# Can Government Demand Stimulate Private Investment? Evidence from U.S. Federal Procurement*

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**Abstract**

We study the effects of federal purchases on firm investment using a novel panel dataset that combines federal procurement contracts in the United States with key financial firm-level information. Using panel fixed-effect models, propensity score matching, and inverse probability weighting estimation techniques, we find that 1 dollar of federal spending increases firms' capital investment by 10 to 13 cents. However, this average effect masks heterogeneity across firms. Particularly, the effect is stronger for firms that face financing constraints and it is zero for unconstrained firms. This finding is robust for various measures of financing constraints. In line with the financial accelerator model, our findings indicate that the effect of government purchases works through easing firms' access to external borrowing. Moreover, an industry-level analysis suggests that that the increase in investment at the firm level translates into an industry-wide effect without crowding-out capital investment of other firms in the same industry.

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# 1 Introduction

A key question in macroeconomics and finance is whether government demand stimulates private investment. In this paper, we examine the effects of government spending on firms' capital investment using novel micro-level data on federal procurements in the United States.

We argue that the response of capital investment of financially constrained firms to government demand shocks is more pronounced than that of non-constrained firms. This argument is motivated by the financial accelerator framework of Bernanke et al. (1996). Without financial frictions, optimal capital investment is determined by equating the marginal product of capital and the real price of capital. However, consider a firm that cannot reach this optimum due to financing constraints, thus requiring external funding to invest in inputs of its production function. Because the collateral-in-advance constraint is binding, a financing premium hinders firms' external borrowing. Within this minimal setup, the creation of new government demand increases the net wealth of the firm through the additionally generated cash flow. The new government demand reduces the external financing premium, thereby relaxing the constraint and hence increasing firms' demand for inputs. The hypothesis that follows from this simple model is that government demand shocks increase capital investment particularly for financially constrained firms.

To test this hypothesis, we link data from two different sources. The Federal Funding Accountability and Transparency Act (FFATA), signed in September of 2006, requires the Office of Management and Budget (OMB) to organize a database including each contract transaction awarded by federal agencies in the United States from 2000 onwards. Key information includes the name of the contractor, the value of the award, and the date of the award. According to the OMB, the aggregate value of awarded federal contracts in 2017 in the United States was approximately 655 billion dollars — with similar annual values in the last years. We merge the data on federal contracts with information on the contractors, such as capital expenditure, total assets, and other financial variables obtained from Compustat.

We construct a measure of government spending shocks at the firm level linking federal procurement contracts with firms' financial information. We ensure that the demand shock is unanticipated by firms by only including a contract if it was awarded in a full and open competition with at least two bidders. This enables us to filter out potential anticipation effects and focus on unexpected changes to a firm's future cash flows.[1] We scale the sum of all awarded contracts at the firm-quarter by the firm lagged capital. The resulting dataset is novel and includes about 91,000 quarterly observations from 1999Q4 to 2018Q3.

The starting point of our empirical analysis is a panel data approach to estimate an investment equation, as in Chaney et al. (2009). The identification in this approach is based on variation within and across firms. We account for time-invariant dimensions of heterogeneity among firms by using firm-fixed effects, which nests all unobserved industry-specific effects, such as monopolistic

[1] Moreover, we provide a formal test for anticipation in section 5.

structure. In addition, the analysis of government spending should consider the issue of time- or regime-dependency as recent studies suggest that government spending can have differential effects depending on the stance of the business cycle.[2] Our detailed micro-analysis enables us to address this concern by using industry-period-fixed effects. In this set up, the inclusion of a fixed effect for each industry-period in the sample captures all time-variant macroeconomic variables such as changes in the interest rate, changes in legislation, or shocks to the U.S. economy that are common among all firms within an industry (i.e., including for instance industry-specific private demand shock in a period). In contrast with studies that use aggregate time series within one country, and hence cannot employ a period-fixed effect as it eliminates all variations in the sample, we can disentangle heterogeneous responses by exploiting cross-sectional variation in the data.

The fixed-effect approach, though simple, offers a powerful and informative starting point. However, potential concerns about selection bias may remain, for example because firms that were awarded contracts in a certain period are inherently of a "different type". To address this issue, we use two additional estimation methods. In the first method, we employ propensity score matching (PSM) techniques, whereby the causal effect of government spending on firms' investment is estimated by matching treatment (winning a contract) and control (not winning a contract) observations with similar values of the propensity score. Hence, the PSM constructs a control group from the non-treated firms that resembles the treatment group within the same industry by having similar propensities to obtain a federal contract. The second method is the inverse probability weighting (IPW) estimation, whereby observations are weighted by the inverse of the propensity score obtained from PSM analysis. The intuition is to give more weights for firms within the control group that are likely to be treated but were actually not treated and, similarly, more weights for treated firms that are close to the control firms.[3]

Our findings are as follows. Overall, the estimates suggest that 1 dollar of federal spending increases firm capital investment by about 12 cents. However, the evidence indicates that firms that face financing constraints display the highest increase in investment following a new government award. This pattern occurs for different measures of financing constraints that are commonly used in the literature, based on firm size, payout ratio, and corporate bond rating. All three estimation methods — the fixed-effect panel model, the PSM, an the IWP — yield qualitatively and quantitatively similar results. We complement this analysis by showing additional results suggesting that capital investment is mainly financed via short-term debt. An industry-level analysis suggests that firms' investment is leading to an increase in investment at the industry-level ruling out a crowding-out hypothesis. Additionally, the evidence indicates that industries with higher dependence on external financing tend to respond more to industry-level government spending, in line with Aghion et al. (2014).

As mentioned above, one general concern with this type of analysis is that awards can be anticipated. We test whether competitive federal contracts are anticipated by examining stock

[2]See, for example, Auerbach and Gorodnichenko (2012), DeLong and Summers (2012), Christiano et al. (2011), and Michaillat (2014).

[3]See Imbens (2000) for details about inverse probability weighting.

market returns. The idea is that if contracts are anticipated, then they should be priced in the financial markets. We find no evidence for anticipation effects, a finding that supports the interpretation of our results.

While a number of studies examine the response of private consumption to fiscal stimuli (for example, Sahm et al. (2010) or Parker et al. (2013)), less attention has been paid to the reaction of private investment to government demand. Understanding the link between government spending and investment at the firm level is a central issue in several contexts in economics. From a macroeconomic standpoint, the Keynesian doctrine views government spending as a stimulator for the economy; however, it is well known that not all economists subscribe to this macroeconomic notion.[4] One source of the disagreement comes from the ambiguous predictions regarding the response of private investment to changes in government purchases. Our micro-based evidence sheds light on one transmission mechanism whereby government purchases can affect aggregate private investment. An effective fiscal intervention is, generally, one that helps reduce the external financing costs of firms. This finding is broadly consistent with recent insights into the role of credit market conditions in the propagation of economic shocks (Gertler and Kiyotaki (2010)). An effective public intervention should address the disparity in firms' access to external funding.

**Related Literature:** Our paper is related to three strands of the literature. The first strand is empirical and focuses on the effects of financing constraints on firms' investments. Fazzari et al. (1988) argue that financing constraints lower firms' investments. Recently, the findings in Almeida and Campello (2007), Chaney et al. (2012), and Rauh (2006) lend empirical support for this hypothesis. These papers, however, do not consider the potential role of fiscal policy in easing financing constraints. Zwick and Mahon (2017) and Dobridge (2015) consider the effects of tax incentives on investment. They find that financially constrained firms tend to increase investments more than unconstrained firms as a reaction to tax refunds' stimulus policy in the United States. Against this background, we contribute to the literature by studying the spending side of fiscal policy at the firm level and showing that government purchases can also influence financing constraints through cash flow. Related to our paper, Ferraz et al. (2015) study the new hiring patterns of Brazilian firms that win a procurement contract. Our paper uses firms in the United States, looks at capital investment, and focuses on a specific channel via financing constraints.

The second strand of the literature is concerned with estimating the effects of fiscal policy on macroeconomic activities. Available evidence in this area is largely based on vector autoregression models using aggregate data, and the discussion is centered on the size of government spending multipliers — that is, the final effect on key macroeconomic variables such as output and investment.[5] Increasingly, to strengthen identification, studies are relying on a disaggregated level such as regions or industries. Brueckner and Tuladhar (2014) estimate local government spending multipliers in Japan using data at the prefecture level and find that multipliers tend to be lower in

[4]See, for example, Barro (2009) and Krugman (2008).

[5]Ramey (2011a) and Hebous (2011) provide overviews. In a distinct but related application based on detailed spending data, Auerbach and Gorodnichenko (2016) construct a quarterly spending shock at the US level from daily spending series and study the reaction of the exchange rate.

prefectures characterized by a high degree of financial distress. Wilson (2012) estimates the job multiplier of ARRA grants. Cohen et al. (2011) find that government spending shocks, identified at the state-level in the United States, lead to corporate retrenchment. Aghion et al. (2014) examine a panel of OECD countries and find that the effect of a countercyclical fiscal policy is higher in industries that are more dependent on external finance. While our study is not about estimating the spending multiplier, it provides the first micro-level evidence on one transmission mechanism through which government spending can affect the economy, namely, via private investment of constrained firms.

The third related strand of the literature is within the ambit of theoretical macroeconomics and financial economics modeling the links between financial frictions and fiscal policy in a Dynamic Stochastic General Equilibrium (DSGE) framework. Studying the interaction between credit market conditions and macroeconomic fluctuations is currently a very active and extensive area of research, such that a survey is beyond our scope (see, e.g., Hall (2011)). However, while earlier studies do not include a fiscal block, an increasing number of papers address interlinks between government spending and credit market conditions. Examples include Fernández-Villaverde (2010), Canzoneri et al. (2015), Carrillo and Poilly (2013), and Challe and Ragot (2011). Generally, the message arsing from this literature is that the spending multiplier is larger when government spending improves financial intermediation. Our contribution provides firm-level evidence in line with this theoretical prediction.

The paper proceeds as follows. In section 2, we motivate the role of government spending in a framework with a collateral-in-advanced constraint. In section 3, we discuss our identification strategies and describe the data. In section 4, we present the estimation results. Section 5 presents additional results, inter alia, at the industry-level. Finally, we conclude in section 6.

## 2 Hypothesis Development

Lenders provide firms with funds as governed by the discounted value of their collateral. In the absence of a binding collateral-in-advance constraint, the optimal demand for input follows from equating the marginal product with the real price of that input, a familiar result maintained in any model without frictions. However, the financial accelerator model of Bernanke et al. (1996) posits that when the collateral-in-advance constraint is binding, a firm faces a financing premium and the demand for input and capital investment is given by this constraint.

The simplest way to illustrate a link between government spending and firms' investment in their inputs is to consider a prototypical two-period collateral-in-advance constraint:

$$x_{t+1} \leq a_t f(x_t) + \left(\frac{p_{t+1}}{r_{t+1}}\right) K - r_t B_t, \tag{1}$$

where $x_{t+1}$ is the demand for input $x$ in the second period, $a_t f(x_t)$ is available cash flow from last period (the price of output is normalized, and $f(x_t)$ is the production function with the usual properties), $\left(\frac{p_{t+1}}{r_{t+1}}\right)K$ is the discounted value of the collateral $K$, and $r_t B_t$ is the cost of servicing existing debt $B_t$ for an interest rate $r_t$. $a_t$ can be viewed as market capacity and is generally considered to be a function of a number of characteristics, such as consumers' taste and industrial structure. Because the constraint is binding, the demand for $x_{t+1}$ is given by equation 1. In our context, the main point is that government spending can also act as a factor that influences market capacity.

As the financing premium is firm specific, the effect of a newly awarded government contract is heterogeneous across firms depending on whether or not the constraint was initially binding. If the constraint was initially binding, the additionally generated cash flow from new government demand reduces the external financing premium through $a_t$, hence easing the constraint and increasing the firm's demand for inputs and production.

In the absence of new government demand, ceteris paribus, a firm would be still facing a binding constraint. Note that if the government contract is awarded to a financially non-constrained firm, there is no effect on the financing. The reason is that such a firm is already at the optimum and follows the optimal path to address demand changes. Thus, we expect that government purchases have a positive effect on firms' investment, particularly for financially constrained firms.

Recent full pledged models predict similar outcomes in spite of different details. For example, Carrillo and Poilly (2013) show in DSGE setup that increases in government spending stimulate capital accumulation leading to an increase in the price of capital and thus an increase in the value of collateral. The increase in the value of collateral reduces credit spreads and raises firms' investments. In a similar spirit, Challe and Ragot (2011) show that the government spending multiplier is relatively large when government expenditures increase liquidity and loosen firms borrowing constraints. Canzoneri et al. (2015) present a DSGE model predicting that the government spending multiplier is larger when spending affects financial frictions.

Against this background, in the following we empirically assess the link between government spending and firms' capital investment. It is important to stress that this link is independent from the nature of the final good or service that is purchased by the government (i.e., whether it is government consumption or government investment, or whether it is wasteful or not wasteful from a macroeconomic standpoint). For instance, a bridge may or may not present productive spending affecting long-term productivity and output in the economy. However, this paper is not about the effect of the 'bridge' on the economy, but it is about the effect of spending on the 'firm that builds the bridge', or more generally the effect of spending on the firm upon which government demand falls. This effect is one element that feeds into an aggregate "multiplier".[6]

[6] For studies on the nature of spending and aggregate output, see for example Leduc and Wilson (2013) and Boehm (2018).

# 3 Data and Identification

The mechanism that we outlined above operates via a shift in government demand for firm-specific products. Thus, testing it requires detailed data on government purchases at the firm level. This section describes the data collection of contract-level federal awards, the aggregation to the firm-quarter level, and the matching with firms' accounting information. The matching procedure can be useful for other researchers that want to combine federal awards data with other firm-level information.

## 3.1 Identification

### 3.1.1 Panel Specification

We start with the following panel reduced-form specification:

$$\frac{I_{it}}{K_{i,t-1}} = \alpha_0 + \beta \frac{Award_{i,t}}{K_{i,t-1}} + \alpha_i + \lambda_{t,s} + \gamma' X_{it} + u_{it}, \tag{2}$$

where $Award_{it}$ is the cumulative sum of the values of all awarded government contracts to firm $i$ in quarter $t$ to $t+4$.[7] We include firm-fixed effects ($\alpha_i$) and period-industry-fixed effects ($\lambda_t, s$) and a set of control variables ($X_{it}$). We estimate equation (2) using the sample of all firms or subsamples including constrained or non-constrained firms. We are interested in $\beta$, and we expect that the marginal effect is larger for financially constrained firms than for unconstrained firms.

In specification 2, the coefficient $\beta$ is identified from two different sources of variation. First, we exploit differences across firms that won contracts and those firms that did not win a contract in a certain quarter $t$. The second source of variations is within a firm $i$ — that is, periods when a firm $i$ has not been awarded contracts versus periods when a firm $i$ has been awarded a contract. We run this model for the sample including all contracts.

The firm-fixed effects capture firm-specific unobserved characteristics. Note that all industry-specific time-invariant unobserved heterogeneous effects, such as the market structure, are nested within the set of firm-fixed effects, $\alpha_i$. The effects of government demand on firms' output can be regime-dependent. Bernanke et al. (1999) provide a comprehensive overview clarifying the relation between the finance premium and the business cycle suggesting that the external finance premium can be countercyclical. Therefore, during periods of financial turmoil, the premium is higher than in normal times and the constraint becomes binding for a larger number of firms. Liebman and Mahoney (2013) find that quality of federal spending in the IT sector declines at the end of the fiscal year. We deal with potentially time-dependent impacts of government spending by using period-industry fixed effects, $\lambda_{t,s}$, capturing all factors that are common across firms *within an industry* in a quarter.

One potential concern is that signing a contract can be predicted leading to a correlation

[7] Chaney et al. (2009) show that this reduced-form corresponds to a simple model of investment under collateral constraint.

with the error terms $u_{it}$. However, because all contracts in our sample were awarded through a competitive procedure, we expect that predictability is unlikely to be a serious concern in our application. Nonetheless, we consider this issue by testing whether stock returns can predict subsequent contracts and find no evidence that awards are anticipated.

As guided by theory, the vector of controls, $X_{it}$, is based on Chaney et al. (2012) and includes cash, lagged market-to-book value of assets (Mkt to Book), lagged returns on assets (RoA), and the lagged size of the firm.

#### 3.1.2 Propensity Score Matching (PSM)

One challenge facing the fixed-effect model is that firms that win a federal contract can be inherently different from those that do not. For example, firms are more inclined to bid for federal government contracts if their private sector demand is weak. While the period-industry fixed effects and the firm fixed effects largely control for such a scenario and unobserved heterogeneity, a priori and theoretically, selection bias remains a concern.

The PSM is one way to address this concern by constructing a control group that includes firms with observable characteristics that match those that were awarded a federal contract (treated) in a period. In the first step, we estimate the propensity to win a contract for all firms (treated and control) using a logistic regression model. As shown in the Supplementary Appendix, the distribution of predicted probabilities of wining a contract for the treated and control firms do overlap, which is needed to find matches (Figure 9).

In the second step, for each treated firm, we identify a set of control firms within the same industry and the same period that were not awarded a contract. Thirdly, among the set of potential control firms, one firm is matched on the propensity score with each treated firm, i.e., pairing each treated firm with that firm that was not awarded a contract but had the same probability of wining a contract as the one that actually won it. We match a treated firm to the nearest firm in the control group (i.e., based on the minimum distance between predicted probabilities). Finally, we estimate the effect of federal contracts on firm investment including the same covariates and fixed effects as in the fixed-effect model, but using the PSM control group.

#### 3.1.3 Inverse Probability Weighting (IPW) Estimation

One drawback of the PSM method is that the sample size potentially shrinks by dropping observations from the non-treated group that do not get matched. The IPW method maintains all observations but assigns different weights to different observations. In particular, as proposed by Imbens (2000), treated firms receive the weight of $1/p$ and non-treated firms receive the weight of $1/1-p$, where $p$ is the predicted probability of wining a contract obtained form the logistic model used for the PSM (described above).

The intuition is that the lack of natural experiment (or random assignment) in our application requires adjusting for covariate differences (and those are summarized by the propensity score).

The IPW gives more weight to firms that are more likely to be treated (which would receive a weight of 1 in a randomized experiment) to compute the average outcome in the treatment group. Similarly, the IPW gives higher weight to those firms that are more likely to be in the control group. The estimation is conducted with the same set of covariates as in the previous estimations including period-industry fixed effects as well as firm fixed effects.

### 3.2 Federal Procurement Data

The Federal Funding Accountability and Transparency Act of 2006 required the creation of a public database that includes comprehensive information on federal expenditure. The database contains contract-level transactions for each federal award of more than $3,000. Available information includes: the entity that receives the award, the amount that was awarded, the awarding agency, and specifics of the award (for example, whether the winner of the award was determined in a competitive bidding process).[8] The database is publicly available and it covers the time period from 2000 onwards. The last quarter-year in our sample is 2018Q3.

We proceed in steps imposing necessary restrictions on the data. First, we restrict the contracts database to firms that can be matched with financial information in Compustat. This step removes very small companies for which accounting information is not available. Second, we include only those contracts that were awarded in a full and open competition with at least two bidders. Our hypothesis implies that only unexpected changes to a firm's future cash flows should affect investment, and the purpose of the restriction is to capture the unanticipated component of a firm's future government demand.[9] We directly test for anticipation effects in section 5. Third, we drop observations that seem to be reporting errors; e.g., when the signing date of a contract is after its effective date.

The total value of contracts (after our restrictions) is 950 billion dollars of which we match roughly 760 billion dollars (about 80 percent). In order to match the awards with firm-level financial information, we collapse the awards data to the quarterly level by summing over the amounts of all awards that a firm has received in each quarter. The mean of awarded firm-quarter contracts is about 28.4 million dollars and the distribution of awards is right-skewed as is evident from the median that is much lower than the mean (Table 1). Table 2 shows the number of awards by firm-year. Typically, a firm in our sample receives between 1 and 5 contracts per year, but some firms receive more contracts per year.

### 3.3 Firm-Level Data

We obtain firm-level accounting information at the quarterly level from Compustat and merge the data with the federal government contracts' database. The final sample includes firms that

[8] In this database, the OMB defines a federal contract as "An agreement between the federal government and a prime recipient to execute goods and services for a fee." See: www.usaspending.gov.

[9] The issue of anticipation has been discussed in fiscal policy research raising concerns that foresight can lead to biased estimates (for example, Leeper et al. (2013)).

at least obtained once a contract from the federal government that satisfies the above described restrictions during the sample period. The sample includes 90,684 quarterly observations covering 1,175 unique firms spanning from 2000Q1 to 2018Q3. Our main variable of interest is defined as the received amount of contracts scaled by lagged property, plants, and equipment (PPE) for each firm and quarter ($\frac{Award_{it}}{K_{i,t-1}}$). Figure 1a is a histogram of $\frac{Award_{it}}{K_{i,t-1}}$. In the benchmark case, we do not restrict the sample of contracts (beyond the procedure described above) to compute $\frac{Award_{it}}{K_{i,t-1}}$.

We define capital investment as capital expenditures normalized by the lagged value of PPE, as is standard in the literature on firms' investments (see, for example, Kaplan and Zingales (1997)). In addition, we construct control variables such as cash, return on assets, and the market-to-book ratio. Appendix 8.2 describes all variables in detail. Table 1 displays descriptive statistics of the main accounting variables that are used in our study.

Federal contract recipients operate in various sectors of the economy. Figure 1b displays major economic sectors (SIC, 2 digit) according to their share of the value of received contracts. Major recipients of awards are manufacturing, including sectors such as industrial machinery and computer equipment, as well as business services. The supplementary appendix documents the complete distribution of industries.

To define financially constrained firms, we follow the literature and look at three different definitions — as in, e.g., Almeida et al. (2004) and Almeida and Campello (2007). First, using firm size as a proxy for constraints, we rank firms based on their total assets and consider those in the lower (upper) 30$^{th}$ percentile as constrained (unconstrained). Second, in a similar fashion, we rank firms based on their payout ratios and consider those in the lower (upper) 30$^{th}$ percentile as financially constrained (unconstrained). Last, we consider firms to be constrained if the S&P domestic long-term issuer credit rating is in the high yield range or lower.

# 4 Results

## 4.1 Baseline Results

Figure 2 presents benchmark results from estimating equation 2. The estimated "$\beta$" from equation 2 is presented by the white dot in the center of the colored bars. The bars show the confidence bands. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a firm over time. In the top row, the specification refrains from including controls or sets of fixed effects. The estimated coefficient suggests that a 1 dollar increase of federal spending increases investment by 14.3 cents. In specifications (2) to (4), we interchangeably include firm-fixed effects and/or period-industry-fixed effects. In the last specification (bottom row), we include the full sets of fixed effects as well as the control variables. The estimated coefficients remain statistically significant at the 1 percent level and become only slightly smaller, with an estimated impact of 10.3 cents in the last specification.

The above results motivate the question: Which firms invest more in reaction to new government demand? We estimate equation (2) for the subsamples of constrained and unconstrained firms separately to test the hypothesis that financially constrained firms invest more into capital after receiving an unanticipated government award. Recall that we define financially constrained firms as those that are either small, pay low dividends, or have a low corporate credit rating.

Figure 3 displays the results. The first specification (the top row) shows that small firms increase investment by 12.6 cents for every dollar of federal government awards. However, we do not find a significant effect for large companies. Interpreting small firms as more likely to be financially constrained, these findings indicate that firms with financing constraints do raise investment more in reaction to federal spending.

The result is robust to using other indicators of financing constraints. Using the payout ratio as an indicator, we find that firms that pay low dividends increase investment by 11.2 cents, whereas we find lower and non-significant effects for firms that pay higher dividends. Using the credit rating as an indicator, we find that firms that have a high-yield or no credit rating increase investment by 12 cents, whereas we find no effect for firms with an investment grade rating.

### 4.2 Impulse Response Functions (IRFs)

It is indicative to look at the impulse response function of quarterly firm investment to unanticipated federal government spending (contract) shocks. We estimate IRFs following the local direct projections method proposed by Jordà (2005):

$$I_{t+h} = a^h + b^h Award_t + \sum_{j=0}^{K} \phi_j^h \Delta I_{t-j} + \epsilon_t^h, \forall h \in \{0, \dots, H\}, \tag{3}$$

where $I$ is shorthand for $\frac{I_{it}}{K_{i,t-1}}$ and $Award$ is shorthand for $\frac{Award_{i,t}}{K_{i,t-1}}$ as in equation 2. The IRF is directly given by the vector of coefficients $\{b^h\}_{h=0}^{H}$.[10] Figure 4 shows the results with 95 percent confidence bands. For financially constrained firms, and according to the three different indicators, there is no dynamics and the IRFs are statistically insignificant. In contrast, investment by unconstrained firms immediately reacts reaching a peak in 4 to 5 quarters. The effects fade away after 8 quarters.

### 4.3 PSM and IPW Results

Figure 5 presents the estimated treatment effect on investment using the PSM estimation. The full results are in the Supplementary Appendix. Without distinguishing between constrained and unconstrained firms, we obtain a treatment effect of about 10 cents per 1 dollar of federal contracts (Figure 5a). Consistently with the the fixed-effect panel model results, Figure 5b shows that the effect of federal contracts on investment is significant only for constrained firms (small, low payout ratio, or low credit rating). The magnitude of the effect ranges from 9 to 11 cents per 1 dollar of federal contracts, which is comparable to the benchmark results in Figure 3.

[10] Jordà (2005) shows that the resulting IRF from equation (3) is identical to that obtained from autoregressive models.

Figure 6 shows results obtained from the IPW estimation. We obtain a similar pattern of results to those from the PSM estimation and the panel fixed-effect model. The robustness of the findings confirms that government spending can increase firm investment especially by financially constrained ones.

# 5 Testing for Anticipation and Additional Results

## 5.1 Testing for Anticipation

Are competitive contracts anticipated? If yes, winning a federal contract per se may not represent actual demand shocks to firms. However, as mentioned above, in this study, we safeguard against that concern: Throughout the analysis, we have focused on contracts that were awarded competitively with the bidding process involving at least two firms.

To formally test for anticipation effects in our main measure of government demand shocks, we use daily firm-level stock market information. If awarded contacts are anticipated, stock returns should predict subsequent contracts. We construct a daily series of signed contracts for each company and estimate the following model:

$$Award_{it} = \alpha + \sum \theta_k Ret_{it-k} + \epsilon_{it}, \tag{4}$$

where $k = 1, 2, .., 20$. $Ret_{it-k}$ are daily stock returns over the past month and Award$_{it}$is the contract amount signed on a particular day. Positive statistically significant $\theta_k$ would imply that contracts are anticipated by financial markets.

We use two different measures of returns $Ret_{it-k}$. Our first measure of $Ret_{it-k}$ is a firm's raw daily stock returns. Our second measure uses the Capital Asset Pricing Model (CAPM) to correct for regular swings in the market. In particular, for each firm, we estimate the equation

$$Ret_{it} - R_t^f = \alpha^i + \beta^i R_t^m + \nu_{it}, \tag{5}$$

where $R_t^f$ and $R_t^m$ are the risk-free and the market return. Our second measure of returns is the residual $\hat{\nu}_{it}$ from that regression.[11]

We estimate equation (4) for two different samples, using all days between the year 2000 and the year 2012, and using only the days for each firm when the firm won a contract. This can be effectively interpreted as regressions with two different control groups: Using all days measures whether winning or not winning a contract is associated with past returns. Using only days when contracts are awarded measures whether winning large and small contracts are differentially associated with past returns.

[11] We estimate equation (5) for every year of a firms' stock returns separately to account for changes in the structural relationship.

Panel A of table 3 shows the estimation results for equation (4). For both samples and both measures of returns, we do not find evidence for anticipation effects. Naturally, some coefficients are significant when 80 different ones are estimated, but the timing patterns do not give rise to a consistent pattern. The $F$-statistics for the hypothesis of the joint significance of $\theta_k$ indicates that signing a contract is not anticipated by financial markets (except for column (1)). Panel B uses quarterly stock returns and supports these conclusions as well.

Moreover, we find evidence that winning a contract is predictive of future stock returns. This finding complements the results in Table 3. Table 4 displays stock returns of the following strategy: At the beginning of month $t+1$, buy all firms that won a contract in month $t$ and short-sell firms in the sample that did not win a contract in month $t$. The portfolio is updated each month with new information on contract winners in the previous month. Table 4 shows returns of that strategy against standard equilibrium models of returns, that is, the Capital Asset Pricing Model, the Fama-French three factor model and the four-factor model that adds a momentum factor. Column (1) shows that the average monthly strategy return is .5 percent or approximately 6 percent per year. Columns (2) to (4) show that this strategy return is virtually unaffected by standard factors.[12] This result indicates that, while the stock market does not anticipate the winner of a contract, it reflects the winning of a contract after the contract has been awarded.

### 5.2 Additional Results

**Financing:** Our findings suggest that financing constraints play an important role in the transmission of government demand to firm investment. Next, we examine whether an awarded contract facilitates firms' access to external borrowing. We estimate the impact of federal procurements on debt changes using the following model

$$\frac{\Delta y_{it}}{y_{i,t-1}} = \alpha_0 + \beta \frac{Award_{it}}{K_{i,t-1}} + \alpha_i + \delta_{t,s} + \gamma' X_{it} + u_{it}, \tag{6}$$

where $y_{it}$ is short-term debt. Note that, unlike in the baseline regression (2), we are using the growth rate as the dependent variable in equation (6) because liability is a state variable from the balance sheet (unlike investment, which is a flow variable). We estimate equation (6) for constrained and unconstrained firms separately.

Figure 7 shows the results. Regardless of the measure of financial constraints, we find that constrained firms increase debt in response to winning government contracts. Point estimates for unconstrained firms are smaller throughout all specifications and are less precise and non-significant. Overall, these results are consistent with the hypothesis that federal contracts increase firms' capacity to obtain external funding.

**Industry-Level Results:** One question is whether the increase in investment by some firms

[12] Factor loadings are significant throughout but generally of small magnitude. The negative correlation with the market factor indicates that the strategy is a hedge against market risk. The negative correlation with the size factor indicates that the strategy loads on larger firms, as expected by the sample selection.

crowds out investment by others. Consider, for example, a firm that increases investment in inputs following a demand shock. If the additional demand drives up inputs' prices in the industry, investment projects of other firms might become less profitable. This might result in lower capital investments by other firms in the same industry. On the other hand, the increase in investment of some firms can generate new demand for other firms' outputs such that the initial shock creates positive investment spillovers.

We offer suggestive evidence on industry-wide effects based on aggregating the firm-level data to the industry level. In this exercise, we include all firms in the same industry, regardless of whether or not they won a contract during our sample period. The sample of firms is the universe of firms in Compustat and industries are defined at the 4 digit standard industry classification (SIC) level, and we compute industry investment and government demand shocks on a quarterly basis.

Our first simple test relies on comparing the investment response at the industry level to that at the firm level, reported in section 4.1. If the industry-level investment effect is smaller than the firm-level effect, this would suggest that government demand shocks crowd out other firms' investments in the same industry. If the industry-level investment response was larger, this would suggest positive spillovers to firms in the same industry.

Figure 8 presents the results. The estimates using all industries in the upper two rows indicate that the effects of federal procurements transmit to the industry level and do not lend support to the crowding-out hypothesis. The estimated coefficients are similar in magnitude to those in Table 5. For instance, our estimates in Table 5 suggest that the capital-investment response is around 10 to 12 cents for every dollar of government contracts. Figure 8 suggests that the industry-level effect is about 15 cents, which is statistically indistinguishable from the firm-level response. If at all, the industry effect is slightly higher, potentially pointing to a crowding-in effect (e.g., due to subcontracting to other firms).

Furthermore, we present results from re-estimating the model for two subsamples distinguishing between industries based on financial dependence to check whether or not the transmitted effect depends on the external financial dependence of the industry. As an indicator of external financial dependence at the industry level, we use the industry median of capital expenditures minus cash flows over capital expenditures. This index was advocated by Rajan and Zingales (1998) and it has been heavily used in subsequent studies (for example, Aghion et al. (2014) and Duygan-Bump et al. (2015)). Higher values indicate higher debt ratios and hence higher dependence on external financing. Next, we split the sample into industries with low financial dependence, if the index is below the median, or high financial dependence, if the index is above the median. The bottom two rows in Figure 8 show that the rise in investment is higher for industries with higher needs for external financing. Admittedly, it is challenging to pin down the exact mechanism whereby the effect transmits from the firm-level to the industry level as it potentially involves within- and cross-industry spillover effects. The main point of our exercise, however, is that firms' investment is leading to an increase in investment at an aggregate level.

This compelling finding implies that government spending can lead to an increase in aggregate private investment, which challenges the traditional crowding-out hypothesis.

**Department of Defense (DoD) Contracts:** The literature on fiscal multipliers often focuses on defense spending as a component of government spending that might be less correlated with the business cycle (for example, Ramey (2011b), Nakamura and Steinsson (2014)). While in our application there is no clear arguments to select only DoD contracts, it might be of interest to look at results from a sample including only those contracts. Figure 10 reports the results. The increase in investment is again concentrated among financially constrained firms.

**Dynamic Specification:**

While our benchmark regression model in equation (2) is a standard specification in the investment literature and the PSM and IWP models provide alternative identification strategies, we provide further results form a dynamic panel-data model that includes one lag of investment as an additional regressor. As is well known, using lagged values of the dependent variable as regressors in a fixed-effects panel model introduces estimation bias. We follow the literature and address the bias by using an Arellano-Blundell-Bond estimation. In these dynamic models, the long-run multiplier is given by adjusting the point estimate $\beta$ for the autoregressive structure of investment as $\frac{\beta}{1-b_1}$ (where $b_1$ is the coefficient on lagged investment). The results are similar (Table 9 in the online Supplementary Appendix). The long-term estimated effect of government demand on capital investment is higher than the benchmark estimates of the static model.

## 6 Conclusion

Fiscal policy can affect the economy through several channels, most prominently via its effects on private consumption or investment. While a number of studies use micro-data to examine the response of private consumption to fiscal stimuli, firm-level evidence on the link between government spending and private investment is rarely available. In another strand of literature, several studies suggest that external financing constraints can hinder firms' investment response to shocks.

Against this background, we analyze the effects of government demand shocks on capital investment at the firm level using rich data on government contracts matched to firms' financial information. To isolate a specific mechanism, we focus on the investment patterns of firms that are financially constrained, and we argue that their investment response is expected to be more pronounced. These results robust to different identification approaches.

A key finding of our analysis is that financially constrained firms react to new government demand by raising capital investment. We find that the average response of capital investment is between 10 and 15 cents per dollar of government demand. The average, however, masks substantial heterogeneity: We find larger effects for firms that are plausibly constrained and non-significant effects for unconstrained firms. The evidence indicates that government contracts enable firms to increase their capacity to obtain external financing.

When we aggregate our data to the industry-level, we find an almost one-to-one pass-through of private capital investment to industry-level capital investment. This suggests that government contracts do not crowd out private investment, an important concern for policy considerations. However, we cannot rule out crowd-out effects in other industries. An important avenue for future research is to address potential cross-industry spillover effects of government spending.

# 7 Tables and Figures

**Table 1:** *Summary Statistics*

| Variable | Mean | Median | Std | p25 | p75 | N |
|---|---|---|---|---|---|---|
| Contract amount (quarter) | 28,400,000 | 369,000 | 161,000,000 | 57130.000 | 2,910,000 | 26,728 |
| $\frac{Award_{i,t}}{K_{i,t-1}}$ | 0.077 | 0.002 | 0.241 | 0.000 | 0.016 | 25,470 |
| Capital investment ($\frac{I_{it}}{K_{i,t-1}}$) | 0.069 | 0.045 | 0.080 | 0.026 | 0.080 | 81,974 |
| RoA | 1.624 | 2.022 | 3.717 | 0.828 | 3.310 | 83,822 |
| Market to book | 1.943 | 1.507 | 1.333 | 1.166 | 2.182 | 89,113 |
| Cash | 0.102 | 0.105 | 0.680 | 0.034 | 0.250 | 78739 |
| Rating | 11.326 | 12.000 | 3.289 | 9.000 | 14.000 | 35,605 |
| Size | 6.894 | 6.927 | 2.089 | 5.484 | 8.317 | 90,679 |
| Payout ratio | 0.806 | 0.028 | 2.492 | 0.000 | 0.501 | 83,044 |

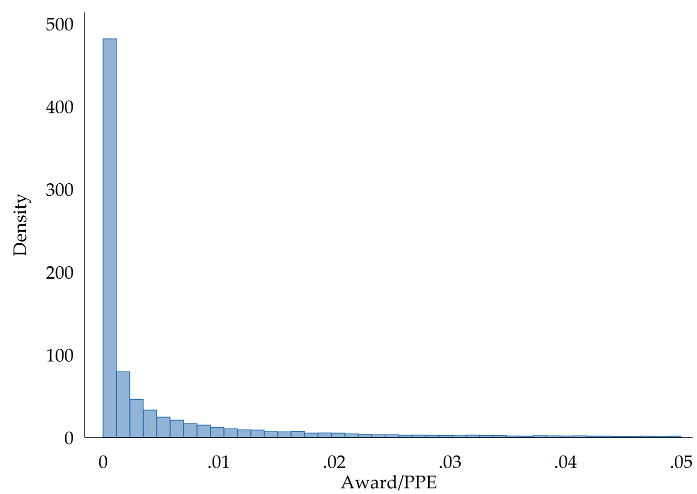
Note: Contract amount is the quarterly sum of the values of awarded contracts to a firm and it is expressed in millions of U.S. dollar. $\frac{Award_{i,t}}{K_{i,t-1}}$ is cumulative sum of contract amount over 4 quarters scaled by PPE. Capital investment and cash are scaled by PPE. RoA is return on assets divided by total assets. Size is the natural logarithm of total assets. Rating is a numerical variable reflecting the S&P corporate bond rating; high values reflect better rating. Section 8 provides the definitions and sources of all variables. Payout ratio is distributed dividends over net income.

**Table 2:** *Number of Contracts per Firm-Year*

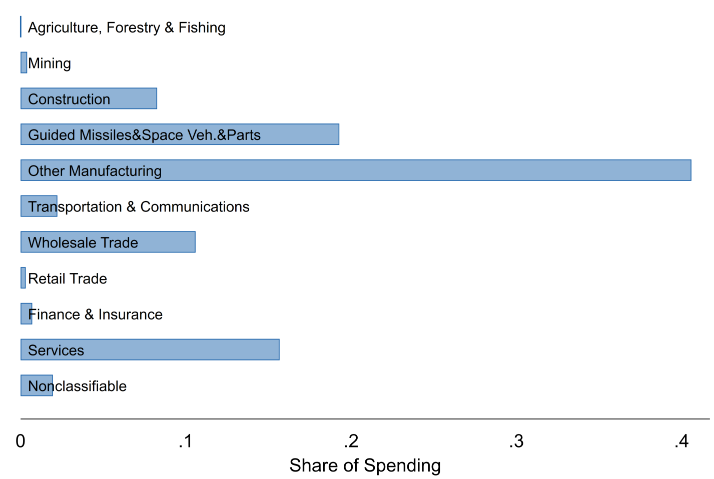
| Item | Number | Per cent |
|---|---|---|
| 1-5 | 3,645 | 46 |
| 6-10 | 900 | 11 |
| 10-15 | 542 | 7 |
| 16-20 | 308 | 4 |
| 21-25 | 241 | 3 |
| >25 | 2,210 | 28 |
| Total | 7,846 | 100 |

Note: This table shows the numbers of firm-year awarded competitive federal contracts in our sample.

**Figure 1:** *Awarded Federal Contracts*

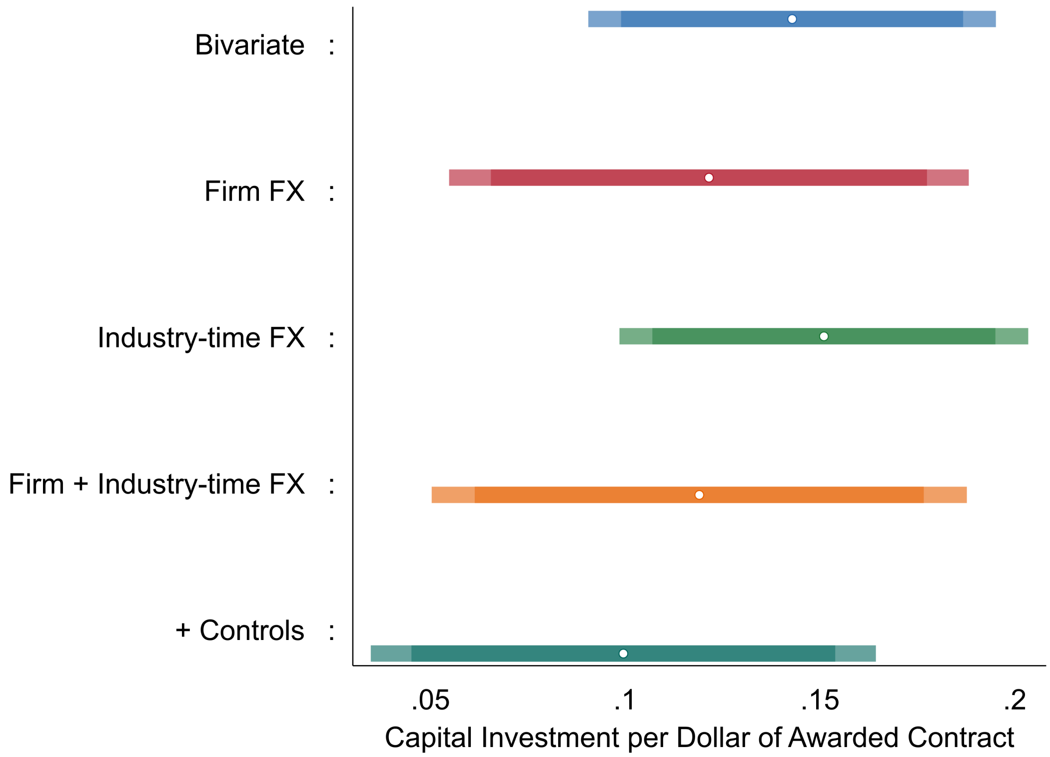



**(a)** *Histogram of Awarded Contracts (Scaled by PPE)*



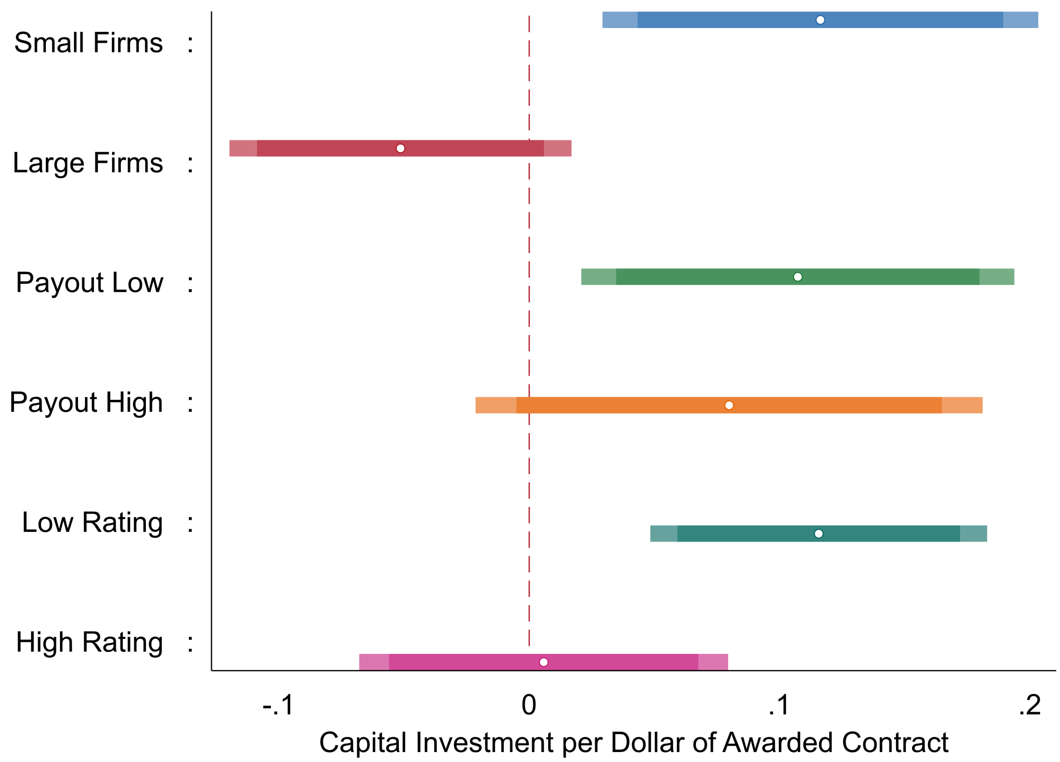

**(b)** *Industry Distribution*

**Figure 2:** *Benchmark Results: The Effects of Federal Contract on Firm Investment*




Note: This figure displays the estimated "$\beta$" from equation 2, presented by the white dot in the center of the colored bars. The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. The set of controls and the associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

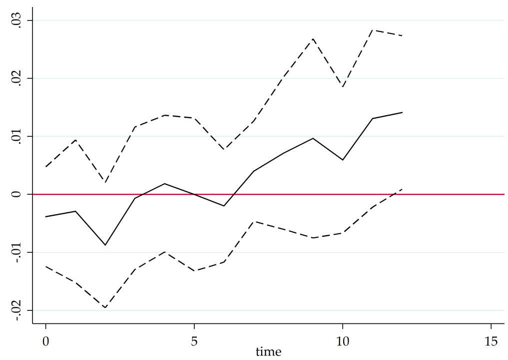
**Figure 3:** *Benchmark Results: Financially Constrained vs. Unconstrained Firms*



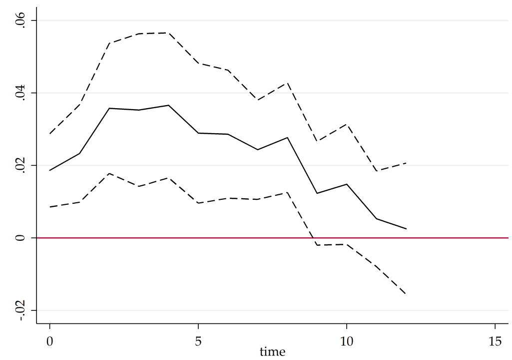

Note: This figure displays the estimated "$\beta$" from equation 2 obtained from subsamples including financially constrained or unconstrained firms. The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. All regressions include a set of controls. The associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 4:** *Impulse Response Functions: The Effects of Federal Contract on Firm Investment*

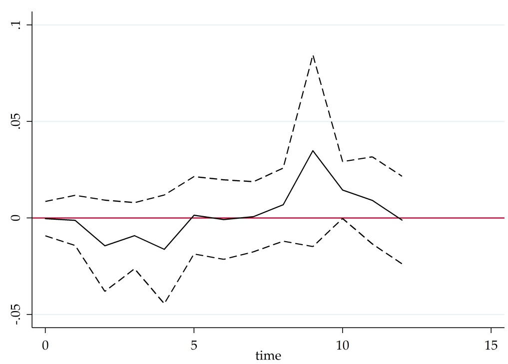
**(a)** *Unconstrained Firms (Size)*




**(b)** *Constrained Firms (Size)*




**(c)** *Unconstrained Firms (Rating)*




**(d)** *Constrained Firms (Rating)*

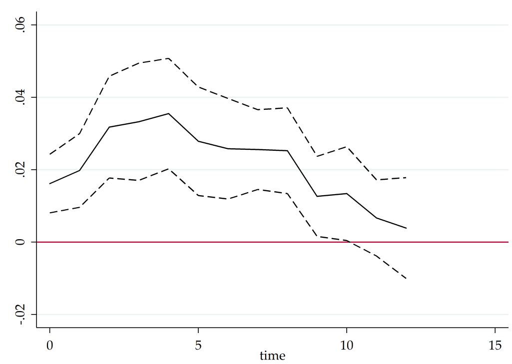
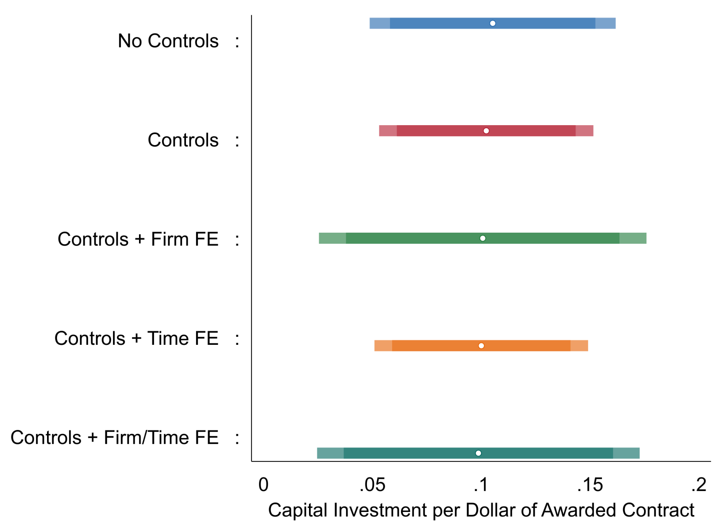
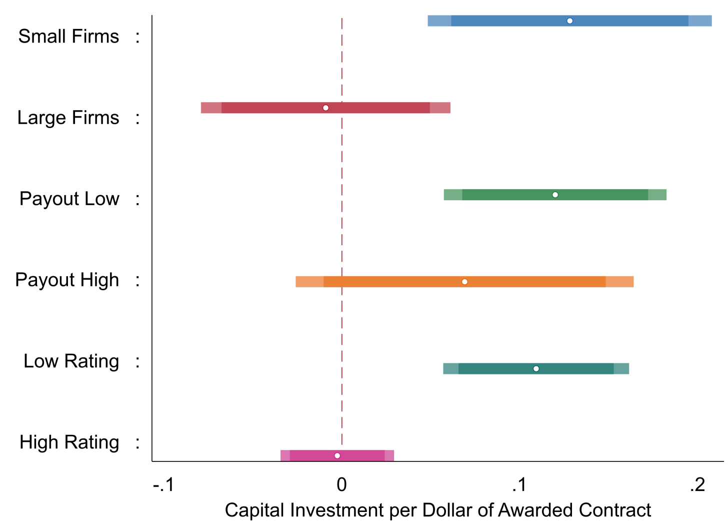


**Figure 5:** *Propensity Score Matching Results*

**(a)** *All Firms*

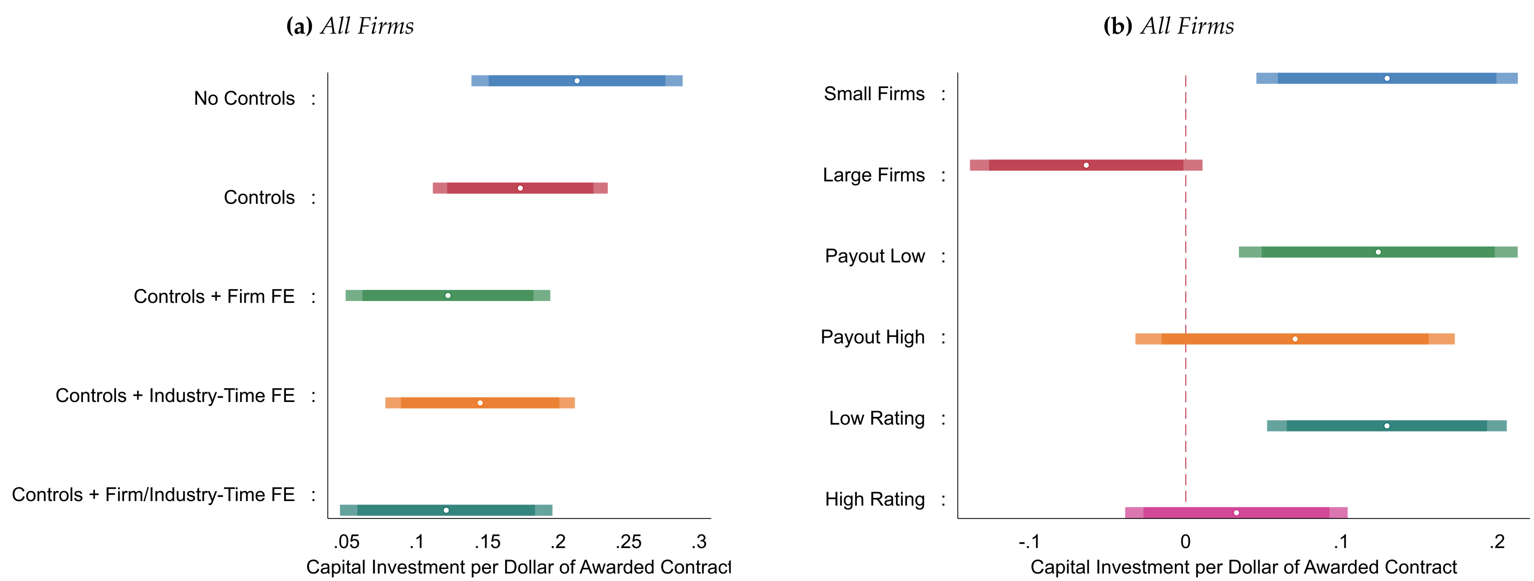



**(b)** *Constrained vs. Unconstrained Firms*



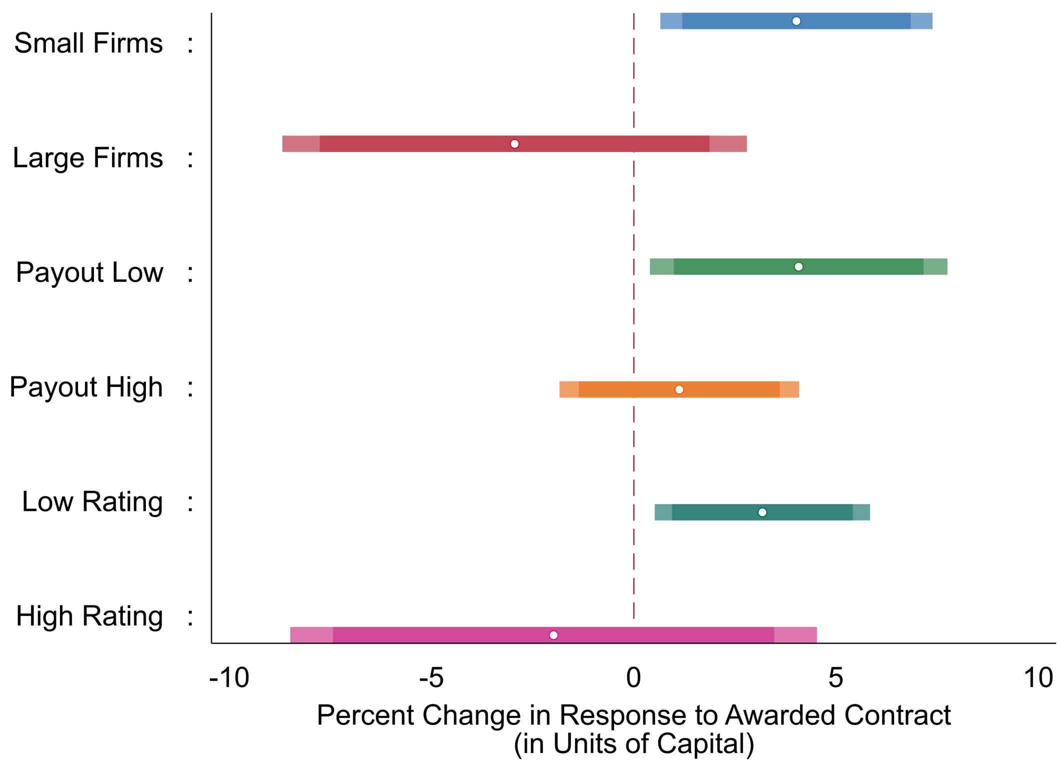

Note: This figure displays the estimated effect of federal contracts on firm investment using the propensity score matching method described in section 3.1. The treatment effect is presented by white dot in the center of the colored bars. The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. The set of controls and the associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 6:** *Inverse Probability Weighting*



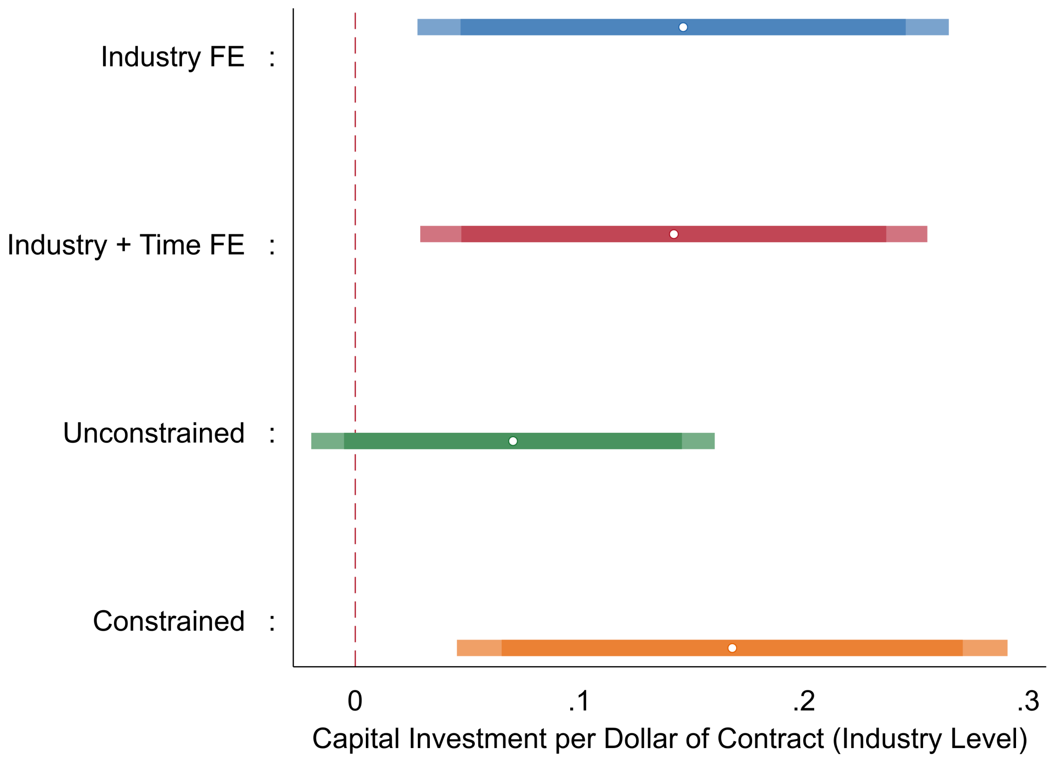

Note: This figure displays the estimated effect of federal contracts on firm investment using the inverse probability weighting method described in section 3.1. The treatment effect is presented by white dot in the center of the colored bars. The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. The set of controls and the associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 7:** *Effect of Winning Government Contracts on Firms' Liabilities*




Note: This figure displays the estimated "$\beta$" from equation 6 obtained from subsamples including financially constrained or unconstrained firms. The bars show the confidence bands. The dependent variable is the growth rate of short-term debt. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. All regressions include a set of controls. The associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 8:** *Industry Level Results*




Note: This figure displays the estimated effect of federal contracts on investment at the industry level (SIC, 4 digits). The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE aggregated at the industry level. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE aggregated at the industry level. Section 8 provides the definitions of all variables. All regressions include period- and industry-fixed effects. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Table 3:** *Awarded Contracts and Stock Returns*

| | Panel A: Using Daily Returns | | | |
|---|---|---|---|---|
| | Raw returns | | Adjusted returns | |
| | (1) | (2) | (3) | (4) |
| | All days | Non-zero days | All days | Non-zero days |
| $Ret_{it-1}$ | -0.001 | -0.001 | -0.002* | -0.029 |
| $Ret_{it-2}$ | -0.000 | -0.004 | -0.001 | -0.001 |
| $Ret_{it-3}$ | -0.001 | -0.015 | -0.001 | -0.019 |
| $Ret_{it-4}$ | -0.001** | -0.002 | -0.001 | 0.012 |
| $Ret_{it-5}$ | -0.001 | 0.002 | -0.001 | 0.019 |
| $Ret_{it-6}$ | -0.001 | 0.001 | -0.001 | 0.025 |
| $Ret_{it-7}$ | -0.001 | 0.001 | -0.002 | 0.003 |
| $Ret_{it-8}$ | -0.001 | -0.007 | -0.004*** | -0.014 |
| $Ret_{it-9}$ | 0.001 | 0.016 | -0.002 | 0.008 |
| $Ret_{it-10}$ | -0.000 | 0.011 | -0.002 | -0.037 |
| $Ret_{it-11}$ | 0.000 | 0.029* | -0.000 | 0.006 |
| $Ret_{it-12}$ | 0.001* | 0.024 | 0.001 | 0.028 |
| $Ret_{it-13}$ | 0.000 | -0.005 | 0.001 | -0.001 |
| $Ret_{it-14}$ | -0.001 | -0.013 | -0.001 | -0.018 |
| $Ret_{it-15}$ | -0.001* | -0.018 | -0.002* | -0.057* |
| $Ret_{it-16}$ | 0.000 | 0.010 | 0.002 | 0.000 |
| $Ret_{it-17}$ | 0.000 | 0.017 | -0.001 | -0.032 |
| $Ret_{it-18}$ | -0.002** | -0.029* | -0.002 | -0.041 |
| $Ret_{it-19}$ | 0.000 | 0.006 | 0.002 | 0.021 |
| $Ret_{it-20}$ | -0.001** | -0.005 | -0.001 | 0.002 |
| Constant | 0.000*** | 0.001*** | 0.000*** | 0.001*** |
| Firm FE | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| R2 | 0.049 | 0.008 | 0.057 | 0.009 |
| N | 3382448 | 103711 | 1696236 | 80604 |
| F-Statistic | 1.630 | 0.681 | 1.394 | 0.985 |
| p | (0.039) | (0.848) | (0.116) | (0.478) |

| | Panel B: Using Quarterly Returns | | | |
|---|---|---|---|---|
| | Raw returns | | Adjusted returns | |
| | (5) | (6) | (7) | (8) |
| | All days | Non-zero days | All days | Non-zero days |
| $Ret_{it-1}$ | 0.000 | 0.050 | 0.028 | 0.142* |
| $Ret_{it-2}$ | -0.024* | -0.136** | -0.017 | -0.050 |
| Constant | -0.000 | 0.008*** | -0.000 | 0.008*** |
| Firm FE | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| R2 | 0.669 | 0.450 | 0.669 | 0.450 |
| N | 105427 | 20612 | 105427 | 20612 |
| F-Statistic | 1.631 | 3.433 | 1.100 | 2.078 |
| p | (0.196) | (0.033) | (0.333) | (0.126) |

Note: This table shows results from estimating: $Award_{it} = \alpha + \sum \theta_k Ret_{it-k} + \epsilon_{it}$, where $k = 1, 2, .., 20$. $Ret_{it-k}$ are daily stock returns over the past month and $\text{Award}_{it}$is the contract amount signed on a particular day. $Ret_{it-k}$ is either a firm's raw daily stock returns or adjusted returns defined as the residual $\hat{\nu}_{it}$ from the regression: $Ret_{it} - R_t^f = \alpha^i + \beta^i R_t^m + \nu_{it}$, where $R_t^f$ and $R_t^m$ are the risk-free and the market return. The $F$-statistics for the hypothesis of the joint significance of $\theta_k$ indicates that signing a contract is not anticipated by financial markets. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell. $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$.

**Table 4:** *Strategy Returns against Factor Models*

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\alpha$ | 0.005** | 0.006** | 0.005** | 0.005** |
| $\beta_{MKT}$ | | -0.180*** | -0.145*** | -0.096** |
| $\beta_{SMB}$ | | | -0.124** | -0.146*** |
| $\beta_{HML}$ | | | 0.092* | 0.097** |
| $\beta_{UMD}$ | | | | 0.086*** |
| N | 156 | 156 | 156 | 156 |

Note: This table shows strategy returns against the CAPM, the Fama-French three factor model and the four-factor model that adds momentum. The strategy works as follows: At the beginning of month $t+1$, buy all firms that won a contract in month $t$ and short-sell firms in the sample that did not win a contract in month $t$. The portfolio is updated each month with new information on contract winners in the previous month. Regressions are of the form:

$$r_{it} - r_{ft} = \alpha + \beta_{MKT}(r_{MKT,t} - r_{ft}) + \beta_{SMB} r_{SMB,t} + \beta_{HML} r_{HML,t} + \beta_{UMD} r_{UMD,t} + \epsilon_{it},$$

where $MKT$ indicates returns to the market factor, $SMB$ to the size factor, $HML$ to the value factor and $UMD$ to the momentum factor. $r_{ft}$ is the riskfree rate. Newey-West standard errors are used throughout. Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$.

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# 8 Supplementary Online Appendix

## 8.1 Variable Definitions

- **Award:** $\frac{\text{Award}_{it}}{K_{i,t-1}}$ is the obliged amount of a federal competitive contract obtained from the database of the Office of Management and Budget normalized by the lagged book value of properties, plant and equipment, PPE, obtained form Compustat (*ppentq*).

- **Capital investment:** $\frac{I_{it}}{K_{i,t-1}}$ is capital expenditure (*capxy*) normalized by the lagged book value of properties, plant and equipment, PPE, (*ppentq*).

- **Cash:** is income before extraordinary items + depreciation and amortization (*iby* + *dpq*) normalized by lagged book value of value of properties, plant and equipment, PPE, (*ppentq*).

- **Market to book value of assets:** MkttoBook is the market value of assets (*atq* - *ceqq* + (*cshoq* $\times$ *prccq*) - *txdbq*) normalized by their book value (*atq*).

- **Size:** is the log of total assets (*atq*).

- **RoA:** is return on assets ((*oibdpq* - *dpq*) divided by *atq*).

- **Ex ante measures of credit constraints (Firm-level)**:

  - Firm Size: In every quarter, we rank firms based on their total assets and consider those in the lower (upper) $30^{\text{th}}$ percentile as constrained (unconstrained).
  - Dividend payments (payout ratio): In every quarter, we rank firms based on their payout ratios and consider those in the lower (upper) $30^{\text{th}}$ percentile as constrained (unconstrained). The payout ratio is (*dvpsxq* + *cshopq*) divided by *oibdpq*
  - Corporate credit rating: We consider firms to be constrained if the S&P domestic long term issuer credit rating (*splticrm*) is BBB or lower.

- **Financial dependency (industry-level)**: As in Rajan and Zingales (1998), we compute the industry-median (at the 4 digits, Standard Industrial Classification system) of capital expenditures minus cash flows over capital expenditures.

- **Returns:** *Ret* is a daily series of stock returns from CRSP.

- **Short-term debt:** The growth rate of short-term debt (*ltq* - *lltq*).

- **Total debt:** The growth rate of total debt (*ltq*).

  All variables are winsorized at the 10 percent level to account for outliers.

## 8.2 Procedure for Merging Procurement Contracts with Compustat

The Federal Funding Accountability and Transparency Act (FFATA) requires the disclosure of information on entities that receive Federal awards. These include types of contracts, grants, loans, and other types of spending.

The data are at the *plant level*, company name, address and telephone numbers are given. In addition, each entry has a DUNS number which is a plant-level company identifier that is used by some government agencies. The DUNS number of the *parent company* is also part of the data set. It is called *parentdunsnumber* and is our primary identifier for companies. We collapse all data at the parent company level and we extract a list of all unique parent DUNS numbers that are part of the dataset, a total of 566,271 different DUNS numbers.

Only few data sets have the DUNS number as an identifier.[13] One dataset that includes DUNS numbers is Bureau van Dijk's Orbis database. To quote the provider, it is a "global database containing information on millions of companies that is unique in its breadth of geographies and extent of companies covered as well as the availability of private company financial information."

We uploaded our list of unique parent DUNS numbers to Orbis and were able to match 313,935 company records. For the companies that we could match, we downloaded the company name (for checking purposes), a BvD ID number, a BvD account number and the ticker symbol alongside with the DUNS number. Ticker information was not available for 310,523 companies which is about the size that we expected.

We could use the ticker directly in a standard financial database such as CRSP but we are careful to note that tickers might change over time. We therefore included one more step.

Another BvD product, Osiris provides financial accounting data for publicly listed companies around the world. Osiris also includes each company's current ticker for each year.

The OS ID number is identical to the BvD account number and can be used to access the data. We uploaded our list of BvD accout numbers to Osiris (a total of 312,586 because 1349 observations do not have a unique DUNS - BvD account number match), and received data for a total of 2754 companies, by OS ID number and year from 2000 to 2012. We also downloaded the current ticker, the current CIK number, the current stock exchange and the listing status. We obtained 32,106 valid observations over the 13 years.

## 8.3 Detailed Results

[13] S&P Capital IQ claims to have it but since we did not have access to their dataset, we could not validate how helpful it is.

**Table 5:** *Effect of Winning Government Contracts on Investment*

| | Full Sample | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Awarded Contract$_t$ | 0.143*** | 0.121*** | 0.151*** | 0.119*** | 0.100*** |
| | (0.027) | (0.034) | (0.027) | (0.035) | (0.033) |
| Cash$_t$ | | | | | 0.020* |
| | | | | | (0.011) |
| Mkt to Book$_{t-1}$ | | | | | 0.077*** |
| | | | | | (0.006) |
| RoA$_{t-1}$ | | | | | 0.011*** |
| | | | | | (0.002) |
| Size$_{t-1}$ | | | | | 0.013 |
| | | | | | (0.010) |
| Constant | 0.290*** | 0.291*** | 0.290*** | 0.225*** | -0.032 |
| | (0.005) | (0.001) | (0.005) | (0.016) | (0.077) |
| Firm FE | No | Yes | No | Yes | Yes |
| Industry-Time | No | No | Yes | Yes | Yes |
| R2 | 0.005 | 0.002 | 0.029 | 0.056 | 0.131 |
| N | 62816 | 62816 | 62816 | 62816 | 59140 |

Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$. This table corresponds to Figure 2. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Award is the obliged amount of a federal contract normalized by the lagged book value of PPE. Section provides the definitions of all variables. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

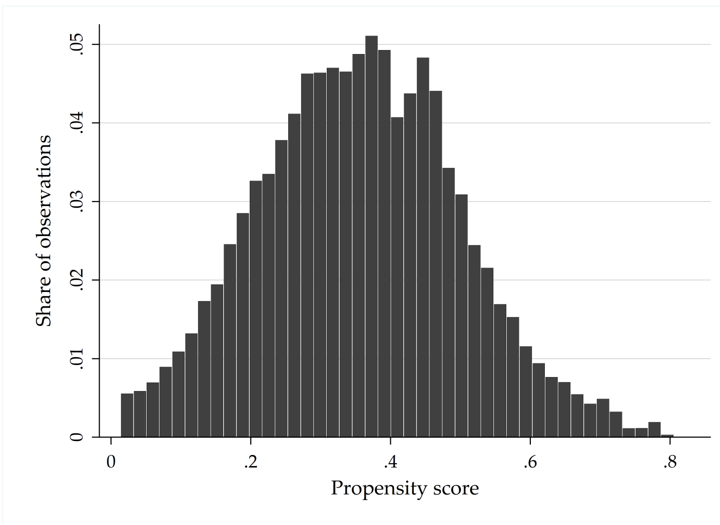
**Table 6:** *Effect of Winning Government Contracts on Investment: Constrained vs Unconstrained Firms*

| | Constrained vs Unconstrained Firms | | | | | |
|---|---|---|---|---|---|---|
| | Firm size | | Payouts | | Credit rating | |
| | Small | Large | Low | High | Low | High |
| Awarded Contract$_t$ | 0.116*** | -0.051 | 0.107** | 0.080 | 0.116*** | 0.006 |
| | (0.044) | (0.035) | (0.044) | (0.052) | (0.034) | (0.037) |
| Cash$_t$ | 0.002 | 0.208*** | -0.004 | 0.153*** | 0.018 | 0.065** |
| | (0.012) | (0.049) | (0.011) | (0.023) | (0.011) | (0.026) |
| Mkt to Book$_{t-1}$ | 0.074*** | 0.062*** | 0.085*** | 0.037*** | 0.080*** | 0.040*** |
| | (0.008) | (0.011) | (0.007) | (0.007) | (0.006) | (0.006) |
| RoA$_{t-1}$ | 0.017*** | 0.002 | 0.015*** | 0.001 | 0.012*** | 0.005*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Size$_{t-1}$ | 0.024 | 0.011 | 0.036*** | -0.017 | 0.010 | 0.055*** |
| | (0.018) | (0.013) | (0.014) | (0.012) | (0.011) | (0.019) |
| Constant | -0.031 | -0.075 | -0.191* | 0.257** | -0.001 | -0.476** |
| | (0.107) | (0.130) | (0.099) | (0.104) | (0.081) | (0.195) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry-Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| R2 | 0.138 | 0.228 | 0.160 | 0.144 | 0.133 | 0.376 |
| N | 18818 | 20395 | 27427 | 19883 | 49878 | 6209 |

Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$. This table corresponds to Figure 3. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Award is the obliged amount of a federal contract normalized by the lagged book value of PPE. Section provides the definitions of all variables. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 9:** *Distribution of Predicted Probability for the PSM*

**(a)** *Control Group*




**(b)** *Treated Group*

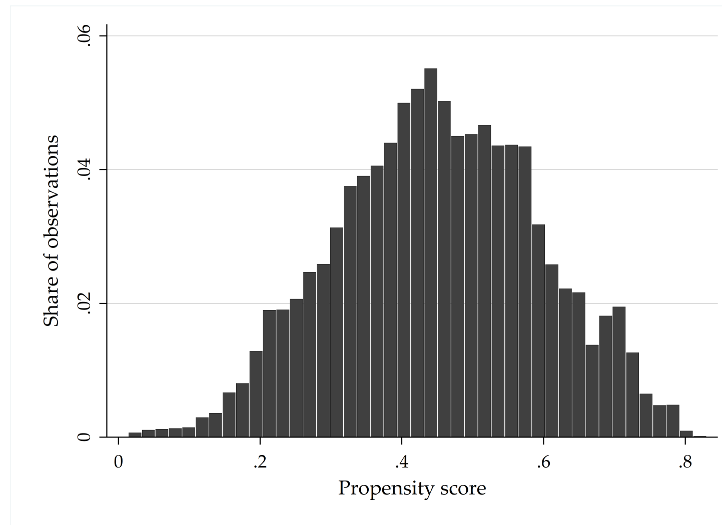


**Table 7:** *PSM Results*

| | Constrained vs Unconstrained Firms | | | | | |
|---|---|---|---|---|---|---|
| | Firm size | | Payouts | | Credit rating | |
| | Small | Large | Low | High | Low | High |
| | Small | Large | Payout low | Payout high | Low rating | High rating |
| Awarded Contract$_t$ | 0.128*** | -0.009 | 0.120*** | 0.069 | 0.109*** | -0.003 |
| | (0.040) | (0.035) | (0.031) | (0.047) | (0.026) | (0.016) |
| $\Delta$ Cash$_t$ | 0.090*** | 0.289*** | 0.090*** | 0.273*** | 0.141*** | 0.088** |
| | (0.024) | (0.069) | (0.021) | (0.041) | (0.024) | (0.036) |
| $\Delta$ Mkt to Book$_{t-1}$ | 0.097*** | 0.030*** | 0.094*** | 0.016** | 0.078*** | 0.024** |
| | (0.015) | (0.009) | (0.009) | (0.007) | (0.008) | (0.011) |
| $\Delta$ RoA$_{t-1}$ | -0.005 | -0.004 | -0.003 | -0.001 | -0.008** | -0.003 |
| | (0.005) | (0.004) | (0.003) | (0.003) | (0.003) | (0.004) |
| $\Delta$ Size$_{t-1}$ | 0.007 | 0.010 | -0.004 | -0.013 | -0.016 | 0.020 |
| | (0.034) | (0.012) | (0.015) | (0.014) | (0.017) | (0.023) |
| Constant | -0.033** | -0.004 | -0.016* | -0.001 | -0.005 | -0.003 |
| | (0.013) | (0.005) | (0.008) | (0.006) | (0.006) | (0.008) |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| R2 | 0.148 | 0.173 | 0.156 | 0.199 | 0.152 | 0.134 |
| N | 4542.000 | 8089.000 | 7631.000 | 7551.000 | 15658.000 | 2967.000 |

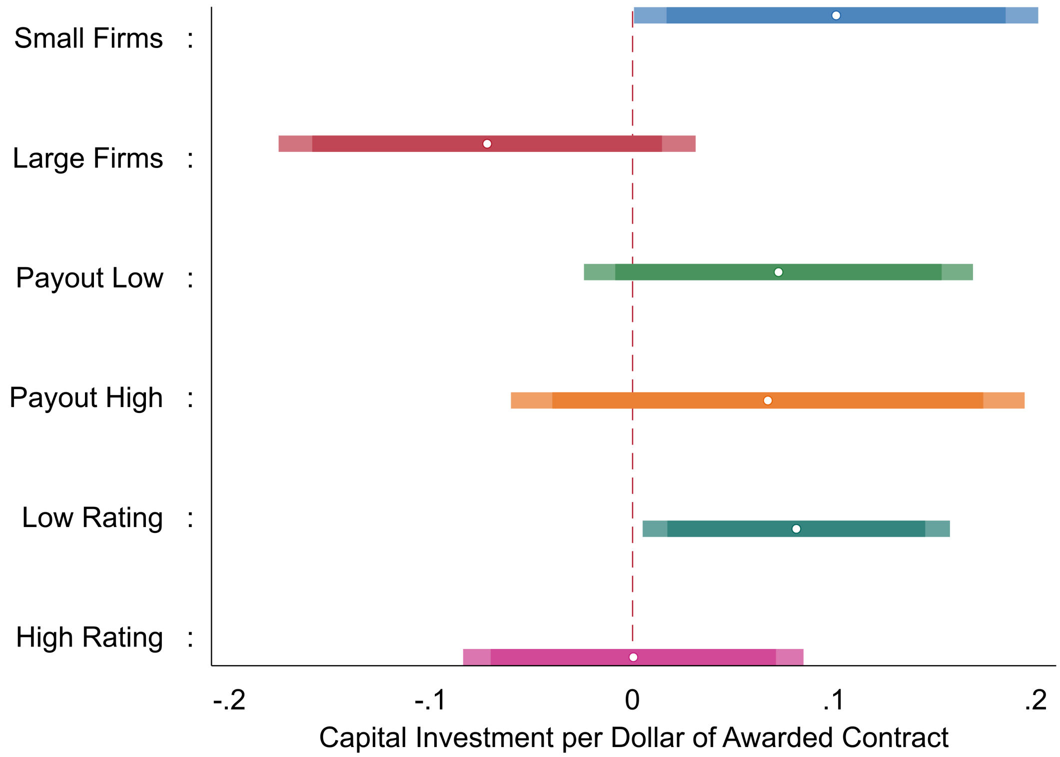
Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$. This table corresponds to Figure 5. It shows the estimated effect of federal contracts on firm investment using the propensity score matching method described in section 3.1. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Award is the obliged amount of a federal contract normalized by the lagged book value of PPE. Section provides the definitions of all variables. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Table 8:** *IPW Results*

| | Constrained vs Unconstrained Firms | | | | | |
|---|---|---|---|---|---|---|
| | Firm size | | Payouts | | Credit rating | |
| | Small | Large | Low | High | Low | High |
| Awarded Contract$_t$ | 0.129*** | -0.064* | 0.124*** | 0.070 | 0.129*** | 0.033 |
| | (0.042) | (0.037) | (0.045) | (0.051) | (0.039) | (0.036) |
| Cash$_t$ | 0.028* | 0.212*** | 0.022 | 0.148*** | 0.041*** | 0.066* |
| | (0.015) | (0.055) | (0.014) | (0.040) | (0.014) | (0.035) |
| Mkt to Book$_{t-1}$ | 0.081*** | 0.062*** | 0.091*** | 0.041*** | 0.084*** | 0.042*** |
| | (0.012) | (0.010) | (0.011) | (0.008) | (0.010) | (0.006) |
| RoA$_{t-1}$ | 0.012*** | 0.002 | 0.011*** | 0.002 | 0.008*** | 0.005** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Size$_{t-1}$ | 0.030 | 0.013 | 0.036** | -0.022* | 0.011 | 0.058*** |
| | (0.021) | (0.014) | (0.016) | (0.012) | (0.014) | (0.019) |
| Constant | 0.065 | -0.047 | -0.054 | 0.287*** | 0.055 | -0.467** |
| | (0.109) | (0.126) | (0.104) | (0.095) | (0.094) | (0.182) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry-Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| R2 | 0.389 | 0.520 | 0.416 | 0.555 | 0.414 | 0.729 |
| N | 19024 | 19065 | 26553 | 18965 | 48431 | 5916 |

Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$. This table corresponds to Figure 6. It shows the estimated effect of federal contracts on firm investment using the inverse probability weighting method described in section 3.1. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Award is the obliged amount of a federal contract normalized by the lagged book value of PPE. Section provides the definitions of all variables. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Figure 10:** *Restricted Sample Including only DoD Contracts*




Note: This figure displays the estimated "$\beta$" from equation "2", presented by the white dot in the center of the colored bars. The samples includes only contracts that are awarded by the DoD. The bars show the confidence bands. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Awarded contract is the obligated amount of a federal contract normalized by the lagged book value of PPE. Section 8 provides the definitions of all variables. The set of controls and the associated vector of estimated coefficients are shown in the Supplementary Appendix. All standard errors are clustered at the firm-level correcting for a correlation between error terms within a cell.

**Table 9:** *Dynamics Blundell-Bond Estimation*

| | Arellano and Bover/Blundell and Bond System Estimator | | | | | |
|---|---|---|---|---|---|---|
| | Firm size | | Payouts | | Credit rating | |
| | Small | Large | Low | High | Low | High |
| $\text{Investment}_{t-1}$ | 0.907*** | 0.773*** | 0.869*** | 0.841*** | 0.889*** | 0.891*** |
| | (0.011) | (0.029) | (0.015) | (0.019) | (0.009) | (0.027) |
| $\text{Awarded Contract}_t$ | 0.049*** | 0.011 | 0.028* | 0.010 | 0.036*** | -0.008 |
| | (0.016) | (0.012) | (0.016) | (0.012) | (0.014) | (0.010) |
| $\text{Cash}_t$ | 0.008** | 0.087*** | 0.013*** | 0.022** | 0.017*** | 0.009 |
| | (0.004) | (0.021) | (0.004) | (0.009) | (0.004) | (0.016) |
| $\text{Mkt to Book}_{t-1}$ | 0.012*** | 0.021*** | 0.014*** | -0.008 | 0.010*** | 0.006** |
| | (0.004) | (0.006) | (0.004) | (0.005) | (0.003) | (0.003) |
| $\text{RoA}_{t-1}$ | 0.007*** | 0.001 | 0.008*** | 0.001 | 0.007*** | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| $\text{Size}_{t-1}$ | -0.067*** | -0.027*** | -0.091*** | -0.022** | -0.066*** | -0.020** |
| | (0.011) | (0.007) | (0.011) | (0.008) | (0.009) | (0.008) |
| Constant | 0.375*** | 0.229*** | 0.559*** | 0.185*** | 0.470*** | 0.204** |
| | (0.078) | (0.065) | (0.086) | (0.068) | (0.071) | (0.080) |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| R2 | | | | | | |
| N | 18650 | 20331 | 27147 | 19834 | 49537 | 6198 |

Note: $*p \leq 0.1, **p \leq 0.05, ***p \leq 0.01$. The dependent variable is capital investment defined as capital expenditure normalized by the lagged book value of PPE. Award is the obliged amount of a federal contract normalized by the lagged book value of PPE. Section provides the definitions of all variables. Robust standard errors are between brackets.