending emphasized in the empirical analysis, along the lines of Leeper et al. (2010). We further allow the flow of defence spending to generate spillovers to the private sector via measured productivity, as in Barro (1990). We estimate the parameters governing these features via an impulse response function matching approach (Christiano et al., 2005). The implementation lags associated with defence spending implied by the model are well in line with those documented in the data.

We then exploit the calibrated model to conduct two counterfactual exercises that shed light on the specificity of defence spending effects. First, we quantify the economic relevance of Spain's implementation lags, which are substantially longer than those documented for the US (Briganti et al., 2026; Leeper et al., 2010).[9] Our counterfactual exercise shows that defence spending with US-style implementation lags would generate substantially different economic consequences: the stimulus to economic activity would be significantly more frontloaded. These results show that implementation lags are an issue that not only raises identification

[8]These data comply with EU regulations, which mandate reporting only for contracts above high thresholds and subject to public competition, thereby excluding major defence contracts exempted for national security reasons

[9]Such a feature could be due, for example, to a less developed defence industrial base in Spain than in the US.

challenges but is also important for understanding the economic effects of defence spending across different countries and regions.

Second, we examine whether defence spending should be treated analogously to general public investment. General public investment is typically modeled as public capital –rather than investment flows –generating positive productivity spillovers. In an alternative calibration where defence capital (instead of investment flows) generates positive spillovers with the elasticity estimated in Leeper et al. (2010), we obtain results that are counterfactual to our empirical findings. Specifically, defence spending would give rise to a persistent increase in GDP rather than the transitory stimulus we observe in the data. This exercise highlights that defence investment exhibits fundamentally different economic effects than general public investment.

Related literature. This paper contributes to several strands of the literature related to defence expenditure and its impact on the macroeconomy, which are thoroughly reviewed in Ilzetzki (2025).

Military expenditure has proven to be an adequate source of variation to estimate the effects of fiscal policy, as for example in Hall (2009), Barro and Redlick (2011), Ramey and Shapiro (1998), Ramey (2011), Ramey and Zubairy (2018), or Nakamura and Steinsson (2014). However, the renewed geopolitical tensions and the policy discussions on military buildups have spurred a new wave of research focusing particularly on the macroeconomic effects of defence expenditure.[10] Brunet (2024) analyses the effects of US fiscal policy during World War II by compiling a new dataset of defence procurement data. Antonova et al. (2025) show that the effects of military buildups have been declining over time in the US, as the military and industrial sectors have become smaller. McClure and Yding (2025) identify U.S. defense spending news using high-frequency stock-market reactions around defense appropriations events.

While the previous set of papers focus on US data, Ilzetzki et al. (2013) and Sheremirov and Spirovska (2022) have documented that the effects of fiscal policy can differ substantially across countries. In this regard, focusing on the effects of defence expenditures using European data, two contemporaneous papers are also related to ours.[11] García-Serrador et al. (2025) relies on variation in government NA data to estimate the effects of defence expenditure on a panel of European countries by means of local projections. Ben Zeev et al.

[10] For an earlier contribution focusing in particular on the effects of military spending see Hooker and Knetter (1997).

[11] Gabriel et al. (2023), Canova and Pappa (2024), and Coelho (2019) also examine the effects of European fiscal policy, but they do not focus on the effects of defence spending and rely on different empirical methodologies.

(2025) uses annual defence expenditure data for European countries to identify defence expenditure news within a Bayesian panel structural vector autoregressive setting by means of medium-term restrictions. While annual data from sources such as the Stockholm International Peace Research Institute or government national accounts allow us to broaden the geographical scope of the analysis of defense expenditure's macroeconomic effects, our self-constructed defense procurement dataset for Spain offers higher-frequency series and enables a narrative identification of defense spending shocks, with particular attention to their timing and implementation lags. As noted earlier, to assess the external validity of our findings, we also draw on procurement-level data from the EU.

The implementation lags of US fiscal policy have been previously discussed in, for example, Leeper et al. (2012), Ramey (2011), and Ben Zeev and Pappa (2017). Within this literature, Briganti et al. (2026) is the closest paper to us in that they also, focusing on US data, highlight the identification challenges associated with the time mismatch between government spending as recorded in national accounts and the actual production of goods purchased by the government. The authors also propose to use defence procurement data to bypass these implementation lags. We build on this intuition and complement this US evidence by assembling the first comprehensive defence procurement dataset for a European country. This allows us to document substantially longer implementation lags than those found in US data, and to correctly estimate the macroeconomic effects of defence expenditure, which we interprete in light of a theoretical framework.

The granularity of our dataset allows us to go beyond total defence procurement, identifying the investment-related defence contracts often associated with larger military buildups. This focus on the composition of defence expenditures relates our work to Antolin-Diaz and Surico (2025), who focus on the long-run effects of R&D defence expenditure on economic activity, and to Ilzetzki (2024), who analyses the implications of military production on productivity.[12] More generally, Basso et al. (2025) also document the relevance of considering the different components of public investment to assess their economic impact, a point that is supported by our model simulations when differentiating between defence investment and more general public investment projects.

The rest of the paper is structured as follows. Section 2 discusses the institutional background of defence expenditures and presents our novel procurement-level dataset. Section 3 outlines the empirical methodology and discusses our main empirical findings regarding the macroeconomic effects of defence expenditure. Section 4 describes our model-based simulations and counterfactuals. A final section concludes.

[12] See also Fieldhouse and Mertens (2024) for the wider effects of R&D on economic activity.

2 Defence Spending Data

This section documents the main data employed to empirically identify the macroeconomic consequences of defence spending. First, we describe main institutional characteristics associated with the process of defence spending and its recording in national accounts data, which give rise to relevant implementation lags that threaten identification. Second, we provide a newly constructed dataset from procurement-level data for Spain that allows us to overcome these identification challenges and to more precisely describe the composition and life-cycle of military purchases.

2.1 Institutional Background

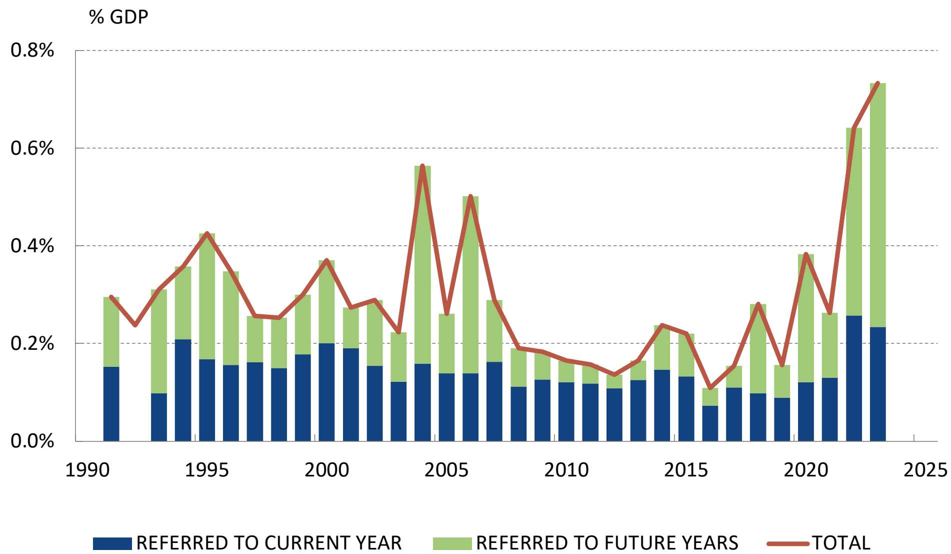
Military procurement contracts are a central mechanism through which governments allocate defence spending, often structured to accommodate the complexities of long-term strategic planning and budgetary constraints. In the United States, these contracts are typically issued by the Department of Defence (DoD) and may span multiple fiscal years through mechanisms such as multi-year contracting and incremental funding.

Similarly, in Spain, the Ministry of Defence (*Ministerio de Defensa*) operates under a framework that allows for multi-annual planning and contracting, guided by the Annual Procurement Plan of the Ministry of Defence (*Plan Anual de Contratación del Ministerio de Defensa*, PACDEF). Spanish defence contracts are governed by the Law on Public Sector Contracts (*Ley 9/2017*), which incorporates EU directives and allows for the structuring of contracts with financial commitments distributed over several fiscal years. As in the case of the US, this approach facilitates the acquisition of complex defence systems and is subject to Congress appropriations in the subsequent years.[13]

Multi-annual nature of defence spending As initially hinted above, defence contracts typically span multiple years due to the complexity and scale of major procurements such as military equipment and infrastructure. These long-term projects often require extended development, production, and delivery timelines. In addition, they are prone to changes in specifications, design adaptations, or technological updates, which frequently necessitate budgetary revisions over the course of the contract. As a result, defence spending patterns tend to reflect this multi-annual and adaptive nature.

[13] In Spain, certain strategic Defence programs (*Programas Especiales de Modernización*) are pre-financed by the Ministry of Industry, with the Ministry of Defence repaying the investment through annual installments. This mechanism supports industrial development while enabling long-term military procurement without overburdening the Defence budget in a single fiscal year.

Figure 2: Defence Procurement in Spain



Source: Ministry of Defence.

For example, in 2004 the Ministry of Defence awarded 92,659 contracts, worth 4.9 bn euro (0.6% of GDP). However, the bulk of these contracts was concentrated in a few large multi-annual projects, such as the supply of 4 submarines to the Spanish Navy, which was awarded to Izar Construcciones Navales, S. A. [14]

Figure 2 exemplifies the multi-annual nature of defence spending most clearly. It shows the evolution of annual defence contracts in Spain over the 1991-2023 period, based on the dataset whose construction we describe further below. Figure 2 also distinguishes between the component of contracts related to the current year and that related to outyear installments. About half of the total volume of defence contracts signed at a given date refer to future years.

The multi-annual nature of defence spending illustrated in Figure 2 already indicates that there are important implementation lags associated with defence spending. First, the spending volume of a given year has been often committed in defence contracts awarded several years in advance. That is, there are important "time-to-spend" lags that render actual defence spending easily anticipated. Second, the fact that defence contracts span multiple years indeed anticipates that production takes time. That is, there are "time-to-build" lags.

[14] Other contracts in that year include 212 Pizarro infantry fighting vehicles (0.7 bn euro) awarded to Santa Bárbara Sistemas, 24 Tiger helicopters (amounting to 1.3 bn) and a strategic projection vessel (0.4 bn).

Statistical recording of defence spending The multi-annual nature of defence spending contracts also has important implications for the timing and classification of military equipment expenditures in government NA.

In the European Union, National Accounts data are elaborated on an accrual basis according to the European System of Accounts (ESA). Its most recent update is described in Eurostat (2013). There are two relevant factors in the way military equipment is statistically treated.

First, and unlike its civilian counterparts, a large share of military equipment is treated as investment. Eurostat (2013) states (p. 443):

> *"Military weapon systems, comprising vehicles and other equipment such as warships, submarines, military aircrafts, tanks, missile carriers and launchers etc. are used continuously in the production of defence services. They are fixed assets, like those used continuously for more than one year in civilian production. Their acquisition is recorded as* ***gross fixed capital formation****, i.e. as capital expenditure [...]"*

Secondly, government gross fixed capital formation is generally recorded *when the ownership of the fixed assets is transferred to the institutional unit that intends to use them in production*, and this is indeed the case for military equipment, where it is specifically stated (p. 443):[15]

> *"The time of recording of asset acquisition is the time of the transfer of the ownership of the asset. In case of long-term contracts involving complex systems, the* ***time of recording of the transfer of assets should be upon actual delivery of the assets****, not the time of cash payments."*

In other words, defence spending is only recorded in national accounts once production has taken place and has been delivered to the government. This inherently implies that there is a "time-to-delivery" lag between the start of a production and its recording in national accounts data. This time-to-delivery effectively derives from the time-to-build process described above, but as we document in the next section it also includes a "time-to-register" lag when there are delays between the finalisation of production and its delivery to the government.

The time-to-delivery documented here implies that estimating the fiscal effects of defence expenditure based on variation in government NA expenditure data is likely to omit the ramp-up process of production of such equipment until delivery. Indeed, such an approach

[15] See Eurostat (2013), p75.

would likely yield estimates that are more associated to those components which are contemporaneously recorded in national accounts, such as defence-related consumption expenditure (e.g. variation in military personnel numbers or wages).

In sum, the process of defence spending is inevitably associated with implementation lags. The multi-annual nature of defence contracts introduces "time-to-spend" and "time-to-build" lags, while the statistical treatment of defence spending introduces a "time-to-delivery" – which also includes a "time-to-register"– delay in national accounts data. These implementation lags severely complicate causal identification from traditional government spending data, which is likely to be anticipated well in advance and to be recorded once an important share of the production process has already taken place. We next provide a newly constructed dataset from procurement-level data that overcomes these empirical challenges.

2.2 A New Dataset of Defence Procurement

We construct a novel dataset based on procurement defence spending that overcomes the identification issues associated with implementation lags. More precisely, our final dataset aggregates the universe of defence contracts for Spain recorded at the time of awarding, therefore capturing the precise moment when new defence spending is officially announced to private agents. As a result, our measure of defence spending does not suffer from time-to-spend and time-to-delivery lags that would complicate empirical identification of defence spending shocks.

More in detail, we compile a series of military procurement from several bibliographical sources provided by the Spanish Ministry of Defence.

First, we use the Statistical Yearbooks of the Ministry of Defence *(Anuarios estadísticos del Ministerio de defensa)*, from where we extract the monthly series of all contracts awarded by the Ministry of Defence. These data are not always readily available for download and required digitalising and curating monthly data from this source. The data include all finalised contracts by the Ministry of Defence including expedited ones yet to be formalised [16].

Second, we obtain more granular data from the yearly Procurement Report of the Ministry of Defence *(Memoria de Contratación del Ministerio de Defensa)*. Although the reported information is not fully consistent over time, it typically includes details on the main contractors, the nature of the contracts, the type of tender, and other relevant characteristics.[17] This information is verified and complemented with granular contract-level data available

[16] In the Spanish Ministry of Defence, certain contracts may be initiated through an "order to proceed" following adjudication. This mechanism allows contractors to begin execution prior to the full formalisation of the contract, enabling faster implementation of critical defence programs while administrative procedures are finalised.

[17] These reports are available starting in 1997.

Table 1: The life-cycle of defence spending: Examples of major military contracts

Contract	**Size (% GDP)**	**Contract Signed**	**First Production**	**First Unit Ready**	**First Delivery**
4 F-100 frigates	0.32%	1997	1999	2000	2002
219 Leopard 2E tanks	0.34%	1998	2003	2004	2004
4 S-80 submarines	0.20%	2004	2006	2021	2023
45 NH90 helicopters	0.13%	2006	2010	2011	2014
5 F-110 frigates	0.34%	2019	2022	2025	2028
348 VCR 8x8	0.15%	2020	2022	2022	2025

Note: Examples of major military contracts.

since 2018 through the official public procurement platform,[18] as well as defense-specialized journals and other periodicals. A comprehensive description of the data construction process is provided in Appendix A.

The life-cycle of defence spending Our data allows us to more clearly illustrate the life-cycle of defence spending, characterized by important implementation lags.

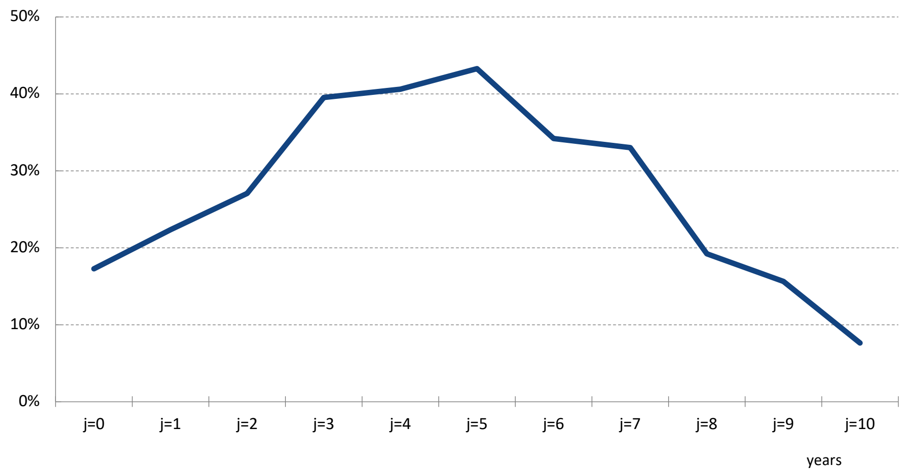
Towards this end, in Table 1 we provide examples of several major military contracts contained in our dataset over different periods of time. In most cases these refer to large military investments such as the construction of tanks, submarines, or frigates. As documented in the second column, each of these contracts is substantial, amounting to roughly 0.20% of GDP on average.

The third to last column documents different milestones of the life-cycle of military purchases, illustrating the implementation lags associated with these contracts. The first column captures the year when the contract was signed, spanning all three decades contained in our dataset. The second column shows when the first production associated with the contract started. It shows that this time-to-spend lag can be substantial, ranging from one to five years in the examples considered. The third column documents when the production of the first unit was finalised, therefore documenting a time-to-build lag. This lag can be as long as fifteen years for the case of submarines (compare second and third column, third row). The last column illustrates the time-to-register: even if production is finalised, it is often the case that it is not immediately delivered to the government, and therefore recorded in government NA.

To illustrate, consider using variation in government national accounts (NA) data to measure defense spending. Take the first example in Table 1, the construction of frigates.

[18] https://contrataciondelestado.es

Figure 3: Dynamic Correlation of Defence Expenditure and Defence Contracts



Note: Correlation between defence expenditure in national accounts in time $t + j$ and defence procurement in time t. Results are smoothed with a 3-year moving average.

In NA data, this expenditure would only appear in 2002, when the first unit was delivered. However, the investment was announced in 1997, and production began in 1999—three years before its recording in national accounts. Consequently, traditional government spending data would fail to capture the economic effects of this investment. By contrast, our contract award data correctly identifies the period when defense spending was officially announced to private agents: the time of contract award.

We more formally document the time mismatch between defence contract award and defence spending in national accounts in Figure 3 by means of a correlation map, as in Briganti and Sellemi (2023). More precisely, the figure shows the 3-year moving average correlation between our defence procurement data recorded in year t and defence expenditure recorded in national accounts in year $t + j$. The results show that the comovement between these series is far from being contemporaneous, with national accounts data lagging well behind procurement-level data. The maximum correlation is attained between years four and five.

Breakdown of defence spending contracts Defence spending is not a single homogeneous good but it consists of a composite of different items, as in the case of more general government spending (Cox et al., 2024). Of particular relevance for defence spending is the distinction between consumption and investment goods. While the former relate to more routine items, such as fuel, investment goods (as those illustrated in Table 1) are the items often associated with large military buildups. Defence investment expenditures are, therefore, not only likely to be more economically relevant but are also the type of defence expenditures often surrounding policy discussions.[19]

Given the relevance of defence-investment expenditures we construct a breakdown of our measure of defence contracts in two categories: consumption-related contracts and investment-related contracts. We construct such breakdown of defence spending contracts by exploiting an additional classification from the Military Statistical Yearbook that aggregates the contracts to broad categories, the "Contracted amount distributed by type of material" tables. These tables provide a yearly classification of all contracts according to the type of material they fall into. Examples of these categories include "Maintenance", "Ships", "Helicopters", "Healthcare", or "Ammunition".

The information contained in these tables allows for the division of contracts into consumption or investment. In this vein, we assign the contracts to "Consumption" or "Investment" depending on the category of the product. In order to do so, we combine our monthly data on total contracts and our annual series on consumption and investment-related items. We support the exact dating of investment contracts with external information such as the Naval magazine, Army websites, historical repositories, or the Official State Gazette (*Boletín Oficial del Estado*), along with newspapers and granular data from the official public procurement platform. We provide an extensive description on how we constructed the investment- and consumption-related defence contracts series from the mentioned sources, on a year-by-year basis, in Appendix A.

Figure 4 displays the resulting quarterly time series of investment- and consumption-related defence contracts expressed as a share of previous-quarter GDP. The series for investment-related contracts is markedly more volatile, reflecting the nature of expenditures on large and complex projects that governments undertake only intermittently. In contrast, the series for consumption-related contracts is smoother and more stable over time, consistent with its association with items essential for the day-to-day functioning of military infrastructure

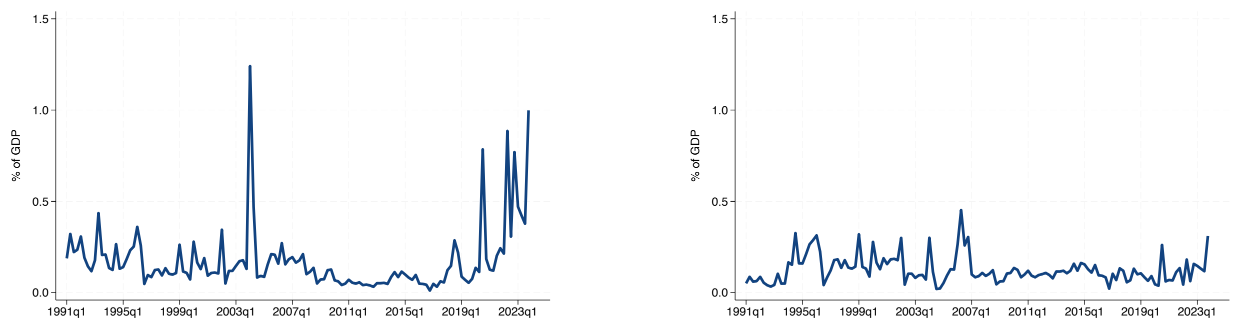
3 The Macroeconomic Effects of Defence Spending

We present in this section the empirical estimates of the macroeconomic effects of defence expenditures, as measured by our defence procurement data. We first outline the empirical methodology employed to gauge the causal effects of military expenditures. Second,

[19]See (European Commission, 2025a) for the relevance of investment-related expenditures such as anti-drones, anti-missiles, and space defence systems on the discussion of a common EU defence strategy.

Figure 4: Consumption-related and Investment-related Defence Contracts

(a) Investment-related Contracts (b) Consumption-related Contracts



Note: Includes all contracts from the Ministry of Defence at quarterly frequency, both consumption-related (left panel) and investment-related (right panel). The series is seasonally adjusted and normalised by previous-quarter nominal GDP.

we present our main results on aggregate outcomes as well as fiscal multipliers, using the investment-related defence shocks as our baseline for estimation. Third, we discuss a wide variety of robustness checks and present complementary European evidence based on less-representative EU procurement data.

3.1 Empirical Specification

We estimate the macroeconomic effects of defence spending by means of local projections (Jordà, 2005). Local projections provide a flexible alternative to structural vector autoregressions, allowing for a direct estimation of impulse response functions without imposing dynamic restrictions. More precisely, we consider the following specification:

$$z_{t+h} = \alpha_h + \gamma_h \text{trend}_t + \beta_h s_t + \Theta_h' w_t + \xi_{t+h}, \quad h \geq 0, \tag{1}$$

where z_{t+h} is the endogenous variable of interest, output (Y_t) or government spending (G_t) as measured in national accounts.[20] We normalised these variables by nominal trend GDP so that both equations are expressed in the same units.[21] s_t is the main explanatory variable of interest, either total defence contracts or investment-related defence contracts, in both cases normalised by previous-quarter trend-GDP. Following Montiel Olea and Plagborg-Møller (2021) we augment the local projections with lags, so w_t includes 8 lags of both endogenous variables and the contracts variables. The regressions also include a constant (α_h) and a

[20]Government spending is defined as the sum of public purchases and public investment, as in Ramey and Zubairy (2018). See Appendix B for further details on data construction.

[21]Following Ramey and Zubairy (2018), we construct real trend-GDP by estimating a lag polynomial of order 5 and then deflate the series using the GDP deflator.

linear trend, trend_t.

The main coefficient of interest is β_h. It measures the dynamic effect at period $t+h$ on the variable of interest z of an increase of defence contracts occurring at time t. The identification of this effect relies on the exogeneity of defence procurement. Hence our main identifying assumption is that, conditional on the controls included in w_t, current economic conditions do not affect the awarding of defence contracts in that specific quarter, as in Ramey (2011) and Ramey and Zubairy (2018), among others. As highlighted previously, this is a weaker restriction than if we were to use variation in government national accounts data given the documented implementation lags of defence expenditures. The orthogonality of defence procurement to current economic conditions at quarterly frequency is likely to hold in our dataset, and even more so for investment-related contracts, given that these contracts are the result of strategic planning from the Ministry of Defence deciding to embark on large and complex defence projects that may take several years to conclude.

Fiscal multipliers. We also summarize the macroeconomic effects of defence procurement by estimating fiscal multipliers. We consider two definitions of fiscal multipliers. The first one is the *cumulative fiscal multiplier*, commonly employed in the literature. We introduce a second fiscal multiplier: the *total fiscal multiplier*. As we argue below, this second statistic is better suited to measure fiscal multipliers in the presence of implementation lags, as in the case of defence expenditure.

The *cumulative fiscal multiplier*, as in Mountford and Uhlig (2009), is defined as the ratio of the integral of the output and government spending responses:

$$\mathcal{M}(h)^C = \frac{\sum_{s=0}^{h} Y_{t+s}}{\sum_{s=0}^{h} G_{t+s}}. \tag{2}$$

$\mathcal{M}(h)^C$ measures the cumulative increase in GDP up to period h relative to the cumulative increase in government spending up to the same period which results from an innovation in defence procurement.

In practice, following Ramey and Zubairy (2018), we compute cumulative multipliers in one step through an instrumental-variables (IV) regression. More precisely, we modify regression (1) as follows:

$$\sum_{j=0}^{h} y_{t+j} = \alpha_h + \gamma_h \text{trend}_t + \beta_h \sum_{j=0}^{h} g_{t+j} + \Theta_h' w_t + \xi_{t+h}, \quad h \geq 0, \tag{3}$$

where the left-hand-side is the sum of GDP from t to $t+h$ and $\sum_{h=0}^{H} g_{t+h}$ is the sum of government spending from t to $t+h$, which is instrumented with our series of defence procurement contracts at time t, s_t.

The considerations detailed in the previous section imply that government spending might be predated by economic activity. More precisely, since defence expenditures are typically recorded in national accounts only upon delivery, government spending (g_t) may rise with a substantial delay after a defence procurement shock. As a consequence, the ratio that defines the cumulative multiplier in (2) might be subject to large swings, being undefined or uninformatively large during the initial years only due to statistical reasons.

We introduce the *total fiscal multiplier*, $\mathcal{M}(h)^T$, to address this issue. This statistic aims at estimating the cumulated effect on GDP up to a given period h relative to the total cumulative effect that defence contracts will have on government spending over the *entire response horizon* H:

$$\mathcal{M}(h)^T = \frac{\sum_{s=0}^{h} Y_{t+s}}{\sum_{s=0}^{H} G_{t+s}}. \tag{4}$$

Note that, different from the cumulative multiplier, the denominator of the total fiscal multiplier as defined in (4) considers the complete integral of the empirical response of government spending up to horizon H. Furthermore note that, by construction, we have that $\mathcal{M}(h)^C = \mathcal{M}(h)^T$ for $h = H$.

Similarly to the cumulative multiplier, we conveniently estimate the total fiscal multiplier in a one-step IV regression:

$$\sum_{j=0}^{h} y_{t+j} = \alpha_h + \gamma_h \text{trend}_t + \beta_h \sum_{j=0}^{H} g_{t+j} + \Theta_h' w_t + \xi_{t+h}, \quad h \geq 0, \tag{5}$$

where note that now government spending in (5) is always cumulated up to the final horizon considered, H. As in the case of the cumulative multiplier, we instrument $\sum_{j=0}^{H} g_{t+j}$ with defence procurement contracts at time t, s_t.

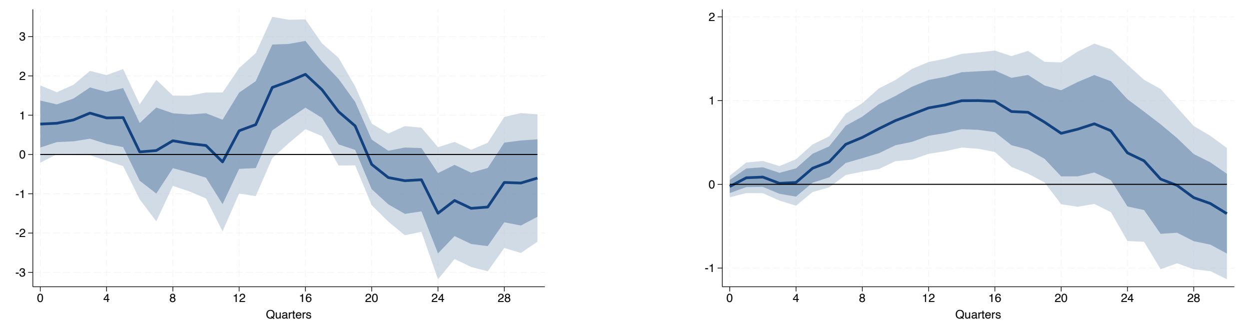
3.2 Empirical Results

We start by considering the effects of total defence procurement on GDP and general government spending (as measured in national accounts). Figure 5 shows the dynamic responses of output (left panel) and of government spending (right panel) to an increase in total defence procurement. Responses are scaled such that government spending increases by 1% at its maximum, and shaded areas represent 68% and 90% confidence intervals.

The effects of an increase in total defence procurement on output take time to materialise. Namely, output increases by about 1% during the first year, with the effects becoming

Figure 5: Macroeconomic Effects of Total Defence Procurement

(a) Output (b) Government Spending



Notes: Dynamic responses to a total defence procurement shock that raises government spending by 1% at its maximum. Shaded areas represent 68% and 90% confidence bands computed with heteroskedasticity-robust standard errors.

statistically significant three years after the shock has occurred. Output then peaks at about 2% around the fourth year. The increase is transitory, lasting about two years, as the effect starts to gradually decline after the fifth year. Such a lagged response of output would be in line with the time-to-spend and time-to-build features of defence expenditure discussed previously.

The dynamic response of government spending is indicative of the implementation lags of defence expenditure. More precisely, the right panel in Figure 5 shows that the increase in total defence procurement is only reflected in government spending as measured in national accounts with several lags. Government spending essentially does not react during the first year, starting to slowly build up during the second year, while reaching its peak 4 years after the shock has occurred. Such a delayed peak response aligns well with the raw correlation between defence procurement and government spending shown in Figure 3. The estimated response of government spending remains elevated past 5 years, once effects on economic activity have already vanished.

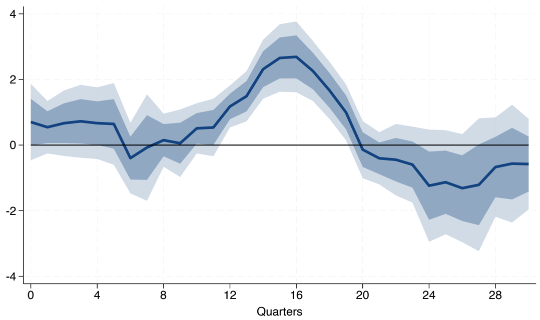
Figure 6 turns to the macroeconomic effects of investment-related defence procurement. Investment-related contract awards, as indicated in previous sections, are of particular economic relevance given their role in large military buildups and in policy discussions.

The figure shows that the dynamic effects of an increase in investment-related defence contracts are more pronounced than those under total defence procurement. More precisely, effects on output are still transitory and take about the same time to materialise, but now the peak response occurs at around 3% in Figure 6 in contrast to the peak of 2% in Figure 5.

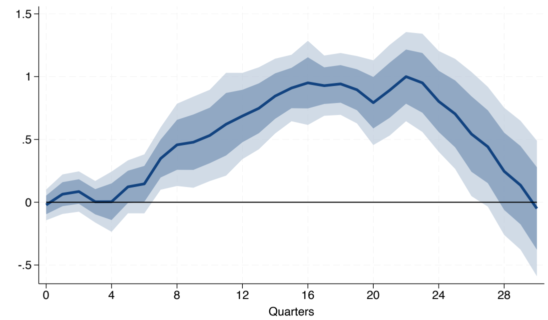
The response of government spending to an increase in investment-related procurement shows an even sharper time mismatch relative to the output response. Such time mismatch

Figure 6: Macroeconomic Effects of Investment-related Defence Procurement

(a) Output



(b) Government Spending



Note: The figures show the response of output and government spending to a defence procurement based shock in investment-related contracts. Responses are scaled such that government spending increases by 1% at its maximum. Shaded areas represent 68% and 90% confidence bands computed with heteroskedasticity-robust standard errors.

is illustrative of the register-upon-delivery feature that characterises defence spending, which is naturally more pronounced for investment-related expenditures. Namely, the peak in government spending occurs between 5 and 6 years after the investment-related procurement shock, once the effects on output have already dissipated. This aligns well with, first, a time-to-build lag and second, a time-to-register delay, implying a registration of defence expenditures in national accounts data once an important share of its economic impact has already taken place.

The lagged responses of government spending also illustrate why usual cumulative fiscal multipliers might be an ill-suited statistic to summarize the effects of defence spending. Namely, as indicated, the response of government spending during the first periods is close to zero, observe the right panels in Figure 5 and in Figure 6. This means that the ratio that defines the cumulative multiplier in Equation (2) will be uninformatively large or even undefined during this period. Importantly, such large cumulative multiplier would not be indicative of large economic effects of defence spending, but instead a consequence of the register-upon-delivery feature of defence expenditures.

We therefore supplement cumulative multipliers with the computation of the total fiscal multiplier, which always takes into account the complete integral of the response of government spending over the entire response horizon H (in this case, $H = 30$).

Figure 7 and Table 2 show the estimated total fiscal multipliers of investment-related defence contracts for the complete horizon considered, alongside the usual cumulative fiscal multipliers for medium-run horizons ($h \geq 15$).[22]

[22]See Figure C.1 in Appendix C.1 for the fiscal multipliers associated with total defence procurement.

Table 2: Medium-run Investment Multipliers

Year	Total Multiplier	Cumulative Multiplier
1	0.09	
	(0.06)	
2	0.22	
	(0.13)	
3	0.45	2.42
	(0.20)	(0.98)
4	1.02	2.15
	(0.19)	(0.52)
5	1.31	1.98
	(0.21)	(0.39)
6	1.13	1.22
	(0.25)	(0.28)
7	0.86	0.86
	(0.21)	(0.23)

Note: The table reports total multipliers (see Eq. (4)) and cumulative multipliers (Eq. (2)) for an investment-related defense shock. Standard errors in parentheses.

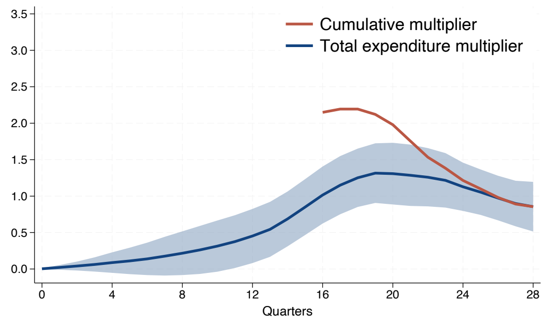
The estimates show that total fiscal multipliers can be significant, but they take time to materialise: see the left panel of Figure 7 and Table 2. Namely, total multipliers remain close to zero over the first two years, and then peak at values around 1.3 during the fifth year. The right panel zooms into the medium-run, showing that the total fiscal multiplier stabilises around unity at the end of the estimation horizon. Note further that, by construction, cumulative and total fiscal multipliers coincide at long horizons.

In sum, these findings indicate that while defence investment has relevant economic consequences, these are bound to occur in the medium run insofar as the spending process is hindered by implementation lags. More precisely, as documented in the impulse responses and the associated fiscal multipliers, the effects of defence expenditures on output take time to materialise, then become economically significant, but remain transitory. Furthermore, the responses of government spending as measured in national accounts clearly indicate the identification and economic challenges associated with defence expenditure and why using the defence contract awards provided by our novel dataset is key to overcoming these.

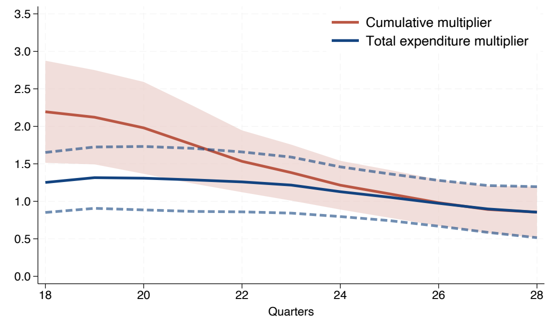
We explore next the main macroeconomic aggregates that can explain the positive output response to defence procurement. Hence, we estimate a version of equation (1) where the

Figure 7: Investment-related Procurement Fiscal Multipliers

(a) Overall fiscal multipliers



(b) Medium-run fiscal multipliers



Notes: Cumulative fiscal multipliers as computed and defined in equation (2). The total fiscal multiplier is defined in equation (4). Unlike the cumulative multiplier, the total fiscal multiplier always takes into account the complete integral of the government spending responses in the empirical horizon considered (in this case, $H = 30$). Shaded areas and dotted lines represent 90% confidence bands computed with heteroskedasticity-robust standard errors.

endogenous variable is substituted by different macroeconomic aggregates.

Figure 8 shows the dynamic responses of different GDP components and prices to an increase in investment-related defence procurement.[23] Panels (a) and (b) show that investment-related defence procurement has a crowding-in effect on variables related to private agents, albeit positive responses come with a delay as in the case of GDP. Namely, panel (a) shows that gross fixed capital formation starts to increase roughly a year after the shock, peaking around the third year and becoming insignificant 5 years after the shock. The response of private consumption (panel b) is more subdued and only responds significantly around the fourth year, dissipating quickly in the fifth year as well.

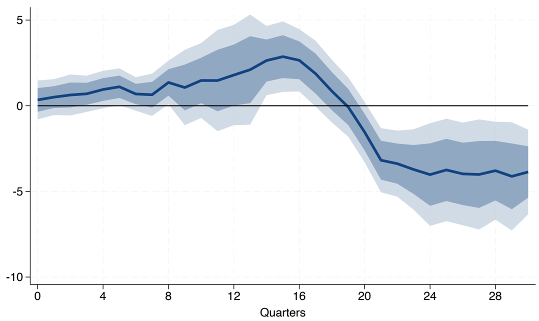
Net exports (panel c) tend to decline by the end of the fourth year. This response is compatible with an increase in imports required to satisfy a given military investment, given that Spain is an open economy characterized by a relatively small military infrastructure. Next, panel (d) highlights the role of inventories, where we observe an initial build-up that fades away as the horizon increases. These dynamics align well with findings of Briganti et al. (2026) for the case of the US: due to the time-to-build and time-to-register lags the increase in production triggered by higher defence investment is initially reflected as an increase in inventories, only to be later recorded as government spending. [24] Finally, panel (e) shows

[23]Figures C.2 and C.3 in Appendix C.1 replicate the results presented in this section for the case of total defence procurement.

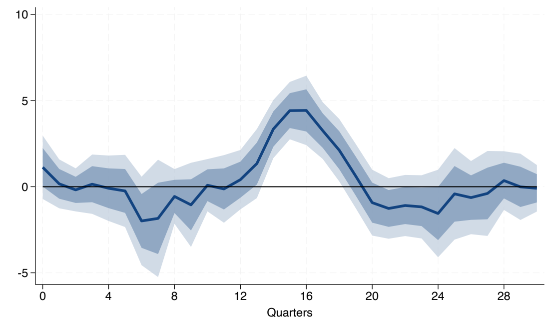
[24]Panel (d) is estimated using a more parsimonious version of our baseline specification, excluding lags of Y and G. We exclude lags of Y because, when inventories are the outcome, Y may be an inappropriate control given that changes in inventories are used as a balancing variable in the National Accounts and are therefore subject to adjustments aimed at reconciling GDP with its expenditure components (Eurostat, 2020,

Figure 8: Responses to Investment-related Defence Procurement: GDP components and Prices

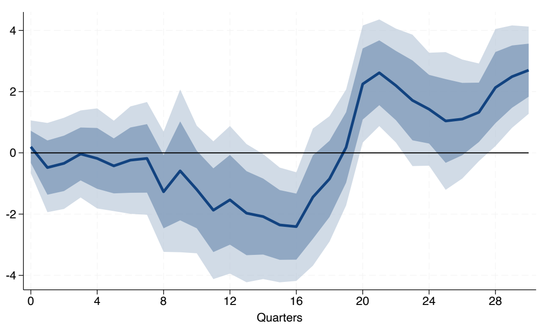
(a) GFCF



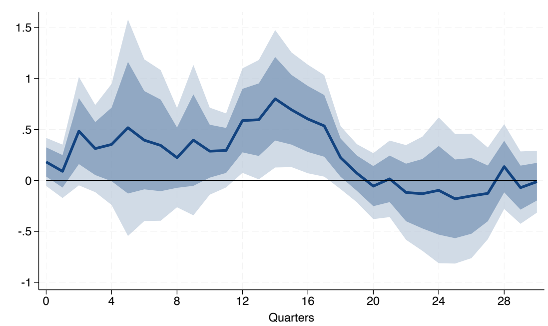
(b) Private Consumption



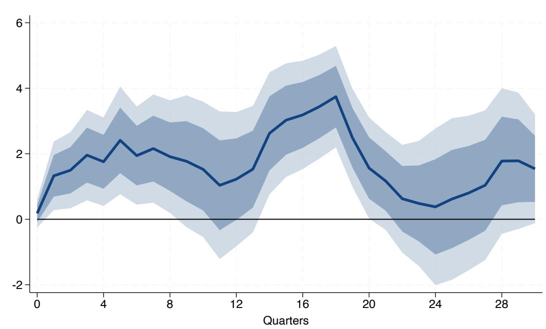
(c) Net Exports



(d) Inventories

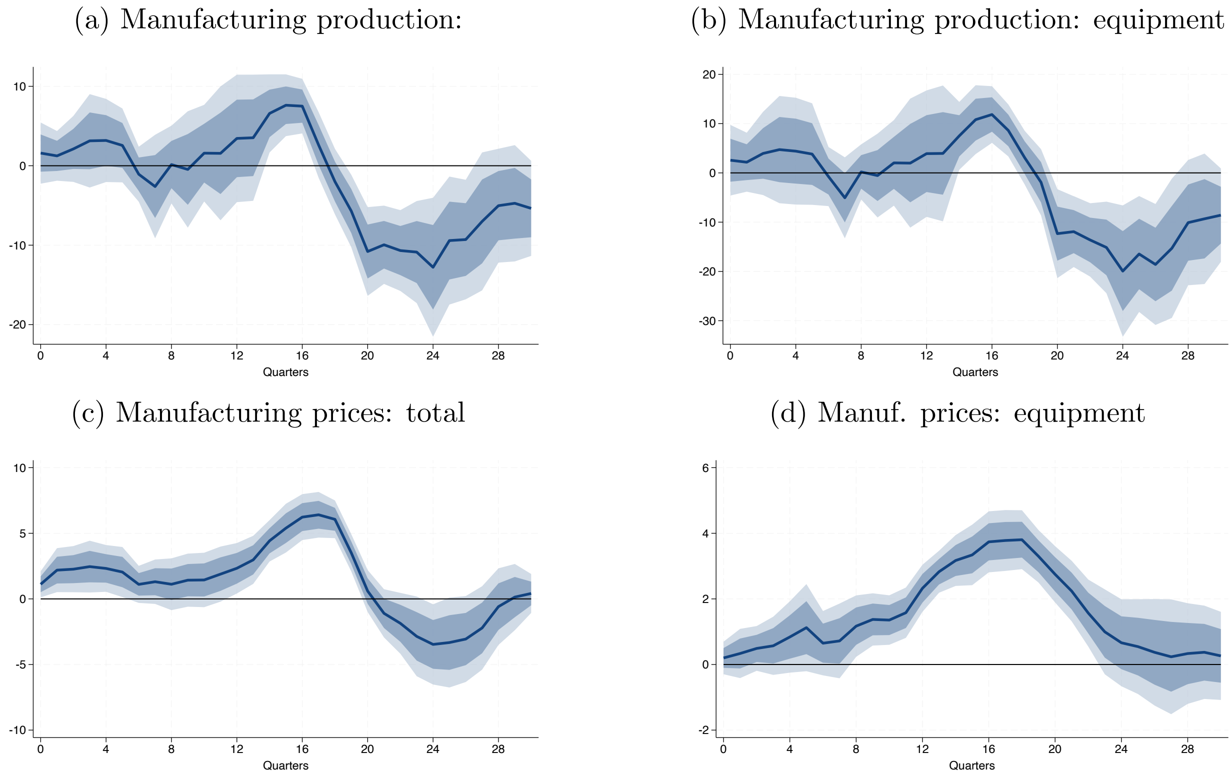


(e) Consumer Prices



Notes: The figures show the responses to an investment-related defence procurement shock. Shaded areas represent 68% and 90% confidence bands computed with heteroskedasticity-robust standard errors.

Figure 9: Responses to Investment-related Defence Procurement: Manufacturing



Notes: The figures show the responses to an investment-related defence procurement shock. Shaded areas represent 68% and 90% confidence bands computed with heteroskedasticity-robust standard errors. Manufacturing prices total does not include energy.

that defence procurement generates inflationary pressures: consumer prices increase as both economic activity picks up and defence spending expands.

Defence procurement is heavily biased towards the manufacturing sector, particularly in the case of equipment products, which include military equipment such as vehicles or aircrafts. Therefore, Figure 9 provides a more granular view of the transmission of investment-related defence procurement by focusing on manufacturing. The figure shows that the increase in investment-related defence procurement creates a substantial expansion of manufacturing production, which is more pronounced for the case of equipment (observe panels (a) and b). This increase in economic activity in the manufacturing sector is mirrored by an increase in prices (panels (c) and d), in line with the observed increase in consumer prices discussed previously.

p. 57). Such adjustments have also affected the measurement of inventories in Spain: the INE reports that revisions to changes in inventories resulted, in part, from the supply-demand balancing based on the Supply and Use Tables (Instituto Nacional de Estadística, 2024, p. 7). The estimated responses are qualitatively consistent with those obtained from the full baseline specification, which includes all lags (see Figure C.4).

3.3 Robustness and EU Procurement Data

We further sustain our main empirical analysis by providing an extensive battery of robustness checks and by comparing our main results using our new dataset of defence procurement for Spain with available procurement data at the EU level.

Robustness. We have explored an extensive number of variations of our baseline specification to verify that our main empirical results hold robustly in the data. Figure 10 provides the responses of output (left panels) and government spending (right panels) to an increase in investment-related defence procurement alongside the baseline responses (recall Figure 6).

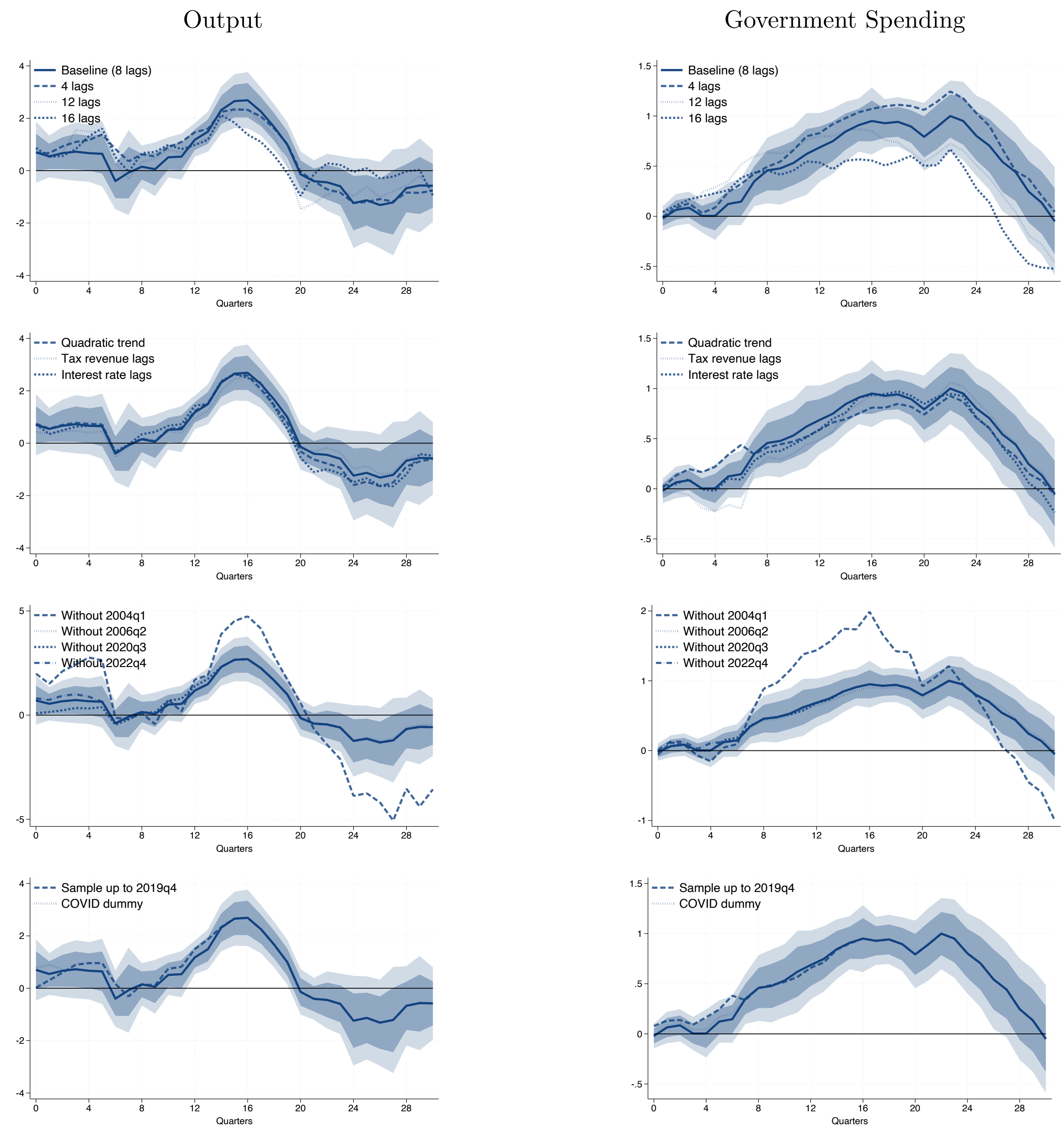
The first row of Figure 10 considers our first set of variations, which shows that our main results are robust to alternative lag structures. Namely, our baseline includes 8 lags of the defence procurement as well as of our endogenous variables. The panels in the first row show that the estimated responses of output and government spending remain roughly unchanged when we reduce the number of lags to 4, or when we double them to 16.

The second row shows that our results do not change much when we include additional controls in our regressions. The first additional control that we consider is tax revenue, to account for possible swings in tax revenue that could lead the government to modify defence contract award. In a similar spirit, the second additional control that we include is the interest rate paid on government debt. The third modification that we include among our set of controls is the consideration of a quadratic trend instead of the linear time trend included in our baseline. As it can be observed in the panels of the second row, our baseline results barely change under these alternative specifications.

In the third row we show the estimates when we remove from the sample specific quarters in which the defence procurement is larger than twice the mean value. This allows us to understand the robustness of our results to the exclusion of specific shocks in our sample, as well as to understand if a single shock is responsible for most of the response in our IRFs. In particular, we find quarters in which we detect large shocks (where the value is, at least, twice the mean). Maintaining all of our specification settings, we individually remove from the sample each of these peaks by introducing the mean value.

The final row of Figure 10 shows that our results are not driven by the COVID-19 period. Namely, these panels document that results are close to our baseline even if we stop our estimation in the last quarter of 2019 or if we include specific dummies for the pandemic period.

Figure 10: Robustness for Investment-related Defence Procurement



Notes: The figures show the responses to an investment-related defence procurement shock. Shaded areas represent 68% and 90% confidence bands computed with heteroscedasticity-robust standard errors.

EU Procurement Data We additionally complement our main empirical analysis based on Spanish procurement data with official procurement data from the European Union (EU), contained in the Supplement of the Official Journal of the EU, and published online in Ted

Electronics Daily (TED). [25].

Unfortunately, and in contrast to our dataset, EU procurement data from this available source suffers from several drawbacks that limit their adequacy for a main empirical analysis. First and foremost, EU procurement data from TED is not representative of the universe of defence procurement in the EU. More precisely, the contracts reported in this database are only those above a relatively large threshold, following EU procurement rules.[26] In addition, only those contracts subject to public competition are required to be reported, thereby excluding major defence contracts which due to national security reasons are not subject to public competition. This implies that it is not possible to recover a comprehensive measure of investment-related shocks, in contrast to the results shown in the previous section.[27]

Nevertheless, thanks to its granular structure, the TED database enables us to identify the nationality of the winning bidder. This, in turn, allows us to compute the share of tenders awarded to domestic versus foreign firms by country. This feature is particularly relevant in our context because—despite the aforementioned limitations—it provides a way to explore potential heterogeneity in fiscal multipliers depending on the ultimate location of the investment.[28]

Notwithstanding these caveats, we repeat our main empirical analysis with the available EU procurement data. Namely, focusing on defence-related contracts, we construct an unbalanced panel for all EU countries in which we aggregate data to a quarterly basis, from 2005 to 2022. Endowed with this panel, we replicate the same exercise using a panel-equivalent version of Equation 1.[29]

Figure 11 depicts the responses of output and government spending to an increase in EU defence procurement, together with the associated cumulative fiscal multiplier. Similar to the Spanish case, output reacts with a delay, though the adjustment occurs slightly earlier than in our baseline results for Spain (panel a), likely reflecting the omission of the largest investment procurement contracts in the European database. Government spending also rises with a lag (panel b), peaking a few quarters earlier than in our main Spanish dataset. The cumulative fiscal multiplier (panel c) builds gradually, reaching its peak about three years

[25] See also Furceri et al. (2026)

[26] Since January 1, 2024, contracts for sectoral services and supplies in the field of defence and security must be published in the Official Journal of the EU (via TED) when their estimated value equals or exceeds €443,000.

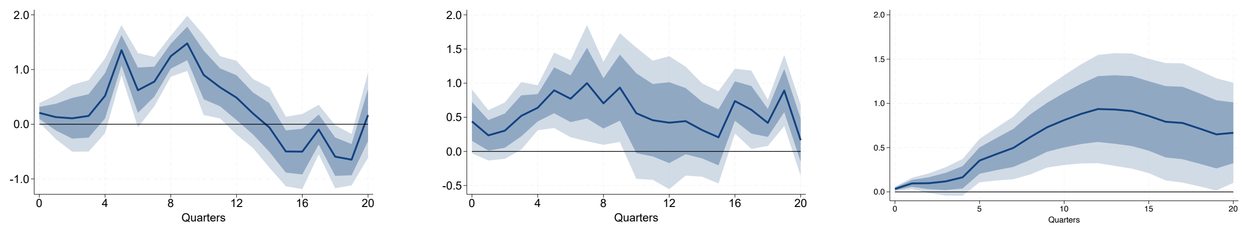
[27] Cernat et al. (2025) suggest that this database might over-represent less-sensitive items, which could explain why some heavy military equipment such as fighter jets or submarines are generally absent from such procurement. The authors suggest that this database accounts for only some 10% of defence procurement.

[28] In our sample of European contracts, approximately 82% of military contracts are awarded to domestic firms. While we cannot replicate this calculation for our full sample of total contracts in Spain across all years, evidence for selected years suggests a similar pattern. For example, in 1997 about 90% of total defence contracts were awarded to national firms (see Appendix A).

[29] We remove Malta, Luxembourg and Croatia from the sample due to data limitations.

Figure 11: Effects of EU Defence Procurement

(a) Output (b) Gov. Spending (c) Fiscal Multiplier



Notes: The figure shows dynamic responses to an EU defence procurement shock that raises government spending by 1% at its maximum. Shaded areas represent 68% and 90% confidence bands computed using standard errors clustered at the country level.

after the shock at values close to those estimated using our defence procurement dataset (0.9 and 1.5, for the measures of total and cumulative multipliers, respectively).

Interestingly, when restricting the analysis to contracts awarded to national firms, the estimated multipliers remain virtually unchanged.[30] In contrast, when focusing solely on contracts awarded to foreign firms, the economic effects—as measured by fiscal multipliers—are statistically indistinguishable from zero. These findings suggest that the domestic allocation of defence procurement drives the observed fiscal effects, while contracts awarded abroad generate negligible macroeconomic impact.

4 Interpreting the Results Through a DSGE Model

We interpret our empirical results through the lens of a dynamic stochastic general equilibrium (DSGE) model. We recover the value of a set of structural parameters by matching the impulse response functions (IRFs) of GDP growth and public expenditure to a defence procurement shock in defence investment, as identified using the local projection methods explained in the previous section. We then use the model as a laboratory to quantify the economic relevance of implementation lags and to compare defence expenditures to more conventional public investment spending.

Model description. We consider an updated and extended version of the model of Stähler and Thomas (2012), a DSGE framework developed for fiscal policy analysis within a two-country monetary union, calibrated for Spain and the rest of the Euro Area. The model features a detailed disaggregation of government spending and tax instruments, enabling nuanced simulations of fiscal shocks. We provide here a brief discussion of the main features

[30]These results are available in Table C.1 and Figure C.5 from Appendix C.

of the model, and relegate to Appendix D a complete and detailed description of model equations and calibration.

Planned defence investment in the model, denoted by $I_t^{\text{gdef}\star}$, is the equivalent of defence contract awards in the data. We model this as following an $AR(1)$ process in deviations from its long-run steady-state value, $\bar{I}^{gdef\star}$, with persistence $\rho^{I^{gdef\star}}$ and subject to normally distributed shocks $\varepsilon_t^{I^{gdef\star}}$ with standard deviation $\sigma^{I^{gdef\star}}$:

$$\frac{I_t^{gdef\star}}{\bar{I}_t^{gdef\star}} = \left(\frac{I_{t-1}^{gdef\star}}{\bar{I}^{gdef\star}}\right)^{\rho^{I^{gdef\star}}} \cdot \exp(\varepsilon_{I_t^{gdef\star}}), \quad \log \varepsilon_t^{I^{gdef\star}} \sim \mathcal{N}\left(0, \sigma^{I^{gdef\star}}\right). \tag{6}$$

Defence investment is subject to time-to-spend, as in the data. More precisely, and similar to Leeper et al. (2010), we assume that planned defence investment translates into *actual defence investment*, I_t^{gdef}, with some lags according to the following structure:

$$I_t^{gdef} = \frac{\xi_1^{I^{gdef}}}{8} \sum_{h=0}^{7} I_{t-h}^{gdef\star} + \frac{\xi_2^{I^{gdef}}}{8} \sum_{h=8}^{15} I_{t-h}^{gdef\star} + \frac{1}{8}\left(1 - \xi_1^{I^{gdef}} - \xi_2^{I^{gdef}}\right) \sum_{h=16}^{23} I_{t-h}^{gdef\star}. \tag{7}$$

In words, the government signs a defence contract $I_t^{gdef\star}$ at period t which slowly translates into actual spending I_t^{gdef} with the lag structure given in (7). The first term in the right-hand-side of (7) captures the fraction of actual current spending that corresponds to planned defence investment announced over the last two years (from current quarter $h = 0$ to seven quarters in advance, $h = 7$), which is controlled by the parameter $\xi_1^{I^{gdef}}$. Similarly, the second term captures the fraction of actual spending in the current quarter that was announced between two and four years ago, controlled by the parameter $\xi_2^{I^{gdef}}$. The third and last term says that the remaining current actual defence investment corresponds to planned defence investment announced between the third and fourth years ago.

In the model, production takes place contemporaneously to actual spending. Therefore, our previous measure of "time-to-spend" should be read as the time that it takes to fully complete a defence contract. To be more concrete, it should be also understood as including the "time-to-build" described in the data in the sense of capturing the time that it takes to fully build an investment good.

Defence investment is only recorded in national accounts as government spending only upon delivery of the assets. What is more, as described in the empirical section, defence investment is characterized by a time-to-register lag between actual investment (I_t^{gdef}), and hence production, and its delivery to the government. Therefore, the model counterpart of government spending in the data does not include the moment when defence investment is announced ($I_t^{gdef\star}$) or when spending actually takes place (I_t^{gdef}). Instead, defence investment is recorded as government spending with a time-to-register lag:

$$\begin{aligned} G_t = & \frac{\lambda_1^{I^{gdef}}}{4} \sum_{h=0}^{3} I_{t-h}^{gdef} + \frac{\lambda_2^{I^{gdef}}}{4} \sum_{h=4}^{7} I_{t-h}^{gdef} \\ & + \frac{1}{4}\left(1 - \lambda_1^{I^{gdef}} - \lambda_2^{I^{gdef}}\right) \sum_{h=8}^{11} I_{t-h}^{gdef} + \mathcal{G}_t, \end{aligned} \tag{8}$$

where $\mathcal{G}_t$ includes other types of government spending included in the model, such as conventional government consumption, general public investment, or wages of public employees. It is worth pointing out that equation (8) is only an *accounting* equation which is useful to track government spending from the data. It is not an equilibrium equation required to solve the model.

For reference, we also define *defence capital* as the defence assets delivered to the government (and hence registered in national accounts), K_t^{def}, according to:

$$\begin{aligned} K_t^{gdef} = (1 - \delta^{I^{gdef}}) \cdot K_{t-1}^{gdef} + \frac{\lambda_1^{I^{gdef}}}{4} \sum_{h=0}^{3} I_{t-h}^{gdef} + \frac{\lambda_2^{I^{gdef}}}{4} \sum_{h=4}^{7} I_{t-h}^{gdef} \\ + \frac{1}{4}\left(1 - \lambda_1^{I^{gdef}} - \lambda_2^{I^{gdef}}\right) \sum_{h=8}^{11} I_{t-h}^{gdef} \end{aligned} \tag{9}$$

where $\delta^{I^{gdef}}$ is the depreciation rate of defence capital.

Production in the model, Y_t, is given by the following production function:

$$Y_t = \varepsilon^a \cdot (K_{t-1}^g)^\eta \cdot (I_t^{gdef})^{\eta^{gdef}} \cdot K_{t-1}^\alpha \cdot L_t^{1-\alpha}, \tag{10}$$

where K_{t-1} is private capital, L_t is employment, and ε^a is total factor productivity.

The government generates two direct spillovers to private production. The first one, as in Leeper et al. (2010) and Ramey et al. (2020), comes from general public capital K_{t-1}^g, with η measuring the elasticity of output to public capital. This captures, for example, positive externalities to private activity of public infrastructure.

Second, we also allow defence investment I_t^{gdef} to generate spillovers, with an elasticity given by η^{gdef}. We separate this from general public investment for two main reasons. A first one is that we prefer to avoid assuming that defence investment into goods like submarines or tanks have the same economic consequences for private activity as public infrastructures such as, for example, highways. Instead, as we describe next, we will estimate η^{gdef} to be consistent with our empirical evidence. A second reason is that we prefer to allow for possible spillovers of the flow of defence investment rather than the defence capital stock, as we see little reason for defence assets (such as tanks or frigates) to generate positive spillovers in private production. However, we find it more plausible that investment in this complex equipment can generate positive externalities to economic activity during its production. Indeed, as we will document in Section 4.1, treating defence investment spillovers as more general public investment capital would deliver counterfactual results in light of our empirical evidence.

In addition to the features mentioned above, the model is characterized by a New Keynesian block with staggered price setting à la Calvo (1983) and nominal wage rigidities (see, for example, Christoffel et al. 2009). In order to provide a better account of labor-market dynamics the model also incorporates equilibrium unemployment in form of search-and-matching frictions, building on the work of Mortensen and Pissarides (1994). Finally, the household block of the model is characterized by two agents, ricardian households and hand-to-mouth households, helping to generate a more realistic transmission of fiscal policy and its macroeconomic effects (Galí et al., 2007).

Taking the model to the data. We adopt an indirect inference approach, where the DSGE model is simulated under alternative parameter configurations, and the resulting IRF of GDP is compared to their empirical counterparts (Christiano et al., 2005). The parameters we aim to recover include the time-to-spend of defence investment $\{\xi_1^{I^{gdef}}, \xi_2^{I^{gdef}}\}$, the standard deviation ($\sigma^{I^{g}def\star}$) and persistence ($\rho^{I^{g}def\star}$) of the defence investment shock, and the elasticity of output with respect to defence investment ($\eta^{I^{gdef}}$). Once we have estimated the aforementioned parameters, we then set the time-to-register parameters $\{\lambda_1^{I^{gdef}}, \lambda_2^{I^{gdef}}\}$ in order to match the path of defence investment.[31]

Let $\hat{\theta} = \{\xi_1^{I^{gdef}}, \xi_2^{I^{gdef}}, \sigma^{I^{gdef\star}}, \eta^{I^{gdef}}, \rho^{I^{gdef\star}}\}$ denote the vector of structural parameters to be estimated. Let $IRF^{\text{data}}_{GDP,h}$ and $IRF^{\text{model}}_{GDP,h}(\hat{\theta})$ denote the empirical and model-implied IRFs of GDP at horizon h, respectively. In the calibration we minimize the following loss function:

$$\mathcal{L}(\hat{\theta}) = \sum_{h=0}^{H} \frac{\left(IRF^{\text{data}}_{GDP,h} - IRF^{\text{model}}_{GDP,h}(\hat{\theta})\right)^2}{\sigma^2_{IRF^{\text{data}}_{GDP,h}}}. \tag{11}$$

where H is the maximum horizon over which the IRFs are matched. Following our empirical exercise, we set $H = 30$.

We report the matched structural parameters in Table 3. The elasticity of output with respect to defence investment ($\eta^{I^{gdef}}$) is estimated to be 0.0047, while for the persistence

[31]Note that under our assumptions these parameters are only informative for government spending accounting and therefore have no impact on the response of GDP.

Table 3: Matched Structural Parameters

Symbol	**Description**	**Estimated Value**
$\eta^{I^{gdef}}$	Elasticity of output with respect to defence investment	0.0039
$\sigma^{I^{gdef\star}}$	Standard deviation of the investment shock	5.30
$\rho^{I^{gdef\star}}$	Persistence of the investment shock	0.83
$\xi_1^{I^{gdef}}$	Time-to-spend first 2 years	0.01
$\xi_2^{I^{gdef}}$	Time-to-spend between years 2 and 4	0.99
$\lambda_1^{I^{gdef}}$	Time-to-register first year	0.24
$\lambda_2^{I^{gdef}}$	Time-to-register between year 1 and 2	0.25

of defence investment ($\rho^{I^{gdef}\star}$) we obtain 0.81 and the standard deviation of the defence investment shocks ($\sigma^{I^{gdef}\star}$) is estimated to be equal to 5.30. Intuitively, these parameters jointly control the increase in GDP and the duration of this stimulus for a given shock to defence investment.

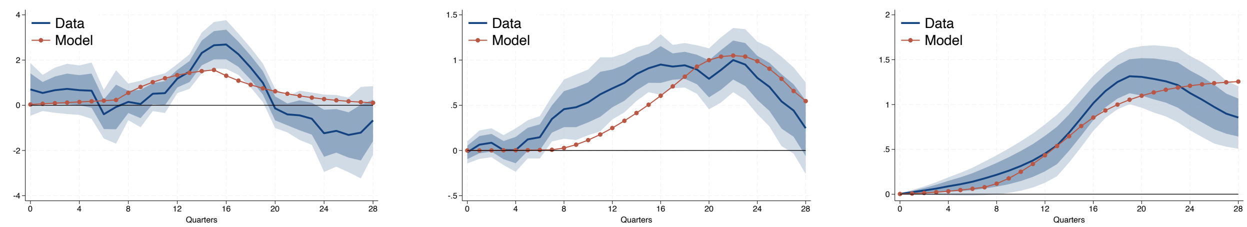
The estimated parameters controlling the time-to-spend of defence investment, $\{\xi_1^{I^{gdef}}, \xi_2^{I^{gdef}}\}$, have the following implications. First, the value of $\xi_1^{I^{gdef}}$ close to zero, which controls the time-to-spend within the first two years, means that a defence investment announced at time t ($I_t^{\text{gdef}\star}$), does not start to be spent until roughly two years after the announcement. Furthermore, since $\xi_2^{I^{gdef}}$ – which controls the time-to-spend between years 2 and 4 — is close to one, it implies that defence investment is completed (spent and produced) approximately 4 years after the announcement. Finally, note that by taking the average of the time-to-spend we have that a given euro spent in the current quarter in defence investment was already announced, on average, roughly 2.9 years ago.[32]

As indicated before, once these parameters have been estimated we then set the time-to-register parameters, $\{\lambda_1^{I^{gdef}}, \lambda_2^{I^{gdef}}\}$, to approximate the empirical response of government spending as measured in national accounts (observe the right panel of Figure 6). The resulting parameters imply that a defence expenditure registered in government spending in the current quarter was, on average, produced about 1.6 years ago. This, together with the lags described in the previous paragraphs, imply that an increase in government spending in the current quarter was announced, on average, as defence investment already 4.5 years ago, very much in line with the evidence shown in Figure 3.

[32]To see this, note that we have that the average time-to-spend is given by $\frac{\xi_1^{I^{gdef}}}{8}\sum_{h=0}^{7} h + \frac{\xi_2^{I^{gdef}}}{8}\sum_{h=8}^{15} h + \frac{1}{8}(1-\xi_1^{I^{gdef}}-\xi_2^{I^{gdef}})\sum_{h=16}^{23} h$.

Figure 12: Model vs. Data

(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



Notes: Dynamic effects of a defence investment procurement shock in the model (red lines with circles) and in the data (blue solid lines with confidence bands).

4.1 Model Results

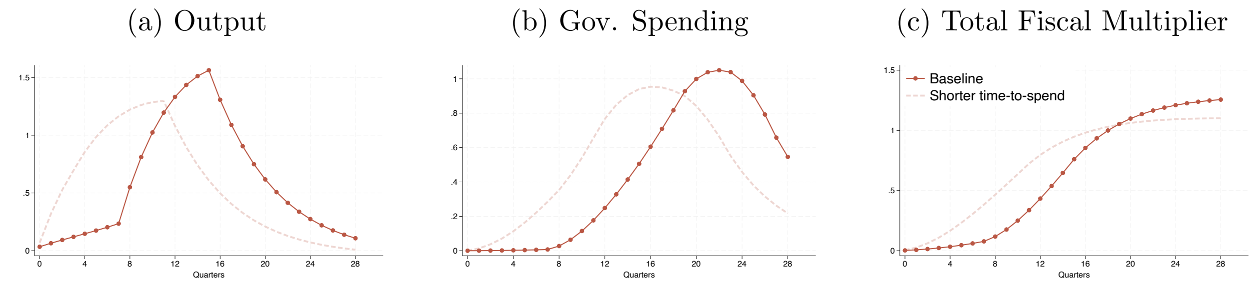
Figure 12 presents the model-implied responses to a defence investment shock (red lines with circles) in comparison with the estimated empirical responses (blue lines with the confidence bands) under the baseline structural parameters discussed in the previous section. Panels (a) and (b) display, respectively, the output and government spending responses. The last panel compares total fiscal multiplier in the data and in the model.

The increase in output, as in the data, takes time to materialise; observe panel (a). This is a consequence of planned defence investment ($I_t^{gdef\star}$) starting to be executed – that is, to be translated into actual defence investment, $I_t^{gdef\star}$ – with several lags, since our estimated parameter for the time-to-spend for the first quarters is close to zero (recall $\xi_1^{I^{gdef}}$ in Table 3). The increase in output precedes the peak response of government spending (panel b), as measured following the national accounts rules, since defence investment goods are subject to a time-to-register lag, governed by $\{\lambda_1^{I^{gdef}}, \lambda_2^{I^{gdef}}\}$ in equation (8). Overall, as shown in panel (c), the model delivers defence multipliers that are in line with the estimated empirical responses.

Our baseline exercise presented in Figure 12 assumes that the increase in defence investment is financed through an initial increase in debt, and then repaid via lump-sum taxes on Ricardian households. As a robustness exercise we consider in Appendix D.3 simulations where repayment instead occurs at different speeds through either VAT taxes or labour taxes, obtaining that results barely change under these alternative financing schemes.

The Macroeconomic Consequences of Implementation Lags. Figure 13 quantifies the role of implementation lags for the macroeconomic effects of defence investment. More precisely, it compares our baseline model responses (solid lines) with the responses under a counterfactual calibration where the time-to-spend parameters follow a US-style calibration

Figure 13: The Macroeconomic Consequences of Implementation Lags



Notes: Dynamic effects of a defence investment procurement shock in the model under the baseline calibration (solid lines) and in a counterfactual US-style calibration with shorter time-to-spend lags (dashed lines).

(dashed lines). This thought experiment is meant to represent a broader military industrial base where manufacturing orders are processed faster. In order to build this counterfactual we follow the work of Leeper et al. (2010) and replace our time-to-spend equation (7) by:

$$I_t^{gdef\star} = \frac{\xi_1^{I^{gdef}}}{3}\sum_{h=1}^{3} I_{t-h}^{gdef\star} + \frac{\xi_2^{I^{gdef}}}{8}\sum_{h=4}^{11} I_{t-h}^{gdef\star} + \frac{1}{12}\left(1-\xi_1^{I^{gdef}}-\xi_1^{I^{gdef}}\right)\sum_{h=12}^{23} I_{t-h}^{gdef\star}, \tag{12}$$

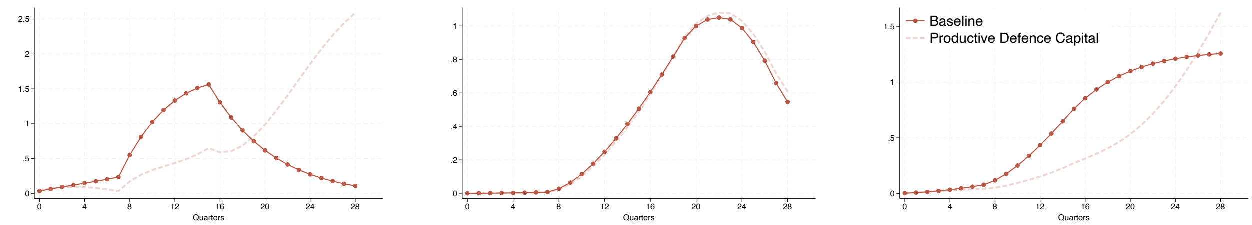
with $\xi_1^{I^{gdef}} = 0.25$ and $\xi_2^{I^{gdef}} = 0.75$.

That is, and contrary to our baseline, in the US-type of calibration there is an important share of planned defence investment that is already spent within the first year ($\xi_1^{I^{gdef}} = 0.25$) and the planned investment is completely spent within the first 2.5 years, to be compared to the 4 years in our baseline. Such shorter implementation lags in the US could be due, for example, to a larger and more established military industry in the US relative to Spain.

The results displayed in Figure 13 show that the longer implementation lags identified in our dataset have important macroeconomic consequences, and that as a result the effects of defence investment can be expected to vary substantially across regions or countries differing in this dimension. Under the shorter implementation lags of the US, the increase in output shown in panel (a) happens substantially earlier and peaks about a year and a half earlier than in our baseline. A similar pattern arises for government spending (panel b), despite the time-to-register lags being identical to the baseline calibration, since faster actual spending of planned defence investment also translates more quickly into registered government spending. As a result, total fiscal multipliers shown in panel (c) are substantially larger for nearly the first five years after the shock.

Figure 14: Defence Investment as Productive Public Capital

(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



Notes: Dynamic effects of a defence investment procurement shock in the model under the baseline calibration (solid lines) and in a counterfactual calibration where defence investment is treated as general public investment, with a productive defence capital stock (dashed lines).

Defence Investment as Productive Public Capital. Figure 14 turns the focus to the differences between defence investment, considered in this paper, and the more general public investment projects. Red solid lines show again the baseline responses, where defence investment generates positive spillovers to private activity. Dashed lines consider a counterfactual where instead defence expenditures are treated as public investment: it assumes that spillovers come from defence capital (k_{t-1}^{gdef}) – instead of from the flow of defence investment, I_t^{gdef}. Namely, we assume that:

$$Y_t = \varepsilon^a \cdot (K_{t-1}^g)^\eta \cdot (K_{t-1}^{gdef})^{\eta^{gdef}} \cdot K_{t-1}^\alpha \cdot L_t^{1-\alpha}, \tag{13}$$

with $\eta^{gdef} = 0.05$, a value which follows Leeper et al. (2010).

Figure 14 shows that treating defence investment expenditures as general public investment would deliver results that fit poorly our empirical findings. First, observing panel (a) we see that the increase in output would be too small relative to the baseline over the medium run (from the second to the fifth year). Second, and conversely, allowing defence capital (instead of defence investment) to generate positive spillovers to private activity delivers an output response that is too persistent, hence generating substantially large effects in the long run. This is a natural consequence of defence capital being a long-lived asset. As a result, total fiscal multipliers (panel c) would be too small in the short run but too large in the long run. This experiment highlights that modelling defence expenditure as public investment might not adequately capture the dynamics observed in the data.

5 Conclusions

This paper provides new evidence on the macroeconomic effects of defence expenditure by exploiting a newly built dataset of the universe of defence procurement contracts in Spain. Our approach addresses key limitations in traditional fiscal data, particularly the delayed recording of military spending in national accounts, which often obscures the true timing of economic effects. By using procurement-based information we are able to identify shocks at the point of contract award, offering a clearer view of how defence spending translates into economic activity, and to further disentangle the investment component of defence expenditures. Our empirical findings reveal that the macroeconomic effects of defence expenditures take time to materialise, are transitory, but can be significant. Using a rich DSGE model that incorporates the implementation lags of defence expenditure documented in our empirical analysis, we show that reducing these lags to U.S. levels could substantially alter the macroeconomic effects of defence spending. Moreover, we find that broader public investment projects may generate more persistent effects than those observed for defence investment.

A natural extension of the work presented in this paper would be to extend our procurement database for Spain to other European countries. This could, for example, provide a rich cross-sectional variation to investigate how the effects of defence expenditure vary with structural characteristics, such as the size of the military and industrial sector highlighted in Antonova et al. (2025). Furthermore, it is worth pointing out that our estimates only concern the direct effects of defence expenditure. However, policymakers may also need to take into account the economic costs caused by military conflicts (Federle et al., 2024) and the possible deterrence effects of improved defence capabilities via defence investment.

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Online Appendix to "The Macroeconomic Effects of Defence Expenditure: Evidence from Spain"

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A Classification of Defence Procurement

In this appendix, we provide a yearly account of major defense procurement contracts and describe the procedure used to construct the quarterly series employed in the main text. Our analysis draws on several sources, notably the *Statistical Yearbooks of the Ministry of Defence* and the *Procurement Report of the Ministry of Defence*, which enable the classification of defense contracts into investment- and consumption-related categories. As noted earlier, this classification relies on detailed information from the tables entitled "Contracted amount distributed by type of material" contained in the Statistical Yearbooks. To complement these sources, we also incorporate data from the *Memoria de Contratación del Ministerio de Defensa*, granular contract-level information available since 2018 through the official public procurement platform (https://contrataciondelestado.es), as well as defence-specialized journals and other periodicals which are detailed below.

Combining all these sources enables us to identify the majority of defence contracts and to classify total official contracts into investment- and consumption-related categories. For quarters without external information, we assume that the seasonally adjusted share of consumption-related procurement within the year remains constant at its annual value.

1991-1996

During the year 1991, the Ministry of Defence awarded contracts for a total value of 1,071 million euros. Most of the contracts were relatively small, with just two contracts above 60 million euros. However, these two contracts alone explain 20% of the total awarded volume of contracts. December was, the most relevant month, representing almost half of the total awarded value of contracts during the year. In line with this information, we were able to identify the nature of one of these contracts, which was signed in December for the acquisition of 192 transportable firing positions and 840 Mistral low-altitude anti-aircraft missiles from the French company Matra, for a total of 93.76 million euros[33]. Overall, using the information from the Statistical Yearbook of the Ministry of Defence (see the description of year 1997 for a detailed explanation), we classify 22% of the value of contracts as consumption-related

[33] https://elpais.com/diario/1991/12/14/espana/692665225_850215.html

and 78% as investment-related.

During the year 1992, the Ministry of Defence awarded contracts for a total value of 926 million euros, making it the lowest aggregate contract volume in our sample in nominal terms. Following the distribution by type of material, we classify 22% as consumption-related and 78% as investment related.

In 1993, the Ministry of Defence awarded contracts for a total value of 1,250 million euros. During this year, three contracts over 60 million euros were signed. These three contracts together represent some 44% of the yearly total. May was the most relevant month, followed by November. The main contract in 1993, which amounted to some 291 million euros, was signed in May, for the construction of four minesweepers vessels[34]. Following the distribution by type of material, we classify 19% of the total value of contracts as consumption-related and 81% as investment-related.

In 1994, the Ministry of Defence awarded contracts for a total value of 1,531 million euros. During 1994, only two contracts above 60 million euros were signed. Together, these two contracts represent 15% of the yearly total. One of these contracts was the acquisition of 13 Mirage F1 fighter jet from Qatar for 105 million euros in July 1994[35]. Following the distribution in the Statistical Yearbooks of the Ministry of Defence, we classify 55% of the total value of contracts as consumption-related and the remaining 45% as investment.

In 1995, the Ministry of Defence awarded contracts for a total value of 1,958.3 million euros. During this year, only five contracts amounted to more than 60 million euros. Nevertheless, these 5 contracts represent a third of the total yearly volume. Following the distribution by type of material, we classify 53% of the total yearly value as consumption-related and 47% as investment-related.

Finally, in 1996 the Ministry of Defence awarded contracts for a total value of 1,699.6 million euros. There were three contracts above 60 million euros during this year, which together account for some 28% of the total. April and December were the most relevant months, followed by February. Following the distribution by type of material, we classify 47% of the total as consumption-related and 53% as investment.

1997

During the year 1997, the Ministry of Defence awarded contracts for a total value of 1,322 million euros. On top of this, during 1997 there was an agreement to launch two major purchase programs: the F-100 frigates (signed in April) and the EFA-2000 (Eurofighter). However, disbursements were set to start only in 2002 for both of these contracts.

[34] https://elpais.com/politica/2019/09/13/actualidad/1568394832_121042.html

[35] https://www.defensa.com/ayer-noticia/verano-94-llegan-manises-nuevos-mirage

Most of the contracts during this year were relatively small, with just 5 of them over the 30 million euros threshold, and only one above 60 million euros. While the annual documents do not explicitly detail the major contracts of each year, they do include information on the firms that received the major part of the contracts in monetary value. These contractors together accounted for 44% of all the value of contracts issued during the year. One of the main contracts during this year was the agreement with the national firm Bazán to build 4 frigates F-100.[36]. The first frigate (F-101) was delivered to the army on 19/09/2002. The second one, on 03/12/2003. The third one, a year later. The fourth one, on 21/03/2006.

Table A.1: Main contractors in 1997

Contractor	**Contracts**	**Value**
E. N. BAZAN DE C.N.M., S.A.	400	180,742
IND. TURBO PROPULSORES, S.A.	10	77,152
ELECTRONICA MANDO Y CONTROL, S.A.	3	53,400
REPSOL C.P. PETROLIFEROS, S.A.	44	43,994
UNITED DEFENSE	1	36,301
SERVICIO MILITAR DE CONST., MDE	299	31,385
CONSTRUCCIONES AERONAUTICAS, S.A.	32	29,522
E.N. SANTA BARBARA DE I.M., S.A.	25	27,785
DEPARTMENT OF DEFENCE USA	40	23,950
COMPAÑIA DE PETROLEOS S.A.	23	23,295
TELEFONICA DE ESPAÑA, S.A.	27	21,324
HISPASAT, S.A.	1	19,280
INDRA DTD, S.A.	22	18,992
Sum	927	587,123

Note: Thousand euros. Includes the multi-annual nature of the contracts.

Defence procurement with foreign firms represented in 1997 a 11% of total procurement, being the remaining 89% allocated to national firms.

Following the distribution by type of material from the Statistical Yearbook of 1997, we classify the different categories into consumption and investment. There are 49 types of materials, which we divide in two groups. First, contracts classified as "consumption-related" include those which are listed in categories of materials such as "Maintenance" or "Clothing". Second, contracts classified as "investment-related" include those which are

[36] https://www.buquesdeguerra.com/es/buques-armada-espanola/fragatas/fragatas-clase-alvaro-de-bazan-f-100/tag/SPY1D.html

in categories such as “Warships” or “Combat vehicles”. For example, in 1997 there were contracts for warships for a total value of 118,758 thousand euros (9% of the yearly total). The outcome of this classification for the year 1997 is as follows: 785,836 thousand euros allocated into consumption-related contracts and 546,268 into investment-related contracts. This represents 59 and 41% of the total, respectively.

To provide an illustrative picture on the tables used for this classification, Table A.2 shows the 1997 table of materials and how each of the 49 categories has been classified into consumption or investment-related contracts.

Table A.2: Table of Materials 1997

Category	**Value**	**Consumption**	**Investment**
Air conditioning	548	X	
Food supply	146,316	X	
Livestock feed	1,065	X	
Live animals	190	X	
Miscellaneous weaponry	3,034		X
Cleaning supplies	4,073	X	
Technical assistance	123,758	X	
Pumps (Motor-driven)	10,936		X
Ships / Vessels	118,629		X
Heating, sanitation, and plumbing	1,455	X	
Fuels and carburants	97,427	X	
Communications	60,630	X	
Construction	26,075		X
Agricultural and gardening equipment	86	X	
Kitchen equipment	1,520	X	
Protocol expenses	321	X	
Relocation and related expenses	9,268	X	
IT / Computing	24,637	X	
Infrastructure	49,058		X
Measuring and precision instruments	6,857	X	
Cleaning and gardening	12,526	X	
Wood / Timber	380	X	
Maintenance	292,154		X
Machinery, tools, etc.	4,058		X
Office machines	1,656		X
Transport machinery	657		X
Firefighting equipment	2,356	X	
Office supplies	7,995	X	
Hardware supplies	4,199	X	
Electrical and electronic material	4,048	X	
Medical supplies	3,039	X	
Field equipment	685	X	
Metals	1,392	X	
Miscellaneous furniture	8,981	X	
Engines	4,079	X	
Ammunition	37,567		X
Parachutes	2,425	X	
Paints, pastes, etc.	1,686	X	
Haberdashery items	4,524	X	
Chemical products	3,481	X	
Publications	5,571	X	
Radars, simulators, etc.	2,808	X	
Spare parts	169,003	X	
Clothing	22,012	X	
Healthcare	24,229	X	
Security	4,798	X	
Insurance	9,271	X	
Vehicles	8,197	X	
Combat vehicles	2,444		X
Sum	1,332,104	785,836	546,268

Note: Thousand euros.

1998

During the year 1998, the Ministry of Defence awarded contracts for a total value of 1,407.3 million euros. On top of this, in 1998 there was an agreement to acquire 219 Leopard tanks for a total of 1,909.5 million euros, disbursed in equal annuities from 2001 to 2016.

Most of the contracts were relatively small during 1998, with just 1 contract being above the 60,101,210 euros threshold. This contract took place in December 23 and refers to the agreement to buy helicopters SH-60B LAMPS III for the army, for a total of 204,921 thousand euros, disbursed in seven annuities over the years 1998-2004. [37]. The main contractors during the year were the US Department of Defense and the national firm Bazán, which together accounted for one-fourth of the yearly total. Moreover, 28,20% of contracts (in monetary value) were given to foreign firms.

Following the distribution from the Statistical Yearbook of 1998, we classify the different categories into consumption and investment. There are 50 types of materials, which we divide in two groups, as detailed previously. The most notable example is the category "Helicopters", which corresponds to the major contract discussed above, which we classify as investment. Generally speaking, in 1998, we report 57% of the contracts as consumption-related and the remaining 43% as investment.

1999

During the year 1999, the Ministry of Defence awarded contracts for a total of 1,799.2 million euros.

Most of the contracts were relatively small, with just two contracts over 60 million euros and four in the range of 30 to 60 million euros. Table A.3 shows the biggest contractors during the year. The most important contracts were formalised in the months of July and December. February follows closely due to a major multi-annual contract for clothing amounting to 175 million euros. In July, the Spanish Army formalized the contract for the acquisition of 22 VRC-105 Centauro vehicles with IVECO FIAT-OTO MELARA for 67 million euros. In December, there were several contracts, such as the acquisition of 35 standard SM-2 surface-to-air missiles for the first frigate of the F-100 class, for 30.87 million euros. Moreover, contracts awarded to foreign firms represented 12.83% of the total.

Following the distribution by type of material from the Statistical Yearbook of 1999, we classify the different categories into consumption and investment. There are 26 types of materials, which we divide in two groups, as detailed previously. While the missiles and the Centauro vehicles discussed above are assigned to investment, the clothing contract is

[37] https://alojados.revistanaval.com/armada/noticias/notici98.htm

assigned to consumption. As a result, 55% of the contracts are consumption-related and the remaining 45%, investment.

Table A.3: Main contractors in 1999

Contractor	**Contracts**	**Value**
TJV INDUYCO, FECSA, ITURRI, ETC.	1	175,291
DEPARTMENT OF DEFENCE USA	53	129,975
INDRA	36	103,044
E. N. BAZAN DE CONS. MILITARES	362	87,616
CONS. AERONAUTICAS ,S.A.	28	67,235
CONSORZIO IVECO FIAT-OTO MELARA	1	67,103
TELEFONICA DE ESPAÑA, S.A.	44	54,566
IVECO PEGASO, S.A.	19	47,540
AMPER PROG.DE ELEC. Y COM. SA	27	41,734
SERVICIO MILITAR DE CONS.	283	40,520
EXPLOSIVOS ALAVESES, S.A.	38	33,687
Sum	892	848,311

Note: Thousand euros.

2000

During the year 2000, the Ministry of Defence awarded contracts for a total of 2,401,494 thousand euros.

Most of the contracts were relatively small, with just 4 contracts over 60 million euros and three in the range of 30 to 60 million euros. Table A.4 shows the largest contractors during the year. The most important contracts occurred in December, corresponding mainly to the acquisition of 2 Airbus A310 for 172.35 million euros and the construction of the second series of minehunters, for an amount of 123.84 million euros. These contracts are consistent with the main contractors, notably "Construcciones Aeronáuticas SA (CASA)", which would later become part of the Airbus group. Moreover, contracts awarded to foreign firms kept decreasing in 2000, representing just 7.76% of total awarded contracts in monetary value.

Following the distribution by type of material from the Statistical Yearbook of 2000, we classify the different categories into consumption and investment. There are 40 types of materials, which we divide in two groups, as detailed previously. During the year 2000, the classification of contracts yields a balanced distribution of contracts into consumption an investment (50/50).

Table A.4: Main contractors in 2000

Contractor	**Contracts**	**Value**
CONST. AERONAUTICAS S.A.	30	495,655
E. N. BAZAN DE C.N.M, S.A	217	222,278
INDRA	57	105,063
REPSOL C.P. PETROLIFEROS SA	80	60,937
DEPARTMENT OF DEFENCE USA	40	60,011
RAFAEL	2	52,595
IND. TURBO PROPULSORES, S.A	6	47,173
SERVICIO MILITAR DE CONST., MDE	197	45,418
CEPSA	37	35,574
PAGE IBERICA SA	22	32,978
Sum	688	1,157,682

Note: Thousand euros. Includes the multi-annual nature of the contracts.

2001

During the year 2001, the Ministry of Defence awarded contracts for a total of 1,920.9 million euros.

Most of the contracts were relatively small, with just 5 contracts over 30 million euros. Table A.5 shows the biggest contractors during the year. The most important contracts happened in the last quarter of the year. IZAR[38] was the main contractor, with 206 contracts in the domain of weapons and ammunition. Moreover, contracts awarded to foreign firms increased in 2001, reaching 11.41% of the total, with the 39 contracts awarded to the US DoD accounting for almost half of this.

Following the distribution by type of material from the Statistical Yearbook of 2001, we classify the different categories into consumption and investment. There are 30 types of materials, which are divided into consumption-related (63% of contracts) and investment (37%).

2002

During the year 2002, the Ministry of Defence awarded contracts for a total value of 2,165.7 million euros.

Most of the contracts were relatively small, with only 6 contracts over 30 million euros,

[38]IZAR was born in 2000, following a merger between Astilleros Españoles and the E.N Bazán.

Table A.5: Main contractors in 2001

Contractor	**Contracts**	**Value**
IZAR	227	115,905
DEPARTMENT OF DEFENCE USA	39	100,670
SERVICIO MILITAR DE CONST., MDE	177	53,610
INDRA SISTEMAS	63	52,402
HECKLER & KOCK GMBH	3	51,531
TELEFONICA ESPAÑA S.A.	77	50,347
NECSO ENTRECANALES CUBIERTAS,SA	1	45,887
MOWAG	1	45,412
CONSTRUCCIONES AERONAUTICAS ,S.A.	40	35,346
INDRA ELECT. MANDO Y CONTROL,S.A.	3	31,818
Sum	631	582,928

Note: Thousand euros.

totalling 538,212 thousand euros. December was the month with the highest volume of awards, while February, July, September and November were also significant. For example, in August, there was a contract to buy 62 VRC Centauro vehicles for 218.49 million euros. Similarly, in November, the Ministry of Defence formalised the acquisition of the second phase of anti-Aircraft artillery (Skydor Fire-Control System) for 113 million euros. The importance of these contracts is also reflected in the table of main contractors for the year 2002, where we see in first position the manufacturer of the Centauro vehicles (IVECO FIAT-OTO MELARA) and the manufacturer of the Skydor system in second position (IZAR)[39]. Contracts awarded to foreign firms in 2002 reached 12.68% of the total.

Following the distribution by type of material from the Statistical Yearbook of 2002, we classify the 27 different categories into consumption and investment.This results in 47% of consumption-related contracts and 53% of investment.

2003

In 2003, the Ministry of Defence awarded contracts for a total value of 1,911.1 million euros.

Most of these contracts were relatively small, with just 5 of them being above 30.05 million

[39]The Skydor system was born from a collaboration agreement between Izar and Oerlikon Contraves, which resulted in the delivery of 24 units during the period 2000-2007. Source: https://www.larazon.es/economia/navantia-mantendra-sistema-skydor-artilleria-antiaerea-ejercito-tierra_202506306862b7d311ba9753e9e36438.html

euros. September and December were the most relevant months. Some of the most relevant contracts this year are the acquisition of the "COOAASM" Command and Control System (206 million euros) and the contract for the mid-life update of the C-15 (185 million euros). The Command and Control System contract was awarded to INDRA on 09/07/2003 [40]. The mid-life update of the C-15 aircraft (EF-18 Hornet) was awarded to EADS-CASA (now Airbus Defence and Space). These two firms were the major contractors in 2003. Contracts awarded to foreign firms in 2003 represented 12.68%.

Following the distribution by type of material from the Statistical Yearbook of 2003, we classify the 14 types of materials into consumption and investment. Here, "Maintenance" is the second biggest class, just behind "Weapons and Ammunition". Both categories are assigned to investment, which reaches 65% of the yearly total (being the remaining 35% allocated to consumption).

2004

During the year 2004, the Ministry of Defence awarded contracts for a total value of 4,855.8 million euros. This makes it the second highest year until the Russian invasion of Ukraine in 2022.

Most of the contracts were relatively small, with only 8 of them being above 30 million euros. Nevertheless, these eight contracts represent almost two thirds of the total volume of the year. March was the most relevant month, as 44.66% of the total volume of contracts of that year was awarded during March. This can be traced down to two major contracts that were awarded that month. First, the four submarines S-80, financed from 2011 up to 2024. Second, the L-61 "Juan Carlos I" Landing Helicopter Dock (LHD), originally designated as "strategic projection vessel". Both contracts were awarded to Navantia/Izar[41] and represented a major push for the naval industry in Spain. The L-61 was built in Ferrol and delivered to the army on september 2010, after 775,000 hours of engineering and 3,100,000 hours of producction. The estimated final cost sits around 400 million euros [42]. Spain had previously manufactured S-70 submarines in collaboration with the French firm DCN; however, in 2003, the Spanish government formally approved the S-80 program to initiate the independent production of a new generation of technologically advanced submarines. The project encountered substantial delays due to unforeseen design challenges, notably issues

[40] https://www.boe.es/diario_boe/txt.php?id=BOE-B-2003-219003

[41] In 2004, there was a separation of the civilian and military branches of IZAR. Later, in January 2005, the IZAR group got separated in two: Navantia (public firm focused on military) and "IZAR liquidación" (civilian and on the market for privatisation. Source:http://www.buques.org/astilleroscadiz/Navantia/Navantia.htm

[42] https://vadebarcos.net/2018/03/31/el-buque-de-proyeccion-estrategica-juan-carlos-i/

related to weight distribution. The first vessel, originally slated for delivery in 2012, was ultimately commissioned by the Spanish Navy in 2023.

Following the distribution by type of material, we classify the 49 categories into consumption and investment. As expected, the prevalence of investment-related contracts is significantly higher than in other years, where we classify materials such as "vessels" into investment. The resulting annual distribution is 20% consumption and 80% investment, with a huge peak in the first quarter.

2005

In 2005, the Minsitry of Defence awarded contracts for a total value of 2,421 million euros.

Most of these contracts were relatively small, with just 8 of them being above 30 million euros. In value terms, these contracts represent one third of the total. December and July were the most relevant months, where 28.5% and 21% of the total volume was awarded, respectively. There was also a significant contract in June, for the acquisition of a replenishment oiler ("Buque de Aprovisionamiento en Combate"), with funding allocated from 2008 to 2022. The main contractors in 2005 were Navantia/Izar, Santa Bárbara, Indra and Atlas Elektronik. The later received a contract for the provision of torpedoes for the S-80 submarines up to 2014 for a total of 76 million euro. Santa Bárbara received 39 contracts during the year, one of them for 180.5 million euro in the framework of the special modernization program. The contract, awarded in July, refers to the acquisition of 82 howitzers, 82 VET towing vehicles, 82 integrated communications systems, and logistical support for both the howitzers and the towing vehicles[43].

Following the distribution by type of material, we classify the 51 different types of materials into consumption (38%) and investment (62%).

2006

The Ministry of Defence awarded contracts for a total value of 5,042.3 million euros during 2006.

Most of the contracts were relatively small, with 13 of them being above 30 million euros. These 13 contracts represent slightly over half of the total volume. Table A.6 shows the main contractors which, together, account for 70% of the total volume. December (42.5%) and June (22.92%) were the key months, followed by July. In June, there was a contract to build a fifth F-100 frigate (the F-105), financed from 2009 to 2021. In July, the main contract was the acquisition of four Meteoro-class offshore patrol vessels, also known as "Buque de Acción

[43] https://www.boe.es/buscar/doc.php?id=BOE-B-2005-258010

Marítima (BAM)", financed from 2009 to 2020. Finally, the main contract in December was the acquisition of 45 NH-90 helicopters, financed from 2009 to 2022 and totalling 1,260 million euros. These main contracts are consistent with the two main contractors of the year (Navantia, which received the F-105 and 4 BAM contracts; and Eurocopter, which was awarded the contract for the acquisition of the 45 NH-90).

Our estimates of investment-related contracts in this year include the Eurocopter contracts worth 1,301.47 million euros and Navantia contracts worth 1,141 million euros. The provision of 45 NH-90 helicopters amounted to some 1,260 million[44] euros and the two contracts to build the F-105 and the four Meteoro vessels amounted to 1,102 million euros[45].

Table A.6: Main contractors in 2006

Contractor	**Contracts**	**Value**
NAVANTIA	143	1,375,702
EUROCOPTER ESPASA	56	1,320,293
DEPARTMENT OF DEFENSA USA	27	182,720
CONST. AERONAUTICAS	73	133,757
SERVICIO MILITAR DE CONST.	326	121,733
INDRA SISTEMAS	95	118,110
IVECO-ESPAÑA	34	77,554
SAAB MICROWAVESN SYSTEM	1	69,093
INDUSTRIA DE TURBO PROPULSORES	3	60.947
INDRA ESPACIO	41	41,984
AMPER SA	32	37,388
VEHICULOS ESPECIALES URO	35	32,893
Sum	866	3,572,174

Notes: Thousand euros.

2007

During 2007, the Ministry of Defence awarded contracts for a total value of 3,118.9 million euros.

Most of the contracts were relatively small, with just 3 contracts being over the 30 million euros threshold. Moreover, December and November were the most important months. In

[44] https://www.eleconomista.es/empresas-finanzas/noticias/129063/01/07/Espana-firmo-el-contrato-con-Eurocopter-para-45-helicopteros-NH90.html

[45] https://www.farodevigo.es/espana/2006/05/25/defensa-encarga-construccion-fragata-navantia-18228294.html

fact, the contracts awarded during December account for 39% of the total. During the year, Navantia was the main contractor, followed by Amper, Eurocopter and Servicio Militar de Construcciones. Amper signed several contracts with the Ministry of Defence during the year, such as the agreement to provide 6,000 PR4G VHF communication terminals with F@STNET technology for 180 milion euros, or the devliery of communication systems for the Military Emergency Unit (UME) and the agreement to supply communication equipment for the Tiger helicopter (10 million euros) [46]. Some other contracts were the acquisition of helicopters and 2 CL415 planes for the Military Emergency Unit (UME)[47], as well as the acquisition of 2 "Piraña III" vehicles. Following the distribution by type of material, we classify the 40 different categories into consumption (34%) and investment (66%).

2008

During the year 2008, the Ministry of Defence awarded contracts for a total value of 2,123,822 thousand euros.

Most of the contracts were relatively small, with just 5 of them being above the 30 million euros threshold. July (16.65%), September (14.56%) and December (14.42%) were the most intense months. The main contractors during the year are shown in table A.7.

Following the distribution by type of material, we classify the 49 available categories into consumption (48%) and investment (52%).

2009

During 2009, the Ministry of Defence awarded contracts for a total value of 1,969.8 million euros.

Most of these contracts were relatively small, with just 6 of them being over 30 million euros. December was the most intense month in terms of volume of awards, followed by November. The two main contractors during 2009 were the TJV Ingesan OHL-SICE, and Indra Sistemas. Indra Sistemas recieved 93 contracts for a total value of 174,875,953 euros. Some of the most relevant ones include the maintenance of several systems of the Army for 18.7 million euros (program "Moscardón"), or the sustainment services for the observation periscopes on board S-70 class submarines[48].

[46] https://www.infodefensa.com/texto-diario/mostrar/3149196/amper-duplica-2007-beneficios-atribuibles-negocios-defensa-seguridad-hasta-62-millones-euros

[47] https://www.infodefensa.com/texto-diario/mostrar/3149313/ume-compra-primeros-aviones-apagafuegos-44-millones-euros

[48] https://www.infodefensa.com/texto-diario/mostrar/3147251/defensa-adjudica-indra-contratos-cerca-40-millones-euros

Table A.7: Main contractors in 2008

Contractor	**Contracts**	**Value**
TJV EQUIPO BÁSICO III	1	137,355
TJV TELEFONICA - TEL. MOV	5	97,982
SANTA BÁRBARA	17	92,934
INDRA ESPACIO	24	79,296
INDRA SISTEMAS	69	77,915
REPSOL	136	71,007
NAVANTIA	57	69,292
CASA	464	68,258
TELEFONICA	51	67,624
IVECO ESPADA	19	66,056
USA GOVERNMENT	21	47,681
SER. MILITAR DE CONS.	96	46,274
UNION FENOSA COMERCIAL	102	40,445
ISDEFE	20	40,210
Sum	1,082	1,002,329

Notes: Thousand euros. Includes the multi-annual nature of the contracts.

Following the distribution by type of material, we classify the 47 categories into consumption (46%) and investment (54%). The two most relevant categories during 2009 are "Maintenance of weaponry" (classified as investment) and "Peacekeeping Missions" (classified as consumption).

2010

During 2010, the Ministry of Defence awarded contracts for a total value of 1,778.6 million euros.

During this year, there was just one contract over 30 million euros, and almost half of the total were contracts smaller than 600,000 euros. December was the month in which most contracts were awarded, representing 29.56% of the total. The only contract over 30 million euros was the agreement for the provision of supplies to ships and units of the DAT (Supply and Transport Directorate), valued at 71.869 million euros, awarded in the month of December. This contract was awarded to TJV EMS SHIP SUPPLY (SPAIN)/ EITZEN MARITIME, which was also the main contractor of 2010, followed by Repsol and Navantia.

All in al, this results in around two thirds of the total defence contracts in this year being classified as consumption during 2010.

2011

During 2011, the Ministry of Defence awarded contracts for a total value of 1,675.9 million euros.

Similarly to 2010, the contracts awarded during this year were particularly small, with not even one contract over 30 million euros. There were, nevertheless, four contracts between 12 and 30 million euros. In line also with the previous year, December accumulated most of the volume, representing almost 30% of the total. The main contractors were Repsol, Indra Sistemas and Navantia.

Finally, the distribution by type of material follows closely that of last year, with 63% of consumption-related awards and the remaining 37% classified as investment.

2012

During 2012, the Ministry of Defence awarded contracts for a total value of 1,412.2 million euros. In line with previous years, most of the contracts were relatively small, with just two contracts above 30 million euros and 6 between 12 and 30 million euros. Awards were most intense during December, which accounted alone for some 30% of the yearly total.

The main contractors during 2012 were Navantia, Repsol, El Corte Inglés, and Indra Sistemas. Navantia recieved 101 contracts for a total value of 97.8 million euros. Two contracts stand out: the comprehensive overhaul of the submarine Mistral S-73 and maintenance of diesel engines abroad Navy ships. Together, these two contracts account for some 41 million euros[49].In the same vein, El Corte Inglés, together with other firms, received a contract to supply uniforms for the Army for 76.27 million euros the 5th of December[50].

Following the distribution by type of material, we classify the 62 categories into consumption (71%) and Investment (29%). This makes 2012 the year in our sample period in which consumption-related contracts represent the highest percentage of the total.

2013

The Ministry of Defence awarded contracts for a total value of 1,691.9 million euros during 2013. Only three contracts were above 30 million euros, and five between 12 and 30 million.

[49] https://www.infodefensa.com/texto-diario/mostrar/3142505/defensa-autorizado-firmar-contratos-destinados-navantia-valor-413-millones

[50] https://contratos.gobierto.es/adjudicatarios/el-corte-ingles-fecsa-iturri-m-aura-y-otros-ute-gc-9001-11-s?locale=es

November and December were the most important months, accounting for 19.31 and 17.77% of the total, respectively.

The main contractors for 2013 were Eurocopter, Repsol and Indra Sistemas. Eurocopter received 27 contracts for a total value of 122.5 million euros. Particularly relevant here is the contract awarded in December for the provision of eight helicopters EC-135, for a total value of 49 million euros [51].

Following the classification by type of material, we classify the 64 different categories into consumption (69%) and investment (31%).

2014

During 2014, the total value of contracts awarded by the Ministry of Defence reached 2,470.8 million euros.

Most of the contracts were relatively small, with just six of them between 12 and 30 million euros and other six over 30 million. Most of the contracts were awarded in December, which alone accounts for 40.2% of the total. The main contractor was Navantia, with 27 contracts adding up to 429 million euros. HISDESAT and INDRA Sistemas followed with 140.7 million and 95, respectively. The main contract of 2014 was awarded to Navantia for the construction of two oceanic Maritime Action Ships (BAM) for an amount of 335 million euros distributed during the 2014-2019 period[52].

Following the distribution by type of materials, we classify the 64 different categories into consumption (59%) and investment (41%).

2015

During 2015, the Ministry of Defence awarded contracts totalling 2,393.7 million euros.

Most of the contracts were relatively small, with just 5 contracts being above 30 million euros. December was the most relevant month with 38.6% of the total, followed by November (14.15%) and October (10.3%). The figure for December is significantly higher than the average due to four big contracts being awarded. In particular, there were four contracts over 85 million each during the month. The first was the acquisition of Remotely Piloted Aircraft System (RPAS). The second refers to the development and integration of mast-mounted sensors for the SCOMBA (F-110). The third one covered technological programs related to the future 8x8 VCR. Finally, the fourth contract locked the supply of a simulation center for the NH90 GSPA along with upgrades to CESIFAMET simulators.

[51] https://www.boe.es/diario_boe/txt.php?id=BOE-B-2013-49388

[52] https://cincodias.elpais.com/cincodias/2014/12/05/empresas/1417793488_206385.html

The main contractors during 2015 appear in A.8. These are consistent with the most relevant contracts mentioned above. For example, Indra Sistemas was awarded 184 contracts for a total value of 168 million euros. The largest of them, amounting to 92.8 million euros, refers to the provision of the simulation facility for the NH90 GSPA mentioned above (together with the upgrades to the CESIFAMET simulators)[53]. In the same vein, the second biggest contractor refers to the acquisition of four Reaper MQ-9 (RPAS) manufactured by General Atomics[54]. It should be noted that, while the contractor appears as "Banco de España", the contract is part of the Foreign Military Sales (FMS) program account, for which the Bank of Spain acts as a financial intermediary. The third biggest contractor (consortium of Indra and Navantia) recieved one contract for 134 million euros to develop mast-mounted sensors for the F-110 frigates [55]. Finally, the last of the four contracts above 85 million euros was awarded to the consortioum Indra - Santa Bárbara - Sapa, to develop the future 8x8 VCR.

Following the distribution by type of material, we classify the 65 categories into consumption (61%) and investment (39%).

Table A.8: Main contractors in 2015

Contractor	**Contracts**	**Value**
INDRA SISTEMAS	184	168,414
BANCO DE ESPAÑA FMS ACCOUNT	1	136,607
TJV INDRA S. - NAVANTIA	1	135,314
TJV INDRA S. - SANTA BARBARA - SAPA	1	89,298
USA GOVERNMENT	29	58,268
NAVANTIA	59	55,780
ISDEFE	35	46,006
URO VEHICULOS ESPECIALES	16	38,665
NSPA	57	37,265
TJV TECNOVE - UCALSA	1	36,000
CLECE	257	34,076
AIRBUS HELICOPTERS SPAIN	21	29,017
Sum	662	864,710

Notes: Thousand euros.

[53] https://www.boe.es/diario_boe/txt.php?id=BOE-B-2015-37624

[54] https://abcblogs.abc.es/tierra-mar-aire/espana/reaper-drone-ejercito.html

[55] https://www.infodefensa.com/texto-diario/mostrar/3134096/gobierno-autoriza-firma-contrato-desarrollos-tecnologicos-nueva-f-110-1353-millones

2016

During 2016, the Ministry of Defence awarded contracts for a total value of 1,228.8 million euros.

In 2016, there was just one contract above 30 million euros and another one between 12 and 30 million euros. July and August were the most relevant months, with 20.33% and 14.92% of the total awards, respectively. The main contractors during 2016 were NAMSA/NSPA (79 million euros distributed in 89 different contracts), Indra Sistemas (67 million euros distributed over 164 contracts), ISDEFE (50 million euros distributed over 40 contracts) and Banco de España FMS Account. The latter was the financial intermediary that handled the FMS transaction via which the Ministry of Defence acquired two SH-60F helicopters for the Navy for 40 million euros in December [56]. This is the single biggest contract of the year and also the only one above the 30 million euros threshold. The other major contract of 2016 (between 12 and 30 million) was Spain's contribution to the Organisation for Joint Armament Cooperation (OCCAR), which includes programs such as the European MALE RPAS or the TIGER. In particular, the 2016 contribution of 17.5 million euros from Spain went to the common project to design a European military drone (MALE RPAS) to replace the US-made Reaper [57].

Following the distribution by type of material, we classify the 54 categories into consumption (66%) and investment (34%).

2017

During 2017, the Ministry of Defence awarded contracts for a total value of 1,803.5 million euros.

Most of the contracts were relatively small, with just two contracts over 30 million euros and six between 12 and 30 million euros. The most relevant months were November (306 million euros), December (304 million euros) and July (247 million euros).

Following the distribution by type of material, we assign the 62 different categories into consumption (68%) and investment (32%). The most relevant consumption category for 2017 was Operational expenses of the Armed Forces, and the most relevant one attributed to investment was the Maintenance of Weapons and Equipment.

[56] https://www.infodefensa.com/texto-diario/mostrar/3078692/gobierno-aprueba-compra-helicopteros-sh-60f-armada-40-millones

[57] https://www.infodron.es/texto-diario/mostrar/3531547/espana-une-diseno-dron-militar-europeo-reemplazara-039reaper-039

2018

During the year 2018, the Ministry of Defence awarded contracts for a total value of 3,404.2 billion euros.

Most of the contracts were relatively small, with just two of them being above 30 million euros. The main contractors were Aribus Helicopters España, DSCA (FMS Program), NAMSA/NSPA, and Navantia. December was the most relevant month, followed by September. In line with this information, the biggest single contract for 2018 was given in December to Airbus Helicopters España, with the objective of providing 23 NH90 Helicopters for 1,381 million euros[58]. The next single biggest contract was a 687 payment related to the Defense Security Cooperation Agency (DSCA) in the framework of the FMS program, which most likely took place in September.

Since the distribution by type of material is not available for the year 2018, we approximate the share of investment-consumption contracts using the historical average, and complement it with granular data from the official public procurement platform (https://contrataciondelestado.es). This results in a breakdown of 33% classified as consumption-related and the remaining 67% as investment-related.

2019

During the year 2019, the Ministry of Defence awarded contracts for a total value of 1,960.7 million euros.

Most of the contracts during this year were relatively small, although some of them were nevertheless quite sizeable. To find the most relevant contracts, we turn to the main contractors during the year, which are Pilatus Aircraft, Indra Sistemas, a Temporary Joint Venture including El Corte Ingles, and Navantia. These four firms account for more than a quarter of the total volume of contracts awarded during the year. The most relevant period was the last quarter of the year, with November and December being the most relevant months of 2019. The single biggest contract was awarded in November to the Swiss firm Pilatus Aircraft for the delivery of 24 training aircraft for a total of 204.75 million euros[59]. The next biggest contractor was Indra Sistemas, although the total amount awarded (169 million euros) is distributed over 146 contracts. This means that the next single biggest contract was awarded to the TJV including El Corte Ingles for 79.5 million euros for the provision of the Army's clothing[60]. Finally, the fourth main contractor was Navantia, which

[58] https://www.defensa.com/espana/formalizada-adquisicion-nuevos-nh90

[59] https://abcblogs.abc.es/tierra-mar-aire/industria-de-defensa/defensa-adjudica-a-una-empresa-suiza-el-nuevo-avion-entrenador-del-ejercito-por-204-millones.html

[60] https://www.defensa.com/espana/gran-ute-suministrara-uniformidad-ejercito-valor-79-5

recieved a contract to produce five F-110 frigates.

Unfortunately, we also do not have the distribution by type of material for the year 2019. Therefore, we apply the same procedure as the one detailed for 2018 to obtain our consumption and investment series. The resulting breakdown is as follows: 57% is defined as consumption and the remaining 43% is classified as investment.

2020

During the year 2020, the Ministry of Defence awarded contracts for a total value of 4,323 billion euros.

Unfortunately, we do not have information on the main contractors starting from this year. Nevertheless, from 2018 we can retrieve granular data on public tenders from the State Contracting Platform ("Plataforma de Contratación del Sector Público"). In particular, we are interested in one contract that took place in August, were we observe a significant peak. In fact, the awarded volume just during this month represents half of the yearly total. This peak can be attributed to the VCR 8×8 Dragón armored vehicle program, which was awarded to the to the consortium Tess Defence, made up of the companies Indra, Santa Bárbara, Escribano, and Sapa. The value of this single contract reached 1,736 million euros, which makes one of the biggest contracts awarded by the Ministry of Defence since the beginning of our sample[61]. Also from the State Contracting Platform, we extract the second biggest contract, which was awarded in November to Indra Sistemas for 111 million euros for the Development, production, and supply of the electronic warfare system for NH90 helicopters[62].

Concerning the distribution by type of material, while we do not have the granularity of the years 1991-2017, we do have some information on the nature of the contracts. In particular, we were able to retrieve the distribution by nature of contract (Supplies, services, construction works, and mixed contracts). While this information is not as detailed as in previous years, we are nevertheless able to approximate the classification into consumption and investment contracts. In particular, we assign Supplies and Construction into investment, while services and mixed contracts remain in consumption. The resulting breakdown is as follows: 25% is assigned to consumption and 75% is classified as investment. These figures are consistent with the 2,000 million euro investment contract related to the VCR 8x8 and

-millones

[61] https://contrataciondelestado.es/wps/portal/!ut/p/b0/04_Sj9CPykssy0xPLMnMz0vMAfIjU1JTC3Iy87KtUlJLEnNyUuNzMpMzSxKTgQr0w_Wj9KMyU1zLcvQjVQ0CK5K8qixTPXKN84LzQyKMq1QNzMsdbW31C3JzHQFhUTM-/

[62] https://contrataciondelestado.es/wps/portal/!ut/p/b0/DcqxCoAgEADQT7qllsDBQNxagkqXOFLk6LSwq36_xgcPPCzgCz6UUOgoyL9diPFkKnsXoiBzXJk2Etz-ADN48BTMw-Bs6gfzNnUKZrzTJbq3tdVKwZmz_gCcmzYH/

are comparable to those of 2004, which featured a 1,800 million euro contract related to the S-80 submarines.

2021

During the year 2021, the Ministry of Defence awarded contracts for a total value of 3,243,253 thousand euros.

Similar to 2020, we do not have information on the main contractors. Therefore, we also use information published since 2018 in the State Contracting Platform to find the most relevant contracts. We find that only five contracts sit above 30 million euros. The single biggest contract was awarded to Airbus for 675 million euros in the framework of the A330 MRTT program[63]. This contract was awarded in November, which is (by far) the most relevant month of the year according to the data from the Military Statistical Yearbook. The next single biggest contract was awarded to Indra Sistemas for 98.7 million euros, for the replacement of the ALENIA air surveillance radars of the Air Command and Control System (SIMCA)[64]. This contract was awareded in August, which is the second-highest month of the year in terms of volume of contracts.

Concerning the distribution by type of material, having only the same breakdown as in 2020, we apply the same methodology detailed above. The resulting classification assigns 36% of the contracts to consumption and the remaining 64% to investment.

2022

In 2022, the Ministry of Defence awarded contracts for a total value of 8,818,087 thousand euros. This represents the biggest aggregate volume of contracts since the start of our sample and almost twice the amount recorded in 2004 were the government invested heavily in the S-80 program.

In 2022 we do have (again) information on the main contractors during the year. These are Airbus, the Spanish consortium for the Eurofigther Program, NSPA, NETMA, and Airbus helicopters. In fact, we find that Aribus recieved a contract for over 2,000 million euros for the provision of 20 Eurofighter jets to the Spanish Ministry of Defence, to substitute the F-18[65]. This contract follows closely the information outlined above on the main contractors, which

[63] https://www.defensa.com/espana/cifras-dudas-programa-a330-mrtt-para-ejercito-aire

[64] https://contrataciondelestado.es/wps/portal/!ut/p/b0/04_Sj9CPykssy0xPLMnMz0vMAfIjU1JTC3Iy87KtUlJLEnNyUuNzMpMzSxKTgQr0w_Wj9KMyU1zLcvQjVQ0MMnMLQ1wsnEtzi6qM3QNTTIvMggNtbfULcnMdARNYsgQ!/

[65] https://www.elmundo.es/espana/2022/06/23/62b48904e4d4d8ec158b45e2.html

for this year include also contributions of the Spanish Ministry of Defence to international organizations.

Concerning the distribution by type of material, having only the same breakdown as for the last two years, we apply the same methodology detailed above. The resulting classification assigns 17% of the contracts to consumption and the remaining 83% to investment. This 83% represents the maximum in the sample, surpasing the 80% of investment-contracts recorded in 2004.

2023

During the year 2023, the Ministry of Defence awarded contracts for a total value of 10,981,954 thousand euros.

As detailed in the yearly Procurement Report, more than half of this aggregate figure can be traced down to the "Special Modernization Programs" ("Programas Especiales de Modernización"). The table below outlines the main ones

Table A.9: Main Special Modernization Programs

Program	**Awarded amount**
Tracked Support Vehicle	1,970
Multisensor Aerial Surveillance Program	1,655
MH-60R Multipurpose Helicopters	820
High Mobility Rocket Launcher System	698
Tactical Remotely Piloted Aerial System	495
Spike LR2 Anti-Tank Missile Systems	288
Coastal Hydrographic Vessels	159
Sum	6,084

Note: Million euros

The main contractors during the year 2023 were Airbus Defence, Tess-defence, DSCA-FMS Program, an the TJV Escribano - Rheinmetall. We can closely trace down the individual contracts that yield this ranking.

First, Airbus and the Ministry of Defence signed in November a contract for the purchase of 27 Sirtap drones, amounting to 500 million euros[66]. The company also received another contract for 1,650 million euros for the provision of 16 C-295 maritime patrol and surveillance aircraft[67].

[66] https://www.infodefensa.com/texto-diario/mostrar/4632680/espana-firma-airbus-compra-27-drones-sirtap

[67] https://www.infodefensa.com/texto-diario/mostrar/4655008/espana-adjudica-airbus-suministro-16-c-295-vigilancia-patrulla-maritima-1700-millones

Second, the consortium Tess Defence (composed of four Spanish firms: Santa Bárbara, Indra, Sapa, and Escribano Mechanical & Engineering) received in August the contract for the development and purchase of 394 units of a Spanish-made VAC for some 2,000 million euros[68].

Third, Lockheed Martin received a contract in April for the purchase of eight helicopters MH-60R Romeo for the Army for a total of 820 million euros[69].

Finally, the TJV Escribano - Rheinmetall received in December a contract for some 700 million euros for the provision of a High Mobility Rocket Launcher System (SILAM). In particular, the PULS system was chosen, giving the army once again rocket launchers after more than a decade since the former Teruel system was withdrawn[70].

Concerning the distribution by type of material, we draw on the same information available as for the last three years, which we fine-tune with the procurement-level information outlined above. Consumption-related contracts represent 24% of the total, while the remaining 76% is assigned to investment.

B Data

In this section we provide a detailed description of the data employed in the empirical analysis beyond that regarding procurement data.

GDP and GDP deflator We construct a quarterly series of real GDP from 1989 to 2023, using two distinct datasets. For the period 1995-2024, we use quarterly real GDP extracted on 02/04/2025 from Eurostat. Data are seasonally and calendar adjusted and the unit of measure is chain linked volumes (2010), expressed in million euros. For the period 1989-1994, we use quarterly real GDP from Alloza et al. (2019) for the period 1989 to 1994. Data are seasonally and calendar adjusted and the base year for the GDP deflator is also 2010. The reconstructed series is then normalized by trend GDP. The GDP deflator series is constructed using the same data sources and the same methodology.

Trend GDP We estimate trend GDP as a fifht-degree polynomial for real GDP (described above), following Ramey and Zubairy (2018).

[68] https://www.infodefensa.com/texto-diario/mostrar/4409850/asi-sera-blindado-espanol-basado-pizarro-sustituira-vetusto-m113-toa

[69] https://www.infodefensa.com/texto-diario/mostrar/4267060/luz-verde-compra-ocho-helicopteros-mh-60r-romeo-armada-820-millones-euros

[70] https://www.infodefensa.com/texto-diario/mostrar/4652545/defensa-cierra-escribano-expal-compra-lanzacohetes-ejercito-tierra-casi-700-millones

Government Spending Government spending series is constructed using quarterly data on Government Consumption Expenditures and Gross Investment. We also construct the time series using two distinct datasets. For the period 1995-2023, we use gross capital formation and adquisitions less disposals of non-financial non-produced assets, in million euro. We then proceed to seasonally adjust the data for both seasonal and calendar effects. We also use data on quarterly nominal Government Consumption Expenditure from INE (*Instituto Nacional de Estadística*) for the period 1995-2023. To obtain the equivalent data for the 1989-1994 period, we use Alloza et al. (2019) and reconstruct the global Government Spending series as the sum of both components. Finally, the series is deflated using the GDP deflator and normalised with trend GDP, following Ramey and Zubairy (2018).

Inventories Quarterly series from 1995q1 to 2023q4, extracted from INE (*Instituto Nacional de Estadística*). Variation in inventories, seasonally and calendar adjusted data. Expressed in million euros (current prices). We then proceed to deflate and normalise the series using the GDP deflator and the trend GDP described above.

Employment Defined as "total affiliates". Extracted from: "Worker affiliation to the Social Security system", affiliated workers: Social Security schemes (Total). Data correspond to the last day of each month. The series begins in January 1989. Seasonal and calendar adjustments are applied to the monthly observations, which are then aggregated to a quarterly frequency. To estimate the local projection, we take the logarithm of the series.

Private Consumption, Investment, Exports, Imports and Net Exports These macroeconomic variables are all extracted from INE, but from two distinct datasets. First, the series ranging from 1995q1 to 2023q4 are extracted from the contemporary GDP series, expressed in million euros (current prices) and SCA. Then we use the historical series with base in 1995 *(Principales series trimestrales de Contabilidad Nacional del INE base 1995)*, also SCA and expressed in current prices to obtain data from 1987 to 1994. We also deflate and normalise the series as explained in GDP and Government Spending.

Manufacturing: total and equipment To analyse the impact of defence shocks on manufacturing, we use the Industrial Production Index from INE (*Índice de Producción industrial*) with 2021 as the base year. We include both the total index, as well as the equipment one. The series is available at a monthly frequency from 1975. We apply seasonal and calendar adjustment at monthly frequency and then compute the quarterly series as the mean of the values comprised in each quarter. To estimate the local projection, we take the logarithm of the series.

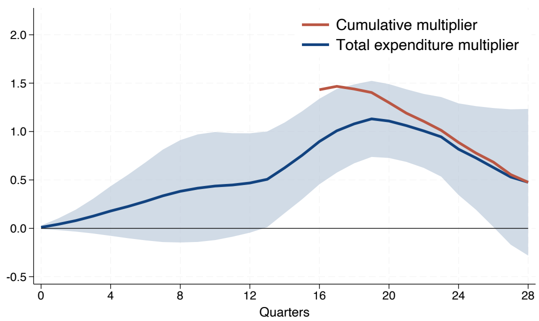
Industrial prices To analyse the impact of defence shocks on manufacturing prices, we use the Industrial Production Prices Index from INE (*(IPRI) Índice de Precios Industriales*) with 2021 as the base year. We include both the total index, as well as the equipment one. The series is available at a monthly frequency from 1975. We apply seasonal and calendar adjustment at monthly frequency and then compute the quarterly series as the mean of the values comprised in each quarter. To estimate the local projection, we take the logarithm of the series.

C Additional Empirical Results

C.1 Additional Results for Total Defence Procurement

Figure C.1: Total Defence Procurement Fiscal Multipliers

(a) Overall multipliers



(b) Medium-run multipliers

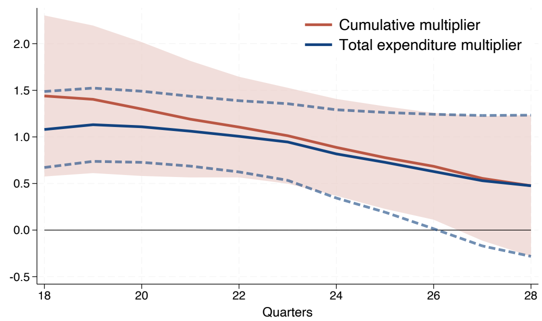
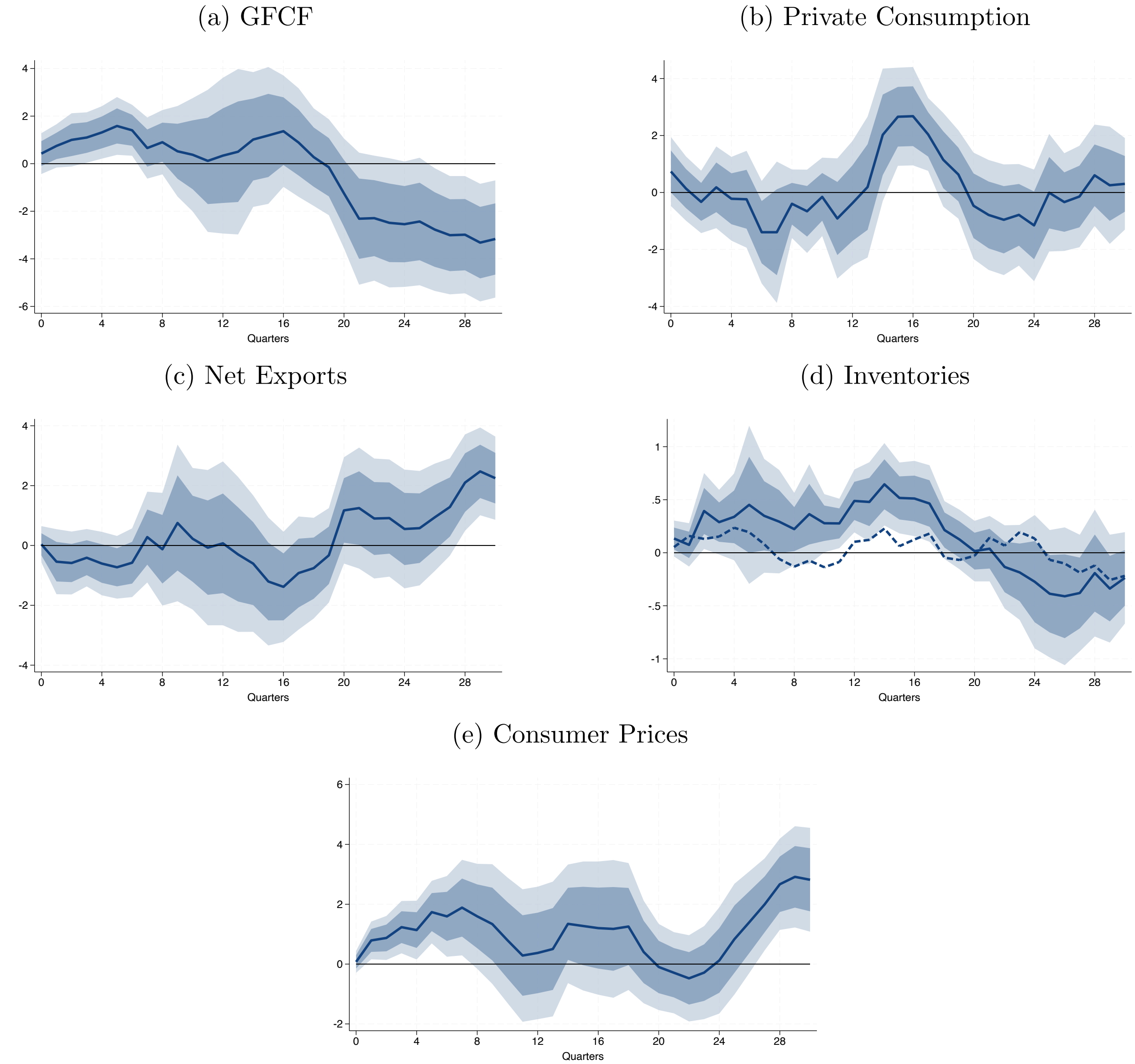


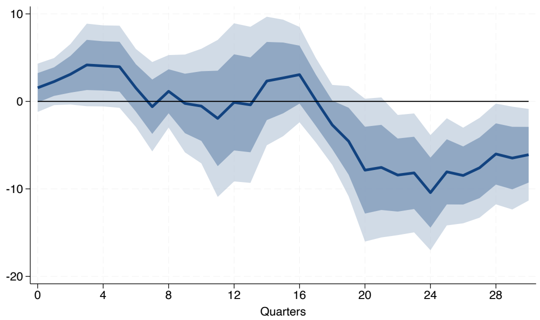
Figure C.2: Dynamic Responses to Total Defence Procurement



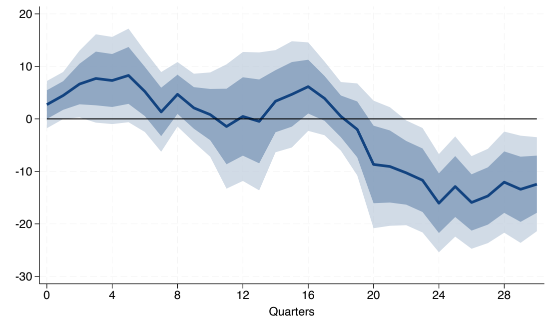
Note: The figures show the responses to a total defence procurement shock. Shaded areas represent 68% and 90% confidence bands computed with heteroscedasticity-robust standard errors. The solid line and confidence intervals in panel (d) do not include lags of Y and G, following the discussion in footnote 24, while the dashed line corresponds to the results of estimating our baseline equation.

Figure C.3: Responses to Total Defence Procurement: Manufacturing

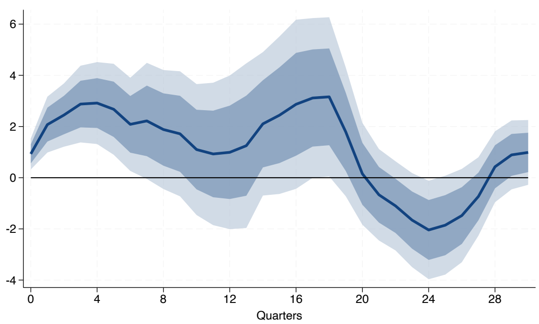
(a) Manufacturing: total



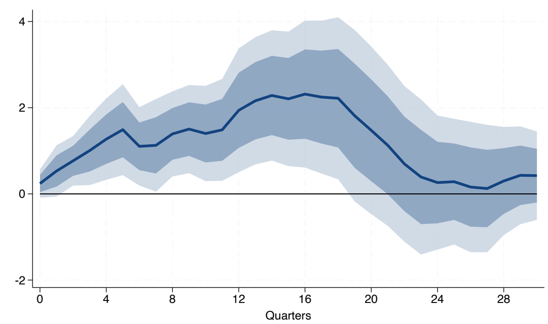
(b) Manufacturing: equipment



(c) Manufacturing prices: total

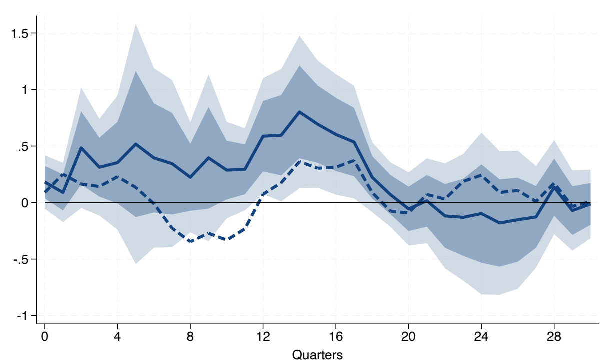


(d) Manuf. prices: equipment



Note: The figures show the responses to a total defence procurement shock. Shaded areas represent 68% and 90% confidence bands computed with heteroscedasticity-robust standard errors. Manufacturing prices total does not include energy.

Figure C.4: Inventories response to an investment-related Defence Procurement



Note: The figure shows the response of inventories to an investment-related shock. Shaded areas represent 68% and 90% confidence bands computed with heteroscedasticity-robust standard errors. The solid blue line replicates the results of the specification presented in panel (d) of Figure 8, while the dashed blue line represents the coefficients of estimating our baseline model with the full set of lags.

Table C.1: European defence multipliers

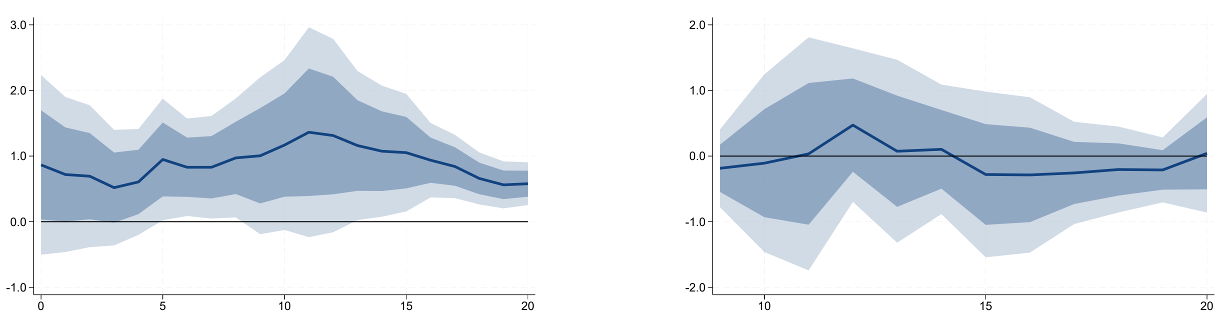
Year	All contracts	National contracts	Foreign contracts
Total multipliers			
1	0.16	0.16	0.01
	(0.13)	(0.10)	(0.15)
2	0.62	0.56	0.48
	(0.26)	(0.20)	(0.33)
3	0.94	0.80	0.87
	(0.37)	(0.25)	(0.41)
4	0.79	0.62	-0.10
	(0.40)	(0.23)	(0.60)
5	0.67	0.58	0.04
	(0.34)	(0.20)	(0.55)
Cumulative multipliers			
1	0.52	0.61	-2.89
	(0.45)	(0.49)	(1.60)
2	0.93	0.97	-0.68
	(0.24)	(0.55)	(0.52)
3	1.45	1.31	0.47
	(0.71)	(0.90)	(0.71)
4	1.03	0.94	-0.29
	(0.38)	(0.35)	(0.72)
5	0.67	0.58	0.04
	(0.34)	(0.20)	(0.55)

Note: The table reports total (top panel) and cumulative (bottom panel) defence multipliers. Standard errors are reported in parentheses. Column 2 reports aggregate results, column 3 refers to contracts awarded to national firms, and column 4 to foreign firms.

Figure C.5: Multipliers: EU defence contracts

(a) National

(b) Foreign



D Model Appendix

D.1 Model Equations

We provide next a more detailed description of the model employed in Section 4 of the main text. As highlighted, the analysis builds on the work of Stähler and Thomas (2012) and therefore follows the exposition where there is overlay.

Households

The model considers a two-country monetary union in which population is normalized to unity, with fraction $\omega \in (0,1)$ living in the home country and $(1-\omega)$ in the foreign country. Both regions are modeled analogously, while structural parameters are allowed to differ.

Following Galí et al. (2007), each country is inhabited by two types of households. A share $(1-\mu)$ consists of optimizing (or Ricardian) households who have unrestricted access to capital markets and can substitute consumption intertemporally. The remaining share $\mu \in [0,1)$ consists of liquidity-constrained households, known as rule-of-thumb households, who can neither save nor borrow and thus consume all their disposable income in each period, behaving in a non-Ricardian fashion. This heterogeneity allows the model to capture non-Ricardian effects of fiscal policy.

Each household has a continuum of members who may be employed in the public sector, in the private sector, or unemployed. Full consumption insurance within the household is assumed, following Merz (1995). However, the level of unemployment affects the disposable income of rule-of-thumb households, such that they still face income risk from employment fluctuations.

Preferences The welfare function of each type of representative household is given by the expected discounted sum of instantaneous utilities:

$$E_0 \sum_{t=0}^{\infty} \beta^t \cdot u_t(c_t^i, c_{t-1}^i, \tilde{g}_t) \tag{14}$$

where E_t is the expectations operator conditional on time-t information, β is the discount factor, and the superscripts $i = o, r$ denote optimizing and rule-of-thumb households, respectively.

The instantaneous utility function is given by:

$$u(c_t^i, c_{t-1}^i, \tilde{g}_t) = \begin{cases} \frac{[c_t^i - h \cdot c_{t-1}^i]^{1-\sigma_c} - 1}{1-\sigma_c} + \zeta \cdot \frac{\tilde{g}_t^{1-\sigma_c} - 1}{1-\sigma_c}, & \sigma_c > 0, \sigma_c \neq 1 \\ \log[c_t^i - h \cdot c_{t-1}^i] + \zeta \cdot \log[\tilde{g}_t], & \sigma_c = 1 \end{cases} \tag{15}$$

where c_t^i denotes household consumption of final goods, σ_c is the coefficient of relative risk aversion (equal to the inverse of the intertemporal elasticity of substitution), h captures the degree of habit formation in consumption, $\zeta > 0$ is a parameter measuring the relative valuation of public consumption in households' utility, and $\tilde{g}_t$ represents government services produced by public employees, which is taken as given by private households.

Consumption and Investment Baskets Both countries trade consumption and investment goods. The consumption basket of a type-i household in the home country is given by:

$$c_t^i = \left(\frac{c_{At}^i}{\omega + \psi}\right)^{\omega+\psi} \left(\frac{c_{Bt}^i}{1 - \omega - \psi}\right)^{1-\omega-\psi} \tag{16}$$

where c_{At}^i and c_{Bt}^i are consumption of goods produced in countries A (home) and B (foreign), respectively, and ψ is a parameter capturing the degree of home bias in consumption. The basket of investment goods (owned by optimizing households only) is analogously defined. The corresponding before-VAT consumer price index is:

$$P_t = (P_{At})^{\omega+\psi}(P_{Bt})^{1-\omega-\psi} \tag{17}$$

where P_{At} and P_{Bt} are the producer price indexes (PPI) in countries A and B.

The terms of trade are defined as $p_{Bt} \equiv P_{Bt}/P_{At}$. Before-VAT CPI inflation evolves according to:

$$\pi_t = \pi_{At} \left(\frac{p_{Bt}}{p_{Bt-1}}\right)^{1-\omega-\psi} \tag{18}$$

where $\pi_{At} \equiv P_{At}/P_{At-1}$ is PPI inflation in country A.

Optimizing Households Optimizing households' real labor income (gross of taxes) is $w_t^p n_t^{p,o} + w_t^g n_t^{g,o}$, where w_t^p is the average real wage in the private sector, w_t^g is the real wage in the government sector, and $n_t^{p,o}$ and $n_t^{g,o}$ are the number of type-o household members employed in the private and government sector. Wages are taxed at rate τ_t^w. When unemployed, household members receive unemployment benefits κ^B. Consumption expenditures are taxed at rate τ_t^c.

The household can invest in physical capital k_t^o, which earns real rental rate r_t^k and depreciates at rate δ^k. Returns on physical capital (net of depreciation allowances) are taxed at rate τ_t^k. The household can purchase nominal government bonds B_t^o, which pay gross nominal interest rate R_t, with returns taxed at rate τ_t^b. Finally, optimizing households can hold international nominal bonds D_t^o at interest rate $R_t^{ecb}\exp(-\psi_d(d_t-\bar{d})/Y_t)$, where the risk premium increases with the country's net foreign asset position.

The budget constraint in real terms is:

$$\begin{aligned}(1+\tau_t^c)c_t^o + I_t^o + \frac{B_t^o + D_t^o}{P_t} + \frac{T_t}{1-\mu} = {} & \frac{\Pi_t}{P_t} \\ & + [(1-\tau_t^k)r_t^k + \tau_t^k\delta^k]k_{t-1}^o + \frac{R_{t-1}B_{t-1}^o}{P_t} + \frac{R_{t-1}^{ecb}e^{-\psi_d(d_{t-1}-\bar{d})/Y_{t-1}}D_{t-1}^o}{P_t} \\ & - \tau_t^b(R_{t-1}-1)\frac{B_{t-1}^o}{P_t} + \frac{Sub_t}{1-\mu} + (1-\tau_t^w)(w_t^p n_t^{p,o} + w_t^g n_t^{g,o}) + (1-n_t^{p,o}-n_t^{g,o})\kappa^B \end{aligned} \tag{19}$$

where Π_t are nominal per capita profits from firms, T_t are lump-sum taxes, and Sub_t are lump-sum subsidies.

The law of motion of private physical capital features investment adjustment costs:

$$k_t^o = (1-\delta^k)k_{t-1}^o + \left[1 - \frac{\kappa_I}{2}\left(\frac{I_t^o}{I_{t-1}^o} - 1\right)^2\right] I_t^o \tag{20}$$

where κ_I is the investment adjustment cost parameter.

Rule-of-Thumb Households As rule-of-thumb households can neither save nor borrow, their budget constraint simplifies to:

$$(1+\tau_t^c)c_t^r = (1-\tau_t^w)(w_t^p n_t^{p,r} + w_t^g n_t^{g,r}) + (1-n_t^{p,r}-n_t^{g,r})\kappa^B \tag{21}$$

which determines their consumption c_t^r.

Per capita consumption in the home country equals the weighted average:

$$C_t = (1-\mu)c_t^o + \mu c_t^r. \tag{22}$$

Production

Private production is split in three sub-sectors: retailers, intermediate goods producers, and labor firms. The retail and intermediate goods sectors are similar to Smets and Wouters (2003), with the exception that labor services are not hired directly from households but from a sector of firms that produce homogeneous labor services following Krause and Lubik

(2007).

Retailers There is a measure-ω continuum of firms in the retail (or final good) sector. Each retail firm purchases a variety of differentiated intermediate goods, bundles these into a final good and sells the latter under perfect competition. The law of one price holds within the union, such that the price of the home country's final good is the same in both countries and equal to P_{At}. Final good production follows a Dixit-Stiglitz aggregator:

$$Y_t = \left[\int_0^{\omega} \left(\frac{1}{\omega}\right)^{1/\varepsilon} (\tilde{y}_t(j))^{(\varepsilon-1)/\varepsilon} dj\right]^{\varepsilon/(\varepsilon-1)} \tag{23}$$

where $\varepsilon > 1$ is the elasticity of substitution between intermediate goods. Cost minimization yields the demand for intermediate input j:

$$\tilde{y}_t(j) = \left(\frac{P_{At}(j)}{P_{At}}\right)^{-\varepsilon} Y_t \tag{24}$$

Intermediate Goods Firms in the intermediate goods sector have mass ω. Each producer $j \in [0, \omega]$ operates the following technology:

$$y_t(j) = \varepsilon^a \cdot (K_{t-1}^g)^{\eta} \cdot (I_t^{gdef})^{\eta^{gdef}} \cdot [\tilde{k}_t(j)]^{\alpha} \cdot [l_t(j)]^{(1-\alpha)} \tag{25}$$

where $\alpha \in [0, 1]$ is the elasticity of output with respect to private capital, $l_t(j)$ denotes the demand for labor services, $\tilde{k}_t(j)$ is the demand for capital services, and ε^a is total factor productivity. Importantly, K_{t-1}^g is the public capital stock available in period t, which is determined by the government and is assumed to be productivity-enhancing with elasticity $\eta \in [0, 1)$. Finally, I_t^{gdef} denotes the public defence investment produced in period t.

Intermediate goods firms acquire labor and capital services in perfectly competitive factor markets at real (CPI-deflated) prices x_t and r_t^k, respectively. Cost minimization implies the following factor demand conditions:

$$r_t^k = mc_t \cdot \alpha \cdot \frac{y_t(j)}{\tilde{k}_t(j)}, \quad x_t = mc_t \cdot (1-\alpha) \cdot \frac{y_t(j)}{l_t(j)} \tag{26}$$

where mc_t is the real (CPI-deflated) marginal cost common to all intermediate good producers.

Intermediate goods firms set nominal prices à la Calvo (1983). Each period, a randomly chosen fraction $\theta_P \in [0, 1)$ of firms cannot re-optimize their price. A firm that has the chance to reoptimize in period t chooses the nominal price $\tilde{P}_{At}$ that maximizes expected discounted profits, leading to the first-order condition:

$$E_t \sum_{z=0}^{\infty} (\beta\theta_P)^z \frac{\lambda^o_{t+z}}{\lambda^o_t} \left[\frac{\tilde{P}_{At}}{P_{t+z}} - \frac{\varepsilon}{\varepsilon - 1} mc_{t+z} \right] \left(\frac{\tilde{P}_{At}}{P_{At+z}} \right)^{-\varepsilon} Y_{t+z} = 0 \tag{27}$$

The law of motion of the producer price index is:

$$1 = \theta_P \left(\frac{1}{\pi_{At}} \right)^{1-\varepsilon} + (1 - \theta_P) \tilde{p}_t^{1-\varepsilon} \tag{28}$$

where $\tilde{p}_t \equiv \tilde{P}_{At}/P_{At}$ is the relative (PPI-deflated) optimal price.

Labor Market

The labor market is characterized by search and matching frictions in the tradition of Mortensen and Pissarides (1994). This implies that it takes time for unemployed workers and vacant jobs to be matched, thereby generating involuntary unemployment. The model incorporates the modern theory of equilibrium unemployment along the lines of Blanchard and Galí (2010).

Labor Services and Employment Labor firms hire workers from the household sector to produce homogeneous labor services, which they sell to intermediate goods producers at the perfectly competitive price x_t. Each labor firm can at most hire one worker, whose production is linear in hours worked (fixed at $\bar{h}$). Letting N_t^p denote both the fraction of the labor force employed in the private sector and the per-capita number of labor firms, total per-capita supply of labor services is:

$$L_t = N_t^P \cdot \bar{h} \tag{29}$$

Equilibrium in the market for labor services, combined with the intermediate goods production function, implies:

$$Y_t D_t = \varepsilon^a \cdot (I_t^{gdef})^{\eta^{gdef}} (K_{t-1}^g)^{\eta} K_{t-1}^{\alpha} L_t^{1-\alpha} \tag{30}$$

Workers can be in one of three states: unemployed, employed in the public sector (N_t^g), or employed in the private sector (N_t^p). The unemployment rate is given by:

$$U_t = 1 - N_t^p - N_t^g \tag{31}$$

Matching Process The hiring round takes place at the beginning of each period, and new hires start producing immediately. Workers dismissed at the end of period $t-1$ start searching for a new job at the beginning of period t. The pool of searchers is:

$$\tilde{U}_t = U_{t-1} + s^p N_{t-1}^p + s^g N_{t-1}^g \tag{32}$$

where s^f represents the constant separation rate in sector $f = p, g$ (private and public).

Both private firms and the government search in the same pool of unemployment. Unemployed workers do not direct search to either sector and are matched randomly. The matching process is governed by a standard Cobb-Douglas aggregate matching function for each sector $f = p, g$:

$$M_t^f = \kappa_e^f \cdot (\tilde{U}_t)^{\phi^f} \cdot (v_t^f)^{(1-\phi^f)} \tag{33}$$

where $\kappa_e^f > 0$ is the sector-specific matching efficiency parameter, $\phi^f \in (0,1)$ is the sector-specific matching elasticity, and M_t^f is the number of new matches formed in period t from searchers and sector-specific vacancies v_t^f.

The probability for an unemployed worker to find a job in sector f is $p_t^f = M_t^f / \tilde{U}_t$, while the probability of filling a vacancy is $q_t^f = M_t^f / v_t^f$. The law of motion for sector-specific employment is:

$$N_t^f = (1 - s^f) \cdot N_{t-1}^f + p_t^f \cdot \tilde{U}_t \tag{34}$$

Wage Bargaining Staggered bargaining of nominal wages follows Gertler and Trigari (2009). Each period, a randomly chosen fraction θ_w of continuing firms cannot renegotiate wages, while a fraction θ_w^n of newly created firms does not bargain over wages and simply pays the average nominal wage of the previous period.

Because of search frictions, formed matches entail economic rents. Firms and workers bargain about their share of the overall match surplus through Nash bargaining. Following Gertler et al. (2008), the model assumes unionized wage bargaining, where the union's utility is the weighted average of the surplus of optimizing and rule-of-thumb workers.

The value function of a firm that renegotiates in period t with nominal wage $\tilde{W}_t^p$ is:

$$\begin{aligned} J_t(\tilde{W}_t^p) = E_t \sum_{z=0}^{\infty} [\beta \cdot (1 - s^p) \cdot \theta_w]^z \cdot \frac{\lambda_{t+z}^o}{\lambda_t^o} \cdot \left[\bar{h} \cdot x_{t+z} - (1 + \tau_{t+z}^{sc}) \cdot \frac{\tilde{W}_t^p}{P_{t+z}} \right] \\ + (1 - \theta_w) \cdot E_t \sum_{z=1}^{\infty} [\beta \cdot (1 - s^p)]^z \cdot \theta_w^{z-1} \cdot \frac{\lambda_{t+z}^o}{\lambda_t^o} \cdot J_{t+z}(\tilde{W}_{t+z}^p) \end{aligned} \tag{35}$$

where τ_t^{sc} is the social security contribution rate paid by employers.

Opening a vacancy has a real (CPI-deflated) flow cost of κ_v^p, and matching firms incur a training cost κ_{tc}. Free entry into the vacancy posting market implies:

$$\frac{\kappa_v^p}{q_t^p} + \kappa_{tc} = (1-\theta_w^n)\cdot J_t(\tilde{W}_t^p) + \theta_w^n \cdot J_t(W_{t-1}^p) \tag{36}$$

The surplus value of a job for a type-i worker in a renegotiating firm is:

$$\begin{aligned} H_t^{i,p}(\tilde{W}_t^p) = E_t \sum_{z=0}^{\infty} [\beta\cdot(1-s^p)\cdot\theta_w]^z \cdot \frac{\lambda_{t+z}^i}{\lambda_t^i}\cdot[(1-\tau_{t+z}^w)\cdot\frac{\tilde{W}_t^p}{P_{t+z}} - \Xi_{t+z}^{i,p}] \\ + (1-\theta_w)\cdot E_t \sum_{z=1}^{\infty}[\beta\cdot(1-s^p)]^z \cdot \theta_w^{z-1}\cdot\frac{\lambda_{t+z}^i}{\lambda_t^i}\cdot H_{t+z}^{i,p}(\tilde{W}_{t+z}^p) \end{aligned} \tag{37}$$

where $\Xi_t^{i,p}$ represents the outside option of a type-i worker (unemployment benefits plus the expected value of searching).

Nash bargaining between the firm and the union maximizes:

$$\max_{\tilde{W}_t^p} [(1-\mu)H_t^{o,p}(\tilde{W}_t^p) + \mu H_t^{r,p}(\tilde{W}_t^p)]^{\xi}[J_t(\tilde{W}_t^p)]^{(1-\xi)} \tag{38}$$

where $\xi \in [0,1)$ is the union's bargaining power parameter.

The average real wage in the private sector evolves according to:

$$w_t^p = (1-s^p)\frac{N_{t-1}^p}{N_t^p}[(1-\theta_w)\tilde{w}_t^p + \theta_w\cdot\frac{w_{t-1}^p}{\pi_t}] + \frac{M_t^P}{N_t^p}[(1-\theta_w^n)\tilde{w}_t^p + \theta_w^n\cdot\frac{w_{t-1}^p}{\pi_t}] \tag{39}$$

where $\tilde{w}_t^p \equiv \tilde{W}_t^p/P_t$ is the real optimally bargained wage. Public sector wages w_t^g and employment N_t^g are autonomously set by the government.

Fiscal Policy

Fiscal policy is conducted autonomously in each country. The model provides a notable degree of disaggregation on the fiscal expenditures side. In particular, it explicitly distinguishes between public investment and public consumption; the latter in turn is divided between public purchases and the public sector wage bill. Each of these components has a distinct effect on the rest of the economy.

On the fiscal revenues side, the model considers a wide range of taxes: consumption tax τ_t^c, labor income tax τ_t^w, tax on bond returns τ_t^b, tax on physical capital returns τ_t^k, and social security contributions τ_t^{sc}. Lump-sum taxes T_t complete the revenue side. On the expenditures side, governments spend on privately-produced consumption goods C_t^g (public purchases), public investment I_t^g, public investment in defence I_t^{gdef}, public sector wages w_t^g and employment N_t^g, unemployment benefits $\kappa^B U_t$, lump-sum subsidies Sub_t, and interest payments on outstanding debt.

Government Budget The real (CPI-deflated) per capita value of end-of-period government debt evolves according to:

$$b_t = \frac{R_{t-1}}{\pi_t} b_{t-1} + PD_t \tag{40}$$

where PD_t denotes real (CPI-deflated) per capita primary deficit, given by per capita fiscal expenditures minus per capita fiscal revenues:

$$\begin{aligned} PD_t = &\left[\frac{G_t}{p_{Bt}^{1-\omega-\psi}} + \kappa^B U_t + Sub_t\right] \\ &- \left[(\tau_t^w + \tau_t^{sc})(w_t^p N_t^P + w_t^g N_t^g) + \tau_t^b \frac{(R_{t-1}-1)}{\pi_t} b_{t-1} + \tau_t^c C_t + \tau_t^k (r_t^k - \delta^k) k_{t-1} + T_t\right] \end{aligned} \tag{41}$$

Government spending in goods and services (expressed in PPI terms) is the sum of public purchases, public investment, and the public sector wage bill:

$$G_t = C_t^g + I_t^{gdef} + I_t^g + (1 + \tau_t^{sc}) w_t^g N_t^g \cdot p_{Bt}^{1-\omega-\psi} \tag{42}$$

Public investment accumulates into a stock of public capital that enters the private production function and thus increases private sector productivity:

$$K_t^g = (1 - \delta^g) K_{t-1}^g + I_t^g \tag{43}$$

where δ^g is the depreciation rate of public capital.

Public defence investment accumulates into a stock of defence capital according to equation (9).

Fiscal Rules For the tax rates, fiscal rules take the form:

$$X_t = \bar{X} + \phi_X \cdot \left(\frac{b_{t-h}}{Y_{t-h}^{tot}} p_{Bt-h}^{1-\omega-\psi} - \omega^b\right) \tag{44}$$

for $X \in \{\tau^w, \tau^c, Sub\}$, where $\bar{X}$ denotes the long-run target, $b_{t-h} p_{Bt-h}^{1-\omega-\psi} / Y_{t-h}^{tot}$ is the ratio of public debt over GDP at period $t-h$ with $h \geq 1$, ω^b is the long-run target for the debt ratio, and ϕ_X measures the responsiveness of the corresponding instrument to deviations in the debt ratio.

In our baseline simulations presented in Section 4.1 we consider that the instrument used to stabilize debt are lump-sum subsidies (or taxes, if negative) to Ricardian households. More precisely, we set $\phi_{Sub} = -1$ and $h = 1$, and assume that all other instruments remain at other steady-state values. In Appendix D.3 we consider alternative fiscal schemes.

International Linkages

International linkages between the two countries result from trade in goods and services as well as in international bonds. The home country's net foreign asset position, expressed in terms of PPI, evolves according to:

$$d_t = \frac{R^{ecb}_{t-1} \cdot e^{-\psi_d (d_{t-1} - \bar{d})/Y_{t-1}}}{\pi_{At}} \cdot d_{t-1} + \frac{1-\omega}{\omega}(C^*_{At} + I^*_{At}) - p_{Bt}(C_{Bt} + I_{Bt}) \tag{45}$$

where the last two terms represent the trade balance: $(1-\omega)(C^*_{At} + I^*_{At})/\omega$ are real per capita exports and $p_{Bt}(C_{Bt} + I_{Bt})$ are real per capita imports. The interest rate on international bonds includes a risk premium that increases with the country's net foreign asset position, where $\psi_d > 0$ is the risk premium parameter.

Zero net supply of international bonds implies:

$$\omega d_t + (1-\omega) p^*_{Bt} d^*_t = 0 \tag{46}$$

where $p^*_{Bt} \equiv P_{At}/P_{Bt}$ is the foreign country's terms of trade.

The home country's terms of trade evolve according to:

$$p_{Bt} = \frac{\pi_{Bt}}{\pi_{At}} p_{Bt-1} \tag{47}$$

Market Clearing and GDP

Market clearing implies that private per capita production in the home country is used for private and public consumption as well as private and public investment demand:

$$Y_t = C_{At} + I_{At} + C^g_t + I^{gdef}_t + I^g_t + \frac{1-\omega}{\omega}(C^*_{At} + I^*_{At}) \tag{48}$$

where the last term represents exports to the foreign country.

Consistently with national accounting, each country's GDP is the sum of private-sector production and government production of goods and services. The latter is measured at input costs, i.e., by the gross government wage bill. Real (PPI-deflated) per capita GDP in the home country is:

$$Y_t^{tot} = Y_t + (1 + \tau_t^{sc}) w_t^g N_t^g p_{Bt}^{1-\omega-\psi} \tag{49}$$

Monetary Policy

The area-wide monetary authority (ECB) sets its nominal interest rate R_t^{ecb} according to a Taylor-type rule that responds to deviations of area-wide after-VAT CPI inflation from its long-run target $\bar{\pi}$ and to area-wide GDP growth:

$$\frac{R_t^{ecb}}{\bar{R}^{ecb}} = \left(\frac{R_{t-1}^{ecb}}{\bar{R}^{ecb}}\right)^{\rho_R} \left\{ \left[\left(\frac{\pi_t^{\tau_c}}{\bar{\pi}^{\tau_c}}\right)^{\omega} \left(\frac{\pi_t^{\tau_c,*}}{\bar{\pi}^{\tau_c,*}}\right)^{1-\omega} \right]^{\phi_\pi} \left[\left(\frac{Y_t^{tot}}{Y_{t-1}^{tot}}\right)^{\omega} \left(\frac{Y_t^{tot,*}}{Y_{t-1}^{tot,*}}\right)^{1-\omega} \right]^{\phi_y} \right\}^{(1-\rho_R)} \tag{50}$$

where ρ_R is a smoothing parameter, ϕ_π and ϕ_y measure the monetary policy's stance on inflation and output growth respectively, and area-wide aggregates are population-weighted (with weights ω and $1 - \omega$).

D.2 Calibration

The model is calibrated to quarterly frequency, calibrating the home country to Spain and the foreign country to the rest of the European Monetary Union. Most of parameters – beyond the parameters specific to defence investment, discussed in the main text – follow the calibration strategy presented in Stähler and Thomas (2012) and are collected in Table D.1, Table D.2, and Table D.3.

Table D.1: Targeted values (home country: Spain).

Target	**Symbol**	**Value**
PPI inflation	$\bar{\pi}_A$	1.0000
Current account	$\bar{d} = -\bar{d}^*$	0.0000
(Average) Labor income tax rate	$\bar{\tau}^w$	0.1633
Bond tax rate	$\bar{\tau}^b$	0.1296
VAT rate	$\bar{\tau}^c$	0.0860
Social security contribution rate	$\bar{\tau}^{sc}$	0.1657
Capital tax rate	$\bar{\tau}^k$	0.0872
Unemployment rate	$\bar{U}$	0.1400
Fraction of publ. employment	$frac^{pub} = \frac{N^G}{1-\bar{U}}$	0.1630
Vacancy filling rate (private)	$\bar{q}^P$	0.7000
Vacancy filling rate (public)	$\bar{q}^G$	0.8000
Gov. SS spending	$\omega^G = \bar{G}/\bar{Y}^{tot}$	0.1800
Gov. SS purchases	$\omega^{g^c} = \bar{C}^G/\bar{Y}^{tot}$	0.0780
Gov. SS investment (Infrastructure)	$\omega^{g^i} = \bar{I}^G/\bar{Y}^{tot}$	0.0210
Gov. SS investment (Defence)	$\omega^{g^{idef}} = \bar{I}^{def}/\bar{Y}^{tot}$	0.005
SS debt-to-annual-GDP ratio	$\omega^b = \frac{\bar{p}^1_{-1}\bar{b}}{\Delta \bar{Y}^{tot}}$	0.97
SS subsidy-to-GDP ratio	$\omega^s = \frac{\bar{p}^s_{-1}\bar{b} - \bar{\omega}^{sub}}{\bar{Y}^{tot}}$	0.1800
Replacement ratio	$rrs = \frac{\bar{b}^s}{(1-\bar{\tau}^w)\bar{w}}$	0.6940

Source: All parameters are set following Stähler and Thomas (2012), except for the tax rates and government steady-state expenditure, which are calibrated using data from Banco de España for the 2019 Spanish economy. Additionally, the unemployment rate and the fraction of public employment are taken from Eurostat for 2019.

Table D.2: Targeted values (rest of EMU).

Target	Symbol	Value
(Average) Labor income tax rate	$\bar{\tau}^w$	0.2225
Bond tax rate	$\bar{\tau}^b$	0.1267
VAT rate	$\bar{\tau}^c$	0.0955
Social security contribution rate	$\bar{\tau}^{sc}$	0.1706
Capital tax rate	$\bar{\tau}^k$	0.0724
Unemployment rate	$\bar{U}$	0.0844
Fraction of publ. employment	$frac^{pub} = \frac{N^G}{1-\bar{U}}$	0.1814
Vacancy filling rate (private)	$\bar{q}^P$	0.7000
Vacancy filling rate (public)	$\bar{q}^G$	0.8000
Gov. SS spending	$\omega^G = \bar{G}/\bar{Y}^{tot}$	0.2256
Gov. SS purchases	$\omega^{g^c} = \bar{C}^G/\bar{Y}^{tot}$	0.0985
Gov. SS investment	$\omega^{g^i} = \bar{I}^G/\bar{Y}^{tot}$	0.0238
SS debt-to-GDP ratio (annualized)	$\omega^b = \frac{\bar{p}^1_{-1}\bar{b}}{(4\bar{Y}^{tot})}$	0.78
SS subsidy-to-GDP ratio	$\omega^s = \frac{\bar{p}^s_{-1}\bar{b} - \bar{\omega}^{sub}}{\bar{Y}^{tot}}$	0.2126
Replacement ratio	$rrs = \frac{\bar{b}^s}{(1-\bar{\tau}^w)\bar{w}}$	0.7050

Source: All parameters follow Stähler and Thomas (2012), except for the unemployment rate, the fraction of public employment, and the public debt-to-GDP ratio, which are taken from Eurostat (2019).

D.3 Additional Results

In this section we present the macroeconomic effects of defence investment under alternative fiscal financing schemes for the increase in government spending. Recall that in our baseline we assumed that this is initially financed via government debt and then repaid through lump-sum taxes on Ricardian households. That is, in equation (44) we set $\phi_{Sub} = -1$ and $h = 1$.

First, we consider the case of repayment through VAT taxes instead of through lump-sum taxation, while assuming that other tax instruments remain at their steady-state levels. We examine two such cases depending on the speed of repayment. In the first case, we set $\phi_{\tau^c} = 1$ and $h = 1$, implying that VAT taxes are increased with just a one-period delay. In the second case, we assume that the government keeps rolling over debt for several years and repayment takes place only slowly, by setting $\phi_{\tau^c} = 0.04$ and $h = 24$.

Second, we assume that repayment takes place only through labour taxes. As with VAT taxes, we also consider two cases depending on the speed of repayment. In the fast-repayment

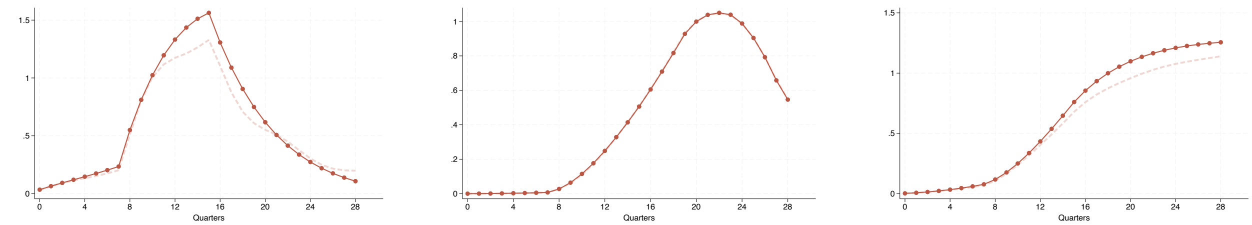
Table D.3: Baseline parameter calibration.

Parameter	**Symbol**	**Value**
Relative size of home country	ω	0.1
Monetary policy		
Interest rate smoothing	ρ_r	0.9
Stance on inflation	φ_π	1.5
Stance on output gap	φ_y	0.5
Price and wage stickiness		
Calvo wage parameter	ξ_w	0.75
Calvo price parameter	ξ_p	0.75
Markup power (markup)	θ	6.8
Calvo parameter (existing wages)	ξ_w^e	0.8
Calvo parameter (new wages)	ξ_w^n	0.8
Preferences		
Share of RoT consumers	μ	0.4
Discount rate	β	0.99
Risk aversion	σ_c	2
Habits in consumption	h	0.85
Home bias	ψ, ψ^*	0.56; 0.03
Trade in internat. bonds		
Risk premium parameter	$\psi_2 = \psi_2^*$	0.01
Production		
Private sector capital depreciation	δ^P	0.025
Public sector capital depreciation	δ^G	0.025
Public sector capital depreciation	$\delta^{I_{gdef}}$	0.025
Private sector capital share in prod.	α^P	0.45
Adjustment cost parameter	ϕ^P	1.0
Matching elasticity (private sector)	η^P	0.5
Matching elasticity (public sector)	η^G	0.5
Separation rate (private sector)	σ^P	0.060
Separation rate (public sector)	σ^G	0.030
Matching efficiency (private sector)	κ^P, κ^{p*}	0.40; 0.48
Matching efficiency (public sector)	κ^G, κ^{g*}	0.274; 0.32
Vacancy posting costs	κ_v, κ_v^*	0.4859; 0.03
Training costs	$\kappa_{tc}, \kappa_{tc}^*$	0.55; 0.55
Unemployment benefits	κ_B, κ_B^*	0.486; 0.26

*Notes:*All parameters follow Stähler and Thomas (2012).

Figure D.1: Contemporaneous VAT

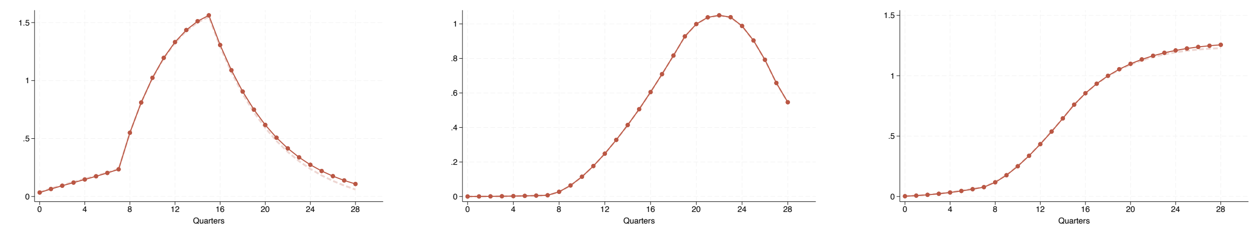
(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



Dynamic effects of a defence investment procurement shock in the model under the fiscal rule with parameters $\phi_{Sub} = 0.00$, $\phi_{\tau^c} = 1.00$, $\phi_{\tau^w} = 0.00$, and $h = 1$.

Figure D.2: Delayed VAT

(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



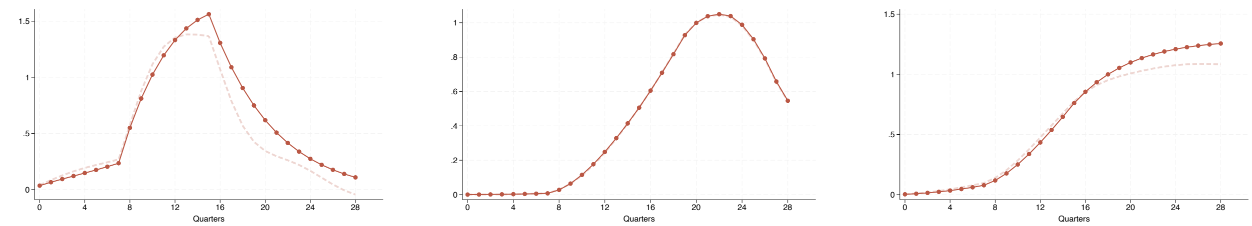
Dynamic effects of a defence investment procurement shock in the model under the fiscal rule with parameters $\phi_{Sub} = 0.00$, $\phi_{\tau^c} = 0.04$, $\phi_{\tau^w} = 0.00$, and $h = 24$.

scenario, we set $\phi_{\tau^w} = 1$ and $h = 1$, while in the slow-repayment scenario, we set $\phi_{\tau^w} = 0.04$ and $h = 24$. Figures D.3 and D.4 plot the corresponding responses to the defence investment shock under these fiscal financing schemes.

Figures D.1 and D.2 plot, with dashed lines, the responses of output, government spending, and the associated total fiscal multiplier when VAT taxes are used to repay the debt issued to finance the increase in defence investment. Similarly, Figures D.3 and D.4 plot, also with dashed lines, the corresponding responses to the defence investment shock under the fiscal financing schemes that use labour taxes. For reference, all plots include, with solid lines, the baseline responses presented in section 4.1. In all cases, we observe that the differences with respect to the baseline responses tend to be quantitatively minor. In the case of fast repayment—either through VAT or labour taxes—the overall stimulus tends to be slightly muted and, therefore, the size of the total fiscal multiplier is smaller as a result of the increase in distortionary taxes. For the case of delayed repayment, responses are almost identical to the baseline.

Figure D.3: Contemporaneous Labour Tax

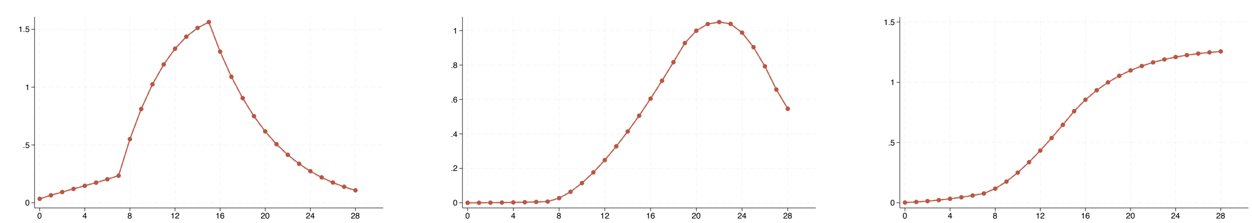
(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



Dynamic effects of a defence investment procurement shock in the model under the fiscal rule with parameters $\phi_{Sub} = 0.00$, $\phi_c = 0.00$, $\phi_{\tau^w} = 1.00$, and $h = 1$.

Figure D.4: Delayed Labour Tax

(a) Output (b) Gov. Spending (c) Total Fiscal Multiplier



Dynamic effects of a defence investment procurement shock in the model under the fiscal rule with parameters $\phi_{Sub} = 0.00$, $\phi_c = 0.00$, $\phi_{\tau^w} = 0.04$, and $h = 24$.