How Government Procurement affects Trade: Evidence from the U.S.

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Abstract

Government procurement is a major fiscal instrument, yet its implications for international trade remain poorly understood. Using granular U.S. Department of Defense contract data from 2000–2024, I provide the first industry-level evidence on how government spending shapes trade flows. Estimating panel local projections across 375 industries, I find that defense spending leads to modest but persistent increases in imports—accumulating to roughly 29% of initial spending over two years—while exports respond minimally. These effects are concentrated in industries that are defense-intensive and globally integrated, suggesting that transmission operates through supply-chain linkages within the defense industrial base. A network decomposition further shows that upstream procurement shocks generate import responses comparable to direct effects, whereas downstream procurement shocks crowd out exports at longer horizons. These findings highlight that defense spending, while predominantly domestic in nature, generates sizable fiscal leakage through international trade channels.

JEL Classification: E62, F14, H56, H57
Keywords: fiscal policy, international trade, local projections, network linkages

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1 Introduction

Government procurement represents one of the largest and most direct instruments of fiscal policy in the United States. In fiscal year 2024, federal contract obligations totaled $755 billion, of which defense contracts accounted for roughly 59% (U.S. Government Accountability Office, 2025). These contracts exhibit three distinctive features that make them particularly suitable for studying fiscal policy effects: they are highly volatile across fiscal years, granular and detailed in nature, and strongly concentrated in few sectors, with a small number of contractors receiving the lion's share of spending (Cox et al., 2024). Despite the scale and economic significance of government procurement, its open economy effects remain poorly understood.

This paper investigates how government procurement shocks affect international trade flows, providing the first industry-level analysis of this critical yet underexplored transmission channel of fiscal policy. I exploit granular variation in U.S. Department of Defense contract awards across industries and time, applying panel local projection methods. The analysis covers 375 industries at the NAICS six-digit level, observed monthly over 25 fiscal years from October 2000 to September 2024. The empirical strategy further incorporates a network decomposition based on domestic input–output linkages to distinguish direct effects on contract recipients from indirect effects transmitted through supplier and customer relationships. Finally, I examine heterogeneity by defense intensity and trade openness to identify the industries that primarily drive these trade responses.

Government procurement affects international trade through multiple channels, operating from both government and firm perspectives. From the government's standpoint, procurement policies directly influence trade through home bias in purchasing decisions and strategic industrial support. Home bias manifests through both explicit provisions, such as Buy American requirements mandating minimum domestic content thresholds, and implicit barriers created by complex compliance rules, security clearances, and procurement procedures that disproportionately disadvantage foreign suppliers. These policies shift demand toward domestic producers, potentially reducing imports of goods and services that government agencies directly procure. Beyond these market access restrictions, governments can deploy procurement as an industrial policy tool, directing contracts toward sectors with high export potential or technological importance. By providing stable demand that allows nascent industries to achieve scale and develop competitive capabilities, procurement can enhance long-run export competitiveness in strategically targeted sectors such as aerospace, advanced manufacturing, or emerging technologies.

From the firm's perspective, winning government contracts triggers several responses that affect trade behavior. First, large procurement awards provide guaranteed revenue that enables firms to expand production and realize economies of scale, reducing costs and potentially improving competitiveness in domestic and international markets. Second, securing a federal contract, particularly in defense or high-technology sectors, serves as a powerful quality signal, certifying the firm's ability to meet stringent performance, reliability, and security standards. This certification effect enhances

firm reputation and reduces information frictions that might otherwise impede entry into foreign markets. Third, government contracts often require substantial R&D investments to meet demanding technical specifications. The stable funding base they provide can de-risk innovation spending, stimulating productivity growth and technological advancement that ultimately strengthen export capacity. Finally, procurement creates indirect effects through supply chains. When prime contractors receive government orders, they increase demand for intermediate inputs from upstream suppliers. These suppliers may themselves source components or materials from abroad, creating a channel through which domestic procurement can indirectly increase imports.

Theoretical frameworks offer competing predictions about the fiscal policy-trade relationship. The traditional Keynesian view emphasizes aggregate demand channels. Government spending boosts overall economic activity, including demand for imports, generating *twin deficits* where budget deficits lead to trade deficits. The Mundell-Fleming framework introduces exchange rate and monetary policy considerations. Fiscal expansion can strengthen the domestic currency through higher interest rates, making imports cheaper and exports more expensive. The ultimate trade effect depends on capital mobility and exchange rate flexibility. The neoclassical intertemporal approach focuses on saving-investment dynamics, arguing that trade effects depend critically on whether fiscal changes are perceived as permanent or temporary. Households smooth consumption over time, so temporary spending increases current account deficits, while permanent changes have muted trade impacts as households adjust saving accordingly. These competing theoretical predictions, combined with mixed empirical evidence to date, underscore the need for careful empirical analysis using credibly exogenous variation in government spending. My paper contributes to this literature by providing new industry-level evidence on the international spillovers of fiscal spending, using plausibly exogenous variation in U.S. government procurement to isolate causal effects on trade flows. The analysis focuses on industry-level responses in a partial-equilibrium framework, providing a granular view of how fiscal shocks transmit through production networks.

My analysis yields several key findings. Defense procurement generates modest but persistent import increases, accumulating to approximately 29% of the initial spending over a two-year horizon, with minimal corresponding export response. These effects concentrate exclusively in industries characterized by high defense intensity, those receiving substantial procurement relative to their revenue, and high trade openness, measured by the ratio of trade flows to industry revenue. Industries outside the defense industrial base, including those with low defense exposure or predominantly domestic orientation, show no significant trade responses to procurement shocks. This concentration pattern establishes that the mechanisms operate through global supply chain integration in complex weapons production rather than through economy-wide aggregate demand spillovers that would affect civilian sectors broadly.

Network decomposition using input-output linkages reveals that procurement affects trade through both direct channels, industries receiving contracts adjusting their own import and export behavior, and indirect propagation through supplier and customer relationships. Own-industry effects remain stable when controlling for network shocks, but supply chain channels contribute substantially to

aggregate impacts. Upstream shocks, defined as procurement to an industry's suppliers weighted by input-output linkage strength, generate import increases comparable in magnitude to direct effects. Downstream shocks, representing procurement to an industry's customers, crowd out exports at longer horizons as recipient industries reallocate output to meet elevated domestic government demand. These findings prove robust to alternative identification strategies and specifications, including residualized procurement that isolates unanticipated shocks, pre-trends tests that check for anticipation bias and reverse causality, and long-difference specifications that address potential dynamic misspecification.

The findings have several implications for policy design and evaluation. Import leakage implies that conventional closed-economy fiscal multiplier calculations overstate the domestic spending retention rate and should be adjusted downward to account for trade leakage. Buy American provisions and domestic content requirements appear to constrain imports relative to civilian manufacturing procurement, but they do not eliminate foreign sourcing in globally integrated defense sectors where complex weapons systems require specialized components unavailable domestically. Given the sizable network effects, policymakers evaluating procurement programs cannot focus solely on direct recipients but must account for supply chain propagation. The minimal export response suggests that defense spending primarily serves its direct purpose of acquiring military capabilities, with limited spillovers to export competitiveness, cautioning against relying on defense procurement as an industrial policy tool for boosting export sectors.

Related Literature. This paper contributes to multiple strands of economic research, bridging literatures on fiscal policy, international trade, and production networks. In the fiscal policy literature, it extends extensive work on fiscal multipliers and the real effects of government spending. Seminal contributions by Ramey and Shapiro (1998) documented that military buildups generate sectoral reallocation and productivity costs, while subsequent research refined our understanding of output multipliers using various identification strategies (Auerbach and Gorodnichenko, 2013; Nakamura and Steinsson, 2014). Recent methodological advances have emphasized estimating dynamic effects through local projection methods (Auerbach et al., 2019, 2022) and documenting heterogeneity across economic states (Ramey and Zubairy, 2018). Related work by Komarek et al. (2022) and Briganti (2023) shows that the sectoral composition of procurement affects local multipliers, with differential effects depending on whether spending targets manufacturing versus services. While this literature has thoroughly characterized domestic employment and output responses, it has paid limited attention to international spillovers through trade flows. I contribute to this research by being, to my knowledge, one of the first to systematically connect granular procurement shocks, network decomposition, and industry-level trade outcomes.

The paper also contributes to emerging research using granular federal contract data to study regional and sectoral economic effects. di Giovanni et al. (2022) and Bouakez et al. (2023) examine how geographically localized procurement affects local economies, while Proebsting (2022) studies firm-level responses to contract awards. Barattieri et al. (2023) and Cox et al. (2024) document sub-

stantial heterogeneity in procurement effects across industries. While these studies have advanced our understanding of how procurement propagates domestically, none have systematically linked this propagation to international trade. My analysis explicitly connects industry-level procurement variation to exports and imports, revealing that global supply chain integration in the defense industrial base generates trade consequences that previous domestic-focused studies have overlooked.

In the international trade and fiscal policy literature, this paper addresses how government spending affects external balances. Theoretical work has long recognized that government spending can affect the current account through multiple channels (Monacelli and Perotti, 2010; Kim, 2015; Miyamoto et al., 2019), with recent empirical contributions examining fiscal consolidations (Born et al., 2019; Ferrara et al., 2021; Born et al., 2024) and the relationship between government size and trade openness (Rodrik, 1998; Epifani and Gancia, 2009; Ilzetzki et al., 2013). However, this literature largely focuses on aggregate fiscal variables, like total government spending or deficit measures, missing the rich heterogeneity in how different types of spending affect trade. By studying procurement specifically and exploiting industry-level variation, I provide evidence that the composition of government spending matters significantly for trade outcomes, addressing identification challenges that plague cross-country studies where fiscal policy and trade openness are simultaneously determined.

The integration of production network analysis represents a significant methodological innovation, connecting this work to foundational contributions in network economics. Acemoglu et al. (2012) and Carvalho (2014) demonstrated that production networks can substantially amplify idiosyncratic shocks through input-output linkages, while subsequent research has explored structural dependencies (di Giovanni et al., 2014; Carvalho and Tahbaz-Salehi, 2019) and innovation-driven interactions (Acemoglu et al., 2016). Recent applications have shown how network structures affect the transmission of trade shocks (Barrot and Sauvagnat, 2016) and monetary policy (Ozdagli and Weber, 2017). The granular approach to macroeconomics (Gabaix, 2011), combined with methods for identifying production network effects (Boehm et al., 2019), provides the conceptual foundation for network decomposition in studying procurement effects. Building on Barattieri et al. (2023), who decompose procurement shocks into own-industry, upstream, and downstream components to study domestic employment and wage effects, I extend this network decomposition framework to international trade flows. I am the first to estimate how these distinct network channels affect exports and imports, demonstrating that production network considerations are essential for understanding fiscal policy transmission in open economies.

The rest of the paper is organized as follows. Section 2 describes the data sources, providing descriptive analysis of temporal and sectoral patterns in procurement and trade. Section 3 outlines the econometric strategy, including the local projection specification and network decomposition. Section 4 presents the main findings on baseline effects, network effects, and heterogeneity analysis, discussing economic mechanisms and interpretation. Section 6 concludes.

2 Data and Institutional Background

This section describes the datasets used in my analysis and presents key descriptive patterns that motivate the empirical strategy. I draw on two primary data sources: Department of Defense contract data from USASpending.gov, and international trade flows from the U.S. International Trade Commission. Understanding the institutional features of defense procurement and the structure of U.S. trade flows is essential for interpreting the econometric results that follow.

2.1 Defense Procurement Data

2.1.1 Data Source and Coverage

I obtain data on federal contracts from USASpending.gov, the official U.S. government website that tracks federal spending since fiscal year 2001. This comprehensive transaction-level dataset links contract awards above $25,000 to recipient firms, with detailed information on awarded amounts, contract duration, performance location, and industry classification using the North American Industry Classification System (NAICS). Federal contracts represent a substantial fiscal instrument in the U.S. economy, accounting for approximately 40% of federal government spending and 16% of total government spending at all levels (Cox et al., 2024). This paper focuses specifically on defense procurement contracts, which constitute the single largest category of federal contracting activity. The magnitude and persistence of defense spending make it a particularly valuable setting for studying fiscal policy effects, as contracts often span multiple years and involve significant dollar amounts that can materially affect recipient industries.

The sample covers defense contracts from fiscal year 2001 through fiscal year 2024, providing nearly a quarter-century of data spanning multiple business cycles, defense buildups, and drawdowns. The raw dataset contains 45.68 million individual contracts totaling $7,736 billion in nominal dollars. Each observation represents a discrete contract, creating a rich panel structure that tracks the temporal and cross-sectional evolution of defense procurement.

2.1.2 The Defense Procurement Process: An Overview

To interpret the contract data and understand their suitability for studying trade effects, it is helpful to first outline the basic institutional features of federal defense procurement. The process involves several stages, each with implications for data interpretation and empirical strategy.

Before bidding on federal contracts, firms must register in the System for Award Management (SAM), a centralized database maintained by the General Services Administration. Registration requires firms to provide basic information (legal name, address, tax identification), designate relevant indus-

try codes (NAICS) for their capabilities, and undergo various certifications (small business status, disadvantaged business status, etc.). For defense contracts involving classified information or sensitive technologies, firms must also obtain appropriate facility security clearances from the Defense Counterintelligence and Security Agency, a process that can take months or years and requires background checks, physical security measures, and information security protocols. This registration requirement ensures that the USASpending.gov data capture the universe of potential contractors, though it means that the pool of eligible bidders is not infinitely elastic—particularly for classified or high-technology contracts where security clearances create entry barriers.

When a military program office or contracting agency identifies a procurement need, it issues a solicitation (Request for Proposal or Invitation for Bid) specifying requirements, evaluation criteria, and submission deadlines. Qualified firms submit bids containing technical proposals, cost estimates, and past performance documentation. The government evaluates submissions according to pre-announced criteria, typically either *lowest price technically acceptable* or *best value* (balancing cost and technical merit), and awards the contract to the selected offeror. This process typically takes 3-6 months for competitive awards, though urgent or simplified acquisitions may be faster, and major weapons systems can involve year-long competition periods. The timing matters for my analysis: I date contracts to the month of award (when the obligation is recorded), but firms may anticipate potential awards months earlier based on solicitation announcements, creating possible anticipation effects that I address through competitive contracting filters.

When a contract is awarded, the government records an *obligation*—a legal commitment to pay up to the specified contract value if the contractor performs. However, the government does not immediately transfer funds. Instead, *outlays* (actual payments) occur incrementally as the contractor delivers goods, meets performance milestones, or submits invoices. For a multi-year aircraft contract, for example, the full $500 million obligation might be recorded in month 1, but outlays occur monthly over 36 months as production progresses. This obligation-outlay distinction is crucial for interpreting my treatment variable, which uses obligations (the data available in USASpending.gov) rather than the theoretically preferable but unobserved outlays.

After award, contractors perform work according to specifications, with government oversight through contracting officers and quality assurance personnel. For goods contracts in my sample, performance typically involves manufacturing, testing, delivery, and acceptance by the government. Contracts may be modified during performance to adjust quantities, extend deadlines, or accommodate scope changes, with each modification generating a new transaction in the USASpending.gov database. Upon successful completion, the government closes the contract and any unspent obligated funds are de-obligated (recorded as negative values in the data, which I remove as described below).

2.1.3 Understanding Defense Contract Awards

The previous overview described the general procurement lifecycle. Here, I focus specifically on *how* contracts are awarded, as award methods have direct implications for the identification strategy. The federal government uses multiple procurement methods, each with different implications for predictability and competition:

Full and open competition requires that all qualified firms can submit bids, with contracts awarded based on objective evaluation criteria (typically *lowest technically acceptable price* or *best value*). These competitive awards are relatively unpredictable to individual firms, as outcomes depend on the evaluation of multiple bids. The competitive process typically takes several months from solicitation to award, and firms cannot perfectly anticipate winning.

Sole-source contracts are awarded to a single firm without competition, often justified by unique capabilities, urgency, or national security considerations. These contracts may be more predictable, particularly when they represent follow-on awards to existing prime contractors.

Limited competition restricts bidding to a subset of firms (e.g., small businesses, specific geographic areas, or qualified vendors on existing contracts). These awards fall between pure competition and sole-source in terms of predictability.

This distinction matters for identification. Following the fiscal multiplier literature (Demyanyk et al., 2019; Auerbach et al., 2019; Barattieri et al., 2023; Cox et al., 2024), I focus on competitively awarded contracts because they are less predictable to recipients and thus more plausibly approximate exogenous fiscal shocks at the firm and industry level.

2.1.4 Data Processing and Sample Construction

I apply several filters to construct an analysis sample suitable for studying trade effects. Each filter serves a specific purpose related to either data quality or research design.

I retain only contracts awarded through full and open competition. This restriction addresses anticipation effects—if firms know they will receive contracts (as with sole-source awards to established primes), they may adjust employment, production, and trade patterns before the official award date. Competitive contracts are less predictable, making the award itself more informative. This filter removes 16.61 million contracts (36.3% of count) valued at $4,303 billion (55.6% of value), reflecting that the largest contracts often involve sole-source or limited competition for specialized weapons systems.

Since international trade data covers merchandise trade (goods) but not services trade, I exclude service contracts to ensure commensurability between treatment and outcomes. Service contracts include categories such as consulting, facilities management, medical services, and R&D. This filter drops 13.72 million contracts (30% of count) valued at $1,780 billion (23% of value). The lower value

share indicates that goods contracts tend to be larger on average, consistent with major procurement programs for aircraft, ships, vehicles, and equipment.

I restrict the sample to contracts performed within the United States. Including foreign-performed contracts would create measurement issues—a contract performed in Germany, for example, does not represent a U.S. domestic fiscal shock, even though it appears in DoD obligation data. This filter removes 1.28 million contracts (2.8% of count) valued at $371 billion (4.8% of value). The relatively high value share of foreign-performed contracts reflects large overseas construction and logistics contracts supporting U.S. military bases abroad.

I drop contracts with inconsistent dates (such as end dates before start dates) that indicate data entry errors. Additionally, I remove terminated contracts by matching de-obligations to original contracts based on recipient identifiers, location, and dollar amounts. Contract termination is relatively rare but can occur due to poor performance, changed requirements, or budget cuts. These quality filters remove 0.09 million contracts (0.2% of count) valued at $23 billion (0.3% of value). The small magnitudes indicate that data quality in USASpending.gov is generally high for the filtered sample.

The final analysis dataset includes 14.04 million contracts valued at $1,265 billion—30.7% of the original contract count and 16.4% of the original dollar value. While this represents a substantial reduction in both dimensions, the filters are necessary to isolate fiscal shocks that are: (1) relatively unpredictable (competitive), (2) relevant for goods trade (excluding services), (3) domestic in nature (excluding foreign performance), and (4) accurately recorded (excluding errors and terminations).

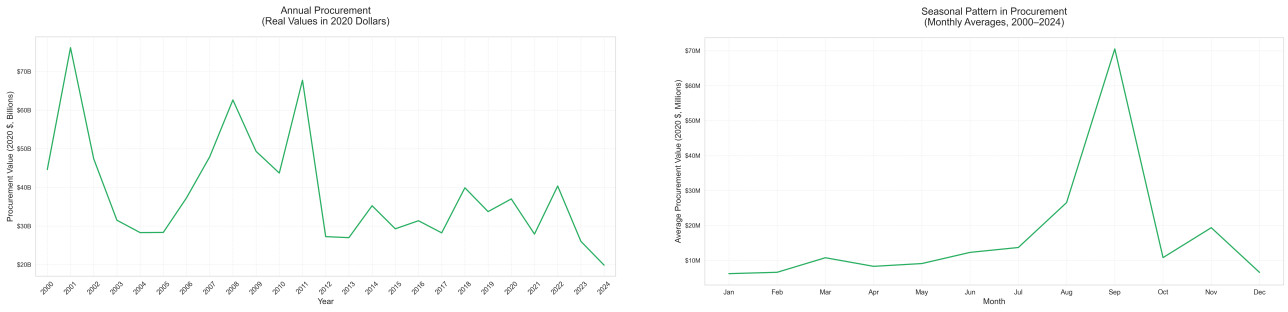
Treatment variable. I aggregate contract obligations to the industry-month level using NAICS six-digit industry codes hamonized to the NAICS 2017 version. My primary treatment measure assigns the full contract obligation to the month of signing. Ideally, one would use contract outlays, the actual cash payments from the government to contractors, as the treatment variable, since outlays represent the true flow of fiscal resources into industries. However, outlay data are not publicly available at the industry-month granularity required for this analysis.

Despite this data limitation, obligations remain an appropriate treatment measure for several reasons. First, obligations capture the initial fiscal impulse: when a contract is signed, firms immediately adjust hiring, production planning, and procurement decisions in anticipation of future production needs, even though cash payments arrive gradually. These immediate responses are precisely what local projection methods aim to trace over subsequent horizons. Second, the fiscal multiplier literature routinely uses obligations rather than outlays when studying defense procurement effects (Nakamura and Steinsson, 2014; Auerbach et al., 2019; Cox et al., 2024), establishing obligations as the standard approach when outlay data are unavailable. Third, for the competitive contracts in my sample, obligations are relatively unpredictable to firms, making them suitable for identifying causal effects despite the timing mismatch between commitment and payment.

2.1.5 Temporal Patterns in Defense Procurement

Long-run trends. Figure 1 (left panel) displays yearly contract totals over the sample period. Several features are immediately apparent. First, real procurement exhibits substantial variation, ranging from under $30 billion in 2003-2005 to over $75 billion in 2001 and 2011. These fluctuations reflect both policy decisions (defense buildups and drawdowns) and major geopolitical events.

The time series reveals three distinct periods. The early 2000s showed elevated procurement associated with post-9/11 military mobilization and the wars in Afghanistan and Iraq. Contract values peaked in 2001 and 2011, reaching about $70 billion annually, driven by ongoing overseas operations and associated equipment needs. Since 2012, procurement has declined substantially, falling below $30 billion by 2024. This decline reflects both the drawdown of overseas operations and broader fiscal constraints, including the Budget Control Act of 2011 which imposed caps on defense discretionary spending.



(a) Annual Contract Totals

(b) Monthly Averages (Seasonal Pattern)

Figure 1: Temporal Patterns in Defense Procurement

Notes: Panel (a) shows annual contract totals in real 2020 dollars. Panel (b) shows monthly averages across all years. The September spike reflects fiscal year-end budget pressures.

Fiscal year seasonality. Figure 1 (right panel) reveals one of the most striking patterns in federal procurement: sharp spikes in August and September, the final two months of the federal fiscal year. Monthly averages rise from around $10-20 million in most months to over $70 million in September, nearly a four-fold increase.

This end-of-year surge reflects well-documented "use-it-or-lose-it" budget dynamics in government agencies (Liebman and Mahoney, 2017). Federal agencies operate under annual appropriations that expire at the end of the fiscal year (September 30). Unobligated funds generally cannot be carried forward to the next year, creating strong incentives for program managers to commit remaining budget authority before the deadline. This institutional feature generates predictable within-year variation in the timing of contracts, even if the total annual amount is less predictable.

For empirical analysis, this seasonality has an important implication. It underscores the importance of including time fixed effects in the econometric specification, as month-specific effects will absorb

these fiscal year patterns that are common across all industries.

2.1.6 Sectoral Distribution of Defense Procurement

Figure 2 ranks industries by total contract value over the entire sample period. The distribution is highly concentrated. The top 20 industries account for the vast majority of procurement spending, with the top 10 alone receiving over 70% of total obligations.

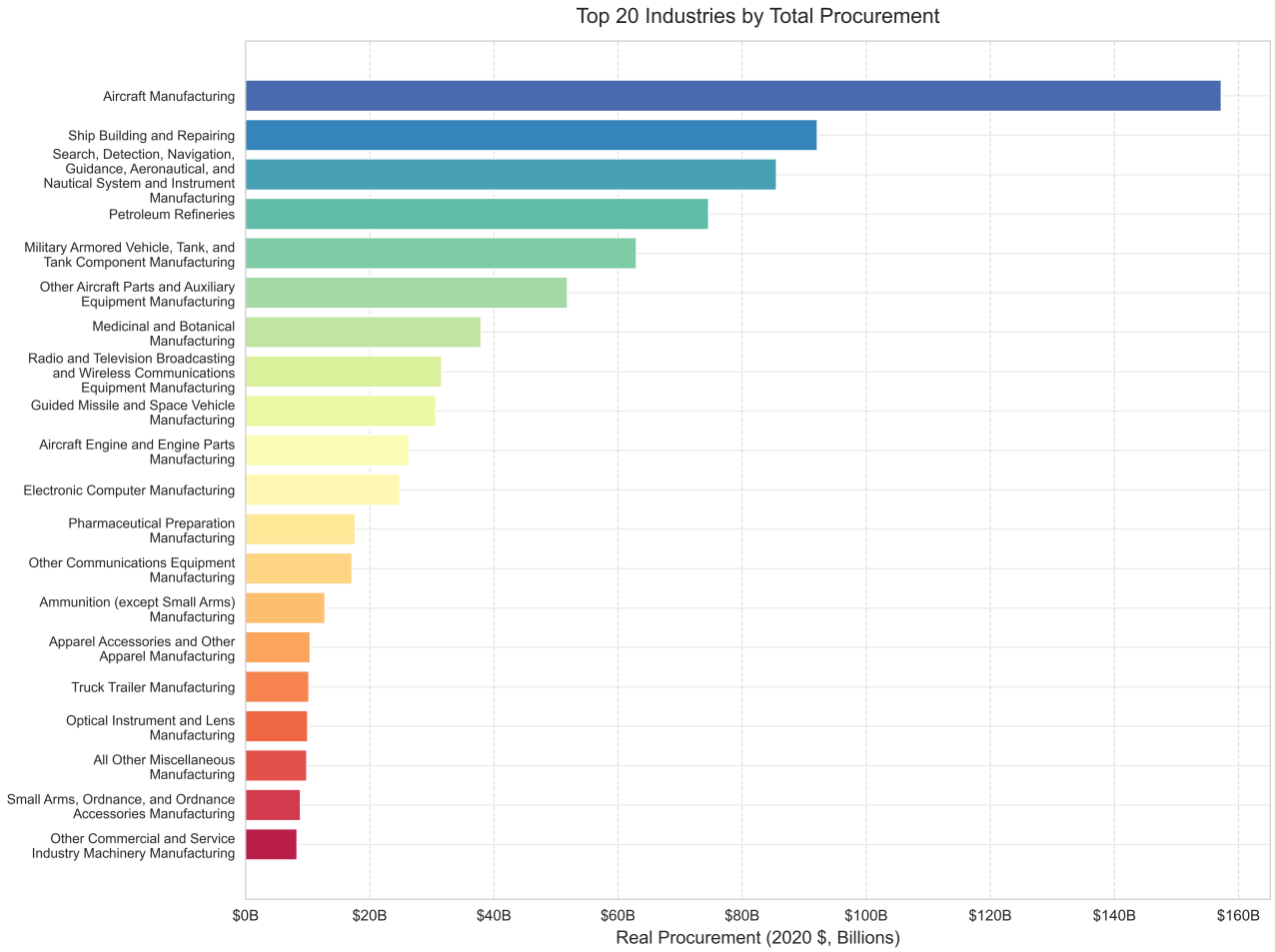


Figure 2: Top 20 Industries by Total Procurement Value, FY 2001-2024

Notes: Values in real 2020 dollars. Aircraft manufacturing dominates, followed by ship building and repairing. Consumer goods industries have minimal defense exposure.

Aircraft manufacturing dominates overwhelmingly, with $157 billion in contracts, nearly 70% more than the second-place industry. This includes production of fighter aircraft (F-16, F-18, F-35), bombers (B-2, B-21), transport aircraft (C-17, C-130), helicopters (Apache, Black Hawk), and unmanned aerial vehicles. Ship building and repairing ranks second with $92 billion, covering aircraft carriers, destroyers, submarines, amphibious assault ships, and maintenance of the naval fleet. Search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing appears third with $86 billion. This broad category encompasses radar systems, sonar equipment, GPS and inertial navigation systems, fire control systems, and targeting equipment.

This sectoral concentration confirms patterns documented by Ramey and Shapiro (1998) and recently verified by Cox et al. (2024)—defense procurement is not evenly distributed across the economy but instead flows disproportionately to a small number of specialized industries that produce weapons systems, platforms, and supporting technologies.

Notably, consumer goods industries, food products, beverages, textiles, apparel, furniture, household goods, appear far down the distribution with minimal defense exposure. Even when the military procures these items (uniforms, rations, furnishings), the dollar amounts pale in comparison to major weapons systems. This heterogeneity in defense intensity across industries is not merely a matter of degree but represents a fundamental distinction between defense contractors deeply embedded in military procurement and civilian industries largely outside the defense ecosystem.

This cross-sectional heterogeneity motivates a central question for subsequent analysis—do procurement effects on trade vary systematically by defense intensity? If effects operate through direct defense supply chains, we might expect stronger responses in high-defense industries. Alternatively, if effects operate through aggregate demand or general equilibrium channels, low-defense industries might respond as much or more than direct contractors.

2.2 International Trade Data

2.2.1 Data Source and Coverage

I obtain trade data from the U.S. International Trade Commission's DataWeb (USITC), which provides comprehensive monthly statistics on U.S. merchandise trade flows compiled from U.S. Census Bureau records. The dataset covers general imports (imports for consumption plus imports into bonded warehouses), total exports (domestic exports plus re-exports), and the implied trade balance at the NAICS six-digit industry level from October 2000 through September 2024.

This trade data tracks only trade in goods, excluding services trade entirely. Consequently, my analysis is limited to goods-producing industries and cannot speak to how defense procurement affects service exports or imports, which comprise roughly one-third of total U.S. trade. However, this limitation aligns naturally with the defense contract data, which also predominantly covers goods procurement after the filtering described above.

The trade data are reported in nominal dollars at the monthly frequency, matched to shipment date for exports and entry date for imports. I convert all values to real 2020 dollars using industry-specific price deflators from the Bureau of Economic Analysis (Producers Price Index), ensuring that observed trade fluctuations reflect quantity changes rather than price movements. The deflation procedure accounts for differential price trends across industries, which is particularly important given that high-technology goods (electronics, aircraft) have experienced different inflation rates than commodities (petroleum, raw materials) or manufactured consumer goods.

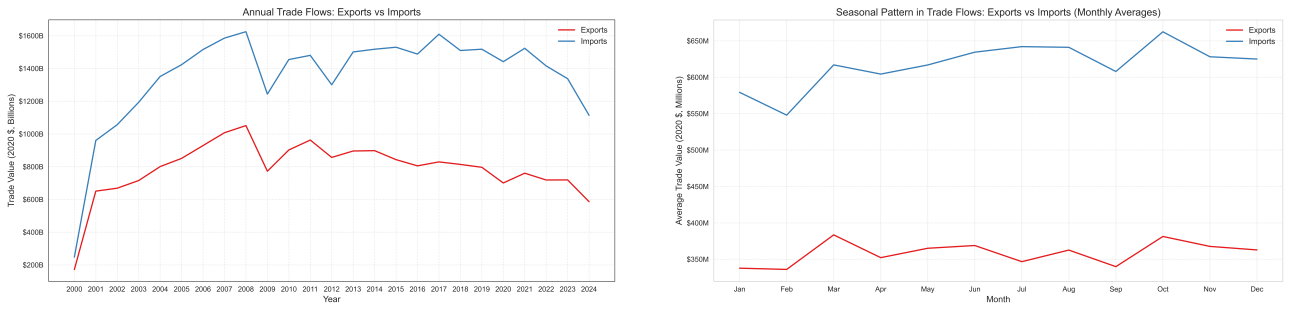
2.2.2 Temporal Patterns in U.S. Trade

Long-run evolution. Figure 3 (left panel) shows the evolution of real U.S. exports and imports over the sample period. Both series display several notable features. First, imports substantially exceed exports throughout the period, reflecting the persistent U.S. trade deficit. The gap between the lines represents the trade balance, which average approximately $600-800 billion annually in real terms.

Second, both series show gradual upward trends through the 2000s, consistent with the general expansion of global trade and the deepening of international production networks. Note that 2000 appears artificially low because data coverage begins in October 2000. Between 2001 (the first complete year) and 2008, real imports grew approximately 60% (from $1,000 billion to $1,600 billion), while exports increased similarly from $650 billion to $1,050 billion.

Third, two sharp disruptions interrupt these trends: the 2008-2009 financial crisis and the 2020 COVID-19 pandemic. During the financial crisis, trade collapsed dramatically—imports fell by nearly 25% peak-to-trough, with exports experiencing similar declines. The COVID-19 pandemic induced another sudden but shorter-lived contraction. Imports fell by approximately 20% in early 2020 as global production halted and international shipping faced severe constraints.

Fourth, the post-2018 period exhibits greater volatility, likely reflecting trade policy uncertainty, tariff changes, pandemic disruptions, and supply chain realignments. This increased volatility underscores the importance of controlling for aggregate time shocks in my empirical specification, as industry-level trade flows in recent years contain substantial common variation unrelated to defense procurement.



(a) Annual Trade Totals

(b) Monthly Averages (Seasonal Pattern)

Figure 3: Temporal Patterns in U.S. Trade Flows

Notes: Panel (a) shows annual totals for exports and imports in real 2020 dollars. Panel (b) shows monthly averages across all years. Trade shows limited seasonality compared to procurement.

Seasonal patterns. Figure 3 (right panel) presents monthly averages, revealing relatively muted seasonal patterns in trade flows compared to procurement. Imports show a slight upward drift from spring through fall, possibly reflecting the buildup of inventories ahead of holiday shopping

seasons, with a noticeable dip in February (the shortest month, which may create mechanical effects in monthly averages). Exports exhibit even less seasonality, oscillating modestly around $350-380 million throughout the year.

The contrast with procurement seasonality is striking: while defense contracting shows extreme fiscal year-end spikes, trade flows remain relatively stable across months. This suggests that seasonal effects, if present, are much weaker in trade than in government spending, or alternatively that trade seasonality operates on a calendar-year basis (holiday shipping) rather than a fiscal-year basis, creating different timing patterns.

2.2.3 Sectoral Patterns in Imports

Figure 4 shows the top 20 importing industries ranked by total import value over the sample period. The distribution is notably more concentrated than exports, with the top industries accounting for a larger share of total trade.

Automobile manufacturing dominates with over $2,600 billion in imports, dwarfing all other categories. This reflects multiple factors: strong U.S. demand for vehicles, substantial foreign production by both U.S.-based firms and foreign manufacturers, and the integration of automotive supply chains globally. Pharmaceutical preparation manufacturing ranks second with $1,900 billion, highlighting U.S. dependence on imported medications and active pharmaceutical ingredients. Much pharmaceutical production has shifted to India, Ireland, and Puerto Rico, while high-value branded drugs are imported from European manufacturers. Radio and television broadcasting and wireless communications equipment appears third with $1,800 billion, covering smartphones, tablets, telecommunications infrastructure, and related electronics. This category reflects the offshore production of consumer electronics, with imports predominantly from China, Vietnam, and other East Asian manufacturing hubs.

Comparing import composition to procurement reveals distinct patterns. Several top import categories (automobiles, pharmaceuticals, consumer electronics) have minimal defense procurement, indicating they are civilian sectors largely outside the defense industrial base. However, some important defense sectors (semiconductors, telecommunications, electronics) are also major import categories, suggesting that defense contractors themselves rely heavily on imported components and materials.

2.2.4 Sectoral Patterns in Exports

Figure 5 displays the top 20 exporting industries. The composition reveals U.S. comparative advantages in specific sectors. Petroleum refining leads with over $1,030 billion in total exports, reflecting the transformation of U.S. energy markets following the shale revolution. While the U.S. imports

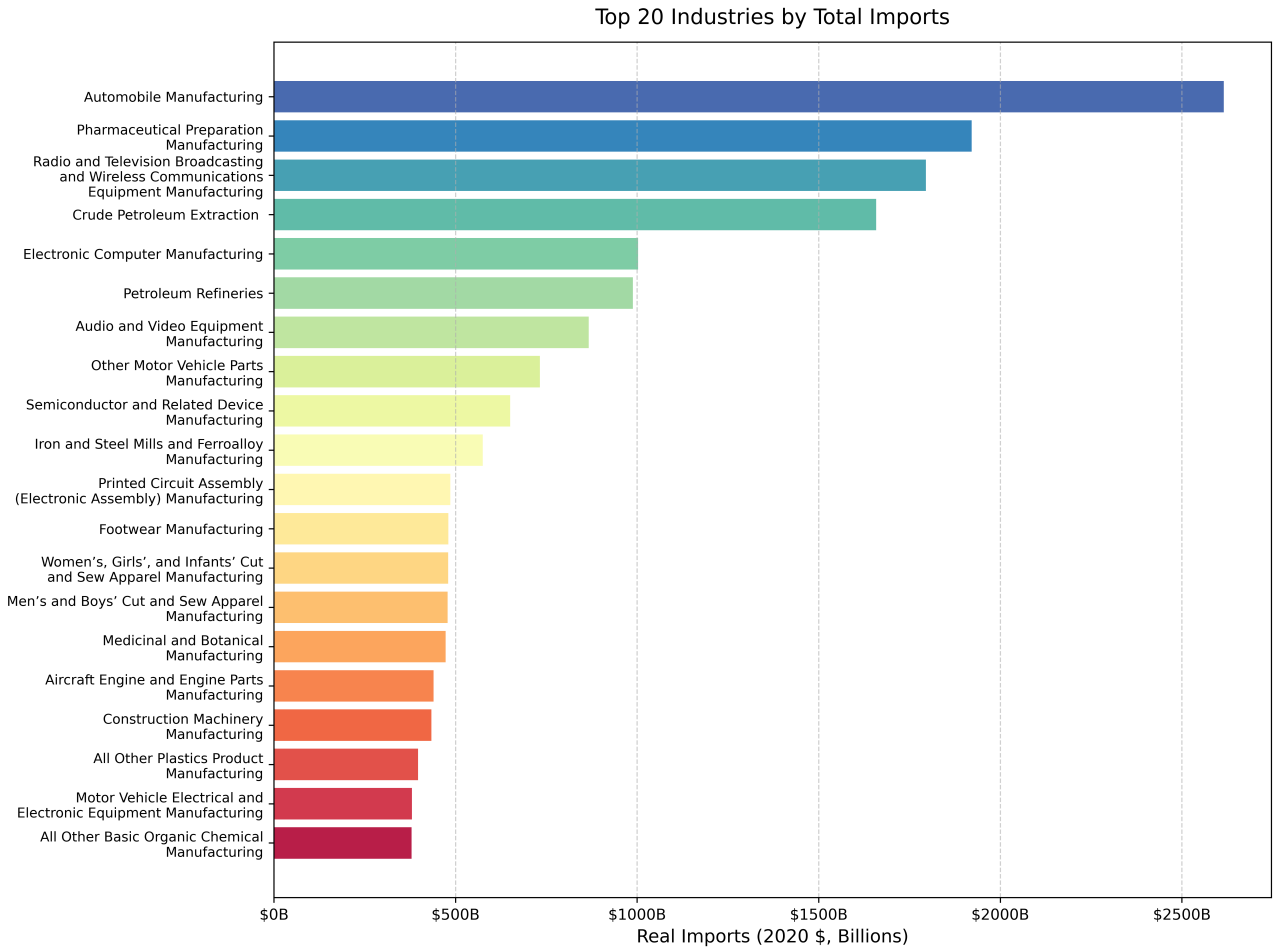


Figure 4: Top 20 Industries by Total Import Value, 2000-2024

Notes: Values in real 2020 dollars. Automobile manufacturing dominates, followed by pharmaceuticals and electronics. Import distribution is more concentrated than exports. Comparison with Figure 2 shows some overlap in electronics and high-technology sectors.

crude petroleum, it exports refined products (gasoline, diesel, jet fuel) to global markets, particularly Latin America and Asia. Pharmaceutical preparation manufacturing ranks second with $881 billion, encompassing prescription medications, over-the-counter drugs, vaccines, and biologics. The U.S. pharmaceutical industry's strength in research-intensive drug development, combined with intellectual property protections and high domestic prices, enables substantial exports of branded and specialty medications to global markets. Semiconductor and related device manufacturing appears third with $764 billion, reflecting U.S. strength in designing and producing advanced chips even as basic manufacturing has shifted offshore. This category includes microprocessors, memory chips, and specialized semiconductors for communications, computing, and defense applications.

Comparing export composition to procurement patterns (Figure 2) reveals limited overlap. Aircraft manufacturing, a major procurement recipient, does appear among significant export sectors (though outside the top three), suggesting some defense contractors are also major exporters. However, the top three export sectors (petroleum refining, pharmaceuticals, semiconductors) receive minimal defense procurement relative to their economic importance, while many top defense sectors (shipbuilding, military vehicles, weapons systems) export little to foreign buyers due to arms

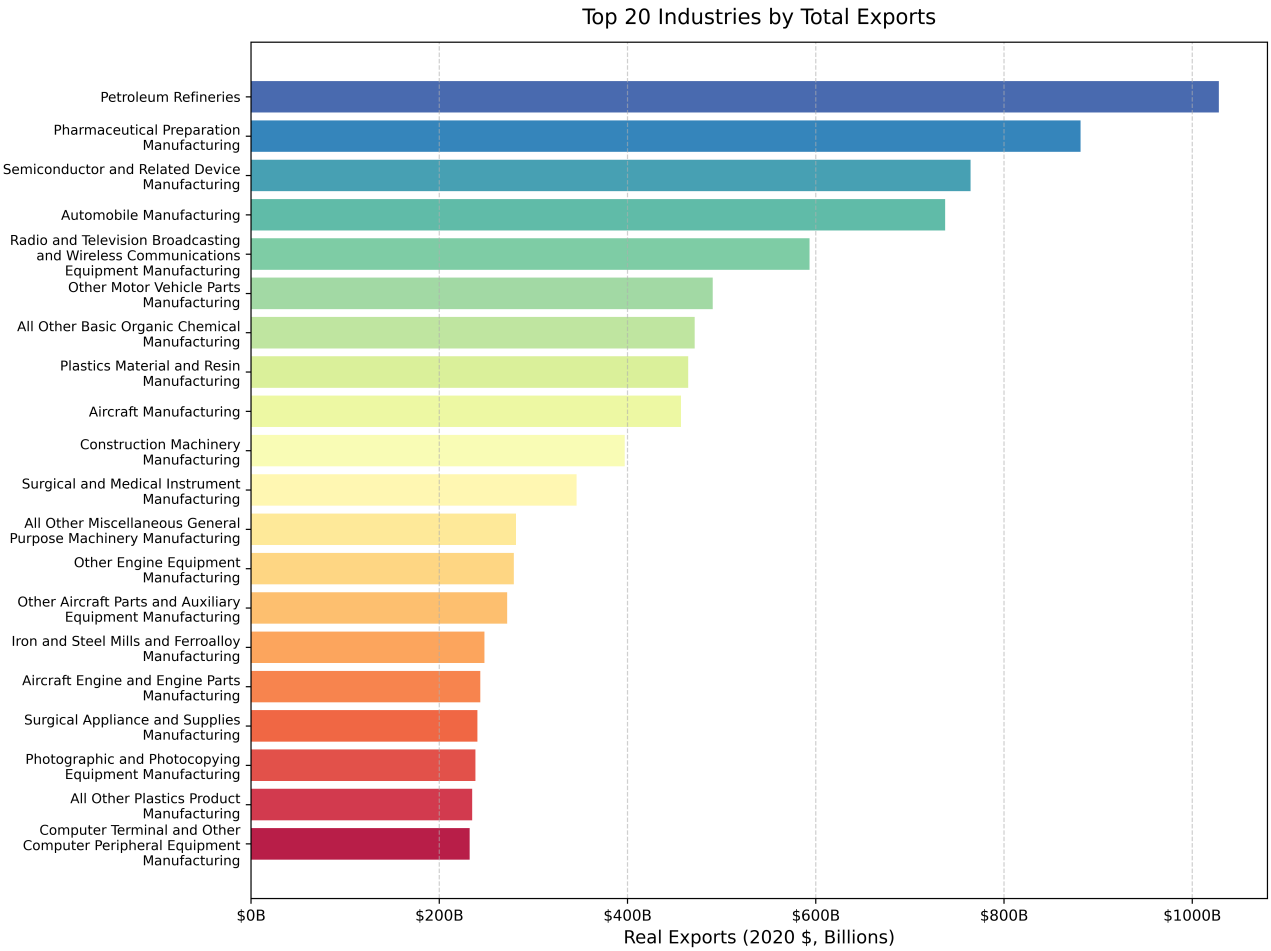


Figure 5: Top 20 Industries by Total Export Value, 2000-2024

Notes: Values in real 2020 dollars. Petroleum refining, pharmaceuticals, and semiconductors dominate U.S. exports. Comparison with Figure 2 shows limited overlap between defense-intensive and export-intensive industries.

export controls and specialized military specifications.

The descriptive statistics alone suggest that the defense industrial base is not a uniform entity but rather a heterogeneous collection of industries with different trade exposures, supply chain positions, and integration into global production networks. Understanding how procurement effects vary across this landscape is central to evaluating the aggregate trade consequences of defense spending and to designing policies that account for supply chain realities.

3 Empirical Strategy

3.1 Baseline Specification

I estimate the dynamic causal effects of defense procurement on trade flows using local projections (Jordà, 2005). This approach offers several advantages over vector autoregressions (VARs) for esti-

mating impulse response functions in panel settings. First, local projections do not impose the strong parametric restrictions inherent in VAR models. This allows the data to determine the shape of dynamic responses without assuming a specific lag structure applies uniformly across all horizons. Second, they are robust to misspecification: even if the underlying data-generating process is nonlinear or has time-varying parameters, local projections remain consistent for the average impulse response (Plagborg-Møller and Wolf, 2021). Third, they accommodate large panels with industry and time fixed effects more naturally than VAR frameworks. Fourth, they allow straightforward incorporation of control variables and heterogeneous treatment effects across subsamples.

3.1.1 Panel Structure and Identification

The data form an unbalanced panel of 375 NAICS industries observed over 288 months from October 2000 to September 2024, yielding approximately 55,000 industry-month observations after harmonizing at the NAICS 2017 version. The panel structure is:

$$\{(G_{it}, Y_{it}^{imp}, Y_{it}^{exp}, Y_{it}^{tb}) : i = 1, \ldots, 375; \quad t = 1, \ldots, 288\}$$

where G_{it} denotes real defense procurement obligations (in 2020 dollars) for industry i at month t, and Y_{it}^{imp}, Y_{it}^{exp}, Y_{it}^{tb} denote real imports, exports, and trade balance respectively.

Identification relies on the assumption that conditional on industry and time fixed effects plus 18 lags of procurement and outcomes, contemporaneous procurement shocks are as-good-as-randomly assigned to industries. Formally, I assume:

$$E[\varepsilon_{it+h} \mid G_{it}, G_{it-1}, \ldots, G_{it-18}, Y_{it-1}, \ldots, Y_{it-18}, \alpha_i, \lambda_t] = 0$$

where ε_{it+h} is the error term at horizon h, α_i represents industry fixed effects, and λ_t represents time fixed effects.

The fixed effects play critical roles. Industry fixed effects (α_i) absorb time-invariant industry characteristics that jointly determine procurement receipts and trade patterns—for example, defense specialization, technological capabilities, or geographic location of production facilities. Time fixed effects (λ_t) control for aggregate shocks affecting all industries simultaneously—macroeconomic conditions, defense budget cycles, exchange rate movements, or broad policy changes. The 18 lags of procurement and outcomes control for persistence and serial correlation, ensuring that estimated effects reflect responses to innovations in procurement rather than predictable components based on recent history.

3.1.2 Local Projections Specification

For each horizon $h \in \{0, 1, 2, \ldots, 24\}$ months, I estimate separate regressions of the outcome at time $t + h$ on current procurement and controls:

$$Y_{i,t+h} = \beta_h G_{it} + \sum_{l=1}^{18} \gamma_{hl}\, G_{i,t-l} + \sum_{l=1}^{18} \delta_{hl}\, Y_{i,t-l} + \alpha_i + \lambda_t + \varepsilon_{i,t+h} \tag{1}$$

The coefficient β_h is the impulse response at horizon h—the expected change in the outcome h periods after a one dollar increase in procurement, holding constant past procurement and outcomes. The sequence $\{\beta_0, \beta_1, \ldots, \beta_{24}\}$ traces the full impulse response function over 24 months.

Standard errors allow for heteroskedasticity and are clustered at the industry level to account for arbitrary serial correlation within industries over time. I construct 90% confidence intervals following standard practice for panel local projections.

All variables are measured in real 2020 dollars using the Producer Price Index (by industry and time), ensuring that results capture real rather than nominal effects. The interpretation of β_h is therefore—a \$1 increase in real defense procurement at time t generates a β_h dollar change in the real trade variable at time $t + h$, holding constant the past 18 months of procurement and trade.

3.1.3 Addressing Persistence and Anticipation

A central identification challenge is that procurement may be partly anticipated through advance contract announcements, budget projections, or predictable appropriations cycles. If industries adjust trade flows before procurement arrives, estimates would conflate responses to actual shocks with expectation effects, overstating causal impacts. To address this, I conduct two complementary robustness checks: residualized procurement that isolates unanticipated variation, and pre-trend placebo tests that directly verify absence of anticipation effects.

Residualized Procurement. I first regress procurement on industry fixed effects, time fixed effects, and 18 lags of own procurement:

$$G_{it} = \alpha_i + \lambda_t + \sum_{l=1}^{18} \rho_l\, G_{i,t-l} + \nu_{it} \tag{2}$$

The residual $\hat{\nu}_{it}$ represents the surprise component of procurement orthogonal to: (1) industry-specific average procurement levels, (2) aggregate time-varying procurement patterns, and (3) predictable components based on 18 months of history. This captures procurement shocks that could not be anticipated given available information at $t - 1$.

I then re-estimate equation (1) replacing G_{it} and its lags with $\hat{\nu}_{it}$ and its lags:

$$Y_{i,t+h} = \beta_h^{resid}\, \hat{\nu}_{it} + \sum_{l=1}^{18} \gamma_{hl}\, \hat{\nu}_{i,t-l} + \sum_{l=1}^{18} \delta_{hl}\, Y_{i,t-l} + \alpha_i + \lambda_t + \varepsilon_{i,t+h} \tag{3}$$

If baseline estimates are driven by anticipation effects, residualizing should substantially attenuate β_h^{resid} relative to β_h. The 18-lag specification is critical: with only 12 lags, responses using actual versus residualized procurement diverge substantially (Appendix Figure A.1), indicating insufficient control for persistence. With 18 lags, the specifications converge closely, validating adequacy of the lag structure.

Pre-Trend Placebo Tests. As a direct test for anticipation effects, I estimate equation (1) for negative horizons $h = -6, -5, \ldots, -1$, using past outcomes as dependent variables:

$$Y_{i,t+h} = \beta_h^{pre}\, G_{it} + \sum_{l=1}^{18} \gamma_{hl}\, G_{i,t-l} + \sum_{l=1}^{18} \delta_{hl}\, Y_{i,t-l} + \alpha_i + \lambda_t + \varepsilon_{i,t+h} \quad \text{for } h < 0 \tag{4}$$

For negative horizons, $Y_{i,t+h} = Y_{i,t-|h|}$ represents a past outcome. These regressions test whether current procurement predicts outcomes from 1-6 months prior, conditional on past procurement, past outcomes, and fixed effects. If industries anticipate shocks or if procurement systematically responds to recent trade conditions, β_h^{pre} would differ significantly from zero. Conversely, coefficients indistinguishable from zero validate that procurement shocks are exogenous with respect to past outcomes, confirming no anticipation or reverse causality.

3.1.4 Alternative Specification: Long Differences

As an additional robustness check, I estimate the model in long differences to address potential small-sample bias. While levels and long-difference specifications are asymptotically equivalent, they have different finite-sample properties (Jorda and Taylor, 2025). Estimating both specifications ensures findings are not driven by functional form assumptions or small-sample distortions that may affect one specification more than the other.

The long difference specification differs in three ways from the baseline. First, the dependent variable becomes the cumulative change $\Delta Y_{i,t+h} \equiv Y_{i,t+h} - Y_{i,t-1}$ rather than the level $Y_{i,t+h}$. Second, I use changes in procurement $\Delta G_{it} \equiv G_{it} - G_{i,t-1}$ as the treatment variable. Third, I control for lags of *changes* in both treatment and outcomes rather than lags of levels. The local projection then becomes:

$$Y_{i,t+h} - Y_{i,t-1} = \beta_h^{LD} \Delta G_{it} + \sum_{l=1}^{18} \gamma_{hl}\, \Delta G_{i,t-l} + \sum_{l=1}^{18} \delta_{hl}\, \Delta Y_{i,t-l} + \alpha_i + \lambda_t + \varepsilon_{i,t+h} \tag{5}$$

The coefficient β_h^{LD} measures the cumulative change in the outcome from $t-1$ to $t+h$ following a unit change in procurement from $t-1$ to t.

3.2 Network Effects

Defense procurement shocks may propagate through the economy via production networks beyond their direct effects on procurement-receiving industries. Understanding these network channels is critical for three reasons. First, it reveals whether trade effects cascade through supply chains or remain localized within recipient industries. Second, it identifies the relative importance of upstream (supply-side) versus downstream (demand-side) linkages in propagating shocks. Third, it allows decomposition of total effects into own-industry versus network-mediated components, clarifying whether baseline estimates conflate direct responses with correlated network shocks.

I follow the network decomposition approach of Acemoglu et al. (2012), constructing upstream and downstream procurement shocks using input-output linkages to weight procurement received by related industries. This methodology has been widely applied to study shock propagation in production networks (Barattieri et al., 2023; Boehm et al., 2019; Barrot and Sauvagnat, 2016), but has not previously been used to examine defense procurement's trade effects.

3.2.1 Network Shock Construction

I construct network shocks using BEA Total Requirements matrices (Leontief inverse) from benchmark years 2007, 2012, and 2017. The matrix element L_{ij} from the Total Requirements table represents the total (direct plus indirect) dollar value of output from industry i required to produce one dollar of final output in industry j. These coefficients capture the full supply chain: L_{ij} includes not only direct inputs from i to j, but also indirect inputs through all intermediate industries. I average coefficients across the three benchmark years to create a time-invariant network structure, reducing sensitivity to year-specific shocks while capturing stable production linkages.

The upstream shock for industry i at time t aggregates procurement received by industries in i's full supply chain, weighted by total input requirements:

$$G_{it}^{up} = \sum_{j=1}^{N} L_{ji} \cdot G_{jt} \tag{6}$$

where L_{ji} indicates the total dollar value of inputs from supplier j (both direct and indirect through intermediate industries) required to produce one dollar of output in industry i. The shock G_{it}^{up} rises when industries anywhere in i's supply chain receive defense contracts. Economically, upstream shocks capture supply-side pressures throughout the production network: when suppliers—or suppliers' suppliers—expand due to procurement, effects propagate downstream through

multiple stages, potentially affecting purchasing industries' costs, input availability, and sourcing decisions.

The downstream shock aggregates procurement received by industry i's full customer base, weighted by total sales requirements:

$$G_{it}^{down} = \sum_{j=1}^{N} L_{ij} \cdot G_{jt} \tag{7}$$

where L_{ij} indicates the total dollar value of output from industry i (both direct and indirect through intermediate industries) required to produce one dollar of final output in customer industry j. The shock G_{it}^{down} captures demand-side effects throughout the value chain: when customers—or customers' customers—expand due to procurement, derived demand propagates upstream through multiple production stages, potentially affecting suppliers' production and trade decisions.

Critically, both network shocks are constructed using other industries' procurement (G_{jt} for $j \neq i$), making them exogenous to industry i's own procurement and trade flows by construction. This allows separate identification of network propagation channels distinct from own-industry effects, addressing concerns that baseline estimates might capture correlated shocks across linked industries rather than true own-industry responses.

3.2.2 Empirical Specification with Network Shocks

I estimate the full model that includes own-industry procurement alongside both upstream and downstream network shocks:

$$Y_{i,t+h} = \beta_h^{own} G_{it} + \beta_h^{up} G_{it}^{up} + \beta_h^{down} G_{it}^{down} + \sum_{l=1}^{18} \gamma_{hl}\, \mathbf{G}_{i,t-l} + \sum_{l=1}^{18} \delta_{hl}\, Y_{i,t-l} + \alpha_i + \lambda_t + \varepsilon_{i,t+h} \tag{8}$$

where $\mathbf{G}_{i,t-l}$ denotes the vector of lagged variables including own, upstream, and downstream procurement. This specification decomposes total effects into three channels: β_h^{own} captures direct own-industry effects, β_h^{up} captures propagation from upstream procurement, and β_h^{down} captures propagation from downstream procurement.

The key empirical question is whether β_h^{own} in equation (8) differs from β_h in the baseline specification (1). If baseline estimates conflate own-industry responses with correlated network shocks, controlling for G_{it}^{up} and G_{it}^{down} should substantially alter the own-procurement coefficient. Alternatively, if effects operate primarily within procurement-receiving industries with limited propagation, β_h^{own} should remain stable, indicating that baseline estimates represent true own-industry effects rather than spurious correlation with network shocks.

3.3 Heterogeneity Analysis

Beyond baseline specifications, I examine heterogeneity in procurement's trade effects to identify which industries drive aggregate impacts. I split industries along two dimensions: trade openness and defense intensity. For trade openness, I use a median split to distinguish globally integrated from domestically oriented sectors. For defense intensity, I employ a more stringent threshold—the 90th percentile—to isolate true defense contractors with economically meaningful procurement relationships from industries with negligible defense exposure. I then estimate the baseline specification (1) separately for each group, producing split-sample impulse responses that reveal whether effects concentrate in globally integrated versus domestically oriented sectors, and in defense-specialized versus peripheral industries.

Industry revenue data for constructing these splits comes from the Census Bureau's Economic Census, averaged across available years in my sample period (2002, 2007, 2012, 2017, 2022), to create time-invariant industry characteristics. 29 industries in NAICS sector 11 (agriculture, forestry, fisheries) are excluded from heterogeneity analysis due to missing Census revenue data, leaving 346 industries for the analysis.

3.3.1 Trade Openness

To measure global integration, I construct trade openness, which captures total trade exposure combining both imports and exports:

$$\text{Trade Openness}_i = \frac{\text{Avg Annual Imports}_i + \text{Avg Annual Exports}_i}{\text{Avg Annual Revenue}_i} \tag{9}$$

Industries are split at the median (0.24) to create high and low trade openness groups. High-openness industries include globally engaged sectors with substantial cross-border flows in both directions—computers and their parts, semiconductors and electronic components, and basic chemicals. Low-openness industries are domestically oriented—mining and quarrying, food products, and paper mills.

3.3.2 Defense Intensity

I construct defense intensity as the share of industry revenue attributable to defense procurement:

$$\text{Defense Intensity}_i = \frac{\text{Avg Annual Defense Procurement}_i}{\text{Avg Annual Revenue}_i} \tag{10}$$

Rather than using median splits, which would classify industries with negligible defense exposure

(0.05% of revenue) as "high defense," I employ the 90th percentile threshold to isolate true defense contractors. High defense intensity industries are defined as those in the top decile (defense intensity $>$ 1.21% of revenue), comprising 34 industries with mean defense intensity of 5.90%. This group represents the core defense industrial base—guided missiles and space vehicles, military armored vehicles and tank parts, search and navigation equipment, aircraft and aircraft parts, and shipbuilding. The remaining 312 industries (bottom 90%) have minimal defense exposure, with mean intensity below 0.15%, spanning civilian manufacturing sectors with negligible defense ties.

The correlation between defense intensity and trade openness is positive (0.24) and statistically significant, suggesting defense-specialized industries tend to be more globally integrated, though the two dimensions capture distinct industry characteristics.

4 Results

This section presents empirical findings on how defense procurement affects international trade flows. I begin with baseline impulse response estimates using the harmonized NAICS 2017 panel spanning October 2000 to September 2024. I establish robustness through alternative specifications, examine network propagation through domestic input-output linkages, document heterogeneity across industries, and synthesize findings to characterize economic mechanisms.

4.1 Baseline Effects

I estimate local projections following equation (1) using the full sample of 375 harmonized NAICS industries over 288 months. Figure 6 presents impulse responses of real imports, exports, and trade balance to a \$1 increase in real defense procurement obligations, with 18 lags of treatment and outcomes.



Figure 6: Baseline Impulse Responses to Defense Procurement

Notes: Point estimates from local projections with 18 lags of treatment and outcomes. Shaded regions: 90% confidence intervals with robust standard errors clustered at industry level. All variables in real 2020 dollars.

The baseline patterns reveal three key findings. First, defense procurement generates persistent increases in imports. Effects oscillate between \$0.02-\$0.03 per month for the first three months, staying within \$0.01-\$0.02 for most months. Second, exports remain largely unresponsive with no significant effects witnessed throughout the horizon. Third, the trade balance deteriorates significantly, driven primarily by import increases, with peak deficits of around \$0.03 per month in the first quarter.

Defense procurement thus increases trade deficits through an import channel rather than stimulating trade surpluses through exports. Table 1 summarizes effects at selected horizons. At the 12-month horizon, each dollar of procurement generates \$0.02 in imports, worsening the trade balance by \$0.03. Cumulatively over 24 months, procurement increases imports by \$0.29 per dollar with negligible offsetting export gains.

Table 1: Baseline Effects at Selected Horizons

	Imports		Exports		Trade Balance	
Horizon	Coef.	(SE)	Coef.	(SE)	Coef.	(SE)
3 months	0.028^{***}	(0.008)	-0.001	(0.006)	-0.029^{***}	(0.009)
6 months	0.014^{**}	(0.006)	-0.006	(0.009)	-0.021^{**}	(0.010)
12 months	0.017^{**}	(0.008)	-0.008	(0.010)	-0.027^{**}	(0.011)
24 months	0.020^{**}	(0.009)	-0.008	(0.010)	-0.033^{**}	(0.013)
Cumulative (0-24)	0.292		-0.061		-0.418	

Notes: Coefficients represent dollar change in outcome per dollar increase in defense procurement. Robust standard errors clustered at industry level in parentheses. Cumulative row sums point estimates over all horizons 0-24 months. Negative trade balance indicates deficit expansion. Significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2 Robustness Checks

4.2.1 Residualized Procurement Shocks

Figure 7 overlays baseline and residualized responses, from equation 3, demonstrating tight overlap throughout all horizons for imports, exports, and trade balance. The similarity establishes two results. First, the baseline specification with 18 lags successfully removes anticipated components, providing credible identification. Second, anticipation effects do not confound baseline estimates—industries do not systematically adjust trade before procurement arrives. The near-identical responses also imply that procurement shocks are largely orthogonal to prior trade dynamics, reflecting genuine shifts in demand rather than endogenous reactions to market trends. This reinforces that the estimated effects capture unanticipated fiscal impulses rather than predictable fluctuations in procurement timing.

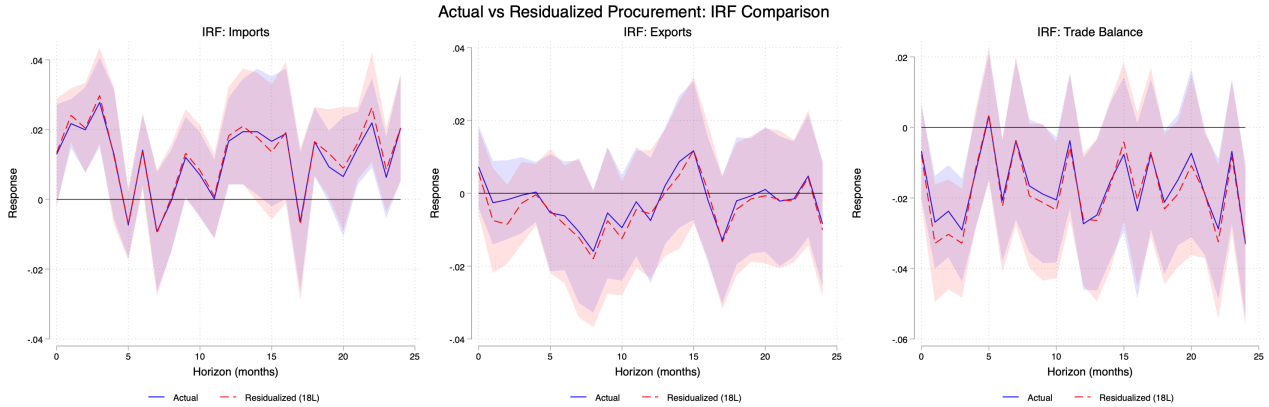


Figure 7: Baseline vs. Residualized Procurement: IRF Comparison

Notes: Blue lines: baseline using actual procurement. Red lines: residualized procurement from equation (3). Shaded regions: 90% confidence intervals. Tight overlap confirms baseline captures primarily unanticipated variation.

4.2.2 Pre-Trend Placebo Tests

Figure 8 presents impulse responses including six pre-treatment periods ($h = -6$ to -1) to test for anticipation effects following equation (4). All pre-period coefficients are statistically and economically zero across imports, exports, and trade balance. Point estimates are on the order of 10^{-16}, representing computational machine precision rather than meaningful economic effects. No pre-period exhibits systematic correlation between current procurement and lagged outcomes, confirming that industries do not adjust trade flows in anticipation of procurement shocks.

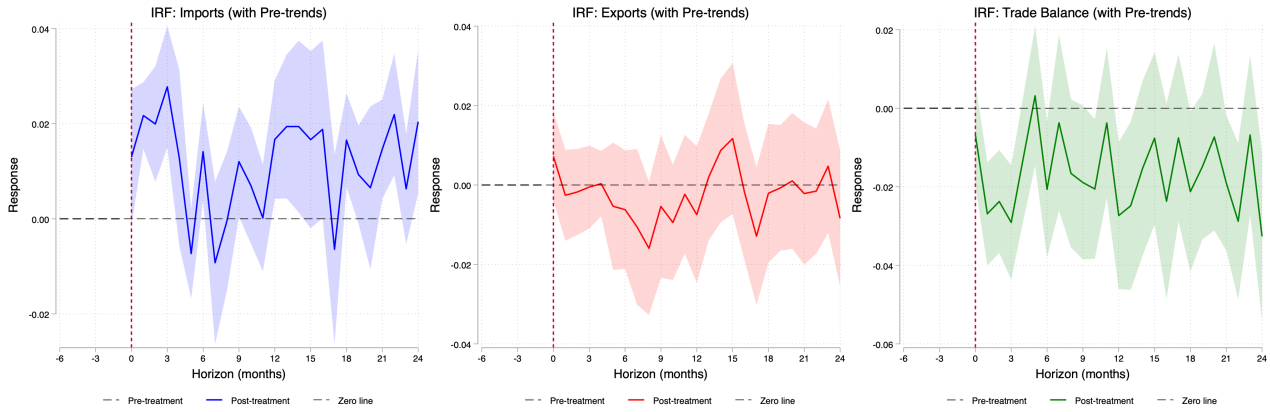


Figure 8: Impulse Responses with Pre-Trend Placebo Tests

Notes: Gray dashed lines and shading indicate pre-treatment period ($h < 0$). Colored solid lines and shading indicate post-treatment period ($h \geq 0$). Vertical red line marks treatment time ($h = 0$). All pre-period coefficients are computationally zero (order 10^{-16}), confirming no anticipation effects or reverse causality. Shaded regions: 90% confidence intervals.

The sharp break at horizon zero, where responses transition from flat pre-trends to the dynamic post-treatment patterns documented in the baseline, provides visual confirmation of temporal precedence. This validates that procurement shocks generate genuine responses in trade flows rather than

merely correlating with pre-existing trends. Combined with the tight overlap between baseline and residualized specifications, these results establish that the 18-lag baseline specification successfully isolates unanticipated procurement variation.

4.2.3 Long Difference Specification

Figure 9 overlays long difference responses (red dashed) from equation 5 with baseline levels estimates (blue solid). The comparison reveals an important and economically interpretable pattern: long difference estimates show significant effects concentrated in early horizons (1-3 months), after which point estimates converge toward zero and confidence intervals widen substantially. In contrast, levels estimates remain significant through half of the 24-month horizon.

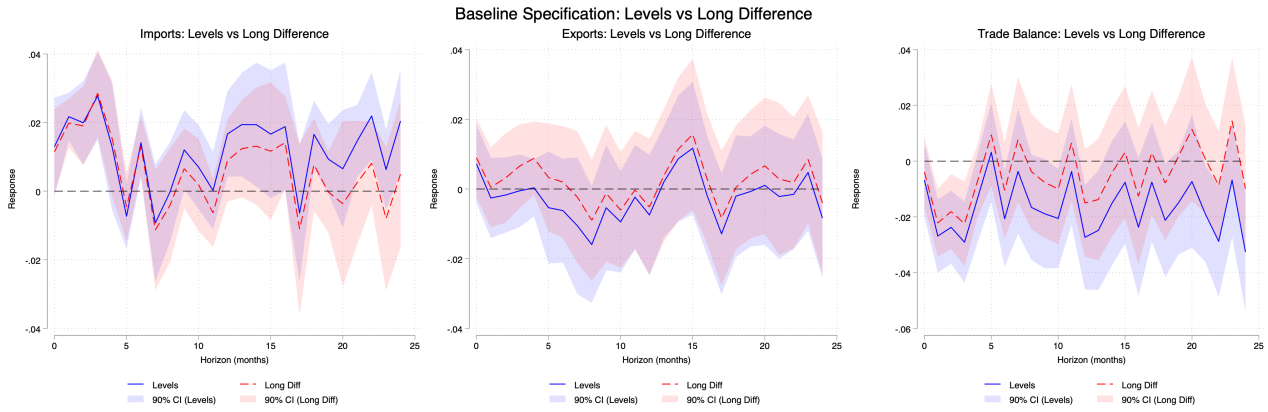


Figure 9: Baseline vs. Long Difference Specification Comparison

Notes: Blue solid lines: baseline levels specification. Red dashed lines: long difference specification. Shaded regions: 90% confidence intervals. For imports, long difference effects are significant only at short horizons (1-3 months), while levels effects persist for more horizons. This pattern indicates effects represent persistent level shifts rather than explosive cumulative growth.

This divergence between levels and long differences is not a failure of robustness but rather provides important information about the dynamic structure of procurement effects. The pattern is consistent with procurement inducing a *persistent level shift* in imports rather than a continuously growing cumulative impact. Specifically, when procurement increases at time t, imports rise to a new higher level and remain elevated. The levels specification captures this sustained elevation, while the long difference specification shows that after the initial adjustment (horizons 1-3), the cumulative change stabilizes. The trade balance exhibits a similar pattern, with initial cumulative deterioration followed by stabilization at the new deficit level.

The consistency between specifications in the *short run* (both show significant positive effects on imports at horizons 1-3) combined with the economically interpretable divergence in the *long run* (levels show persistence, long differences show stabilization) strengthens confidence in the baseline findings. The levels specification accurately captures the policy-relevant persistent impact of

defense procurement on trade flows: each procurement increase generates a lasting elevation in imports and trade deficits that persists through at least 24 months without reverting or exploding.

4.3 Network Propagation Through Input-Output Linkages

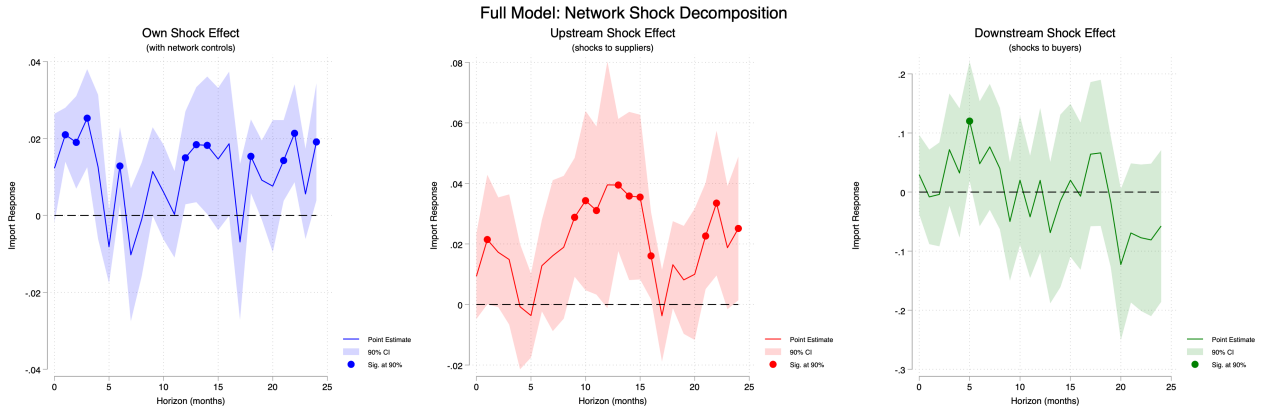
As described in Section 3.2, I construct upstream shocks G_{it}^{up} that capture procurement to an industry's suppliers, and downstream shocks G_{it}^{down} that capture procurement to its customers, using averaged BEA input-output technical coefficients as weights. Both network shocks are exogenous to industry i's own procurement by construction, allowing separate identification of propagation channels. This subsection presents the network effects of upstream and downstream shocks on trade outcomes along with own-industry effects, after controlling for these network linkages.

4.3.1 Upstream Effects

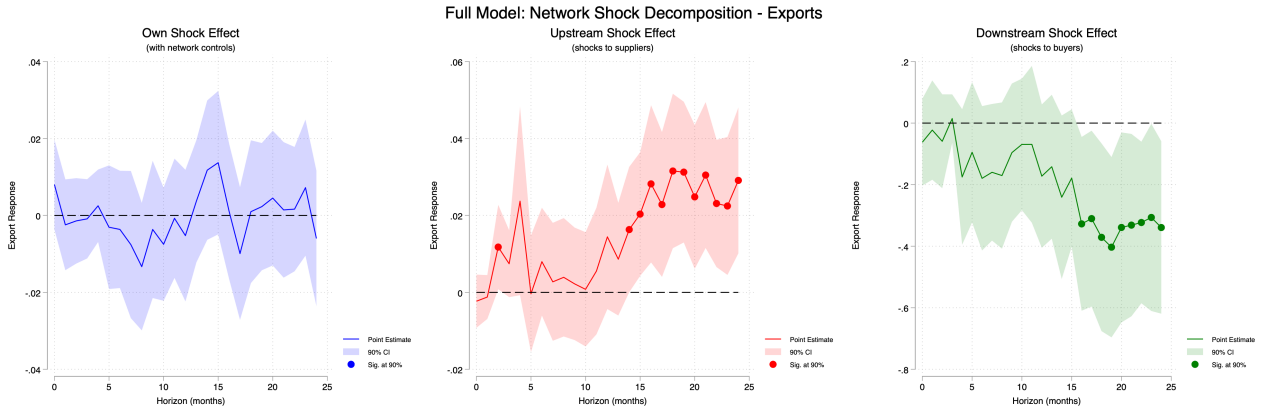
Panel (a) of Figure 10 reveals that when an industry's suppliers receive defense procurement, the industry experiences significant increases in imports. The effect reaches approximately \$0.03-\$0.04 per dollar of supplier procurement at horizons 10-15 months, and remains statistically significant towards the end of the horizon. This indicates that procurement anywhere in the supply chain creates substantial derived import demand downstream.

The mechanism operates through supply chain pressures. When suppliers receive defense contracts, they scale up production to fulfill military orders. This expansion tightens supply conditions for their downstream customers through three channels. *First, capacity constraints*—suppliers operating near full capacity must allocate limited production between defense and civilian customers, potentially reducing availability for non-defense purchasers. *Second, price effects*—increased demand for suppliers' outputs may raise prices, making imported alternatives relatively more attractive. *Third, quality/delivery adjustments*—defense contracts often require higher quality standards or faster delivery schedules, causing suppliers to prioritize defense orders over civilian sales. Downstream industries facing these supply-side pressures respond by substituting toward imported inputs, generating the observed import increases.

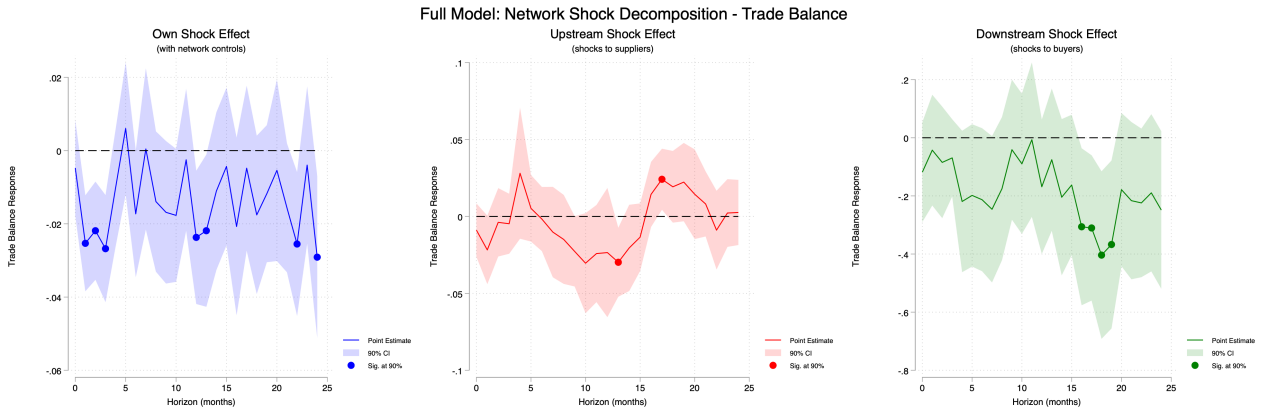
Strikingly, Panel (b) shows that upstream shocks also increase exports, with effects emerging around horizon 14 and reaching \$0.025-0.03 by horizons 16-24. This dual expansion—simultaneous import and export increases—reveals more complex supply chain dynamics than simple input substitution. The export response suggests that upstream procurement generates positive spillovers to downstream industries beyond just supply constraints. Potential mechanisms include: (1) *productivity transfers* as defense suppliers upgrade technology or improve processes, with knowledge diffusing to customers; (2) *scale economies* as procurement anywhere in the supply chain reduces input costs through learning-by-doing or fixed cost spreading, enhancing downstream competitiveness; (3) *quality improvements* as defense contracts require higher standards that spill over to civilian pro-



(a) Import Responses to Network Shocks



(b) Export Responses to Network Shocks



(c) Trade Balance Responses to Network Shocks

Figure 10: Trade Responses to Network Procurement Shocks

Notes: Each panel shows responses to own shocks, upstream shocks (procurement to suppliers) and downstream shocks (procurement to customers). Shaded regions represent 90% confidence intervals. Dots indicate horizons where effects are statistically significant at the 90% level. Upstream shocks generate both import and export increases, while downstream shocks primarily crowd out exports at long horizons with minimal import effects.

duction. These supply-side improvements enable downstream industries to expand export-oriented production, explaining the positive export response.

The net trade balance effect in Panel (c) does not show much change, with the trade deficit first increasing and then falling towards the end of the 24-month horizon.

4.3.2 Downstream Effects

Panel (a) reveals that when an industry's customers receive procurement, the industry exhibits minimal and statistically insignificant import responses throughout the horizon. The increased demand for inputs from customers can be met through several adjustment margins that do not require foreign sourcing: (1) *capacity utilization*: suppliers operating below full capacity can increase output using existing resources; (2) *inventory drawdown*: suppliers can deplete inventories accumulated during previous periods; (3) *production margin adjustments*: suppliers can extend hours, add shifts, or defer maintenance to boost short-run output. These domestic adjustment channels allow suppliers to accommodate procurement anywhere in the customer value chain without requiring additional imported inputs.

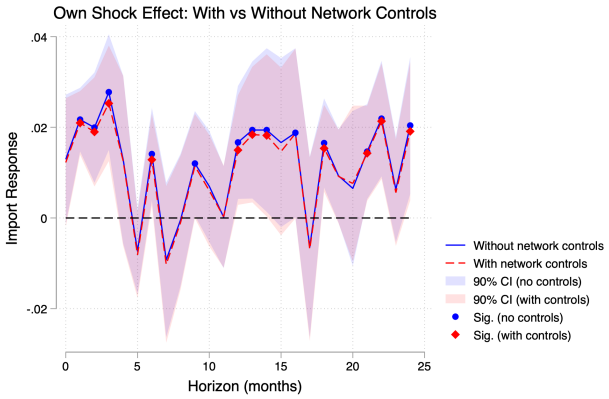
Panel (b) shows a markedly different pattern for exports: downstream shocks generate significant *reductions* in exports at long horizons. Effects are statistically insignificant through horizon 15, then turn negative and significant from horizons 16-24, reaching $-\$0.3$ to $-\$0.4$. This delayed crowding-out reveals a demand reorientation mechanism—when customers receive procurement and expand domestic production, they absorb more of their suppliers' output for domestic uses, reducing the quantity available for export markets. This reallocation intensifies over time as suppliers—(1) prioritize domestic contracts with more certain and profitable long-term relationships; (2) adjust capacity investments toward domestic-market-specific configurations; (3) deplete export-oriented inventories that are not replenished due to domestic demand priority.

Panel (c) confirms that the net trade balance effect of downstream shocks reflects primarily export crowding-out, with trade balance deterioration emerging at the same long horizons where exports decline. The magnitude of deterioration ($-\$0.3$ to $-\$0.4$) closely matches the export decline, consistent with minimal import adjustment.

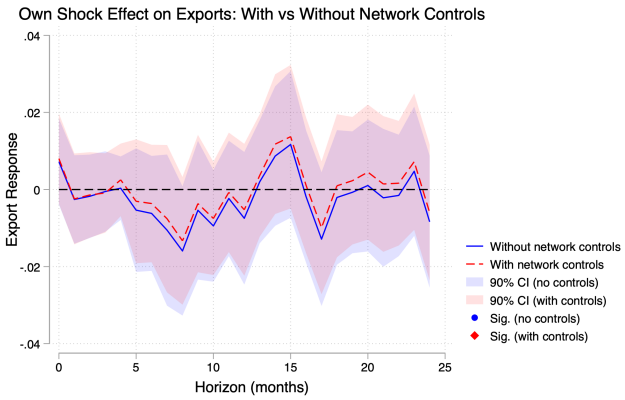
4.3.3 Stability of Own-Industry Effects

Figure 11 presents the decomposition results from equation 8, comparing baseline estimates to network-controlled own effects for each outcome. The most striking result is the near-perfect overlap of baseline (blue solid) and network-controlled (red dashed) own-procurement effects across all three outcomes: imports, exports and trade balance.

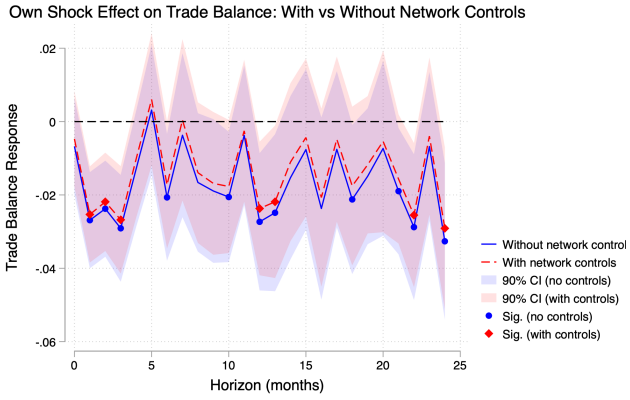
This stability has two important implications. First, it establishes that baseline import and trade bal-



(a) Import Responses: Network Decomposition



(b) Export Responses: Network Decomposition



(c) Trade Balance Responses: Network Decomposition

Figure 11: Own-Industry Effects With and Without Network Controls

Notes: Blue solid lines: baseline own-procurement IRFs without network controls (reproduced from Figure 6). Red dashed lines: own-procurement coefficients β_h^{own} controlling for upstream and downstream shocks. Shaded regions are 90% confidence intervals for baseline estimates. The near-perfect overlap of blue and red lines across all outcomes confirms that own-industry are robust to controlling for network dynamics.

ance effects reflect direct responses within procurement-receiving industries, not correlation with supplier or customer procurement. Industries increase imports because of their own procurement receipts, not because their production partners are simultaneously expanding. Second, it rules out substantial omitted variable bias in baseline estimates. If network shocks were important confounders, controlling for them would change own-industry coefficients materially—instead, coefficients remain unchanged.

The key insight is that while network effects exist and are economically meaningful in their own right (as documented in Section 4.3.1), they do not substantially propagate or amplify own-industry responses. This distinguishes defense procurement from other shocks studied in the network propagation literature where cascading effects dominate aggregate impacts (Acemoglu et al., 2012; Boehm et al., 2019).

4.3.4 Interpreting Network Effects

The network analysis yields several central insights about how defense procurement affects trade through production linkages. First, controlling for upstream and downstream shocks does not materially alter own-industry coefficients for any trade outcome (Figure 11). The near-perfect overlap of baseline and network-controlled estimates establishes that baseline results represent genuine own-industry responses, not spurious correlation with procurement to suppliers or customers. This validates the identification strategy and confirms that industries respond to their own procurement experiences.

Second, while own effects remain stable, the network shocks themselves generate economically meaningful trade responses. Upstream shocks (supplier procurement) produce import increases of \$0.03-\$0.04—comparable to or exceeding own-procurement effects—indicating that procurement anywhere in the supply chain creates substantial derived import demand downstream. Upstream shocks also generate export increases of \$0.025-\$0.03, suggesting productivity spillovers from expanding suppliers. Downstream shocks (customer procurement) exhibit minimal import effects but significant export crowding-out ($-\$0.3$ to $-\$0.4$) at horizons 16-24, as suppliers reallocate output toward domestic customers. These network effects are not secondary or trivial—they represent important propagation mechanisms operating alongside own-industry responses.

Third, the sharp asymmetry between upstream and downstream effects provides insights into propagation channels. Upstream shocks generate dual expansion (imports and exports increase), consistent with supply-side channels: supplier capacity constraints create import demand, while supplier productivity improvements enable export growth. Downstream shocks generate export crowding-out without import effects, consistent with demand reorientation: procurement anywhere in the customer value chain absorbs supplier output domestically. This asymmetry indicates that supply-side propagation (through supplier linkages) operates through both cost/availability and productivity channels, while demand-side propagation (through customer linkages) operates primarily through

output allocation.

4.4 Exploring Heterogeneous Effects

The baseline results in Figure 6 document average effects pooling all industries. However, substantial heterogeneity may exist based on industries' participation in international trade and defense contracting relationships. This subsection examines how procurement-trade linkages vary systematically across these two dimensions. Understanding which industries drive aggregate effects reveals the economic mechanisms and identifies policy-relevant margins.

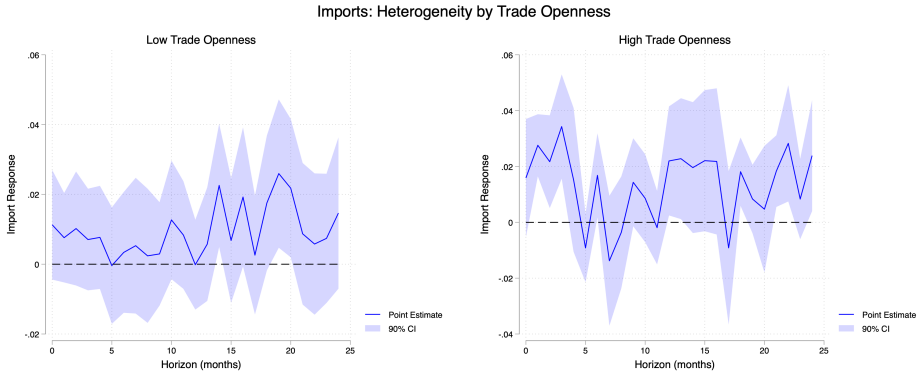
4.4.1 Heterogeneity by Trade Openness

To test whether baseline trade integration moderates procurement-trade linkages, Figure 12 presents impulse responses separately for industries above and below median trade openness (23.6%).

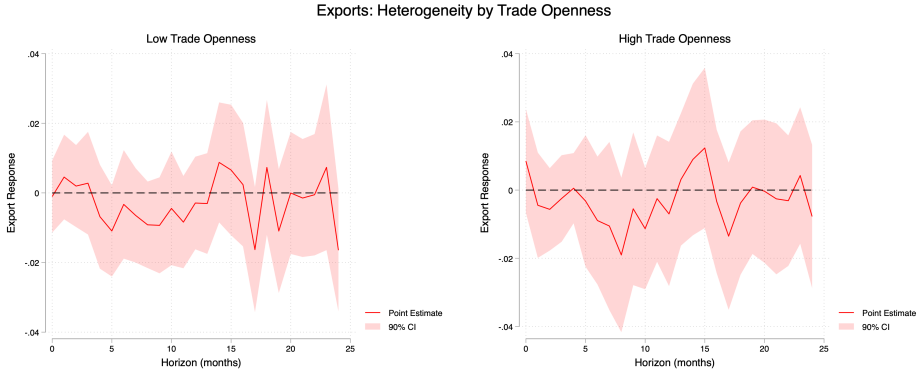
Panel (a) shows that import responses concentrate in the high trade openness group, with point estimates of $0.01-0.025 that closely match baseline magnitudes. The low trade openness group exhibits muted responses near zero, indicating that procurement-induced import increases occur specifically among industries with high global integration. Panel (b) confirms that export responses remain near zero in both groups, consistent with baseline findings that the mechanism operates primarily through the import margin. Panel (c) shows correspondingly differentiated trade balance responses. The high trade openness group exhibits trade balance deterioration matching baseline patterns, while the low trade openness group shows minimal response.

The concentration of effects in high trade openness industries indicates that procurement-induced import increases require substantial global integration. Industries heavily engaged in international trade respond to procurement shocks by increasing imports, while domestically oriented industries show minimal response. To decompose the composite measure, Appendix Figures A.2 and A.3 present separate analyses by import intensity and export intensity.

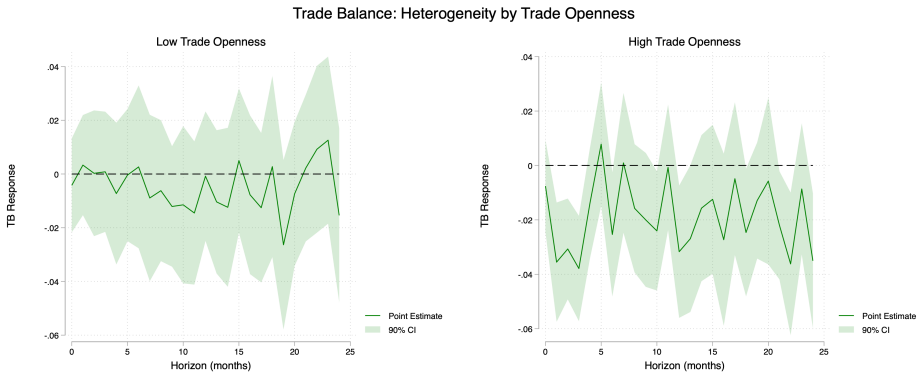
The decomposition reveals that industries with low import intensity (below the median of 12.2%) drive the baseline effects with stable import increases of $0.01-0.02, while high import intensity industries show noisier responses with larger magnitudes but wider confidence intervals. Conversely, for export intensity, it is the high export intensity group (above the median of 8.4%) that matches baseline patterns with persistent import increases. The joint profile—low import intensity yet high export intensity—characterizes industries that drive aggregate procurement-trade effects. These are industries like ammunition, aircrafts, and military tanks, with established global sales networks but limited import dependence—positioned to increase imports when procurement shocks require additional inputs (See Appendix Table B.1 for a list of these industries).



(a) Import Responses



(b) Export Responses



(c) Trade Balance Responses

Figure 12: Trade Responses by Trade Openness

Notes: Each panel shows separate IRFs for high trade openness (right, above median 23.6%) and low trade openness (left, below median). Shaded regions: 90% confidence intervals. Sample excludes NAICS sector 11 (agriculture). High-trade-openness industries seem to be driving the baseline results.

4.4.2 Heterogeneity by Defense Intensity

Figure 13 presents impulse responses separately for 34 high-defense-intensity industries (top 10%, defense procurement exceeding 1.21% of revenue, listed in Appendix Table B.2) and 312 low-defense-intensity industries (bottom 90%, minimal defense exposure). The heterogeneity is stark and economically meaningful.

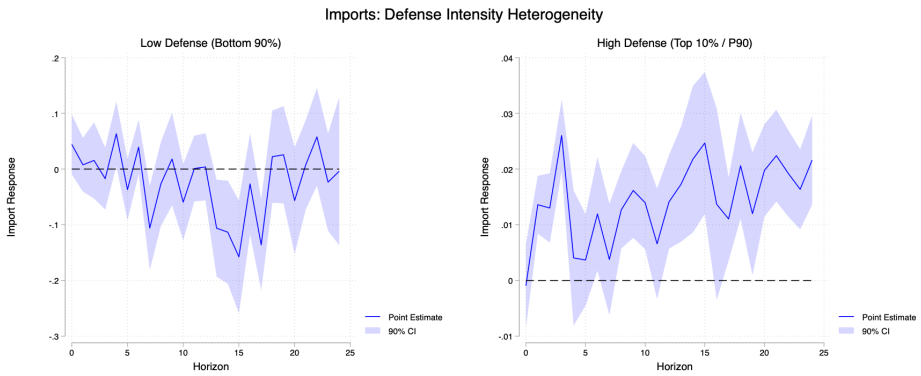
Panel (a) demonstrates that import effects concentrate decisively in high-defense-intensity industries, with point estimates rising to approximately \$0.015-0.025 for almost all horizons. In contrast, the low-defense group oscillates around zero with no discernible pattern, confirming that industries with minimal defense relationships do not alter import behavior in response to aggregate procurement shocks. Panel (b) reveals that export responses remain near zero in both groups, reinforcing the baseline finding that procurement effects operate primarily through the import margin. Neither defense contractors nor non-defense industries expand exports meaningfully following procurement increases, suggesting the mechanism does not involve enhanced export competitiveness or capacity. Panel (c) shows that trade balance deterioration occurs exclusively in high-defense-intensity industries, driven by the import increases documented in Panel (a).

The findings indicate a clear threshold effect: only industries with substantial defense contracting relationships (top 10%, defense intensity exceeding 1.21% of revenue) generate trade effects from procurement shocks. This concentration pattern suggests the mechanism operates through direct procurement channels—defense contractors scaling production in response to government contracts and sourcing specialized components and materials internationally—rather than through indirect aggregate demand spillovers to non-defense sectors. The absence of effects in the bottom 90% of industries rules out broad-based multiplier effects or economy-wide trade responses to defense spending.

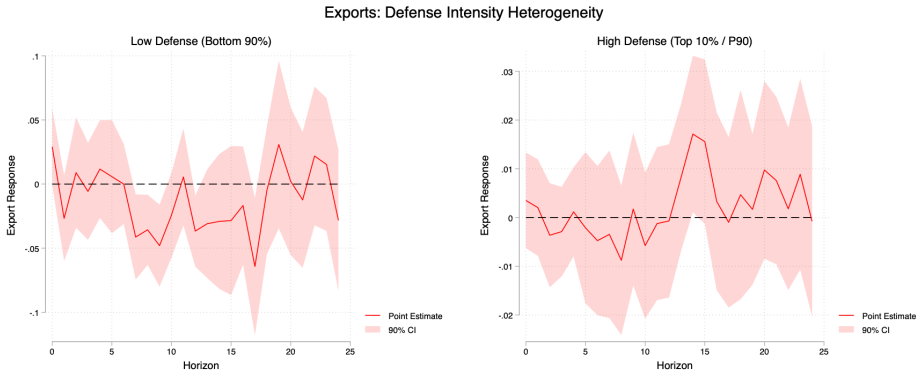
4.4.3 Joint Heterogeneity: Defense Intensity and Trade Openness

The separate heterogeneity analyses reveal that high trade openness and high defense intensity drive baseline import effects, but remain silent on whether defense intensity and trade openness interact. To examine potential complementarities, Figure 14 presents import responses for four industry groups based on the intersection of both characteristics.

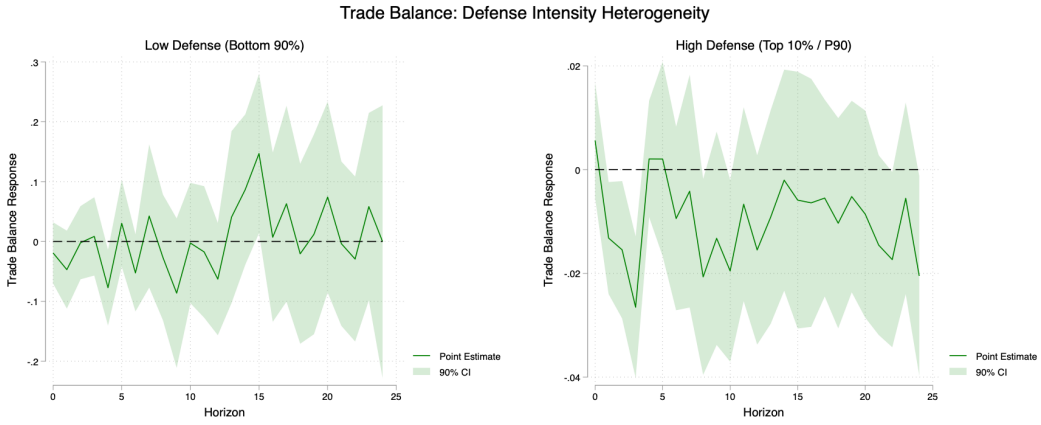
The joint heterogeneity reveals a clear complementarity: import increases require *both* high defense intensity *and* high trade openness. Group 4 (high defense, high trade; listed in Appendix Table B.3) exhibits import increases of \$0.02-0.03 that closely match baseline magnitudes, indicating this group drives aggregate effects. Group 1 (low defense, low trade) shows positive responses close to \$0.2 towards the end of the period, but with wide confidence intervals. Group 2 (low defense, high trade) exhibits a muted import response with no statistically significant change following a procurement shock. Group 3 (high defense, low trade) shows responses near zero, indicating that defense expo-



(a) Import Responses



(b) Export Responses



(c) Trade Balance Responses

Figure 13: Trade Responses by Defense Intensity

Notes: Each panel shows separate IRFs for high defense intensity (right, top 10% with defense procurement >1.21% of revenue, 34 industries) and low defense intensity (left, bottom 90%, 312 industries). Shaded regions: 90% confidence intervals. Sample excludes NAICS sector 11 (agriculture). High-defense industries show persistent import increases and trade balance deterioration, while low-defense industries exhibit no systematic trade responses.

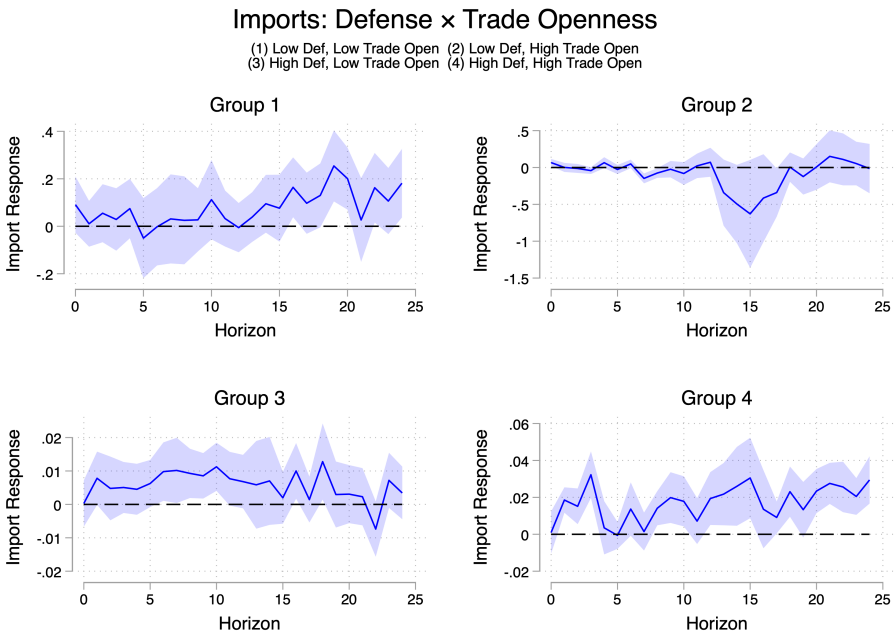


Figure 14: Import Responses: Defense Intensity × Trade Openness

Notes: Local projection estimates for four industry groups. Group 1: low defense, low trade openness; Group 2: low defense, high trade openness; Group 3: high defense, low trade openness; Group 4: high defense, high trade openness. Shaded regions: 90% confidence intervals. Defense intensity split at 1.21% (90th percentile); trade openness split at 23.6% (median).

sure alone is insufficient without global trade integration.

This pattern reconciles the separate heterogeneity findings: high trade openness industries drive baseline effects because defense contractors—who dominate the high trade openness category due to their characteristic profile of low import intensity yet high export intensity—are concentrated in this group. The joint analysis reveals that procurement-trade linkages operate specifically through globally integrated defense contractors rather than through either characteristic alone.

Appendix Figures A.4 and A.5 present corresponding results for exports and trade balance. Export responses remain near zero across defense-reliant industries (Groups 3 and 4), confirming that procurement effects operate exclusively through the import margin regardless of industry characteristics. Groups 1 and 2 (low defense intensity) exhibit noisier export responses with wider confidence intervals. Trade balance responses mirror the import patterns: Group 4 shows deterioration matching baseline, while the others exhibit minimal systematic responses. These findings reinforce that the mechanism concentrates in industries combining defense contracting with substantial global trade engagement.

4.4.4 Summary of Heterogeneity Findings

The heterogeneity analysis establishes that procurement-trade linkages operate through a specific joint condition: industries require *both* high defense intensity *and* high trade openness to exhibit

baseline-matching import increases. Group 4—combining defense contracting with substantial global integration—drives aggregate effects with import increases of $0.02-0.03.

The decomposition reveals that low import intensity yet high export intensity industries drive baseline effects—a profile characterizing defense contractors who maintain predominantly domestic sourcing (due to Buy American and ITAR constraints) while exporting military equipment. These contractors require marginal imported inputs (specialized materials, precision components) when scaling production, generating the modest but persistent import increases in baseline estimates.

The concentration of effects in globally integrated defense contractors indicates the mechanism operates through direct procurement channels rather than broad spillovers. Trade openness identifies which contractors maintain sufficient global supply chain connections to increase imports when scaling. Defense spending's trade impact thus concentrates in industries combining defense exposure with global integration, rather than propagating broadly through the economy.

4.5 Discussion: Economic Mechanisms

Four empirical patterns structure the interpretation of these findings—(1) procurement generates modest import expansion without corresponding export growth—imports increase $0.02-$0.03 per dollar (2-3% of spending), while exports remain near zero throughout the horizon; (2) effects concentrate in high-defense-intensity industries, occurring among defense contractors receiving procurement rather than peripheral sectors; (3) impacts amplify in trade-intensive sectors, with the strongest effects appearing in industries characterized by high trade openness; and (4) network propagation operates alongside own effects, with both own-industry and supply chain channels contributing meaningfully to aggregate trade impacts.

4.5.1 Mechanism: Moderate Import Leakage Through Global Supply Chains

The evidence supports a mechanism where defense procurement generates modest import increases through specialized component sourcing in global supply chains. When defense contractors receive procurement and expand production, they increase purchases of specialized inputs—some of which are sourced internationally—resulting in a 2-3% import content ratio. This leakage is economically significant in aggregate while remaining limited relative to total procurement value.

Supporting Evidence. The 2-3% import response indicates moderate but non-trivial foreign content in defense production, substantially lower than civilian manufacturing (typically 10-25%) and consistent with Buy American provisions constraining but not eliminating foreign sourcing. Effects concentrate entirely in high-defense-intensity industries (aerospace, shipbuilding, defense electronics, weapons systems), with industries outside the defense industrial base showing no responses, ruling out economy-wide spillover mechanisms. Amplification in high-trade-openness industries

confirms that global supply chain integration matters: defense contractors already engaged in international sourcing increase imports more when scaling production, while domestically-oriented sectors show muted responses.

Network effects operate alongside own-industry responses, with upstream shocks generating import increases of \$0.03-\$0.04—comparable to own effects—indicating that supply chain pressures propagate through production networks. Exports remain near zero through most horizons, with only small effects emerging at 18-24 months. The absence of meaningful export expansion rules out productivity spillover mechanisms and indicates that procurement does not enhance export competitiveness over the 24-month horizon.

4.5.2 Alternative Interpretations and Caveats

The 2-3% import leakage could reflect either: (1) *inherent foreign content in defense systems*, where specialized components (semiconductors, rare materials, precision sensors) are unavailable domestically and must be imported; or (2) *short-run capacity constraints*, where domestic suppliers cannot rapidly scale production to meet procurement-induced demand spikes, forcing temporary import substitution. Distinguishing these requires longer-horizon data to test whether import intensity declines as domestic capacity adjusts—a question I leave for future research.

The concentration in high-defense-intensity industries could alternatively reflect endogenous specialization: industries receiving more procurement may have invested in global sourcing networks precisely because they anticipated future contracts. If so, the observed import increases might partly reflect prior strategic decisions rather than purely mechanical responses to current shocks. Addressing this concern would require instruments for procurement that are orthogonal to industries' historical sourcing strategies.

The cumulative 24-month import effect (approximately \$0.29 per dollar) suggests that import leakage accumulates over the contract execution period but stabilizes rather than growing indefinitely. Whether this stabilization reflects completed import substitution or incomplete contract execution requires extending the horizon beyond 24 months.

4.5.3 Policy Implications

The import leakage generated by defense procurement is approximately 2-3% of the initial spending in the short run (monthly) and 29% cumulatively over two years. This represents meaningful but limited fiscal leakage: roughly 71% of procurement value remains domestic even after accounting for trade effects. Standard fiscal multiplier calculations should incorporate this import propensity, particularly for sustained multi-year procurement programs where cumulative leakage matters more than instantaneous effects.

The finding that import leakage concentrates in high-trade-openness defense industries suggests current Buy American provisions effectively constrain imports in domestically-oriented defense sectors but are less binding for globally integrated contractors producing complex systems. This pattern is consistent with DFARS exceptions permitting foreign sourcing of specialty materials, commercial components, and allied-nation inputs that cannot be economically produced domestically.

The substantial upstream propagation—where supplier procurement generates import increases comparable to own effects—implies that aggregate trade impacts of procurement programs cannot be estimated by simply examining direct recipients. Evaluating a proposed defense budget requires accounting for: (1) direct import increases by prime contractors; and (2) induced import increases by their suppliers.

Defense procurement generates asymmetric trade effects concentrated in imports, indicating that defense spending primarily serves its direct purpose—acquiring military capabilities and supporting domestic production—with limited export spillovers. Policymakers seeking to leverage procurement for export competitiveness should recognize that export effects are substantially smaller than import effects, require 18-24 months to materialize, and remain economically modest even at long horizons. The 2-3% import propensity represents a trade-off between domestic economic impact and access to specialized global defense supply chains that policymakers must navigate when designing procurement strategies.

5 Conclusion

This paper examines how defense procurement affects international trade flows using a comprehensive contract-level dataset spanning 25 fiscal years. I estimate panel local projections at the NAICS six-digit industry-month level with 18 lags of treatment and outcomes. This is augmented with network decomposition using domestic input-output linkages and heterogeneity analysis by defense intensity and trade openness. The analysis reveals that defense spending generates modest but persistent import increases without corresponding export expansion, with effects operating through global supply chain integration in the defense industrial base. These findings are robust to isolating unanticipated procurement shocks through residualization, to anticipation and reverse causality by checking for pre-trends, and to long-difference specifications that test for specification errors.

Network analysis reveals that procurement affects trade through both own-industry and supply chain channels. Own-industry effects remain stable when controlling for network shocks, but network effects themselves are substantial—upstream shocks (supplier procurement) generate import increases of \$0.03-\$0.04 per dollar, comparable to own effects. Downstream shocks (customer procurement) crowd out exports at long horizons. The combination of stable own effects and substantial network propagation implies that aggregate trade impacts require accounting for both channels.

Import increases and trade balance deterioration concentrate exclusively in high-trade-openness in-

dustries (above median trade exposure) and high-defense-intensity industries (above median defense procurement relative to revenue). Industries outside the defense industrial base—those with low defense exposure or domestic orientation—show no significant trade responses. This concentration establishes that mechanisms operate through global supply chain integration in complex weapons production rather than through economy-wide aggregate demand spillovers.

The findings have several policy implications. The cumulative import leakage of $0.29 per dollar procurement shock implies that fiscal multiplier calculations ignoring trade should be adjusted downward. Buy American provisions effectively constrain imports relative to civilian manufacturing but do not eliminate foreign sourcing in globally integrated defense sectors. Network effects mean that evaluating procurement programs requires examining not just prime contractors but their supply networks. The minimal export response suggests that defense spending serves primarily its direct purpose—acquiring military capabilities—with limited spillovers to export competitiveness over 24-month horizons.

Future research could extend this analysis in several directions. First, examining horizons beyond 24 months would test whether import intensity declines as domestic capacity adjusts or whether export spillovers eventually materialize as technology transfers mature. Second, analyzing procurement heterogeneity by contract type (R&D versus production, fixed-price versus cost-plus) could reveal whether certain contracting structures generate different trade effects. Third, investigating the composition of imports—distinguishing raw materials, components, and finished goods—would clarify which supply chain stages drive foreign sourcing. Fourth, examining bilateral trade flows could identify whether imports concentrate in specific partner countries (allies versus adversaries) with implications for economic security. Finally, welfare analysis incorporating price data would assess whether import increases reflect efficient access to specialized global technologies or inefficient distortions from temporary demand surges.

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A Additional Figures

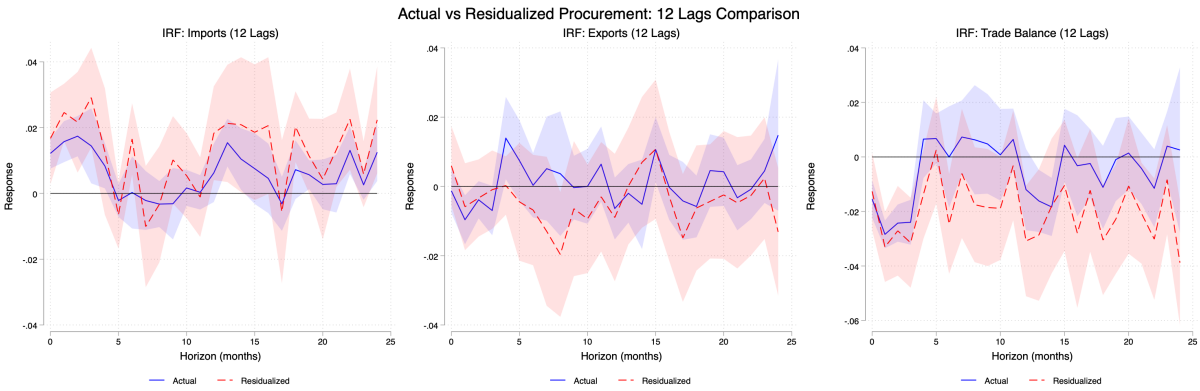
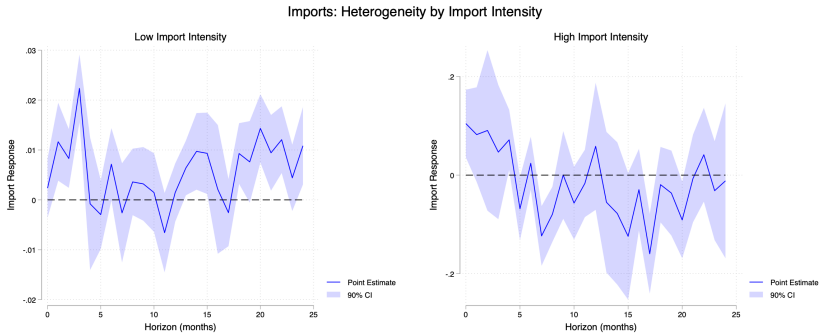


Figure A.1: Baseline vs. Residualized Procurement: 12-Lag Specification

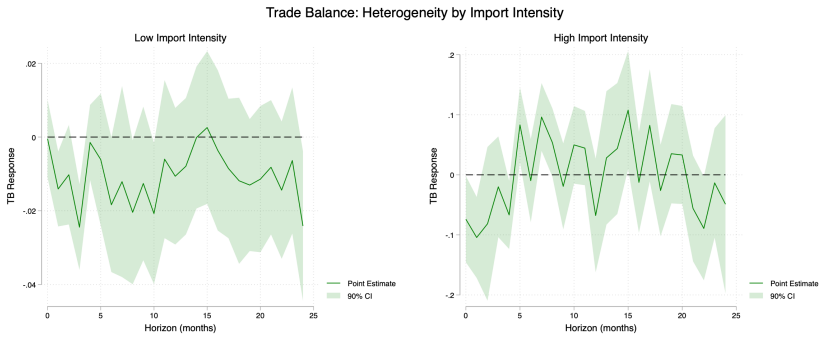
Notes: Comparison shows substantial divergence with 12 lags, indicating insufficient control for persistence. Main results use 18 lags where specifications converge (Figure 7).



(a) Import Responses



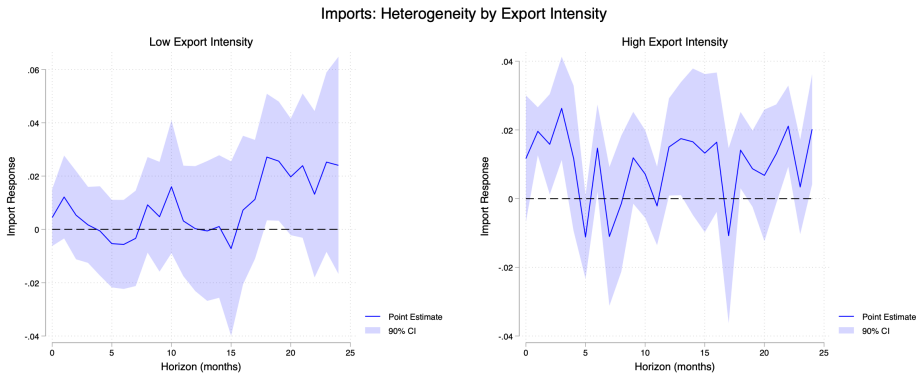
(b) Export Responses



(c) Trade Balance Responses

Figure A.2: Trade responses by Import Intensity

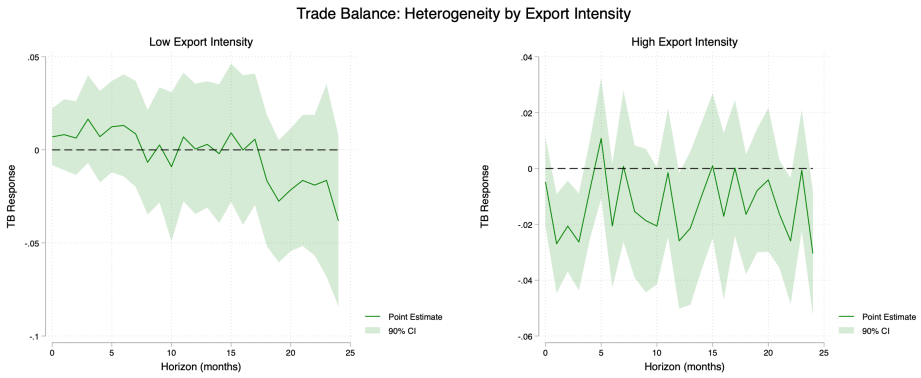
Notes: Each panel shows separate IRFs for high import intensity (right, above median) and low import intensity (left, below median). Shaded regions: 90% confidence intervals. Industries with low import intensity drive procurement's trade effects with significant import increases and trade balance deterioration, while import-dependent industries (high intensity) show noisier responses with bigger magnitudes.



(a) Import Responses



(b) Export Responses



(c) Trade Balance Responses

Figure A.3: Trade responses by Export Intensity

Notes: Each panel shows separate IRFs for high export intensity (right, above median) and low export intensity (left, below median). Shaded regions: 90% confidence intervals. Export-intensive industries (high intensity) drive procurement's trade effects with significant import increases and trade balance deterioration, while industries reliant on domestic sales (low intensity) show muted responses.

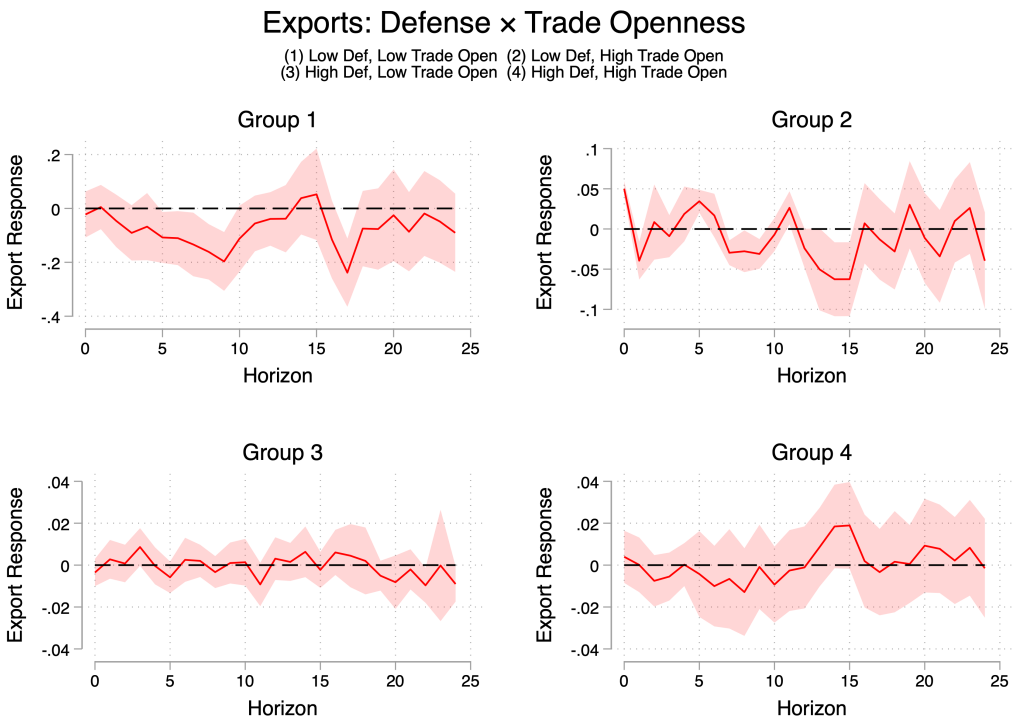


Figure A.4: Export Responses: Defense Intensity × Trade Openness

Notes: Each panel plots the export response to a one–dollar increase in real defense obligations for industries grouped by defense intensity (high/low) and trade openness (high/low). Shaded bands denote 90% confidence intervals. Export responses are muted across high-defense industries (Groups 3 and 4) and noisy in low-defense industries (Groups 1 and 2).

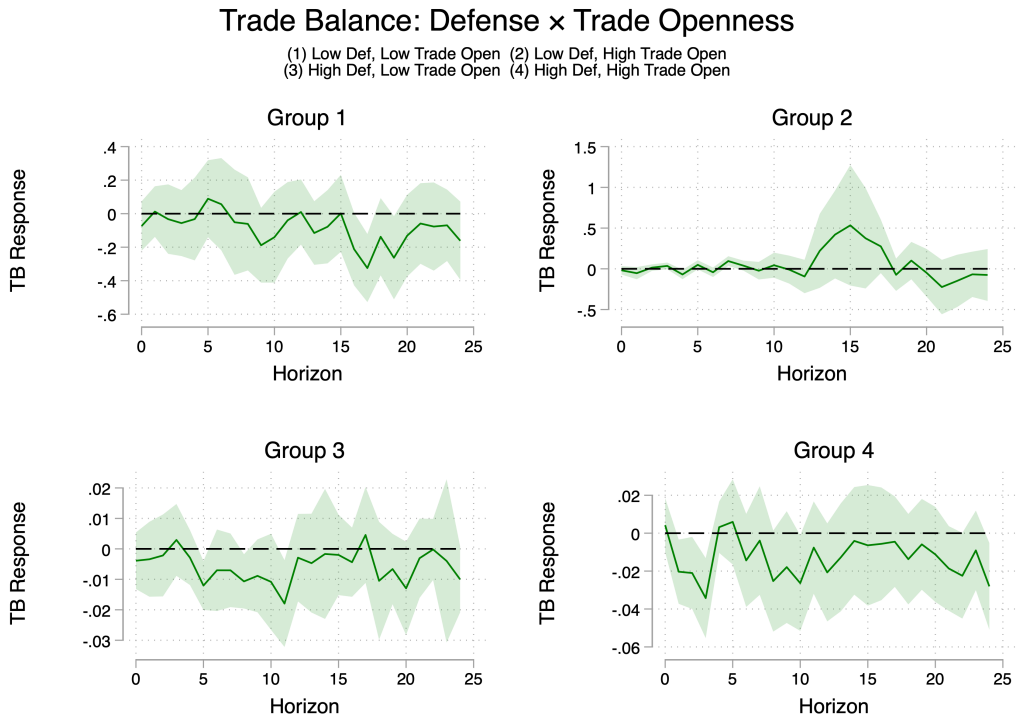


Figure A.5: Trade Balance Responses: Defense Intensity × Trade Openness

Notes: Each panel plots the trade balance response to a one–dollar increase in real defense obligations for industries grouped by defense intensity (high/low) and trade openness (high/low). Shaded bands denote 90% confidence intervals. Trade balance effects are closest to the baseline in Group 4.

B Additional Tables

Table B.1: Industries with High Export Intensity and Low Import Intensity

NAICS Code	Industry	Export Intensity	Import Intensity
212112	Bituminous Coal Underground Mining	0.137	0.029
212299	All Other Metal Ore Mining	0.130	0.110
311514	Dry, Condensed, and Evaporated Dairy Product Mfg.	0.128	0.052
311611	Animal (except Poultry) Slaughtering	0.121	0.070
313230	Nonwoven Fabric Mills	0.175	0.116
313240	Knit Fabric Mills	0.159	0.116
322110	Pulp Mills	0.100	0.079
324110	Petroleum Refineries	0.112	0.108
325211	Plastics Material and Resin Mfg.	0.213	0.091
325212	Synthetic Rubber Mfg.	0.247	0.121
325311	Nitrogenous Fertilizer Mfg.	0.097	0.120
325510	Paint and Coating Mfg.	0.090	0.037
325520	Adhesive Mfg.	0.123	0.042
325613	Surface Active Agent Mfg.	0.123	0.041
326122	Plastics Pipe and Pipe Fitting Mfg.	0.103	0.057
327211	Flat Glass Mfg.	0.084	0.058
327215	Glass Product Mfg. Made of Purchased Glass	0.084	0.079
327999	All Other Misc. Nonmetallic Mineral Product Mfg.	0.115	0.108
331315	Aluminum Sheet, Plate, and Foil Mfg.	0.136	0.118
332993	Ammunition (except Small Arms) Mfg.	0.258	0.037
333112	Lawn and Garden Tractor and Equipment Mfg.	0.099	0.099
333132	Oil and Gas Field Machinery and Equipment Mfg.	0.277	0.039
333249	Other Industrial Machinery Mfg.	0.094	0.121
333923	Overhead Traveling Crane, Hoist, Monorail System Mfg.	0.085	0.112
334511	Search, Detection, Navigation, Guidance System Mfg.	0.084	0.110
334614	Software and Prerecorded Media Reproducing	0.168	0.079
336211	Motor Vehicle Body Mfg.	0.330	0.050
336411	Aircraft Mfg.	0.154	0.119
336419	Other Guided Missile and Space Vehicle Parts Mfg.	0.207	0.072
336510	Railroad Rolling Stock Mfg.	0.088	0.044
336992	Military Armored Vehicle, Tank, Component Mfg.	0.165	0.077

Notes: Export intensity = average real exports / average real revenue. Import intensity = average real imports / average real revenue. Industries sorted by NAICS code. The median splits define these groups.

Table B.2: Industries with High Defense Intensity

NAICS Code	Industry	Defense Intensity
315990	Apparel Accessories and Other Apparel Mfg.	0.151
332993	Ammunition (except Small Arms) Mfg.	0.151
336611	Ship Building and Repairing	0.151
336992	Military Armored Vehicle, Tank, Component Mfg.	0.151
334290	Other Communications Equipment Mfg.	0.135
325411	Medicinal and Botanical Mfg.	0.112
336419	Other Guided Missile and Space Vehicle Parts Mfg.	0.107
334111	Electronic Computer Mfg.	0.094
333314	Optical Instrument and Lens Mfg.	0.074
332992	Small Arms Ammunition Mfg.	0.073
336414	Guided Missile and Space Vehicle Mfg.	0.069
336413	Other Aircraft Parts and Auxiliary Equipment Mfg.	0.061
334511	Search, Detection, Navigation, Guidance System Mfg.	0.060
336411	Aircraft Mfg.	0.053
332994	Small Arms, Ordnance, and Ordnance Accessories Mfg.	0.053
325920	Explosives Mfg.	0.051
316210	Footwear Mfg.	0.047
334220	Radio and TV Broadcasting Equipment Mfg.	0.045
336212	Truck Trailer Mfg.	0.043
314910	Textile Bag and Canvas Mills	0.040
334417	Electronic Connector Mfg.	0.027
339999	All Other Miscellaneous Mfg.	0.026
336412	Aircraft Engine and Engine Parts Mfg.	0.026
314999	All Other Miscellaneous Textile Product Mills	0.022
333316	Photographic and Photocopying Equipment Mfg.	0.022
334210	Telephone Apparatus Mfg.	0.022
337214	Office Furniture (except Wood) Mfg.	0.022
333318	Other Commercial and Service Industry Machinery Mfg.	0.019
335999	All Other Misc. Electrical Equipment and Component Mfg.	0.017
334419	Other Electronic Component Mfg.	0.017
332439	Other Metal Container Mfg.	0.017
333612	Speed Changer, Industrial High-Speed Drive, Gear Mfg.	0.016
315220	Men's and Boys' Cut and Sew Apparel Mfg.	0.015
334519	Other Measuring and Controlling Device Mfg.	0.014

Notes: Defense intensity = average real defense procurement obligations / average real revenue. Industries sorted by defense intensity (descending). The 90th percentile threshold (0.121) defines high defense intensity industries.

Table B.3: Industries with High Defense Intensity and High Trade Openness

NAICS Code	Industry	Defense Intensity	Trade Openness
314910	Textile Bag and Canvas Mills	0.040	0.400
314999	All Other Misc. Textile Product Mills	0.022	0.800
315220	Men's and Boys' Cut and Sew Apparel Mfg.	0.015	3.866
315990	Apparel Accessories and Other Apparel Mfg.	0.151	2.920
316210	Footwear Mfg.	0.047	4.643
325411	Medicinal and Botanical Mfg.	0.112	1.806
325920	Explosives Mfg.	0.051	0.387
332439	Other Metal Container Mfg.	0.017	0.337
332992	Small Arms Ammunition Mfg.	0.073	0.520
332993	Ammunition (except Small Arms) Mfg.	0.151	0.295
332994	Small Arms, Ordnance, and Ordnance Accessories Mfg.	0.053	0.439
333314	Optical Instrument and Lens Mfg.	0.074	1.685
333316	Photographic and Photocopying Equipment Mfg.	0.022	4.114
333318	Other Commercial and Service Industry Machinery Mfg.	0.019	0.347
333612	Speed Changer, Industrial High-Speed Drive, and Gear Mfg.	0.016	1.088
334111	Electronic Computer Mfg.	0.094	4.643
334210	Telephone Apparatus Mfg.	0.022	0.986
334220	Radio and TV Broadcasting and Wireless Comm. Equipment Mfg.	0.045	3.404
334290	Other Communications Equipment Mfg.	0.135	0.371
334417	Electronic Connector Mfg.	0.027	1.044
334419	Other Electronic Component Mfg.	0.017	1.269
334519	Other Measuring and Controlling Device Mfg.	0.014	1.036
335999	All Other Misc. Electrical Equipment and Component Mfg.	0.017	1.524
336212	Truck Trailer Mfg.	0.043	0.234
336411	Aircraft Mfg.	0.053	0.273
336412	Aircraft Engine and Engine Parts Mfg.	0.026	0.663
336413	Other Aircraft Parts and Auxiliary Equipment Mfg.	0.061	0.669
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Mfg.	0.107	0.279
336992	Military Armored Vehicle, Tank, and Tank Component Mfg.	0.151	0.241
339999	All Other Miscellaneous Mfg.	0.026	0.728

Notes: Defense intensity = average real defense procurement obligations / average real revenue. Trade openness = (average real exports + average real imports) / average real revenue. Industries sorted by NAICS code.