Government Spending Shocks, Cost of Capital, and Corporate Investment*

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Abstract

This paper sheds novel light on how government spending shocks affect firm investment. Using the narrative military spending news shock to identify exogenous variation in government spending (Ramey, 2011b; Ramey and Zubairy, 2018), we find that increases in government spending cause the capital expenditures of publicly-listed firms to increase by up to one percentage point on average. The investment response of the average firm is not driven by the set of firms plausibly directly affected by the government spending news. Instead, we show empirically that government spending leads to a persistent decline in long-term real interest rates. Firms respond to falling costs of capital by issuing more debt and increasing corporate investment.

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1 Introduction

A longstanding question in macroeconomics is how government spending affects private investment. The conventional wisdom in theoretical and empirical macroeconomics asserts

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that government spending crowds out private investment in the business cycles unless there is a severe recession accompanied by monetary policy accommodation. Although the existing empirical literature at the aggregate level generally confirms these theoretical predictions, there is relatively scant firm-level empirical evidence on the causal effect of government spending on corporate investment and firms' corresponding cost of capital.

This paper fills the gap by documenting novel empirical facts that contradict the conventional wisdom concerning the effect of government spending on investment. Using the narrative military spending news shock introduced first by Ramey (2011b) and updated in Ramey and Zubairy (2018), we find that a one percentage point increase in unanticipated military spending over trend GDP causes corporate investment to increase by one percentage point on average five years after the shock within a quarterly panel of large, publicly-traded and non-financial firms from 1983 to 2019. Our regressions control for firm fixed effects to capture permanent differences across firms, sector-by-quarter fixed effects to capture variation in sectoral-specific responses to aggregate shocks, and other key firm-time and time-specific variables that plausibly influence firm investment opportunities.

The increase in corporate investment is mirrored by a decline in long-term Treasury yields, which pass through to the borrowing costs firms face. Indeed, we find that firms' cost of capital falls in response to the government spending shock. The decline in firms' cost of debt is particularly pronounced. Consistent with the interest rate and cost of capital dynamics we observe, we find that firms respond to the government spending shock by issuing more debt to finance their investment projects.

Although our empirical findings contradict workhorse general equilibrium macroeconomic models, our evidence is consistent with recent papers documenting puzzling stylized facts in the fiscal shocks literature. For example, some studies have found that the effect of positive fiscal shocks on interest rates—both nominal and real—and inflation tends to be weak or even negative (Mountford and Uhlig, 2009; Corsetti, Meier, and Müller, 2012; Ramey, 2016). Our evidence on interest rates corroborates and extends these insights.

While our baseline result confirms that firms increase their investment following the government spending shock on average, is there evidence that a particular set of firms drives this average effect? The first dimension of heterogeneity we explore is firms' degree of financial constraints. Here, we drew on the insights from Hebous and Zimmermann (2021a), who showed that financially constrained firms increase their investment by more after winning a government contract. We obtain weaker evidence that financially constrained firms increase their investment by more than financially unconstrained firms. In other words, the crowding-in effect we document appears to apply more broadly across firms, regardless of their degree of financial constraints.

Moreover, we also build on evidence that government spending is granular (Cox, Müller, Pasten, Schoenle, and Weber, 2020). To this end, we exploit the crucial fact that variation in military spending signaled in the news shock we use is ultimately dispensed into the real economy via federal procurement contracts with the Department of the Defense (DOD). Merging our panel dataset with contract-level data associated with the DOD, we can, therefore, identify the set of firms that *never* had a DOD contract over our sample period. If the crowding in effect we observe is driven entirely by firms who receive cash injections as a result of winning new contracts with the DOD, then the firms that never had a DOD contract should not increase their investment following the military spending news shock. Remarkably, we find that following the shock, the set of firms that never had a contract with the DOD increase their investment similarly to the firms that had a DOD contract at least once in the sample.

We also conducted several additional exercises that illuminate the nature of the crowding-in effect we documented. First, we investigate whether there is state-dependence on the effect of military spending news shocks on corporate investment. Building on the literature demonstrating that fiscal multipliers are larger in recessions, we find that the increase in capital investment is more than twice as large on average during recessions compared to the estimated response from the full sample. In a separate exercise, we rule out that the increase in corporate investment is driven entirely by investment opportunities afforded by unconventional monetary policy and the ZLB on interest rates during and following the 2008 Great Financial Crisis. Furthermore, finally, we add measures of economic policy uncertainty (Baker, Bloom, and Davis, 2016) and geopolitical risk (Caldara and Iacoviello, 2022) to our vector of time-varying controls, and rule out that the military spending news shock and the associated corporate investment response are endogenous to these potentially confounding factors.

The sum of our evidence points strongly toward an indirect effect of the military spending shock on firm investment. Indeed, the crowding-in effect we observe is consistent with some degree of monetary accommodation translating into a *fall* of real interest rates. To explore this potential channel, we ran time-series local projections to estimate the dynamic response of the nominal and *ex-ante* real rates to the government spending news shock in our sample. Empirically, we find that nominal and expected real yields on the three-month T-Bill and ten-year T-Note fall by 5-10 basis points on impact, even after controlling for information priced in the yield curve. In addition, we document that shocks to government spending produce an asymmetric long-run effect on short- and long-term yields. In particular, the drop in the ten-year Treasury yield following a shock to government spending persists up to five years after the shock. In contrast, the three-month real T-Bill yield increases by up to

20 basis points four years after the shock.

The Treasury yield dynamics are consistent qualitatively with the notion that government spending shocks actually *lower* the real cost of borrowing for firms. But to what extent do falling Treasury yields pass through to firms' cost of capital? We build on Frank and Shen (2016) to construct firm-specific weighted-average cost of capital (WACC) measures that comprise firms' equity and debt costs of capital. Projecting the WACC measures onto the military spending news shock and a rich set of controls, we find that firms' cost of capital falls in the years following the shock. The cost of debt exhibits a particularly pronounced decline that reaches a trough around two years after the shock before reverting to its pre-shock level in the long run.

Firm investment increases following an exogenous increase in military spending news, and we argue that the channel through which the crowding-in effect operates is declining real borrowing costs for firms. If firms use falling borrowing costs as an opportunity to finance their investment projects following the government spending shock, then an empirically testable corollary of this theory would be that firms respond by issuing more debt. We explore this proposition by projecting the firms' debt stock change onto the government spending shocks and controls. After the government spending shock, firms' debt stock increases by two percentage points on average in the long run. Moreover, consistent with the persistent decline in longer-term interest rates discussed above, the firms' long-term debt stock increases fivefold more than their short-term debt stock.

Related literature. This paper contributes to two strands of literature. First, it relates to a vast empirical literature on the macroeconomic effects of fiscal shocks. Although the literature on the identification of fiscal shocks and causal macroeconomic effects of government spending has grown enormously in the past twenty years, results across studies may considerably differ depending on the sample period, identification strategy, specification, and detrending approaches selected.

The three most prominent identification strategies used in the empirical macroeconomics literature have focused on military buildups as an instrument to government spending (Hall, 1980, 1986; Barro, 1981), narrative techniques based on U.S. involvement in wars (Ramey and Shapiro, 1998; Ramey, 2011b), and decision and implementation lags in fiscal policy (Blanchard and Perotti, 2002). Subsequent studies have either analyzed military spending within war periods (Ramey and Zubairy, 2018) or taken into account anticipation of government spending (Auerbach and Gorodnichenko, 2012, 2013). In turn, we connect our paper to this broad literature by using Ramey and Zubairy (2018) and Auerbach and Gorodnichenko (2012) measures of government spending shocks to study the effects on corporate investment, focusing on firm-level responses rather than on aggregate outcomes.

Using alternative identification strategies, Mountford and Uhlig (2009) and Corsetti, Meier, and Müller (2012) documented that a deficit-financed increase in fiscal spending is associated with a decline in the real interest rate. Similar empirical results have also been documented by Ramey (2016). More recently, Jørgensen and Ravn (2022) have found that prices' responses are flat or even negative in response to a positive government spending shock. While our results corroborate these previous studies, we further document that the *nominal* interest rate declines across different maturities regardless of the shock measure considered, while inflation expectations display muted responses. These puzzling results are consistent with the findings in Cox, Müller, Pasten, Schoenle, and Weber (2020). Building on the universe of federal procurement contracts, they provided evidence that government spending is granular and concentrated in sectors with relatively stickier prices.

Second, this paper connects to the corporate finance literature on the drivers of corporate investment. To this end, the paper is most closely related to Hebous and Zimmermann (2021b). Using federal procurement contracts, they found a positive fiscal multiplier on corporate investment over a horizon of one year among financially-constrained firms, but of zero in the unconstrained sample. Similarly, we document a crowd-in effect of government spending on corporate investment, yet among unconstrained and constrained firms alike with the impact loading more in the second group.

Our finding of a crowding-in effect of government spending on corporate investment among publicly-traded firms aligns with Hebous and Zimmermann (2021b), although we use a more standard identification strategy and connect this effect to changes in borrowing costs instead of the loosening of financial constraints as in their paper. Our study also differs from theirs along two dimensions. First, we identify fiscal shocks by following the aforementioned strategies, which are more standard and, in turn, facilitate comparison of results across studies. Second, while the mechanism posited by Hebous and Zimmermann (2021b) relies on the financial accelerator framework (Bernanke, Gertler, and Gilchrist, 1996), ours relies on the accommodative response of nominal and real interest rates to fiscal spending shocks.

Kim and Nguyen (2020); Cohen, Coval, and Malloy (2011) also examined the effects of government spending on firm-level investment using the universe of Compustat firms, and they found a crowding out effect. However, they identify fiscal shocks through variation in state-level federal government expenditures and the headquarter location of firms.

The remainder of this paper is structured as follows. Section 2 reviews the data that we utilize throughout this paper. Section 3 details our empirical strategy. Section 4 lays out our main results on the effect of government spending shocks on corporate investment. Section 5 investigates the mechanism driving our results. Finally, section 6 concludes.

2 Data

This section outlines the data we use to address our research questions. As noted above, our goal is to empirically estimate the impact of unanticipated government spending shocks on corporate investment. We gathered firm-level balance sheet and financial information from the CRSP-Compustat merged dataset, considering a post-Great Moderation sample period from 1983:4–2019:4. The sample period was chosen due to data availability, as data in Compustat are sparse before the 1980s. As our shock measure, we consider the discounted present value of military spending associated with major U.S. war events as in Ramey and Zubairy (2018). We also utilize aggregate data on macroeconomic quantities and prices, which we obtain from a variety of sources. Table A.1.1 gives more details on the variables utilized in the analysis.

2.1 Firm level data

We obtain firm-level accounting data at the quarterly frequency from the merged CRSP-Compustat (CCM) dataset starting in 1983:4 – 2019:4. We exclude financial firms (SIC codes 6000 - 6799) and utility firms (SIC codes 4900 - 4999). We require that all firm-years have non-negative data for book assets and capital stock. Given that our focus is on the dynamic response of investment to fiscal shocks, we require that firms have investment spells that are longer than 40 quarters. Additionally, we drop firms with acquisitions larger than 5 percent of assets to focus on the response of changes in the capital stock due to investment as opposed to acquisition. All other variables are winsorized at the 0.5 and 99.5 percentiles to mitigate the effect of outliers. At the end of this cleaning procedure, we are left with 360,736 unique firm-quarter observations.

Compustat has a few notable advantages. First, it provides a lengthy sample of data for firms at a high enough frequency to study within-firm responses to fiscal policy shocks. Second, Compustat provides rich accounting and cash-flow data, allowing us to construct our key variables of interest and control for confounding factors that may impact firms' investment decisions. Following Frank and Shen (2016), we used the CCM dataset to compute firm-level measures of the average cost of capital (WACC), which is a combination of equity and corporate debt costs weighted by market leverage. A detailed exposition of our approach to compute the WACC can be found in Section 5.2.

Summary statistics are noted in Panel A of Table 1 and detailed variable definitions are reported in Table A.1.1 in the appendix. Average investment done by firms just shy of one percent in annualized terms. The average firm holds a moderate amount of leverage (27%).

The investment and leverage distribution are both skewed rightward, given the presence of the mean exceeding the median. Tobin's Q—a proxy for firm investment opportunities—exceeds one, indicating there are profitable investment opportunities for the average firm.

2.2 Department of defense (DOD) procurement contracts

To investigate the impact of news about military spending on firm-level outcomes, we merged firm-level contracts from the Department of Defense (DOD) to Compustat data.[1] Since news about wars may arguably affect expected future contract awards in order to supply materials and war-related goods and services to the government, we compared outcomes in the group of treated firms that have had at least one contract with the DOD in the past with the control group consisting of firms that have never had any such contract. If firms' responses look similar across groups, this evidence suggests that government spending shocks have demand spillovers on the overall economy consistent with the Keynesian paradigm; alternatively, the average effects of government spending stem from firms benefiting from earning a contract with the government.

Due to the Federal Funding Accountability and Transparency Act, signed into law on September 26, 2006, federal procurement contracts, grants, loans, and other financial assistance awards over $25,000 must be publicly available on the USASpending.gov website, hosted by the Treasury Department.[2] Cox, Müller, Pasten, Schoenle, and Weber (2020) compiled subsets of the USASpending.gov data starting in 2000, which we used in our empirical analysis.

We successfully matched around 1,800 firms, which represents roughly 30% of the Compustat sample. Although DOD contracts comprise a subset of the universe of federal procurement contracts—which span a wide range of goods and services from labor-intensive to R&D-intensive industries—military-based contracts tend to be much higher in value than other more ordinary types of contracts. We found that the mean value of a contract is $53 million with a median of $300,000, suggesting a heavily right-skewed distribution. In contrast, Cox, Müller, Pasten, Schoenle, and Weber (2020) found for the universe of federal procurement contracts $206,023 and $3,640 for the mean and median contract values, respectively. These figures are consistent with the fact that firms involved in contracts with the DOD tend to display larger book values: $4.03 billion versus $1.64 billion, respectively.

[1]According to the Federal Acquisition Regulation, these "contract actions" denote "any oral or written action that results in the purchase, rent, or lease of supplies or equipment, services, or construction using appropriated dollars over the micro-purchase threshold, or modifications to these actions regardless of dollar value."

[2]See Cox, Müller, Pasten, Schoenle, and Weber (2020) for an in-depth discussion on the background, details, scope, and limitations of the federal procurement contracts in the USAspending.gov database.

Figures A.1.2, A.1.3, and A.1.4 present plots of summary statistics.

2.3 Time series data

Our primary measure of government spending shocks follows (Ramey and Zubairy, 2018). The time series identifies shocks using narrative methods and is an extension of the defense news series found in (Ramey, 2011b), focusing on major war events involving the U.S. and changes in the associated present discounted value of military spending. The identifying assumption is that wars and the corresponding variation in military spending are exogenous to the business cycles. Panel B of Table 1 presents summary statistics of Ramey's Military News Shock, and Figure 1 plots the time series of shocks. Conditional on a government spending shock, the average shock size is -0.4% of GDP, meaning that the government plans to cut military spending. As seen from Figure 1, much of the variation in the shock series comes in the 2000s. There is a significant spread in the shock, ranging as low as 10% of GDP to as high as 5% of GDP.

Concerning other macroeconomic variables used in our empirical work, we collect quarterly time series data on government consumption expenditures and gross investment, GDP, taxes, and the government debt-to-GDP ratio from FRED. All variables with the exception of the government debt-to-GDP ratio are deflated using an implicit price deflator and detrended by taking the logarithm and applying the Hamilton (2018) filter. Because the debt-to-GDP ratio is not stationary in our sample, we also detrend this variable by directly applying the Hamilton filter.

Finally, we utilize data on Treasury yields and inflation expectations. We build zero-coupon spot curves for U.S. Treasuries from 1983:4 to 2019:4 (148 quarters) using a few sources. First, we obtain data on the 3-month T-Bill yield from the H.15 release published by the Federal Reserve Board. We supplement this data with the zero coupon yield data constructed by Gürkaynak, Sack, and Wright (2007), which include yield estimates based on fitted Nelson-Siegel-Svensson curves for bonds with maturities between one and 30 years. We follow Adrian, Crump, and Moench (2013) to extract the principal components from the Treasury yields with maturities of three months, one to five years, and ten years.

In addition to the yield curve data, we obtain data on the term structure of inflation expectations estimated by the Cleveland Fed. The Cleveland Fed produces yearly inflation expectations estimates from one to 30 years.

3 Empirical strategy

We gather firm-level balance sheet information from Compustat and consider a sample period from 1983–2019. To shed light on the effect of fiscal shocks on corporate investment, we begin by investigating the average firm investment response to a fiscal shock. We estimate the following panel cumulative local projections (Jordà, 2005), for $h = 0, 1, 2, \ldots 20$ quarters:

$$\Delta \log(k_{i,t+h}) = \boldsymbol{\alpha}_{i,h} + \boldsymbol{\alpha}_{s,q,h} + \gamma_h \varepsilon_t^g + \boldsymbol{\Gamma}'_{1,h}\mathbf{Z}_{i,t-1} + \boldsymbol{\Gamma}'_{2,h}\mathbf{Y}_{t-1} + e_{i,t+h} \tag{1}$$

where $\Delta \log(k_{i,t+h})$ is corporate investment, $\boldsymbol{\alpha}_{i,h}$ is firm fixed effects, $\boldsymbol{\alpha}_{s,q,h}$ is a sector-quarter fixed effect, and ε_t^g is the government spending shock using military spending news announcements (Ramey and Zubairy, 2018). $\mathbf{Y}_{t-1}$ and $\mathbf{Z}_{i,t-1}$ are vectors of aggregate and firm-level controls, respectively. $\mathbf{Y}_{t-1}$ includes 4 quarter lags of the cyclical component of real GDP, the cyclical component of real government consumption expenditures and gross investment, the cyclical component in the government debt-to-GDP ratio, the cyclical component of real taxes, and the government spending shock. $\mathbf{Z}_{i,t-1}$ includes a set of lagged firm-level variables commonly used in the literature, such as size, leverage, Tobin's Q, cash-flow and profitability. Standard errors are clustered at the firm and time level.

It is important to note that the validity of our results rests on the following identifying assumption: Military news shocks are macroeconomic-level variables that are not influenced by individual firm-level investment decisions. Thus, our measure of fiscal shocks is exogenous to an individual firm's investment decision.

Our preferred method to estimate the dynamic response of corporate investment to government spending shocks is the Local Projection method for a few reasons. First, Local Projections allow us to handle issues of endogeneity at the firm level, by controlling for firm characteristics that are important for their investment decision, as well as unobserved heterogeneity with firm fixed effects. In addition, the flexibility of Local Projections allows us to study the heterogeneous responsiveness of corporate investment to government spending shocks.

When exploring the heterogeneous response of firms, we estimate the following specification:

$$\Delta \log(k_{i,t+h}) = \boldsymbol{\alpha}_{i,h} + \boldsymbol{\alpha}_{s,q,h} + \gamma_h \varepsilon_t^g S_{i,t} + \beta_h \varepsilon_t^g (1 - S_{i,t}) + \boldsymbol{\Gamma}'_{1,h}\mathbf{Z}_{i,t-1} + \boldsymbol{\Gamma}'_{2,h}\mathbf{Y}_{t-1} + e_{i,t+h}, \tag{2}$$

where $S_{i,t}$ is a dummy that takes a value of 1 if a specific firm characteristic is satisfied—for example, if a firm has a high leverage ratio or not.

4 Corporate Investment Response to Government Spending Shocks

This section presents the results of the estimated impacts of fiscal shocks on corporate investment. As discussed earlier, we will present the average dynamic response of corporate investment to government spending shocks and investigate which firms appear to be driving the result. Figure 2 plots the average investment response to fiscal shocks and highlights a striking result: Contrary to the prediction of conventional macroeconomic models, corporate investment *increases* on average in the long run in response to an unanticipated fiscal spending shock. The results suggest an unexpected increase in military spending as a fraction of GDP by one percent leads to a one percentage point increase in firm investment four years after the shock. This result is economically and statistically significant. Our sample's average (annualized) investment rate is around 1 percent. Thus, the average Compustat firm increases its investment significantly in response to the government spending shock.

The crowding-in result is robust to various alternative model specifications and variable definitions. First, we studied whether the impact of fiscal shocks on firm-level investment is affected by how one defines investment in the data. In our baseline specification, investment was calculated using the perpetual inventory method. Another commonly used definition for investment in the literature uses the ratio of capital expenditures to the capital stock. We redefine investment using this method, and the result is in Figure A.1.1a. Investment dynamics are qualitatively similar, with average firm-level investment exhibiting a long-run crowding-in of around 1.75 percentage points.

Second, we analysed whether the impact of fiscal shocks on firm-level investment is affected by unconventional monetary policy seen during the period surrounding the Global Financial Crisis (GFC). Investment may qualitatively respond differently in these periods because interest rates (the cost of capital) are low, implying firms may take advantage of cheap investment financing. We analyze this hypothesis in Figure A.1.1b by excluding observations after the Great Financial Crisis (GFC) period from our sample. Indeed, we find that unconventional monetary policy undertaken after the GFC does not drive results, as corporate investment still exhibits a long-run crowding-in.

Third, we studied whether the state of the business cycle affects the impact of fiscal shocks on firm-level investment. There is evidence that fiscal spending shocks have more significant impacts on economic activity in recessions (see, among others, Auerbach and Gorodnichenko, 2012; Ramey and Zubairy, 2018; Ramey, 2016). In Figure A.1.1c, we add to the findings from this existing literature by documenting that the state of the economy affects the corporate investment response to government spending. Investment is over twice as responsive to fiscal shocks in recessions than expansions.

Fourth, we studied whether the impact of fiscal shocks on firm-level investment is explained by controlling for geopolitical and economic policy risk. Unanticipated military spending may be associated with economic or political risks currently faced in the United States. To assess whether our results are explained by contemporaneous variation in geopolitical and economic risk, we include controls for geopolitical risk and economic policy uncertainty. Geopolitical risk is proxied by the Geopolitical Risk Index of Caldara and Iacoviello (2022), and economic policy uncertainty is proxied by the Economic Policy Uncertainty index of Baker, Bloom, and Davis (2016). Figure A.1.1d plots the responsiveness of corporate investment after controlling for economic and geopolitical risk. Indeed, investment still exhibits a prominent crowding-in response in the long run.

Fifth, we investigated if financially-constrained firms are more responsive to the shock relative to less constrained firms in Figure A.1.5, as argued first by Hebous and Zimmermann (2021b). We considered three standard measures of financial constraints in the empirical analysis: small versus big firms, high-leveraged versus low-averaged firms, and sorted according to the Whited-Wu index. Similar to Hebous and Zimmermann (2021b), the crowding-in effect of government spending on corporate investment is more prominent, with the peak ranging between 0.3-0.4 percentage points after seven to eleven quarters. In contrast to their paper, however, lesser constrained firms also increase investment in response to news to government spending. As we argue later, we connect the widespread crowding-in effect to the accommodative response of nominal and real interest rates to fiscal spending shocks.

Sixth, we consider an alternative approach for identifying exogenous variation in government spending introduced in Blanchard and Perotti (2002); Auerbach and Gorodnichenko (2012). Details on this approach are in the Appendix A.2. Depicted in Figure A.2.2, we cannot reject the null hypothesis that this alternative government spending shock measure does not effect corporate investment. Hence, the military spending news shock appears to capture economic variation that is unique from that induced by this alternative shock measure.

Finally, in Appendix A.3, we step into a time series setting to explore the effect of government spending shocks on aggregate macroeconomic variables. After all, our main result that military spending news shocks cause the capital investment of Compustat firms to *increase* on average might appear to contradict existing empirical evidence in the fiscal multipliers literature. Our time series analyses corroborate the main results we obtain in the panel setting and provide a set of results for comparison with those from the existing literature in macroeconomics.

4.1 Direct vs Indirect Effects of Military News Shocks

Conceptually, it is possible to decompose the total effect of a military news shock into a direct and indirect effect, where the direct effect is the military spending shock impacting firm investment through new government contracts awarded to the firm. The indirect effect is the effect of government spending on firm investment through other channels, e.g., through the effect on prices.

Given the nature of the shock we use (i.e., news about military spending), a plausible explanation is that the direct effect dominates, and firms more associated with military spending—e.g., Boeing, Raytheon, or Northrop Grumman—are the primary drivers of corporate investment in response to the shock. The mechanism for these firms being responsible for the average investment response is straightforward: When the government announces new spending for military goods, a substantial amount will translate into future government contract awards. Having previously won contracts, these firms are well-suited to benefit from future fiscal spending. To investigate whether this is the case, we analyzed all DOD procurement contracts awarded from 2000:3–2018:4 and merged them with our sample of Compustat firms. Data on procurement contracts includes the date when the contract was released, the awarded firm, the duration of the contract, and its dollar amount.

While decomposing a military news shock into a direct and indirect effect is conceptually feasible, this task is more challenging in practice. News of government spending increases often do not translate into immediate government spending due to implementation delays. In summary, tracking how much government spending will be allocated toward procurement contracts and, most importantly, the delay in which that new spending translates into increased demand for firms' goods and services is difficult to gauge.

In response to this, we proxy the direct versus indirect effect of government spending shocks by investigating the investment responsiveness of firms that are DOD contract winners at least once over the time of our sample with those that were never DOD contract winners. The investment responsiveness of firms that were *never* DOD contract winners will give a reliable estimate of the lower bound of the indirect effect associated with government spending because one can ensure that these firms were *never* affected by a DOD contract. Any investment response by these firms to a government spending shock should come from spillovers and indirect channels.

Figure 3 plots the results. We find that firms that never held a DOD contract over our sample were equally responsive to the shock as firms that held a DOD contract at least once. This result suggests a vital role for indirect effects associated with the shocks and a less critical role for direct effects associated with the shocks.

The results thus far suggest the prevalence of indirect Keynesian (demand spillovers) effects in driving the corporate investment response. We documented that firms that have won at least one government contract over our sample are no more responsive to the government spending shock than those that have never had one. In addition, we documented that financially constrained firms – those that are very sensitive to changes in interest rates – appear to be critical drivers in the average investment response we observe. To explore the validity of this channel, we will investigate interest rate dynamics in response to government spending shocks in Section 5.1.

5 Mechanism: Firm cost of capital

To account for the crowding-in effect of government spending news, we studied the effects of these shocks on yields across different maturities as well as the firm-level average cost of capital in Compustat by following the methodology laid out in Frank and Shen (2016), which accounts for both the cost of equity and debt. Previous to our work, a few studies have documented muted, or even negative, interest rate responses to aggregate government spending shocks (Mountford and Uhlig, 2009; Corsetti, Meier, and Müller, 2012; Ramey, 2016), which stand in contrast to theoretical predictions of workhorse neoclassical and new Keynesian general equilibrium models. Other studies have focused on the impacts of government spending on the yield curve, finding mixed results that depend on anticipation effects, if the government spending deficit-financed, and the type of fiscal spending (Plosser, 1987; Dai and Philippon, 2005; Bretscher, Hsu, and Tamoni, 2020).

5.1 The effect of government spending on interest rates

Our econometric approach for computing the dynamic responses of nominal and *ex-ante* real interest rates is motivated by the literature in financial economics adopting an affine model of the term structure (see, e.g., Litterman and Scheinkman, 1991; Dai and Singleton, 2000; Duffee, 2002). Denote by y_t^m ($\tilde{y}_t^m = y_t^m - \tilde{\pi}_t^m$, $\tilde{\pi}_t^m \equiv \mathbb{E}_t[\pi_{t,t+m}]$) the (*ex-ante* real) zero coupon spot rate on a Treasury bill or note with m quarters to maturity.[3] Then for $m = 1$ and 40 and $h = 1, 2, \ldots, 20$ quarters, we estimate the following linear regressions projecting, respectively, nominal and *ex-ante* real interest rate changes onto the government spending shock and several controls:

$$y_{t+h}^m - y_t^m = \alpha_{m,h} + \beta_{m,h}\varepsilon_t^g + \mathbf{\Phi}_{m,h}(4)\mathbf{X}_{t-1} + \epsilon_{t+h}^m \tag{3}$$

[3] Because we do not observe one-quarter ahead inflation expectations, we use the one-year inflation expectation when constructing the *ex-ante* real yield for the three-month T-Bill.

and

$$\tilde{y}^m_{t+h} - \tilde{y}^m_t = \alpha_{m,h} + \beta_{m,h}\varepsilon^g_t + \mathbf{\Phi}_{m,h}(4)\mathbf{X}_{t-1} + \epsilon^m_{t+h}. \tag{4}$$

The main coefficients of interest in equations (3) and (4) are the $\{\{\beta_{m,h}\}_{h=1,\ldots,20}\}_{m=4,40}$, which capture the effect of the government spending shock on the change over an h-quarter horizon in the spot rate on a Treasury with a duration of m quarters. We also control for four lags of a vector of macro-financial variables in $\mathbf{X}_{t-1}$ that includes the first three principal components from the nominal or *ex-ante* real term structure, the cyclical components of real GDP, government consumption expenditures and gross investment, government debt, and taxes, as well as the government spending shock ε^g and the one-period *change* in the (*ex-ante* real) yield $y^m_t - y^m_{t-1}$ ($\tilde{y}^m_t - \tilde{y}^m_{t-1}$).

The OLS estimates $\{\{\beta_{m,h}\}_{h=1,\ldots,20}\}_{m=1,40}$ capturing the dynamic responses of interest rates to government spending shocks are portrayed in Figure 4. Panels (a) and (b) report the effects of the government spending shock on the change in the nominal and *ex-ante* real three-month and 10-year Treasury yields, respectively. According to panel (a), an increase in military spending news causes both the nominal and *ex-ante* real T-Bill yields to *fall* on impact. The effect is somewhat larger for the nominal rate, suggesting a small negative effect of the shock on inflation expectations. The negative effect is short-lived, however, as the response in the nominal rate is not statistically significantly different from zero for each $h \geq 4$ quarters after the shock. In contrast, the *ex-ante* real rate increases in the long-run due to a marked fall in short-term inflation expectations. Four years after an increase in military spending news, *ex-ante* real yields on the three-month T-Bill increase by over 20 basis points on average.

Turning to panel (b), we find similar short-run dynamics in the nominal and expected real yields on the ten-year T-Note following the government spending news shock. On impact, the nominal yield on the 10-year Treasury falls by over ten basis points. Moderate declines in expected inflation ten-years ahead lead to around a 5 basis point decline in the expected real rate. Impressively, this effect appears to be somewhat permanent over the five-year horizon following the increase in military spending news. The point estimates are almost always negative and often statistically significant. 4.5 years after the shock, the nominal (*ex-ante* real) 10-year Treasury yield remains almost 20 (10) basis points below its level prior to the government spending news shock.

These results provide strong evidence that shocks to government spending induce meaningful variation in the term structure of interest rates. Contrary to the conventional wisdom concerning the effect of government spending shocks on interest rates, we find that nominal and expected real yields—both on short- and long-dated Treasuries—immediately fall in response to military spending news. Furthermore, the government spending news shock leads to asymmetric long-run dynamics along the term structure, with short-dated yields tending to increase and long-dated yields tending to decrease. Stated differently, the term structure slope appears to *flatten* in the long-run following the shock.

Given the surprising nature of the results we find, we conduct several robustness checks to ensure their veracity. First, to rule out that the results we find above are driven by the zero lower bound on the policy rate and the Federal Reserve's use of unconventional monetary policy to stimulate the economy, we estimated 3 and 4 on a restricted sample that drops observations after the Great Recession in 2008. As Figures A.1.6a and A.1.6b indicate, the dynamic responses of nominal and real interest rates are not driven by observations from the period of unconventional monetary policy and the ZLB.

We also explore the dynamics of the policy rate, term and credit spreads, and other measures of economic and political risk in Appendix A.4. As expected, the dynamics of the Federal Funds rate are similar to those of the three-month T-Bill discussed above. Moreover, we confirm the term spread, or the difference between the 10-year and three-month yields, significantly falls by up to 30 basis points in the long run following the shock. Interestingly, we find that credit spreads tend to significantly *increase*, a result which suggests an incomplete pass-through of the drop in yields to the drop in interest rates faced by large, publicly-traded firms. Finally, we do not find that the military spending news shock induces significant variation in measures of economic and political risk.

As a whole, we regard our main results as being broadly consistent with a Keynesian mechanism in which the fiscal news shock induces a fall in long-term expected real interest rates, which plausibly affects firm investment decisions.[4] Indeed, how do the dynamics of Treasury yields discussed in this section pass through to the borrowing cost of the firm? To shed light on this question, we, next, turn our attention back to the firm to investigate the effect of government spending news shocks on of firms' cost of capital.

5.2 Cost of Capital

Turning to the firm-level evidence, we followed Frank and Shen (2016) to compute firm-level measures of the weighted average cost of capital (WACC) in Compustat by combination equity and corporate debt costs, weighted by market leverage (mkt_lvg_{it}) according to the

[4] Attempting to rationalize the effects of government spending on the real exchange rate and consumption, Corsetti, Meier, and Müller (2012) argued that spending reversals induced by fiscal rules may decrease the long-term real interest rate despite the short-term rate increase. However, we do not observe long-run spending reversals in government spending in response to military spending news shocks in our sample.

equation:

$$wacc_{it}^{j} = r_{it}^{\mathrm{E}_j} \times (1 - mkt\_lvg_{it}) + r_{it}^{D} \times mkt\_lvg_{it} \times (1 - tax\_rate_{it}), \tag{5}$$

for firm i in the year-quarter t, where $j \in \{\mathrm{CAPM}, \mathrm{FF3}, \mathrm{FF5}, \mathrm{Car4}\}$ denotes alternative measures for the cost of equity in the CAPM, three-factor Fama-French, five-factor Fama-French, and four-factor Carhart models, respectively; tax_rate_{it} denotes the corporate tax rate faced by firm i.

Our goal is to assess whether the decline in Treasury yields also translates into a decline in the cost of borrowing faced by a publicly traded firm, which is crucial to generating expansionary effects on investment following a news shock on government spending.

Our preferred measure considers $j = \mathrm{FF3}$, which is shown in the first panel of Figure 5 along with the equity and debt costs and Tobin's Q. As observed, the WACC dynamics mimic the equity cost in panel 5b, displaying a cumulative decline for seven quarters up to four percentage points, and drop again towards the end of the horizon period of 20 quarters after rising for roughly a year. The debt cost in panel 5c follows similar dynamics, decreasing up to -0.6 percentage points, after which it increases to a non-significant estimate of 0.3 percentage points at the end of the horizon period. Consistent with the increase in corporate investment and the decline in equity costs, the spending news shock also induces an increase in Tobin's Q of around one percentage point between two and three years after the shock, as seen in panel 5d.

The alternative WACC measures are portrayed in Figure A.1.8, and display similar dynamics except for the CAPM. As observed, the responses of the WACC are either negative or hover around zero across measures, with the trough occurring around the seventh quarter after the shock. The magnitudes vary, ranging from -0.5 to -4 percentage points in response to the spending news shock, and drop again after rising for roughly a year towards the end of the horizon period, as it happens to the Fama-French three-factor model. In contrast, the CAPM equity cost measure in Figure A.1.7a exhibits a steady increase of up to 0.75 percentage points after 20 quarters.

In Figure A.1.8, we portray the equity and debt cost components used to compute the WACC across alternative definitions in equation (5). As noted, the cost of equity is the primary driver of the decrease in the WACC since it determines the shape and the magnitude of the decrease in the latter variable.

Finally, to conduct robustness checks, we estimate the responses of WACC measures and their components to the government spending shock under the approach of Auerbach and Gorodnichenko (2012) in Figures A.2.3 and A.2.4. Similar to previous results and again except for the measure under CAPM, the shock induces a decline in the cost of capital in the first five quarters with a trough of -5 percentage points, followed by a steady increase up to 5 percentage points three years after the shock. For the measure under CAPM, we find a quantitatively negligible and non-significant response.

5.3 Validation: Firm-Level Debt Dynamics

Declining nominal and real yields are consistent with firms' decisions to increase their investment in response to government spending shocks due to the falling cost of new capital, as evidenced by the decline in the average cost of capital discussed in section 5.2. In this section, we study the debt dynamics of firms in response to government spending shocks. In response to falling costs of capital, one should expect that firms not only increase investment but also increase their level of debt to finance that investment.

To investigate debt dynamics at the firm level, we compute empirical impulse response functions by running the following panel local projection to estimate the responsiveness of debt to a government spending shock:

$$\%\Delta b_{i,t+h} = \boldsymbol{\alpha}_{i,h} + \boldsymbol{\alpha}_{s,q,h} + \gamma_h \varepsilon_t^g + \boldsymbol{\Gamma}'_{1,h}\mathbf{Z}_{i,t-1} + \boldsymbol{\Gamma}'_{2,h}\mathbf{Y}_{t-1} + e_{i,t+h} \tag{6}$$

where $\%\Delta b_{i,t+h}$ is the cumulative percent change in the firm's debt stock from quarter t to $t+h$. All other variables are the same as the ones defined in equation (1).

The results for the average Compustat firm's debt dynamics are presented in Figure 6. In response to the shock, firms steadily increase their total debt, with a more prominent increase in long-term debt of around one percentage point five years after the shock, whereas short-term debt levels increase by 0.2 percentage points in the same horizon. The results suggest that firms use lower interest rates on debt to increase short and long-term debt holdings in service of financing new investment projects.

6 Conclusion

This paper provides novel evidence on the effects of government spending shocks on corporate investment. We document that corporate investment increases in response to government spending shocks. The effect persists for up to five years following the shock. This result stands in stark contrast to much of the current literature on government spending shocks and private investment. We demonstrate that the shock does not operate exclusively through direct (contract awards) channels but through indirect (price) channels. In particular, long-term *ex-ante* real interest rates fall on average in response to the government spending shock, an effect which transmits to the real borrowing costs faced by firms. Indeed, firms significantly increase their debt holdings and corporate investment.

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Tables

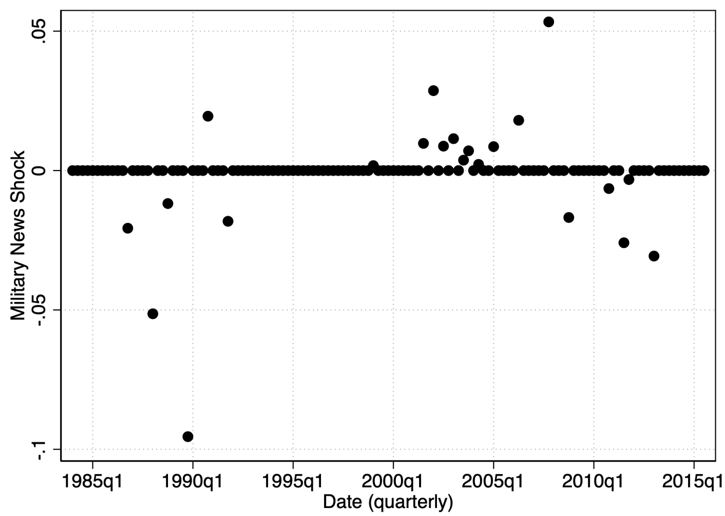
Table 1
Summary Statistics

Variable	Mean	Median	St. Dev.	95th Percentile
		Panel A: Panel Data		
Capital Investment	0.00286	-0.00449	0.09498	0.12009
%Δ Debt Stock	0.06048	-0.01183	0.74503	0.50813
Leverage	0.27331	0.23420	0.23250	0.67825
Tobin's Q	1.91226	1.40310	1.71576	4.67807
Market leverage	0.1874867	0.1471436	0.1742802	0.5393966
Corporate tax rate	0.301568	0.3499899	0.1580175	0.5
Debt cost	0.0889602	0.0779737	0.0648927	0.1773507
$\text{WACC}_{\text{CAPM}}$	0.0890243	0.0873135	0.0369198	0.1538499
WACC_{FF3}	0.1093625	0.0956037	0.3637045	0.7379617
WACC_{FF5}	0.1045011	0.0982473	0.4912701	0.9304146
WACC_{Car}	0.0914304	0.087143	0.4347223	0.8166987
		Panel B: Time Series Data		
Military spending news (full)	-0.00088	0.00000	0.01235	0.00929
Military spending news (non-zero)	-0.00466	0.00190	0.02859	0.02736
$cycl(\log(G))$	0.00126	0.00342	0.03081	0.04551
$cycl(\log(GDP))$	0.00284	0.00688	0.02390	0.03727
$cycl(\log(Taxes))$	0.03182	0.06954	0.14552	0.18220
$cycl\,(Gov.\ Debt/GDP)$	0.01008	-0.00411	0.08983	0.16290
$y_t^1 - y_{t-1}^1$	-0.0004658	0.00005	0.0050287	0.0067
$y_t^{40} - y_{t-1}^{40}$	-0.000611	-0.0001756	0.0052903	0.0080493
$\tilde{y}_t^1 - \tilde{y}_{t-1}^1$	-0.0003001	-0.0003541	0.0069039	0.0109883
$\tilde{y}_t^{40} - \tilde{y}_{t-1}^{40}$	-0.0003795	-0.0000535	0.0042426	0.0061575
Level	-0.0055344	-0.0054949	0.0226847	0.0379505
Slope	0.0007756	0.0008412	0.0031362	0.0061744
Curvature	-0.000091	-0.00005024	0.000911	0.0012788
$\widetilde{\text{Level}}$	-0.0006148	-0.0006696	0.0242924	0.0325608
$\widetilde{\text{Slope}}$	0.000316	-0.000103	0.0051425	0.0089403
$\widetilde{\text{Curvature}}$	0.0001685	0.000091	0.0015018	0.0025845
EPU Index	142.9453	134.3147	40.43167	223.213
GPR Index	83.48538	78.35478	31.71938	128.0811

Figures

Figure 1
Narrative-Based Military Spending News Shock

(a) Full Shock Series



(b) Non-zero Shock Series

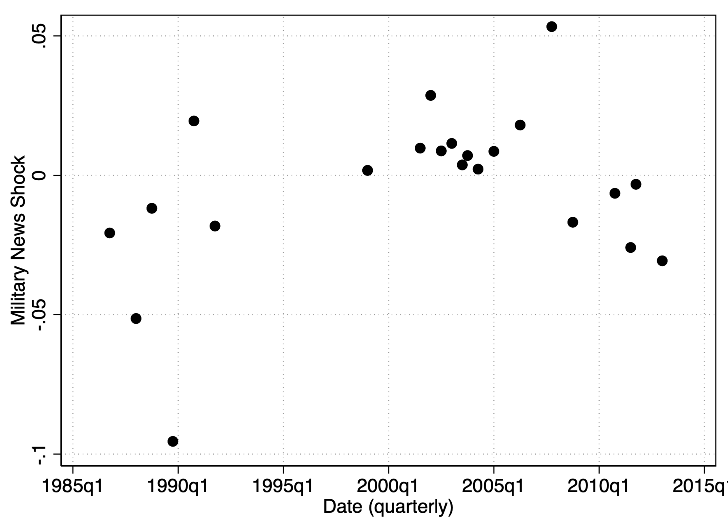


Figure 2
The Average Response of Corporate Investment to Fiscal Shocks

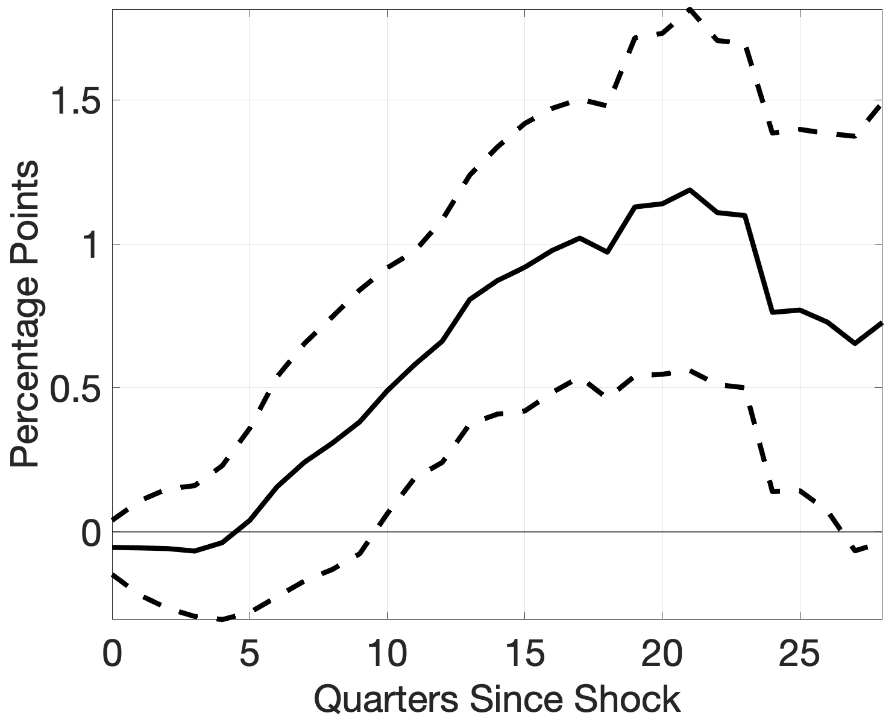


Figure 3
The Average Response of Corporate Investment to Fiscal Shocks
— DOD Contractors vs. Never DOD Contractors —

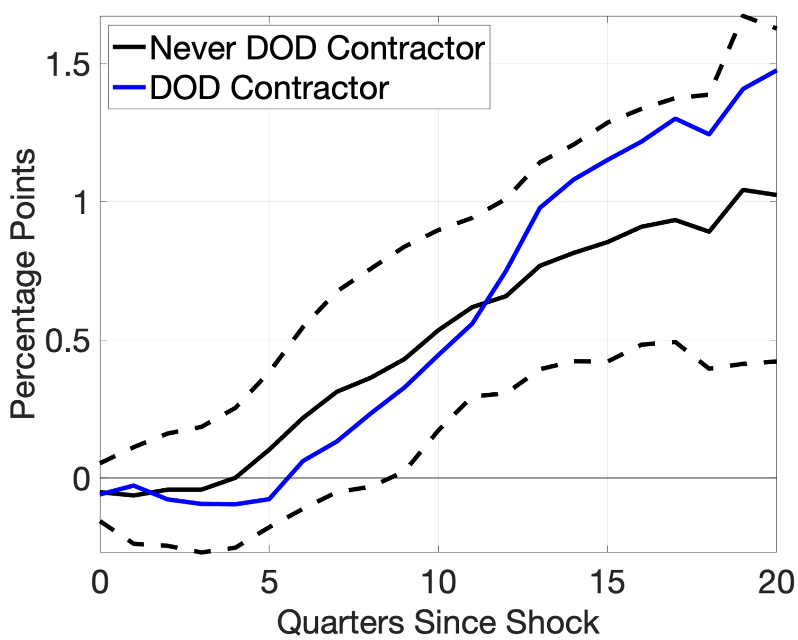
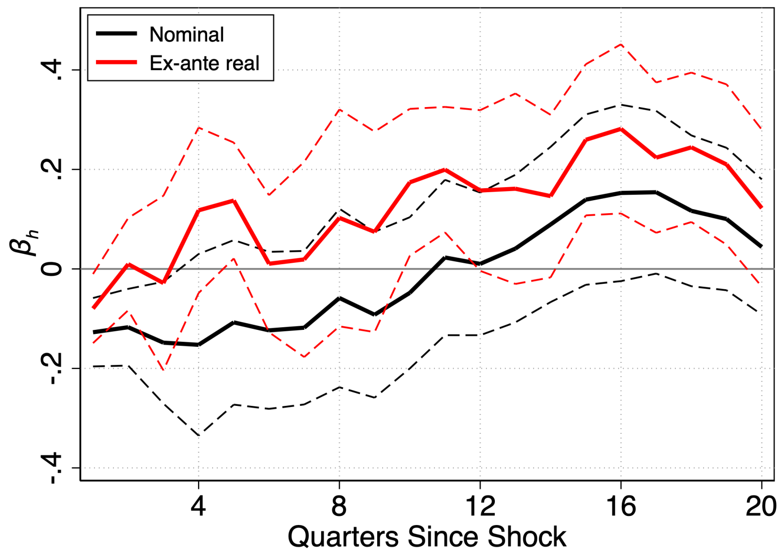


Figure 4
The Response of Interest Rates to Fiscal Shocks

(a) 3-month Treasury Bill Yield



(b) 10-year Treasury Note Yield

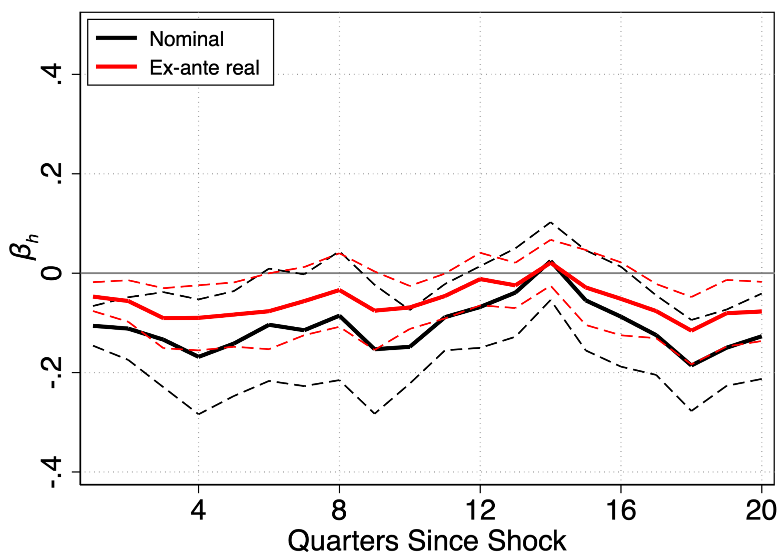
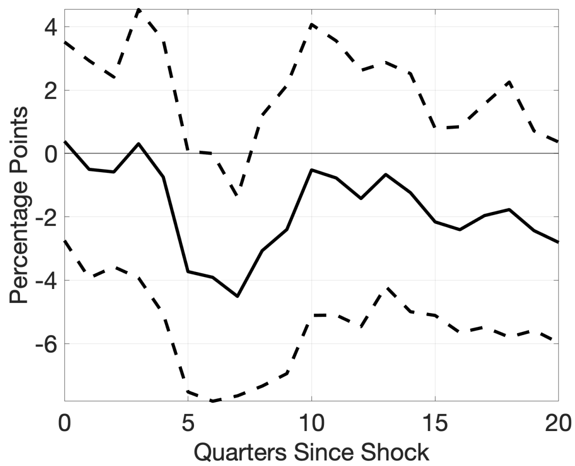
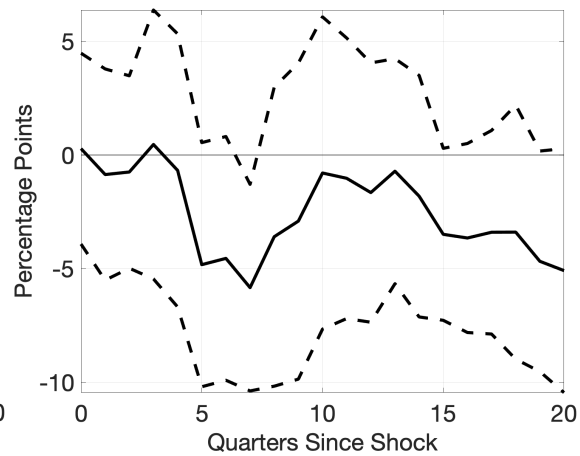


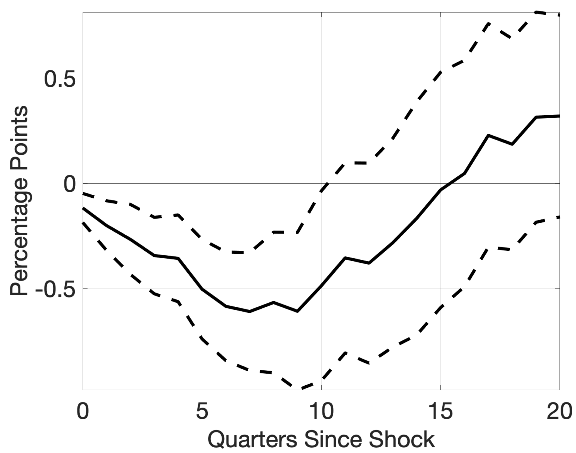
Figure 5
The Response of WACC and Tobin's Q to Fiscal Shocks



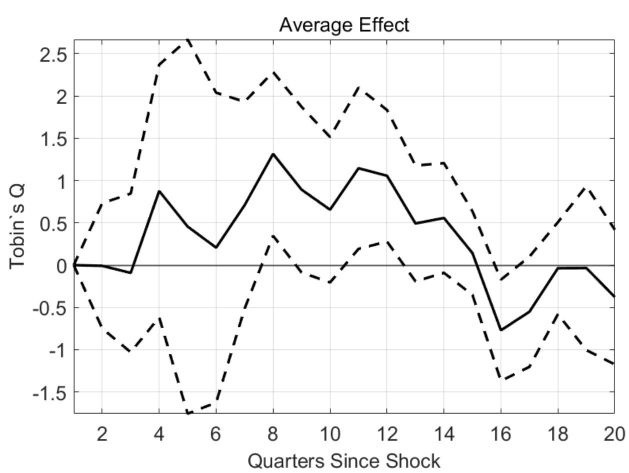
(a) WACC using Fama-French 3-factor model



(b) Equity cost: Fama-French 3-factor model



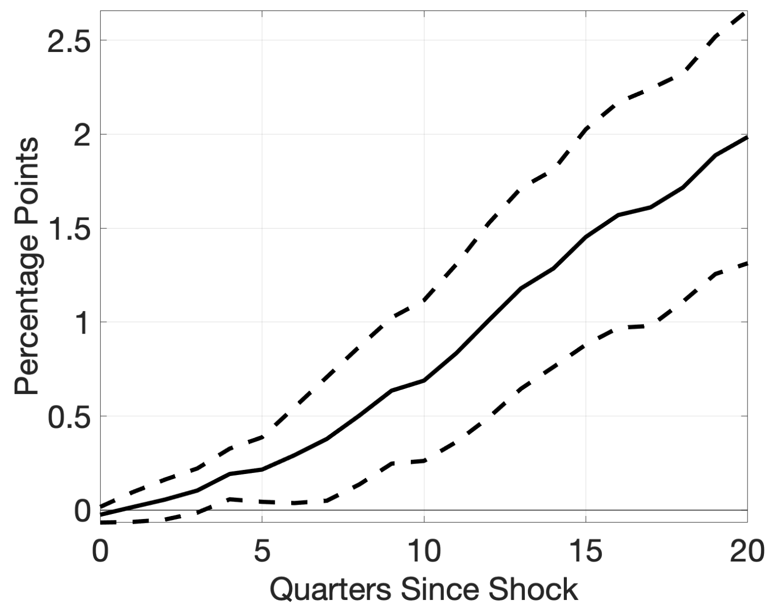
(c) Debt cost



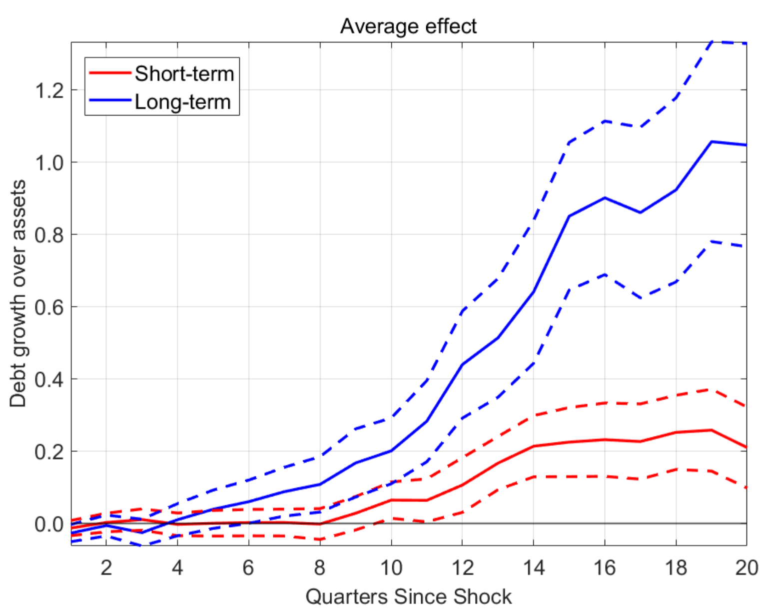
(d) The Response of Tobin's Q to Fiscal Shocks

Figure 6
The Average Response of Corporate Debt to Fiscal Shocks

(a) All Corporate Debt



(b) Short- vs. Long-term Corporate Debt



Appendix A

A.1 Additional Tables and Figures

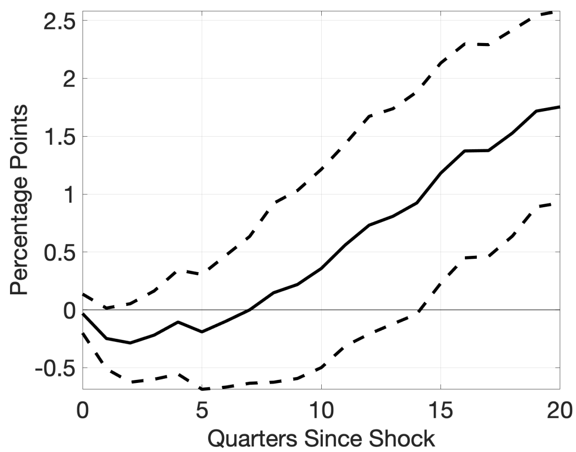
Table A.1.1
Variable Definitions

Variable	Source/Definition	Dates
	Compustat Variables	
Corporate Investment	$\Delta log(k_{j,t+1})$ See Ottonello and Winberry (2020) Appendix for details.	1983:1–2019:4
Size	$log($atq$)$ Log of total assets.	1983:1–2019:4
Leverage	(dlcq + dlttq)/atq Short-term + long-term debt to total assets.	1983:1–2019:4
Tobin's Q	(atq + prccq × cshoq - ceqq)/atq Total assets + stock price × shares outstanding - common equity to total assets.	1983:1–2019:4
Cash-Flow	(ibp + dqp)/atq Income before extraordinary items + depreciation and amortization to total assets.	1983:1–2019:4
Profitability	oiadpq/atq Operating income before depreciation to total assets.	1983:1–2019:4
Market leverage (mkt_lev)	(dlttq + dlcq)/(atq + prccq×cshoq - seqq - txdbq) Short and long-term debt to total assets + stock price × shares outstanding - parent's stockholders equity - deferred taxes.	1983:1–2019:4
Corporate tax rate (tax)	txtq/piq Income taxes (total) to pretax income ratio.	1983:1–2019:4
Debt cost	xintq/(4×(dlttq + dlcq)) Interest expense to total debt ratio.	1983:1–2019:4
$\text{WACC}_{\text{CAPM}}$	eq_cost_capm×(1-mkt_lev) + debt_cost×mkt_lev×(1-tax) Weighted-average cost of capital using the cost of equity from the capital asset pricing model (CAPM).	1983:1–2019:4
WACC_{FF3}	eq_cost_ff3×(1-mkt_lev) + debt_cost×mkt_lev×(1-tax) Weighted-average cost of capital using the cost of equity from the Fama-French three-factor model.	1983:1–2019:4
WACC_{FF5}	eq_cost_ff5×(1-mkt_lev) + debt_cost×mkt_lev×(1-tax) Weighted-average cost of capital using the cost of equity from the Fama-French five-factor model.	1983:1–2019:4

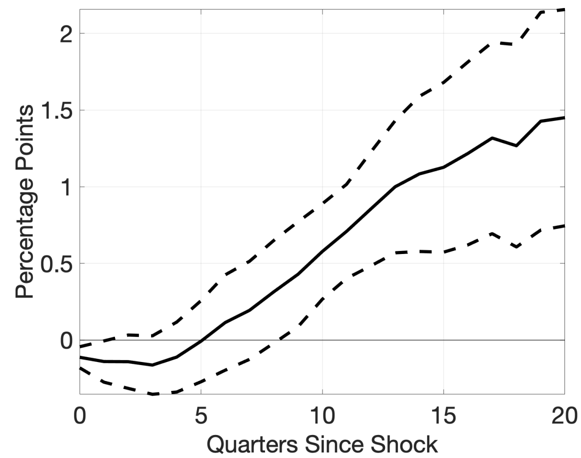
$WACC_{Car}$	eq_cost_car4×(1-mkt_lev) + debt_cost×mkt_lev×(1-tax) Weighted-average cost of capital using the cost of equity from the Carhart four-factor model.	1983:1–2019:4
	Aggregate Variables	
Government spending shock	Military spending news/exp(trend(log(*Real GDP*))), where trend(log(*Real GDP*)) is the trend component from a Hamilton filter and Military spending news is from Ramey and Zubairy (2018)	1983:1–2015:3
Cyclical real GDP	FRED/BEA (GDP, USAGDPDEFQISMEI). Extract cylical component from log(Real GDP) = log(GDP/USAGDPDEFQISMEI) using Hamilton filter	1983:1–2019:4
Cyclical real gov. consumption expenditure	FRED/BEA (GCE, USAGDPDEFQISMEI). Extract cyclical component from log(Real GCE) = log(GCE/USAGDPDEFQISMEI) using Hamilton filter	1983:1–2019:4
Cyclical real taxes	FRED/BEA (USAGDPDEFQISMEI, Table 3.1). Extract cyclical component from log(Real taxes) = log(BEA Taxes/USAGDPDEFQISMEI) using Hamilton filter	1983:1–2019:4
Cyclical gov. debt to GDP ratio	BIS (general gov. debt to GDP). Extract cylical component from *Gov. Debt/GDP* = general gov. debt to GDP using Hamilton filter	1983:1–2019:4
Zero coupon spot rates	FRED/FRB (DTB3); Gürkaynak, Sack, and Wright (2007)	1983:1–2019:4
Expected inflation	FRED/Cleveland Fed (EXPINF<YY>YR for <YY> ∈ {1–30})	1983:1–2019:4
Level factor	The first principal component extracted from the three-month, one-, two-, three-, four-, five-, and ten-year zero coupon Treasury yields.	1983:1–2019:4
Slope factor	The second principal component extracted from the three-month, one-, two-, three-, four-, five-, and ten-year zero coupon Treasury yields.	1983:1–2019:4
Curvature factor	The third principal component extracted from the three-month, one-, two-, three-, four-, five-, and ten-year zero coupon Treasury yields.	1983:1–2019:4

Figure A.1.1
The Average Response of Corporate Investment to Fiscal Shocks
— Robustness Exercises —

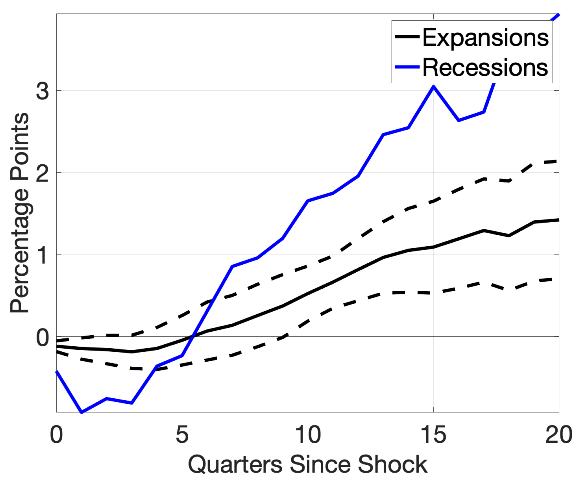
(a) Investment defined by `capxq/ppegtq`



(b) Pre-GFC Sample Period



(c) State Dependence of Investment Response to Fiscal Shocks



(d) Controlling for Political & Economic Risk

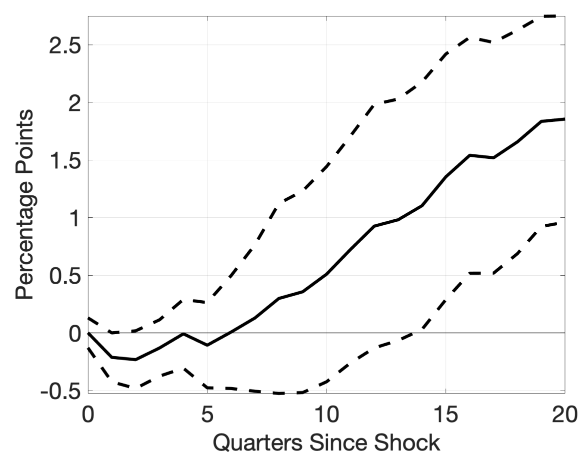


Figure A.1.2
Histogram of DOD contract amounts, in log dollars

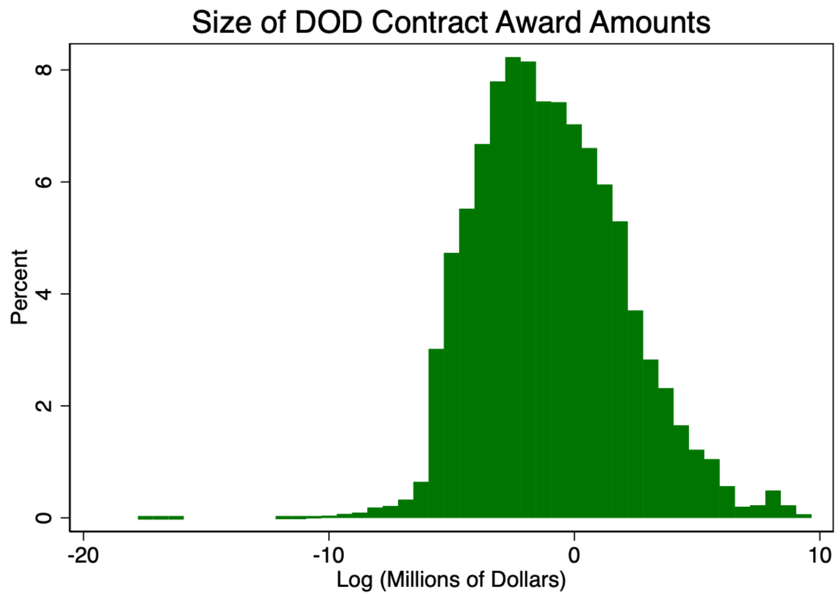


Figure A.1.3
Aggregate DOD contracts time-series

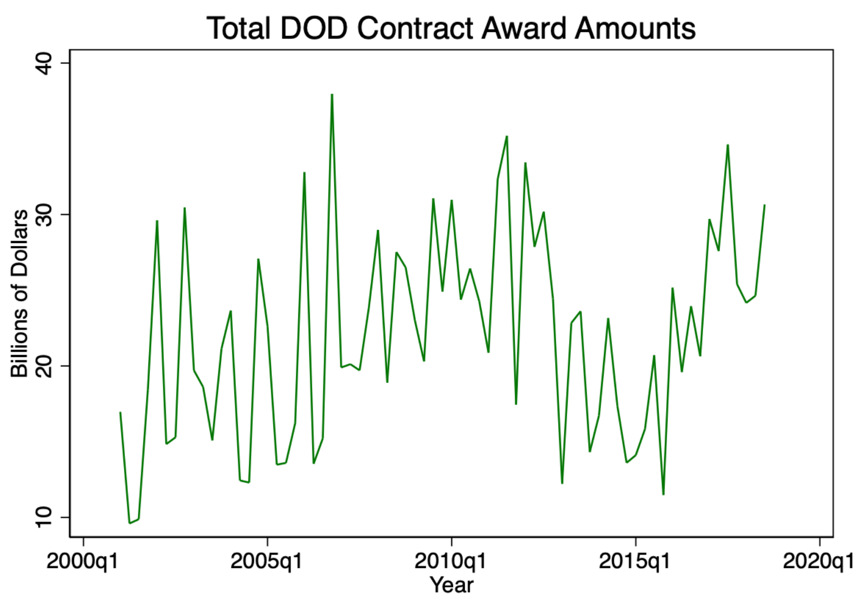


Figure A.1.4
Number of contracts over the sample

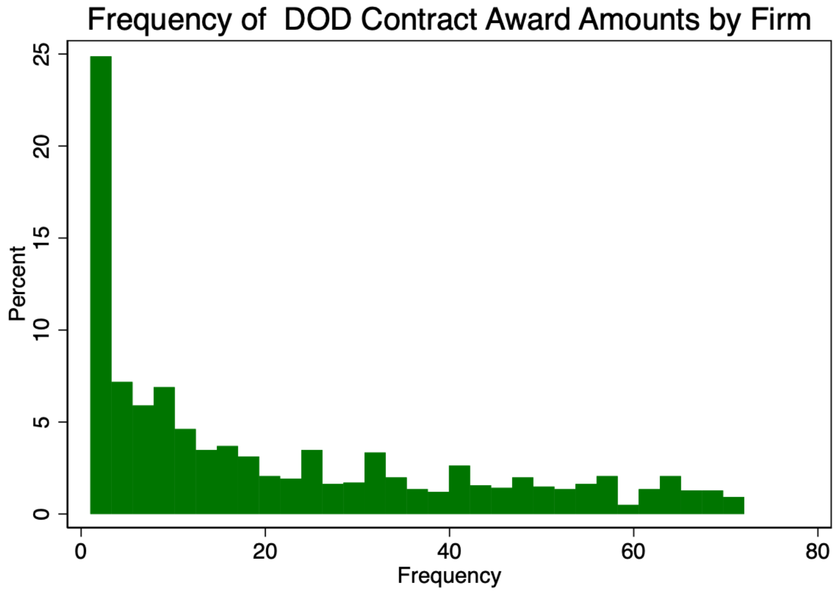
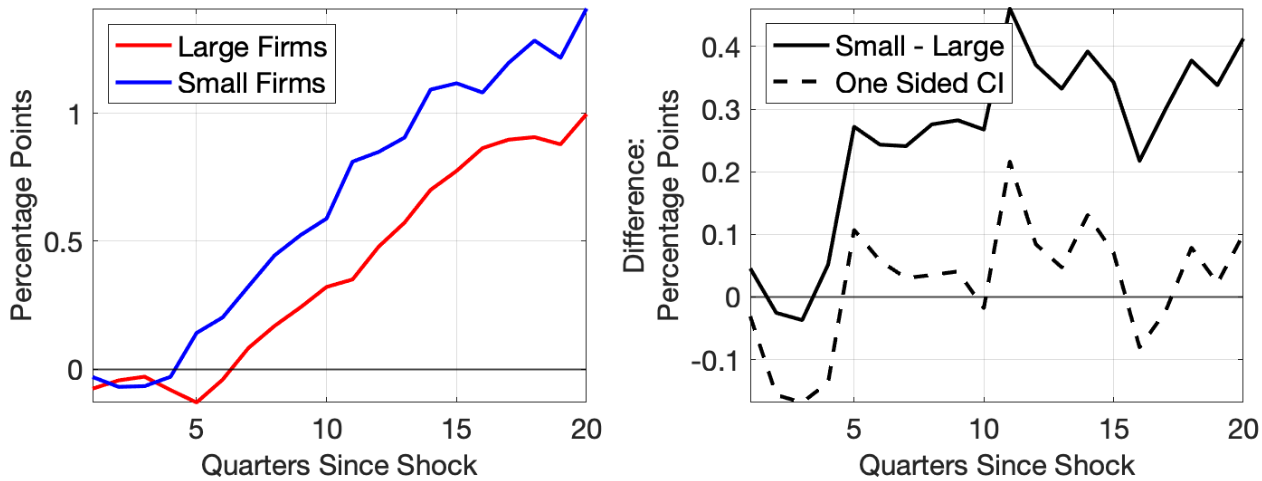
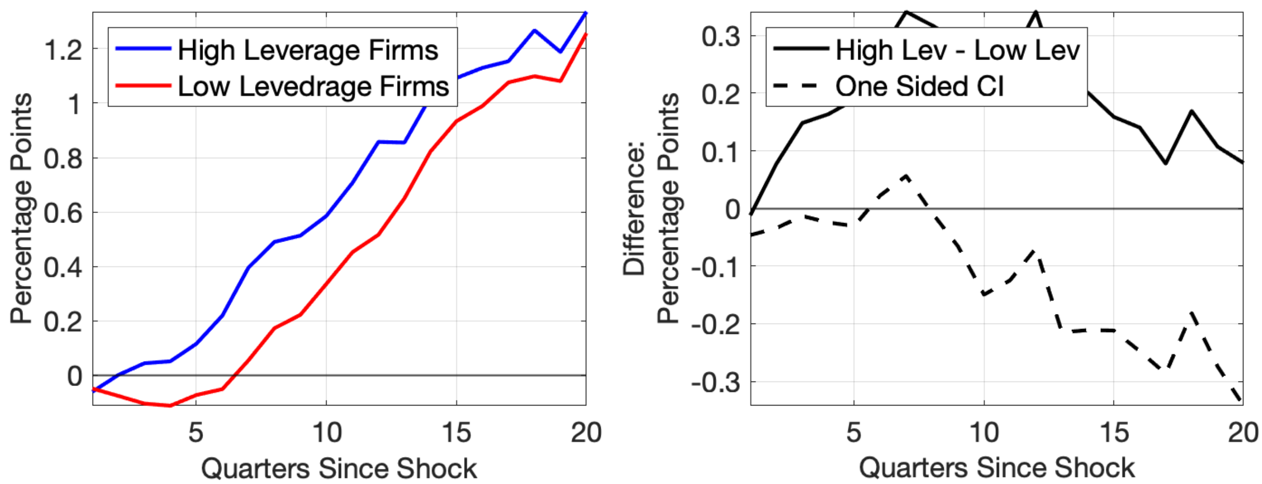


Figure A.1.5
The Heterogeneous Response of Corporate Investment to Fiscal Shocks

(a) Size



(b) Leverage



(c) Financial Constraint Proxy (Whited-Wu Index)

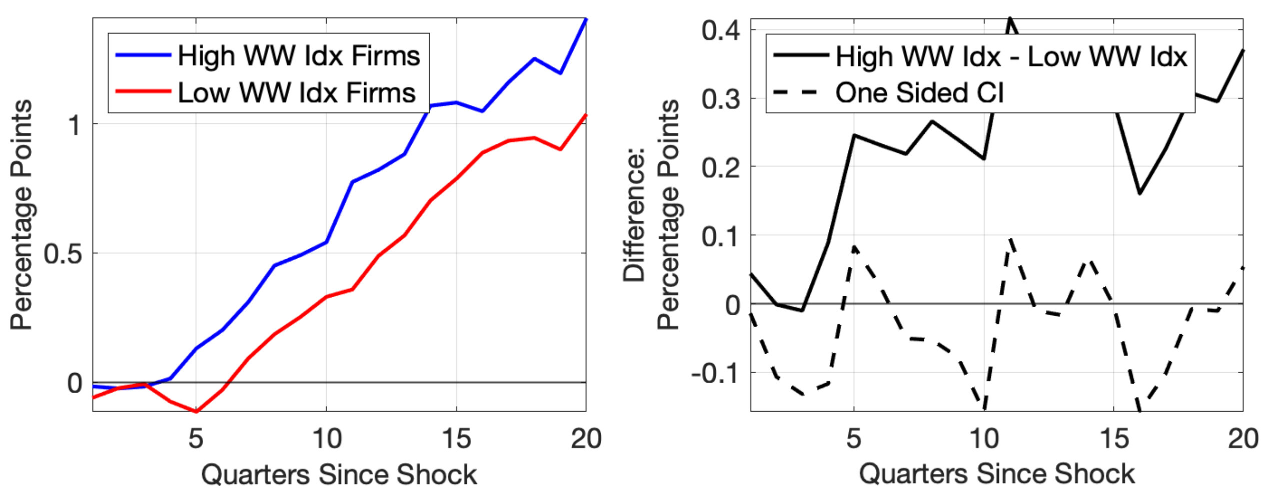
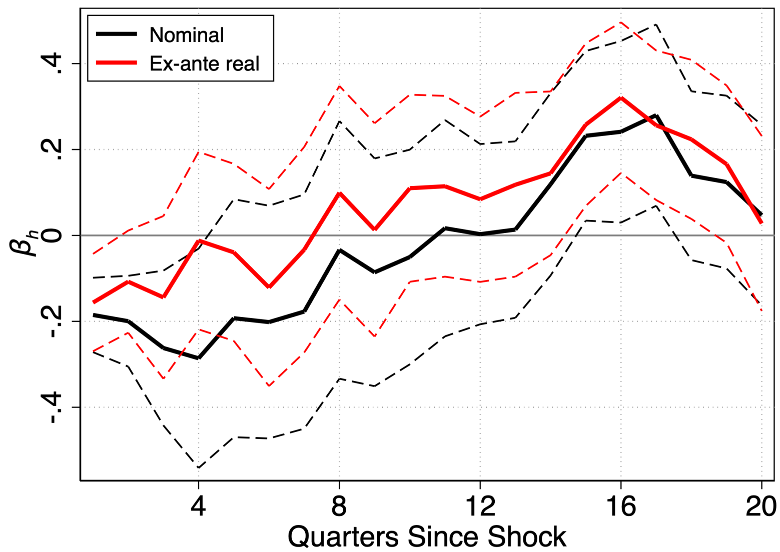


Figure A.1.6
The Response of Interest Rates to Fiscal Shocks in the pre-ZLB Period
— Robustness Exercises —

(a) 3-month Treasury Bill Yield



(b) 10-year Treasury Note Yield

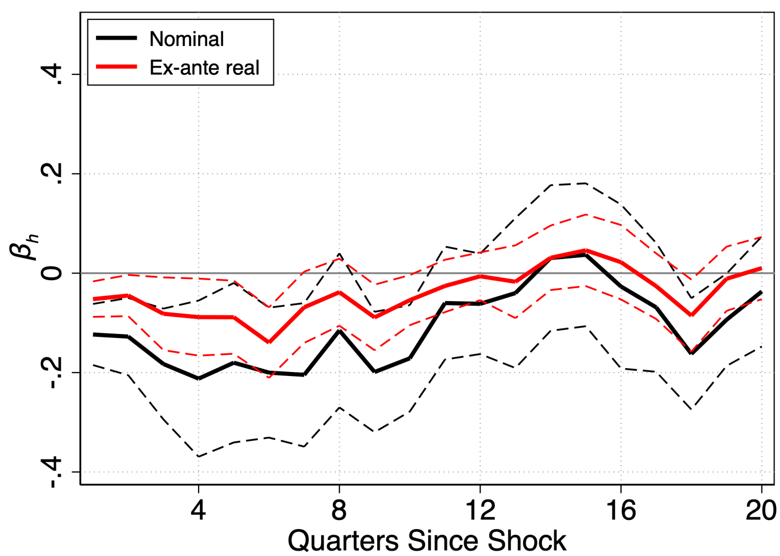
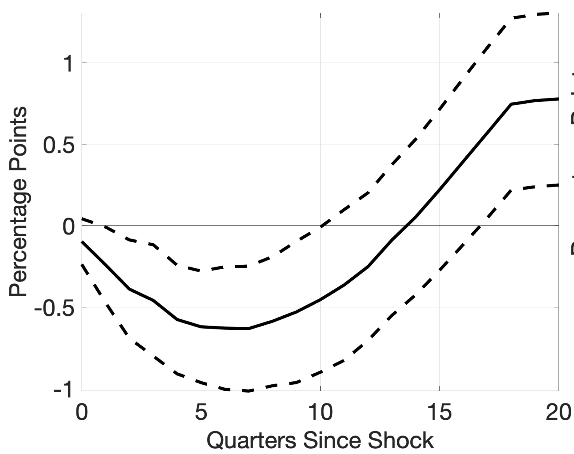
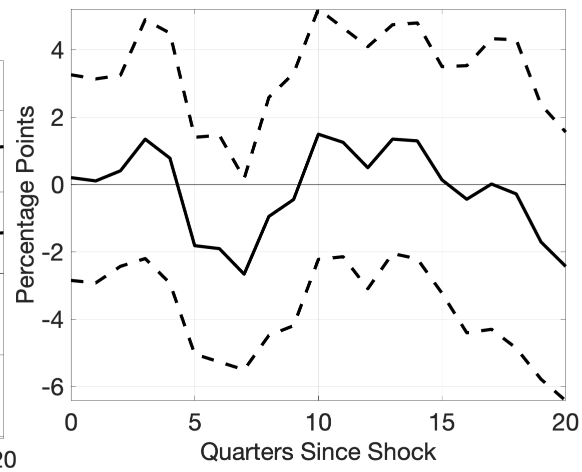


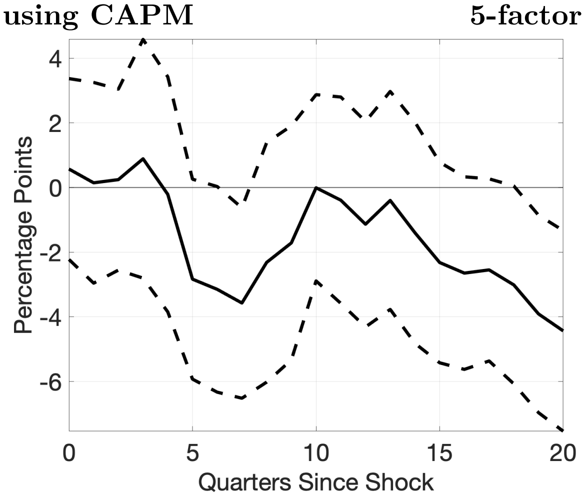
Figure A.1.7
The Response of WACC to Fiscal Shocks



(a) WACC using CAPM

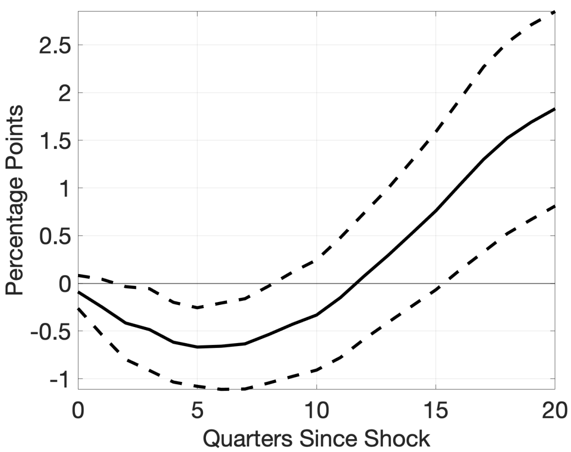


(b) WACC using Fama-French 5-factor model

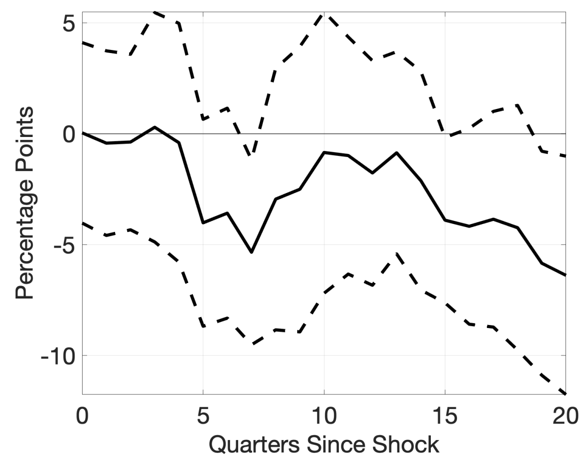


(c) WACC using Carhart 4-factor model

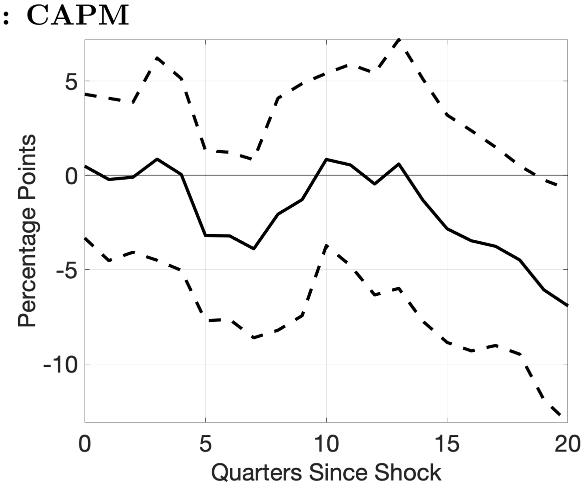
Figure A.1.8
The Response of WACC Components to Fiscal Shocks



(a) Equity cost: CAPM



(b) Equity cost: Fama-French 5-factor model



(c) Equity cost: Carhart 4-factor model

A.2 Auerbach & Gorodnichenko (2012) identification strategy

We also considered the identification strategy in Auerbach and Gorodnichenko (2012) as a robustness check. Building upon the seminal work of Blanchard and Perotti (2002), they assumed that government spending is exogenous to shocks within the quarter, yet accounting for potential anticipation using Greenbook and SPF forecasts. Following their approach, we computed the alternative shocks measure by regressing government consumption spending on the contemporaneous and lagged forecast errors and lags of other controls:

$$g_t = \alpha_0 + \alpha_1(4)\text{fe}_t + \alpha_2(3)g_{t-1} + \alpha_3(3)y_{t-1} + \alpha_2(3)\text{taxes}_{t-1} + \alpha_2(3)\text{debt}_{t-1} + \varepsilon_t^g, \quad \text{(A.2.1)}$$

where we control the government consumption spending g on four lags of itself, GDP (y), U.S. general government debt over GDP (debt), real taxes (taxes), and the contemporaneous and lagged forecast errors (fe) associated with the difference between the first vintage of the quarterly growth rate of government spending and its corresponding professional forecast submitted at the end of the previous quarter. With the exception of forecast errors, which are measured as quarterly growth rates, all variables are Hamilton-filtered.[5] The residuals $\hat{\varepsilon}_t^g$ resulting from regression (A.2.1) are portrayed in Figure A.2.1 and comprise the shock measure under the Auerbach and Gorodnichenko (2012) and Blanchard and Perotti (2002) (AG-BP) identification strategy.

In Figure A.2.2, we portray the average investment response to a one percent innovation in government consumption spending. The corporate investment response is muted in the first three years, after which it displays a crowding-in even though the estimated impulse response is not statistically significant.

[5]Taxes include contributions for government social insurance from persons and transfer receipts from businesses (net) and persons. We deducted from this measure government social benefits to persons. We used the GDP implicit price deflator in the BEA National Accounts to deflate the resulting net taxes measure we computed.

Figure A.2.1
Government spending shocks under Blanchard and Perotti (2002) identification.

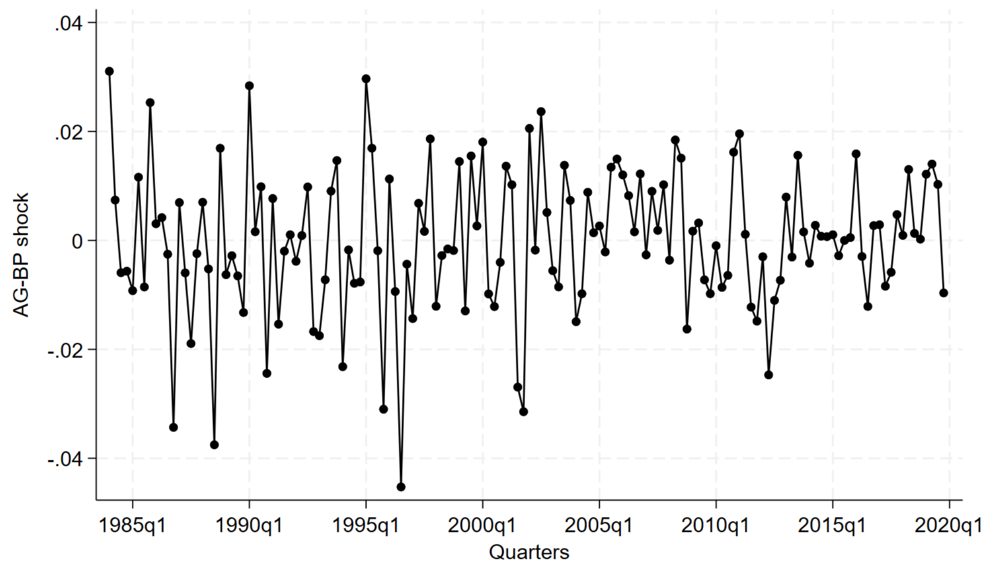


Figure A.2.2
The Average Cumulative Response of Corporate Investment to B-P shock

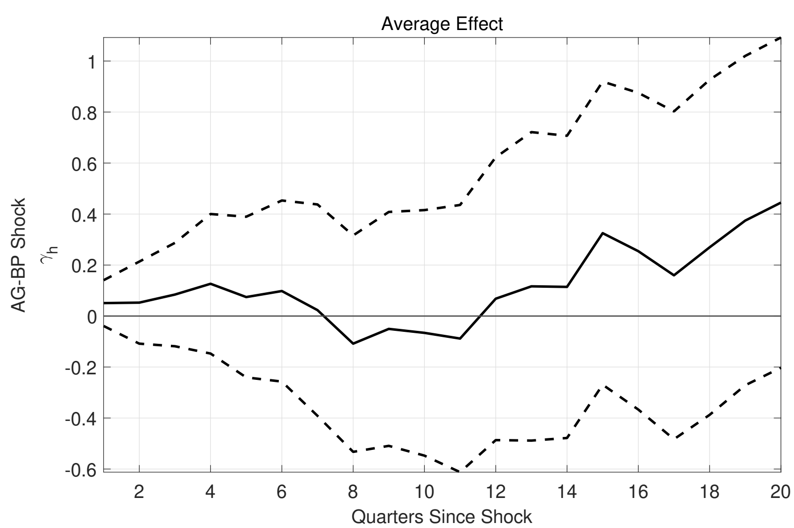
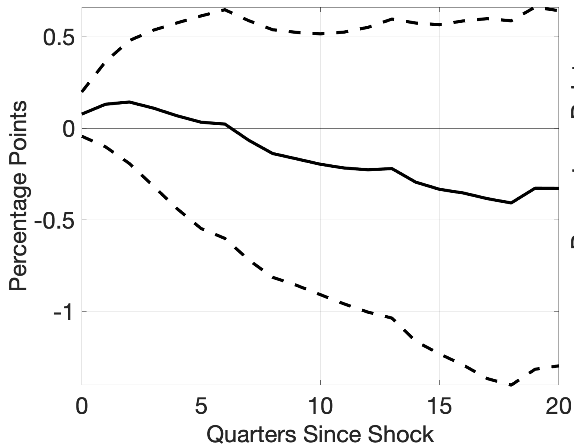
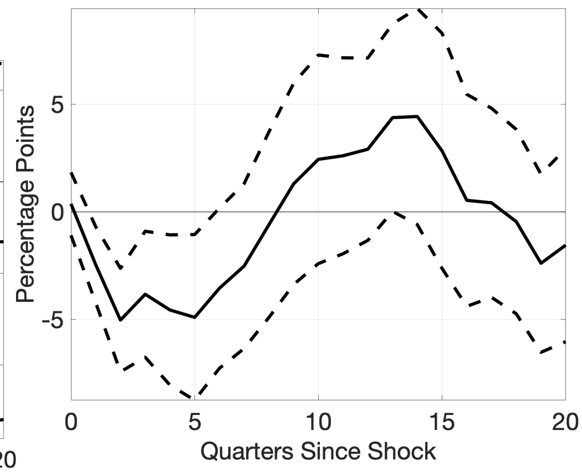


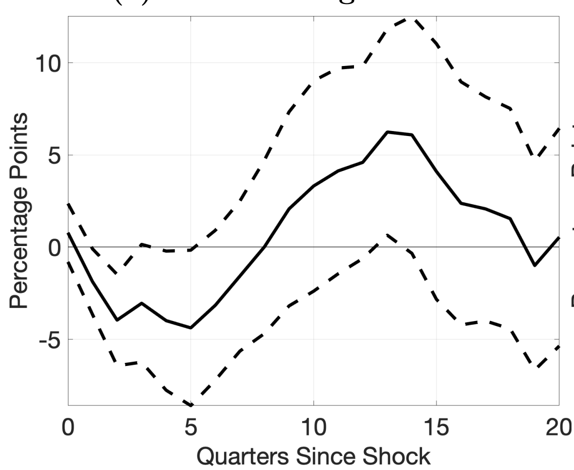
Figure A.2.3
The Response of WACC to Fiscal Shocks: A-G Identification Strategy



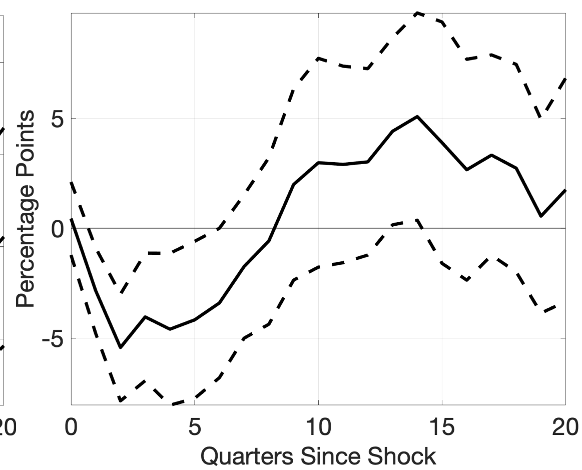
(a) WACC using CAPM



(b) WACC using Fama-French 3-factor model

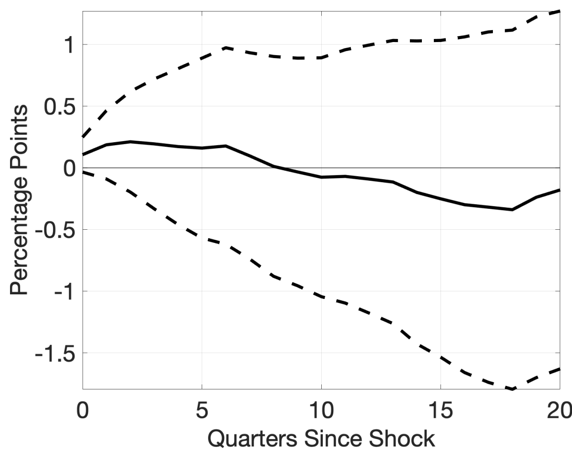


(c) WACC using Fama-French 5-factor model

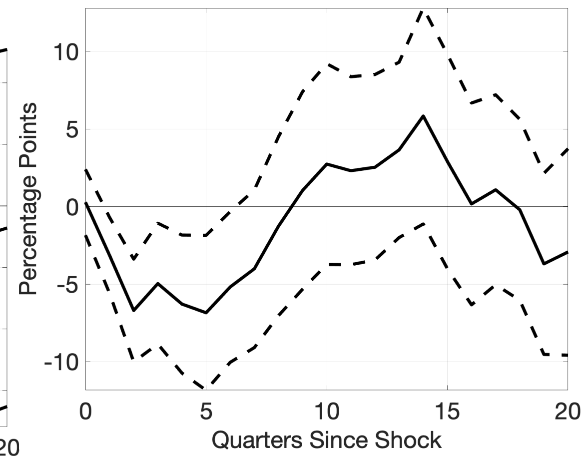


(d) WACC using Carhart 4-factor model

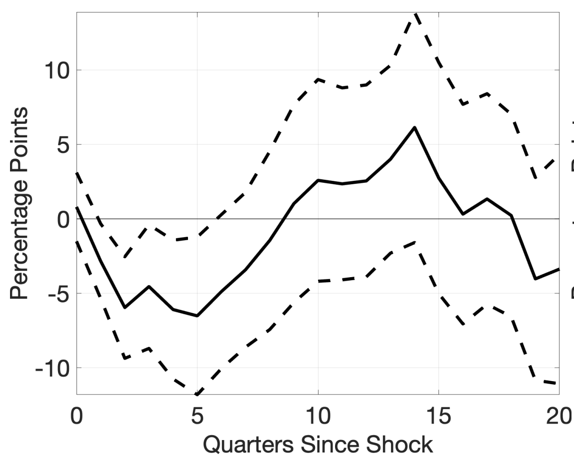
Figure A.2.4
The Response of WACC Components to Fiscal Shocks: A-G Identification Strategy



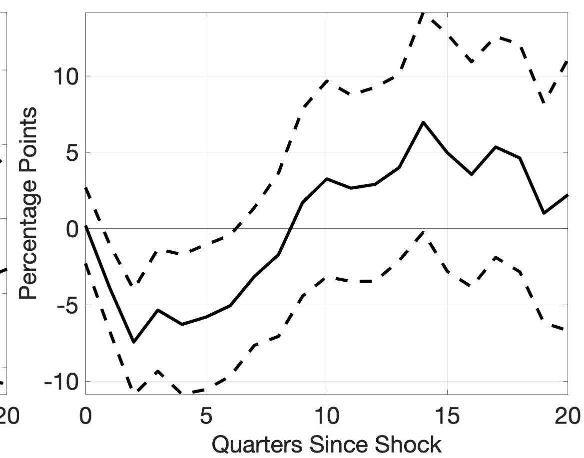
(a) Equity cost: CAPM



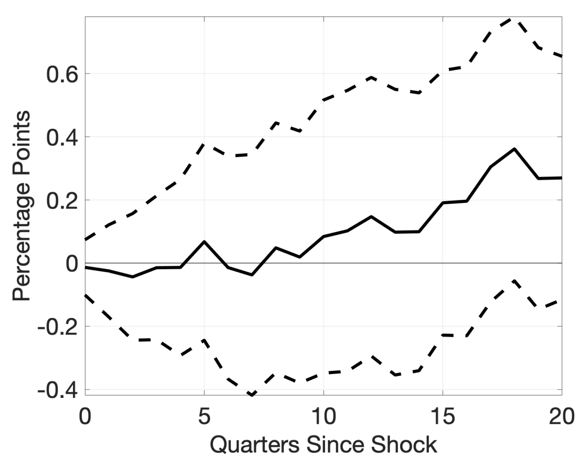
(b) Equity cost: Fama-French 3-factor model



(c) Equity cost: Fama-French 5-factor model



(d) Equity cost: Carhart 4-factor model



(e) Debt cost

A.3 Responses of Economic Aggregates

The empirical evidence that capital investment by Compustat firms crowds *in* following fiscal spending news starkly contrasts the predictions of workhorse macroeconomic models. While some empirical papers using macro-level data have found evidence consistent with these theoretical predictions, more recent papers have documented findings in contrast with the conventional wisdom.[6]

As discussed in Section 2.3, our identification approach in this paper follows the narrative military spending news approach introduced in Ramey (2011b). In this paper and other subsequent work (e.g. Ramey, 2016), aggregate non-residential and residential investment is shown to *fall* in response to positive innovations in military spending news. Hence, how can we reconcile the empirical evidence that aggregate investment crowds *out* in response to fiscal shocks with the responses in the corporate investment we have presented thus far?

First, and most pressingingly, we note that the result in Ramey (2016) that non-residential and residential investment statistically significant decline following the military spending news shock is not robust to the post-Korean War period. In results not shown here, using the same data and specification from Ramey (2016), we find that non-residential and residential investment exhibit muted or even statistically significantly *positive* responses to military spending news in the sample period we consider in this paper.

Next, we acknowledge that there is a significant challenge in comparing our results with those from the existing literature. This challenge is due to the myriad identification approaches, econometric specifications, variable definitions, and sample periods considered by the wealth of papers studying government spending shocks and investment. Hence, we proceed to establish a set of baseline results within a setting most closely mirroring that from our panel regression analysis above.

In this context, we seek to provide answers to several questions concerning the relationship between our results and the evidence from the literature on the effect of fiscal shocks on investment. First, what are the dynamic responses to government spending shocks of the capital expenditures portion of investment in the National Income Product Account (NIPA) tables, aggregate capital investment observed by the universe of Compustat firms, and the "residual" component that nets out the latter from the former? Second, what are the responses of other economic aggregates like output, government spending, the government debt-to-GDP ratio, taxes, and consumption? And finally, how do the fiscal multipliers implied by these aggregate economic responses in our sample compare to those from the existing literature?

[6] For an extensive review of the literature on the effects of fiscal shocks on private investment, see Ramey (2011a).

To establish a baseline set of results about the responses of different components of investment to fiscal shocks, we carefully build a quarterly time series of real, seasonally adjusted corporate investment from Compustat as well as capital investment from NIPA, which we use to construct the residual component that nets out investment from Compustat from the NIPA series. We are scrupulous in construction of these investment series given the disparate sample periods and approaches for seasonal adjustment, deflating, and detrending utilized in "off-the-shelf" variables. Accordingly, we take the following steps in this analysis:

1. Obtain aggregate nominal (not seasonally adjusted) Compustat investment by summing the `capex` variable quarter-by-quarter across firms.
    (a) Multiple series by 4 to convert to an annual rate (dollar flow) for comparison with NIPA series.
2. Obtain nominal (not seasonally adjusted) NIPA capital investment from FRED by summing fixed gross private domestic investment in structures (`NA000339Q`) and equipment (`NA000340Q`).
3. Seasonally adjust aggregate nominal Compustat and nominal NIPA capital investment using X-13 from 1984:1–2019:4.
4. Compute (seasonally adjusted) residual NIPA investment equal to the difference between the two seasonally adjusted series.
5. Deflate all series using a common implicit price deflator, `USAGDPDEFQISMEI` from FRED.
6. Take logs and Hamilton-filter all series to extract the cyclical component of each series.
    (a) Note: Hamilton filtering drops 11 observations. Final series run from 1986:3–2019:4.

We then ask how these three investment series respond to fiscal shocks by estimating the following local projections, for $h = 0, 1, \ldots, 20$:

$$Y_{t+h} = \alpha_h + \beta_h \varepsilon_t^g + \mathbf{\Phi}_h(4)\mathbf{X}_{t-1} + \epsilon_{t+h}, \tag{A.3.1}$$

where we take Y_{t+h} to be the cyclical components of investment described above. ε_t^g is the government spending shock, and $\mathbf{X}_{t-1}$ comprises the cyclical components of real GDP, real government consumption expenditures and gross investment, real taxes, and the government debt to GDP ratio, as well as the government spending shock ε_{t-1}^g and the LHS variable.

The main coefficients of interest from equation (A.3.1) are the β_h, which capture the effect of the government spending shock on investment h periods after the shock.

The results are in Figure A.3.1. Panel (a) highlights that in our sample, which runs from 1986:3 until 2019:4, increases in military spending news lead to a positive and sometimes statistically significant response in capital investment from NIPA. On impact, the shock does not have a statistically significant effect; however, during the three-year period following the shock, the point estimate is positive and occasionally statistically significant. Thereafter, capital investment from NIPA does not appear to change.

In Panel (b), we report the response to the fiscal shock of aggregate capital investment within the universe of Compustat firms. The evidence is consistent with our results from the panel regression analysis in previous sections. On impact, capital investment by Compustat firms does not respond to the shock. However, Compustat firms *increase* their capital expenditures between one and two years following the shock. Remarkably, the effect persists even five years following the shock.

Finally, in Panel (c), we report the response of residual component of capital investment from NIPA that removes capital investment from Compustat firms. The results are consistent with the two distinct responses in NIPA and Compustat firm capital investment. On impact, there is a statistically significant increase in the residual component of capital investment from NIPA. Together with the muted response in capital investment by Compustat firms, we thus understand the overall muted response from Panel (a). A few years after the shock, the response of the residual component is mixed. While the point estimate is positive, it is only occasionally statistically significantly different from zero. Finally, at a four- to five-year horizon after the shock, the point estimate indicates that ex-Compustat capital investment from NIPA is not different from zero. This effect is enough to wash out the long-run crowding in effect for NIPA capital investment that is evident in the capital investment of Compustat firms.

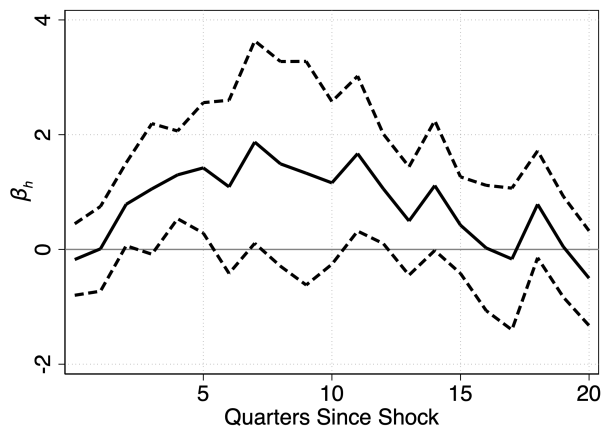
Next, study the responses of other key macroeconomic aggregates by estimating (A.3.1) with these variables entering as Y on the LHS. For more information on the variables we use for output, government expenditures and gross investment, the government debt-to-GDP ratio, and taxes, which comprise the familiar vector of controls $\mathbf{X}$, are defined in Table A.1.1. We also acquire from FRED data on durable (`PCEDG`) and non-durable (`PCEND`) consumption. We deflate these variables using the usual implicit price deflator (`USAGDPDEFQISMEI`), and detrend by taking logs and applying the Hamilton filter.

According to Panel (a) in Figure A.3.2, there is some evidence that the government spending shock increases output on impact. However, while the point estimate is mostly positive over the five-year horizon following the shock, the confidence intervals do not allow us to reject that the response is different than zero. Similarly, in Panel (b), government consumption expenditures and gross investment increase on impact in response to the government spending shock. The IRF further suggests that government spending does statistically significant increase at future horizons as well, with the confidence bands lying above zero at a few points over the five year horizon.

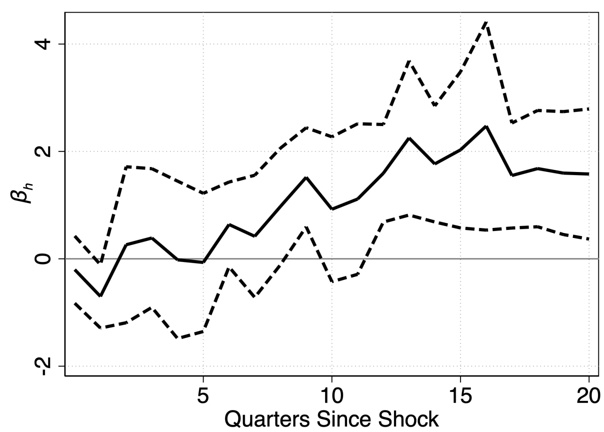
Interestingly, in our sample, the government debt-to-GDP ratio and taxes do not respond to government spending shocks on impact or in the future (Panels (c) and (d)). Finally, we depict the responses of durable and non-durable consumption in Panels (e) and (f), respectively. There is weak evidence that durable consumption responds to the government spending shock; in contrast, non-durable consumption appears to increase with a delay following the shock.

Figure A.3.1
The Response of Aggregate Investment to Fiscal Shocks

(a) NIPA Capital Investment



(b) Compustat Capital Investment



(c) Ex-Compustat NIPA Capital Investment

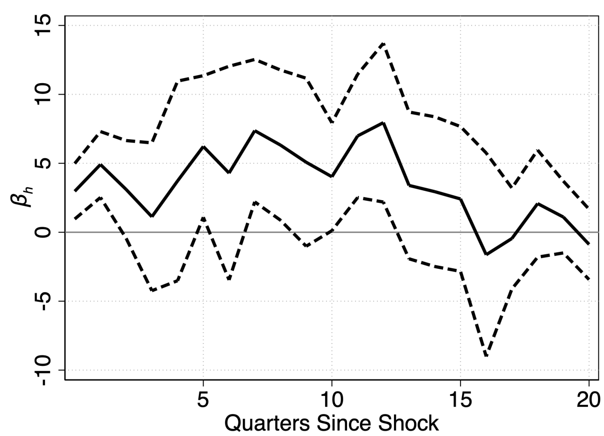
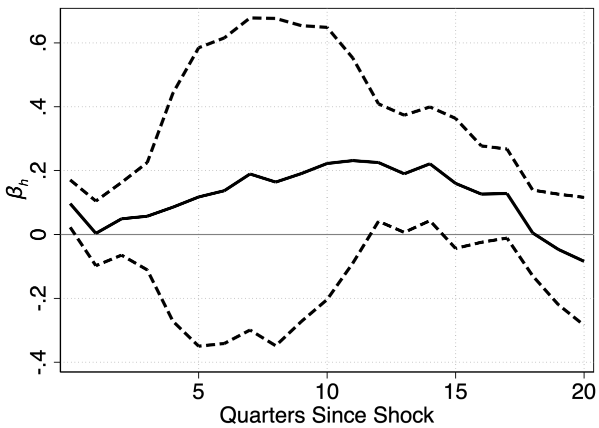
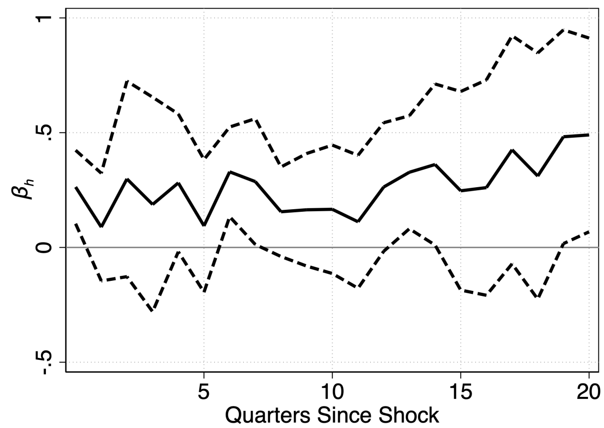


Figure A.3.2
The Responses of Macroeconomic Variables to Fiscal Shocks

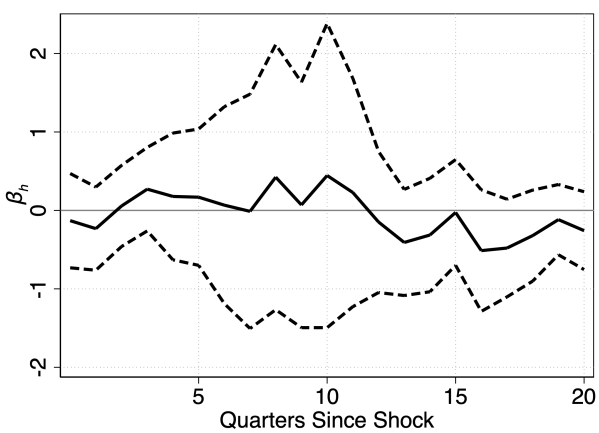
(a) Output



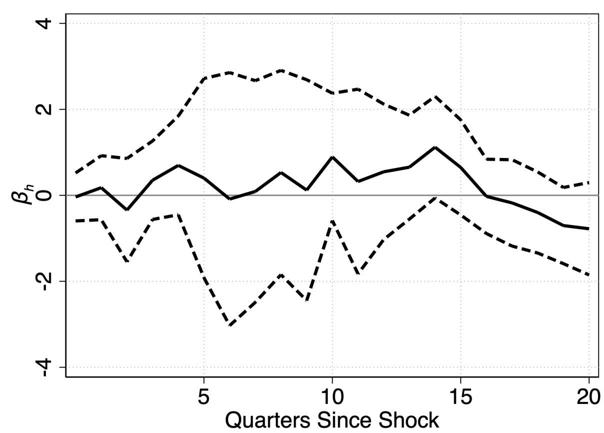
(b) Government Expenditures and Gross Investment



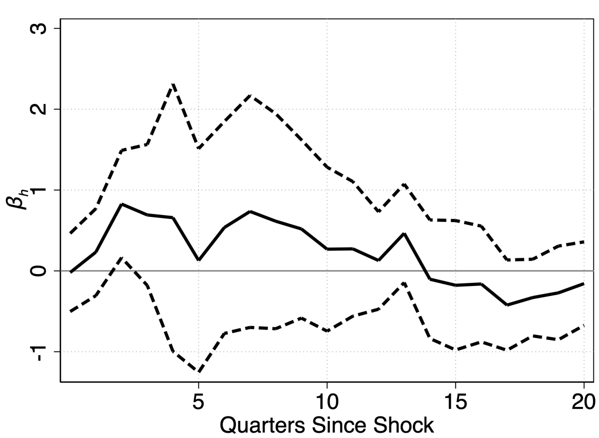
(c) Government Debt/GDP



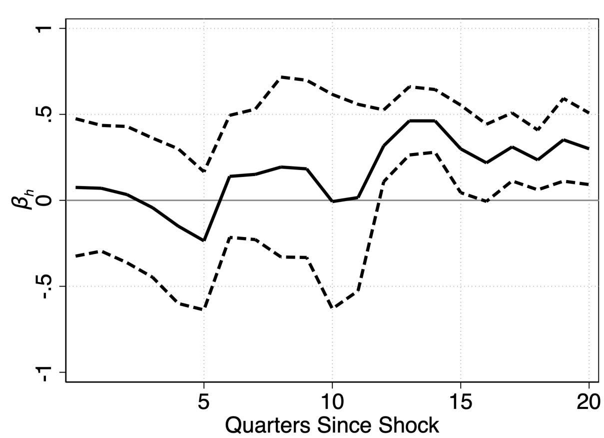
(d) Taxes



(e) Durable Consumption



(f) Nondurable Consumption



Fiscal Multipliers

Having established a set of baseline results on the dynamic responses of aggregate investment to the military spending news shock, next, we estimate the corresponding fiscal multipliers for the investment series. In particular, we follow Hall (2009) and Barro and Redlick (2011) in the outcome variables and government spending changes to the same units. Specifically, we write variables x_t in terms of percentage changes: $x_t = (X_{t+h} - X_{t-1})/X_{t-1} \approx \log(X_{t+h}) - \log(X_{t-1})$, and normalize by lagged output, GDP_{t-1}, as follows:

$$\frac{X_{t+h} - X_{t-1}}{GDP_{t-1}} = \frac{X_{t+h} - X_{t-1}}{X_{t-1}} \frac{X_{t-1}}{GDP_{t-1}} \approx (\log(X_{t+h}) - \log(X_t)) \frac{X_{t-1}}{GDP_{t-1}}.$$

The fiscal multipliers are then derived from the following model, for $h = 0, 1, \ldots, 20$:

$$(y_{t+h} - y_{t-1}) \frac{Y_{t-1}}{GDP_{t-1}} = \gamma_h + m_h (g_{t+h} - g_{t-1}) \frac{G_{t-1}}{GDP_{t-1}} + \mathbf{\Phi}_h(4)\mathbf{X}_{t-1} + \epsilon_{t+h}, \qquad \text{(A.3.2)}$$

where the outcome variable Y_t is one of the three aggregate capital investment series (NIPA, Compustat, or ex-Compustat NIPA), G_t is government consumption expenditures and gross investment, and $\mathbf{X}_{t-1}$ is a vector of controls that includes the LHS variable $(y_{t-1} - y_{t-2}) \frac{Y_{t-2}}{GDP_{t-2}}$, the (endogenous) change government spending $(g_{t-1} - g_{t-2}) \frac{G_{t-2}}{GDP_{t-2}}$, and the cyclical components of real GDP, real taxes, and the government debt to GDP ratio. Lowercase variables denote logs.

We use Ramey's news shock, ε_t^g, as an instrument for $(g_{t+h} - g_{t-1})G_{t-1}/GDP_{t-1}$. The reason for employing an instrumental variable is because of the endogeneity issue arising through reverse causality between changes in investment and changes in government spending. There are two key identifying assumptions. The first is that the instrument ε_t^g is *relevant*, that is, that it correlates with $(g_{t+h} - g_{t-1})G_{t-1}/GDP_{t-1}$ conditional on the controls $\mathbf{\Phi}_h(4)\mathbf{X}_{t-1}$. The second is that the instrument satisfies the *exclusion restriction*, that is, that ε_t^g correlates with the outcomes of interest Y_{t+h} *only through* the endogenous variable $(g_{t+h} - g_{t-1})\tilde{G}_{t-1}$.

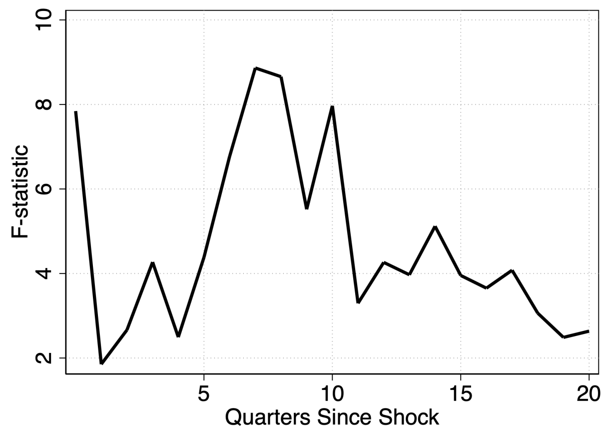
We argue that the exclusion restriction holds, as military spending news is plausibly orthogonal to economic conditions. For more discussion, see Ramey (2011a). Moreover, the evidence we obtain via weak IV tests corroborates Ramey's concerns about the low correlation of the military spending news shock with government spending in the post-Korean war sample. Depicted in Figure A.3.3, the Kleibergen-Paap rk Wald F-statistics are below the critical values of 10 required for relevance.

Hence, we follow Stock and Yogo (2002) and estimate (A.3.2) using the Fuller limited-information maximum likelihood estimator, which is more robust compared to two-staged least squares (2SLS) estimation. The results from this estimation are in Figure A.3.4. Contrary to the existing literature, in Panel (a) we find that the cumulative fiscal multiplier for capital investment in NIPA is not statistically significantly different from zero. Moreover, the point estimate is actually *positive* and statistically significant four years after the shock, suggesting that government spending causes capital investment to crown in. Panels (b) and (c) depicts the cumulative multiplier on capital investment by Compustat and ex-Compustat NIPA firms. We cannot reject that the multipliers are different than zero for these aggregate investment series.

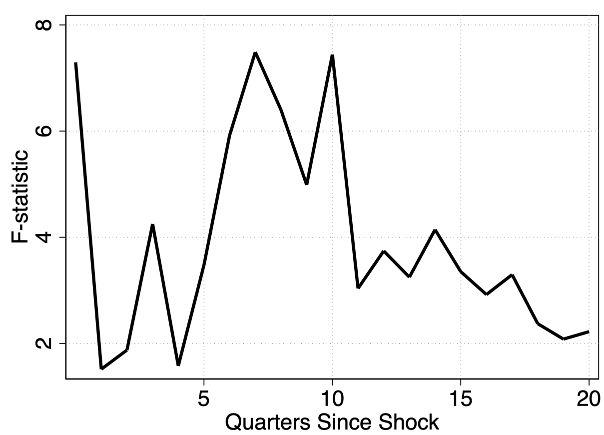
In conclusion, the evidence we find in our time series analyses of the effect of fiscal shocks on components of aggregate investment connects to and sheds new light to the literature in macroeconomics about the effects of fiscal shocks on investment.

Figure A.3.3
F-statistics

(a) NIPA Capital Investment



(b) Compustat Capital Investment



(c) Ex-Compustat NIPA Capital Investment

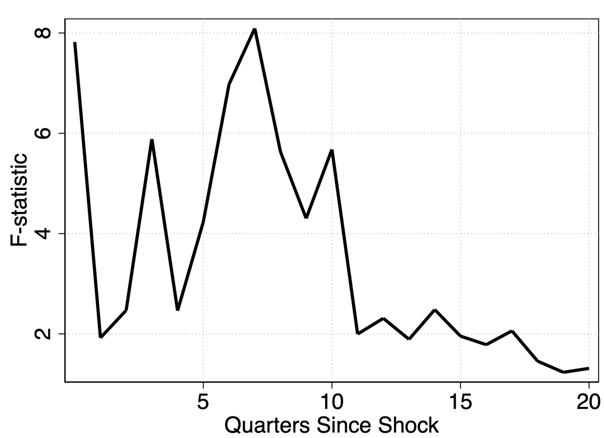
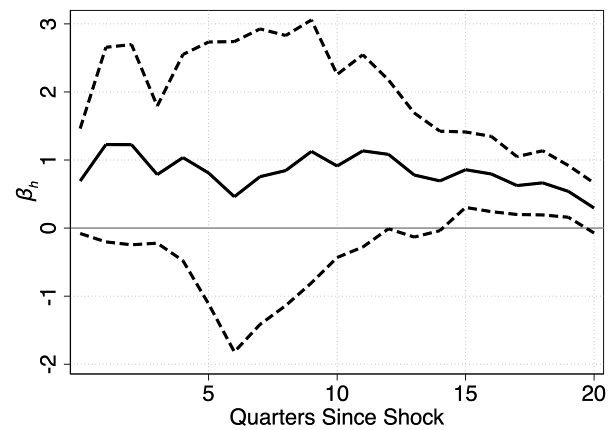
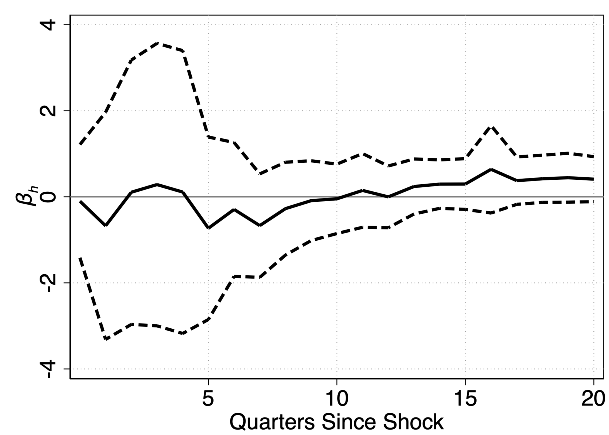


Figure A.3.4
Aggregate Cumulative Investment Multiplier

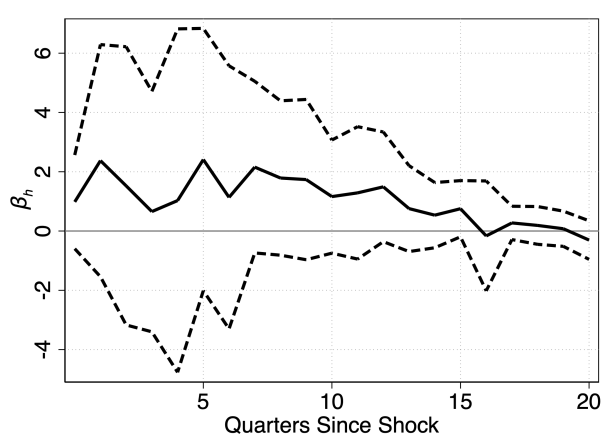
(a) NIPA Capital Investment



(b) Compustat Capital Investment



(c) Ex-Compustat NIPA Capital Investment



A.4 The effect of government spending shocks on asset prices and risk

This appendix provides additional evidence on the effect of the military spending news shock on interest rates and measures of political risk outcomes. In particular, we investigate the dynamics of the Federal Funds Rate, term and credit spreads, the economic policy uncertainty (EPU) index (Baker, Bloom, and Davis, 2016), geopolitical risk (GPR) index (Caldara and Iacoviello, 2022), and presidential party following the shock.

The interest rate regressions follow an analagous specification to equations (3) and (4) in the main text. Specifically, we run the following local projections, for $h = 1, \dots, 20$:

$$y_{t+h} - y_t = \alpha_h + \beta_h \varepsilon_t^g + \mathbf{\Phi}_h(4)\mathbf{X}_{t-1} + \epsilon_{t+h}, \tag{A.4.1}$$

where y is the outcome variable of interest, ε^g is the narrative military spending news shock, and $\mathbf{X}_{t-1}$ is a vector of controls and their lags including the cyclical components of real GDP, government consumption expenditures and gross investment, government debt, and taxes as well as the government spending shock ε_{t-1}^g, the regressand Δy_{t-1}, and the level, slope, and curvature factors derived from the nominal or ex-ante real term structure.

The first set of results, depicted in Figure A.4.1, show the dynamics of the Federal Funds Rate to the military spending news shock. Panel (a) depicts the response in the full sample, and Panel (b) restricts the sample to the pre-ZLB period. As expected, the IRFs closely mirror the responses of the three-month T-Bill yields in Figure 4a. In both the full and pre-ZLB samples, the nominal rate statistically significantly declines by at least 10 basis points, an effect which persists for up to a year following the military spending news shock. Thereafter, there is some evidence of a long-run increase in the policy rate, particularly of the *ex-ante* real Federal Funds rate.

Next, we consider the responses of two measures of interest rate spreads. First, we construct a simple measure of the term spread, which is the 10-year T-Note yield minus the 3-month T-Bill yield. The asymmetric response in the short- and long-term yields suggests a flattening term structure slope, and we present this evidence formally here. Second, we consider a measure of corporate credit spreads from Gilchrist and Zakrajšek (2012), henceforth the GZ spread. Each spread measure enters as y on the LHS of (A.4.1), and so the coefficients of interest, β_h, capture the cumulative change in the spread in response to the military spending news shock. We continue to control for lags of the level, slope, and curvature factors in the (nominal or *ex-ante* real) term structure to account for information already priced in the yield curve at the time of the shock.

Figure A.4.2 reports the results. Consistent with the dynamics of the short- and long-term interest rates in Figure 4, Panel (a) confirms there is a pronounced long-run decline the nominal and *ex-ante* real term spread. Five years after the military spending news shock, the term spread falls by almost 20 basis points. The decline is particularly pronounced for the *ex-ante* real term spread. In Panel (b), we find that the GZ spread statistically significantly *increases* in response to the military spending news shock, both on impact and over most of the five-year horizon following the shock. The increase in the GZ spread is between 10 and 20 basis points, on average.

We note that the increase in the GZ spread, which is a measure of the spread between yields faced by large public firms and Treasury yields of a comparable maturity, is not inconsistent with a falling cost of capital faced by the firms in our sample, as we argue in Section 5.2. In particular, it suggests the pass-through of falling Treasury yields to the yields faced by public firms is merely incomplete.

Finally, we investigate the responses of three measures capturing economic or political risk. To this end, we estimate the following local projections, for $h = 0, \ldots, 20$:

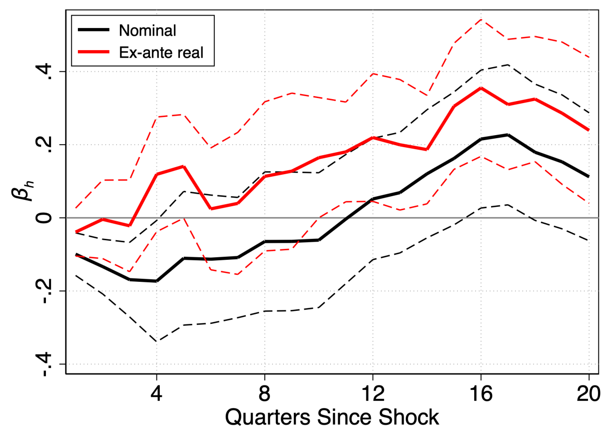
$$Y_{t+h} = \alpha_h + \beta_h \varepsilon_t^g + \mathbf{\Phi}_h(4)\mathbf{X}_{t-1} + \epsilon_{t+h}, \tag{A.4.2}$$

where variables are defined the same as in (A.4.1), except $\mathbf{X}_{t-1}$ now comprises the cyclical components of real GDP, government spending, taxes, and the government spending-to-GDP ratio, as well as the military spending news shock and the LHS variable.

The results are depicted in Figure A.4.3. Panels (a) and (b) report the responses of the EPU index and the GPR indices, respectively. On impact, the military spending news shock does not cause a statistically significant response in the uncertainty and risk indices. Indeed, there is little evidence from the IRFs that the EPU or GPR indices change in response to the government spending shocks. These results, therefore, do not lend support to the hypothesis that the military spending news shock induces a measurable change in economic or political risk. Panel (c) similarly shows that the military spending news shock does not lead to a significant change in the likelihood of a particular presidential party.

Figure A.4.1
The Response of the Federal Funds Rate

(a) Federal Funds Rate



(b) Federal Funds Rate (pre-ZLB)

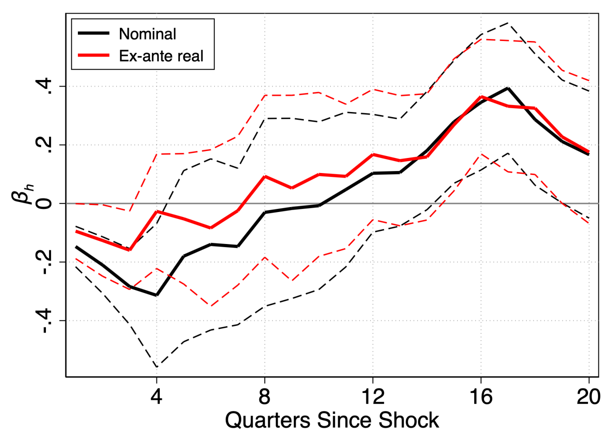
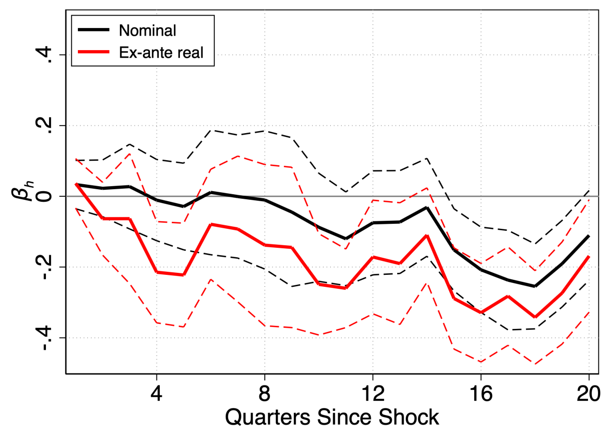


Figure A.4.2
The Response of Interest Rate Spreads

(a) Term Spread



(b) GZ Spread

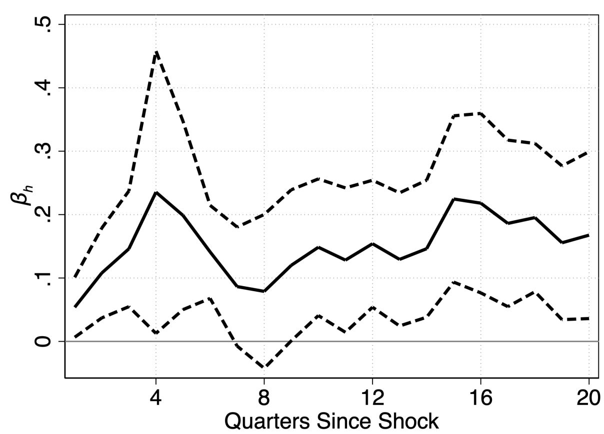
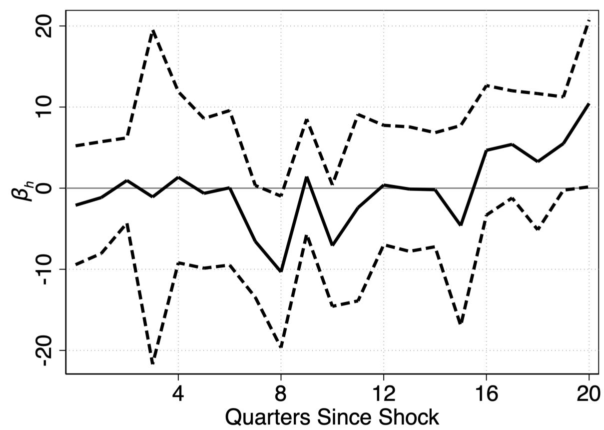
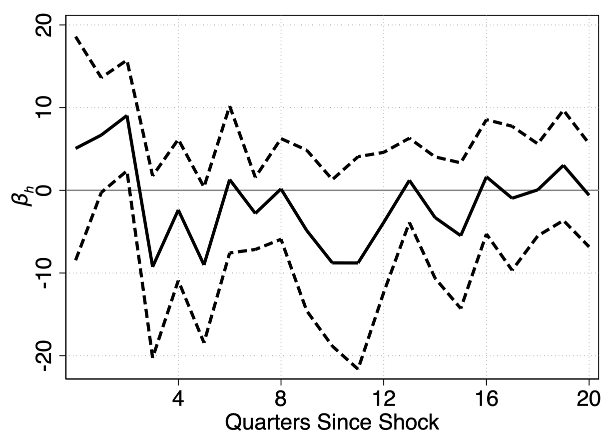


Figure A.4.3
The Responses of Uncertainty Measures to Fiscal Shocks

(a) std(Economic Policy Uncertainty)



(b) std(Global Geopolitical Risk)



(c) 𝟙(Republican President)