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Geumbi Park, Xiaoqing Zhou and Sarah Zubairy

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Subcontracting in Federal Spending: Micro and Macro Implications*

Geumbi Park†, Xiaoqing Zhou‡ and Sarah Zubairy§

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Abstract

This paper studies the critical but underexplored role of subcontracting in shaping the spatial and firm-level effects of federal government spending, introducing a new channel through which fiscal shocks propagate. Using newly available data on defense subcontracts merged with firm-level data, we document that a substantial share of spending is reallocated via subcontracts across regions beyond what is implied by the location of prime contracts. Firm-to-firm flows further show that subcontracting redirects spending toward large, goods-producing firms. We develop an empirical strategy that accounts for this reallocation and separately identifies the local effects of prime and subcontract spending. Accounting for subcontracting modestly raises prime-contract multipliers, while subcontract multipliers are substantially smaller. Firm-level evidence shows that this gap reflects both compositional differences and the inherently less stable nature of subcontracting relationships. We build a spatial multi-region model with prime-subcontracting networks to rationalize these findings. Our analysis suggests that subcontracting constitutes an important margin of fiscal transmission and that its rise weakens the transmission of government spending to local labor markets.

Keywords: Local multipliers, prime contracts, subcontracts, employment, firm dynamics

JEL Codes: E62, H30, H56, H57

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† Geumbi Park, Texas A&M University. Email: geumbi.park@tamu.edu.

‡ Xiaoqing Zhou, Federal Reserve Bank of Dallas. Email: xqzhou3@gmail.com.

§ Sarah Zubairy, Texas A&M University and NBER. Email: szubairy@tamu.edu.

1 Introduction

Government procurement spending, particularly defense purchases, plays a central role in U.S. fiscal policy and has long served as the workhorse for studying fiscal multipliers. Since the influential contribution of Nakamura and Steinsson (2014), cross-sectional variation in Department of Defense (DoD) prime contracts has been widely used to estimate how federal spending propagates through local economies. A large and growing literature exploits these contracts at different levels of geographic aggregation and reaches a broadly consistent conclusion: prime contract spending generates measurable, and often sizable, increases in local output, employment, and income, offering a powerful lens for understanding the regional transmission of fiscal policy.[1]

Yet this literature rests on a key simplifying assumption—that the geography of defense spending is well approximated by the location of *prime* contracts. In practice, prime contractors rarely fulfill the full scope of defense obligations themselves, instead outsourcing portions of production and services to subcontractors who are often located in different regions. As a result, prime contract data may not accurately reflect where federal dollars are ultimately spent or which firms benefit, making subcontracting a critical but largely unmeasured channel through which fiscal funds are redistributed across regions and firms.

Our paper is the first to systematically quantify how *subcontracting* reshapes the geographic, sectoral, and firm-level distribution of federal funds and to examine the resulting micro- and macroeconomic implications. We use a newly available dataset on defense subcontracting, reported continuously since 2011 under the Federal Funding Accountability and Transparency Act, which provides detailed information on subcontract amounts, place of performance, and contractual linkages to prime contracts. This dataset, previously unused in the fiscal-multiplier literature, allows us to document new facts about subcontracting and to revisit longstanding conclusions about the local effects of government spending. In addition, by merging these data with the National Establishment Time Series (NETS), we link prime and subcontracting firms to establishment-level outcomes, enabling us to assess the direct microeconomic effects on firms and uncover mechanisms underlying the transmission of government spending, which we formalize in a spatial multi-region model of prime-subcontracting networks.

Our empirical analysis consists of three parts. In the first, we document new facts about subcontracting and its role in reallocating defense spending across regions, industries, and firms. This analysis yields three main findings. First, subcontracting substantially reshapes the geography of defense spending: more than 70% of subcontract dollars cross state lines, and about 90% cross

[1]Examples include Dupor and Guerrero (2017) and Basso and Rachedi (2021) who study state-level variation, Demyanyk et al. (2019), Auerbach et al. (2020), Auerbach et al. (2022) and Briganti et al. (2025) who use county- or city-level variation, and Hebous and Zimmermann (2021) and Barattieri et al. (2023) who examine industry- and firm-level variation.

county lines. Second, cross-industry reallocation is sizable, with subcontracting shifting spending from services toward goods-producing industries, which account for the majority of subcontract obligations. Third, subcontracting is highly concentrated among large firms.

In the second part of our empirical analysis, we revisit estimates of local fiscal multipliers. The pervasive geographic reallocation implied by subcontracting means that the conventional approach—assigning all spending to the location of the prime contract—misallocates where spending actually occurs. Moreover, because defense procurement operates through two distinct contract types, it is important to ask how subcontract-based multipliers—previously unmeasured—compare with prime-contract multipliers. To address these questions, we propose an empirical approach that (i) corrects the measurement of prime-contract spending by netting out subcontract outflows, (ii) measures subcontract spending by aggregating inflows from all locations, and (iii) jointly identifies prime and subcontract multipliers using a shift-share design. Identification relies on three sources of variation: aggregate changes in defense prime spending driven by geopolitical and strategic considerations; aggregate changes in subcontracting driven by regulatory factors; and cross-sectional variation in initial shares of prime and subcontract spending.

Using this strategy and county-level data for 2011–2024, we find that corrected prime-contract multipliers are modestly larger than those obtained under the conventional approach, by about 10%–20%. This suggests that the downward bias from subcontract outflows, while theoretically unambiguous, is quantitatively small. Conventional estimates therefore provide a reasonable approximation in practice. More importantly, subcontract multipliers are substantially smaller than prime-contract multipliers. Counties receiving spending through subcontracts exhibit smaller gains in employment and earnings than those receiving prime contracts of comparable size. This pattern is robust across specifications and has important implications for the transmission of government spending. Back-of-the-envelope calculations suggest that the rise of subcontracting dampens the impact of federal spending on local economies due to its weaker job creation effects.

In the third part of our empirical analysis, we use firm-level microdata to uncover the mechanisms underlying these differences. We match the vast majority of firms in the defense procurement data to establishment-level records in NETS to study the direct effect of procurement contracts. Consistent with the county-level results, employment and sales at firm-level increase following both prime and subcontract awards, but responses to subcontracts are smaller and less persistent. The firm-level data also reveal important heterogeneity. Large, goods-producing firms are less responsive to new contracts, regardless of contract type, and particularly so when receiving subcontracts. This heterogeneity, combined with the fact that subcontract obligations are concentrated in these firms, provides a compositional explanation for the smaller subcontract multipliers: subcontracting directs spending toward firms and sectors where the incremental effect on employment is limited and short-lived.

However, even after accounting for compositional differences, firms remain less responsive to subcontracts. A decomposition exercise shows that the composition channel explains only about 30%–40% of the gap in employment responses between prime and subcontract spending, suggesting that additional mechanisms are at play. We therefore propose one such mechanism supported by the data: subcontracting relationships are less persistent and less stable than prime contracting relationships with the DoD, limiting employment responses through firms' expectations about future demand.

Motivated by these empirical findings, we develop a spatial multi-region model with heterogeneous firms and production networks that maps different types of procurement spending into local employment through direct and network channels. The model incorporates three empirically grounded features of subcontracting: geographic reallocation, concentration among large, capital-intensive firms, and less stable contractual relationships. These features dampen the local employment effects of subcontracting through two channels: a compositional channel, as subcontract dollars flow to less labor-responsive firms, and a frictional channel, as lower relationship stability weakens firms' incentives to expand employment. Even after allowing for local income–consumption feedback, subcontracting generates weaker local multiplier effects than prime contracting.

Taken together, our analysis highlights two main points. First, ignoring the redistribution of federal funds through subcontracting leads to an overstatement of the local incidence of government spending. Second, the rise of subcontracting—particularly its concentration in large, capital-intensive manufacturing firms—has reduced the overall sensitivity of local labor markets to defense procurement. The pervasive reallocation of funds through subcontracting helps reconcile why defense spending reaches a broader set of locations and industries than prime contract data suggest, yet generates relatively modest aggregate employment responses.

These findings have clear policy implications. The stronger and more persistent responses of small and service-sector firms suggest that directing subcontracting toward these firms could amplify employment gains. In addition, policies that enhance the stability of subcontracting relationships—or firms' expectations of such stability—may help strengthen the labor market effects of government spending delivered through subcontracts.

Relation to the Literature: Our paper contributes to a large and growing body of empirical work that uses defense contracts to study the economic impact of government spending. Since the seminal contribution of Nakamura and Steinsson (2014), which leverages state-level variation in prime contracts to estimate local fiscal multipliers, subsequent research has exploited finer geographic units, linked local multipliers to aggregate effects, and examined heterogeneity and state dependence.[2] Dupor and Guerrero (2017), for example, map local to aggregate multipliers using state-level data, while Demyanyk et al. (2019) use county-level variation and show that local multipliers are larger in areas with higher pre-recession household debt. Basso and Rachedi (2021) find that state-level local multipliers vary with local age composition, and Jo and Zubairy (2025) demonstrate that local multiplier size depends on the phase of business cycles, larger in demand-driven recessions. At the city level, Auerbach et al. (2020) document sizable GDP responses and significant cross-regional spillovers. Our analysis points to subcontracting as a concrete mechanism underlying such spillovers.[3]

More recent work uses industry-, firm-, and contract-level microdata to study how government demand shocks transmit through the economy. Hebous and Zimmermann (2021), for example, find that federal procurement raises capital investment only among financially constrained firms, consistent with financial accelerator effects, while Barattieri et al. (2023) document gains for upstream suppliers through higher employment and producer prices. Cox et al. (2024) study the universe of prime contracts, highlighting differences across contract types and their implications for shock transmission. Muratori et al. (2023) show that service-based defense spending generates larger employment effects than goods spending, and Briganti et al. (2025) find that employment gains are costly, concentrated among large contractors, and only gradually diffuse beyond direct recipients. These papers show that the effects of procurement depend critically on which firms receive government spending and how this spending propagates through production networks. Our paper builds on this insight by studying subcontracting as an observed contractual network that reallocates federal spending across firms, industries, and regions.

In addition, cross-country evidence shows that government procurement affects firm outcomes in a variety of settings: in Austria (Gugler et al., 2020), Brazil (Ferraz et al., 2021), Portugal (Gabriel, 2024), Korea (Lee, 2024), Spain (di Giovanni et al., 2023), and Germany (Hager and Huber, 2025). Together, these papers demonstrate the usefulness of procurement data for evaluating fiscal policy at multiple levels of aggregation. However, the analysis in these studies focuses almost exclusively on prime contracts. The subcontracting channel, which can significantly reallocate spending geographically and across firms, remains largely unexplored due to data limitations, a gap our paper aims to fill.

Finally, on the theoretical front, our paper relates to the literature on production networks

[2] In their influential paper, Nakamura and Steinsson (2014) note that subcontracting may be a concern but abstract from formally assessing its quantitative importance for two reasons. First, subcontracting data are not available for their sample period (1966–2006). Second, they show that prime contract spending closely tracks shipments to the government from defense-oriented industries at the state level during 1963–1983, suggesting that subcontracting may not be quantitatively important for state-level multiplier estimates in their setting. The subsequent availability of subcontracting data, together with the sharp rise in subcontracting after 2010, motivates our analysis.

[3] See Chodorow-Reich (2019) for a comprehensive review of the literature on estimating cross-sectional fiscal multipliers and the link between local and aggregate multipliers.

and shock propagation. Prior work shows that firm- and sector-level shocks can affect aggregate outcomes when production is organized through input-output linkages or concentrated among large firms (e.g., Gabaix 2011; Acemoglu et al. 2012; Carvalho 2014; Atalay 2017; Baqaee and Farhi 2019; Bigio and La'O 2020). Recent work also emphasizes firm-to-firm linkages (Herskovic et al. 2020) and sectoral input-output propagation of government procurement (Barattieri et al. 2023). We contribute by providing direct evidence on how government demand shocks propagate through contractual networks. In our setting, subcontracting directly links prime contractors to upstream firms, and we show that both firm composition and the persistence of relationships shape the transmission of fiscal shocks.

Outline: The remainder of the paper proceeds as follows. Section 2 provides institutional background and describes the data and summary statistics. Section 3 documents key facts about subcontracting and its role in reallocating defense spending. Section 4 presents our empirical strategy and estimates of local multipliers. Section 5 presents firm-level evidence that sheds light on the mechanisms underlying the differences between prime and subcontract multipliers. Section 6 develops a spatial multi-region model to rationalize our empirical findings. Section 7 concludes.

2 Institutional Background and Data

Our empirical analysis draws on multiple datasets at the contract, firm, county, and national levels to assess subcontracting in federal defense spending. This section provides institutional background on defense prime contracts and subcontracts and describes the main datasets. Additional institutional details and summary statistics are reported in Appendices A and D.

2.1 Background on Defense Prime Contracts and Subcontracts

Federal procurement spending consists of goods and services purchased by federal agencies from private firms, primarily implemented through prime contracts. These contracts follow formal procurement procedures—including solicitation, bidding, and evaluation—and are subject to detailed reporting and oversight. Within federal procurement, the DoD is by far the largest buyer, accounting for roughly 50%–60% of total federal contract spending (Congressional Research Service 2026; Cox et al. 2024). This dominance, together with the availability of detailed contract-level data over a long period, makes defense procurement a natural setting for studying government spending shocks and fiscal multipliers (e.g., Nakamura and Steinsson 2014; Dupor and Guerrero 2017). We therefore focus on subcontracting, which has received little attention in the literature.

Subcontracts are agreements between prime contractors and other firms and are not directly awarded by the DoD. Prime contractors frequently rely on subcontracting to source intermediate inputs and services. Table 1 presents an example of this relationship using an \$88 million prime

Table 1: Subcontracting example

Company	Location	Product description	Obligation
Prime contractor			
The Boeing Company	St. Louis, MO	Airframe structural components	88,096,704
Top 10 subcontractors			
PPG Industries, Inc.	Huntsville, AL	Purchase outside production	5,973,532
Brek Manufacturing Co.	Gardena, CA	Purchase outside production	2,630,625
Hill AeroSystems, Inc.	Enumclaw, WA	Purchase outside production	1,889,858
Kitco, LLC	Springville, UT	Common aerospace commodities	1,716,000
Pioneer Aerospace Corp.	Columbia, MS	Aerospace support	1,371,106
AAR Allen Services, Inc.	Wellington, KS	Aerospace support	815,900
Sargent Aero & Defense LLC	Tucson, AZ	Common aerospace commodities	624,225
D-J Engineering Inc.	Augusta, KS	Purchase outside production	519,740
Brenner Aerostructures, LLC	Bensalem, PA	Aerospace support	480,402
Globe Engineering Co., Inc.	Wichita, KS	Purchase outside production	385,388
Total			
Top 10 subcontractors' obligations			16,406,776
Total subcontract obligations			21,850,198
% Of prime contract obligation			24.8%

Source: USAspending.gov. Notes: Obligation amounts are shown in dollars.

contract awarded to Boeing in 2016 for producing airframe structural components. A substantial share of this contract was subcontracted to firms across the country: the top 10 subcontractors received $16 million, and total subcontract obligations accounted for about 25% of the prime contract value. These subcontracts span a broad range of products and services—including production inputs, aerospace support, interiors, and other components—highlighting their role as intermediate inputs. Appendix E provides additional examples of varying prime contract sizes.

At a basic level, subcontracting often resembles the procurement of specialized inputs and services. Unlike off-the-shelf purchases, which are standardized and not relationship-specific, defense subcontracts are often customized, relationship-specific, and tied to large-scale prime contracts, as in the Boeing example. To characterize the nature of these transactions more broadly, Appendix Figure A1 summarizes the most common descriptors in the subcontract data, with font size indicating frequency. Prominent terms—such as "service," "equipment," "support," "assembly," and "supply"—indicate that subcontracting is concentrated in technical and specialized activities that support the prime contractor's production process.[4]

[4] Some descriptors are abbreviated (e.g., "assy" for assembly) or concatenated (e.g., "medicalsurgical"). The word cloud is based on cleaned text (lowercased, lemmatized, and stripped of punctuation and stopwords), but original abbreviations and compound words are preserved.

The subcontracting process differs from prime contracting along several dimensions. First, subcontracting relationships are less formalized and subject to less direct oversight. While prime contracts follow structured procedures and are monitored by contracting agencies, subcontracting arrangements are negotiated privately by prime contractors. Although subject to general guidelines, subcontracts are not part of a centralized procurement process (see Federal Acquisition Regulation, FAR Part 44). Second, subcontracting relationships tend to be less persistent and less stable than prime contracting relationships with the DoD, reflecting their role in sourcing project-specific inputs. This feature suggests that subcontracting may generate weaker and less persistent economic effects, consistent with firms' expectations of future demand (see Section 5).

Federal policy has actively promoted and encouraged subcontracting as a means of expanding participation in federal procurement. Subcontracting provides new and small businesses with a lower-risk entry into the procurement network, allowing them to accumulate experience and credibility. Federal regulations have evolved over time to incentivize and require prime contractors to allocate a portion of their contract value to small and disadvantaged businesses through subcontracting plans. In addition, federal regulations mandate the reporting of subcontracts under Federal Funding Accountability and Transparency Act (FFATA), with reporting requirement applying most broadly beginning in 2011. Appendix D provides details on the timing and implementation of these requirements. These policies have increased participation in federal procurement and promoted diversity in the supplier base. Whether subcontracting in practice reallocates spending toward smaller firms, however, is ultimately an empirical question.

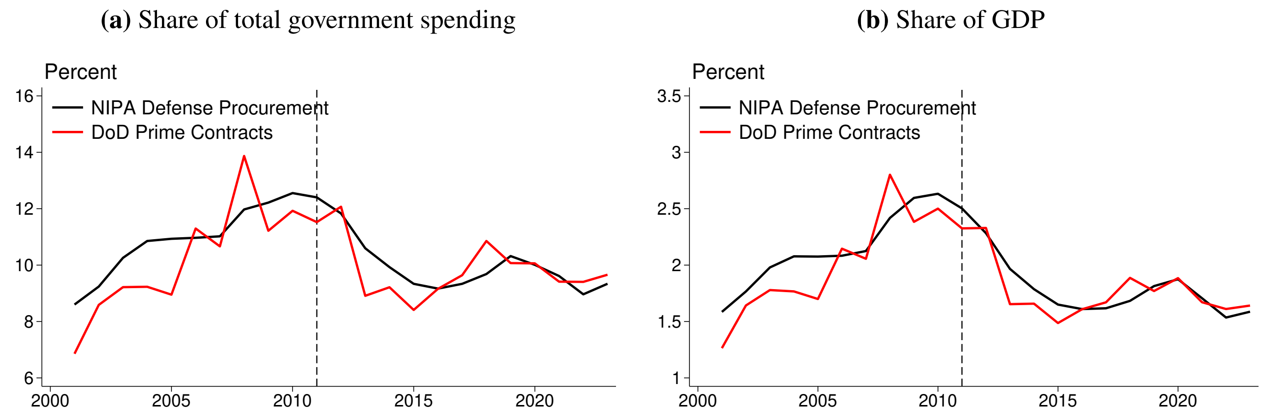
2.2 Data and Summary Statistics of Defense Contract Spending

Our measures of defense prime and subcontract spending are based on contract-level data from `USAspending.gov`. Prime contract data are available from FY2001, while subcontract data are available only after FY2011, following broad reporting requirements. We therefore begin our sample in 2011.[5] The data provide detailed information on contracts—including obligation date, amount, place of performance, and product description—as well as contractor characteristics, such as firm name, location, and industry. We present summary statistics on aggregate trends and industry composition in this section. Section 3 uses linked prime–subcontract data to study reallocation patterns.

The general properties of government prime contracts are well documented in recent work (e.g., Cox et al. 2024). We focus on defense procurement and highlight features relevant for our

[5]Subcontracts that occurred before October 2007 were not captured in the federal procurement data. Although subcontracting records exist for FY2008-FY2010, they are much sparser than those reported after 2011, when reporting became mandatory. This discontinuity suggests that the number of subcontracts prior to 2011 is likely underreported. That said, even in 2011, the aggregate count and value of subcontracts were small and quantitatively insignificant relative to subsequent years.

Figure 1: Defense procurement spending shares



Sources: BEA NIPA tables; USAspending.gov. Notes: NIPA defense procurement is the sum of (i) national defense intermediate goods and services purchased and (ii) gross investment in structure, equipment and software. The vertical line indicates the start of the mandatory subcontract reporting.

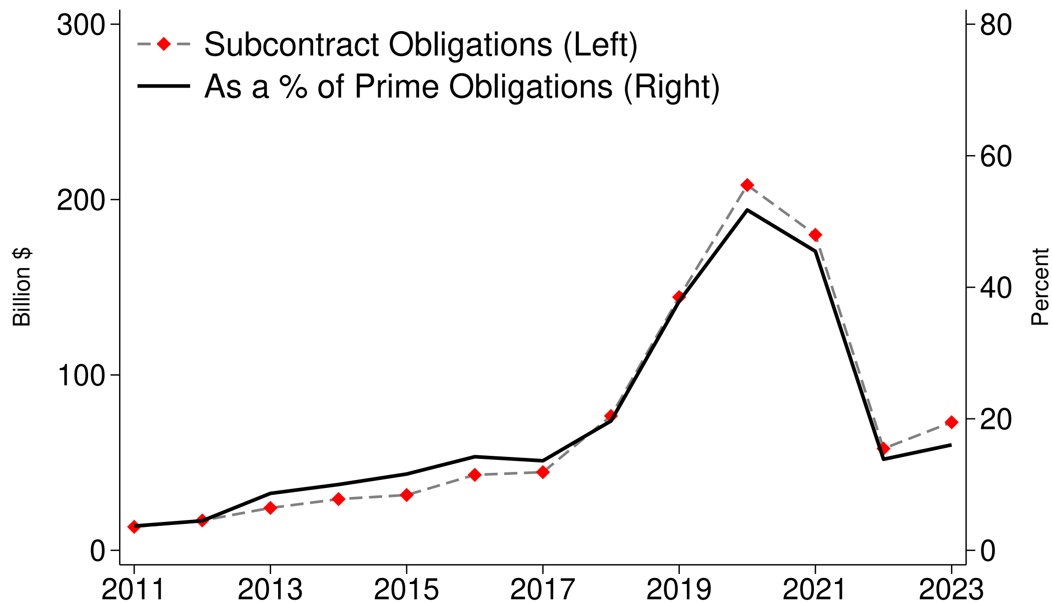
analysis of subcontracting. Figure 1 shows that defense prime contracts account for about 10% of total government spending and 2% of GDP since 2001, consistent with national accounts data on defense expenditures.[6]

At the contract level, consistent with Cox et al. (2024), we distinguish between two prime contract types: (i) one-time contracts, which are small, short-duration, and account for the vast majority of contracts by count; and (ii) recurring contracts, which are larger, longer-duration, and account for a smaller share by count. This distinction is important for understanding the industry composition of prime contract spending (see Figure A2, upper panels). One-time contracts are concentrated in non-durable and less complex manufacturing sectors (e.g., food production, petroleum refining, pharmaceutical supply, and specialized equipment), whereas recurring contracts are concentrated in capital-intensive and technologically advanced industries (e.g., aircraft, missile and shipbuilding, and professional and technical services). Recurring prime contracts generate most subcontract obligations.

Subcontracting has become increasingly important in defense procurement in recent years. Figure 2 shows that subcontracting grew steadily from 2011 to 2017, reaching about 20% of prime obligations. Between 2018 and 2021, subcontracting accelerated sharply, peaking at roughly 55% of prime obligations, before declining after 2021. The 2018–2021 surge was driven not by the extensive margin of subcontracting—the number of contracts or subcontractors—but by the intensive margin, namely, increases in obligations per subcontract (Figure A3). In addition, this

[6] Military spending and defense prime contracts rose after 2001 with 9/11 and the Iraq and Afghanistan wars (Ramey, 2011), declined around 2010, recovered after 2014–2015 amid the end of budget sequestration, geopolitical tensions, and modernization needs (Amodeo and Briganti, 2025; U.S. Department of Defense, Office of Industrial Base Policy, 2023), fell during Covid-19, and rebounded around Russia's 2022 invasion of Ukraine.

Figure 2: Aggregate trends in defense subcontracts



Source: USAspending.gov. Notes: Annual subcontract obligations (left axis) and as a share of prime contract obligations (right axis), aggregated from defense contract-level data.

boom resulted primarily from recurring prime contracts in the aircraft, missile and shipbuilding industries (Figure A2, middle panels), highlighting the central role of high-value prime contracts in shaping subcontracting trends.[7]

An important dimension of subcontracting is its timing relative to associated prime contracts. For one-time prime contracts, this timing is straightforward to measure as the difference between the prime and subcontract obligation dates. As shown in Figure A4 (panel a), subcontracts linked to one-time contracts typically occur with little delay. For recurring prime contracts, however, the relevant lag is less straightforward. The subcontract data record only the timing of the base prime contract—the initial award followed by a sequence of recurring contracts—rather than the specific contract within the sequence that gives rise to a subcontract. To address this, we assign each subcontract to the prime contract within the sequence whose obligation date is closest to that of the subcontract. Figure A4 (panel b) shows that such a closely aligned prime contract typically exists. This timing structure is important for our later analysis, which accounts for geographic reallocation through subcontracting. We will assess the robustness of our results to alternative

[7]DoD publications attribute the post-2021 increase in subcontracting to several factors, including pandemic-related catch-up efforts that led the DoD to rely more heavily on subcontracts to offset delays, as well as new initiatives such as the strategic shipbuilding surge under the FY2021–2022 budget and broader industrial base revitalization efforts implemented through prime contracts and supplier expansion. See, for instance, U.S. Department of Defense, Office of Industrial Policy (2021) and Appendix D.2 for additional details.

timing assumptions.

2.3 Firm-Level and County-Level Economic Data

To obtain more detailed information about prime and subcontractors and to better understand their responses to defense procurement, we employ establishment-level data from the National Establishment Time Series (NETS), a longitudinal dataset collected by Dunn & Bradstreet (D&B) for the Duns Marketing Information file. It contains information on employee counts, sales, credit ratings, industry, and business ownership structure. The data cover approximately 65 million U.S. establishments since 2011 (the start of our sample), with a unique identifier (*dunsnumber*) assigned to each establishment. Our NETS sample ends in 2022, the latest year we have data available.[8]

We use NETS to measure employment, sales, and credit ratings of firms that receive prime or subcontracts by merging DoD procurement data with NETS.[9] Thanks to the availability of the *dunsnumber* in both datasets, we are able to conduct an exact merge using this variable as the identifier. Appendix Table A1 shows that 91% of firms in DoD procurement data can be found in NETS, indicating the broad coverage and usefulness of NETS for our purposes.

That said, the accuracy of the NETS data is challenged by imputations and other potential data artifacts. We therefore follow Barnatchez et al. (2017) and apply additional sample restrictions: (i) excluding establishments with fewer than 10 employees or more than 1,000 employees, and (ii) excluding industries with substantial discrepancies relative to official data or high imputation rates, including educational services, public services, agriculture, mining and utilities. With these restrictions, our final sample covers 44% of firms in the original DoD procurement data. These firms account for 53% of total prime obligations and 70% of total subcontract obligations over our sample period. Firms receiving both prime and subcontracts are larger on average (in employment and sales), whereas those receiving only prime contracts are smaller. Figures A5 and A6 present the corresponding patterns in employment, sales, and firm size distributions.

Finally, we measure local labor market outcomes using the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW). The QCEW aggregates administrative establishment-level records from state unemployment insurance programs, providing near-universal coverage of wage-and-salary employment and consistent measurement across localities. The data report employment, total wage income, average weekly wages (defined as quarterly wage income divided by employment and then by 13), and the number of establishments by county and NAICS industry at a quarterly frequency. We use these data to estimate cross-sectional multipliers.

[8] Although NETS does not cover the full Census-based universe of employers and nonemployers, it can be made comparable to official datasets such as County Business Patterns and the Quarterly Census of Employment and Wages with appropriate sample restrictions (Barnatchez et al., 2017).

[9] Credit ratings are measured by D&B's Paydex score, which assesses a firm's payment reliability based on its payment history with suppliers and vendors, just like the FICO score for consumers.

3 Stylized Facts on Subcontracting and Spending Reallocation

In this section, we document how prime contract spending is reallocated through subcontracting and establish three key facts. First, subcontracting generates substantial geographic reallocation. Second, it reallocates spending across industries. Third, it shifts spending across firm-size categories. The first fact has direct implications for estimating cross-sectional fiscal multipliers, which we examine in Section 4. The second and third facts speak to differences between prime-contract and subcontract multipliers and motivate the firm-level analysis in Section 5.

Fact 1: Subcontracting has led to widespread geographic reallocation of federal spending.

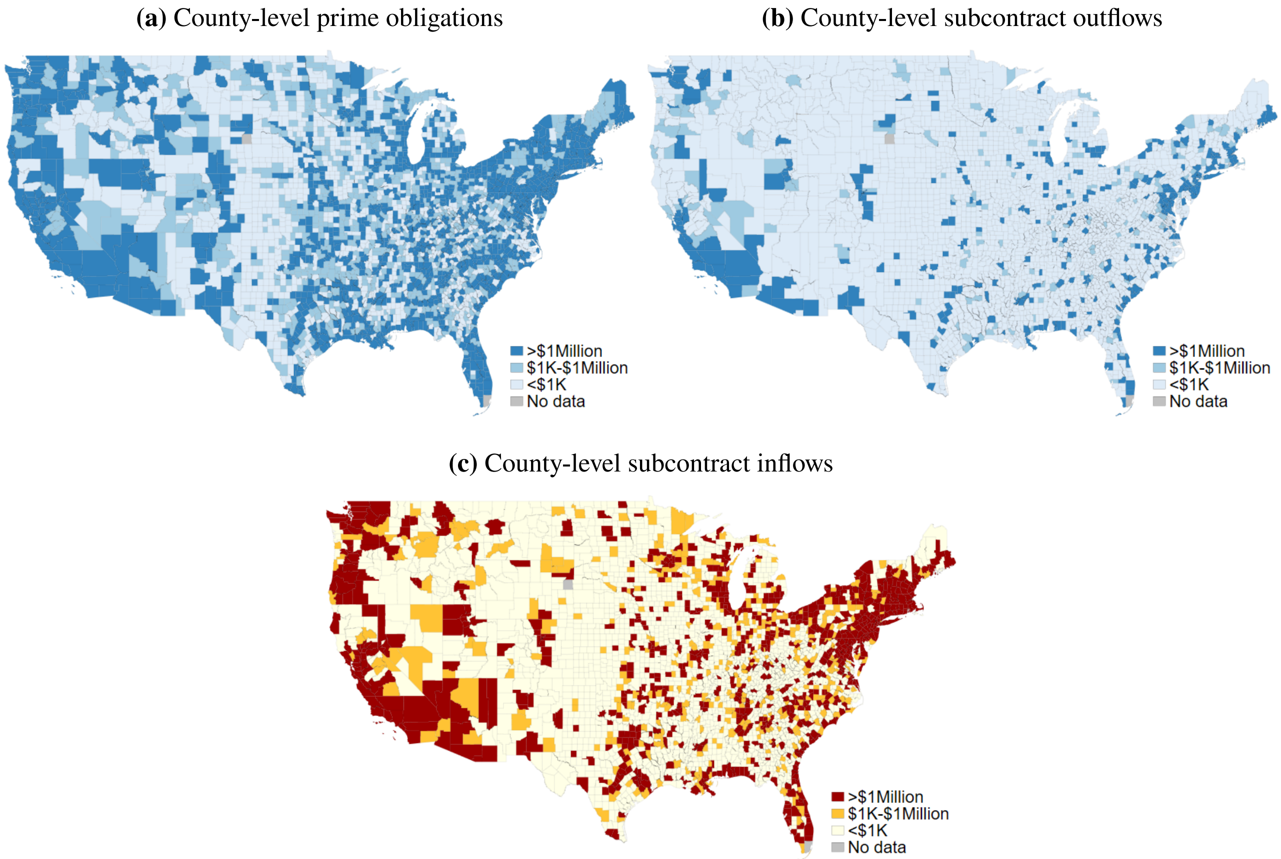
Figure 3 provides an initial view of how subcontracting redistributes prime contract spending across space using 2019 data. Panel (a) maps prime contract obligations received by each county. The footprint of federal defense spending is widespread, although highly uneven across locations. Because not all prime contracts generate subcontracts, panel (b) plots the amount of prime contract obligations flowing out of each county through subcontracting. These outflows—accounting for about 40% of aggregate prime contract obligations in 2019—are concentrated among primes in coastal areas. Panel (c) plots subcontract inflows at the county level, indicating that subcontracting expands the geographic reach of prime contract spending.

We next use linked prime–subcontract data from all years to quantify the prevalence of cross-county, cross-state, and cross-region subcontracting. Table 2 shows that 90% of subcontracts link firms located in different counties and 70% link firms in different states. When we instead use the location of work performed, these shares are lower but remain substantial: over 80% of subcontracts are performed in a different county from the prime contract workplace, and nearly two-thirds in a different state. Splitting prime contracts into one-time (typically smaller and shorter) and repeat (larger and longer) categories shows that subcontracts associated with one-time primes are even more likely to occur in different locations, although these contracts account for a smaller share of linked prime–subcontract data.[10]

Further evidence on the distance between prime contractors and subcontractors shows that the probability of forming a subcontract relationship declines with distance, indicating that geographic proximity remains important (see Appendix Figure A7). This pattern is consistent with prior evidence that defense spending in one region tends to propagate to nearby or economically and socially connected regions through trade and migration (e.g., Dupor and McCrory 2017; Auerbach et al. 2020). Our analysis highlights subcontracting as a concrete channel underlying these spillovers.

[10] Appendix Table A2 shows that when the shares in Table 2 are computed using dollar amounts rather than contract counts, cross-region subcontracting is even more pronounced: 94% of dollars flow to subcontractors in different counties and 78% to different states.

Figure 3: Geographic redistribution of prime obligations through subcontracting, 2019



Source: USAspending.gov. Notes: Panel (a) uses DoD prime contract data and plots county-level prime awards in 2019. Panels (b) and (c) use linked DoD prime–subcontract data and plot subcontract outflows and inflows, respectively, at the county level in 2019.

Fact 2: Sectoral reallocation through subcontracting is substantial, especially from services to goods-producing industries.

We now turn to cross-industry reallocation of defense spending using linked prime-subcontract data. Panel A of Table 3 shows the distribution of funds from prime contractors in each major industry (rows) to subcontractors in each industry (columns) at the NAICS 2-digit level. Goods-producing industries—manufacturing and construction—subcontract primarily within the sector, whereas service industries form broader linkages. Wholesale and retail trade, for example, subcontract largely to manufacturing firms, while high-value service industries (including information, professional and business services, and education and health) tend to subcontract within the sector. Other service industries distribute subcontracts more evenly across industries. Overall, goods-producing industries, particularly manufacturing, dominate the subcontracting network, accounting for 66% of subcontract award obligations.

The dominance of goods-producing firms in the subcontracting network is also evident at the

Table 2: Prime and subcontractor location patterns

	All subcontracts	Subcontracts under	
		One-time prime	Repeat prime
A. Locations of firms:			
Different counties	90%	93%	90%
Different states	71%	85%	68%
Different census regions	49%	60%	46%
# Obs.	1,393,118	259,580	1,133,538
B. Places of performance:			
Different counties	82%	87%	81%
Different states	64%	78%	61%
Different census regions	44%	57%	41%
# Obs.	1,384,042	258,479	1,125,563

Source: Linked DoD prime-subcontract data. Notes: The top panel reports the share of subcontracts in which the prime contractor and subcontractor are located in different places; the bottom panel reports the share in which their places of performance differ.

product level. Panel B of Table 3 shows flows from prime contract product types to subcontractors' industries. Prime contracts for goods predominantly subcontract to manufacturing firms, and service contracts allocate about half of the subcontract value to goods-producing industries.

Consistent with these industry- and product-level patterns, more disaggregated contract-level evidence shows that manufacturing and industrial goods are the most common subcontract contents. Figure 4 reports flows from products specified in prime contracts (left) to subcontracted products (right), with arrows indicating subcontract obligations.[11] Among prime contracts, those for weapons and ammunition, R&D services, and specialized equipment generate most subcontracts. On the subcontract side, computers and electronics, professional equipment, and industrial products—largely produced by manufacturing firms—receive funds from a wide range of prime producers and account for a large share of subcontract value. This pattern is consistent with the central role of computing and advanced technologies in defense procurement. Moreover, recent DoD initiatives in areas such as big data and artificial intelligence further reinforce this demand for computing-intensive inputs (Sayler, 2024).

[11] We use the standard product and service code (PSC) in the Federal Procurement Data System associated with each prime contract to classify its content. The subcontract data do not report PSCs, but include short text descriptions (e.g., "Countering weapons of mass destruction...", "Data visualization support..."). We use these descriptions to predict PSCs for subcontracts using machine-learning methods. Appendix F describes the prediction procedure.

Table 3: Cross-industry reallocation through subcontracting

Sub industry → Prime ↓	Construction	Manufacturing	Wholesale & Retail	High-Valued Services	Other Services	**Goods Producing**
A. By Prime's Industry						
Construction	**69%**	9%	10%	7%	4%	78%
Manufacturing	2%	**81%**	6%	9%	3%	82%
Wholesale & Retail	1%	65%	**15%**	16%	4%	66%
High-Valued Services	4%	18%	5%	**66%**	7%	22%
Other Services	17%	19%	9%	36%	**20%**	35%
Overall	7%	59%	6%	23%	5%	66%
B. By Prime's Product Type						
Product/Goods	1%	82%	6%	8%	2%	84%
Service	12%	38%	4%	39%	7%	50%

Source: Linked DoD prime-subcontract data. Notes: The table reports the share of subcontract obligations (2019 dollars) flowing from prime contracts in each industry or product/service category to subcontractors in a given industry. High-valued service industries include information, professional, business and technical services, and education and health. Within-industry subcontracting shares are highlighted in bold. Prime contractor industry and product information are from USAspending.gov; subcontractor industry information is from NETS.

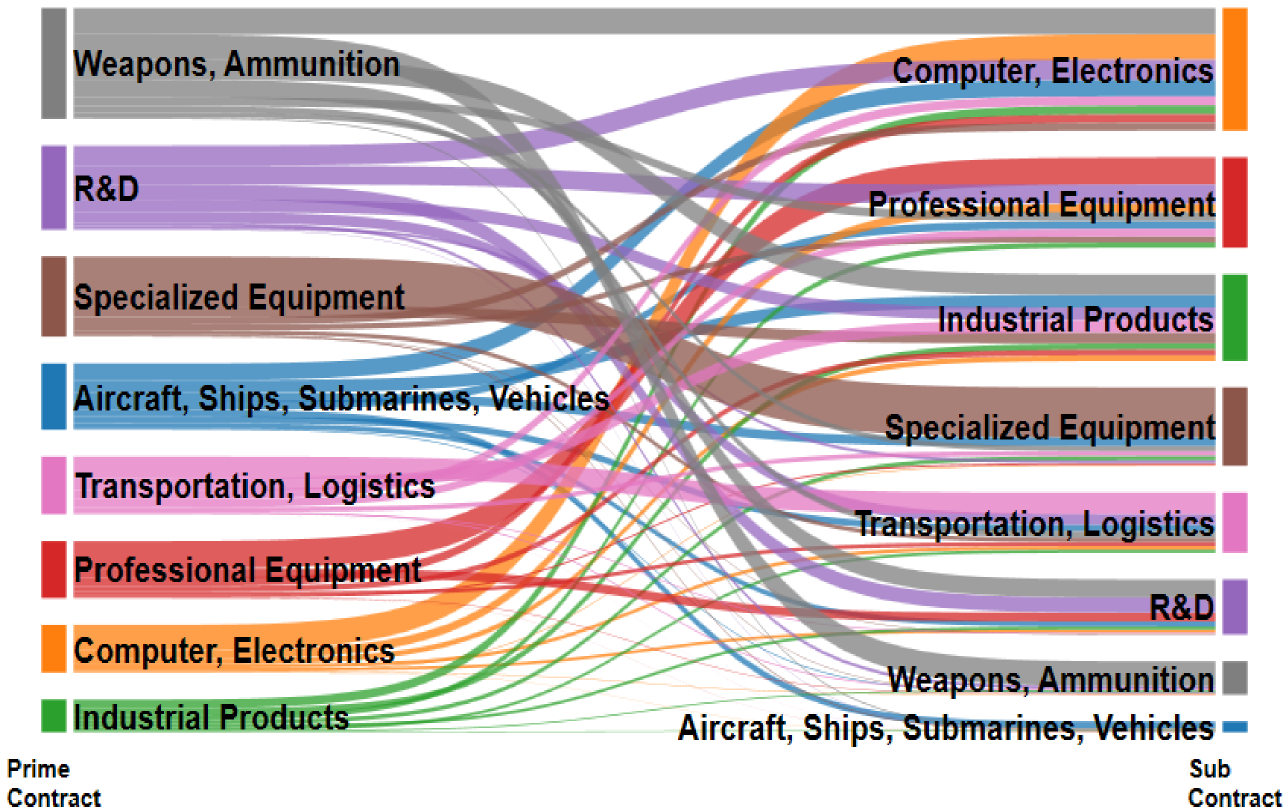
Fact 3: Large firms primarily subcontract to other large firms, while small and mid-sized firms also direct a substantial share of subcontracts to large firms.

We also examine subcontracting linkages by firm size, measured by employment. Table 4 shows the distribution of funds from prime contractors in each size category (rows) to subcontractors in each size category (columns). At both ends of the distribution, prime contractors tend to subcontract to firms of similar size. For example, 27% of obligations from the smallest primes (fewer than 19 employees) are subcontracted to similarly small firms, while 33% of obligations from the largest primes (more than 300 employees) go to firms in the same size category.

Table 4 also reveals a striking pattern: a disproportionate share of subcontracting flows to large firms, defined as those with at least 50 employees (last column). This contrasts with the conventional view that subcontracting primarily allows smaller, specialized firms to supply to larger prime contractors. Instead, the evidence suggests that large firms play an important role on both sides of the relationship, acting not only as prime contractors but also as subcontractors. This pattern suggests that scale advantages, capacity, and established positions within federal procurement networks likely make large firms attractive subcontracting partners as well.

We have shown that subcontracting reallocates federal defense spending across regions, industries, and firms of different sizes. We conclude this section by highlighting a key pattern:

Figure 4: Product linkages between prime and subcontracts



Source: Linked DoD prime-subcontract data. Notes: Flows from prime contracts to subcontracts, with arrows proportional to subcontract obligations (2019 dollars). The left panel classifies prime contracts by product service code; the right panel classifies subcontracts using product service codes predicted from subcontract description texts.

despite policies aimed at supporting small businesses and service providers, most subcontract dollars accrue to large firms and goods-producing industries, as shown in Figure 5. This composition has important implications for both local and aggregate economic outcomes, which we examine in subsequent sections.

4 Subcontracting and Cross-Sectional Fiscal Multipliers

Having documented substantial reallocation of federal defense spending through subcontracting, we revisit estimates of cross-sectional fiscal multipliers to account for this reallocation. We first present an empirical strategy that corrects the measurement of local defense spending, and then characterize the bias in conventional estimates that ignore subcontracting. Guided by this framework, we turn to the data and address two questions. First, to what extent are conventional prime-contract-based multipliers biased once subcontracting flows are incorporated? Second, how do subcontract-based multipliers compare with prime-contract multipliers? Finally, we examine

Table 4: Cross-firm-size reallocation through subcontracting

Subcontractor → Prime contractor ↓	Fewer than 19	20-49	50-99	100-299	More than 300	**Large (≥50)**
Fewer than 19	**27%**	20%	16%	21%	17%	54%
20-49	26%	**23%**	14%	27%	11%	51%
50-99	28%	23%	**18%**	20%	11%	49%
100-299	25%	20%	14%	**21%**	20%	55%
More than 300	18%	15%	11%	22%	**33%**	67%
Overall	21%	17%	13%	22%	27%	62%

Source: Linked DoD prime-subcontract data. Notes: The table reports the share of subcontract obligations (2019 dollars) flowing from prime contractors in each firm-size category to subcontractors in a given category. Within-category shares are highlighted in bold. Firm-size information is from NETS, given by number of employees.

the implications of subcontracting for the U.S. labor market.

4.1 Empirical Strategy

4.1.1 Conventional Approach

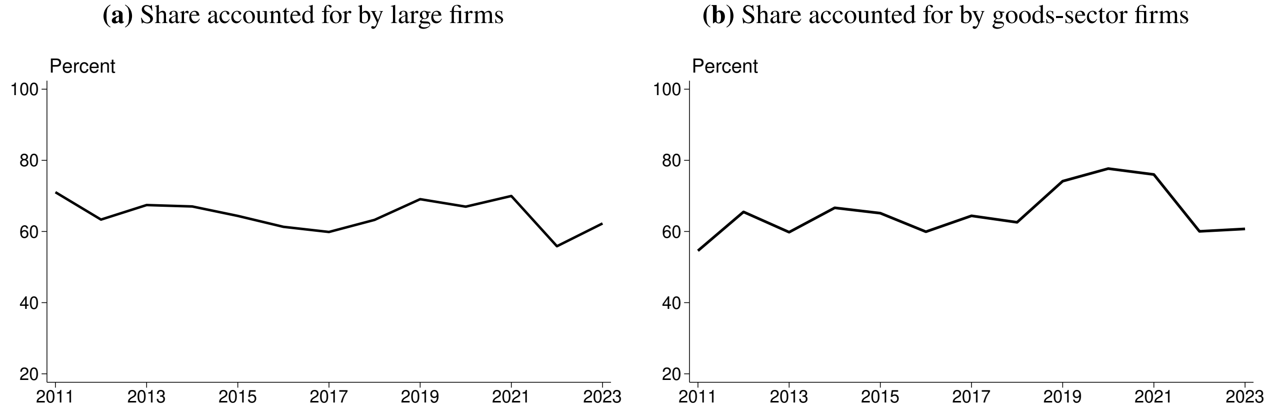
Let $G^P_{i,t}$ denote defense spending received by location i at time t through prime contract awards. This measure does not account for subcontract reallocation. The conventional approach to estimating local fiscal multipliers uses $G^P_{i,t}$ to identify government spending shocks. To obtain these estimates and to facilitate comparison with our corrected estimates, we use local projections similar to Dupor and Guerrero (2017), Chodorow-Reich (2019), and Auerbach et al. (2020) and building on Nakamura and Steinsson (2014), to capture cumulative multipliers:

$$\sum_{h=0}^{K-1} \frac{Y_{i,t+h} - Y_{i,t-1}}{Y_{i,t-1}} = \beta_K \sum_{h=0}^{K-1} \frac{G^P_{i,t+h} - G^P_{i,t-1}}{Y_{i,t-1}} + \alpha_i + \delta_t + \epsilon_{i,t+h}, \quad K = 4, 8, \ldots \tag{1}$$

where i, t and h index location, time and horizon, respectively. $Y_{i,t}$ denotes a local economic outcome.[12] The left- and right-hand-side terms sum over h, so that the coefficient β_K captures the cumulative effect at horizon K. All regressions include location fixed effects α_i and time fixed effects δ_t to control for unobserved heterogeneity and aggregate trends. Standard errors are

[12] In measuring $G^P_{i,t}$, we follow Auerbach et al. (2020) and construct a flow measure by allocating each contract's value evenly over its duration, which captures the component of defense contracts that affects output contemporaneously. Note that duration information is available for prime contracts in DoD procurement data but not for subcontracts. We therefore approximate subcontract duration using that of the prime contract with the closest obligation date.

Figure 5: Composition of subcontract obligations over time



Sources: USAspending.gov; NETS annual establishment-level data. Notes: Panel (a) plots the share of subcontract obligations (2019 dollars) accounted for by large firms (≥ 50 employees); panel (b) plots the share accounted for by firms in goods-producing sectors.

clustered at the commuting-zone-by-year level to allow for spatial correlation of shocks within local labor markets in each year.[13]

4.1.2 New Approach to Estimating Prime-Contract and Subcontract Multipliers

Given the substantial reallocation of defense prime contracts documented in Section 3, we propose an approach that corrects the measurement of local prime spending while separately estimating the effects of subcontracting. Specifically, we construct a measure of retained prime spending, $G^{P,R}_{i,t}$, defined as prime spending net of subcontract outflows from region i, and a measure of subcontract spending, $G^{S}_{i,t}$, defined as total subcontract inflows into region i from all locations:

$$G^{P,R}_{i,t} = G^{P}_{i,t} - \sum_{j} G^{Sub}_{i,j,t}, \qquad G^{S}_{i,t} = \sum_{j} G^{Sub}_{j,i,t},$$

where the first subscript of $G^{Sub}_{i,j,t}$ denotes the location of the prime contractor and the second denotes the location of the subcontractor.[14]

Suppose $G^{P,R}_{i,t}$ and $G^{S}_{i,t}$ are uncorrelated. In that case, one can estimate a “corrected" prime-contract multiplier by replacing $G^{P}_{i,t}$ with $G^{P,R}_{i,t}$ in Equation (1). This assumption is likely

[13]Counties within a commuting zone form an integrated local labor market, so shocks may be correlated across counties in the same zone. Clustering at the commuting-zone–by-year level allows for arbitrary correlation of errors within each zone–year cell, while treating correlations across years as absorbed by the model's fixed effects. This approach accounts for spatial dependence and maintains a sufficiently large number of clusters for reliable inference.

[14]To account for possible anticipation effects, i.e., that a subcontract may already be anticipated when the associated prime contract is awarded, we align the timing of a subcontract obligation with that of the associated prime contract. This timing adjustment has little effect on our baseline estimates in Section 4.3 (see Appendix Table B1, which shows robustness to using subcontract obligation dates directly).

to hold approximately at fine geographic levels, such as counties. However, a more appropriate approach is to estimate prime-contract and subcontract multipliers jointly, allowing their effects to differ:

$$\sum_{h=0}^{K-1} \frac{Y_{i,t+h} - Y_{i,t-1}}{Y_{i,t-1}} = \beta_K \sum_{h=0}^{K-1} \frac{G^{P,R}_{i,t+h} - G^{P,R}_{i,t-1}}{Y_{i,t-1}} + \gamma_K \sum_{h=0}^{K-1} \frac{G^{S}_{i,t+h} - G^{S}_{i,t-1}}{Y_{i,t-1}} + \alpha_i + \delta_t + \epsilon_{i,t+h}. \quad (2)$$

Equation (2) is our preferred empirical specification. We use county-level quarterly data from 2011Q1-2024Q3 for the baseline estimates, where the sample period is determined by subcontracting data availability. We choose counties as the baseline geographic unit for three reasons. First, counties provide a natural setting to study subcontracting-driven inflows and outflows of procurement funds, where reallocation is most visible and mismeasurement in conventional spending data is likely to be pronounced. Second, given the short time dimension of the subcontracting data, identification relies on cross-sectional variation, which benefits from the large number of units. Third, shifts in national defense spending and subcontracting trends are unlikely to be driven by conditions in small units such as counties. We discuss alternative geographic aggregation in Section 4.3.2 and present robustness checks using commuting-zone-level data.

4.1.3 Identification

Even after accounting for subcontracting reallocation, OLS estimates of local fiscal multipliers are likely to be biased due to two reasons. First, regional contract allocations may reflect business cycles or anticipatory behavior by agencies and firms expecting future awards (Auerbach et al., 2020). Second, defense procurement may be influenced by local political dynamics or lobbying (Nakamura and Steinsson, 2014; Choi et al., 2024).

Following Nakamura and Steinsson (2014), the literature commonly employs a shift-share instrument design to identify prime-contract multipliers. The instrument interacts national shifts in defense prime spending—largely driven by geopolitical or strategic considerations—with predetermined local exposure based on initial shares of national procurement. This strategy is particularly plausible in a cross-sectional setting with many geographic units, as national military buildups are unlikely to be correlated with local business cycles. We therefore adopt this approach to identify prime-contract multipliers, β_K. Under the conventional approach (Equation 1), the first stage is:

$$\sum_{h=0}^{K-1} \frac{G^{P}_{i,t+h} - G^{P}_{i,t-1}}{Y_{i,t-1}} = \theta^P_K \sum_{h=0}^{K-1} \frac{s^P_{i,0}(G_{t+h} - G_{t-1})}{Y_{i,t-1}} + \alpha_i + \delta_t + v_{i,t+h},$$

where $G_{t+h} - G_{t-1}$ denotes the change in national defense prime spending and $s^P_{i,0}$ is location i's initial share. We measure $s^P_{i,0}$ using the 2011–2012 average of quarterly shares.

To identify subcontract multipliers γ_K, we use a similar shift-share design that exploits national shifts in subcontract spending and cross-sectional exposure based on initial shares. As discussed in Section 2 and Appendix D, subcontract spending follows a distinct trend from prime spending over our sample period. In particular, the rise in subcontracting after 2010 was largely driven by regulatory and policy changes aimed at promoting subcontracting networks and small business participation. This provides an additional source of variation for identification.

To estimate prime-contract and subcontract multipliers jointly, we use both instruments in a joint first-stage specification:

$$\sum_{h=0}^{K-1} \frac{G^{P,R}_{i,t+h} - G^{P,R}_{i,t-1}}{Y_{i,t-1}} = \hat{\theta}^P_K \sum_{h=0}^{K-1} \frac{s^P_{i,0}(G_{t+h} - G_{t-1})}{Y_{i,t-1}} + \hat{\theta}^S_K \sum_{h=0}^{K-1} \frac{s^S_{i,0}(G^S_{t+h} - G^S_{t-1})}{Y_{i,t-1}} + FE$$
$$\sum_{h=0}^{K-1} \frac{G^{S}_{i,t+h} - G^{S}_{i,t-1}}{Y_{i,t-1}} = \hat{\omega}^P_K \sum_{h=0}^{K-1} \frac{s^P_{i,0}(G_{t+h} - G_{t-1})}{Y_{i,t-1}} + \hat{\omega}^S_K \sum_{h=0}^{K-1} \frac{s^S_{i,0}(G^S_{t+h} - G^S_{t-1})}{Y_{i,t-1}} + FE,$$

where $G_{t+h} - G_{t-1}$ and $G^S_{t+h} - G^S_{t-1}$ denote changes in national defense prime spending and subcontract obligations, respectively, and FE denotes location and time fixed effects. As before, we measure $s^P_{i,0}$, the initial share of prime obligations for county i, using the 2011–2012 average. For subcontracting, we construct initial shares $s^S_{i,0}$ using a slightly longer period, 2011–2014, as aggregate subcontract obligations are small and volatile in 2011–2012 alone. Our results are robust to using alternative initial periods such as 2011-2014 for both prime and subcontracts (see Appendix Table B2).

4.2 Bias in Conventional Multiplier Estimates

Before turning to the data, we derive the bias in the conventional approach that estimates prime-contract multipliers. For notational simplicity, we suppress the time subscript t and focus on a cross-sectional setting, as all regressions include time fixed effects. We also suppress h and K, since the derivation applies to any horizon. Let the data-generating process (DGP) governing the effects of prime and subcontract spending be:

$$\textbf{DGP:} \quad y_i = \alpha + \beta x^{p,r}_i + \gamma x^{sub,in}_i + \varepsilon_i, \quad x^{p,r}_i = x^p_i - x^{sub,out}_i, \quad \varepsilon_i \perp x^p_i, x^{sub,out}_i, x^{sub,in}_i,$$

where y_i denotes the change in a local economic outcome. x^p_i and $x^{p,r}_i$ denote prime spending and retained prime spending (net of subcontract outflows), respectively. $x^{sub,in}_i$ and $x^{sub,out}_i$ denote subcontract inflows and outflows. $\beta > 0$ and $\gamma > 0$ are the true prime-contract and subcontract multipliers.

The conventional approach, which ignores subcontract reallocation, regresses y_i on x_i^p,

$$\textbf{Misspecified model:} \quad y_i = \alpha + \beta x_i^p + u_i, \quad u_i = \varepsilon_i - \beta x_i^{sub,out} + \gamma x_i^{sub,in}. \tag{3}$$

Let $\hat{\beta}$ be the estimate of the prime-contract multiplier from Equation (3). Let $\bar{x}$ and σ_x denote the mean and standard deviation of x_i, and let $\rho(x, y)$ denote the correlation between x and y. In large samples,

$$\begin{aligned}
\hat{\beta} &= \frac{\sum_{i=1}^n (x_i^p - \bar{x}^p)(y_i - \bar{y})}{\sum_{i=1}^n (x_i^p - \bar{x}^p)^2} \\
&= \frac{\sum_{i=1}^n (x_i^p - \bar{x}^p)\left[\beta(x_i^p - \bar{x}^p) - \beta(x_i^{sub,out} - \bar{x}^{sub,out}) + \gamma(x_i^{sub,in} - \bar{x}^{sub,in}) + (\varepsilon_i - \bar{\varepsilon})\right]}{\sum_{i=1}^n (x_i^p - \bar{x}^p)^2} \\
&\to \beta - \beta \underbrace{\rho(x^p, x^{sub,out})}_{+} \frac{\sigma_{x^{sub,out}}}{\sigma_{x^p}} + \gamma \underbrace{\rho(x^p, x^{sub,in})}_{-} \frac{\sigma_{x^{sub,in}}}{\sigma_{x^p}} < \beta.
\end{aligned}$$

We do not know the signs of $\rho(x^p, x^{sub,out})$ and $\rho(x^p, x^{sub,in})$ a priori. In the data, however, $\hat{\rho}(x^p, x^{sub,out}) > 0$, indicating that subcontract outflows increase with prime contract obligations at the county level. In addition, $\hat{\rho}(x^p, x^{sub,in}) < 0$, suggesting that areas receiving more prime contracts do not simultaneously experience larger subcontract inflows. In large samples, $\hat{\rho}(x^p, x^{sub,out}) \to \rho(x^p, x^{sub,out})$ and $\hat{\rho}(x^p, x^{sub,in}) \to \rho(x^p, x^{sub,in})$.

These observations, together with positive multiplier effects, imply that the conventional estimate of the prime-contract multiplier is biased downward. All else equal, the magnitude of the bias increases with both β and γ. Notably, even if $\gamma \to 0$ (i.e., the true subcontract multiplier is small) or $\rho(x^p, x^{sub,in}) \to 0$ (subcontract inflows are uncorrelated with prime obligations), $\hat{\beta}$ remains downward biased. In practice, however, the magnitude of the bias depends on β, γ, and the correlations between prime and subcontract flows, which we examine empirically next.

4.3 Cross-Sectional Fiscal Multipliers: Prime-Contract vs Subcontract Effects

We now turn to local fiscal multiplier estimates and address two questions: (i) how do conventional estimates compare to corrected prime-contract multipliers, and (ii) whether subcontract multipliers differ from prime-contract multipliers.

4.3.1 Labor Market Effects

Table 5 shows estimates of prime-contract multipliers on earnings under alternative approaches. Panels A and B present conventional OLS and IV estimates that ignore subcontract reallocation. Consistent with prior work, the OLS estimates are smaller than the IV estimates, reflecting endogeneity concerns (e.g., Auerbach et al. 2020). The conventional IV multipliers range from 0.1

to 0.3 and rise with the horizon, indicating persistent effects of defense spending. For example, a 1 pp increase in prime spending relative to local earnings raises cumulative earnings by about 0.1% after two years and 0.2% after four years.

Panel C shows IV estimates that replace prime spending in Equation (1) with retained prime spending, yielding modestly larger estimates. Panel D reports results from our preferred IV specification (2), which jointly estimates prime-contract and subcontract multipliers. Two results emerge. First, corrected prime-contract multiplier estimates are modestly larger than those from the conventional approach, by about 10%–20% depending on the horizon. This suggests that the downward bias resulting from subcontract outflows, while theoretically unambiguous as shown in Section 4.2, is quantitatively small. Second, subcontract multipliers are substantially smaller than prime-contract multipliers. This difference has important implications for the transmission of government spending shocks, which we explore in subsequent sections.

Figure 6 compares conventional and preferred multiplier estimates for earnings and employment. Consistent with Table 5, correcting the prime spending measure raises the prime-contract multipliers, although the differences are not statistically significant. By contrast, the estimated subcontract multipliers are substantially smaller than prime-contract multipliers.

The figure also suggests that the observed earnings effects are driven primarily by employment responses. Table 6 confirms this pattern by examining a broader set of labor market outcomes. Across specifications, increases in employment are large and significant, accounting for most of the earnings effects (Panel A), while wage responses are modest (Panel B). Increases in both employment and wages are consistent with the view that defense spending operates as a demand shock to local labor markets. In addition, establishment counts do not change significantly (Panel C), indicating that employment gains arise primarily from the expansion of existing firms rather than from firm entry. This finding motivates our focus on existing firms in Section 5.

Before turning to heterogeneity in employment effects, we consider cost-per-job-year estimates, which are closely related to employment multipliers and of particular policy interest.[15] Using the employment multiplier estimates in Table 6, we report cost-per-job-year estimates in Appendix Figure B1. For prime contract spending, the cost per job-year ranges from \$200,000-\$300,000 (in 2019 dollars). By contrast, the corresponding estimate for subcontract spending is about \$900,000 at a four-year horizon—roughly three times as large. Thus, smaller subcontract employment multipliers translate into substantially higher costs per job-year, with important implications for

[15]This is computed as the reciprocal of the job-year estimate using the formula consistent with Briganti et al. (2025) and Chodorow-Reich (2019):

$$\text{jobs-year}_h = \beta_h \cdot \frac{1}{N \cdot T} \sum_{\ell=1}^{N} \sum_{t=2011+1}^{2025} \frac{1{,}000{,}000}{Y_{\ell,t-1}} \cdot E_{\ell,t-1},$$

where β_h is the horizon h employment multiplier.

Table 5: Estimates of local earnings multiplier

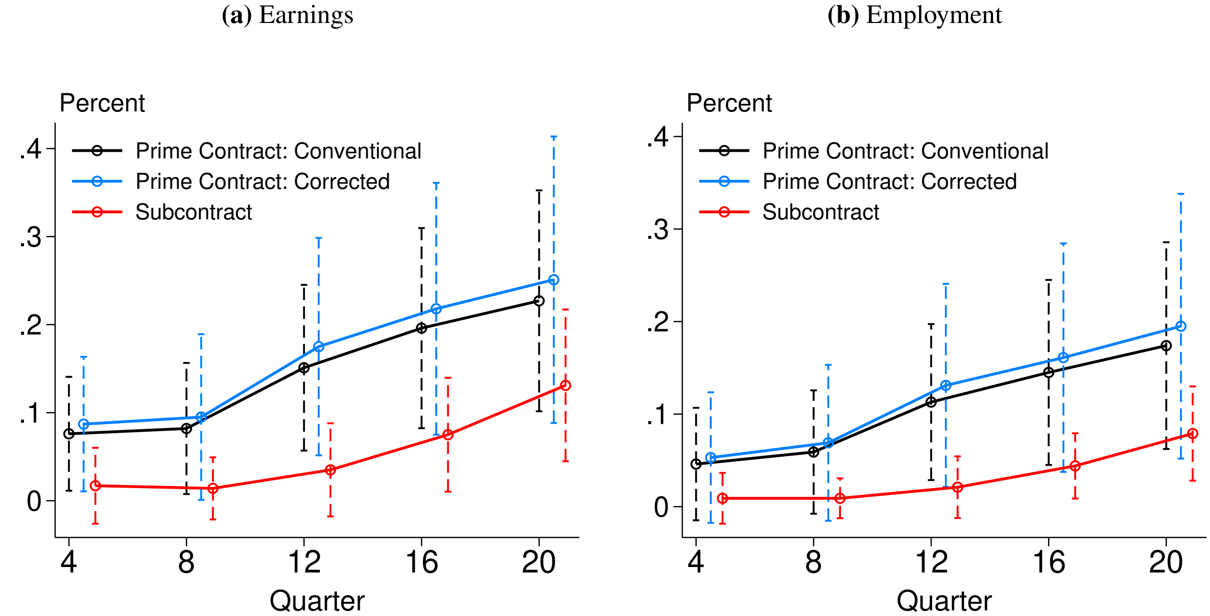
	Outcome Variable: Earnings				
	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Conventional OLS					
$\hat{\beta}^{OLS}$	0.024***	0.036***	0.044***	0.053***	0.063***
	(0.009)	(0.011)	(0.012)	(0.013)	(0.014)
# Obs.	99,708	86,882	76,311	67,078	58,544
B. Conventional IV					
$\hat{\beta}^{IV,Conv}$	0.076**	0.082**	0.151***	0.196***	0.227***
	(0.033)	(0.038)	(0.048)	(0.058)	(0.064)
1st-stage F	5,121	4,817	3,799	3,220	2,926
# Obs.	97,769	85,701	75,550	66,573	58,244
C. Corrected IV					
$\hat{\beta}^{IV,Corr}$	0.087**	0.096**	0.176***	0.223***	0.262***
	(0.039)	(0.048)	(0.064)	(0.074)	(0.086)
1st-stage F	2,191	2,132	1,875	1,753	1,531
# Obs.	97,769	85,701	75,550	66,573	58,244
D. Corrected IV: Joint Estimation					
$\hat{\beta}^{IV,Joint}$	0.087**	0.095**	0.175***	0.218***	0.251***
	(0.039)	(0.048)	(0.063)	(0.073)	(0.083)
$\hat{\gamma}^{IV,Joint}$	0.017	0.014	0.035	0.075**	0.131***
	(0.022)	(0.018)	(0.027)	(0.033)	(0.044)
P-value: $\hat{\beta}^{IV,Joint}=\hat{\gamma}^{IV,Joint}$	0.06	0.08	0.03	0.05	0.16
1st-stage F	369	443	645	689	538
# Obs.	97,769	85,701	75,550	66,573	58,244

Notes: Cumulative multiplier estimates using county-level data, 2011Q1-2024Q3. Panels A and B report OLS and IV estimates from Equation (1) without accounting for subcontract flows. Panel C reports IV estimates from Equation (1) with prime spending adjusted for subcontract outflows. Panel D reports IV estimates from Equation (2) with prime spending adjusted for subcontract outflows and subcontracting measured to include all inflows. *, **, and *** denote significance at the 10%, 5%, and 1% levels. Standard errors are clustered at the commuting-zone-by-year level.

policy design and evaluation.[16]

[16] Our cost-per–job-year estimates exceed those surveyed in Chodorow-Reich (2019) for the 2009 American Recovery and Reinvestment Act (ARRA), which range from $25,000-$125,000 in 2008 dollars. This difference may reflect the unique economic conditions during the ARRA period (i.e., the Great Recession). Our estimates are closer to those in Briganti et al. (2025), who use MSA-level data from 2006 to 2019 and find a cost per job-year of about $305,000 (in 2008 dollars).

Figure 6: IV estimates of local fiscal multipliers



Notes: IV estimates and 95% confidence intervals for cumulative multipliers. The black line plots IV estimates from Equation (1) without accounting for subcontract flows. The blue and red lines plot IV estimates from Equation (2) accounting for subcontract inflows and outflows.

4.3.2 Heterogeneity and Robustness

Employment effects by industry: To assess the effects of prime and subcontract spending across industries, we estimate the IV specification in Equation (2), replacing total employment growth with industry-specific employment growth on the left-hand side. Appendix Figure B2 reports prime-contract effects (upper panel) and subcontract effects (lower panel) by industry. Three findings emerge. First, subcontract effects are smaller than prime-contract effects in nearly all major industries, consistent with the county-aggregate results. Second, manufacturing is the primary driver of employment growth for both types of spending, in line with the concentration of defense contractors, especially subcontractors, in manufacturing. Third, other industries with statistically and economically significant effects include leisure and hospitality (for both types of spending), professional and business services (for prime contracts), and construction (for subcontracts). These patterns are consistent with spillovers and general-equilibrium effects across industries beyond those directly receiving defense contracts.

Subsample analysis: Our main result that subcontract spending has weaker multiplier effects than prime contract spending is not driven by the post-pandemic period, when subcontracting surged. Using the pre-pandemic sample (2011-2019), we find similar patterns: subcontract spending has smaller effects on both earnings and employment than prime contract spending (Appendix Table

Table 6: IV Estimates of broader labor market effects

	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Employment					
$\hat{\beta}^{IV,Conv}$	0.046	0.059*	0.113***	0.145***	0.174***
	(0.031)	(0.034)	(0.043)	(0.051)	(0.057)
$\hat{\beta}^{IV,Joint}$	0.053	0.069	0.131**	0.161**	0.195***
	(0.036)	(0.043)	(0.056)	(0.063)	(0.073)
$\hat{\gamma}^{IV,Joint}$	0.009	0.009	0.021	0.044**	0.079***
	(0.014)	(0.011)	(0.017)	(0.018)	(0.026)
B. Average Weekly Wage					
$\hat{\beta}^{IV,Conv}$	0.035**	0.028*	0.038**	0.045**	0.041*
	(0.016)	(0.017)	(0.019)	(0.022)	(0.022)
$\hat{\beta}^{IV,Joint}$	0.040**	0.032*	0.043**	0.049**	0.044*
	(0.019)	(0.019)	(0.022)	(0.024)	(0.025)
$\hat{\gamma}^{IV,Joint}$	0.012	0.008	0.013	0.027**	0.042***
	(0.011)	(0.008)	(0.010)	(0.013)	(0.016)
C. Establishment Counts					
$\hat{\beta}^{IV,Conv}$	0.011	0.011	0.005	0.006	0.012
	(0.009)	(0.012)	(0.015)	(0.018)	(0.019)
$\hat{\beta}^{IV,Joint}$	0.013	0.013	0.006	0.007	0.013
	(0.010)	(0.014)	(0.017)	(0.020)	(0.022)
$\hat{\gamma}^{IV,Joint}$	-0.004	-0.004	-0.002	0.003	0.004
	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)

Notes: Cumulative multiplier estimates using county-level data, 2011Q1-2024Q3. $\hat{\beta}^{IV,Conv}$ denotes IV estimates from Equation (1) without accounting for subcontract flows. $\hat{\beta}^{IV,Joint}$ and $\hat{\gamma}^{IV,Joint}$ are IV estimates from Equation (2) for prime-contract and subcontract effects, respectively. Local economic outcomes are measured in the QCEW data.

B3). Consistent with earlier results, corrected prime-contract multipliers are only modestly larger than conventional estimates.

Alternative geographic unit: As discussed above, our baseline county-level analysis is well suited to the short panel structure and strengthens identification. However, the literature highlights that cross-sectional multiplier estimates may vary with geographic aggregation (e.g., state, CBSA, and county). In general, more aggregated units tend to yield larger multipliers due to reduced leakage and greater within-unit spillovers (e.g., Dupor and McCrory 2017; Chodorow-Reich 2019).

We therefore assess robustness to alternative geographic units. We do not present state-level results, because the small number of units in a short sample leads to imprecise panel IV estimates. CBSA-level analysis is infeasible because CBSAs do not cover the entire U.S., creating missing subcontract inflows and outflows that are central to our spending measures and multiplier estimation. We therefore present results at the commuting-zone (CZ) level, which aggregates counties and closely approximates local labor markets.

Table B4 shows earnings and employment multiplier estimates using CZ-level data. Compared with county-level estimates, CZ-level estimates are larger at almost all horizons, consistent with reduced leakage and greater spillovers at higher levels of aggregation. Despite these differences, our main conclusions are unaffected. First, corrected prime-contract multipliers are modestly larger than conventional estimates, although the difference is quantitatively small. Second, subcontract multipliers are significantly smaller than prime-contract multipliers.

4.4 Aggregate Implications of Subcontracting for U.S. Labor Markets

Our analysis shows a robust pattern that subcontract spending has smaller local multiplier effects than prime contract spending. We next consider the implications of this pattern for U.S. labor markets, before turning to firm-level evidence on the underlying mechanisms. The key idea is that, given weaker subcontract multipliers, the rise of subcontracting in federal spending may dampen the transmission of government spending shocks to labor markets.

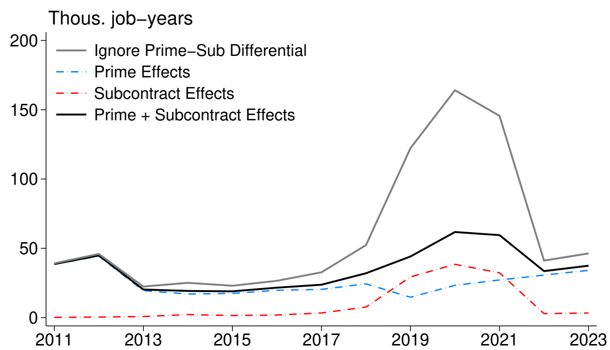
We first illustrate this idea for local labor markets using back-of-the-envelope calculations of job creation from defense procurement after 2011. Specifically, we combine county-level data on prime and subcontract spending with our cost-per-job-year estimates (using the 16-quarter horizon estimates) to compute job-years created in each county. The results exhibit substantial heterogeneity. Panels (a) and (b) of Figure 7 show calculations for two large counties that receive high levels of defense procurement—Los Angeles and Fairfax. We compute job-years separately for prime contract spending (blue) and subcontract spending (red); their sum (black) gives total job-years created. We also construct a counterfactual that assumes subcontract spending has the same multiplier as prime contract spending.

For Los Angeles, the distinction between prime-contract and subcontract effects is particularly important. During 2018–2021, the county received substantial subcontract inflows, yet the implied effects on the labor market are modest. Applying conventional prime-contract multipliers without accounting for this distinction would therefore overstate employment effects. By contrast, Fairfax experienced relatively little subcontracting activity, so the discrepancy is small.

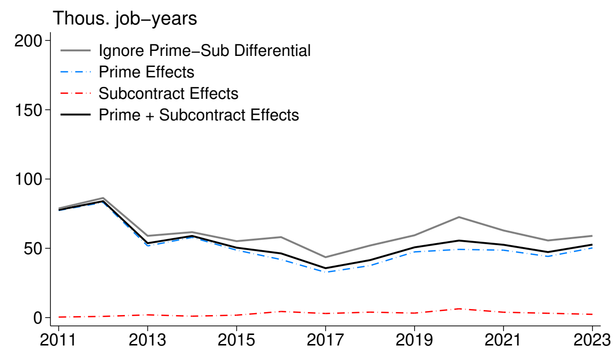
We extend this exercise to the U.S. labor market. Interpreting these results requires caution, as the mapping from cross-sectional to aggregate multipliers is not straightforward. As emphasized in the literature, spillovers across regions and monetary and fiscal policy responses can generate discrepancies between local and aggregate effects. Nevertheless, local multipliers provide useful information about aggregate government spending effects (Dupor and Guerrero, 2017; Nakamura and Steinsson, 2018). We therefore interpret our national job-year calculations as

Figure 7: Defense procurement and job creation

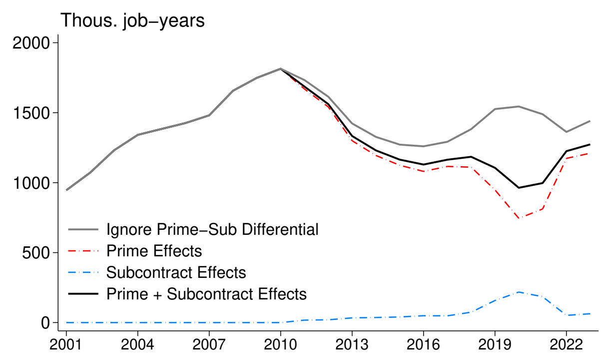
(a) Los Angeles County, CA



(b) Fairfax County, VA



(c) U.S. aggregate



Notes: The blue and red lines in each panel plot implied job-years created by defense prime and subcontract spending, using costs per job-year estimated at the 16-quarter horizon. The black line is the sum of the blue and red lines, reflecting total job-years that account for the difference between prime and subcontract multipliers. The gray line applies the prime-contract cost per job-year estimate to both prime and subcontract spending.

a fixed-policy counterfactual, holding monetary and fiscal policy constant and abstracting from general-equilibrium feedback (Chodorow-Reich 2019). This interpretation is consistent with the theoretical model we develop in Section 6, which provides a framework for linking cross-sectional estimates to aggregate outcomes under fixed policy. The goal is to highlight the role of rising subcontracting relative to a counterfactual without this trend.

Panel (c) of Figure 7 shows job-year calculations for the U.S. aggregate. The rise in subcontracting after 2010 creates a gap between total employment effects and the counterfactual that assumes subcontracting has the same multiplier as prime contracts. The increase in defense spending after 2015 does not translate into a commensurate boost to the labor market. If anything, job creation is lower than in earlier years, as the subcontracting boom generates fewer jobs than would have arisen had funds been allocated solely to prime contracts. While the level of job creation is subject to the caveats discussed above, our main point is that the rise in subcontracting is expected to weaken the transmission of defense spending to the labor market. Moreover, assuming equal effects across contract types would overstate employment effects, for example, by about 21% over 2018–2023.

5 Prime vs Subcontracting Effects: Establishment-Level Evidence

Having shown that subcontract spending has smaller multiplier effects than prime contract spending, we turn to the mechanisms underlying this difference. Geographic aggregates, even at the county level, provide limited insight into these mechanisms. To this end, we use establishment-level microdata from NETS for three purposes: (i) to corroborate the county-level results, (ii) to identify the types of firms that drive the difference, and (iii) to provide evidence on the mechanisms behind the differential effects.

Although NETS data can be aggregated to the firm level, we conduct the analysis at the establishment level for three reasons.[17] First, DoD contracts are performed at specific locations by establishments operating in those locations. Focusing on establishment-level data, as opposed to aggregating them across regions to the firm level, is consistent with our county-level analysis. Second, establishment-level data allow each individual location to be classified into a specific industry, which is essential for analyzing heterogeneity across industries. Third, most U.S. businesses are single-establishment firms (Sadeghi et al., 2016), so the choice of aggregation is unlikely to be quantitatively important. This also implies that our estimates capture the direct effects of federal contracts on establishments, rather than spillovers to other establishments within firms or to the broader local economy. Throughout, we use the terms *establishment* and *firm* interchangeably to refer to establishments.

5.1 Empirical Approach

Our sample includes all establishments that receive a defense prime contract or subcontract at any point between 2011 and 2024. We observe employment, sales, credit ratings and other characteristics annually from 2011 to 2022. To study the cumulative effects of contract awards, we estimate a local-projection panel specification similar to di Giovanni et al. (2023), exploiting within-firm variation in the timing of contract arrival:

$$\frac{y_{j,t+h} - y_{j,t-1}}{y_{j,t-1}} = \beta^h g^P_{j,t} + \gamma^h g^S_{j,t} + \omega \mathbf{x}_{j,t-1} + \alpha_j + \delta_{st} + \nu_{j,t+h}, \tag{4}$$

[17] An establishment is a single physical location where one predominant activity occurs, identified by the *dunsnumber* in our merged dataset. A firm is an establishment or a collection of establishments operating in one or more industries, typically identified by the Employer Identification Number (EIN). An enterprise is a firm or a group of firms spanning multiple industries under one or more EINs. See Sadeghi et al. (2016) for a detailed comparison of establishment, firm, and enterprise definitions.

where $g^P_{j,t}$ is an indicator for whether firm j receives a prime contract in year t, and $g^S_{j,t}$ is defined analogously for subcontracts. The LHS is the cumulative percent change in the outcome at horizon $h = 1, ..., H$. The coefficients β^h and γ^h are the parameters of interest. $\mathbf{x}_{j,t}$ denotes a vector of controls. For employment regressions, we include lagged employment (in log) as a control; for sales and credit rating regressions, we further include the corresponding lagged variable (in log) as a control. All regressions include firm fixed effects to account for unobserved heterogeneity, as well as NAICS-2-digit-by-year fixed effects to control for sector-specific time trends. The standard errors are clustered at the establishment level.

By including firm fixed effects, our empirical strategy exploits within-firm variation, as having a prime or subcontract is relatively rare at the establishment-year level. Our sample is restricted to firms that have ever participated in defense contracts. This helps mitigate the concern of selection bias, because firms that never participated in government procurement may have done so for reasons correlated with their employment and sales growth.[18] In other words, including firms that never participated in defense contracts may introduce a selection problem that biases our estimates, a pitfall we avoid using our defense contractor sample.

While Equation (4) captures the timing of contract arrival, it does not account for treatment intensity. Our county-level multiplier estimates suggest that prime and subcontract spending, even of similar size, have different economic effects. To exploit variation in both timing and scale of contract awards, we also estimate a specification that replaces the indicator variables in Equation (4) with contract obligations in dollar amount (per $million).

Beyond average effects, we examine heterogeneity across firms in the responses to prime and subcontract awards. To assess these patterns, we estimate a specification that interacts prime and subcontract shock measures with a firm characteristic, Z_j,

$$\frac{y_{j,t+h} - y_{j,t-1}}{y_{j,t-1}} = \beta^h_1 g^P_{j,t} + \gamma^h_1 g^S_{j,t} + \beta^h_2 g^P_{j,t} \times Z_j + \gamma^h_2 g^S_{j,t} \times Z_j + \omega \mathbf{x}_{j,t-1} + \alpha_j + \delta_{st} + \nu_{j,t+h}. \quad (5)$$

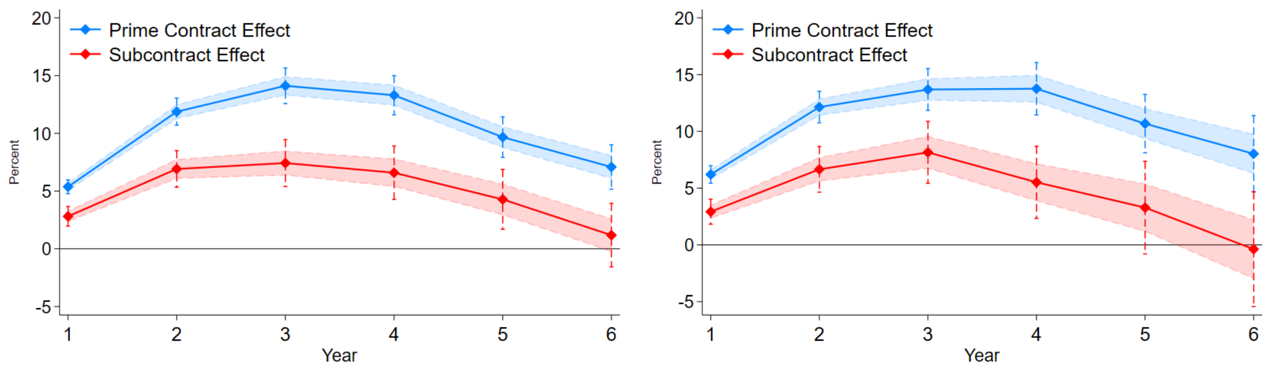
5.2 Establishment-Level Effects of Prime and Subcontracts

Figure 8 shows the effects of prime contract and subcontract arrival on firm employment and sales. Both outcomes increase following contract receipt. More importantly, we find that prime contracts have significantly larger effects than subcontracts at all horizons, and that prime contract effects are more persistent, consistent with our county-level evidence. Figure 9 shows estimates from a specification that accounts for contract size. The results are similar: firms respond more

[18]For example, firms that have never participated in defense contracts may operate under different supply-chain systems, serve different client bases, or perform more or less efficiently than participating firms. These unobserved characteristics could affect the economic outcomes we study, potentially confounding the estimated effects of defense contracts.

Figure 8: Effects of defense contract arrival

(a) Employment **(b)** Sales



Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (4). All regressions include establishment fixed effects, NAICS 2-digit industry-by-year fixed effects, and the control variables described in the text. Standard errors are clustered at the establishment level.

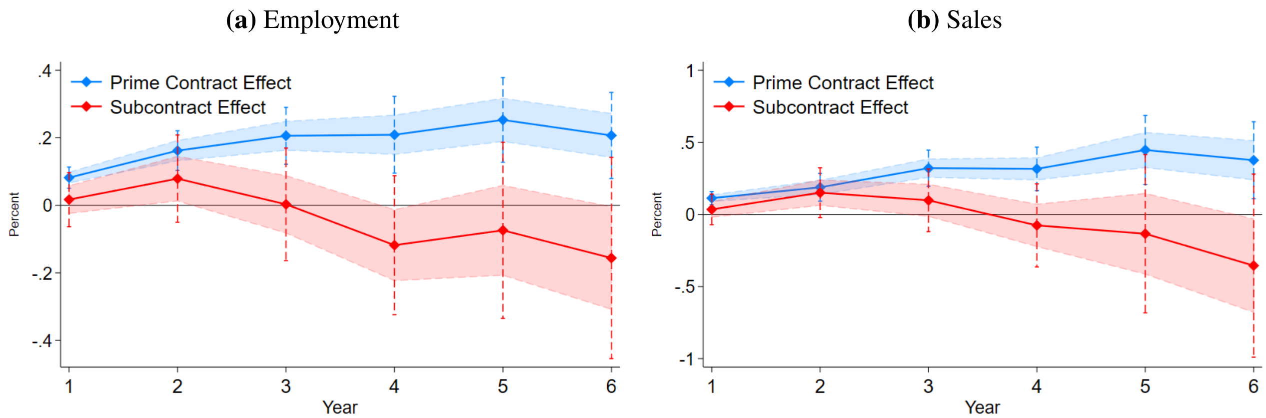
strongly to a prime contract than to a subcontract of the same size, and responses to prime contracts are more persistent. Although these firm-level estimates capture only direct effects of defense contracts, they provide micro-level support for the county-level multiplier results.

To identify which firms drive these differential effects, we examine heterogeneity along two dimensions. First, we compare responses by firm size, distinguishing small firms (less than 50 employees on average) from large firms (50 or more employees). Second, we examine heterogeneity by industry, comparing firms in services with those in goods-producing industries. We present employment results, as sales responses exhibit similar patterns.

The upper panels of Figure 10 show employment responses by firm size following the arrival of prime and subcontract awards. Similar patterns are observed when spending is measured in dollars (see Appendix Figure C1). Two findings stand out. First, large firms exhibit weaker employment responses, regardless of contract type. This is consistent with prior evidence that small firms contribute disproportionately to net job creation (e.g., Neumark et al. 2011; Haltiwanger et al. 2013). Second, large firms respond least to subcontracts. Breaking down the effects by industry, the lower panels of Figure 10 show that goods-producing firms exhibit weaker and less persistent employment responses than service firms. This pattern is consistent with Muratori et al. (2023), who focus solely on defense prime contracts and, using MSA-level data, find larger local multipliers for service-based spending.

Our establishment-level evidence therefore suggests that subcontracting generates weaker employment and sales effects, driven primarily by large firms and firms in goods-producing industries. One might instead expect that the rise in subcontracting, by reallocating spending toward these more capital-intensive firms, could increase productivity, especially during our sample period

Figure 9: Effects of defense contract awards (per $ million)



Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (4). All regressions include establishment fixed effects, NAICS 2-digit industry-by-year fixed effects, and the control variables described in the text. Standard errors are clustered at the establishment level.

when labor market slack was relatively low. To assess this possibility, we examine the response of sales per employee as a measure of firm-level labor productivity. Panel (a) of Appendix Figure C2 shows no evidence that sales per employee increases following either type of contract.

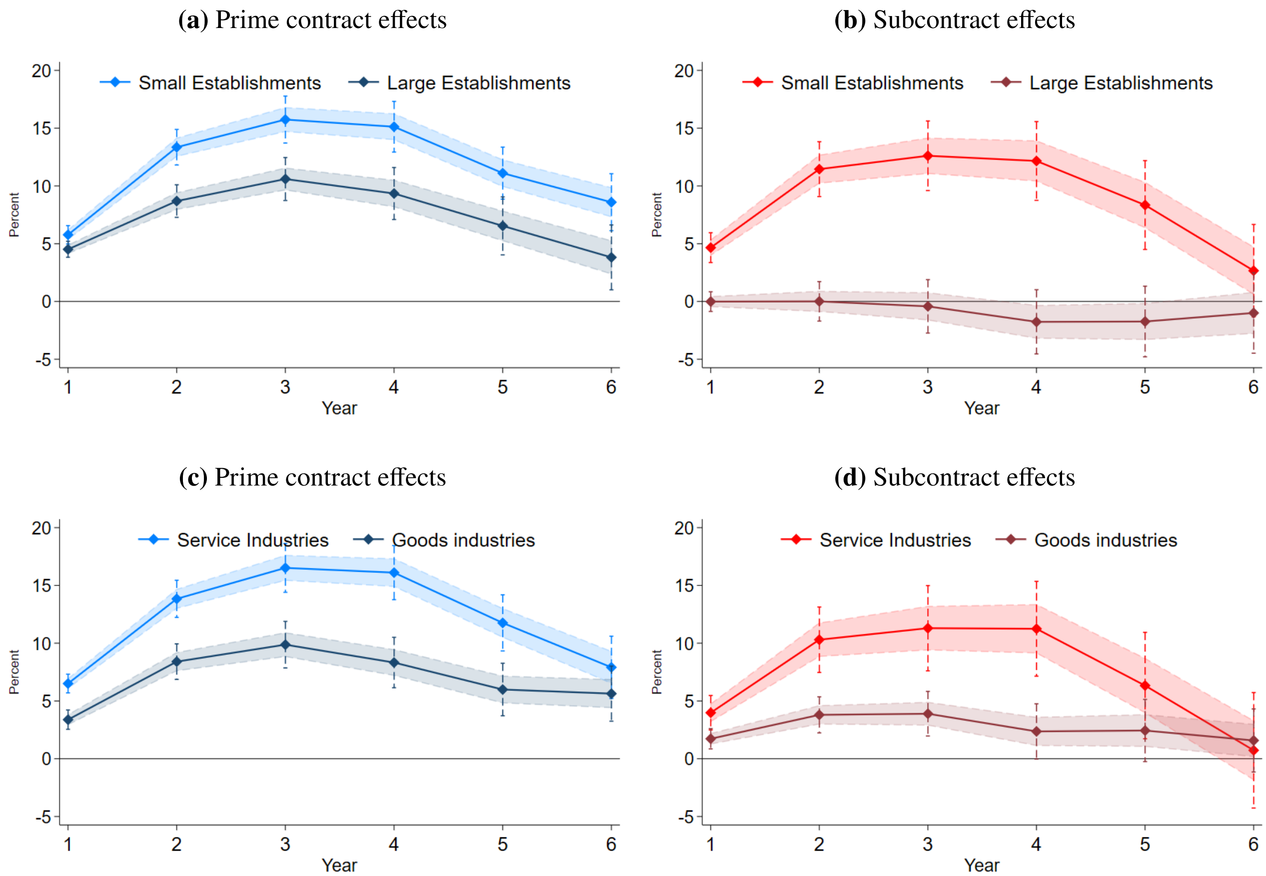
We also examine the effects on firms' financial health measured by credit ratings (Figure C2, panel b). Credit ratings increase in response to both types of contracts, consistent with the view that firms experience improved financial health after participating in federal procurement programs, although the difference between prime and subcontract effects is insignificant. In addition, we find some evidence that the credit-rating improvements are more pronounced for small firms receiving subcontracts. These results are consistent with Hebous and Zimmermann (2021), who find that demand shocks from federal contracts reduce firms' external financing premium, especially for financially constrained firms such as small firms.

5.3 Why Are Firms Less Responsive to Subcontracts?

It is useful to take stock of the empirical evidence we have so far. Our firm-level estimates show that large and goods-producing firms are particularly unresponsive to subcontracting, while aggregate data indicate that subcontract spending flows disproportionately to these firms. Together, these results provide a compositional explanation for why subcontract multipliers are weaker than prime-contract multipliers, as we found in county- and CZ-level data.

To quantify the importance of this compositional channel, we conduct a decomposition exercise. First, we note that small service firms are the most responsive to defense contract shocks and account for 47% of our prime-contractor sample and 29% of the subcontractor sample (by firm counts). Second, using Equation (5), we estimate employment responses to subcontract shocks for small

Figure 10: Heterogeneous employment effects of defense contract arrival



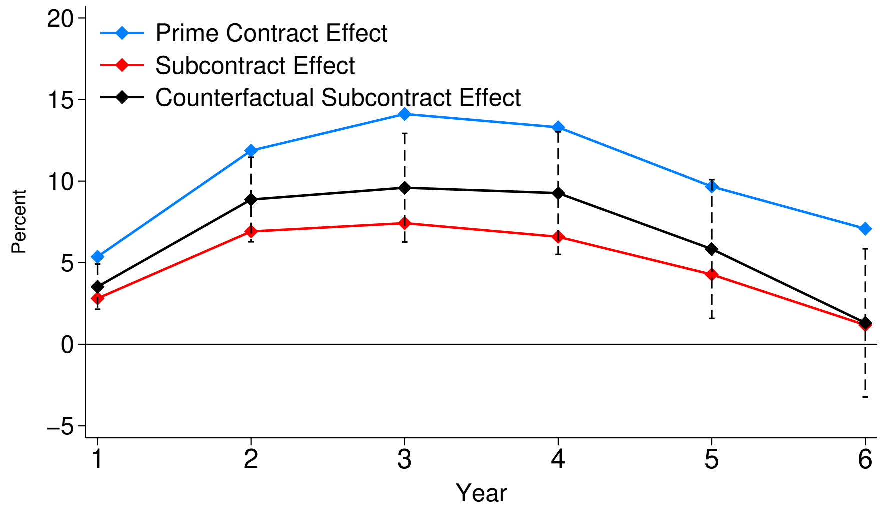
Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (5). The estimates plotted are level effects, not differential effects. For example, the prime contract effects on small establishments are β_1^h and on large establishments are $\beta_1^h + \beta_2^h$; similarly, subcontract effects are γ_1^h for small establishments and $\gamma_1^h + \gamma_2^h$ for large establishments.

service firms and other firms. Third, we construct a counterfactual that re-weights the responses of small service firms and of other firms (large or goods-producing firms), using their respective shares in the prime-contractor sample. This counterfactual captures the average employment response to subcontracting if the composition of subcontractors matched that of prime contractors.

Figure 11 plots this counterfactual (black line) alongside the estimated effects of prime contracts and subcontracts. The counterfactual gap between prime and subcontract effects is smaller than the observed gap, with the compositional channel explaining about 30%-40% of the difference up to a five-year horizon. This exercise suggests that mechanisms beyond composition also contribute to the weaker response to subcontracts.

While multiple behavioral mechanisms may account for this gap, we focus on one for which we provide supporting evidence in the data: differences in the persistence of contracting relationships. The idea is that more persistent relationships raise expected future revenue, making firms more

Figure 11: Decomposition of the prime-subcontract employment effect difference



Notes: Counterfactual subcontract effects (point estimates and 95% confidence intervals in black) are constructed by setting the composition of subcontractors to that of prime contractors. See Figure 8 notes for the blue and red lines.

willing to hire. Using NETS data, we present two pieces of evidence. First, prime-contract relationships are more persistent than subcontract relationships. Second, among subcontractors, relationships with their main prime contractor are more stable for smaller firms than for larger firms. This evidence is consistent with an expectations channel, particularly in shaping firms' hiring decisions.[19]

In column (1) of Table 7, we regress an indicator for having a prime contract in the current year on its lag. The estimate of 0.2 implies that having a prime contract in the previous year increases the probability of having a prime contract in the current year by 0.2 pp (a 51% increase relative to the sample mean). Column (2) shows slightly higher persistence for large firms, although the magnitude of this differential effect is small. Columns (3) and (4) examine the persistence of subcontracting. We find that this relationship is much less persistent than for prime contracts, with an AR(1) coefficient of about 0.1. This persistence is only marginally higher for large firms.[20]

Unlike prime contractors, who always receive contracts from the DoD, subcontractors face an

[19] An alternative explanation is that large, goods-producing firms respond to subcontracts by investing in capital (machinery, equipment, etc.) rather than expanding employment. While our data lack investment measures to directly investigate this channel, our firm-level results show that sales growth mirrors employment growth, suggesting similar dynamics across outcomes. In addition, our county-level analysis, which captures local general-equilibrium effects across all channels, indicates smaller subcontracting multipliers for both earnings and employment. Taken together, these findings suggest that capital investment, though potentially relevant, does not help to explain the differential multiplier effect of subcontracting.

[20] We use linear probability models (LPMs) for the results in Table 7, because LPMs (i) accommodate high-dimensional fixed effects in panel settings, (ii) allow for clustering in a computationally tractable way, and (iii) yield coefficients with a direct interpretation as marginal effects on probabilities (see, e.g., Wooldridge 2010). We verify that our results are robust to alternative nonlinear specifications.

Table 7: Persistence of defense contract relationships

	A. Prime contracting		**B. Subcontracting**		**C. Same Prime Contractor**	
	$\mathbb{I}$(Prime Contract)$_t$	$\mathbb{I}$(Prime Contract)$_t$	$\mathbb{I}$(Subcontract)$_t$	$\mathbb{I}$(Subcontract)$_t$	$\mathbb{I}$(Same Prime)$_t$	$\mathbb{I}$(Same Prime)$_t$
$\mathbb{I}$(Prime Contract)$_{t-1}$	0.210***	0.201***		0.044***		
	(0.002)	(0.002)		(0.003)		
$\mathbb{I}$(Prime Contract)$_{t-1}\times$ Large		0.018***				
		(0.003)				
$\mathbb{I}$(Subcontract)$_{t-1}$		0.041***	0.118***	0.108***		
		(0.002)	(0.002)	(0.003)		
$\mathbb{I}$(Subcontract)$_{t-1}\times$ Large				0.021***		
				(0.005)		
$\mathbb{I}$(Same Prime)$_{t-1}$					0.201***	0.221***
					(0.005)	(0.007)
$\mathbb{I}$(Same Prime)$_{t-1}\times$ Large						-0.040***
						(0.009)
Controls	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Industry × year FE	Y	Y	Y	Y	Y	Y
Firm Sample	Primes	Primes	Subcontractors	Subcontractors	Subcontractors	Subcontractors
# Obs.	704,085	704,085	307,861	307,861	82,113	82,113

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% levels. All regressions include establishment fixed effects and NAICS 2-digit industry-by-year fixed effects. Standard errors are clustered at the establishment level.

additional source of uncertainty—which prime contractor will award them the subcontract. This motivates the analysis in the last two columns of Table 7. We restrict the sample to subcontractors that receive a subcontract in a given year and examine the persistence of relationships with their main prime contractor. Specifically, we construct an indicator for whether a subcontractor is matched with the same main prime contractor as in the previous year and regress this indicator on its lag. The estimates indicate that past relationships are predictive of current matches (column 5). However, as shown in the last column, this persistence is lower for large firms, suggesting less stable relationships between large subcontractors and their prime contractors.[21]

5.4 Robustness

Our establishment-level estimates in Section 5.2 are robust to alternative specifications and sample restrictions that further address concerns about selection, estimation bias, and data quality. We present three key robustness checks.

Restricting to firms receiving both contract types: To further mitigate the concern that firms receiving prime contracts differ systematically from those receiving subcontracts, we restrict

[21] Our results also address whether being a subcontractor increases the likelihood of becoming a prime contractor——a stated motivation for government policies promoting subcontracting. Column (2) of Table 7 shows that this is indeed the case, highlighting the role of prior participation in government contracting networks. Similarly, having a prime contract in the past also raises the probability of being a subcontractor in the current year (column 4).

the sample to firms that receive both types of contracts. These firms account for only 22% of observations in our baseline sample. Figure C3 shows the effects on employment growth (upper panels), along with heterogeneity by firm size and industry (middle and lower panels). The estimated effects are similar to our baseline results, indicating that differential selection into prime versus subcontracting relationships is unlikely to drive our findings.

Including very small or very large firms: In the baseline, we follow Barnatchez et al. (2017) and exclude establishments with fewer than 10 or more than 1,000 employees. Among defense contractors, however, very large establishments (≥1,000 employees) may be particularly relevant given the scale of their contracts, while very small firms may be important for understanding subcontractor responses. We therefore re-estimate the specifications including firms with 5–9 employees (Figure C4, upper panels) and firms with more than 1,000 employees (middle panels). The estimates are very similar to the baseline.

Excluding imputed employment observations: Although imputation is most common among the smallest establishments (1–10 employees), which are excluded from the baseline, a nontrivial share of employment observations remains imputed (about 20%). We therefore drop all imputed observations. As shown in Figure C4 (lower panels), the results are nearly unchanged.

6 Model of Local Fiscal Multipliers with Prime-Subcontracting Networks

Motivated by the county- and firm-level evidence, we develop a spatial multi-region model with heterogeneous firms and production networks to rationalize our empirical findings and to clarify the mechanisms underlying the differential employment effects of prime and subcontract spending. The model serves two purposes. First, it provides a theoretical framework that maps government spending into local employment through both direct and network channels. Second, it characterizes the conditions under which subcontracting dampens local employment responses relative to prime spending.

The model incorporates three key features: (i) geographic reallocation of prime contract awards through subcontracting, as documented in Sections 3 and 4; (ii) the concentration of subcontracting among capital-intensive (less responsive) firms, consistent with the industry and firm-size patterns in Sections 3 and 5; and (iii) contract frictions arising from the inherently less stable nature of subcontract relationships, as shown in the firm-level evidence in Section 5. The model brings these facts together by showing how geographic reallocation, firm heterogeneity, and contract frictions jointly determine the distinct local employment effects of prime and subcontract spending.

The overall structure—linking local employment responses to government spending shocks—follows the approach of Nakamura and Steinsson (2014). We abstract from a full dynamic general equilibrium framework and instead use a parsimonious setup that captures cross-region reallocation and transmission mechanisms suggested by the data. We begin with a baseline partial equilibrium model, which isolates the direct and network effects of exogenous prime spending and subcontract flows.

6.1 Baseline Model

Time is discrete, $t = 0, 1, 2, \ldots$. There are R regions, indexed by i or $j \in \{1, \ldots, R\}$. Each region has a representative household, two types of firms participating in the government contracting network—H-type and L-type—and a local labor market. H-type firms have higher employment responsiveness (e.g., labor-intensive firms), and L-type firms have lower employment responsiveness (e.g., capital-intensive firms). There is also an outside sector in each region that absorbs the remaining labor force.

6.1.1 Households

The representative household in region i has utility

$$U_i = \sum_{0}^{\infty} \beta^t \left[u(C_{i,t}) - \frac{\psi_i}{1+\nu} N_{i,t}^{1+\nu} \right],$$

where $C_{i,t}$ and $N_{i,t}$ are consumption and labor supplied. ν governs the Frisch elasticity and ψ_i is a labor supply shifter. The budget constraint is:

$$C_{i,t} = w_{i,t} N_{i,t} + \Pi_{i,t} + T_{i,t},$$

where $w_{i,t}$ denotes local wage, $\Pi_{i,t}$ are profits rebated from firms located in region i, and $T_{i,t}$ are transfers. The labor supply is given by: $u^{'}(C_{i,t}) w_{i,t} = \psi_i N_{i,t}^{\nu}$.

6.1.2 Government Spending and Prime-Subcontract Network

The federal government allocates prime contract awards across regions following an exogenous process. Let $G_{i,t} \geq 0$ be the dollar amount of prime contracts awarded to region i at time t. A share $s_{i,t}$ of contract value is subcontracted to other firms and regions. For now, we assume $s_{i,t}$ is exogenous, so that subcontracting acts like outsourcing a fixed share of output that would have been produced by prime contractors. This assumption will be relaxed in Section 6.3. Subcontracting outflows $S_{i,t}^{out}$ and retained prime spending $P_{i,t}$ in region i are:

$$S_{i,t}^{out} = s_{i,t} G_{i,t}, \qquad P_{i,t} = (1 - s_{i,t}) G_{i,t}.$$

Let $\theta_{ij,t}$ be the fraction of subcontracting outflows from region i to region j, where $\theta_{ij,t} \geq 0$

and $\sum_{j=1}^{R} \theta_{ij,t} = 1$. Subcontracting inflows into region i are:

$$S_{i,t}^{in} = \sum_{j=1}^{R} \theta_{ji,t} s_{j,t} G_{j,t}.$$

Spending accruing to firms in region i is therefore $E_{i,t} = P_{i,t} + S_{i,t}^{in}$. In the aggregate, total subcontracting inflows equal total outflows and account for a fraction $\bar{s}_t$ of total government prime contract awards $G_t \equiv \sum_{i=1}^{R} G_{i,t}$:

$$\sum_{i=1}^{R} S_{i,t}^{out} = \sum_{j=1}^{R} S_{j,t}^{in} = \bar{s}_t G_t.$$

6.1.3 Production

Within each region, retained prime and subcontract spending is allocated across two types of firms, H and L, which differ in their employment responsiveness. There is a representative firm of each type. Let $P_{i,t}^{m}$ and $S_{i,t}^{m}$ denote retained prime spending and subcontracting inflows received by type m firms in each region, $m \in \{H, L\}$. We assume:

$$P_{i,t}^{H} = \lambda_P P_{i,t}, \quad P_{i,t}^{L} = (1 - \lambda_P) P_{i,t}, \quad S_{i,t}^{H} = \lambda_S S_{i,t}^{in}, \quad S_{i,t}^{L} = (1 - \lambda_S) S_{i,t}^{in},$$

where $\lambda_P > \lambda_S$, consistent with the empirical fact that subcontracts mostly flow to large and manufacturing firms that have low employment responsiveness. In the extreme case of $\lambda_P = 1$ and $\lambda_S = 0$, type-H firms receive all retained prime contracts, while type-L firms receive all subcontracts. Total demand faced by type-m firms is: $Y_{i,t}^{m} = P_{i,t}^{m} + S_{i,t}^{m}$, $m \in \{H, L\}$. We normalize the output price to one, allowing contract dollars to be interpreted as real demand.

Each type of firm uses local labor $N_{i,t}^{m}$ and non-labor inputs $K_{i,t}^{m}$ in production:

$$Y_{i,t}^{m} = A_i^{m} F^{m}(N_{i,t}^{m}, K_{i,t}^{m}).$$

Let the conditional labor demand function be $N_{i,t}^{m} = \Phi_i^{m}(Y_{i,t}^{m})$, which is increasing in output, i.e., $\Phi_i^{m\prime}(Y) > 0$. We assume $\Phi_i^{H\prime}(Y) > \Phi_i^{L\prime}(Y)$ to capture differences in employment responsiveness.[22]

[22]We abstract from specific functional forms to keep the model general. One example of capital-intensive production that implies low employment responsiveness is CES, i.e., $Y = A\left[\alpha N^{\frac{\sigma-1}{\sigma}} + (1-\alpha) K^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$. In this case, $N = \Phi(Y) = Y\Psi(A, \alpha, \sigma, w, r)$, and $\Phi'(Y) = \Psi(A, \alpha, \sigma, w, r)$ is a function of technology A, labor share α, elasticity of substitution σ, wage w, and rental rate r. It can be shown that Ψ is increasing in α for $0 < \alpha < 1$. So, a higher labor share, $\alpha_H > \alpha_S$, implies $\Phi^{H'} > \Phi^{L'}$. Another example is Leontief production, $Y = A\min\{\frac{N}{l}, \frac{K}{k}\}$, where l and k are fixed input requirements per unit of output. In this case, $N = \Phi(Y) = Y\frac{l}{A}$ and $\Phi'(Y) = l/A$ is increasing in l.

Absent contract frictions, employment needed to fulfill government demand in each type of firm is:

$$\tilde{N}_{i,t}^{H} = \Phi_i^H(Y_{i,t}^H) = \Phi_i^H(\lambda_P P_{i,t} + \lambda_S S_{i,t}^{in}), \quad \tilde{N}_{i,t}^{L} = \Phi_i^L(Y_{i,t}^L) = \Phi_i^L((1-\lambda_P)P_{i,t} + (1-\lambda_S)S_{i,t}^{in}). \quad (6)$$

6.1.4 Contract Frictions

Firms may not adjust employment one-for-one in response to demand shocks from government contracts due to adjustment costs and uncertainty about contract persistence. As a result, contract frictions are inherently dynamic. To obtain analytical solutions, we model these frictions using a standard convex adjustment cost framework (e.g., Rotemberg 1982).

Let employment of type-m firms, $m \in \{H, L\}$, in region i evolve according to:

$$V_{i,t}^m(N_{i,t-1}^m, \Omega_{i,t}) = \max_{N_{i,t}^m}\{\Pi_{i,t}^m - \frac{\kappa_m}{2}(N_{i,t}^m - N_{i,t-1}^m)^2 + \xi \mathbb{E}_t[V_{i,t+1}^m(N_{i,t}^m, \Omega_{i,t+1})]\},$$

where $\Omega_{i,t} = (P_{i,t}, S_{i,t}^{in})$ is the state, $\Pi_{i,t}^m$ is current profit, $\kappa_m > 0$ captures employment adjustment costs, and ξ is the discount factor. Let $\tilde{N}_{i,t}^m$ denote the frictionless target employment level in Equation (6), with associated maximized profit $\tilde{\Pi}_{i,t}^m$. We approximate current profit with a quadratic loss around this optimum: $\Pi_{i,t}^m = \tilde{\Pi}_{i,t}^m - \frac{c_m}{2}(N_{i,t}^m - \tilde{N}_{i,t}^m)^2$, where $c_m > 0$ governs the cost of deviating from target employment. Since $\tilde{\Pi}_{i,t}^m$ is taken as given in the firm's employment choice, the first-order condition is:

$$(c_m + \kappa_m)N_{i,t}^m = \kappa_m N_{i,t-1}^m + c_m \tilde{N}_{i,t}^m + \xi \mathbb{E}_t\left[\frac{\partial V_{i,t+1}^m}{\partial N_{i,t}^m}\right]. \quad (7)$$

The solution to Equation (7) implies a partial-adjustment rule in which employment is a weighted average of lagged employment and expected future target employment:

$$N_{i,t}^m = \delta_m N_{i,t-1}^m + \frac{c_m \delta_m}{\kappa_m}\sum_{j=0}^{\infty}(\xi\delta_m)^j \mathbb{E}_t \tilde{N}_{i,t+j}^m, \quad (8)$$

where $\delta_m \in (0, 1)$ is the stable root of the characteristic equation associated with Equation (7). The first term in Equation (8) captures persistence from adjustment costs, and the second term is the discounted value of current and future target employment. Suppose target employment follows an AR(1) process, i.e., $\mathbb{E}_t \tilde{N}_{i,t+j}^m = \rho_m^j \tilde{N}_{i,t}^m$; then Equation (8) reduces to: $N_{i,t}^m = \delta_m N_{i,t-1}^m + \psi^m \tilde{N}_{i,t}^m$, where $\psi^m = \frac{c_m\delta_m/\kappa_m}{1-\xi\delta_m\rho_m}$.

However, as our firm-level evidence suggests, expectations about future government spending may differ across contract types, reflecting the less stable nature of subcontracts. To incorporate this contract friction, we allow the persistent parameter to differ: $\mathbb{E}_t \tilde{N}_{i,t+j}^{m,P} = \rho_{m,P}^j \tilde{N}_{i,t}^{m,P}$, $\mathbb{E}_t \tilde{N}_{i,t+j}^{m,S} = \rho_{m,S}^j \tilde{N}_{i,t}^{m,S}$, and $\rho_{m,P} > \rho_{m,S}$. The last inequality captures perceived higher persistence of prime contracts. Under these conditions and linear labor demand $\Phi_i^m(\cdot)$, Equation (8) yields the employment equation for type-m firms:

$$N_{i,t}^m = \delta_m N_{i,t-1}^m + \psi_P^m \tilde{N}_{i,t}^{m,P} + \psi_S^m \tilde{N}_{i,t}^{m,S},$$

where $\psi_P^m = \frac{c_m\delta_m/\kappa_m}{1-\xi\delta_m\rho_{m,P}}$, $\psi_S^m = \frac{c_m\delta_m/\kappa_m}{1-\xi\delta_m\rho_{m,S}}$. Note that $\psi_P^m > \psi_S^m$, because $\rho_{m,P} > \rho_{m,S}$.

We can now write total employment needed in the government procurement sector in region i, in the presence of contract frictions:

$$\begin{aligned} N_{i,t}^G = N_{i,t}^H + N_{i,t}^L = \delta_H N_{i,t-1}^H + \psi_P^H \Phi_i^H(\lambda_P P_{i,t}) + \psi_S^H \Phi_i^H(\lambda_S S_{i,t}^{in}) \\ + \delta_L N_{i,t-1}^L + \psi_P^L \Phi_i^L((1-\lambda_P)P_{i,t}) + \psi_S^L \Phi_i^L((1-\lambda_S)S_{i,t}^{in}). \end{aligned} \tag{9}$$

6.1.5 Equilibrium

Let $N_{i,t}^G = N_{i,t}^H + N_{i,t}^L$ denote labor demand in the government procurement sector, and $N_{i,t}^O$ denote labor demand in the outside sector. The local labor market clearing condition is $N_{i,t} = N_{i,t}^G + N_{i,t}^O$. Prime spending and subcontract inflows impact local employment through: (i) a direct effect that holds wage fixed and excludes income-consumption feedback, and (ii) a local general equilibrium effect that incorporates these additional channels.

In presenting the main results, we focus on the direct effects of prime and subcontract spending, isolating employment responses within the procurement network. In Section 6.3, we introduce general equilibrium feedback between income and consumption. Throughout, we assume local wages are fixed. This assumption is consistent with our empirical evidence that local earnings responses are driven primarily by employment rather than wages, especially in the short run.

6.2 Model Results

Our model maps government spending into distinct local employment effects by contract type. We characterize the conditions under which subcontracting generates weaker effects, starting with the frictionless case and then introducing contract frictions. We then use the model to analyze aggregate implications in a fixed-policy counterfactual, providing a theoretical foundation for the back-of-the-envelope calculations in Section 4.4.

6.2.1 Frictionless Case

Using Equation (6), the direct effects of prime spending and subcontract inflows on local employment absent contract frictions are:

$$\beta = \frac{\partial \tilde{N}_{i,t}^H}{\partial P_{i,t}} + \frac{\partial \tilde{N}_{i,t}^L}{\partial P_{i,t}} = \lambda_P \Phi_i^{H'} + (1-\lambda_P)\Phi_i^{L'}, \quad \gamma = \frac{\partial \tilde{N}_{i,t}^H}{\partial S_{i,t}^{in}} + \frac{\partial \tilde{N}_{i,t}^L}{\partial S_{i,t}^{in}} = \lambda_S \Phi_i^{H'} + (1-\lambda_S)\Phi_i^{L'}.$$

Proposition 1. Suppose: (a) a positive share of prime awards is subcontracted across regions, so $s_{i,t} > 0$ and $\theta_{ij,t} > 0$ for some $i \neq j$; (b) firms in each region differ in employment responsiveness to a demand shock, i.e., $\Phi_i^{H'} > \Phi_i^{L'} > 0$; and (c) prime contract awards are more concentrated among high-response firms than subcontract spending, i.e., $\lambda_P > \lambda_S$. Then local employment effects depend on retained prime spending $P_{i,t}$ and $S_{i,t}^{in}$, rather than prime awards $G_{i,t}$ alone, and subcontracting generates weaker local employment effects than prime spending.

6.2.2 Frictional Case

Using Equation (9), the direct effects of prime spending and subcontract inflows on local employment with contract frictions are:

$$\beta = \frac{\partial N_{i,t}^G}{\partial P_{i,t}} = \psi_P^H \lambda_P \Phi_i^{H'} + \psi_p^L (1 - \lambda_P) \Phi_i^{L'}, \quad \gamma = \frac{\partial N_{i,t}^G}{\partial S_{i,t}^{in}} = \psi_S^H \lambda_S \Phi_i^{H'} + \psi_S^L (1 - \lambda_S) \Phi_i^{L'}. \tag{10}$$

Proposition 2. Suppose: (a) a positive share of prime awards is subcontracted across regions, so $s_{i,t} > 0$ and $\theta_{ij,t} > 0$ for some $i \neq j$; (b) firms in each region differ in employment responsiveness to a demand shock, i.e., $\Phi_i^{H'} > \Phi_i^{L'} > 0$; (c) prime contract awards are more concentrated among high-response firms than subcontract spending, i.e., $\lambda_P > \lambda_S$; and (d) firms expect subcontract awards to be less persistent than prime contract awards and adjust their employment accordingly, i.e., $\psi_P^m > \psi_S^m$ for $m \in \{H, L\}$. In addition, suppose the model parameters satisfy $\psi_P^H - \psi_S^H \geq \psi_P^L - \psi_S^L$. Then local employment effects depend on retained prime spending $P_{i,t}$ and $S_{i,t}^{in}$, rather than prime awards $G_{i,t}$ alone, and subcontracting generates weaker local employment effects than prime spending.

Proposition 2 highlights all three channels we found in the firm-level evidence: heterogeneity in employment responsiveness, the dominance of low-response firms within the subcontracting network, and contract frictions. A sufficient condition for weaker subcontracting effects is $\psi_P^H - \psi_S^H \geq \psi_P^L - \psi_S^L$, meaning that the hiring of H-type firms are more sensitive to the type of contract than that of L-type firms. Proposition 2 also implies that, even if firm heterogeneity and composition channels are shut down, contract frictions arising from diverging expectations about future contracts alone will still play a role in explaining the weaker subcontracting effects.

6.2.3 Aggregation

We also use our baseline model to derive aggregate employment effects in a fixed-policy counterfactual. This aggregation assumes no national resource constraint and no feedback across regions through prices. Using the linear approximation of the local labor market equilibrium,

$N_{i,t} = \beta P_{i,t} + \gamma S^{in}_{i,t}$,

$$N_t = \sum_{i=1}^{R} N_{i,t} = \beta \sum_{i=1}^{R} P_{i,t} + \gamma \sum_{i=1}^{R} S^{in}_{i,t} = \beta \sum_{i=1}^{R}(1 - s_{i,t})G_{i,t} + \gamma \sum_{i=1}^{R} s_{i,t}G_{i,t} = \beta(1 - \bar{s}_t)G_t + \gamma \bar{s}_t G_t,$$

where β and γ are weighted average multipliers across regions. The key insight here is that

$$\frac{\partial N_t}{\partial G_t} = \beta(1 - \bar{s}_t) + \gamma \bar{s}_t \neq \beta.$$

Subcontracting does not disappear in aggregation as long as $\beta \neq \gamma$, because it changes who produces, not just where it produces.

6.3 Model Extensions

We extend the baseline model in two dimensions: (i) endogenizing subcontracting decisions to capture input-output linkages, and (ii) incorporating a stylized local general equilibrium channel. We show that the model's core implications remain unchanged under these extensions.

6.3.1 Endogenous Subcontracting Shares

We relax the assumption of exogenous subcontracting flows by modeling subcontracting as determined by prime contractors' demand for intermediate inputs. This requires distinguishing production across prime and subcontracting firms within a region. Building on the baseline model, each region contains prime producers and subcontractors of types H and L. For tractability, we adopt specific functional forms and present the full model in Appendix G.

The representative type-m prime firm, $m \in \{H, L\}$, in region i produces output using Cobb-Douglas technology by combining local labor $N^{m,P}_{i,t}$, capital $K^{m,P}_{i,t}$, and a subcontracted intermediate input bundle $M^m_{i,t}$:

$$Y^{m,P}_{i,t} = A^{m,P}_i \left(N^{m,P}_{i,t}\right)^{\alpha^P_m} \left(K^{m,P}_{i,t}\right)^{\eta^P_m} \left(M^m_{i,t}\right)^{1-\alpha^P_m-\eta^P_m}, \quad \alpha^P_m, \eta^P_m > 0, \quad \alpha^P_m + \eta^P_m < 1.$$

The intermediate input bundle is sourced from many regions using a CES form, with input weights ω_{ij} and elasticity of substitution σ_M:

$$M^m_{i,t} = \left(\sum_{j=1}^{R} \omega^m_{ij} (M^m_{ij,t})^{\frac{\sigma_M - 1}{\sigma_M}}\right)^{\frac{\sigma_M}{\sigma_M - 1}}, \quad \omega^m_{ij} \geq 0, \quad \sum_{j=1}^{R} \omega^m_{ij} = 1.$$

Subcontracting flows are measured in terms of expenditures. Let $q_{i,t}$ be the price of the input produced in region i. Subcontracting outflows from region i are: $S^{out}_{i,t} = \sum_{m \in H,L} \sum_{j=1}^{R} q_{j,t} M^m_{ij,t}$.

Subcontracting inflows into region i are: $S_{i,t}^{in} = \sum_{m\in H,L} \sum_{j=1}^{R} q_{i,t} M_{ji,t}^{m}$.

Subcontracting firms' problem and contract frictions are similar to the baseline model. As shown in Appendix G, total employment in the government procurement sector is:

$$N_{i,t}^G = \delta_H^P N_{i,t-1}^{H,P} + \psi_P^H \Phi_{P,i}^{H'} \lambda_P G_{i,t} + \delta_L^P N_{i,t-1}^{L,P} + \psi_P^L \Phi_{P,i}^{L'} (1-\lambda_P) G_{i,t}$$
$$+ \delta_H^S N_{i,t-1}^{H,S} + \psi_S^H \Phi_{S,i}^{H'} \lambda_S S_{i,t}^{in} + \delta_L^S N_{i,t-1}^{L,S} + \psi_S^L \Phi_{S,i}^{L'} (1-\lambda_S) S_{i,t}^{in}.$$

Thus, the employment effects of prime and subcontracts are

$$\beta = \frac{\partial N_{i,t}^G}{\partial G_{i,t}} = \psi_P^H \lambda_P \Phi_{P,i}^{H'} + \psi_P^L (1-\lambda_P) \Phi_{P,i}^{L'}, \quad \gamma = \frac{\partial N_{i,t}^G}{\partial S_{i,t}^{in}} = \psi_S^H \lambda_S \Phi_{S,i}^{H'} + \psi_S^L (1-\lambda_S) \Phi_{S,i}^{L'},$$

which take almost the same form as in the baseline model (Equation 10), except that prime firms' employment responsiveness differs from that of subcontractors. A sufficient condition for $\beta > \gamma$ is $\psi_P^H \lambda_P \Phi_{P,i}^{H'} > \psi_S^H \lambda_S \Phi_{S,i}^{H'}$ and $\psi_p^L (1-\lambda_P) \Phi_{P,i}^{L'} > \psi_S^L (1-\lambda_S) \Phi_{S,i}^{L'}$.

6.3.2 Local General Equilibrium Effects

So far, we have focused on the direct effects of government spending on local employment arising from two sources: (i) firms receiving prime contracts and (ii) firms receiving subcontracts through network reallocation across regions. To the extent that these direct effects increase local income, they may propagate through the broader local economy via general equilibrium channels. To connect our framework to a broader notion of local fiscal multipliers, we augment the model with an outside-sector block in which local employment responds to income changes from higher government spending. This captures, in a stylized way, the local demand amplification emphasized by Guren et al. (2021).

Suppose households in region i spend a fraction c_i^Y of their labor income on the outside sector's output (e.g., non-tradable services), i.e., $D_{i,t}^O = c_i^Y w_i N_{i,t}$. Moreover, the outside-sector production requires local labor, so, $S_{i,t}^O = \chi_i N_{i,t}^O$. Market clearing, $D_{i,t}^O = S_{i,t}^O$, implies that $N_{i,t}^O = (c_i^Y w_i/\chi_i) N_{i,t}$. Since total employment in region i is $N_{i,t} = N_{i,t}^G + N_{i,t}^O$, we can solve for total employment as

$$N_{i,t} = \frac{N_{i,t}^G}{1 - c_i^Y w_i/\chi_i},$$

provided that $c_i^Y w_i/\chi_i < 1$. This expression captures local demand amplification: an increase in procurement-sector employment raises local labor income, which increases demand for outside-sector goods and services, generating additional local employment. The amplification is stronger when households spend a larger share of income locally (higher c_i^Y), or when employment in the outside sector is more responsive to demand shocks (lower χ_i).

Using Equation (10), we can express local multipliers of prime and subcontract spending as:

$$\hat{\beta} = \frac{\partial N_{i,t}}{\partial P_{i,t}} = \frac{\partial N^G_{i,t}/\partial P_{i,t}}{1 - c^Y_i w_i/\chi_i} = \frac{\beta}{1 - c^Y_i w_i/\chi_i}, \quad \hat{\gamma} = \frac{\partial N_{i,t}}{\partial S^{in}_{i,t}} = \frac{\partial N^G_{i,t}/\partial S^{in}_{i,t}}{1 - c^Y_i w_i/\chi_i} = \frac{\gamma}{1 - c^Y_i w_i/\chi_i}. \tag{11}$$

Equation (11) shows that local general equilibrium feedback amplifies the direct employment effects of both prime spending and subcontract spending by raising local income and demand. This result also applies in the presence of endogenous input-output linkages. Thus, even after allowing for local income-consumption feedback, subcontract spending still generates weaker local multiplier effects than prime spending.

7 Conclusion

This paper highlights the critical but underexplored role of subcontracting in shaping the economic incidence of federal defense procurement. Using newly available data on subcontract awards since 2011, matched to establishment-level data from NETS, we document three key facts: subcontracting facilitates widespread geographic reallocation of federal dollars; subcontracts disproportionately flow to goods-producing industries; and most subcontracting dollars accrue to large firms. These patterns have important implications for measuring local fiscal multipliers.

First, conventional prime-contract-based estimates are biased downward because funds flow out of the prime contractor's location through subcontracting. Quantitatively, however, this bias is modest—corrected prime-contract multipliers are about 10%–20% larger than conventional estimates. Second, and more importantly, while subcontracting broadens the geographic footprint of federal spending, its average local effects are smaller than those of prime contracting. Establishment-level evidence shows that subcontractors respond positively to awards, but with smaller and shorter-lived employment gains, consistent with the less stable nature of subcontracting relationships. Third, the aggregate employment effects of subcontracting are further dampened by its concentration in large, capital-intensive firms, which exhibit limited marginal responsiveness. In contrast, smaller and service-sector firms respond more strongly but are underrepresented in subcontract allocations.

We formalize these mechanisms in a theoretical model with production networks that links government spending to local employment through both direct and network channels. The model highlights the joint role of compositional differences and contract frictions in shaping the transmission of fiscal policy and shows that the rise of subcontracting can dampen aggregate employment responses even as it broadens the distribution of spending across regions and firms.

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Online Appendix

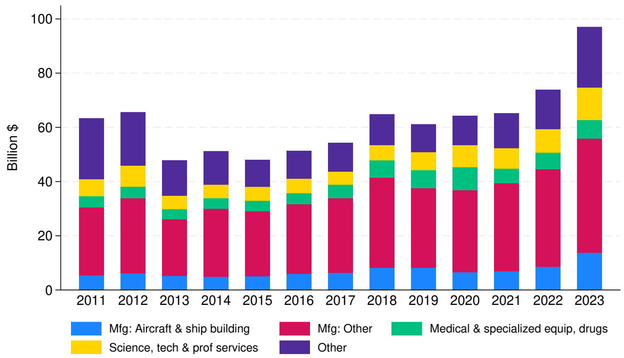
A Data and Stylized Facts: Additional Figures and Tables

Figure A1: Subcontract descriptors

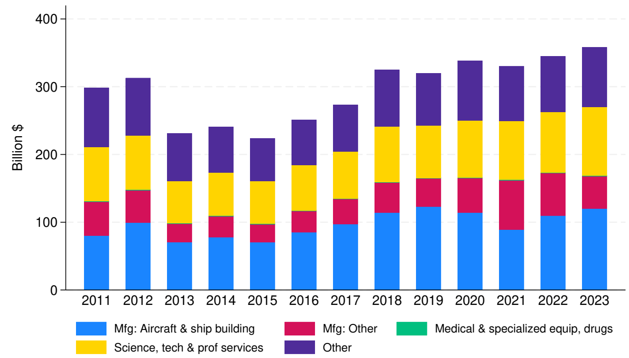
Source: USAspending.gov. Notes: The figure shows a word cloud of the top 200 words in the subcontract descriptors, with the font size reflecting the frequency of usage.

Figure A2: Industry composition of defense contract obligations

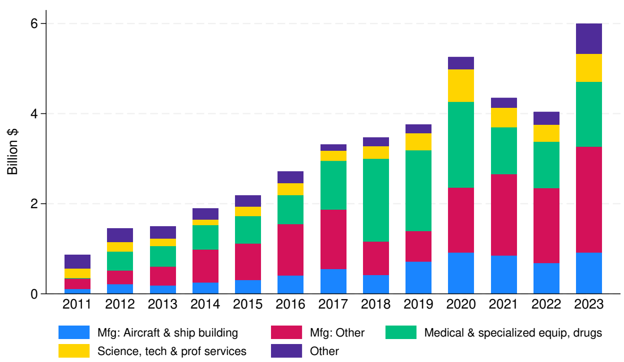
(a) One-time prime contract



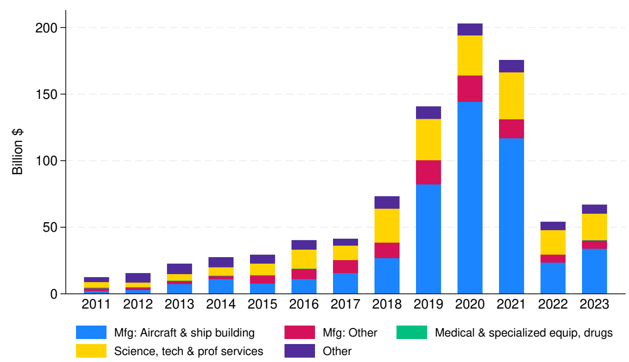
(b) Recurring prime contract



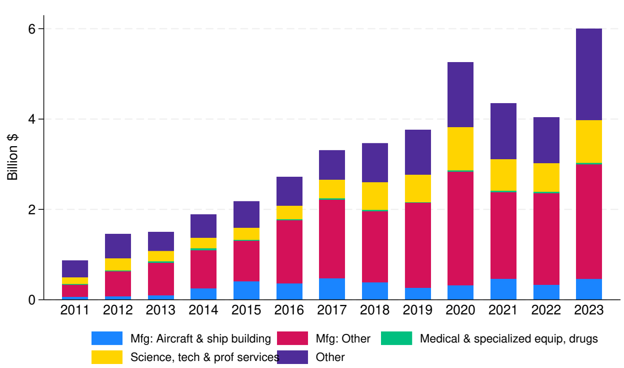
(c) Subcontract under one-time prime:
By prime's industry



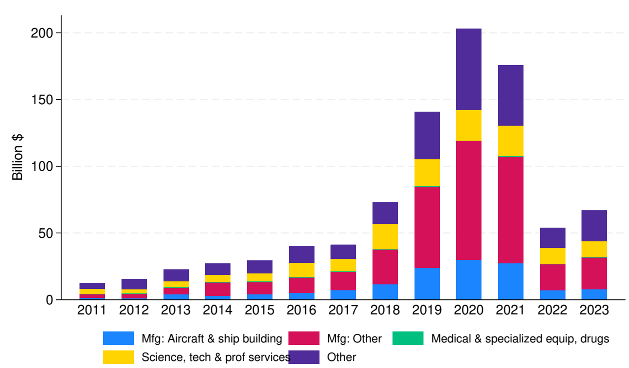
(d) Subcontract under recurring prime:
By prime's industry



(e) Subcontract under one-time prime:
By sub's industry



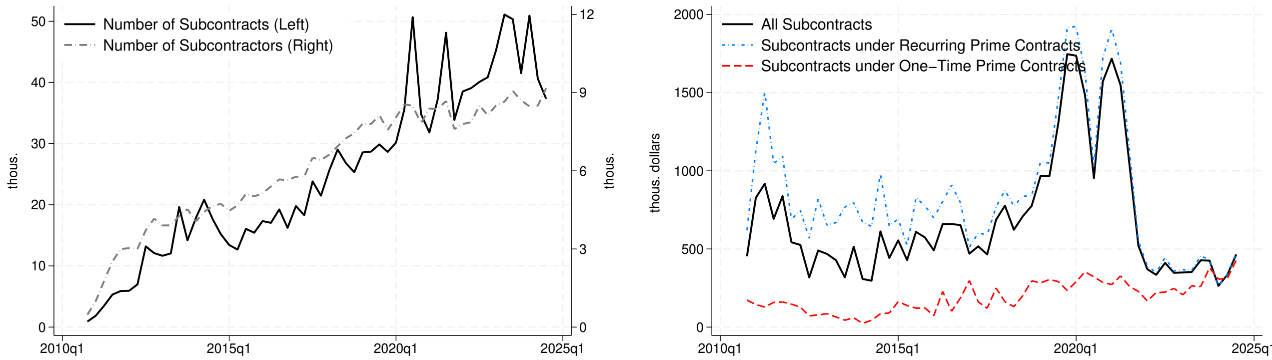
(f) Subcontract under recurring prime:
By sub's industry



Sources: USAspending.gov; Linked DoD prime-subcontract data; NETS annual establishment-level panel data.

Figure A3: Extensive vs intensive margin of subcontracts

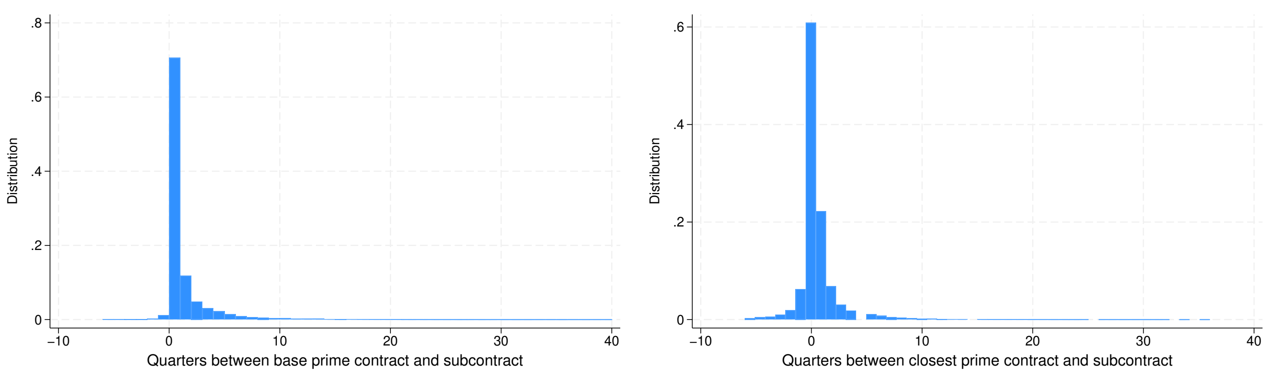
(a) Number of subcontracts **(b)** Average subcontract amount



Source: Linked DoD prime–subcontracting data. Notes: Panel (a) shows the number of subcontracts obligated and the number of unique subcontractors. Panel (b) shows the average subcontract obligation amount by the type of associated prime contract.

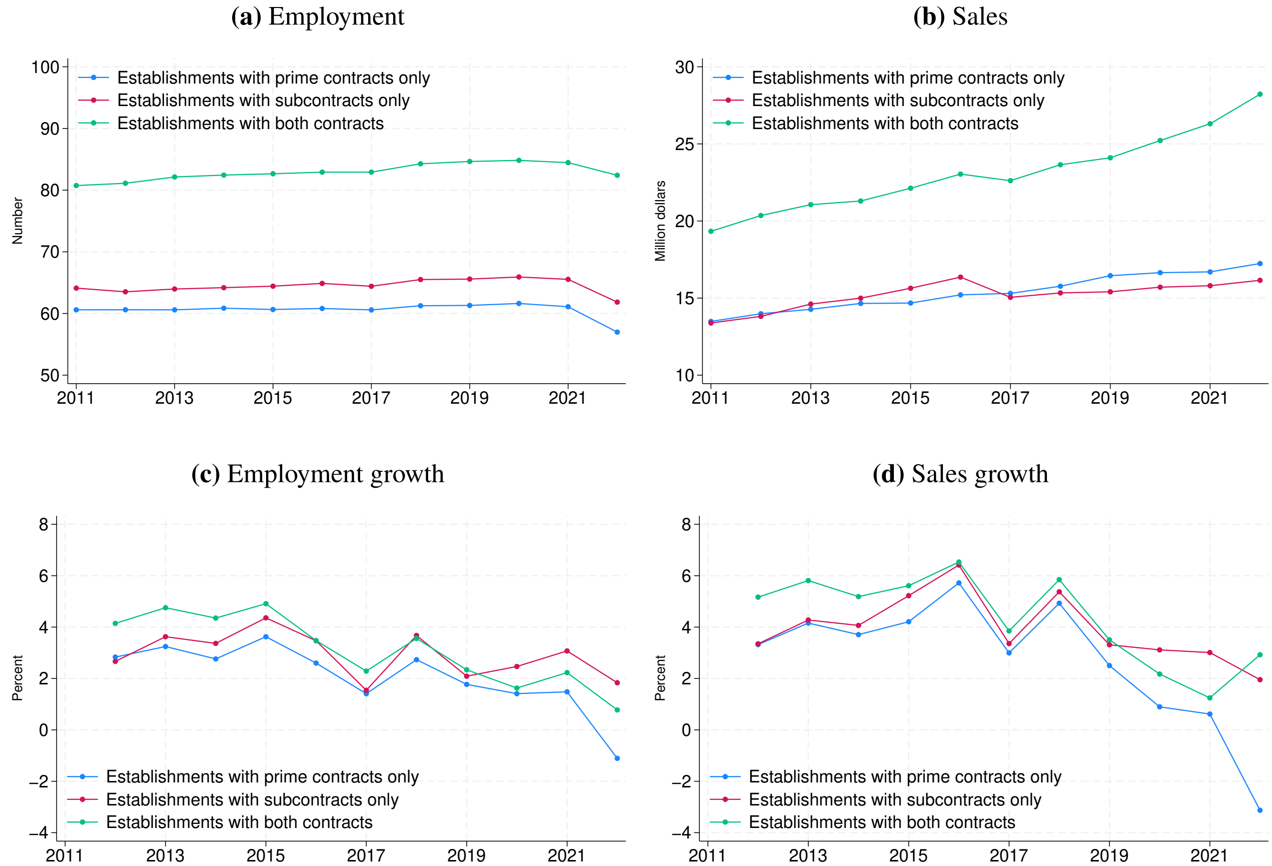
Figure A4: Time lag between prime and subcontract awards

(a) Subcontracts under one-time prime contracts **(b)** Subcontracts under recurring prime contracts



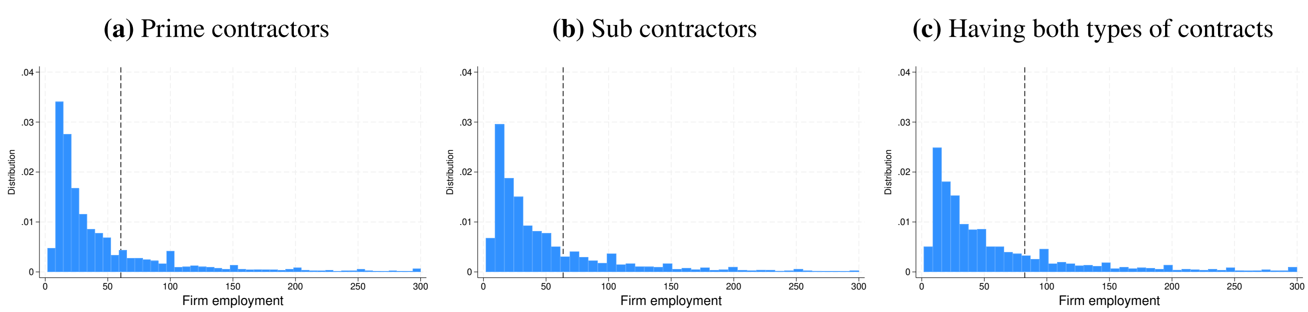
Source: Linked DoD prime–subcontracting data. Notes: Panel (a) shows the distribution of the difference between prime and subcontract obligation dates for subcontracts under one-time prime contracts. Panel (b) shows the distribution of the difference between subcontract obligation dates and the obligation dates of the closest prime contracts within the sequence of recurring contracts.

Figure A5: NETS establishment characteristics



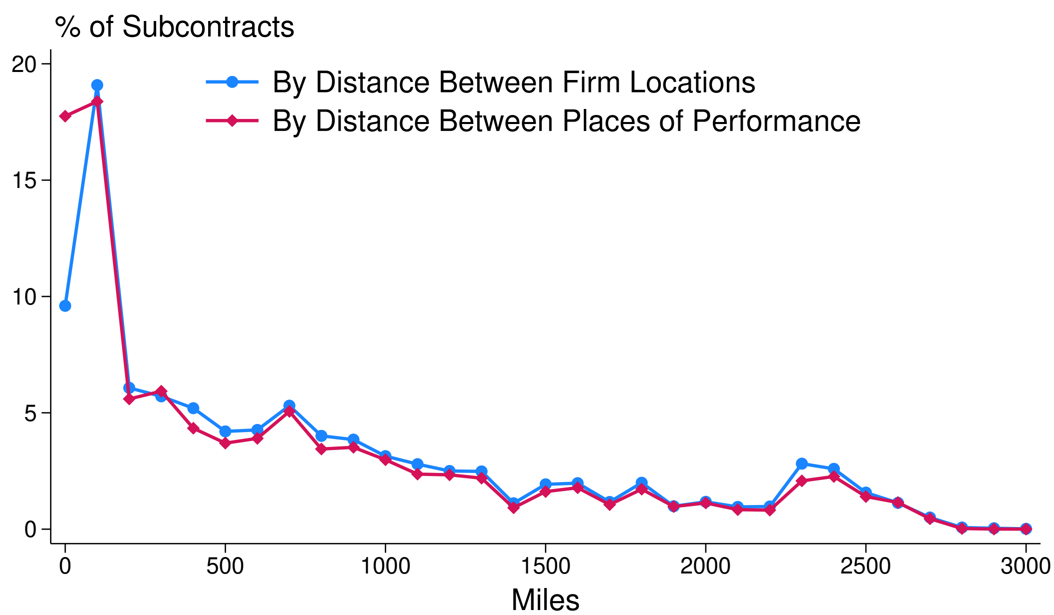
Source: NETS annual establishment-level panel data, 2011-2022.

Figure A6: NETS establishment size (employment) distribution



Source: Merged NETS–DoD contractor data. Notes: Each panel shows the distribution of average establishment-level employment over 2011–2022. The left panel depicts establishments that received only prime contracts, the middle panel shows establishments that received only subcontracts, and the right panel shows establishments that received both. In each panel, the vertical line indicates the mean of the distribution.

Figure A7: Distance between prime and subcontractor locations



Source: Linked DoD prime-subcontract data. Notes: Distribution of subcontract counts by distance between the locations of the prime contractor (or prime-contract place of performance) and the subcontractor (or subcontract place of performance) in 100-mile bins.

Table A1: NETS data summary statistics

	Total	Establishments that receive only prime contracts	only sub-contracts	both contracts
# of establishments in DoD	188,199	138,672	23,020	26,507
# of establishments matched in NETS	171,974	123,419	22,544	26,011
excl. employees≤10	94,019	60,616	13,558	19,845
excl. employees≥1000	85,931	54,934	12,689	18,308
excl. certain industries (Baseline)	83,013	52,519	12,505	17,989
Baseline sample				
# of establishment-year observations	996,156	630,228	150,060	215,868
% of establishments w. employees<50	66%	70%	65%	58%
% of establishments in service industries	60%	67%	41%	53%

Sources: USAspending.gov; NETS annual establishment panel data, 2011-2022.

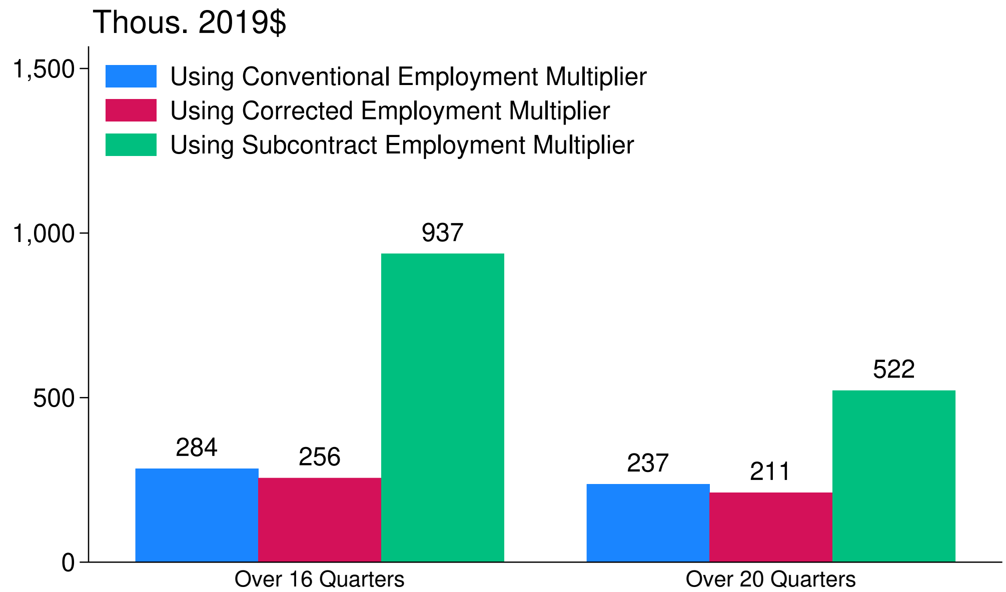
Table A2: Prime and subcontractor location patterns (by subcontract amount)

	All subcontracts	Subcontracts under One-time prime	Subcontracts under Recurring prime
A. Locations of firms:			
Different counties	94%	94%	94%
Different states	78%	81%	78%
Different regions	57%	57%	57%
# Obs.	1,393,118	259,580	1,133,538
B. Places of performance:			
Different counties	92%	92%	92%
Different states	77%	79%	77%
Different regions	55%	55%	55%
# Obs.	1,384,042	258,479	1,125,563

Source: Linked DoD prime-subcontract data. Notes: The top panel reports the share of subcontract obligations (2019 dollars) in which the prime contractor and subcontractor are located in different places; the bottom panel reports the share in which their places of performance differ.

B Local Fiscal Multiplier Estimates: Extensions and Robustness

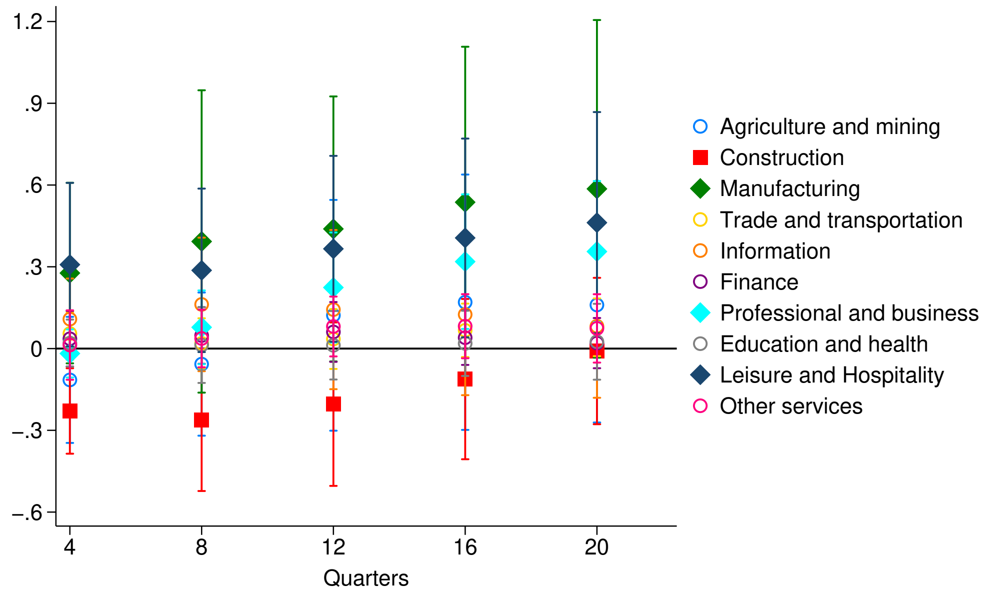
Figure B1: Cost-per-job-year estimates



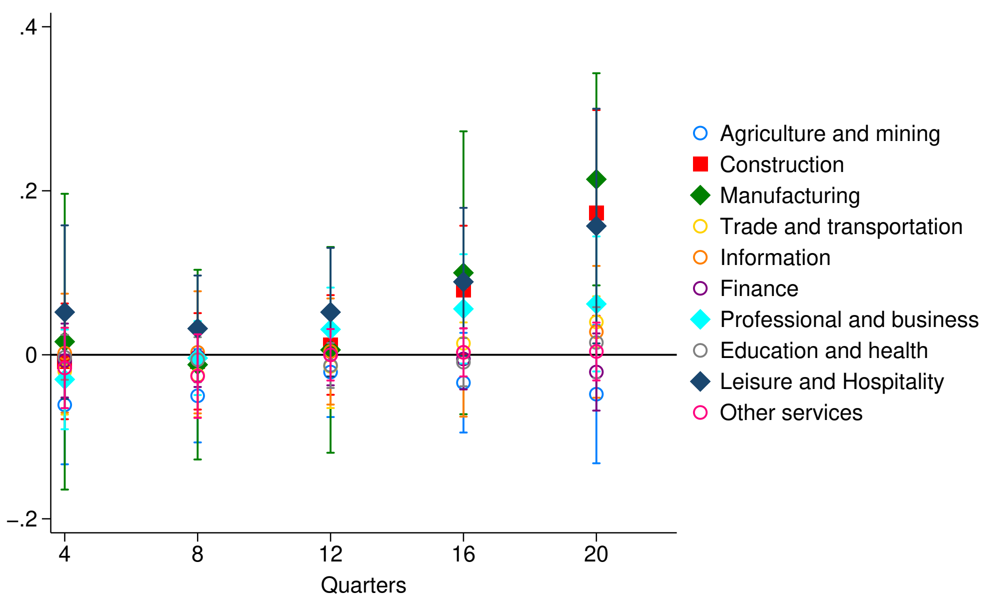
Notes: See footnote 15 for the calculation of cost-per-job-year estimates.

Figure B2: Employment effects by industry

(a) IV estimates of prime contract effect, $\hat{\beta}^{IV,Joint}$



(b) IV estimates of subcontract effect, $\hat{\gamma}^{IV,Joint}$



Notes: Cumulative employment effects by industry, estimated using Equation (2), with the right-hand side equal to the cumulative change in industry employment.

Table B1: Robustness to using subcontract obligation dates directly

	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Earnings					
$\hat{\beta}^{IV,Conv}$	0.076**	0.082**	0.151***	0.196***	0.226***
	(0.033)	(0.038)	(0.048)	(0.058)	(0.064)
$\hat{\beta}^{IV,Joint}$	0.084**	0.093**	0.172***	0.217***	0.250***
	(0.038)	(0.046)	(0.061)	(0.073)	(0.083)
$\hat{\gamma}^{IV,Joint}$	0.007	0.009	0.028	0.070**	0.122***
	(0.019)	(0.016)	(0.024)	(0.030)	(0.041)
B. Employment					
$\hat{\beta}^{IV,Conv}$	0.046	0.059*	0.113***	0.145***	0.174***
	(0.031)	(0.034)	(0.043)	(0.051)	(0.057)
$\hat{\beta}^{IV,Joint}$	0.051	0.067	0.128**	0.161**	0.194***
	(0.035)	(0.041)	(0.055)	(0.063)	(0.073)
$\hat{\gamma}^{IV,Joint}$	0.007	0.007	0.019	0.044**	0.079***
	(0.012)	(0.010)	(0.016)	(0.018)	(0.026)

Notes: County-level measures of prime-contract and subcontract spending are constructed using subcontract obligation dates. See the notes to Table 6.

Table B2: Robustness to using same initial-share periods

	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Earnings					
$\hat{\beta}^{IV,Conv}$	0.077**	0.073*	0.140***	0.191***	0.230***
	(0.036)	(0.039)	(0.048)	(0.063)	(0.073)
$\hat{\beta}^{IV,Joint}$	0.088**	0.085*	0.160***	0.211***	0.254***
	(0.043)	(0.048)	(0.062)	(0.078)	(0.094)
$\hat{\gamma}^{IV,Joint}$	0.016	0.013	0.033	0.074**	0.131***
	(0.023)	(0.017)	(0.026)	(0.033)	(0.044)
B. Employment					
$\hat{\beta}^{IV,Conv}$	0.048	0.057*	0.109**	0.147***	0.184***
	(0.032)	(0.034)	(0.043)	(0.055)	(0.067)
$\hat{\beta}^{IV,Joint}$	0.055	0.066	0.126**	0.163**	0.206**
	(0.038)	(0.042)	(0.055)	(0.068)	(0.086)
$\hat{\gamma}^{IV,Joint}$	0.008	0.008	0.020	0.044**	0.080***
	(0.014)	(0.011)	(0.016)	(0.018)	(0.027)

Notes: The period used to compute the initial share of national spending is 2011–2014 for both the prime-contract and subcontract terms in Equation (2). See the notes to Table 6.

Table B3: Robustness to pre-pandemic sample period, 2011Q1-2019Q4

	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Earnings					
$\hat{\beta}^{IV,Conv}$	0.073**	0.083**	0.122***	0.173***	0.227***
	(0.030)	(0.034)	(0.043)	(0.053)	(0.064)
$\hat{\beta}^{IV,Joint}$	0.079**	0.090**	0.133**	0.188***	0.251***
	(0.035)	(0.041)	(0.053)	(0.065)	(0.083)
$\hat{\gamma}^{IV,Joint}$	0.064	0.061	0.072**	0.096***	0.131***
	(0.052)	(0.039)	(0.030)	(0.032)	(0.044)
B. Employment					
$\hat{\beta}^{IV,Conv}$	0.049*	0.059*	0.093**	0.132***	0.174***
	(0.028)	(0.031)	(0.041)	(0.048)	(0.057)
$\hat{\beta}^{IV,Joint}$	0.052	0.064*	0.102**	0.144**	0.195***
	(0.033)	(0.038)	(0.050)	(0.059)	(0.073)
$\hat{\gamma}^{IV,Joint}$	0.046	0.040	0.046**	0.060***	0.079***
	(0.034)	(0.025)	(0.019)	(0.020)	(0.026)

Notes: Sample: County-level quarterly data, 2011Q1-2019Q4. See the notes to Table 6.

Table B4: Robustness to commuting-zone-level estimation

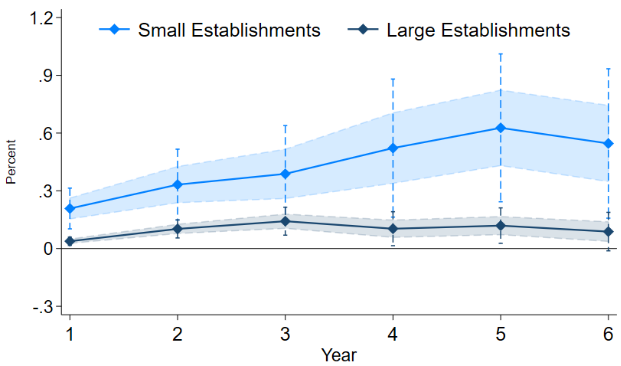
	4-Quarter	8-Quarter	12-Quarter	16-Quarter	20-Quarter
A. Earnings					
$\hat{\beta}^{IV,Conv}$	0.162***	0.229***	0.406***	0.481***	0.518***
	(0.061)	(0.073)	(0.096)	(0.095)	(0.089)
$\hat{\beta}^{IV,Joint}$	0.175***	0.251***	0.434***	0.486***	0.519***
	(0.066)	(0.081)	(0.109)	(0.115)	(0.121)
$\hat{\gamma}^{IV,Joint}$	0.044	0.023	0.116*	0.270***	0.421***
	(0.091)	(0.066)	(0.060)	(0.073)	(0.098)
B. Employment					
$\hat{\beta}^{IV,Conv}$	0.129***	0.169***	0.278***	0.319***	0.335***
	(0.050)	(0.057)	(0.072)	(0.069)	(0.064)
$\hat{\beta}^{IV,Joint}$	0.140***	0.186***	0.301***	0.328***	0.340***
	(0.054)	(0.062)	(0.078)	(0.075)	(0.075)
$\hat{\gamma}^{IV,Joint}$	-0.003	-0.007	0.024	0.094**	0.193***
	(0.074)	(0.051)	(0.043)	(0.048)	(0.061)

Notes: Sample: Commuting-zone-level quarterly data, 2011Q1-2024Q3. See the notes to Table 6.

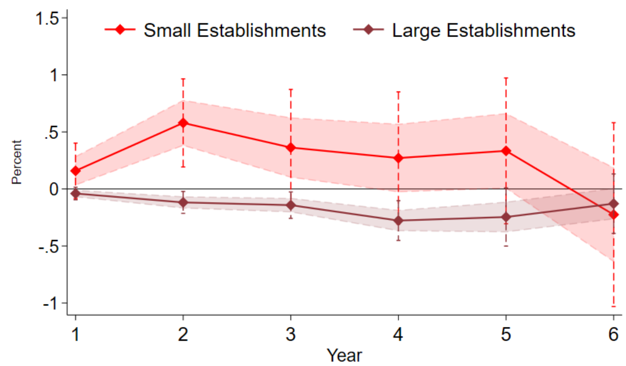
C Establishment-Level Evidence: Additional Results

Figure C1: Heterogeneous employment effects of defense contract awards (per $ million)

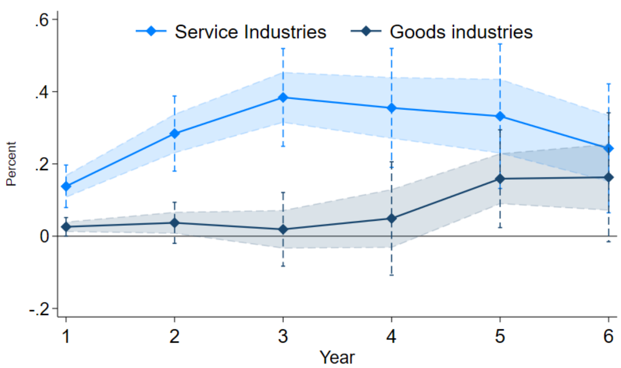
(a) Prime contract effects



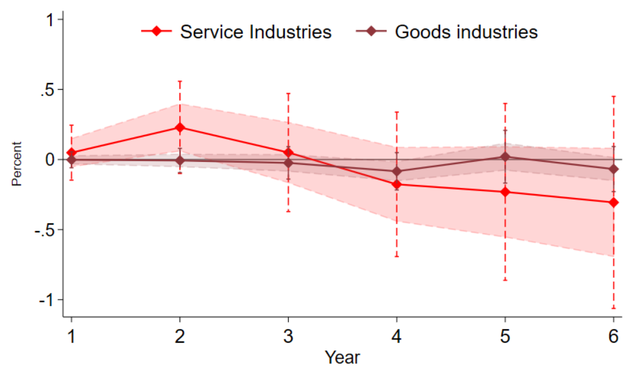
(b) Subcontract effects



(c) Prime contract effects



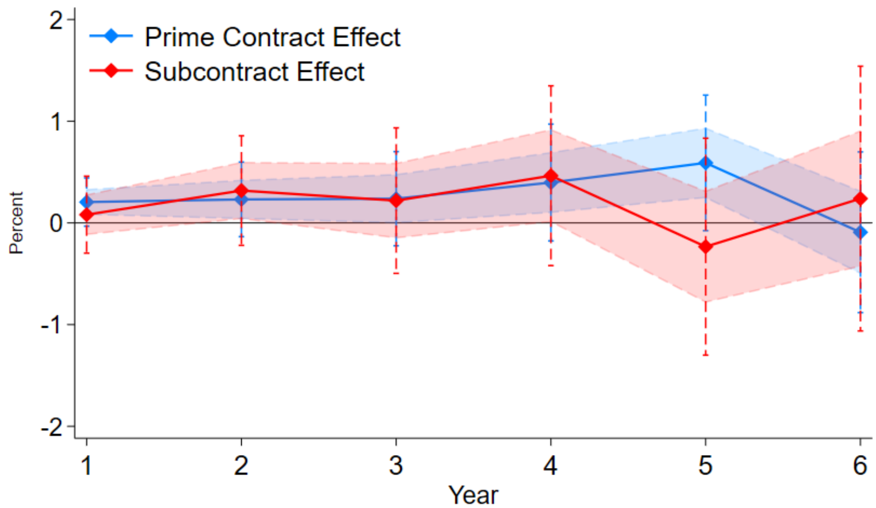
(d) Subcontract effects



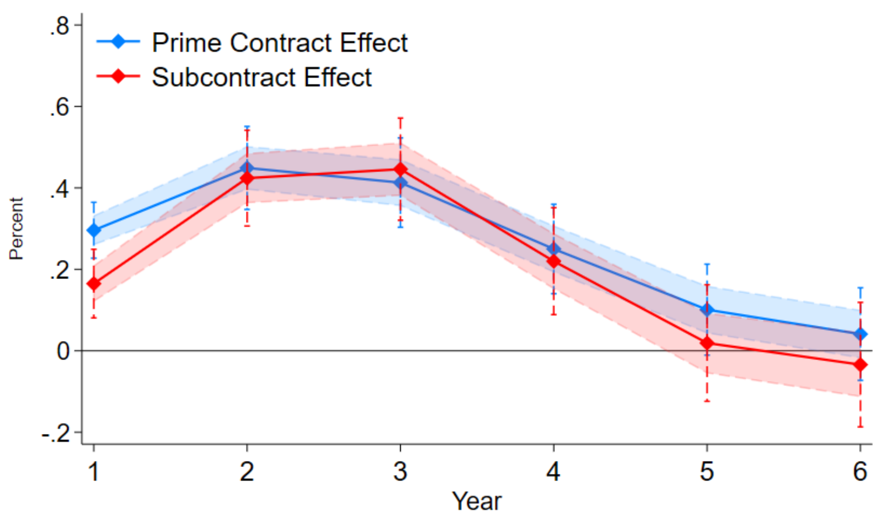
Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (5). See the notes to Figure 10.

Figure C2: Effects of defense contract arrival

(a) Sales per employee

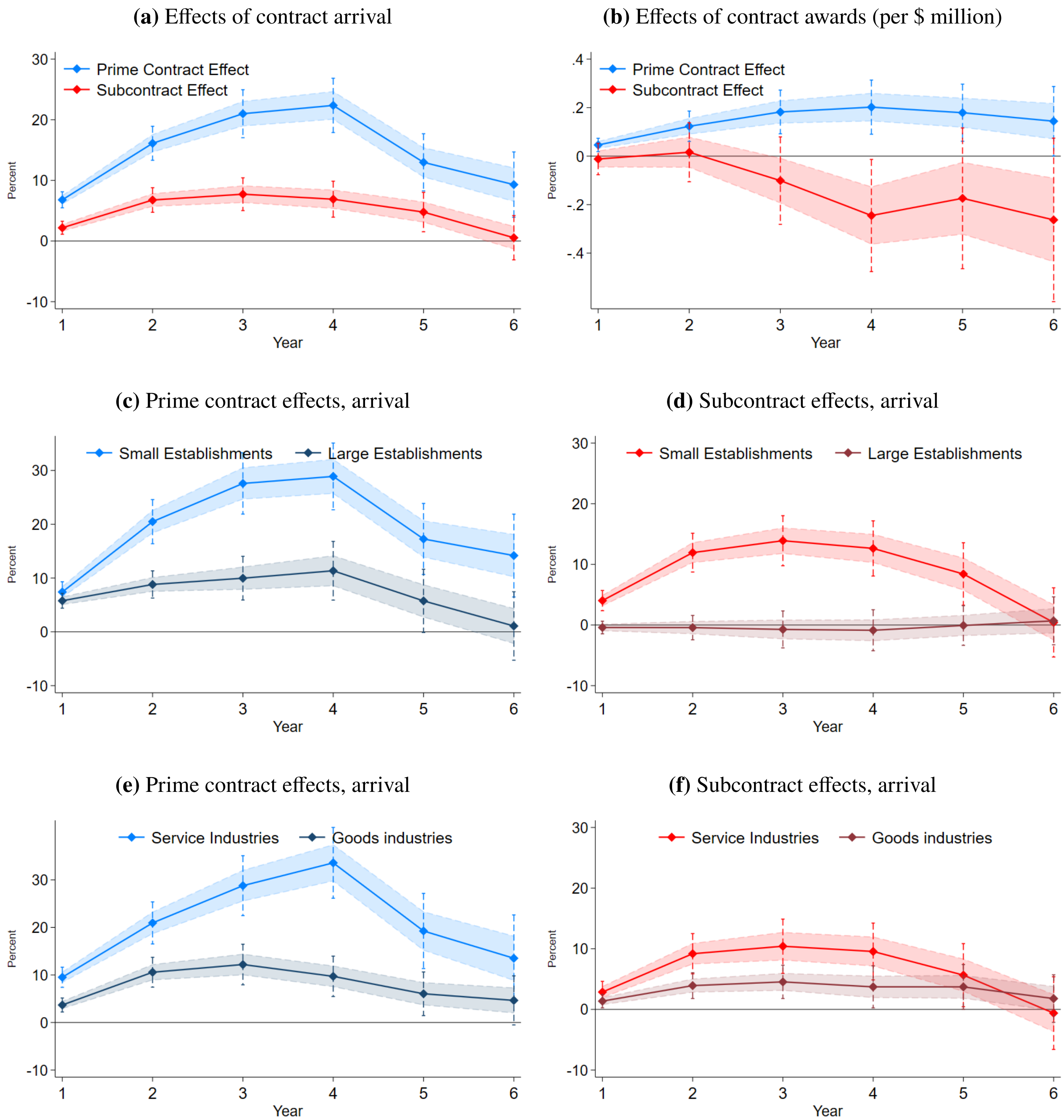


(b) Credit ratings



Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (4). See the notes to Figure 8.

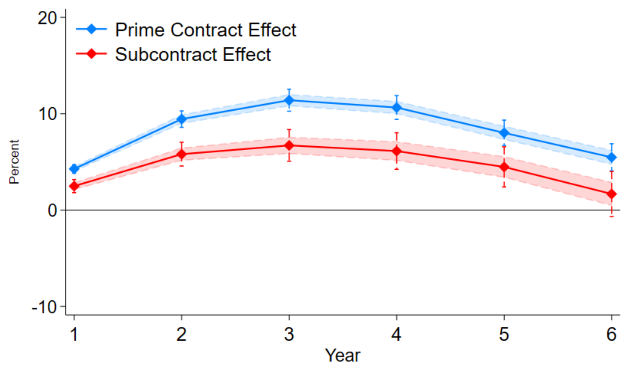
Figure C3: Robustness: Restricting to firms receiving both prime and subcontracts



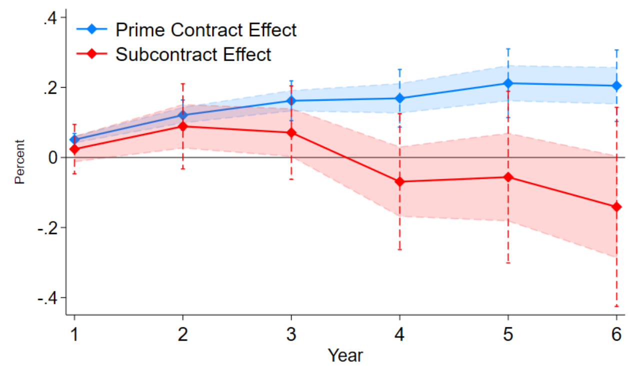
Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (4). Panels (a) and (b) plot average effects (see the notes to Figures 8 and 9). Panels (c)-(f) plot heterogeneous effects (see the notes to Figure 10).

Figure C4: Robustness: Alternative establishment samples

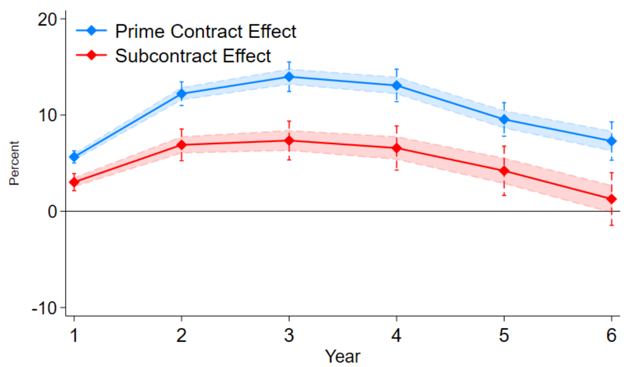
(a) Adding firms with 5-9 employees



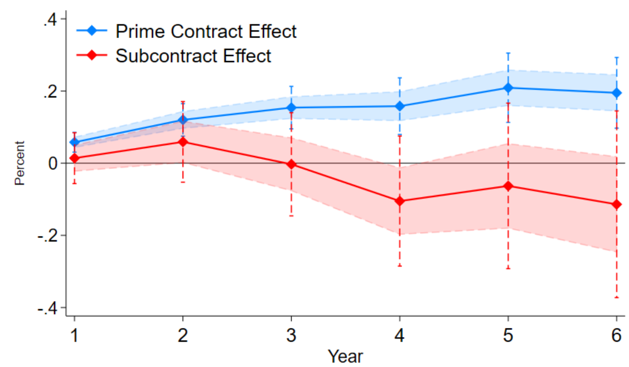
(b) Adding firms with 5-9 employees



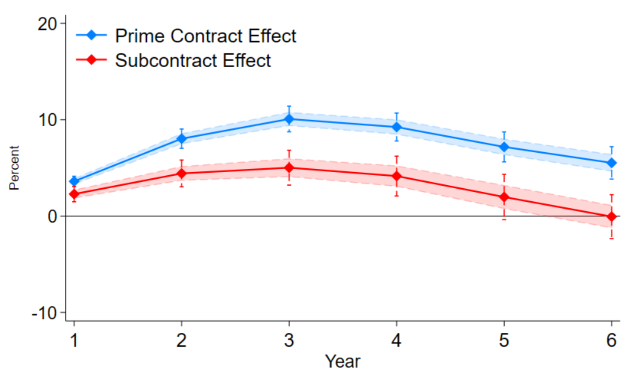
(c) Adding firms with $\geq 1,000$ employees



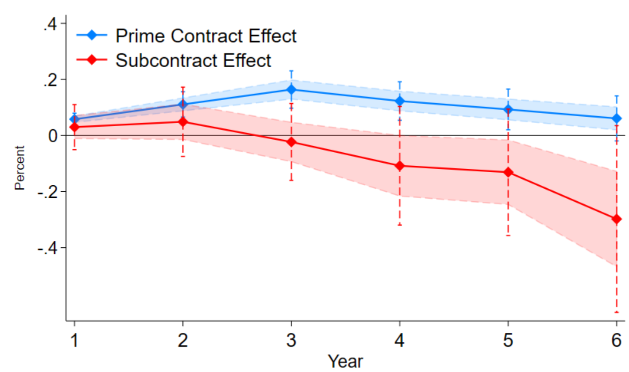
(d) Adding firms with $\geq 1,000$ employees



(e) Dropping imputed observations



(f) Dropping imputed observations



Notes: Point estimates (circles) with 68% confidence intervals (shaded) and 95% confidence intervals (dashed) from Equation (4). Each row reports the average effects of prime contracts and subcontracts using an alternative establishment sample. The left column plots the estimated effects of contract arrivals; the right column plots the estimated effects of contract obligations in millions of dollars (see the notes to Figures 8 and 9).

D Federal Regulation on Subcontracting Activity

Federal regulations have evolved over time and actively promote subcontracting to small businesses. For prime contracts exceeding $750,000 ($1.5 million for construction), prime contractors are required to submit and adhere to formal subcontracting plans. These thresholds have been revised over time, as we detail in this Appendix. These plans must outline specific goals for engagement with small businesses, disadvantaged business enterprises (DBEs), women-owned small businesses, historically underutilized business zone (HUBZone) firms, and service-disabled veteran-owned businesses. Critically, failure to propose an acceptable subcontracting plan renders a prime ineligible for the award, creating strong institutional incentives for prime contractors to seek and maintain partnerships with qualified small subcontractors.

Under Section 8(d) of the Small Business Act (15 U.S.C. § 637(d)), and implemented through the Federal Acquisition Regulation (FAR) Subpart 19.7, federal prime contractors that are not classified as small businesses (i.e., "Other Than Small Businesses" or OTSBs) are required to engage in subcontracting with small businesses when certain thresholds are met.

In addition to promoting subcontracting and engagement with small businesses, there are explicit federal regulations in place that dictate reporting of these subcontracts. The Federal Funding Accountability and Transparency Act (FFATA) was signed on September 26, 2006; reporting requirements were rolled out in 2010; the most consequential change took place on March 1, 2011, with reporting required for all subcontracts under federally awarded contracts and orders valued at least $25,000.

Thresholds and Applicability: A subcontracting plan is mandatory for prime contracts exceeding a value greater than the *simplified acquisition threshold* that offer subcontracting opportunities (FAR 19.702(a)(1); 15 U.S.C. § 637(d)). This threshold is currently $750,000 (or $1.5 million for construction). Before 2015Q4 it was > $650,000 and between 2015Q4-2020Q2 it was > $ 700,000.

These requirements apply both to negotiated procurements and sealed bidding acquisitions, and extend to contract modifications that raise the contract's value above the threshold.

Required Content of Subcontracting Plans: As detailed in FAR 52.219-9, an acceptable subcontracting plan must include: i) Separate goals (in dollars and percentages) for subcontracting to Small Businesses (SB), Small Disadvantaged Businesses (SDB), Women-Owned Small Businesses (WOSB), HUBZone Small Businesses, Veteran-Owned (VOSB) and Service-Disabled Veteran-Owned Small Businesses (SDVOSB); ii) Procedures to ensure the maximum practicable opportunity for these firms to participate, and iii) Mechanisms to ensure timely payments to subcontractors.

Enforcement and Compliance: Failure to comply in good faith with an accepted subcontracting plan is considered a material breach of contract. The contracting officer may impose liquidated damages for noncompliance, as authorized by 15 U.S.C. §637(d)(4)(F) and implemented in FAR 19.705-7. “Some contracting officers face challenges assessing compliance with the good faith standard" -U.S. Government Accountability Office Report

D.1 Federal Regulation on Subcontracting Activity Reporting and Relevant Timeline

The Federal Funding Accountability and Transparency Act (FFATA) was signed on September 26, 2006. The intent is to empower every American with the ability to hold the government accountable for each spending decision. The FFATA legislation requires information on federal awards (federal financial assistance and expenditures) to be publicly available. (Source: https://www.grants.gov/learn-grants/grant-policies/ffata-act-2006.html)

The FFATA Subaward Reporting System (FSRS) is the reporting tool federal prime awardees (i.e., prime contractors and prime grants recipients) use to capture and report subaward and executive compensation data regarding their first-tier subawards to meet the FFATA reporting requirements.[23] Prime contract awardees are expected to report against sub-contracts awarded, and prime grant awardees to report against sub-grants awarded. The sub-award information entered in FSRS is then displayed and associated with the prime award, furthering federal spending transparency.

Prime contractors awarded a federal contract or order that is subject to Federal Acquisition Regulation clause 52.204-10 (Reporting Executive Compensation and First-Tier Subcontract Awards) are required to file an FFATA sub-award report by the end of the month following the month in which the prime contractor awards any subcontract greater than $30,000.

These reporting requirements for subcontracts have been gradually phased-in following the original law passed in 2006. Plans must be submitted to the eSRS, including an individual subcontract report (ISR) semi-annually and a summary subcontract report (SSR) annually (Source: https://www.acquisition.gov/far/subpart-19.7).

- Phase 1: Reporting subcontracts under federally-awarded contracts and orders valued greater than or equal to $20,000,000; reporting starts now.
- Phase 2: Reporting subcontracts under federally-awarded contracts and orders valued greater than or equal to $550,000; reporting starts October 1, 2010.
- Phase 3: Reporting subcontracts under federally-awarded contracts and orders valued greater than or equal to $25,000; reporting starts March 1, 2011.
- Phase 4: Reporting subcontracts under federally-awarded contracts and orders valued greater than or equal to $30,000; reporting starts October 1, 2015.

[23] As of March 8th 2025, FSRS.gov was retired, and all subaward reporting data and functionality are now on SAM.gov.

The announcement also said that: “although the requirement to report subawards is being phased-in at certain dollar levels, if you would like to start reporting prior to the start date for your subcontracts, the system is available for reporting".

D.2 Defense Contracting and Subcontracting During Covid

Part of the sample period we consider coincides with the Covid-19 pandemic. However, unlike many industries, defense contractors and subcontractors were insulated from its effects in many ways. Gupta et al. (2021) reports that many specific actions were taken by the government which include:

1. Designation of Defense Industrial Base (DIB) as critical infrastructure: Through a March 2020 memorandum, DoD recognized the DIB as essential, giving its workforce continuity protections even amid local lockdowns

2. Financial lifelines via CARES Act and other mechanisms: CARES Act allocated substantial funds: $2.45B for DIB support, $1B under the Defense Production Act (DPA), and $1.45B to Defense Working Capital Funds. Additionally, authorities were loosened—e.g., accelerated payments, use of undefinitized contract actions (UCAs), and other transactions authority.

3. Direct DPA Title III investments: DoD leveraged DPA Title III to shore up key suppliers—ranging from aerospace and semiconductors to space and cyber—with selected firms receiving millions (e.g., GE Aviation got $20M to support over 100 specialized jobs)

4. Industry's role in stabilizing supply chains: Major primes like Lockheed Martin and Northrop Grumman accelerated payment to small-tier suppliers ($1.1B in Lockheed's case), helping to keep smaller firms afloat.

In addition Gupta et al. (2021) reports that Paycheck Protection Program (PPP), which targeted small businesses also affected defense contractors. They note that only $\sim 2\%$ of all PPP recipients were defense contractors, but they averaged significantly larger loans ($650K–$1.5M vs. $\sim$ $380K–$920K overall). On average, each DoD contractor loan covered $\sim$ 66 jobs (vs. $\sim$ 50 jobs overall). Most PPP-funded DIB firms were in manufacturing and overwhelmingly small (fewer than 100 employees). The program especially helped lower-tier firms essential to national security supply chains.

E Additional Subcontracting Examples

This section provides examples of subcontracts from the DoD contract database. Subcontracting is not limited to large prime awards (see Section 2) but also occurs in small- to mid-sized contracts. For example, BAE Systems, Inc. (Nashua, NH) received a contract of approximately $3.6 million, of which about 34% ($1.22 million) was allocated to sub-awards (Table E1). These subcontracts span multiple locations and comprise highly technical hardware inputs used in the assembly of electronic equipment.

Table E1: Example of mid-sized subcontracts

Company	Location	Product description	Obligation
Prime contractor			
BAE Systems, Inc.	Nashua, NH	Electronics and Communication Equipment	3,585,825
Subcontractors			
Rodelco Electronics Corp.	Ronkonkoma, NY	Product input; repair product	439,198
Pentek, Inc.	Upper Saddle River, NJ	Product input	231,540
Vishay HIREL Systems	Dover, NH	Product input	140,242
TRAK Microwave Corp	Thousand Oaks, CA	Product input	118,430
Tech Resources, Inc.	Milford, NH	Product input	92,680
Abrams Airborne Manufacturing Inc.	Tucson, AZ	Product input	33,386
Russell Plastics Technology Co., Inc.	Lindenhurst, NY	Product input	53,950
FEI-Elcom Tech, Inc.	Northvale, NJ	Product input	36,060
Spirit America Corp	Phoenix, AZ	Product input	46,990
C&D Electronics	Holyoke, MA	Product input	30,590
Total			
Total subcontract obligation			1,223,066
% of prime contract obligation			34.1%

Source: USAspending.gov. Notes: Obligation amounts are shown in dollars. In this table, any subcontract description that names a specific product or part number is coded as "Product input".

Table E2 shows that subcontracting extends beyond major defense contracts, as prime contractors rely on a wide network of regional suppliers, even for smaller awards.

Lastly, another large prime award—Lockheed Martin Corporation's $2.22 billion guided-missiles contract (Grand Prairie, TX)—channels about 10% ($216.9 million) to subcontractors across the U.S. (AR, FL, CO, NH, MA, AZ, KS). As shown in Table E3, the subcontract mix consists predominantly of production inputs for the defense system.

Table E2: Example of small-sized subcontracts

Company	Location	Product description	Obligation
Panel A.			
Prime contractor			
Oshkosh Defense, LLC	Oshkosh, WI	Packing and Gaskets Materials	192,763
Subcontractor			
Meritor Heavy Vehicle Systems	Thousand Oaks, CA	Driveline	159,167
Total			
Total subcontract obligation			159,167
% of prime contract obligation			82.6%
Panel B.			
Prime contractor			
Lynntech Inc.	College Station, TX	R&D: Other Research and Development (Basic Research)	100,000
Subcontractor			
Cornell University	Ithaca, NY	Characterization of Membrane Samples	30,000
Total			
Total subcontract obligation			30,000
% of prime contract obligation			30.0%

Source: USAspending.gov. Notes: Obligation amounts are shown in dollars.

Table E3: Example of very large subcontracts

Company	Location	Product description	Obligation
Prime contractor			
The Lockheed Martin Corporation	Grand Prairie, TX	Guided Missiles	2,220,000,000
Subcontractors			
Aerojet Rocketdyne Inc.	Camden, AR	Product input; Assembly	216,383,943
Arrow Electronics, Inc.	Lake Mary, FL	Product input	99,566
	Centennial, CO	Product input	58,753
Micross Components, LLC	Manchester, NH	Product input	34,965
Port Electronics Corporation	Lawrence, MA	Product input	100,208
Spirit America Corp	Phoenix, AZ	Product input	66,383
Leading Technology Composites, Inc.	Wichita, KS	Product input	195,520
Total			
Total subcontract obligation			216,939,339
% of prime contract obligation			9.8%

Source: USAspending.gov. Notes: Obligation amounts are shown in dollars. In this table, any subcontract description that names a specific product or part number is coded as "Product input".

F Text Analysis of Subcontract Descriptions

To understand the relationship between a defense prime contract and its subcontracts, we utilize information in the product and service code (PSC) that characterizes the primary good or service delivered by a contract. Unlike prime contract data, subcontract data do not have PSCs, but there is a text description associated with each subcontract—a cluster of words, serial codes, numbers, and abbreviations. Our goal is to transform these text descriptions to likely PSCs that underlie each of the subcontracts in our data. This serves the purpose of quantifying the flow from prime to subcontracts based on contract content, as shown in Figure 4.[24]

The starting point of our analysis is the open source FSCPSC API, which uses a combined word-level and character-level artificial neural network to categorize text descriptions into PSCs.[25] For a user supplied text description, FSCPSC returns the top 5 candidate PSCs with a confidence score between 0 and 1 for each PSC. While convenient, the FSCPSC API has several limitations. First, the prevalence of acronyms (e.g., CMS, which could mean "Content Management Systems" or "Certified Marine Surveyor") greatly reduces information content. The FSCPSC API hence recommends the user to expand these acronyms before sending the query. Second, each query is limited to 250 characters, whereas many of our subcontract descriptions exceed this limit. These limitations motivated us to use text-processing and machine-learning techniques to gain more confidence in the algorithm.

To expand acronyms, we use an external acronym dictionary for defense contracting (DAU), mining acronym-expansion pairs from the text using patterns such as Acronym (Expansion) or Expansion (Acronym), making sure that the initials of the acronym roughly match the first letters of the expansion. We then remove duplicate acronym-expansion pairs using the Jaro–Winkler similarity. Next, we estimate skip-gram Word2Vec embeddings on our subcontract descriptions, generating vector representations that capture semantic relationships among terms. Finally, we use the full acronym dictionary and the semantic word embeddings to expand acronyms in context by computing the cosine similarity between the text vector and the candidate acronym-expansion vectors. In short, we systematically clean the text, identify acronyms, score their possible expansions, and use context-aware semantic similarity to expand acronyms reliably. This makes it easier to map subcontract descriptions to PSCs.

After expanding acronyms, we clean and standardize the description text, including removing duplicate phrases, stripping out administrative or boilerplate add-ons, and converting all texts into individual sentences. Sentences are ranked according to four criteria: the number of verbs (+), the

[24] We thank Theresa Rincker for constructing the predicted PSC 2-digit data underlying Figure 4, including the design and implementation of the text processing and machine learning techniques described in this appendix. The code is written in R, available upon request.

[25] https://api.fscpsc.com/

number of distinctive words (+), the presence of codes, dates and numbers (−), and the length (−). Sentences are ranked by score. We then add the subcontractor's name to high-ranked sentences before sending the query. The FSCPSC API then returns five most likely PSCs for each subcontract.

To improve the precision of the algorithm, we supplement the FSCPSC API results with our predictors based on prime contract data and text embeddings. We use PSC information in the prime contract data, as many subcontractors also served as prime contractors. We proceed as follows:

- Use the sample of prime contractors who had at least two prime contracts to predict the probability that a PSC is associated with a given contractor, i.e., $P(PSC_j|FirmID_i)$.
- Use the NAICS code in the prime contract data to predict the probability that a PSC is associated with a given industry, i.e., $P(PSC_j|NAICS_i)$.
- Compute BM25 similarity between each PSC 2-digit extended title and subcontract description with contractor name, rescaled to be within the unit interval, i.e., $BM25_{i,j}$.
- Embed both the subcontract description and each PSC 2-digit extended title and take their cosine similarity. The PSC 2-digit categories are ranked by cosine similarity rescaled to be within the unit interval, i.e., $EMB_{i,j}$.

Finally, with the above predictors and five PSCs from FSCPSC API, $API_{i,j}$, we run regression:

$$Y_{i,j} = \beta_o + \beta_1 P(PSC_j|FirmID_i) + \beta_2 P(PSC_j|NAICS_i) + \beta_3 BM25_{i,j} + \beta_4 EMB_{i,j} + \beta_5 API_{i,j} + \varepsilon_{i,j},$$

where $Y_{i,j}$ is an indicator equal to 1 if contract i truly belongs to PSC j. The coefficients provide optimal weights for aggregating the features so that the highest-scored PSC is our best prediction.

Model Validation: Using a combination of hand-coded subcontracts and prime-contract observations, we evaluate the model performance using standard classification metrics, including macro metrics and weighted metrics. The macro metrics weight each PSC equally, while weighted metrics reflect the empirical frequency distribution. The results in Table F1 indicate that the algorithm performs especially well for common PSC categories. This is expected: although text-based predictors (BM25, embeddings) help identify rarer categories, firm- and industry-based predictors favor more prevalent PSCs. Overall, the accuracy is high.

Table F1: Model validation metric

Overall Accuracy	Macro Metric			Weighted Metric			# Obs.
	Precision	Recall	F1	Precision	Recall	F1	
0.95	0.91	0.93	0.92	0.95	0.95	0.95	17,134

G Model Appendix

In this appendix, we present the full model with endogenous subcontracting decisions.

Prime contractors' labor demand: Let $w_{i,t}$ denote regional wage, r_t capital rental, and $\{q_{j,t}\}_j$ the input price vector. Given the prime contractors' problem described in Section 6.3.1, by standard Cobb–Douglas cost minimization, direct labor demand is linear in output:

$$N_{i,t}^{m,P} = \frac{\alpha_m^P c_i^{m,P}}{w_{i,t}} Y_{i,t}^{m,P} \equiv \Phi_{P,i}^{m'} Y_{i,t}^{m,P} \tag{12}$$

where $c_i^{m,P} \equiv c_i^{m,P}\left(w_{i,t}, r_t, \{q_{j,t}\}_{j=1}^N\right)$ is the unit cost function.

Let λ_P be the share of prime contract awards obtained by H-type firms, so $G_{i,t} = G_{i,t}^H + G_{i,t}^L = \lambda_P G_{i,t} + (1-\lambda_P)G_{i,t}$. From Equation (12), absent contract frictions, employment needed by prime firms to fulfill government demand is:

$$\tilde{N}_{i,t}^{H,P} = \Phi_{P,i}^{H'} \lambda_P G_{i,t}, \quad \tilde{N}_{i,t}^{L,P} = \Phi_{P,i}^{L'} (1-\lambda_P) G_{i,t}.$$

Subcontract flows: Prime firms' cost minimization also implies that expenditures on subcontracted inputs (i.e., subcontracting outflows) by type-m prime firms in region i is a fraction of their total cost,

$$S_{i,t}^{m,out} = \sum_{j=1}^{N} q_{j,t} M_{ij,t}^m = (1-\alpha_m^P - \eta_m^P) c_i^{m,P} G_{i,t}^m.$$

Thus, total subcontracting outflows from region i is $S_{i,t}^{out} = S_{i,t}^{H,out} + S_{i,t}^{L,out}$. Total subcontracting inflows into region i is :

$$S_{i,t}^{in} = \sum_{m \in H,L} \sum_{j=1}^{R} q_{i,t} M_{ji,t}^m$$

Subcontract Production: Type-m subcontractors have Leontief production:

$$Y_{i,t}^{m,S} = A_i^{m,S} \left\{ \frac{N_{i,t}^{m,S}}{l_i^m}, \frac{K_{i,t}^{m,S}}{k_i^m} \right\},$$

where l_i^m and k_i^m are fixed input requirements per unit of output. Cost minimization implies labor demand:

$$N_{i,t}^{m,S} = \frac{l_i^m}{A_i^{m,S}} Y_{i,t}^{m,S} \equiv \Phi_{S,i}^{m'} Y_{i,t}^{m,S}.$$

Absent frictions, employment needed by subcontractors to fulfill demand from prime contractors is:

$$\tilde{N}^{H,S}_{i,t} = \Phi^{H'}_{S,i}\lambda_S S^{in}_{i,t}, \quad \tilde{N}^{L,S}_{i,t} = \Phi^{L'}_{S,i}(1-\lambda_S)S^{in}_{i,t}.$$

Contract Frictions: As in the baseline model, contract fictions render labor adjustment sluggish, depending on both lagged employment and frictionless employment:

$$N^{m,P}_{i,t} = \delta^P_m N^{m,P}_{i,t-1} + \psi^m_P \tilde{N}^{m,P}_{i,t}, \quad N^{m,S}_{i,t} = \delta^S_m N^{m,S}_{i,t-1} + \psi^m_S \tilde{N}^{m,S}_{i,t}.$$

Government Employment: Total employment in the government procurement sector is:

$$\begin{aligned} N^G_{i,t} &= N^{H,P}_{i,t} + N^{L,P}_{i,t} + N^{H,S}_{i,t} + N^{L,S}_{i,t} \\ &= \delta^P_H N^{H,P}_{i,t-1} + \psi^H_P \Phi^{H'}_{P,i}\lambda_P G_{i,t} + \delta^P_L N^{L,P}_{i,t-1} + \psi^L_P \Phi^{L'}_{P,i}(1-\lambda_P)G_{i,t} \\ &+ \delta^S_H N^{H,S}_{i,t-1} + \psi^H_S \Phi^{H'}_{S,i}\lambda_S S^{in}_{i,t} + \delta^S_L N^{L,S}_{i,t-1} + \psi^L_S \Phi^{L'}_{S,i}(1-\lambda_S)S^{in}_{i,t}. \end{aligned}$$

Direct Employment Effects: Thus, the direct employment effects of prime and subcontracts are

$$\beta = \frac{\partial N^G_{i,t}}{\partial G_{i,t}} = \psi^H_P \lambda_P \Phi^{H'}_{P,i} + \psi^L_p (1-\lambda_P)\Phi^{L'}_{P,i}, \quad \gamma = \frac{\partial N^G_{i,t}}{\partial S^{in}_{i,t}} = \psi^H_S \lambda_S \Phi^{H'}_{S,i} + \psi^L_S (1-\lambda_S)\Phi^{L'}_{S,i},$$

Sufficient Condition: A sufficient condition for $\beta > \gamma$ is $\psi^H_P \lambda_P \Phi^{H'}_{P,i} > \psi^H_S \lambda_S \Phi^{H'}_{S,i}$ and $\psi^L_p(1-\lambda_P)\Phi^{L'}_{P,i} > \psi^L_S(1-\lambda_S)\Phi^{L'}_{S,i}$. Using the specified production functional forms, these conditions are equivalent to:

$$\psi^H_P \lambda_P \frac{\alpha^P_H c^{H,P}_i}{w_{i,t}} > \psi^H_S \lambda_S \frac{l^H_i}{A^{H,S}_i} \quad \text{and} \quad \psi^L_P (1-\lambda_P)\frac{\alpha^P_L c^{L,P}_i}{w_{i,t}} > \psi^L_S (1-\lambda_S)\frac{l^L_i}{A^{L,S}_i} \tag{13}$$

Proposition 3. Suppose: (a) prime contractors use subcontracted inputs in production, generating positive cross-region subcontracting flows, so that $S^{out}_{i,t} > 0$ and $S^{in}_{i,t} > 0$ for some i; (b) firms in each region differ in employment responsiveness to a demand shock, with H-type firms having high responsiveness and L-type firms having low responsiveness; (c) prime contract awards are more concentrated among high-response firms than subcontract spending, i.e., $\lambda_P > \lambda_S$; and (d) firms expect subcontract awards to be less persistent than prime contract awards and adjust their employment accordingly, i.e., $\psi^m_P > \psi^m_S$ for $m \in \{H, L\}$. In addition, suppose the model parameters satisfy conditions in (13). Then local employment effects depend on both prime spending $G_{i,t}$ and subcontracting inflows $S^{in}_{i,t}$, and subcontracting generates weaker local employment effects than prime spending.