The Fiscal Multiplier and World War II: A Revisit from the Stock Market Perspective*

Jianlin Wang†

December 2018

Abstract

Stock returns of the defense industry have been as used as a novel approach in identifying government spending shocks and tend to yield an above-unity fiscal multiplier during the post-Korean War period. In this study, I identify the public aircraft and shipbuilding companies as the defense sector of the U.S. stock market and apply the stock market approach to estimate the fiscal multiplier associated with WWII, the largest fiscal stimulus episode of the modern U.S. history. Based on a monthly sample from 1936 to 1947, I find that the output elasticity with regards to total government spending is around 0.276 during the WWII era, which is very close of the 0.3 output elasticity reported from the post-Korean War sample. I also observe persistent responses in government spending and real output to innovations in the excess returns of defense sector, a feature consistent with the findings of the stock market approach and suggesting the existence of expectation effects at a longer horizon that has yet to be accounted for by the main approaches of the literature. Due to the special economic environments of WWII characterized by a high government spending share, the 0.276 output elasticity implies a fiscal multiplier of 0.72, which is in turn consistent with the multiplier estimated via defense news. Upon comparing the performance of the excess returns and defense news on an overlapping sample, I present evidences emphasize the importance of the expectation effects at a longer horizon. In specific, I discover that the shape of responses to the excess returns and defense news can replicate each other by forwarding the defense news and lagging the excess return series.

*I would especially like to thank Christina Romer and David Romer for valuable comments and advice. I would like to thank Barry Eichengreen, Jonas Fisher, and Ryan Peters for helpful comments, suggestions, and feedback. I am grateful to Gillian Brunet for sharing her knowledge and data regards the U.S. war supply contracts and consumption rationing orders. All errors in this work are my own.

†Department of Economics, University of California at Berkeley, jianlinw@berkeley.edu.

1 Introduction

Wars are often used to identify government spending shocks in estimating fiscal multipliers based on the assumption that military spending during major war episodes is not driven by economic concerns. Large wars, World War II and the Korean War in particular, have played a critical role in the literature of the aggregate fiscal multiplier because of their overwhelming statistical power in identifying government spending shocks. Hall (2009), for example, concludes that essentially all the identifying power in estimating government purchase multipliers from 1930 to 2008 comes from the large movements during the Second World War. Using historical news records to account for the expectation effects of government expenditures, Ramey (2011) discovers as long as WWII or the Korean War is included in the sample, the constructed defense news measure has significant explanatory power and is a strongly relevant instrument. When the two wars are excluded, however, the defense news variable becomes not informative, which motivates her usage of professional forecasts as an alternative approach to estimate the fiscal multipliers during the post-Korean War era.

Despite the overwhelming identifying power associated with the huge swings in military expenditures, the scale of the fiscal multipliers during major war episodes themselves is often estimated to be small. This is especially the case in terms of WWII, which is widely viewed as the quintessential example of fiscal stimulus. In fact, numerous studies in the literature using one of the two main approaches in identifying government spending shocks have observed a limited and below-unity fiscal multiplier associated with WWII.

The first branch of the main approaches is generally associated with the work of Blanchard and Perotti (2002), Berndt et al. (2009), Fatas and Mihov (2001), Gali et al. (2007), Mountford and Uhlig (2002), Perotti (2002, 2007), and etc. To identify a government spending shock, this method directly imposes a timing restriction on government expenditures in a vector autoregression (VAR), where the government spending is ordered first. By imposing such restriction, one would implicitly assume that the economy will not response ahead of the spending through forming any type of expectation. Among other similar studies using this approach, Hall (2009) performs a parsimonious, one-period difference VAR analysis to estimate the fiscal multiplier in the U.S. since the 1930s. He finds that a lower bound for the GDP multiplier during 1930–2008 is around 0.5. Yet, the output multiplier for 1939–1944 reduces to 0.36.[1]

[1]The GDP multiplier would increase to around 0.53 with strong statistical significance when the sample is expanded to 1939–1948 beyond the war years themselves. The significance will be lost as long as WWII is excluded from the estimation sample, which leads to Hall's claim that essentially all the identifying power comes from WWII.

To account for the possibility that exogenous government spending shocks arrive in expectations, the second main method implemented by the literature employs a narrative approach and uses historical records to construct a measure of government spending news. Works follow this line of the literature include Ramey and Shapiro (1998), Edelberg et al. (1999), Burnside et al. (2004), Cavallo (2005), Eichenbaum and Fisher (2005), Ramey (2011), and etc. As a notable example of the narrative approach involves WWII, Ramey (2011) creates a series of defense news based on both historical news records, such as those from *Business Week*, and professional forecasts to control for the expected government spending. She estimates a slightly above-unity output multiplier (1.1) for the full sample of 1939–2008, but the multiplier drops to 0.7 for 1939–1949.[2]

Aside from the two main approaches, Brunet (2018) uses a state-level panel with detailed war supply contracts issued by the U.S. government during 1940–1945 to estimate an open economy relative multiplier of WWII. She finds a relative fiscal multiplier of around 0.25, which implies an aggregate multiplier of around 0.3, a result consistent with the finding from Hall (2009) using the sample of 1939–1944.

In addition to Brunet (2018), many existing studies, such as Higgs (1992), Gordon and Kreen (2010), Fishback and Cullen (2013), Barro and Redlick (2011), Ramey and Zubairy (2018), and etc. have provided evidences that the impacts of fiscal stimulus during major military conflicts, such as WWII, are in fact rather limited. One potential explanation, as proposed by Hall (2009) and Brunet (2018), lies in the special command economy environment during a major war, which is especially the case for WWII. Imagine the textbook New Keynesian multiplier $1/(1 - MPC)$ as a demonstration. During a major conflict, parts of the government expenditures can be spent on converting civilian production to produce for the war effort, instead of going directly into output. This means the numerator of the multiplier would be smaller than 1. At the same time, the marginal propensity to consume for civilians can be constrained by consumption rationing orders, high inflation and/or income tax environment, a strong Ricardian motive associated with a hike in public debts, etc. This would push up the denominator in the multiplier. Together, we can see a depressed fiscal multiplier within major military spending episodes.

Although a reasonable explanation, the current literature associated with the main approaches is subject to several potential concerns. To start with, by focusing only on the periods

[2] The output multiplier for the post-WWII sample is estimated to be around 0.6 to 0.8, though the data source of Ramey's defense news series switches from historical news to professional forecasts during the post-Korean War period, when the historical news lose explanatory power and become not informative.

of major military spending, one may overlook the expectation that a large war would come. In the context of a world war, economic agents can form a relatively long-term expectation about the arrival of the war and start to response to such expectation even before the arrival of defense spending news, such as those in Ramey (2011). If this is the case, important responses in the economy before major military spending could be overlooked.

Furthermore, while the usage of macroeconomic related variables is a standard practice in the literature, these variables may miss potential response channels within an economy facing a major government spending episode. Brunet (2018), for example, uses state-level personal income as a measure of the state-level GDP. The personal income data, however, does not include profits retained and reinvested by firms, which would be recorded as retaining earnings under shareholders' equity on the balance sheet of the firms. An increase in retained earnings can lead to a faster growth of the firms, reflected by a higher return in the stock market. We in fact have evidences that the stock market tends to outperform its long-term average during major wars (Armbruster, 2017).

In the end, by using defense news with a narrative approach to capture the changes in anticipated government spending, one would need to assume that the spending can be known and discounted with a relative certainty. Moreover, the arrival date of the news needs to be accurately selected so that no relevant information can be learnt before the news arrival. In an environment leading towards a major military conflict, however, these assumptions may not be true. In specific, the economy can be characterized with an increasing anxiety during the days before an open conflict. Economic agents can form and begin to response to an expectation about the upcoming war before the defense spending can be known with certainty. In addition, agents could response to false expectations that never materialize. Neglecting the complete picture of these expectation effects may skew the magnitude and persistence of economic responses to a government spending shock.

Using statistical innovations in the excess returns of the top U.S. military contractors in the stock market to identify government spending shocks, Fisher and Peters (2010) develop a novel approach as an attempt to better capture the expectation effects of government military purchases. They estimate an output multiplier of about 1.5 over a horizon of five years based on the U.S. primary military contracts available during the post-Korean War period (1958–2007). Compared with the results from Ramey (2011), Fisher and Peters (2010) show that after a shock in the accumulated excess returns of the top defense contractors, government spending begins to rise in a much timely manner, while output slightly declines in the first five quarters without a statistical significance, then rises with a hump-shape for the rest of the five years.

Overall, Fisher and Peters (2010) report a multiplier with a much stronger scale and persistence compared to most of the estimates from the studies associated with the main approaches.

This finding in turn opens up a debate in the literature of aggregate fiscal multiplier regards the nature of the stock market-based identification approach. On the one hand, Fisher and Peters (2010) estimate a substantially higher multiplier over the post-Korean War sample, where most of the studies using the main approaches suffer from a lose in statistical significance. On the other, Fisher and Peters never extend their analysis back to the WWII era, which arguably has the largest identifying power and is relatively well-studied by the existing literature. As a result, it is difficult for us to directly compare the performance of the stock market-based approach with the rich results available from the other studies.

The objective of this study is to bridge the gap of the literature by applying the stock market-based approach back to the WWII era and compare its performance with the output multiplier estimated using Ramey's defense news shocks. Of course, an empirical challenge of my analysis is the fact that the modern defense industry in the U.S. was largely non-existent back in the WWII era. In fact, during the war, the U.S. government had to convert a staggering portion of the civilian economy to produce for the war effort.

To address this challenge, I turn my attention a 1946 congressional report that meticulously documents the economic activities of each industry sector in the U.S. by SIC code both before and during the war. The report also includes valuable information on the distribution of the U.S. government purchases over the same period among industries and among the leading companies within each industry. Based on the 1946 report, together with other historical evidences, I classify the public aircraft manufacturing and shipbuilding companies during the WWII era as the equivalent defense sector used in Fisher and Peters (2010). I also present evidences from the stock market that the excess returns of the aircraft and shipbuilding companies as a group were indeed driven by shocks in the expected government military purchases during my sample period of 1936–1947. For the other companies that also received substantial military contracts at the same time, I find their excess returns were confounded by idiosyncratic shocks related to the movements in the civilian economy.

Admittedly, my classification of the WWII defense sector is not perfect. Yet, it can offer me a group of firms whose excess returns in the stock market were dominantly driven by the exogenous shocks in the expected government expenditure. This feature will allow me to achieve an identification in estimating the output elasticity with regards to government spending, which is the key to test the performance of the stock market-based approach back in the WWII era.

With my definition of the defense sector, I then estimate the fiscal multiplier associated with WWII using the complete stock market records from CRSP, monthly historical data on the U.S. industrial production and federal budget expenditures, and the original quarterly GDP and government spending measures from Ramey (2011). Based on my complete sample of 1936–1947 that incorporates important early expectation formation regards the upcoming war, I estimate an output elasticity with regards to the federal government spending at around 0.276, which is highly consistent to the 0.3 output elasticity with regards to total government spending reported by Fisher and Peters (2010) over the post-Korean War sample. In addition, the shape of the responses of my government spending and output measures to a positive shock in the excess returns of the defense sector is equivalently persistent compared to the response patterns observed in Fisher and Peters (2010). Due to the special economic environments of WWII characterized by a high nominal government spending share of GDP, the 0.276 output elasticity implies a fiscal multiplier of around 0.72, which is in turn consistent with the 0.7 output multiplier estimated by Ramey (2011) over the sample of 1939–1949.[3] All of my estimates stay robust when I convert the monthly data into a quarterly level.

When comparing the performance of the stock market-based approach with the defense shocks, I use the original quarterly GDP and government spending measures developed by Ramey (2011), together with the defense news series. Since the beginning point of Ramey's data is 1939, I reduce my estimation sample correspondingly to 1939–1947. Given that the VAR implemented in Ramey (2011) controls for 4 or 5 lags, the regression sample effectively starts in 1940, which means all the expectations about the upcoming war before 1940 will either be excluded from the estimation or enter the regressions as controls. Based on this sample, the output elasticity with regards to the total government spending estimated using Ramey's defense news measure is around 0.21. The same output elasticity evaluated using the excess return shocks of the defense sector is around 0.208. Both approaches again imply a fiscal multiplier of around 0.72 over the sample period.

However, by reducing the estimation sample, the responses of government spending and output to the excess return shocks lose most of the statistical significance and become much less persistent. In fact, by excluding or controlling the potential long-run expectations before 1940, the stock market-base approach yields a significantly negative response in both the output and government spending for about five quarters after receiving a positive, one-standard-deviation shock in the excess returns. To further investigate the nature of the dips in the responses, I

[3] I choose to end my estimation sample in Dec. 1947 to exclude the expectation regards the drastic military buildup related with the Cold War starting in 1948, in consistent with what Kofsky (1993) calls the "War Scare of 1948."

show that the dips would disappear by lagging the excess return series and assuming that the expectation formed by the defense sector in the market become public news four quarters later. Moreover, by lagging the excess return series, the output and spending responses become both highly statistically significant and strongly persistent as what I have observed from the full sample. In terms of the sample of 1939–1947, I also demonstrate that one can replicate the shape of the responses from the stock market-based approach by forwarding Ramey's defense news series and assuming the defense news around the time of Pearl Harbor was somehow anticipated in 1939.

Naturally, the two shock series are not identical after shifting. Yet this exercise can provide evidences that shocks in the excess returns of the defense sector can be treated, in a way, as a leading indicator of the defense news, which itself is a leading indicator of the actual military expenditures. More importantly, my exercise indicates the importance in timing when using the stock market-based approach in identifying government spending shocks, a theme echos the title of Ramey (2011). Furthermore, the stronger persistence of the responses from the excess return shocks, when appropriately controlling for the horizons of the expectations, can hint the existence of additional expectation effects that are yet to be captured by the existing literature associated with the main approaches.

Besides the implications directly speak to the literature of the aggregate fiscal multiplier in identifying government spending shocks, the results of this paper can be linked to several broader topics of the literature. To begin with, the starting point of my study is to apply the stock market-based approach in WWII and test its performance with the results from the existing studies. My analysis shows that the magnitude of the output multiplier estimated using the excess return shocks is largely in line with the figure reported by the main literature, though the persistence of the economic responses to a government spending shock is stronger. The stronger persistence of the economic responses is in turn consistent with the findings from Fisher and Peters (2010) and suggests the influence of additional expectation effects. Together, these results can help us better understand the mechanism behind the relatively large fiscal multiplier estimated by Fisher and Peters (2010) over the post-Korean War sample. They can also provide supports for an increase in confidence in Fisher and Peters's estimates.

To the extend that my current findings indicate both the narrative and the stock market-based approaches yield a consistent estimate on the output multiplier during WWII, an interesting question is whether the excess return shocks can identify an increase in consumption and real wages. Studies applying the narrative approach tend to find supports in line with the neoclassical model, where output and hours rise and consumption and real wages fall after a spending shock. While Fisher and Peters (2010) provide evidences agree with the New Keynesian approach, in which consumption and real wages increase with output and hours after a jump in government spending. Given that I have achieved a consistent measure on the output response using both the defense news and excess return shocks, extending my current analysis to include other macroeconomic variables could be a fruitful direction of expansion with useful theoretical implications.

In addition to the different approaches in identifying government spending shocks, there is a sizable body of the literature applying shocks in military expenditures to examine other important aspects of the fiscal multiplier. Among other studies, Nakamura and Steinssion (2014) use prime military supply contracts to develop and estimate the open economy relative multiplier. Auerbach and Gorodnichenko (2012) and Ramey and Zubairy (2018) investigate the performance of fiscal policy under different states of the economy. Auerbach and Gorodnichenko (2013) analyze the output spillovers of government purchases. Because my analysis suggests economic agents can form expectations at various horizons and timing is important to capture the complete expectation effects, the results of this paper may suggest the value of using stock market to better control for the expectation effects when evaluating the impacts of fiscal policy at a different context.

Finally, from an economic history perspective, my research can directly contribute to a better understanding to role of fiscal stimulus in the U.S. economy during the Second World War. Since WWII is widely considered as the quintessential example of fiscal stimulus in the form of temporary government purchases, and since most of the U.S. government spending episodes take the form of temporary government, an improved understanding of the effects of fiscal policy during WWII is important for both history and policy considerations. By showing that both the stock market-based and narrative approaches point to a fiscal multiplier of around 0.7, my study reinforces the insights shared by Brunet (2018) that the fiscal multiplier during WWII was depressed to below unity due to the special wartime economic environments. This result is also consistent with views from Higgs (1992), Gordon and Krenn (2010), Fishback and Cullen (2013), etc. Moreover, by examining the stock market performance of different industry sectors before, during, and after the war, my research can contribute to the literature studying the capital market performance during major military conflicts (Ciccone and Kaen, 2016; Schneider and Troeger, 2006; etc.) and the connections between wartime economic activities and the post-war reconversion experiences (Rhode, 2003).

The remainder of the article proceeds as follows. Section 2 describes the identification of the defense sector. Section 3 describes the stock return variations of the relevant sectors. Section 4 discusses the estimation methodology. Section 5 presents the main results, and Section 6 offers conclusion remarks.

2 The Identification of the Defense Sector

The key of applying the stock market-based approach from Fisher and Peters (2010) in identifying government spending shocks is to locate a well-defined defense sector. Ideally, the excess returns of the defense sector relative to the overall market returns should be driven predominantly by the market expectations regards government military expenditures. During the period of a major war, changes in government military spending should be based primarily on the ground of the war effort, instead of economic concerns. These exogenous shocks in government purchases can then be captured by the defense sector's excess returns if the market is sufficiently efficient.

However, an empirical challenge in implementing the stock market-based approach during the Second World War is that the modern defense industry in the U.S. was largely non-existent back in the WWII era. In fact, the entire U.S. economic environment during the war was characterized by several very special conditions that the country has rarely seen again till this day. In order to find an appropriately classified defense sector, it is therefore necessary for us to understand the very special wartime environment characterized the U.S. economy back in the WWII era, which will be introduced in the coming section.

2.1 The Special Economic Environment during WWII

The first characteristic of the U.S. economy during the war is the enormous increase in government defense spending. As Figure 1 demonstrates, even the military buildup during the Cold War and the spending for the Iraq War we consider so large today are dwarfed by the increase in military expenditures during WWII. Such a drastic surge in government purchases makes WWII the quintessential example of fiscal stimulus.

The second feature of the wartime economy is that, despite the gigantic upswing in military spending, there was not a well-developed defense industry specialized in producing for the military demand. In fact, before Pearl Harbor in December 1941, the U.S. defense industry was largely non-existent, not to mention being prepared for a total war (Nelson, 1946). As a result, the U.S. government had to rely upon converting a significant portion of the civilian economy to produce for the war effort. One of the most notable examples is the total conversion of the automobile industry. In early February 1942, the civilian purchases of automobiles were banned through a consumption rationing order[4]. The entire industry was then converted to engage military production and the normal production for civilian sales did not resume until near the end of the war in the summer of 1945 (Mansfield, 1948).

The fact that the wartime production conversion was critical for the war effort can also be seen from President Eisenhower's farewell address on January 17, 1961:

> Our military organization today bears little relation to that known by any of my predecessors in peacetime, or indeed by the fighting men of World War II or Korea. Until the latest of our world conflicts, the United States had no armaments industry. American makers of plowshares could, with time and as required, make swords as well.

As would be mentioned in the next section, the wartime production conversion was intense and widespread. In a sense, almost all areas of the U.S. economy were involved to contribute for the war effort.

In addition to the two main characteristics, there is a series of other conditions that distinct the behavior of the U.S. economy during WWII from the peaceful era. These conditions can be summarized as follows: 1) An extensive sequence of consumption rationing orders with a strict price and wage control. 2) A near ZLB interest rate environment combining with an expansionary fiscal policy and rising inflation intentionally created as a coordinated move for the war effort. 3) A high corporate and individual income tax environment despite that the war was primarily financed through debt issuance. 4) A strong saving boom in the form of war bond purchases fueled by patriotism and economic constraints.

Together, the special wartime economic environment can suggest a depressed fiscal multiplier during the days when the U.S. actively engaged in the conflict, that is, from December 7th, 1941 (Pearl Harbor) to September 2nd, 1945 (the V-J Day). Imagine the textbook New Keynesian multiplier $1/(1 - MPC)$ as a demonstration. During the war, a large chunk of the government expenditures need to be spent on the wartime production conversion as well as the reconversion to civilian production when the war was about to come to an end. These resources would not be used to directly generate output, which means the numerator of the multiplier would be smaller than 1. Meanwhile, the marginal propensity to consume for civilian populations could be constrained by the consumption rationing orders, the high inflation and tax environment, a strong Ricardian motive associated with the surge in public debts, and so forth, all of which

[4] The Rationing Order No.2 (OPA, 1942).

would push up the denominator. Combining both considerations, the fiscal multiplier during WWII could be severely constrained, as argued by Brunet (2018), Fishback and Cullen (2013), Gordon and Kreen (2010), among others. Given that the stock market-based approach tends to yield a well above-unity multiplier during the post-Korean War period, it is interesting to see if the same approach can provide a consistent estimate compared to the figure reported by the existing literature when applied back to the sample of WWII.

However, the special economic conditions also impose two serious concerns. The first concern is if there was not a true defense sector and all companies who produce for the war effort were converted from civilian production, then the excess returns of the "defense sector," especially during the period before the war, will almost certainly have components related with economic concerns. These components will directly make the identified government spending shocks endogenous. Secondly, if the "defense sector" contains almost all producers in the market, then the sector's stock returns would simply track the overall market performance and there would be no variation in the excess returns to begin with to identify the government spending shocks.

On the other hand, if we can find an appropriate defense sector that meets the requirement of the stock market-based approach, then the special economic environment of WWII can become a blessing. To the extend that many moving parts in the economy associated with the evaluation of a fiscal policy, interest rates, wages, and prices in particular, were explicitly controlled for by the government upon the outbreak of the war, WWII can offer a set up of a natural experiment when examining the impacts of government spending. In addition, if the excess returns of the defense sector are predominantly driven by the expected government military purchases even without any government control, the confounding factors such as civilian sales would be even less of a concern, if any, upon the outbreak of the war due to the strictly implemented consumption rationing orders. Given the importance of finding the correct defense sectors, I spend the next three sections explaining my classification procedure.

2.2 Identifying the Defense Sector through War Supply Contracts

To address the empirical challenge of locating the appropriate defense sector, I turn my attention to a 1946 congressional report, titled as *Economic Concentration and World War II*. The report was prepared by the Smaller War Plants Corporation for the Senate Small Business Committee to examine the economic concentration and activities of the U.S. before and during the Second World War. The report meticulously documents the economic activities of each industry line in the U.S. by SIC code and includes valuable information on the distribution of the U.S. government purchases during the WWII era. The information on the distribution of the government purchases is of particular importance, as it records the defense related procurement from all branches of the government among all industries as well as the leading companies within each industry both before and during the war.[5]

The first lesson I obtain from the report is that, during the war, the U.S. economy can be generally divided into war and nonwar industries. The war industries, such as iron and steel, machinery, aircraft and shipbuilding, petroleum and coal, etc., include the production of products that are directly related with military actions. The nonwar industries, such as food and allied products, tobacco, textiles and apparel, lumber and furniture, etc., cover outputs that can either indirectly support military actions or are not closely related with the war effort.[6]

The second lesson I acquire is both the war and nonwar industries received a substantial amount of supply contracts from different government procurement agencies during the conflict. For the war industries, most, if not all of, the government purchases came from the war supply contracts issued by the War Production Board. For the nonwar industries, government procurement generally took the form of various types of supply contracts issued by the Quartermaster Corps of the War Department. That is to say, at the same time General Motors was awarded war supply contracts to build tanks and bomb shells, textile manufacturers also received procurement arrangements and enjoyed a primary allocation of strategic agricultural resources, such as cotton, to supply the army with uniforms. According to the report, the Quartermaster Corps was the largest procurement agency during the war.

What makes the war and non-war industries different is that, compared with the supply contracts distributed by the Quartermaster Corps, the issuance of the war supply contracts within the war industries was much more heavily concentrated and usually took place after an extensive period of negotiation for a guaranteed profit. From June 1940 through September 1944, around $175 billion ($175,000,000,000) worth of prime supply contracts were issued to 18,539 corporations by the War Production Board.[7] Among the $175 billion worth of the

[5]From the report perspective, the U.S. joined the war on December 7th, 1941. The majority of the information covered by the report goes back to 1939 or 1935. The report also contains statistics for output, employment, and merger movements of certain industries back to 1909 or 1919.

[6]The complete list of the war industries highlighted by the report includes iron and steel and their products, metal products (electrical machinery, machinery excepts electrical, transportation equipment excluding aircraft and shipbuilding, aircraft and shipbuilding), products of petroleum and coal, rubber products and synthetic rubber, and chemicals and allied products. The complete list of the nonwar industries highlighted by the report includes food and allied products, tobacco, textiles and apparel, leather and leather products, paper and paper products, printing and publishing, lumber and furniture, and stone clay, and glass products.

[7]The figures relating to the awards of the prime war supply contracts are based upon prime awards of $50,000 and over reported to the WPB by the Army, Navy, Maritime Commission, Treasury Procurement Division, and purchasing missions of foreign governments. Lend-lease and defense aid contracts awarded by the above agencies are included. Treasury awards include only such contracts. The record does not include contracts for gas, light,

contracts, around 62% were awarded to the top 100 corporations. More than 51% worth of the contracts went to the top 33 companies, each of which received awards totaling $1 billion or more. Around 30.1% worth of the contracts were issued to the top 10 firms, around 20.3% were issued to top 5 firms, and General Motors, which is the top 1 contractor, received around 8% worth of the total awards. Among the top 5 corporations, three are aircraft companies (Curtiss-Wright Corp., Consolidated Vultee Aircraft Corp., and Douglas Aircraft Co.) and two are automobile manufacturers (General Motors and Ford Motor Co.). The top 10 contractors cover the industry lines of aircraft, shipbuilding, and automobile manufacturing.[8] In addition, the report finds no significant change in the concentration of the contract awards between 1941 and 1944.

The fact that a detailed negotiation for profits usually precedes the issuance of the war supply contracts can also be witnessed by historical records regard the situation back in 1940. Holly (1964), for instance, summarizes the demands faced by the Army Air Forces in 1940 during their material procurement:

> They [businessmen] wanted escalator clauses to protect them against unanticipated increases in the cost of labor and materials; they refused to sign liquidated damage clauses that would penalize them for belated deliveries; and, they were reluctant to include the usual option clauses granting the government the right to procure further increments of aircraft in the future at stated prices.

In contrast, though totaling to a substantial sum, the procurement arrangements made by the Quartermaster Corps were significantly less concentrated, potentially due to a more diverse nature of the nonwar industries. Based on the data provided by the congressional report, in 1944, the top 7 cotton textile manufacturers only received a grand total of around $128.79 million worth of the supply contracts. This number can be viewed as relatively small, considering 1944 is a year when the government expenditures reached its peaks during WWII and the cotton textile industry, according to the report, is one of the more concentrated nonwar industry lines.

heat, power, and similar utility services, contracts for food or food processing, and contracts for construction or expansion of production facilities.

[8] The top 10 contractors, ranked by the value of the awarded contracts, are General Motors, Curtiss-Wright, Ford Motor, Consolidated Vultee Aircraft, Douglas Aircraft, United Aircraft, Bethlehem Steel (shipbuilding), Chrysler, General Electric, Lockheed Aircraft. In addition, the top 50 contractors include most of the important shipyards or ship manufacturers, such as Kaiser, Henry J. Co, Newport News Shipbuilding & Drydock Co., Todd Shipyards Corp., Aviation Corp. (New York Shipbuilding Corp.), California Shipbuilding Corp, Bath Iron Works, etc. The complete list of the top 100 corporations with the awarded contracts is attached in the appendix (see Figures A1 and A2).

As a result, if I classify the defense sector using industries that had ever received government military purchases or were influenced by the consumption rationing orders during the war, it is more than likely that my defense sector will include a majority of the firms in the market. As mentioned earlier, this would fail to meet the identification requirements for the stock market-based approach. On the other hand, the top contractors from the aircraft, shipbuilding, and automobile industries seem to offer a promising definition for the defense sector. Because of the staggering degree of concentration of the prime war supply contracts, together with the extensive negotiations before the contract awards, it is likely that the excess returns of this group of firms were heavily affected by the expected government military spending during the war or since 1940.

However, a high concentration of the prime contract awards may mask the distribution of the profits among firms within the same production network. A strong influence of the expected military purchases in the excess returns may coexist with significant components concern the performance of the civilian economy. These concerns will be addressed in the subsequent sections.

2.3 Subcontracting Activities

To examine whether the profits generated from the prime supply contracts were shared by producers in the same production network, I further investigate the subcontracting activities within the war production.

Under the system of procurement adopted at the very beginning of the war effort, prime contractors were given the complete responsibility to obtain the materials, components, and parts needed to produce the final output for which they had been awarded the prime contract. This means, of course, that the figures on the prime contract awards could overstate the concentration of the war production, since a portion of the prime contracts was passed down to other firms in the form of subcontracts.

To evaluate the intensity of the subcontracting activities, I follow a survey conducted by the Smaller War Plants Corporation in 1943, which is documented in the congressional report. This survey contains the prime and subcontracting records of 252 of the largest corporations in the U.S. that received the great bulk of the prime contract awards. It is found in the survey that these companies subcontracted 34% of the value of their prime contracts, but three-fourths of the value of these subcontracts went to other large companies (firms with over 500 employees by the standard of the report) in the relevant production lines. The large company subcontractors, in turn, passed along 13% of their subcontract business to further subcontractors. 56% of these lower-tier subcontracts were received by other relevant large firms. Overall, the survey concludes that the majority value of the prime contracts awarded to the large companies in fact stayed within a group of similarly large firms. In addition, there existed substantial subcontracting activities among the large companies within the same production network.

The evidences so far suggest that a high concentration of government purchases occurred and remained within the scope of public aircraft, shipbuilding, and automobile companies during WWII, rather than being intensively subcontracted away to other smaller firms. Meanwhile, the entire industries as a group, instead of only the top contractors, would feel the heavy influences of the government spending due to both the concentrated prime contract awards and the significant subcontracting activities within the relevant production lines. This point can be further reinforced by the fact that the U.S. government was the dominant, if not the only, customer of the aircraft, shipbuilding, and automobile industries during the conflict, given the strict consumption rationing orders effectively preventing civilian sales.[9] Therefore, to better capture the expectation effects on government military expenditures, it is reasonable for me to take the excess returns of the public companies in the aircraft, shipbuilding, and automobile industries as a group into consideration.

2.4 Other Historical Evidences

Now that I have suggested the public aircraft, shipbuilding, and automobile companies as the potential candidates for the defense sector, it is important to check if their excess returns were primarily driven by the expected government military expenditures without confounding factors, especially during the periods before and around the end of the war. In this section, I consult evidences from other historical sources to show that the excess returns of the aircraft and shipbuilding companies can in fact meet the identification requirements of the stock market-based approach. The returns from the automobile industry, however, are confounded by factors related with the performance of the overall economy. These evidences are then reaffirmed in the next section through examining the stock market returns of the relevant sectors during the WWII era.

The first branch of the evidences come from event studies investigate the profitability of the U.S. defense contractors during WWII. Ciccone and Kaen (2016), for example, record that, during the years leading to the U.S. entered into the conflict, whenever there were news

[9]The automobile industry was completely converted to war productions under the Rationing Order No.2. The civilian sales in the aircraft and shipbuilding industry were almost impossible during the war, because all strategic resources needed to build or use the output, such as iron, steel, tin, fuel oils, etc., were under strict rationing and generally could not be accessed for any civilian purpose.

regard the U.S. military buildup, they would always contain information about the aircraft and shipbuilding industry. When the 1934 Vinson-Trammell Act initiated the start of the U.S. military expansion of the WWII era, the Act was about expanding naval construction that would make the U.S. fleet equal to the British. The Act also imposed profit limitations on the aircraft and shipbuilding companies for their sales to the military to prevent war profiteering. These limitations would eventually be replaced with much favorable conditions to expedite the defense buildup by the Naval Act of 1938. In 1938, when Roosevelt leaked his plan for further military expansion, the plan was about to add 10,000 planes to the Army Air Corp. In May 1940 before the Fall of France, when Roosevelt urged the Congress to accept his request to further expand the military, the request was to add another 50,000 planes to the U.S. army. On the other hand, it was not until the Defense Buildup period, the period between the Fall of France in 1940 and Pearl Harbor in 1941, the War Production Board started to negotiate with the business leaders in the automobile industry about the possibility of converting civilian production lines for military purpose (Nelson, 1946).

As for the stock market returns, Kaen (2012) and Ciccone and Kaen (2016) point out that the stock returns of the aircraft and shipbuilding sector did not suffer too much additional losses relative to the overall market return during the recession of 1937–1938, because the sector's civilian demand was not yet recovered from the Great Depression to begin with. Instead, since the transition period from March 1935 to March 1938, a period marks a change in attitude in the market from pacifism to war anxiety, the returns of the aircraft and shipbuilding sector began to be driven by the anticipation on the upcoming war and the potential arrival of large defense sales. In particular, the returns of the aircraft manufactures were driven by export sales in 1939, which had reached $194.2 million, accounting for around 44% of the year's total sales (Vander Meulen, 1991). The export sales are an important concern in using the excess returns to identify government spending shocks, since these sales are driven by foreign demand, instead of the U.S. government purchases. However, the export sales soon collapsed one year later at the Fall of France. From then on, the majority of the foreign sales took the form of the lend-lease, which was counted towards parts of the U.S. government expenditures. Although the existence of foreign sales introduce a confounding factor, these sales were still not driven by economic concerns in the U.S. Furthermore, the degree of concern should be mostly mitigated by the record-breaking U.S. military spending and the short-lived nature of these foreign exports.

Aside from the observation that the returns of the aircraft and shipbuilding industry were primarily driven by the expected defense sales before Pearl Harbor, the sector's stock returns started to decline upon the U.S. joining the war and the expected issuance of the supply contracts materialized. This downturn in the returns occurred at the same time when most of the aircraft and shipbuilding companies enjoyed an improved accounting profit. Ciccone and Kaen (2016) explain that this phenomenon is caused by the expectation on the temporary nature of the government military expenditures. Investors believed once most of the defense contracts were awarded, the civilian demand would not catch up after the war.

The returns from the automobile manufactures paint a quite different picture. To begin with, it was well-documented that the auto industry suffered substantial losses during the recession of 1937–1938 due to a loss in auto sales, or the durable consumption in general. Kaen (2012) documents that the returns of the automobile sector recovered in 1938 upon the end of the recession, before starting to decline again in the final days leading to the Pearl Harbor. During this period, a widespread concern presented in the market fueled by a rising anxiety over losing sales upon entering an all out war. The returns of the auto industry would start to bounce up upon the industry was converted to produce for the war effort, which replaced the loss of wartime civilian sales with a guaranteed profit from the supply contracts. As shown in Kaen (2012), such a rise would continue till the end of the war, as investors were expecting a boom in the economy due to the pent-up wartime consumption demand.

Overall, the existing event studies provide solid concerns that the excess returns of the automobile companies can include components significantly correlated with the expected performance of the civilian economy. These concerns make it likely that the identified government spending shocks would be endogenous. Meanwhile, for the aircraft and shipbuilding sector, WWII, in a sense, acts like a natural experiment. The sector's excess returns were predominately driven by the drastic swings in the defense expenditures during the WWII era. The effects of the civilian demand were not influential before the war to begin with, thanks to the Great Depression, while the civilian sales were not expected to catch up after the war because the defense purchases during the war were too high, as explained by Ciccone and Kaen (2016).

The point that the civilian demand of the aircraft and shipbuilding sector did not increase after the war, despite a recovering economy, agrees with the literature about the U.S. post-war reconversion experience. As Rhode (2003) discovers, the employment in the manufacturing sector on the U.S. West Coast fell sharply in 1945, but almost all of the contraction was from the aircraft and shipbuilding sector. Many of the other war industries, such as chemicals, petroleum, rubber tires, and automobile manufacturing recovered quickly after their initial cutback in the wartime military demand. Meanwhile, growth in the non-war industries, most notably in retail stores, offsets the decline in the war industries to a far greater extent than was expected by the state government since 1943.

The aircraft industry on the West Coast suffered a severe contraction between 1945 and 1947, but soon activities stabilized at a level above the pre-war production, owning to a resumption of military orders since 1948. The shipbuilding sector, however, virtually collapsed. For several years after mid-1947, the industry received no orders for new ships and performed only repair work.

The experiences from the U.S. West Coast, which may not be identical to the situation in the U.S., can at least provide evidences that the nature of the aircraft and shipbuilding industry during the WWII era has a fundamental connection to the government military demand. Considering the aircraft and shipbuilding sector were heavily concentrated on the West Coast even before the war and many of their factories had not been converted from peacetime production but had been constructed as the conflict raged (Rhode, 2003), we can have further confidence in these evidences.

Finally, the last piece of evidence for using the aircraft and shipbuilding companies as my defense sector comes from the definition of the modern defense sector used by Fisher and Peters (2010). Upon replicating the stock market sample for the list of SIC codes they deem to have a clear military focus from 1958–2007, I find that the top 5 subsectors of the SIC codes are: Aircraft and Parts (SIC 3720), Aircraft Parts and Auxiliary Equipment (SIC 3728), Aircraft (SIC 3721), Aircraft Engines and Engine Parts (SIC 3724), and Ship And Boat Building (SIC 3730). Together, these sectors form 77.57% of the sample for the modern defense sector. Perhaps such a strong relation with the defense business has its root back in the WWII era.

Based on the evidences presented in this section, I conclude it is reasonable to consider that the excess returns of the public aircraft and shipbuilding companies during the periods associated with WWII were dominantly driven by the expected government military expenditures. Thus, they can be used to identify the exogenous government spending shocks. I provide direct supports in the next section by examining the stock market returns of the relevant sectors.

3 Fluctuations in the Stock Market Returns

The stock market data used in this analysis comes from the complete monthly records of CRSP that includes all public companies in the market from January 1936 to January 1950. I choose to start my sample in 1936, since it is early enough to cover the transition period from 1935 to 1938 and the recession of 1937-1938. As documented by Kaen (2012) and Ciccone and Kaen (2016), the period between 1935 and 1938 witnesses a change in attitude from pacifism to war anxiety both in the U.S. economy and in the stock market. If the excess returns of a section were driven by expected defense sales, we should expect an increase at least after this period. The recession of 1937-1938, on the other hand, can sever as an useful check point to see if the excess returns were heavily influenced by economic concerns.

The sample of the market return plots ends in January 1950 to allow us observe the market responses after the War Scare of 1948. As Rhode (2003) and Ciccone and Kaen (2016) point out, the aircraft and shipbuilding industry experienced a severe decline soon after the end of the conflict upon realizing the loss of demand. The depressed industry was saved in 1948, at least for the aircraft manufactures, after Truman and his associates arguing for the need to contain Soviet expansion and inaugurating a military buildup.[10] If the excess returns were dominated by the expected government purchases, this event should mark a turning point in their performance. At the same time, since the War Scare of 1948 was more related to the Cold War buildup, I stopped my regression sample in December 1947 to focus on the expectation effects during the WWII era.

Following Fisher and Peters (2010), the stock market returns used in this paper are calculated as follows. For any group of firms, the monthly returns of the group are calculated as the market-value-weighted sum of the total holding period returns of the individual stocks in the group during any given month. The total monthly holding period return of any individual stock is fully adjusted for splits, dividends, and inflation. I use the market value at the beginning of the month to weight the monthly holding period returns of the individual stocks. The overall market returns are computed similarly as the market-value-weighted sum of the monthly returns of all publicly traded companies in the market. For any given month, the excess return of a given group of firms is defined as the difference between the monthly holding period return of the group and that of the market. Since the excess returns are often noisy and can mask important low frequency movements, I focus on the accumulated excess returns in my analysis consistent with the practice of Fisher and Peters (2010).[11] For the remaining of this paper, the accumulated excess returns are normalized to 1 in the first period of observation of any given sample for ease of comparison.

3.1 Historical Dow Firms

To start the analysis, Figure 2 plots the accumulated monthly holding period returns and the accumulated excess returns of the historical Dow firms.[12] I choose to start my analysis with the

[10] As a related note, the Berlin Airlift began in June 1948 and lasted till May 1949.

[11] The accumulated excess returns are calculated by accumulating the excess returns over each month, where each excess returns are computed based on the corresponding monthly holding period returns.

[12] The Dow firms include the historical components of the Dow Jones Industrial Average from 1936 to 1957.

Dow firms because doing so can help us understand the baseline performance of the market. Also, it is important to see to which degree the excess returns can be explained by the size of the firms during the WWII era.

As shown by Figure 2, Panel A, the performance of the Dow firms in fact tracks the overall market returns in a very close manner, suggesting the size of the firms did not play a critical role in driving the returns during the sample. In addition, we can see that the market performance reflects the economic conditions during this era. In particular, the market experienced a significant downturn during the recession of 1937-1938, before bouncing back in mid-1938. Then there was a general decline following the Fall of France in 1940 till around the first quarter of 1942, indicating a spread of concerns about the performance of the economy during an all out war. Once the majority of the supply contracts started to flow from the government, however, the market entered a stage of "war boom" and continued to rise until after the end of the war, fueled by the expectations on a post-war economic recovery and the release of the pent-up consumption demand. The rapid growth in the market was put to an end in 1946, when regulators increased stock market margin requirements in to 100% from 75%. In order to meet those new requirements, many investors were forced to sell their shares, which contributed to the market going into a short-term tailspin. The market returns stayed relatively stabilized, before starting to rise into the booms of the 1950s. Compared with the overall market returns, if anything, the Dow firms as a group did not beat the market over this period. Figure 2, Panel B shows that for a dollar invested in 1936:m1, one would get approximately 5 cents less either by the end of the war or by 1948:m1, compared to investing the same dollar into the overall market portfolio after adjusting for inflation.

3.2 War Sectors

To investigate if the industries heavily affected by the war behaved systematically differently from the rest of the economy, I define a group of rationed sectors using the 3-digit SIC codes lie within the scope of the consumption rationing orders issued during WWII.[13] The information on the consumption rationing orders comes from various historical records detailing the wartime activities of the Office of Price Administration and the War Production Board (OPA, 1942;

[13]My current list of the rationed sectors include Metal Mining (SIC 100), Coal Mining (SIC 120), Oil and Gas Extraction (SIC 131, 138), Building Construction (SIC 150), Textile Mill Products (SIC 221, 225, 227), Lumber and Logging (SIC 241), Chemicals (SIC 283, 289), Petroleum Refining (SIC 291, 299), Rubber and Plastics (SIC 301, 309), Footwear (SIC 314), Primary Metal (SIC 331, 335), Transportation (SIC 371, 372, 373, 374, 379), Passenger Transportation (SIC 411, 419), Motor Freight, Storage, and Warehousing (SIC 422), Water Transportation (SIC 440), General Merchandise Stores (SIC 531, 532, 533, 534), and Automotive Dealers and Gasoline Services (SIC 533).

WPB, 1945; Mansfield, 1948). I also classify the war and nonwar industries documented in the 1946 congressional report by their 3-digit SIC codes.[14]

The stock market performance of the rationed sectors and the war and nonwar industries are displayed in Figures 3, 4, and 5 respectively. Upon examining the monthly returns of each group of the industries, as demonstrated by Panels A of the Figures, one can find that there is almost no difference between the returns of the group and the overall market returns. This is consistent with the narrative evidence that the influences of the war were profound and widespread in the U.S. economy. In a sense, almost all areas of the economy were involved to contribute for the war effort.

This finding also supports the argument that one should not use the industries that had ever received government military purchases or were impacted by the consumption rationing orders during the war to form the defense sector. Doing so will likely place an overwhelming number of firms in the market to the defense sector such that the excess returns would offer little variation. Furthermore, by applying an overgenerous definition, one would risk invalidating the identification requirements by introducing confounding factors correlated with the economic concerns into the defense group. As have mentioned earlier, the stock market performance during this era indeed reflects the general economic environment.

Panel B of the Figures zooms in the excess returns with details. Though the overall variations are small, we can still observe that the rationed sectors and the war industries performed differently with the nonwar industries in an expected way. In specific, both the rationed sectors (Figure 3, Panel B) and the war industries (Figure 4, Panel B) tend to outperform the market by around 10% during the war, while the nonwar industries (Figure 5, Panel B) suffered an approximately 10% loss in the excess returns. However, the nonwar sector quickly bounced back at the end of the war.

A notable feature from Panels B of Figures 4 and 5 is that the excess returns of the war industries started to rise both before WWII and soon after the War Scare of 1948, while the excess returns of the nonwar industries generally declined at the same time. This behavior indicates, even though the return variations are small, the excess returns of the two industries can still pick up influences from the expected military expenditures.

[14]See footnote 6 for the definitions of the war and nonwar industries.

3.3 The Industries of Aircraft and Shipbuilding vs. Automobile

Figures 6 and 7 plot the stock market performance of the aircraft and shipbuilding companies vs. that of the automobile firms. As can be seen from Panels A of the two Figures, compared with the monthly accumulated returns of the previous groups, the stock returns of these two sectors now display significant differences compared to the overall market returns. Contrasting their excess returns in details, one can observe several important differences.

The first distinct feature, as shown by Panels B of Figures 6 and 7, is the auto sector suffered a much significant drop during the recession of 1937-1938 compared to that of the aircraft and shipbuilding companies. This is consistent with the narrative evidences that the automobile industry experienced a considerable loss in civilian sales during the recession, yet the civilian demand for the aircraft and shipbuilding sector was not strong to begin after the Great Depression.

The second notable trait is that the excess returns of the aircraft and shipbuilding industry were driven by almost all influential events signalling an outbreak of hostile actions, including, among others, Germany annexed Austria in March 1938, Germany took over Czechoslovakia in September 1938, the invasion of Poland in September 1939, the military buildup in the U.S. since 1940, and the War Scare of 1948 (See Figure 6, Panel B). In comparison, upon recovering from the recession in 1948, although the excess returns of the automobile industry displayed similar positive responses around 1939 and 1940, the returns declined intensively during the U.S. military buildup period since mid-1940. In addition, the industry's returns dropped after the War Scare of 1948 (See Figure 7, Panel B). These movements cast serious doubts if one would include the automobile companies in the defense sector, assuming their excess returns were driven by shocks orthogonal to economic concerns. In fact, according to Kaen (2012), the decline in the excess returns before Pearl Harbor reflects the concerns over a loss in auto sales upon the outbreak of a total war.

In addition to the above characteristics, we can observe that the returns of the aircraft and shipbuilding sector indeed declined during the war, which is consistent with the observation made by Ciccone and Kaen (2016) that, upon realizing the arrival of the supply contracts in 1942, investors started to foresee the temporary nature of the government purchases as the civilian demand was not strong enough to begin with to replace the wartime military demand. This point is further reinforced by the decline of the returns soon after the end of the conflict until the Cold War buildup initiated in January 1948.

As for the automobile sector, the excess returns jumped upon the conversion to war production as the supply contract awards with a guaranteed profit effectively removed the concern about the loss in civilian sales. Furthermore, though with an initial set back after the end of the war, the sector's excess returns recovered almost one year earlier than those of the aircraft and shipbuilding industry, consistent with the narrative evidences documented in Rhode (2003).

In the end, a curious phenomenon recorded by Figure 6, Panel B is that the excess returns of the aircraft and shipbuilding firms increased since mid- or late-1944 till around the end of the war, despite the fact a final victory was well-expected during this period. This late-war bump in the excess returns can be explained by two reasons according to Ciccone and Kaen (2016). The first explanation is that there was in fact a renewed arrival of the supply contracts due to the large scale operations involved in the the Normandy Landings. In addition, there were a sequence of unexpected setbacks towards the end of the war, notably, Operation Market Garden, that created an impression that the war would last longer. The market, and the army, was also uncertain about the prospects of a landing in Japan as well as the scope of military spending needed in maintaining peace in the post-war Europe. However, as the uncertainty soon cleared and it was certain that there would be no more supply contracts, the returns of the industry collapsed, as what we have seen from the post-war period. This occurrence can provide an example that we could identify uncertain expectations that never materializes by using the stock market-based approach.

3.4 Top Contractors

The last set of figures document the stock market returns of the top 5 and 10 war supply contractors reported by the 1946 congressional report. As can be seen from Figures 8 and 9, the monthly holding period returns and the excess returns of the top contractors resemble features strikingly close to those of the automobile manufacturers. This is perhaps not surprising, considering large automobile companies dominate the top 5 and 10 contractors with GM along received 8% of the $175 billion worth of the war supply contracts. In the figures that are not reported in this paper, it can be shown that the excess returns of the top contractors were in fact driven by the returns of GM. After dropping GM out of the sample, the returns of the top 5 contractors look remarkably close to the return patterns of the aircraft and shipbuilding firms.

However, as argued before, due to the intensive subcontracting activities and the endogenous concerns associated with the excess returns of the automobile manufacturers, it is more appropriate to use the aircraft and shipbuilding companies as the defense sector to identify the exogenous government spending shocks in the stock market-based approach.

4 Identifying Government Spending Shocks

The previous sections have established that the excess returns of the aircraft and shipbuilding companies were predominantly driven by the expected government expenditures during the WWII era. This section discusses the identification of government spending shocks using these returns with more details.

The key assumption of the stock market-based approach is that innovations to government spending can be identified by innovations to the excess returns of the defense sector, which are orthogonal to the current state of the economy. With this assumption, the economic responses to government spending relevant to the fiscal multiplier can be estimated via a VAR including the necessary macroeconomic variables representing the state of the economy together with the excess returns, where the excess return variable is ordered first with a timing restriction.

Because the government spending during WWII was decided by the goal of achieving a total victory over the Axis powers rather than economic concerns, the government spending shocks can be considered as exogenous. As I have established that the excess returns of the aircraft and shipbuilding companies during this era were dominantly driven by the expected government expenditures, the exogenous government spending shocks can be identified by the excess returns of the defense sector, assuming the market is sufficiently efficient.

Of course, the stock returns of the aircraft and shipbuilding firms can be driven by a wide range of factors other than government defense spending. The performance of these companies can be impacted by the state of the economy through the cost of inputs and civilian sales. The stock returns of an individual firm are affected by idiosyncratic shocks unique to the company. These issues, however, can be addressed by the focus on the excess returns relative to the overall market performance, which should capture the influence of macroeconomic fluctuations. I also consider the combined returns of the aircraft and shipbuilding companies as a group. This should alleviate the concerns over firm-level idiosyncratic determinants that are not related to the expected government expenditures. In fact, as I have shown, the civilian demand of the aircraft and shipbuilding industry was not strong to begin with, and the nature of the industry had a deep connection to the expected defense sales during the WWII era.

Since the focus of my analysis is the aircraft and shipbuilding industry, it is possible that the industry as a whole was influenced by factors correlated with the government expenditures. For example, the production technology of the industry may evolve at a higher trajectory compared to the rest of the economy due to the vast amount resources the government poured in for the relevant research and development. It may also very well be the case that the industry enjoyed a higher markup, given the awarded supply contracts often include a guaranteed profit. The potentially high markup can also result from the industry's capital-intensive production. Since the relative price of the capital could be falling during the war due to a heavy government subsidy and a shortage of labors, the markup of the industry could be increasing.

To account for the concern that the excess returns of the industry may have an upward trend during the study period, I further include a linear trend term in my VAR analysis, which is also the practice of Fisher and Peters (2010). The argument is, by controlling for the trend term, the remaining variations in the excess returns of the defense sector are overwhelmingly dominated by the exogenous shocks in the government military demand.

5 Estimation Results

The following sections present the estimated fiscal multiplier using the excess return shocks. My main analysis starts at the the monthly level to take advantage of the high frequency of the stock market data. I then covert my sample to incorporate the original quarterly series from Ramey (2011) and compare the performance of the excess return shocks with that of the defense news innovations. Upon further investigation, I provide evidences suggesting that the existence of additional expectation effects can be the source of the differences between the two methods.

5.1 Data of the Monthly Sample

The sample of my monthly estimation lasts from January 1936 to December 1947. The beginning of the sample is early enough to include the relevant expectation formation regards the upcoming of the war. As mentioned before, the period around 1936 witnesses an important change in attitude of the market from pacifism to war anxiety. At the same time, my sample ends before the War Scare of 1948, which can be considered as the start of the Cold War military buildup. Doing so would therefore allow me to better focus on the expected government purchases associated with WWII.

Since my sample is still small compared to the full estimation periods of Fisher and Peters (2010) and Ramey (2011),[15] I decide to follow the trivariate VAR specification used by Ramey (2011) when estimating the WWII fiscal multiplier, which includes, asides from the linear trend term, a measured government spending shock series, real output, and real government

[15]The estimation sample used in Fisher and Peters (2010) goes from 1958 to 2007, while the full sample used in Ramey (2011) covers 1939–2008.

expenditures. When replicating Ramey's VAR specification with all inputs over her complete sample, I find the trivariate VAR offers a multiplier estimate very consistent to the estimate yielded by the full measure. The replication of Ramey's original results will be described with more details in Section 5.4.

The macroeconomic sequences I use for the monthly estimation include the monthly, seasonally adjusted industrial production index (IPI) from FRED and the nominal federal budget expenditures from the NBER Macrohistory Database. The nominal federal budget expenditure series is not seasonally adjusted, however, the regression coefficients are all statistically insignificant upon regressing this variable on the twelve monthly dummies, which leads to the observation that the seasonality is not a strong concern. I then convert the nominal federal budget expenditures to a real measure by the CPI for all urban consumers from FRED. The choice of using these variables is primarily based on the concern of data availability, as the selection of historical monthly sequences back to the mid-1930s is rather limited. Admittedly, the IPI is different with real GDP and the federal budget expenditures are not identical to total government spending. Yet, upon taking quarterly averages and comparing my series with the corresponding variables from Ramey (2011) during the overlapping period, I find a correlation of 0.92 between the IPI and Ramey's real GDP measure and a correlation of 0.98 between the real federal budget expenditures and the constructed total government spending sequence from Ramey (2011).

As demonstrated by Figure 10, Panels A and B, the macroeconomic data I use in fact track Ramey's variables in general.[16] A major discrepancy is that the FRED IPI experiences a deeper drop towards the end of the war. This can explained by the fact that the IPI is a more direct representation of the manufactured goods sponsored by the government purchases, which, of course, will result in a different interpretation of the fiscal multiplier by definition. The estimate of the IPI multiplier from the stock market-based approach and estimate of the GDP multiplier based on Ramey's defense news nevertheless agrees each other, as I would describe in the following sections.

To take a glimpse of the arrival of the prime contract awards, I also include the monthly awarded and open contract data from Brunet (2018). The awarded contracts document the aggregated nominal value of the prime contract awards at their issuance date, while the open

[16]Note that the real federal budget expenditures from NBER and the real total government spending series from Ramey (2011) are plotted in Figure 10, Panel B on their individual scales. This does not mean that the federal expenditures can be higher than the total government spending. The point of the figure is to show the patterns of each series trace each other, not to compare their actual scales. It should also be noted that Ramey (2011) relies on a combination of deflators in computing the real GDP and its components.

contracts uniformly distribute the awarded values over the period when a contract is active. Brunet (2018) uses the open contract variable to approximate the effects of the contract awards on the associated economic activities.

Figure 10, Panels C–F visualize the contract and macroeconomic variables vs. the excess returns. Panel C shows that the war supply contracts were indeed issued in a concentrated manner upon the U.S. entering the war. The excess returns also displayed positive responses before the hike in the contract awards in 1943. Consistent with the narrative records, the excess returns started to increase after the resumption of the contract issuance associated with the Normandy Landings, when the market began to speculate if the military demand of the war was higher than what had been expected.

Panels C–F also collectively present the view that the excess returns before, or at the early stage of, the war can be viewed as a leading indicator of the contract awards. The arrival of the contracts then leads the industrial production, which peaks before the government expenditures.[17] This feature is consistent with Ramey's argument that the economy would response before government purchases either through anticipations or the mechanical reason that government spending is recorded at the deliverance of a supply contract.

It is equally important to recognize the situations, in which the excess returns are not a leading indicator of the contract awards. Changes in government spending can lead to new expectations about further government purchases, regardless the expectations are correct or not. Even if the market forms an expectation that never materializes in the future, the economy can still response. These responses may not be captured by the defense news measure developed in Ramey (2011), since one would need to assume the news are learnt and discounted with certainty. As a result, the excess return shocks may contain additional expectation effects that are important in measuring the output response.

Finally, it is noticeable how strongly the federal expenditures overlap with the industrial production during WWII. Given an output elasticity with regards to government expenditures, this attribute can depress the fiscal multiplier through the share of government spending share in output.[18]

[17]The jump in federal spending in 1936 is caused by the government bonus payment to WWI veterans, which is not related to the aspects of WWII.

[18]The fiscal multiplier is calculated as the percentage change in output per a percentage in government spending, divided by the ratio of government spending over output.

5.2 Performance Tests

A necessary step before estimating the fiscal multiplier is to check the performance of the excess returns in explaining government spending and output. I perform two analyses to accomplish this task. The first analysis takes advantage of the awarded and open supply contracts from Brunet (2018) to form an expected government expenditure measure. Following the exercise in Ramey (2011) and Fisher and Peters (2010), I regress the growth of the log nominal values of the supply contracts on the current value and 15 lags of the growth of the log excess returns. The 15 monthly lags are chosen so that the expectations formed during the military buildup period since 1940 can be used to explain the contract awards in 1942.

As shown by Table 1, Columns 1 and 2, the excess returns of the aircraft and shipbuilding companies in face have the strongest predictive power compared to the other groups. This is the case for both the regressions using the awarded and open contracts as the expected government spending measure. Further, the around 0.31-0.34 R-squared values are comparable to those reported from the performance tests in Ramey (2011) and Fisher and Peters (2010) based on their full sample. The R-squared value of the defense news in predicting government spending is around 0.4 from Ramey's full sample of 1939:Q1-2008:Q4. The same value of the excess returns in predicting military spending based on the sample of 1957:Q3-2007:Q4 is around 0.2.

Unfortunately, the prime contract data from Brunet (2018) is not available before 1940, yet it seems the expectation about the upcoming conflict and the associated military demand from the U.S. government was largely formed back in 1938 or 1939. This can been witnessed both by the large scale of movements in the excess returns of the aircraft and shipbuilding companies, and by the historical events, such as the Naval Act of 1938, which was passed to expedite the defense buildup of the U.S. military, and Roosevelt's announcement of the large scale purchases of air planes in 1938.

To include the long-horizon expectations in predicting output and government expenditures, I perform two similar regressions using the growth of the log IPI and that of the federal budget expenditures as the dependent variables, respectively, and controlling for 36 lags. That is to say, I am allowing the information back in 1939 to predict the movements in 1942. The resulting R-squares are reported in Table 1, Columns 3 and 4. As the Columns indicate, the conclusion on the explanatory power generally remains the same.[19]

[19] A notable exception from Column 4 is that the returns of the Dow firms have a strong predicting power in output. This is reasonable as large firms in general should be responsible for a good share of industrial production. Yet, as explained earlier, using the returns of the Dow firms to identify government spending shocks would be problematic due to the endogeneity concern.

An interesting observation from Columns 3 and 4 is that, though Ramey does not report the R-squared on output, the corresponding number from Fisher and Peters (2010) is much lower. In specific, the R-squared on military spending from Fisher and Peters's 1957:Q3-2007:Q4 sample is around 0.21, while the value on output is around 0.08. From my tests, both the R-squares on output and federal spending are about 0.35. The consistent explanatory power on output and government spending during WWII should be expected, however, given the strong co-movement between the two sequences.[20] When I exclude the long-horizon expectations from the performance test and run the regressions with 15 lags instead, the R-squares on output and government spending both fall significantly to around 0.07, which are then comparable to the Fisher and Peters's figure on output.

As a conclusion, the explanatory power of my excess return measure is in a range consistent with the existing works I aim to study. With this outcome, I proceed to describe the estimation results on the fiscal multiplier.

5.3 Monthly Estimation Results

The monthly VAR is estimated using the excess returns of the aircraft and shipbuilding companies, the log of the federal budget expenditures, and the log of the IPI, in that order, with a timing restriction and a linear trend term. Changing the order of the IPI and federal expenditures yields almost identical results. Ideally, the VAR should be run with 36 lags in consistent with the performance test. But given the relatively small sample, adding 36 lags to the system with a linear trend would result in a problem of collinearity. On the other hand, controlling for a full vector of 36 lags may not be necessary, since the variables in level should capture the information on the previous growth. As a result, I follow the specification used in Fisher and Peters (2010) and Ramey (2011) and evaluate the VAR (in level) with 15 monthly lags. The estimation results stay highly consistent when I change the lag order to 12 or 18.[21] The same holds true when I adjust the excess returns by the three-month treasury rate or not adjust the returns by inflation at all.[22]

The impulse responses to a one-standard-deviation innovation to the accumulated excess return variable are presented in Figure 11, Panels A and B. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications for

[20]The correlation between the IPI and federal budget expenditures during my estimation sample is 0.87.

[21]The highest optimal lag selected via Akaikes (AIC), Schwarzs Bayesian (SBIC), and the Hannan and Quinn information criterion (HQIC) is around 14.

[22]The concern on the effects of monetary policy on government spending can be further mitigated by the intentionally created near-ZLB environment during WWII.

the remaining of the paper. As the Panels suggest, upon receiving the one-standard-deviation shock in the excess returns, the responses of the government spending and industrial production both stay statistically insignificant for around 15 months before rising statistically significantly above zero with a hump-shape for about three years. The response of the industrial production reaches its peak after 32 months at around 0.0225. The response of the government spending reaches its peak after 43 months at around 0.0815, which is consistent with the argument that output tends to respond before government expenditures due to anticipations. Together, the implied output elasticity with regards to government spending is $(0.0225/0.0815) = 0.276$. The output elasticity based on the integral under the impulse response function is qualitatively the same.

Several important observations can be made on the monthly estimation results. First, compared to the 0.3 output elasticity with regards to total government spending based on the post-Korean War sample, the output elasticity estimated during WWII with an equivalent approach is surprisingly close. In addition, the responses shown in Figure 11 display a strong persistence similar to those found in Fisher and Peters (2010). In fact, the shape of the output IRFs from the two samples look almost identical.

In contrast, instead of having an almost immediate response, as what has been observed in the post-Korean War period, the responses of the government spending during the WWII era stay around zero for about the first 15 months. This feature, however, can be explained by the unique historical context of my sample. In particular, much of the market expectations about the U.S. involvement in the war seem to have been formed in 1939, if not as far back as in 1936, though the precise scale of the involvement was not known with certainty. The government military purchases then started to gradually build up before the spikes after the U.S. joining the war at the end of 1941. During this period of lag, the responses of the government spending are relatively small and could be further confounded by the short-lived foreign sales before the Fall of France in 1940. In fact, if we assume there were only foreign sales before the Fall of France, the government spending responses would then be biased downward to below zero, which could explain some of the slightly negative responses over the initial flat period. As I would explain later in Section 5.5, failing to account for the complete expectation effects can also lead to a reduction in the response of government expenditures. The negative responses in the initial period can therefore reflect the possibility that there are still additional expectation effects beyond the scope of my current specification. However, compared to the later substantial and persistent rise, the concerns associated with the initial around zero responses, in my opinion, are relatively small in estimating the output elasticity.

To convert the output elasticity to a fiscal multiplier, I estimate the government spending's nominal shares of output to be around 38.23% during my sample using the annual historical statistics available in Bureau of the Census (1975). The government spending share is weighted by annual nominal government spending to reflect the concentration of government purchases during the war years. With this estimate, the WWII industrial output multiplier can be computed as (0.276/0.3823) = 0.72, which is in turn consistent with the 0.7 output multiplier estimated by Ramey (2011) over the 1939-1949 sample. Of course, changing the way to calculate the government spending share will result in a slightly different fiscal multiplier. Yet what remains unchanged is the message that using the excess return shocks, the scale and persistence of the output elasticity with regards to government spending during the WWII era are consistent with the findings from Fisher and Peters (2010), while the relatively high government spending share in real output results in a fiscal multiplier consistent with the figure estimated by Ramey (2011). Therefore, it seems there is indeed an interesting linkage between the two strands of the literature.

Since Ramey's estimates are based on data with a quarterly frequency, I further convert my monthly sample to the quarterly level as a robustness check. I do so by calculating the quarterly excess returns following the procedure laid out by Fisher and Peters (2010)[23] and taking the quarterly averages for my monthly macro sequences. The quarterly level IRFs based on a corresponding VAR with 5 lags are reported in Figure 12, Panels A and B. As can be seen, the shape and persistence of the spending and output responses largely remain the same and statistically significant positive responses can still be picked up at the 95% confidence interval. But the overall statistical significance is reduced compared to the monthly estimation. This indicates that the data frequency matters. By averaging the monthly fluctuations into the quarterly level, some of the high frequency responses could be lost. Nevertheless, the estimates and the associated conclusions remain the consistent. At the quarterly level, the response of the industrial production reaches its peak after 14 quarters at around 0.0978. The response of the government spending reaches its peak after 9 quarters at around 0.0337. These imply an output elasticity of (0.0337/0.0978) = 0.34, which leads to a fiscal multiplier of (0.34/0.3823) = 0.89. Similar to the situation of the monthly estimation, the output elasticity based on the integral under the IRFs is qualitatively the same. Changing the 5 quarterly lags to 4 or 6 lags, together with adjusting the excess returns by the three-month treasury rate or not adjusting

[23]For each given group of firms, the quarterly holding period returns are calculated by first computing the average monthly holding period returns weighted by the market value of the firms at the beginning of each quarter. For each given quarter, the three monthly returns are then accumulated to form the quarterly return of the group. The excess returns are the differences between the quarterly returns of the group and that of the market.

the returns by inflation, yield highly robust results.[24]

5.4 Ramey (2011) over the 1939-1947 Sample

The previous section has established that the magnitude of the fiscal multiplier estimated using the excess return shocks is consistent with the figure from Ramey (2011) over the 1939-1949 sample. Given the War Scare of 1948 witnesses the start of the Cold War military buildup, it is important to know if Ramey's estimates would behave the same after stopping the sample at 1947.[25]

To verify this result, I start by obtaining the original output multiplier estimated by Ramey (2011). Figure 13, Panels A and B display the IRFs based on Ramey's full VAR specification over the complete 1939-2008 sample.[26] The full VAR is consist of the defense news, the log of total government spending, the log of real GDP, the three-month treasury rate, the Barro-Redlick average marginal income tax rate, and the log of total hours, in that order, with a timing restriction as well as a linear and a quartic trend. As explained in Ramey (2011), the VAR is evaluated with 4 lags, but the results stay robust after changing to the nearby lag orders. The full specification gives an output multiplier of around 1.1.

Figure 14, Panels A and B replicate the IRFs based on Ramey's original VAR over the 1939-1949 period. This VAR contains the defense news, the log of the total government spending, and the log of the real GDP, in that order, with a timing restriction and a linear trend term. The VAR is also estimated based on 4 lags with the results being robust when using the nearby lag values. The implied output multiplier is around 0.7, as reported in the paper. From the panels, it is clear that the estimates are less precise for the reduced sample. However, compared with the IRFs of the full specification as shown in Figure 13, the estimates from the trivariate VAR still display a quite consistence shape, which speaks the comparability between the two specifications.

Finally, I conduct the same trivariate VAR with 4 lags over the new 1939-1947 sample. The IRFs are reported in Figure 15, Panels A and B. As the Panels suggest, the responses of the government spending and output are consistent compared to those recorded in Figure 14. In fact, upon dropping the Cold War buildup from the sample, the statistical significance of the real GDP response improves. For the new sample, the response of the real GDP reaches its peaks

[24]The highest optimal lag suggested by AIC, SBIC, and HQIC is around 2, however, I choose to use a higher lag following Fisher and Peters (2010) and Ramey (2011).

[25]Unfortunately, Ramey's quarterly series begin at 1939, which means the period of 1939-1947 is the largest overlapping sample available.

[26]The same panels can be seen in Figure X of Ramey (2011).

after 4-5 quarters at around 0.0133. The response of the government spending reaches its peak after 5 quarters at around 0.0631. The resulting output elasticity is therefore (0.0133/0.0631) = 0.21, which is slightly lower than, but still very close to, the 0.3 output elasticity estimated from my 1936-1947 sample. The output elasticity based on the integral under the IRFs is qualitatively the same. Following the average government spending share from Ramey's sequences, the implied output multiplier is around 0.72.[27] The estimation results also stay robust after changing the lag order to 3, 5, and 6 lags.[28]

As a conclusion, if we compare the scale of the output elasticity evaluated using the excess return shocks from the 1936-1947 sample with the scale based on the defense new shocks over the 1939-1947 sample, the end result is they seems to be rather close. Indeed, an output elasticity of around 0.3 is also consistent with the figure reported from the post-Korean War sample. The difference between the two approaches, however, lies in the persistence of the responses. In particular, the excess return shocks seem to systematically pick up a more persistent response in both government spending and output, whereas the responses from the defense new shocks tend to be temporary. Such a difference indicates the possibility that the excess returns can capture additional expectations formed at various horizons, with or without certainty, upon which economic agents do react even without the knowledge of a detailed defense news. To further investigate the source of the persistence difference, the next section studies the performance of the two approaches over the same sample.

5.5 The Excess Returns vs. Defense News

Given the persistent responses associated with the stock market-based approach seem to originate from the additional expectations formed at a relatively long horizon, this section examines the performance of the excess return shocks in the 1939-1947 sample overlapped with the defense news. To do so, I perform the same trivariate VAR specification with 4 lags using the original variables from Ramey (2011) except for switching the defense news to the accumulated excess returns of the aircraft and shipbuilding companies. The estimation results are displayed in Figure 16, Panels A and B.

As shown by the Figure, once estimated over the reduced sample, the responses of the

[27] Ramey calculates the government spending share as a simple average of the ratio of the total government spending to real GDP, rather than a weighted average. This is perhaps motivated by her long time series of the complete sample. If I use the weighted average, the government spending share would be higher and the fiscal multiplier would drop to around 0.6. But the main message here is the output elasticities from the 1936-1947 and 1939-1947 samples, estimated using the two methods, are in the end consistent.

[28] Similar to the situation of the quarterly estimation over the 1936-1947 sample, the highest optimal lag suggested by AIC, SBIC, and HQIC is around 2.

government spending and real GDP seem to be shifted down from the responses obtained from the full quarterly 1936-1947 sample, which are displayed in Figure 12. The positive responses of the spending and real output now become much weaker, without much of the persistence and statistical significance. At the same time, there are substantial negative responses during the initial periods. In terms of the real GDP, the negative responses at around the third quarter are even statistical significant at the 95% level.[29]

What could be the cause of such considerable changes? One potential explanation is that, by focusing on the 1939-1947 sample with 4 lags, the regressions effectively start in 1940:Q1. This means the important expectations formed in the market around or before 1939 about the upcoming conflict would not be appropriately accounted for. They would either be excluded from the regressions or enter the VAR as controls, instead of being directly used to estimate the spending and output responses. As a result, the IRFs could be biased downward to potentially below zero.

To examine whether the control of the timing of the relatively long-term expectations can be a source of explanation, one would ideally extend the defense news sample back to 1936 to include the early observations in the estimation. However, since the beginning of Ramey's defense news is 1939:Q1, I follow a strategy proposed by Ramey (2011) and conduct a test within the 1939-1947 sample. In specific, Ramey (2011) argues that, if the expectation effects are driving the difference, delaying the timing of the Ramey-Shapiro dates should result in the VAR-type Keynesian results. Similarly, if the changes in the performance of the excess return shocks are caused by the timing of the additional long-term expectations, lagging the excess return series should make the responses look closer to the estimates obtained from the defense news shocks. Meanwhile, forwarding the defense news sequence should generate an outcome resembling the IRFs described by Figure 16.

I start the analysis by plotting the accumulated excess returns against the defense news in the original 1939-1947 sample. As Figure 17, Panel A indicates, at least before the U.S. joining the war at the end of the 1941, the reactions of the market tend to lead the arrival of the defense news. This is especially the case at the outbreak of the war in 1939:Q3, where the

[29] The estimation results behave in a similar manner when using the quarterly IPI and federal budget expenditure series. The estimation results also do not change significantly when using 3, 5, or 6 lags, though decreasing the lag order tends to lead to an improvement. With the current estimates, as shown in Figure 16, Panels A and B, the response of the real GDP reaches its peak after 16 quarters at around 0.0054. The response of the government spending reaches its peak after 14 quarters at around 0.0258. Therefore, the peak estimates result in an output elasticity of (0.0054/0.0258) = 0.21, which, perhaps surprisingly, is almost identical to the elasticity given by the defense news. Of course, due to the obvious reason, the same can not be said for the elasticity evaluated using the integral under the IRFs.

excess returns of the defense firms surged drastically, while there seems to be no information update regards the future U.S. government purchases from the defense news, even though the Naval Act of 1938 had been passed to expedite the U.S. military buildup and Roosevelt had announced his plan in 1938 to prepare the U.S. army by purchasing 50,000 airplanes.

In order to simulate the scenario where the concentrated arrival of the defense news since 1941:Q2 were in fact expected by the market in 1939, I forwarded Ramey's defense news series by 7 quarters. The forwarded defense news vs. the original excess returns series are shown in Figure 17, Panel B. The estimation results using the updated news series without changing the remaining of the trivariate VAR specification are reported in Figure 18, Panels A and B.[30] As the Figure suggests, the forwarded defense news shocks indeed yield IRFs similar to those obtained from the original excess return series (Figure 16, Panels A and B). In addition, without having further fluctuations as those of the excess returns, the shifted news sequence indicates an even more significant drop in both the spending and output responses in the early periods with almost nonexistent positive responses during the later phase.

Based on the performance of the forwarded news series, I then allow the market expectations in 1939 to estimate the IRFs by lagging the excess returns by 4 quarters. This is equivalent in assuming the market was systematically delayed in a way that the information would had been available in 1939:Q1 arrived in 1940:Q1.[31] The shifted returns series vs. the original defense news are presented in Figure 17, Panel C. The estimation results using the same VAR but the lagged returns are displayed in Figure 19, Panels A and B. As the Panels demonstrate, by including the early information in the estimation, instead of using them as controls, the positive responses of the government spending and real GDP both become substantially stronger and statistically significant. The shape of the responses is almost comparable to the findings from the complete sample of Ramey (2011) (Figure 19, Panels A and B). Instead of having a temporary increase, the shifted excess returns also give much more persistent responses in the later periods for both the output and government spending measures.

Admittedly, the shifted series are not identical to the reality. Yet, given the data constraint, this exercise can at least provide evidences that the timing of the additional expectation effects matters. Failing to appropriately account for the complete expectation effects in the sample can result in an underestimation, along with potential negative responses, when using the stock market-based approach. Perhaps more importantly, it seems the additional expectation effects

[30] For the remaining of this analysis, the estimation results are robust when using 3, 5, and 6 lags.

[31] The lag is performed by using the excess return series from the complete 1936-1947 sample at the quarterly level. Lagging the returns by 7 quarters in consistent with the shift in the defense news generates almost identical, if not improved, results.

captured by the excess return shocks contribute to the persistence of the economic responses. This can be used to support the importance of the expectation effects that yet to be captured by the main approaches of the literature.

6 Conclusions

In this paper, I use stock returns to estimate the fiscal multiplier during the WWII era by classifying public aircraft and shipbuilding companies as the defense sector of the U.S. stock market. Using innovations in the excess returns of the aircraft and shipbuilding firms to identify exogenous government spending shocks, I compare the performance of this stock market-based approach, a relatively novel strategy in estimating the fiscal multiplier developed by Fisher and Peters (2010), with the existing findings from the main approaches of the literature. Although never been applied to examine the largest fiscal stimulus episode of the modern U.S. history, the excess return shocks have been implemented and indicate a fiscal multiplier of around 1.5 during the post-Korean War era. My study has suggested several findings connecting the two strands of the literature. Based on a monthly sample from 1936 to 1947, I find that the output elasticity with regards to total government spending is around 0.276 during WWII, which is very close to the 0.3 output elasticity reported by Fisher and Peters (2010) from their post-Korean War sample. In addition, I observe persistent responses in government spending and real output to innovations in the excess returns of defense sector, a feature consistent with the findings of Fisher and Peters (2010) and suggesting the existence of additional expectation effects at a longer horizon that has yet to be accounted for by the main approaches of the literature. Due to the special economic environments of WWII characterized by a high government spending share, the 0.276 output elasticity implies a fiscal multiplier of around 0.72, which is in turn consistent with the 0.7 output multiplier computed by Ramey (2011) using defense news and a narrative approach. The below-unity fiscal multiplier associated with WWII further agrees with the observations from Hall (2009) and Brunet (2018), among others.

Upon comparing the performance of the stock market-based approach with the results of the defense news on an overlapping sample, I present evidences emphasize the importance of the timing of the expectation effects in estimating the fiscal multiplier. Not appropriately controlling for the expectation effects at a longer horizon, can result in an underestimation, along with potential negative responses, when using the stock market-based approach. In fact, by forwarding Ramey's defense news and lagging the excess return sequence within the overlapping sample, the shape of the responses from the two methods can replicate each other. Given that the additional expectation effects seem to contribute to the stronger persistence of the economic responses, more attention could be needed to investigate the influence of the expectation effects that have yet to be fully captured by main methods of the existing literature.

References

Auerbach, A. J., and Gorodnichenko, Y. (2012). Measuring the Output Responses to Fiscal Policy. *American Economic Journal: Economic Policy*, 4(2), 1-27.

Auerbach, A. J., and Gorodnichenko, Y. (2013). Output Spillovers from Fiscal Policy. *American Economic Review*, 103(3), 141-46.

Armbruster, M. (2017). What Happens to the Market if America Goes to War? The CFA Institute. Retrieved from `https://blogs.cfainstitute.org/investor/2017/08/29/u-s-capital-market-returns-during-periods-of-war/`.

Barro, R. J., and Redlick, C. J. (2011). Macroeconomic Effects From Government Purchases and Taxes. *The Quarterly Journal of Economics*, 126(1), 51-102.

Berndt, A., Lustig, H., and Yeltekin, S. (2009). Does the US Government Hedge against Fiscal Risk? Carnegie-Mellon University, manuscript.

Blanchard, O., and Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, 117(4), 1329-1368.

Burnside, C., Eichenbaum, M., and Fisher, J. D. (2004). Fiscal Shocks and Their Consequences. *Journal of Economic theory*, 115(1), 89-117.

Brunet, G. (2018). Stimulus on the Home Front: the State-Level Effects of WWII Spending. (Doctoral Dissertation).

Cavallo, M. (2005). Government Employment Expenditure and the Effects of Fiscal Policy shocks. *Federal Reserve Bank of Chicago Working Paper No. 200516*.

Ciccone, S., and Kaen, F. R. (2016). The Financial Performance of Aircraft Manufacturers during World War II: the Vicissitudes of War. *Defence and Peace Economics*, 27(6), 743-773.

Edelberg, W., Eichenbaum, M., and Fisher, J. D. (1999). Understanding the Effects of a Shock to Government Purchases. *Review of Economic Dynamics*, 2(1), 166-206.

Eichenbaum, M., and Fisher, J. (2005). Fiscal Policy in the Aftermath of 9/11. *Journal of Money, Credit and Banking*, 37(1), 1-22.

Fatas, A., and Mihov, I. (2001). The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence. *CEPR Discussion Paper 2760.*

Fishback, P., and Cullen, J. A. (2013). Second World War Spending and Local Economic Activity in U.S. Counties, 193958. *The Economic History Review*, 66(4), 975-992.

Fisher, J. D., and Peters, R. (2010). Using Stock Returns to Identify Government Spending Shocks. *The Economic Journal*, 120(544), 414-436.

Gali, J., LopezSalido, J. D., and Valles, J. (2007). Understanding the Effects of Government Spending on Consumption. *Journal of the European Economic Association*, 5(1), 227-270.

Gordon, R. J., and Krenn, R. (2010). The End of the Great Depression 1939-41: Policy Contributions and Fiscal Multipliers. *NBER Working Paper 16380.*

Hall, R. E. (2009). By How Much Does GDP Rise if the Government Buys More Output? *NBER Working Paper 15496.*

Higgs, R. (1992). Wartime Prosperity? A Reassessment of the US Economy in the 1940s. *The Journal of Economic History*, 52(1), 41-60.

Holley, I. B. (1964). *Buying Aircraft: Materiel Procurement for the Army Air Forces.* Office of the Chief of Military History, Department of the Army.

Kaen, F. R. (2012). Automobile Manufacturer Returns During World War II: From Cars to Armaments and Back. *International Journal of Business and Social Science*, 3(23).

Kofsky, F. (1995). *Harry S. Truman and the War Scare of 1948: A Successful Campaign to Deceive the Nation.* Palgrave Macmillan.

Mansfield, H. C. (1948). *A Short History of OPA.* Washington: Office of Temporary Controls, Office of Price Administration.

Mountford, A., and Uhlig, H. (2009). What are the Effects of Fiscal Policy Shocks? *Journal of Applied Econometrics*, 24(6), 960-992.

Nakamura, E., and Steinsson, J. (2014). Fiscal Stimulus in a Monetary Union: Evidence from US Regions. *American Economic Review*, 104(3), 753-92.

Nelson, D. M. (1946). *Arsenal of Democracy: The Story of American War Production.* New York: Brace.

Perotti, R. (2005). Estimating the Effects of Fiscal Policy in OECD Countries. *CEPR Discussion Paper 4842.*

Perotti, R., Reis, R., and Ramey, V. (2007). In Search of the Transmission Mechanism of Fiscal Policy. *NBER Macroeconomics Annual*, 22, 169-249.

Ramey, V. A., and Shapiro, M. D. (1998). Costly Capital Reallocation and the Effects of Government Spending. *Carnegie-Rochester Conference Series on Public Policy*, 48, 145-194. North-Holland.

Ramey, V. A. (2011). Identifying Government Spending Shocks: It's all in the Timing. *The Quarterly Journal of Economics*, 126(1), 1-50.

Ramey, V. A., and Zubairy, S. (2018). Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data. *Journal of Political Economy*, 126(2), 850-901.

Rhode, P. W. (2003). After the War Boom: Reconversion on the US Pacific Coast, 1943-49. *NBER Working Paper 9854.*

Schneider, G., and Troeger, V. E. (2006). War and the World Economy: Stock Market Reactions to International Conflicts. *Journal of Conflict Resolution*, 50(5), 623-645.

Smaller War Plants Corporation. (1946). *Economic Concentration and World War II: Report of the Smaller War Plants Corporation to the Special Committee to Study Problems of American Small Business, United States Senate.* Washington: U.S. Govt. print. off.

United States Bureau of the Census. (1975). *Historical Statistics of the United States, Colonial Times to 1970.* U.S. Department of Commerce, Bureau of the Census.

United States Office of Price Administration. (1942). *Quarterly report - U.S. Office of Price Administration.* Washington: U.S. Govt. print. off.

United States War Production Board. (1945). Wartime Production Achievements and the Reconversion Outlook. *Report of the Chairman, War Production Board.*

Vander Meulen, J. A. (1991). *The Politics of Aircraft: Building an American Military Industry.* Lawrence, KS: University Press of Kansas.

Figure 1: Real Defense Spending Index, 1939-2008

This figure plots the real defense spending index developed in Ramey (2011) available from 1939 to 2008. The index is at the quarterly frequency and equals 100 in 2005.

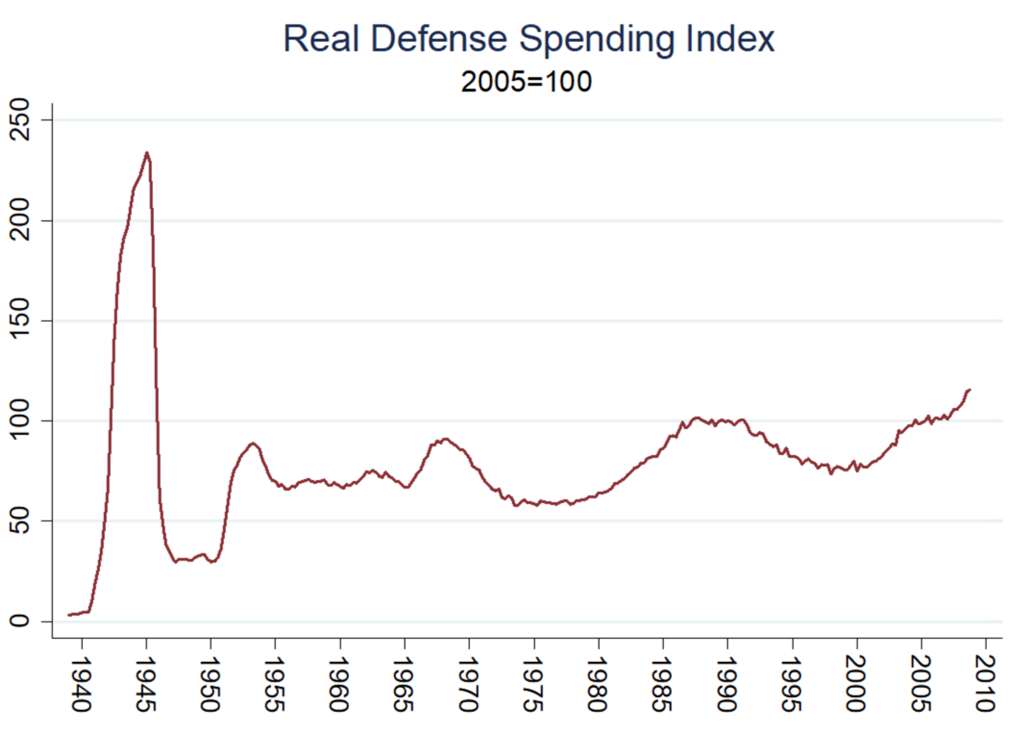
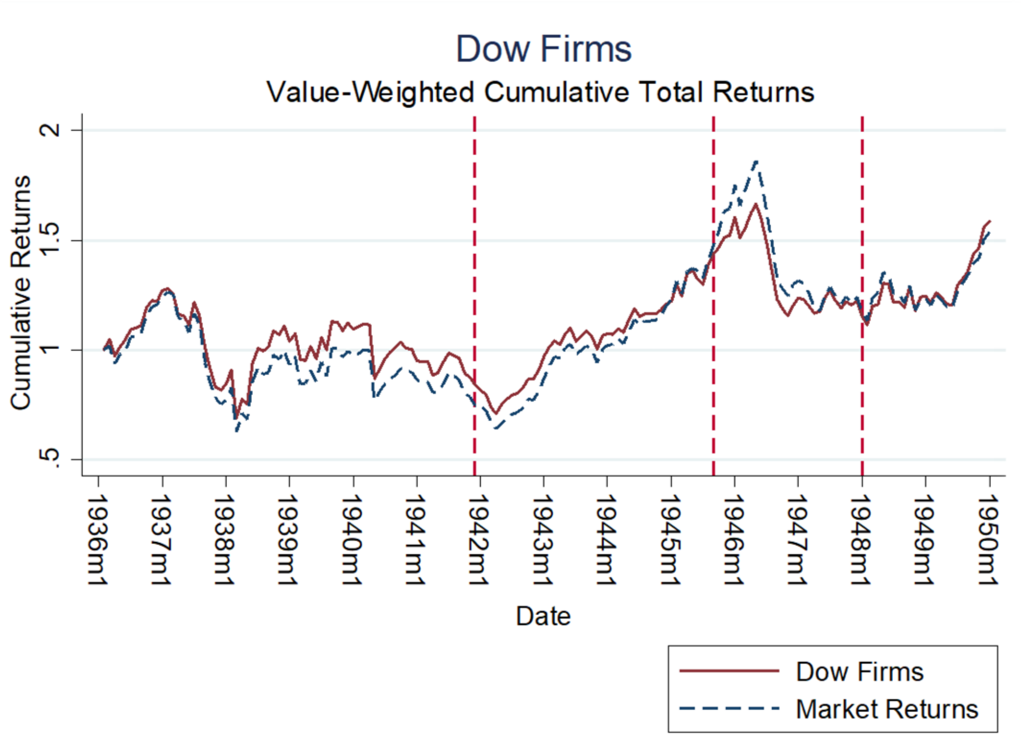


Figure 2: Stock Market Returns of the Historical Dow Firms

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the historical Dow firms from 1936:M1 to 1950:M1. The Dow firms include the historical components of the Dow Jones Industrial Average from 1936 to 1957. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

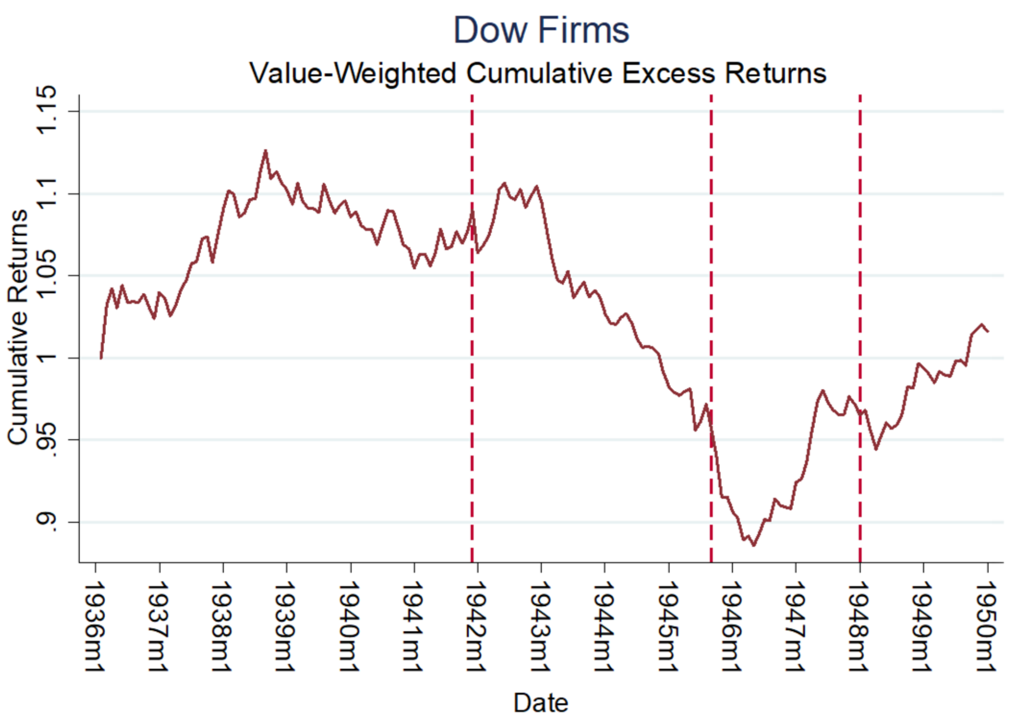
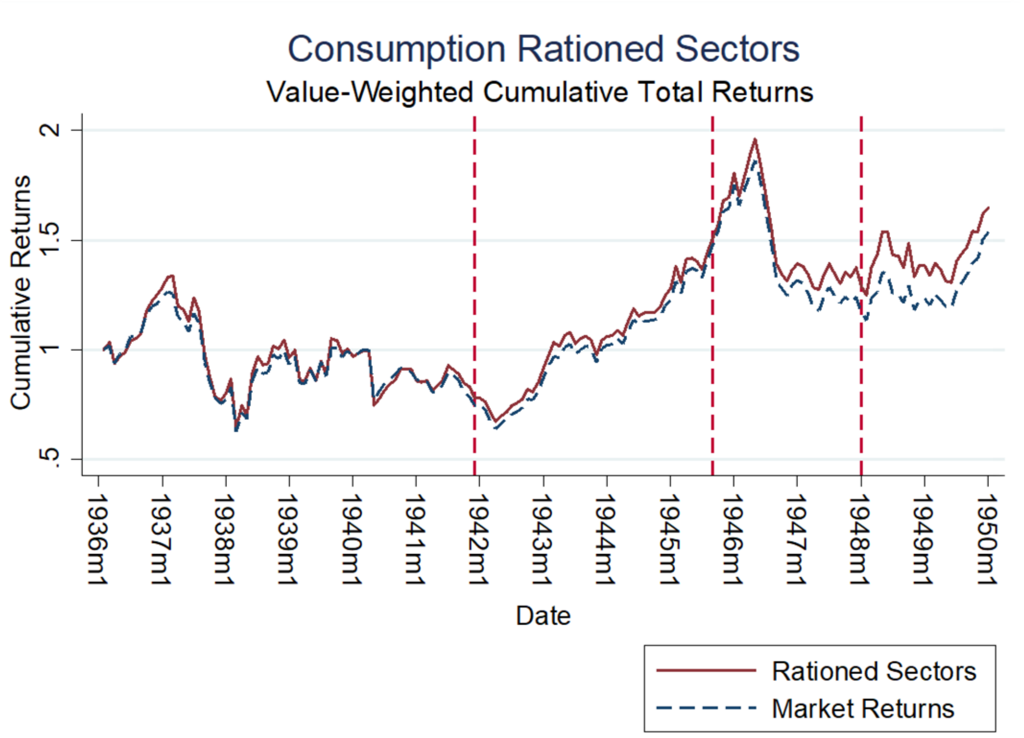


Figure 3: Stock Market Returns of the Rationed Sectors

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the consumption rationed sectors based on the 3-digit SIC codes from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

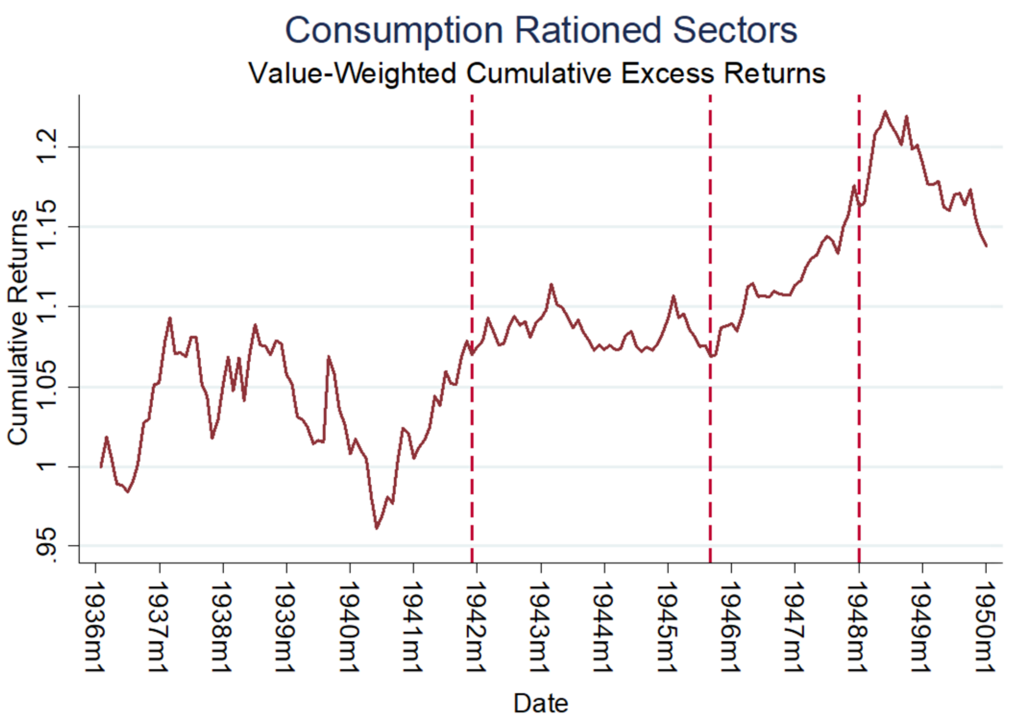
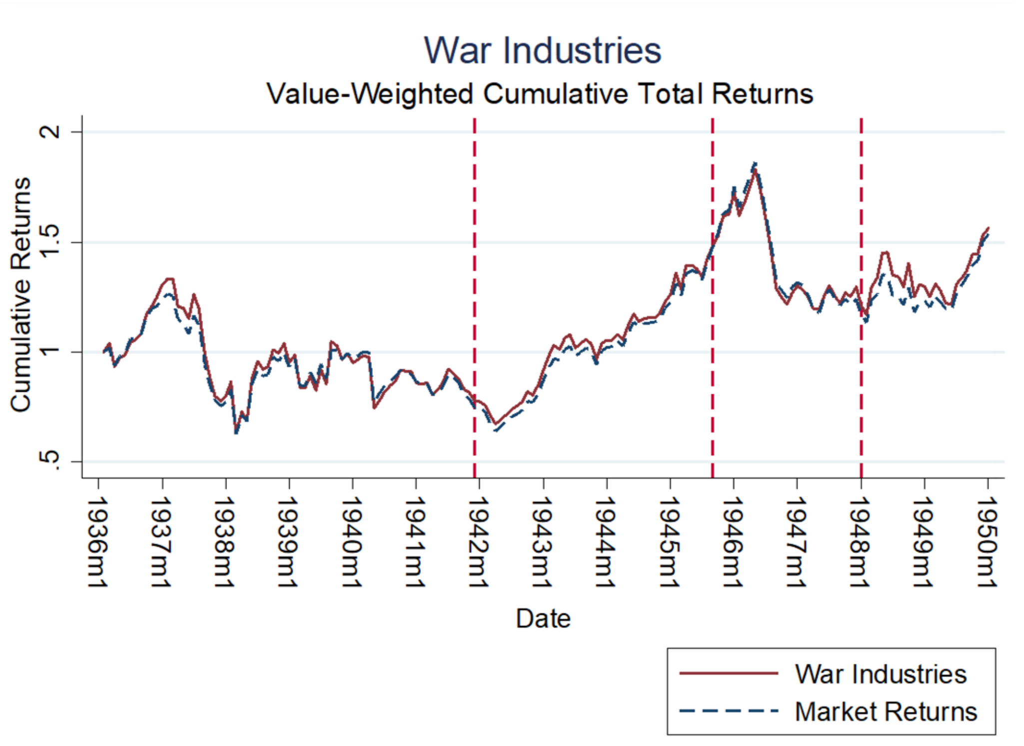


Figure 4: Stock Market Returns of the War Industries

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the war industries highlighted in the 1946 congressional report based on the 3-digit SIC codes from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

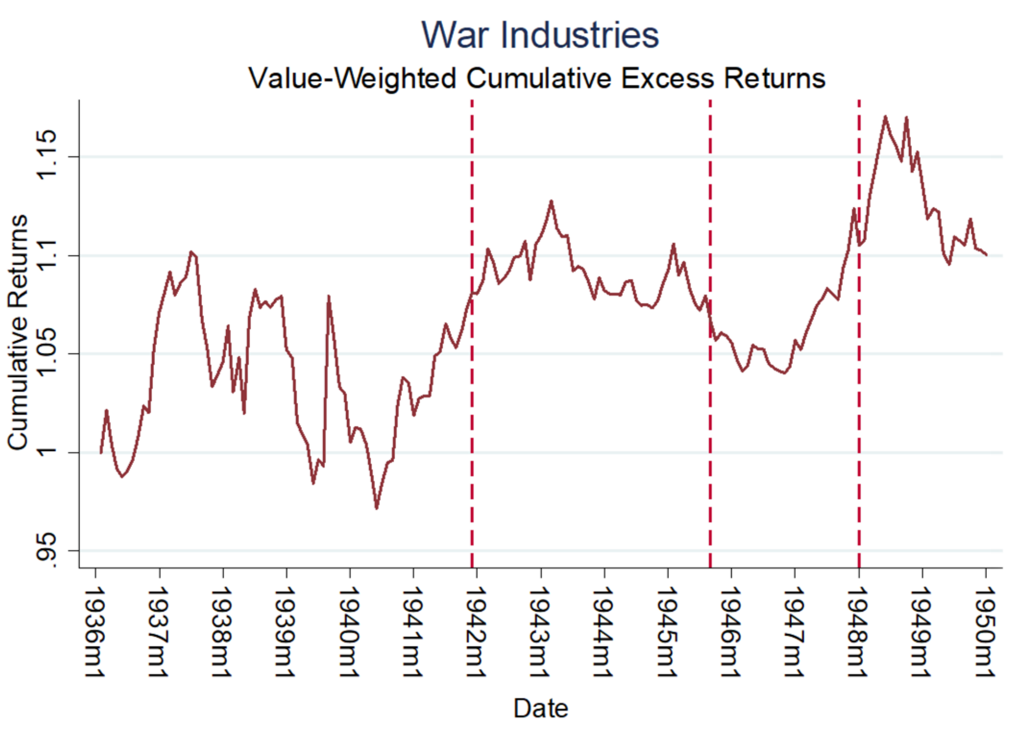
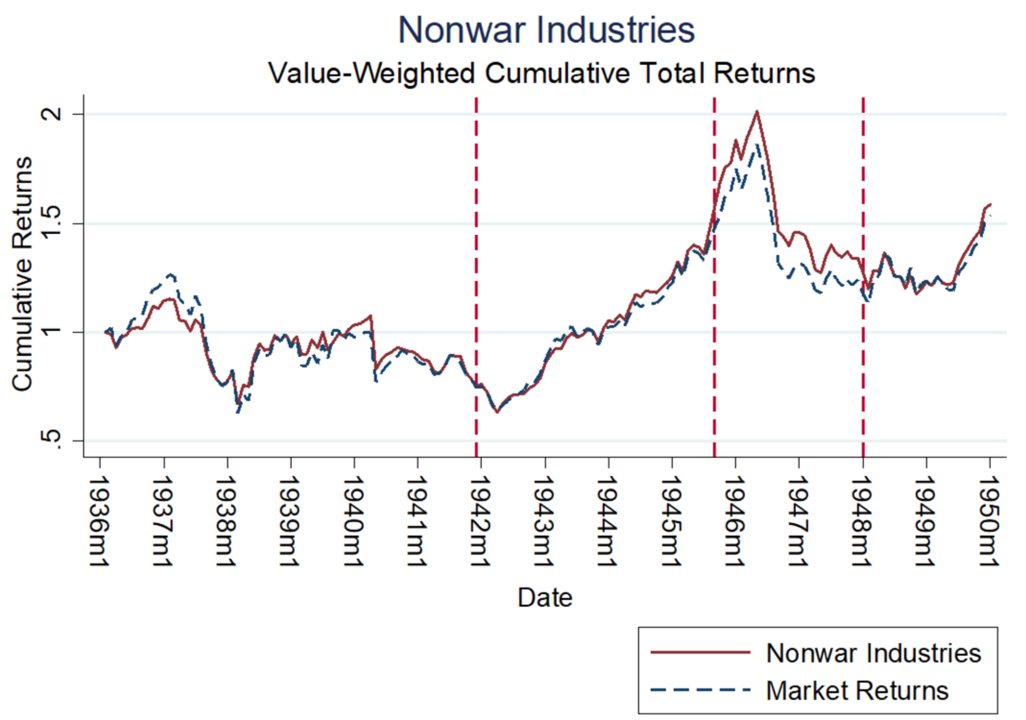


Figure 5: Stock Market Returns of the Nonwar Industries

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the nonwar industries highlighted in the 1946 congressional report based on the 3-digit SIC codes from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

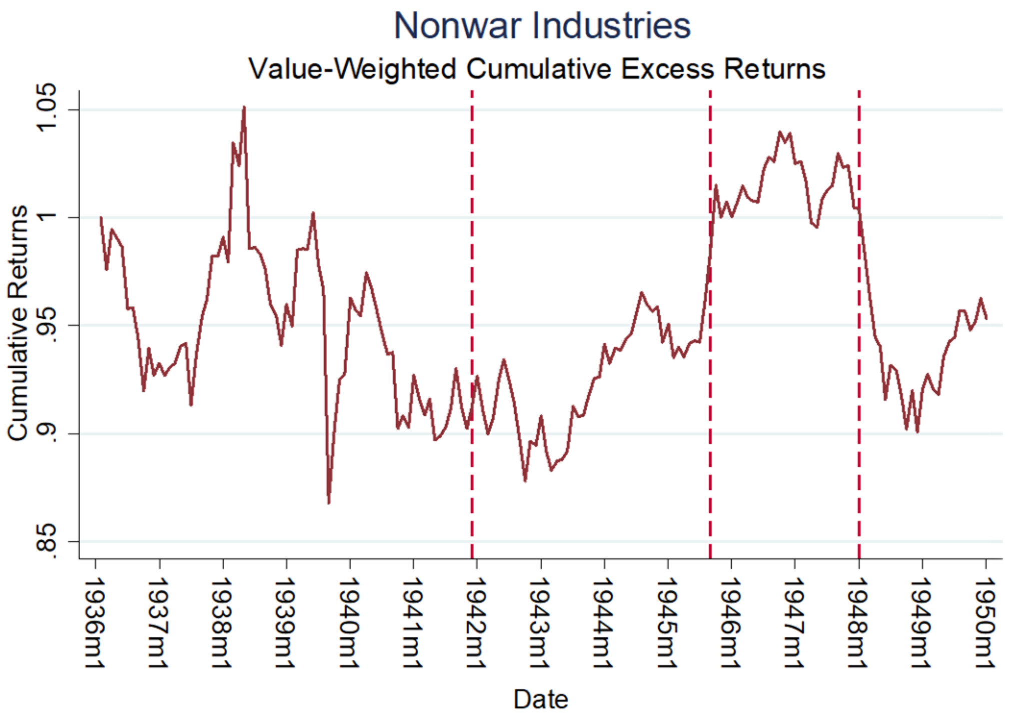
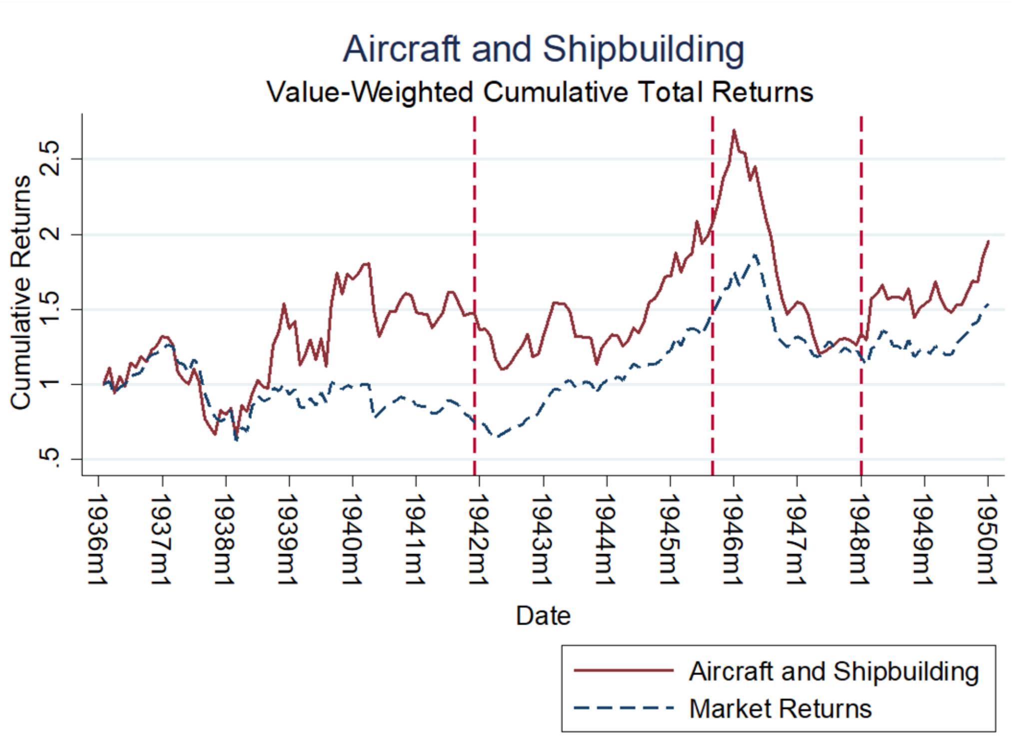


Figure 6: Stock Market Returns of the Aircraft and Shipbuilding Companies

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the public aircraft and shipbuilding companies from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

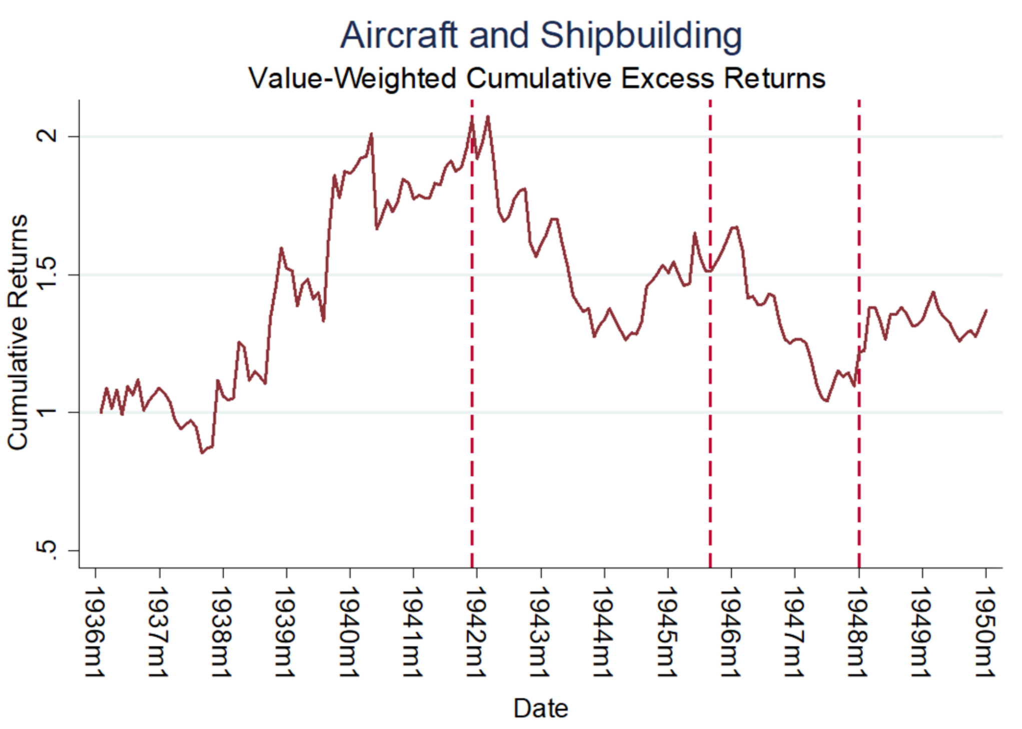
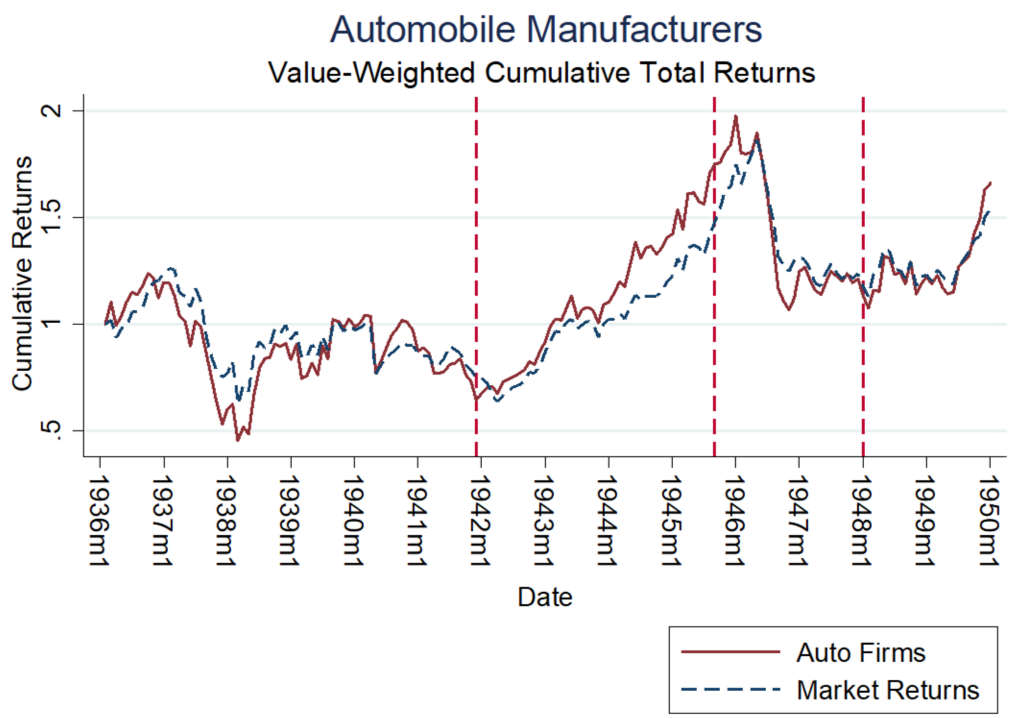


Figure 7: Stock Market Returns of the Automobile Manufacturers

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the public automobile companies from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

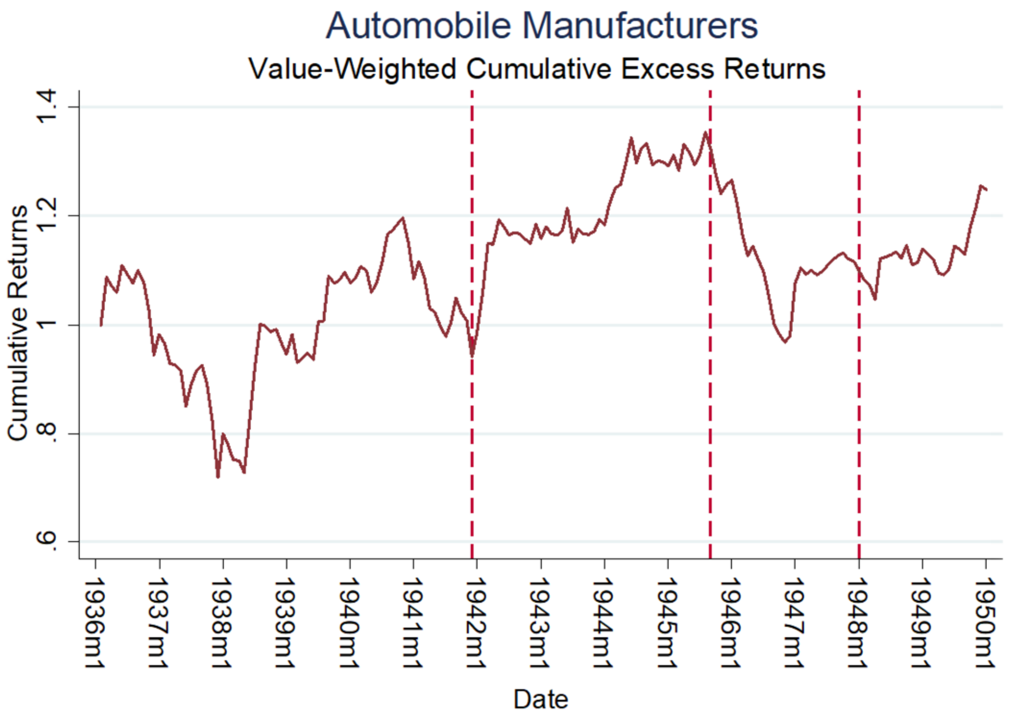
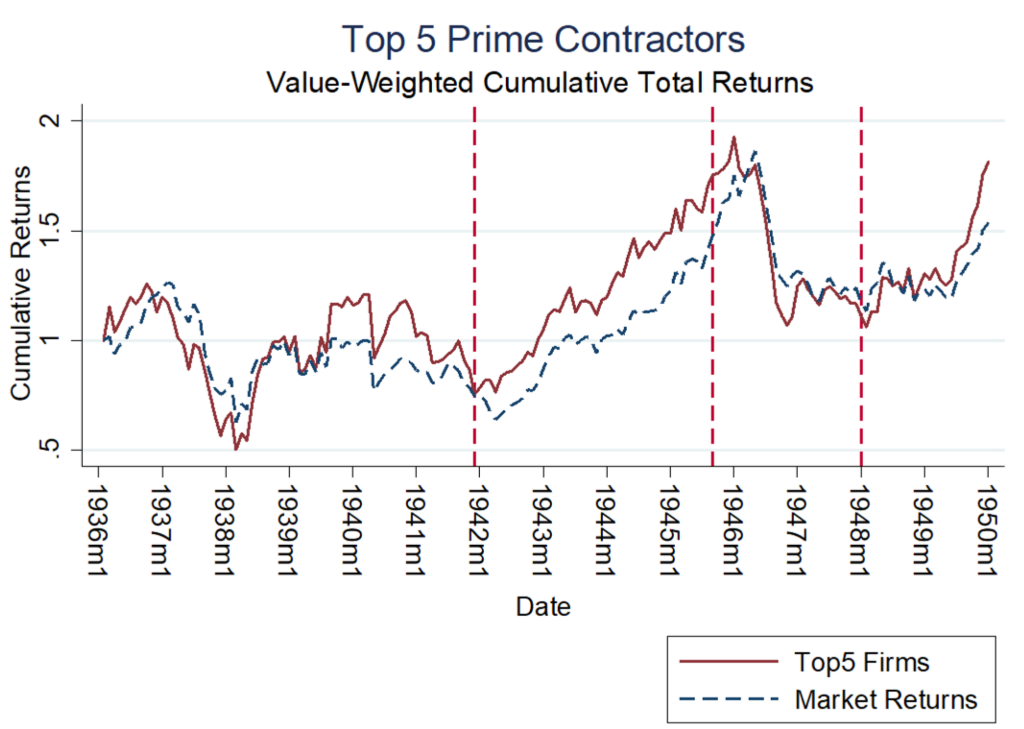


Figure 8: Stock Market Returns of the Top 5 Prime Contractors

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the top 5 prime contractors documented in the 1946 congressional report from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

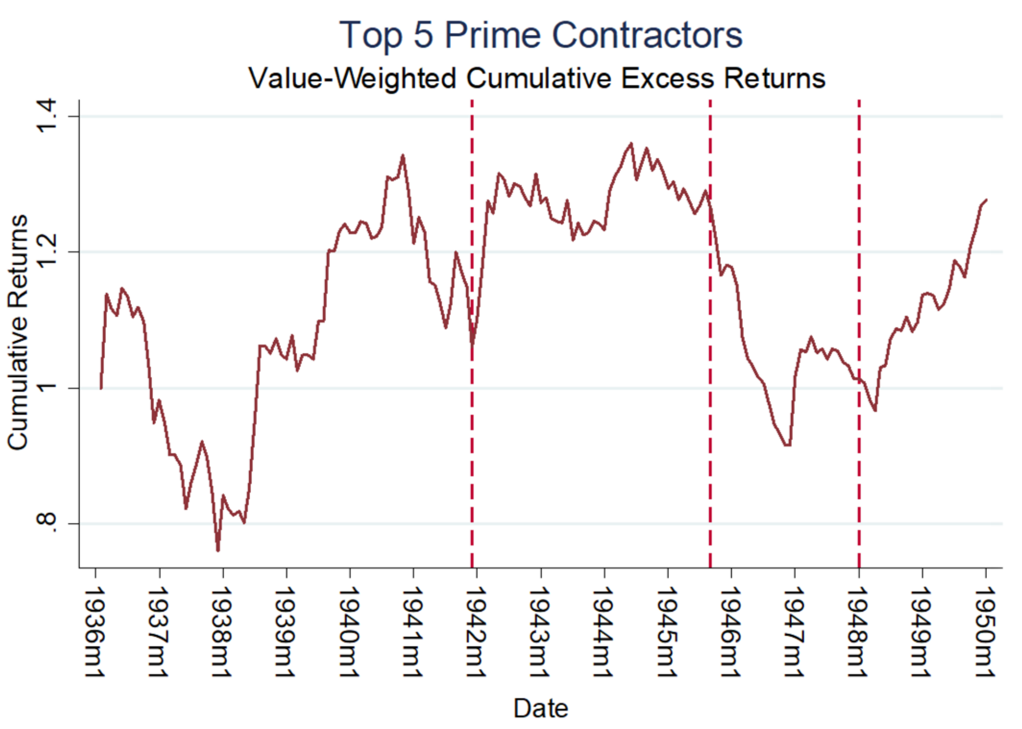
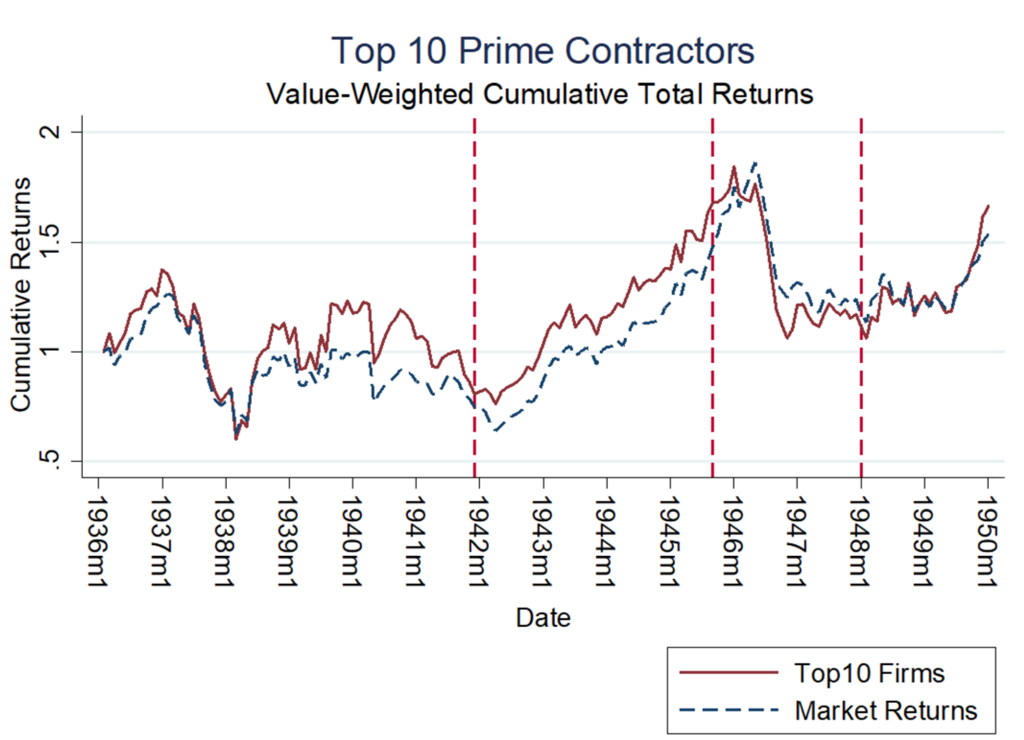


Figure 9: Stock Market Returns of the Top 10 Prime Contractors

This figure plots the accumulated monthly holding period returns and the accumulated excess returns of the top 10 prime contractors documented in the 1946 congressional report from 1936:M1 to 1950:M1. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1). The returns are normalized to 1 in the first period of observation.

Panel A: Accumulated Monthly Holding Period Returns



Panel B: Accumulated Excess Returns

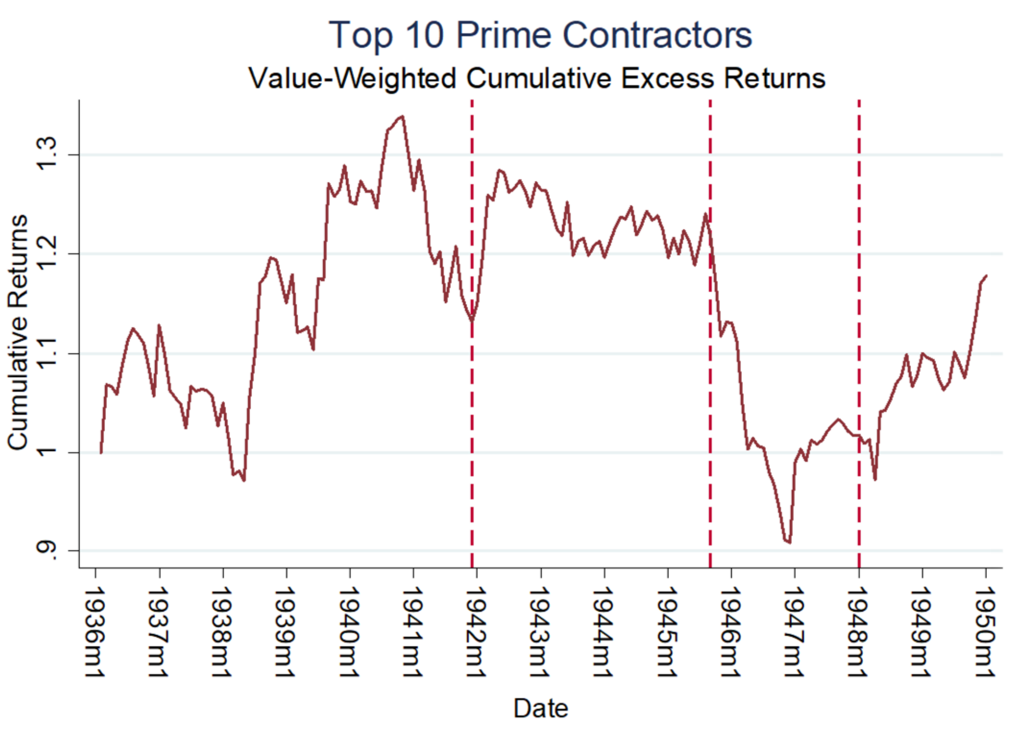
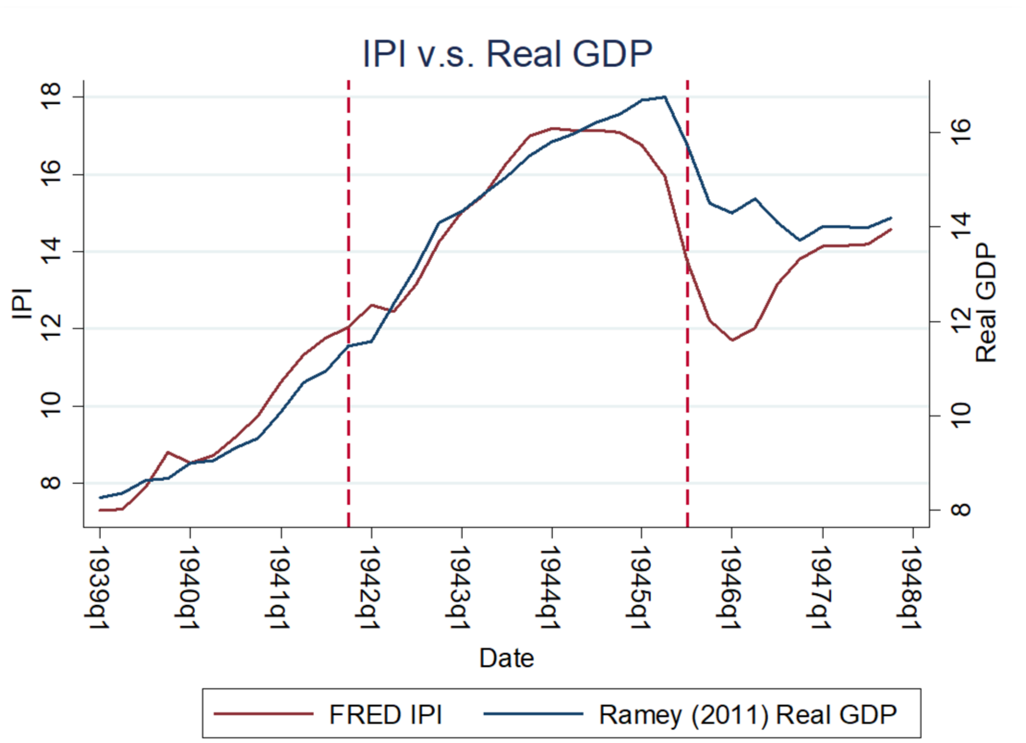


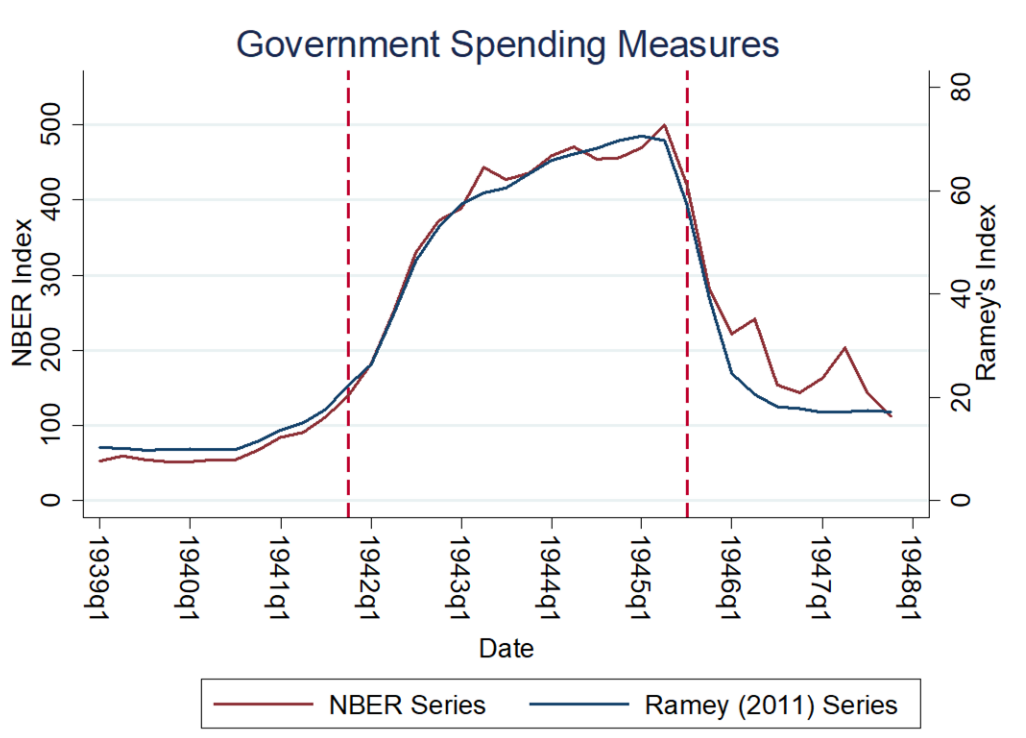
Figure 10: Macroeconomic Data

This figure displays the macroeconomic data I use in the monthly analysis over the sample of 1936:M1 to 1947:M12. Panel A compares the FRED IPI with the real GDP series from Ramey (2011) at the quarterly level. Panel B compares the federal budget expenditures from the NBER Macrohistory Database with the federal spending measure from Ramey (2011) at the quarterly level. Panels C and D plot the accumulated excess returns of the aircraft and shipbuilding companies with the available awarded and open contracts series from Brunet (2018) at the monthly level. Panels E and F plot the excess returns with the NBER federal budget expenditures and the FRED IPI at the monthly level. The first red dashed line indicates Pearl Harbor (1941:M12), the second red dashed line indicates the V-J Day (1945:M9), and the third red dashed line marks the War Scare of 1948 (1948:M1).

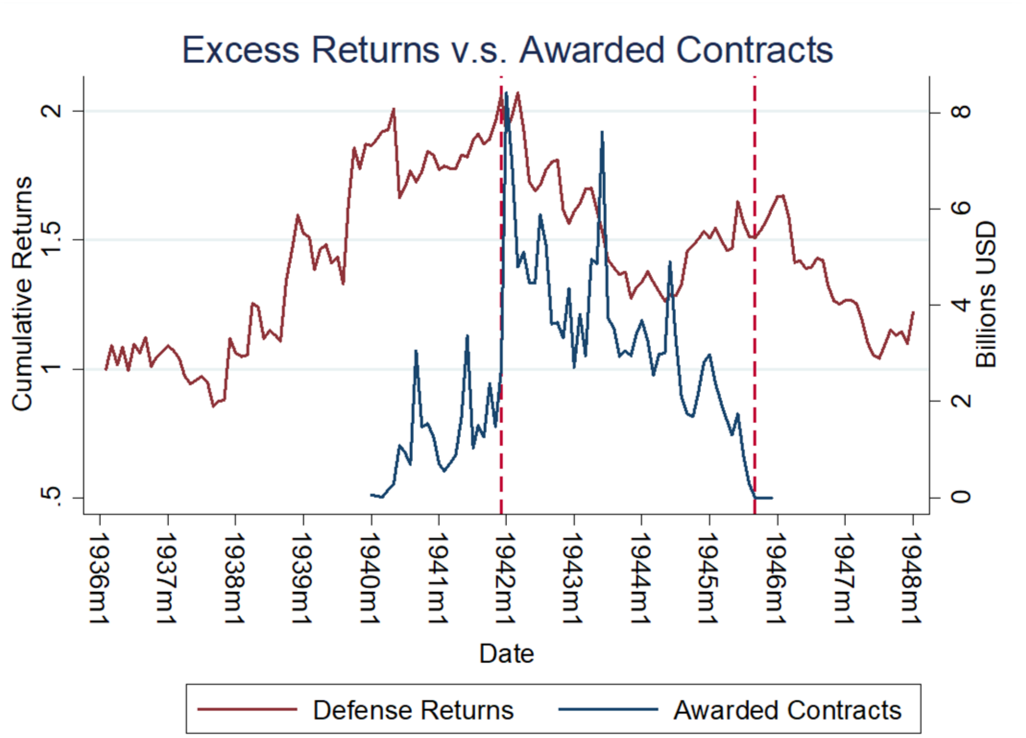
Panel A: Real Output



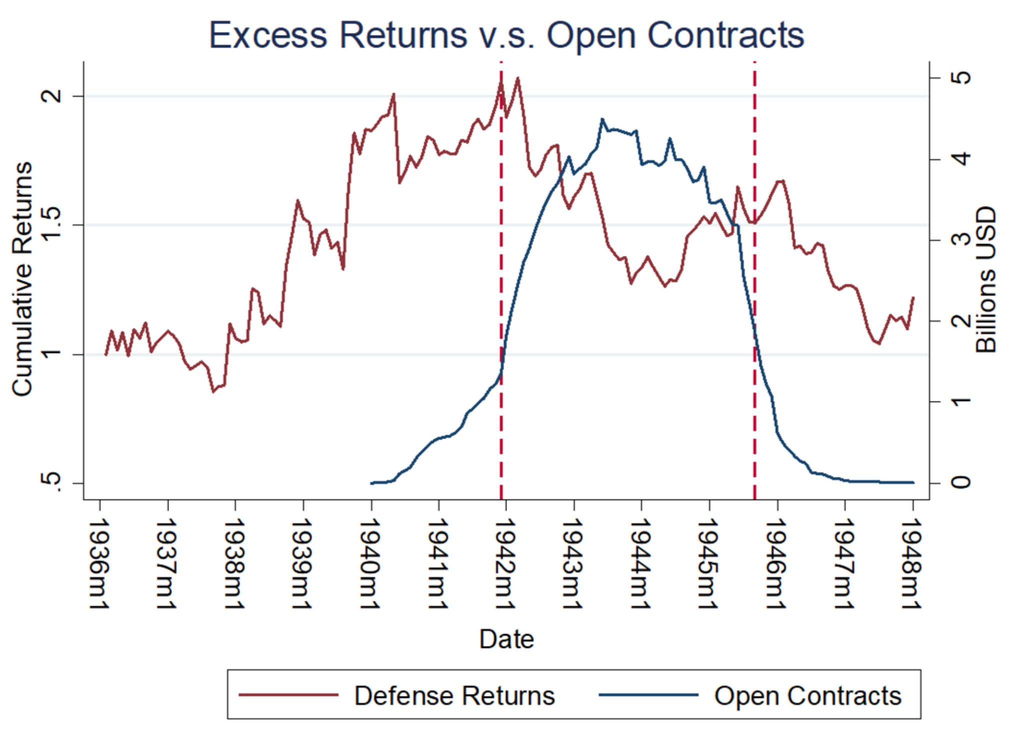
Panel B: Federal Expenditures



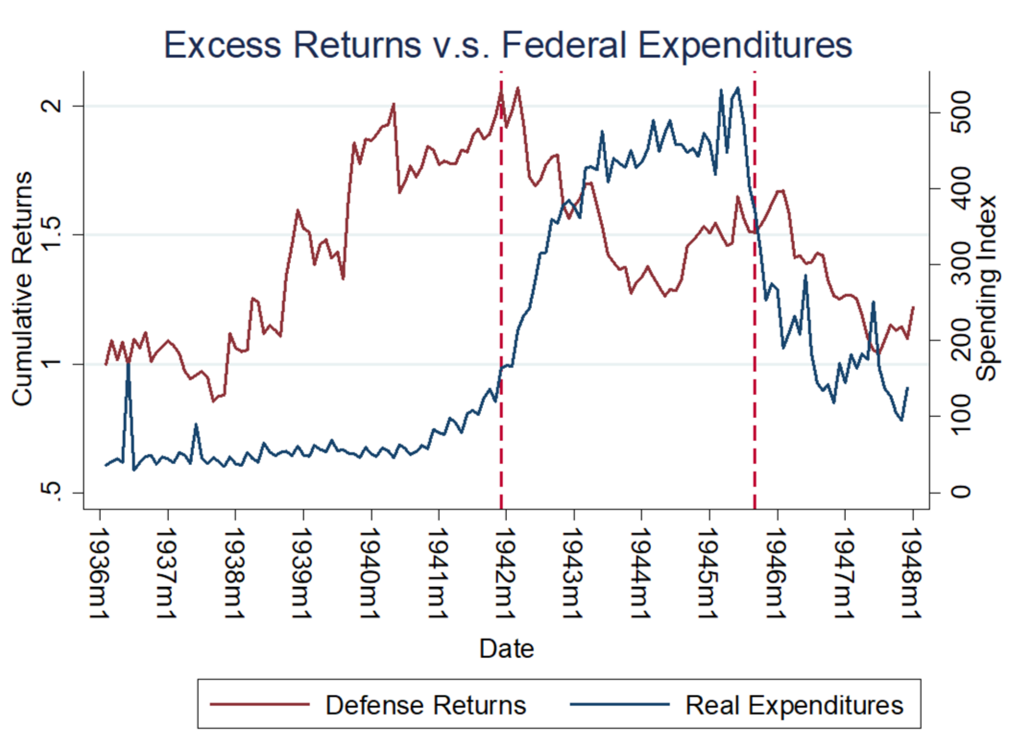
Panel C: Accumulated Excess Returns and Awarded Contracts



Panel D: Accumulated Excess Returns and Open Contracts



Panel E: Accumulated Excess Returns and Federal Expenditures



Panel F: Accumulated Excess Returns and Industrial Production

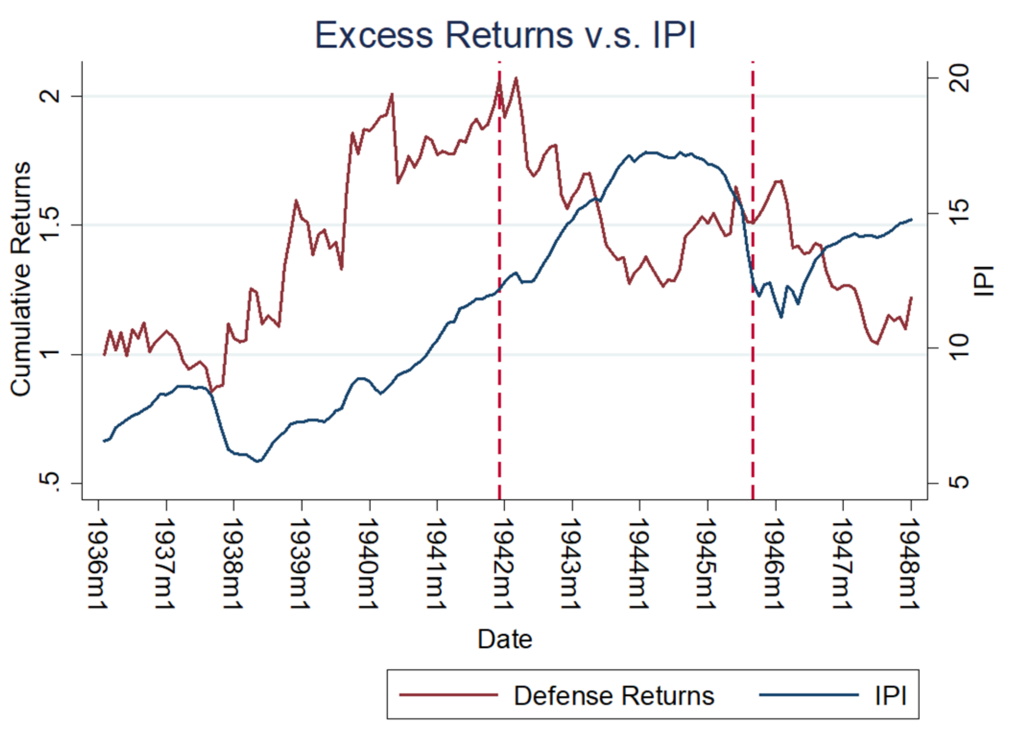
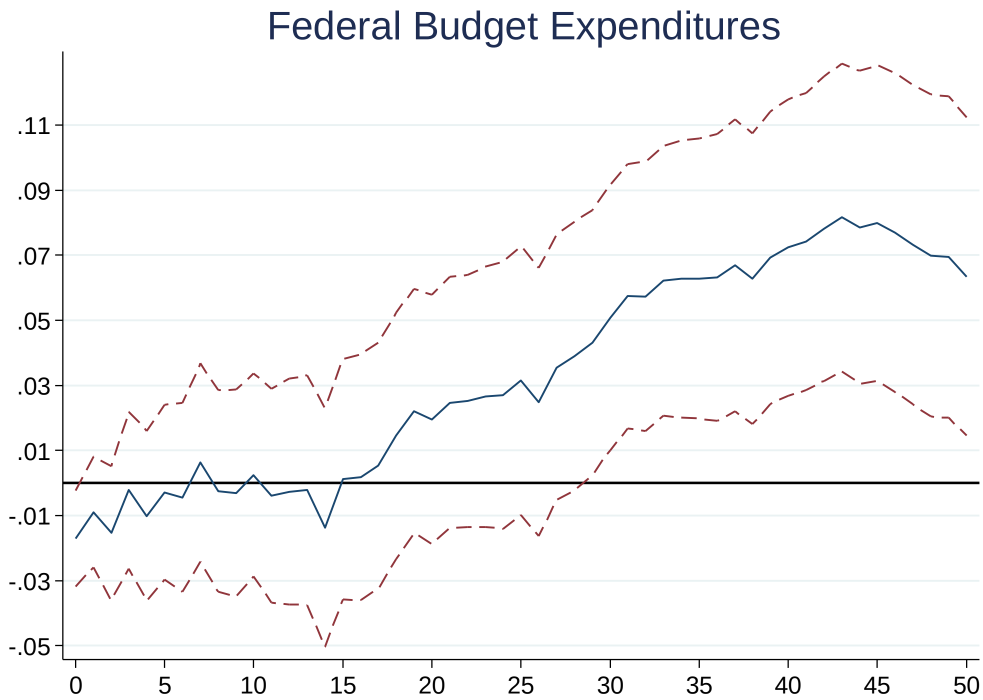


Figure 11: Monthly Responses to an Excess Return Shock

This figure presents the 50 steps impulse responses to a one-standard-deviation innovation to the accumulated excess returns of the defense sector. The monthly VAR is evaluated over the sample of 1936:M1 to 1947:M12 with 15 lags. The VAR includes the excess returns of the aircraft and shipbuilding companies, the log of the federal budget expenditures, and the log of the IPI, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Federal Expenditure Responses



Panel B: Industrial Production Responses

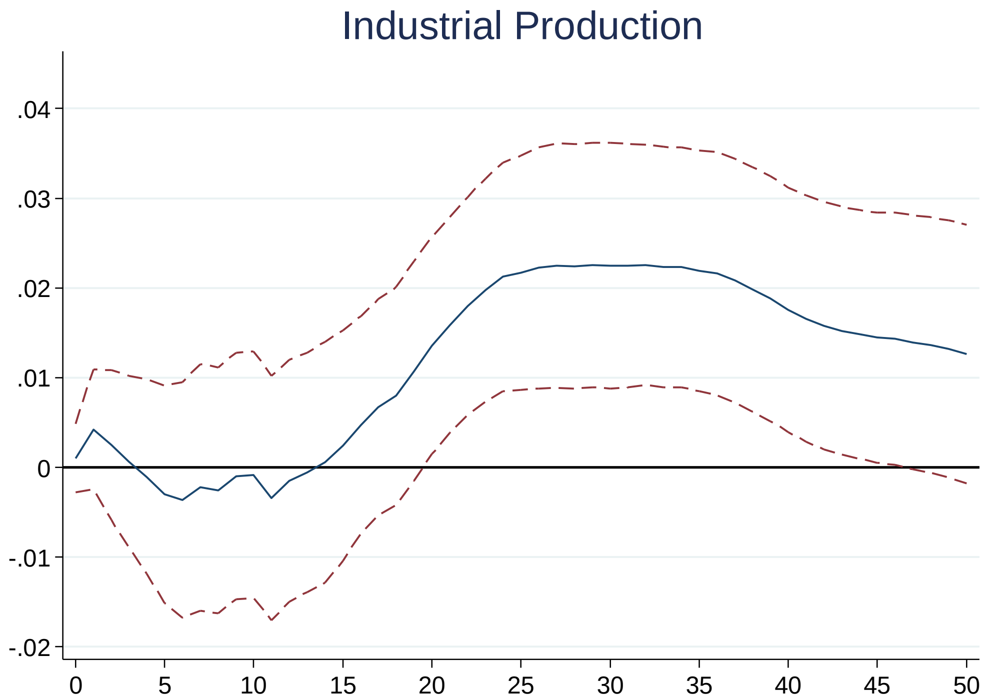
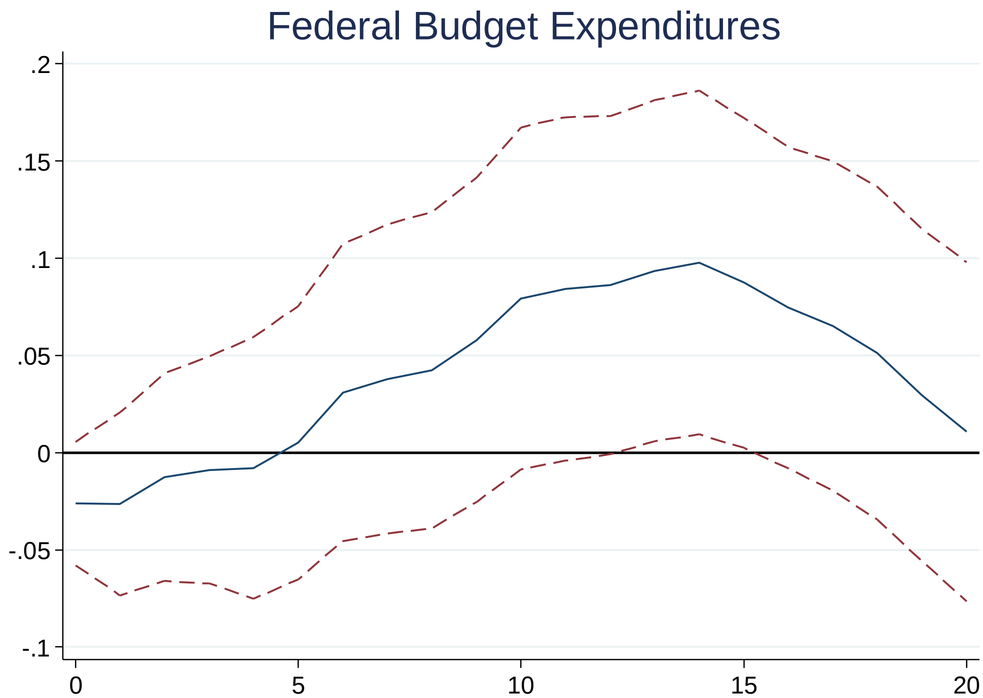


Figure 12: Quarterly Responses to an Excess Return Shock

This figure presents the 20 steps impulse responses to a one-standard-deviation innovation to the accumulated excess returns of the defense sector. The quarterly VAR is evaluated over the sample of 1936:Q1 to 1947:Q4 with 5 lags. The VAR includes the excess returns of the aircraft and shipbuilding companies, the log of the federal budget expenditures, and the log of the IPI, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Federal Expenditure Responses



Panel B: Industrial Production Responses

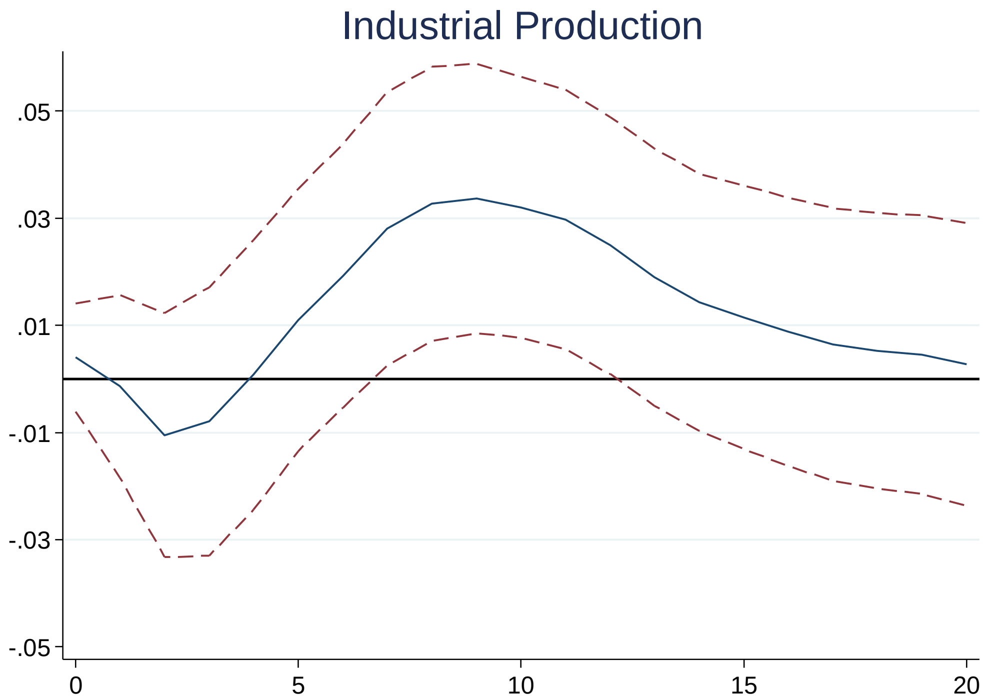
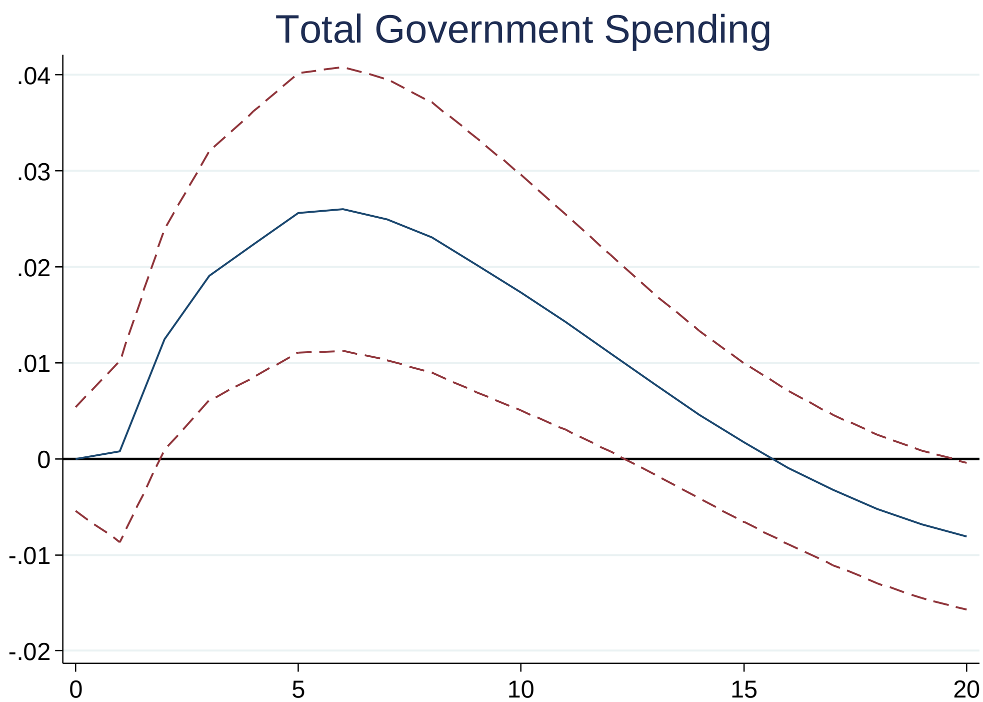


Figure 13: Responses to a Defense News Shock, 1939-2008

This figure presents the 20 steps impulse responses to a one-standard-deviation innovation to the defense news. The quarterly VAR is evaluated over the sample of 1939:Q1 to 2008:Q4 with 4 lags. The VAR includes the defense news, the log of total government spending, the log of real GDP, the three-month treasury rate, the Barro-Redlick average marginal income tax rate, and the log of total hours, in that order, with a timing restriction as well as a linear and a quartic trend. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

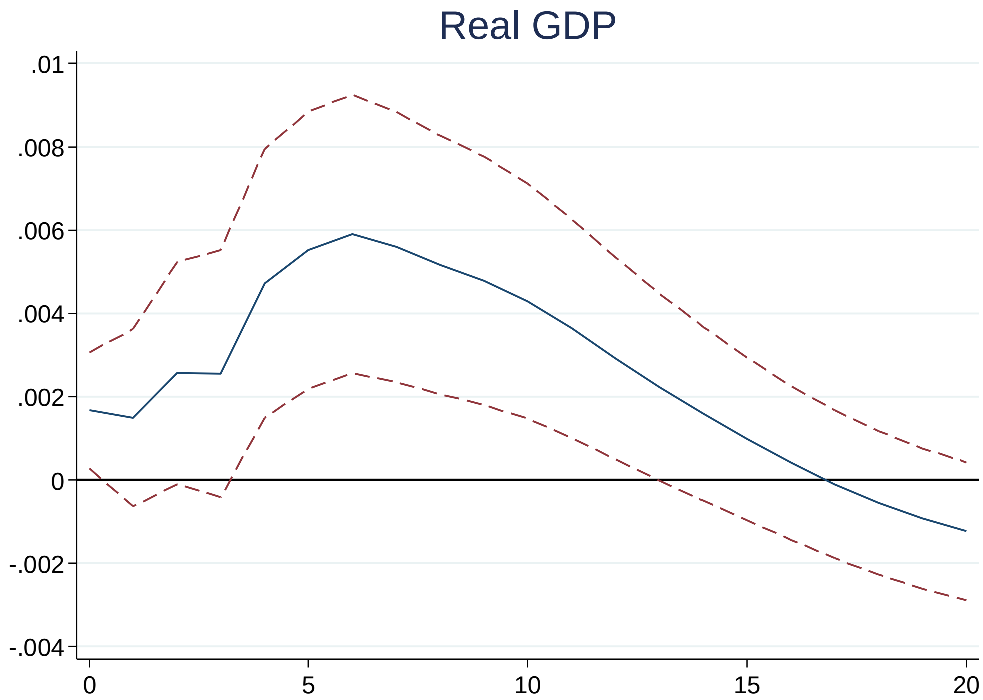
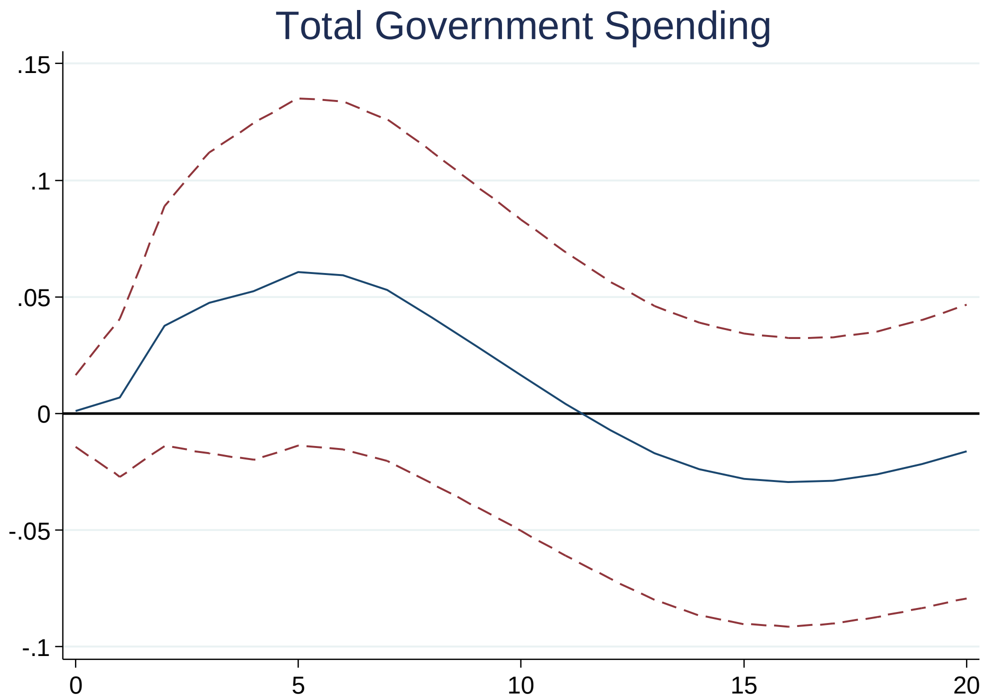


Figure 14: Responses to a Defense News Shock, 1939-1949

This figure presents the 20 steps impulse responses to a one-standard-deviation innovation to the defense news. The quarterly VAR is evaluated over the sample of 1939:Q1 to 1949:Q4 with 4 lags. The VAR includes the defense news, the log of total government spending, and the log of real GDP, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

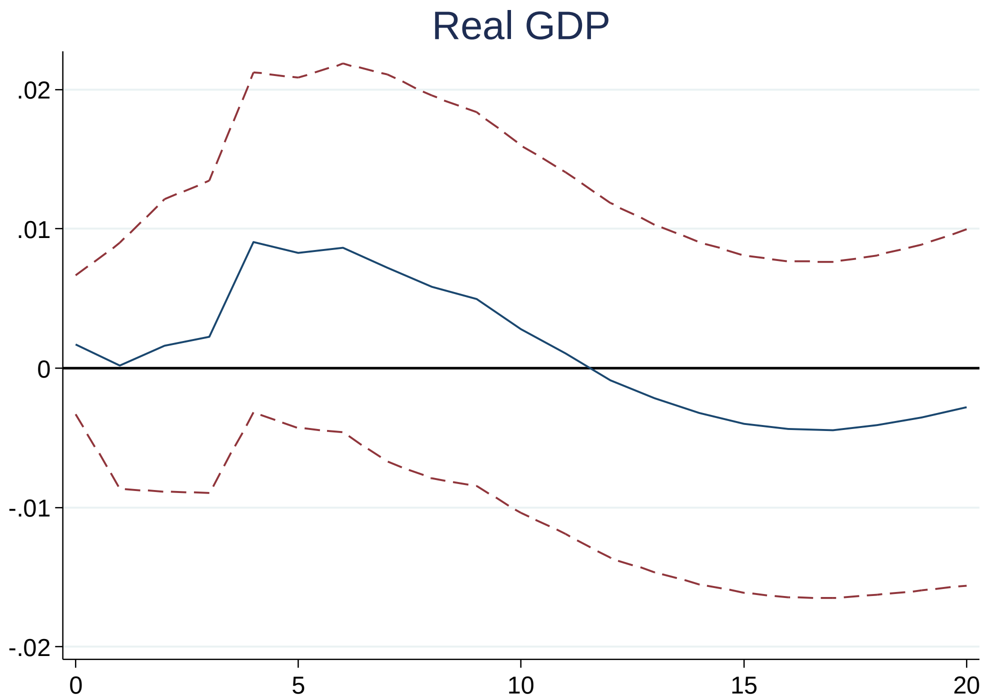
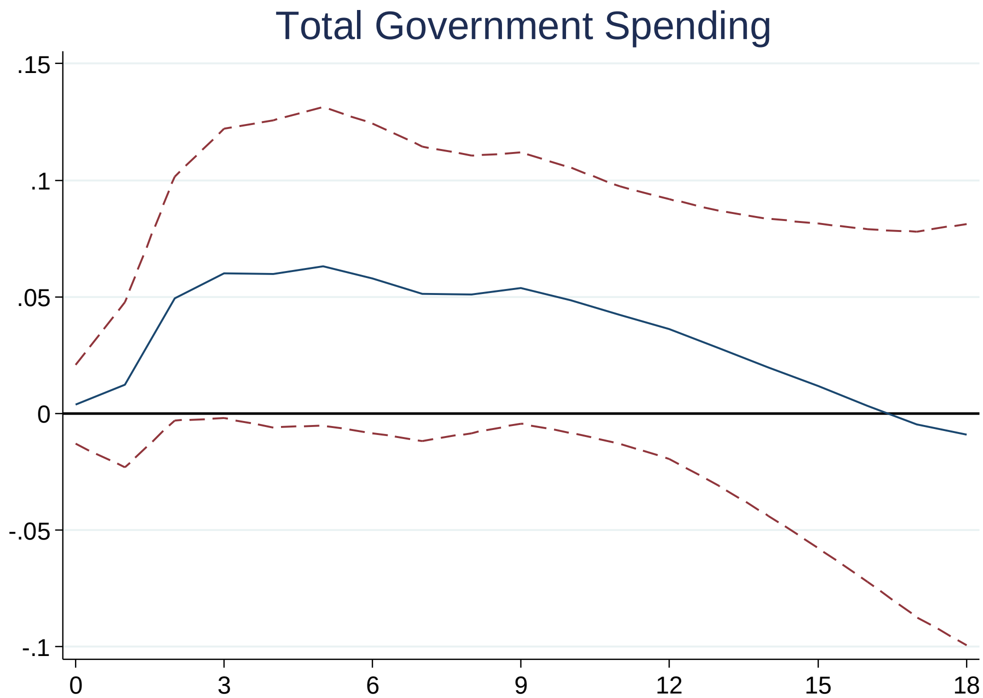


Figure 15: Responses to a Defense News Shock, 1939-1947

This figure presents the 18 steps impulse responses to a one-standard-deviation innovation to the defense news. The quarterly VAR is evaluated over the sample of 1939:Q1 to 1947:Q4 with 4 lags. The VAR includes the defense news, the log of total government spending, and the log of real GDP, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

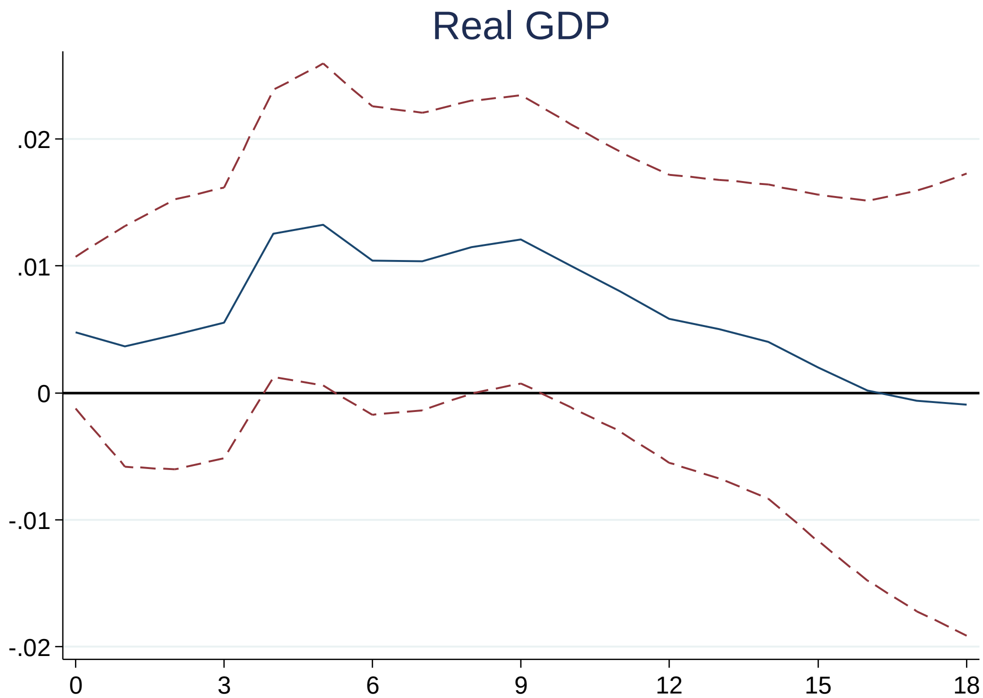
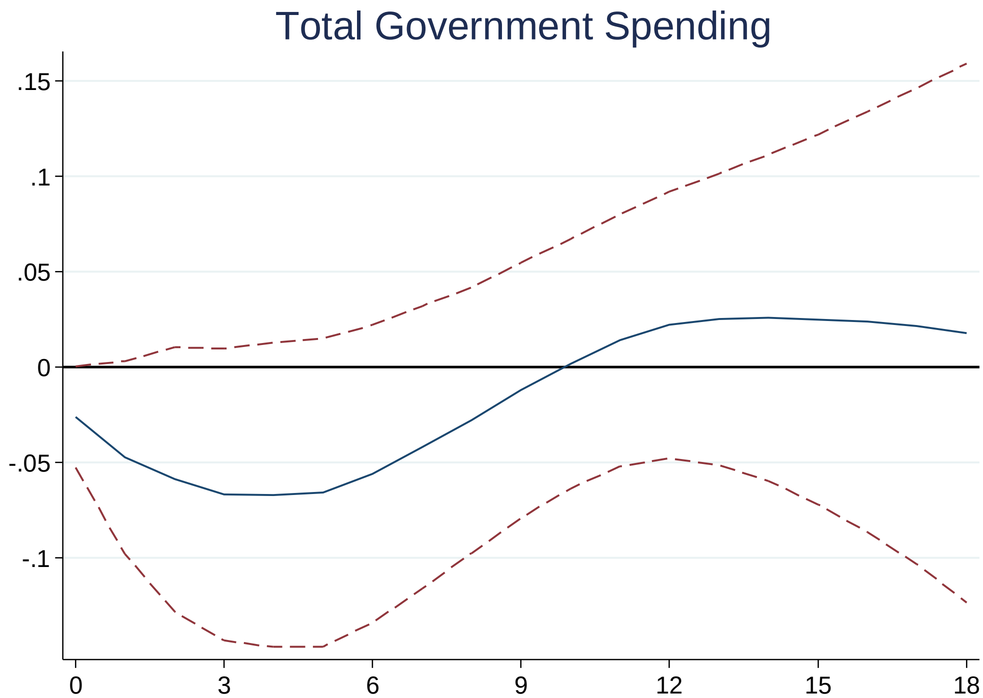


Figure 16: Responses to an Excess Return Shock, 1939-1947

This figure presents the 18 steps impulse responses to a one-standard-deviation innovation to the accumulated excess returns of the defense sector. The quarterly VAR is evaluated over the sample of 1939:Q1 to 1947:Q4 with 4 lags. The VAR includes the excess returns of the aircraft and shipbuilding companies, the log of total government spending, and the log of real GDP, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

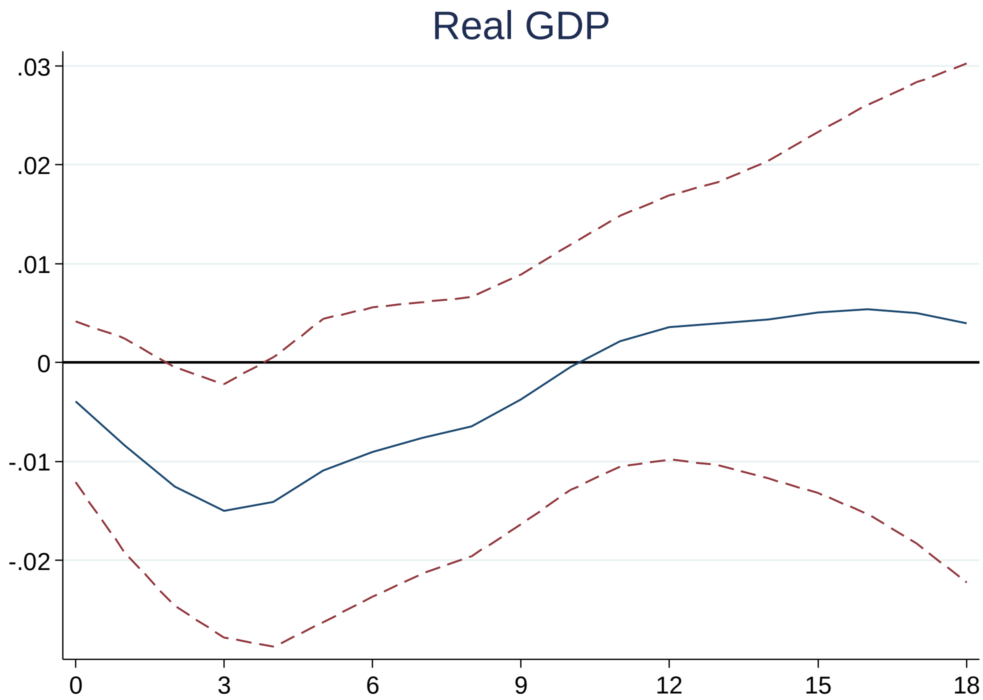
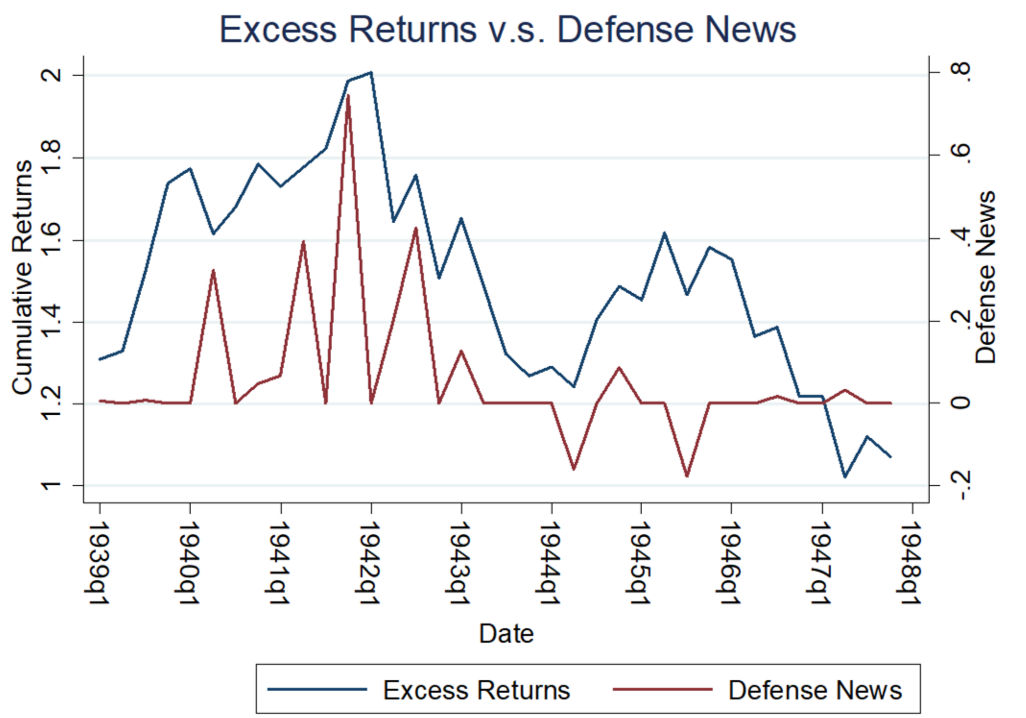


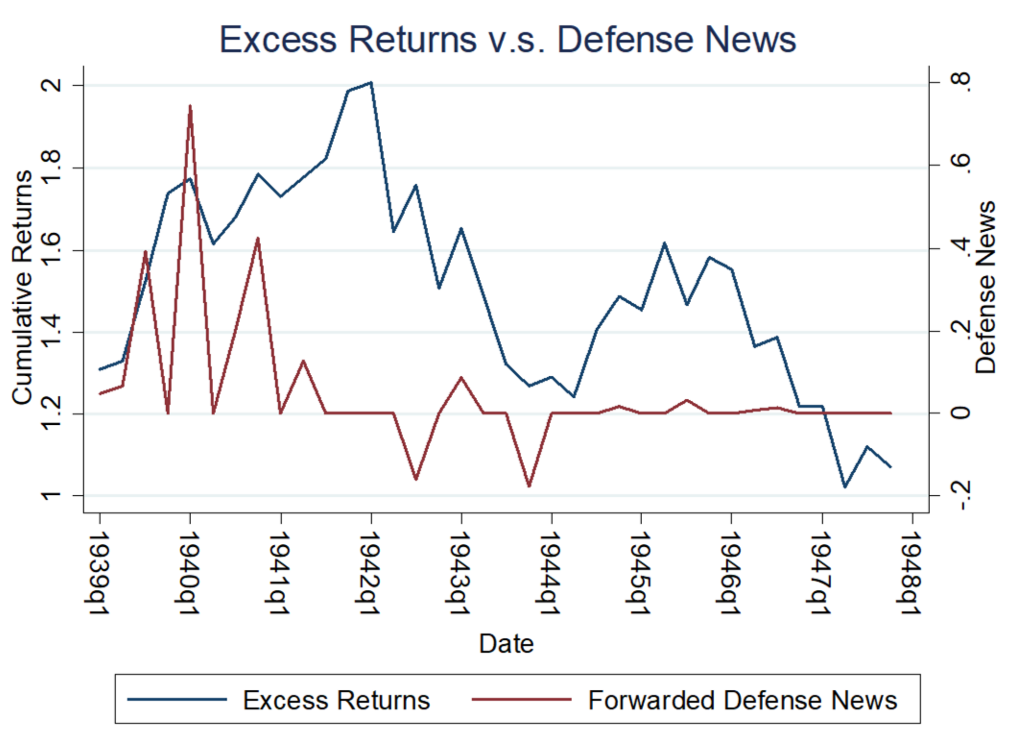
Figure 17: Excess Returns and Defense News

This figure describes the accumulated excess returns of the aircraft and shipbuilding companies vs. the defense news over the quarterly sample of 1939:Q1 to 1947:Q4. Panel A plots the original series. Panel B plots the original excess returns and the defense news forwarded by 7 quarters. Panel C plots the excess returns lagged by 4 quarters and the original defense news.

Panel A: Original Excess Returns and Defense News



Panel B: Original Excess Returns and Shifted Defense News



Panel C: Shifted Excess Returns and Original Defense News

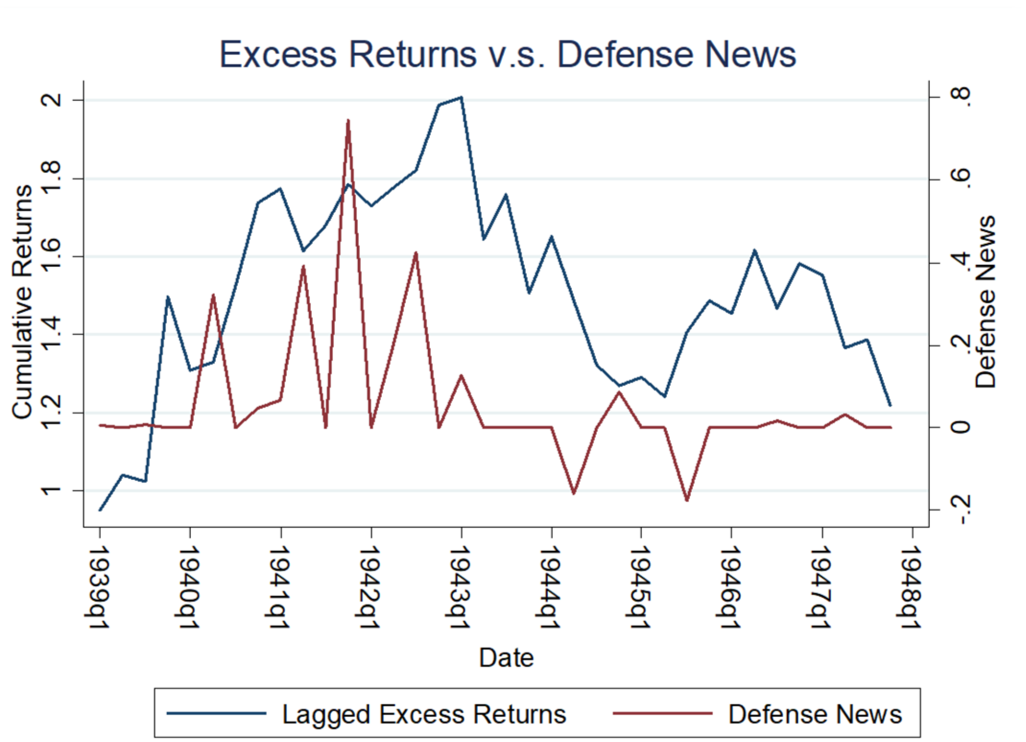
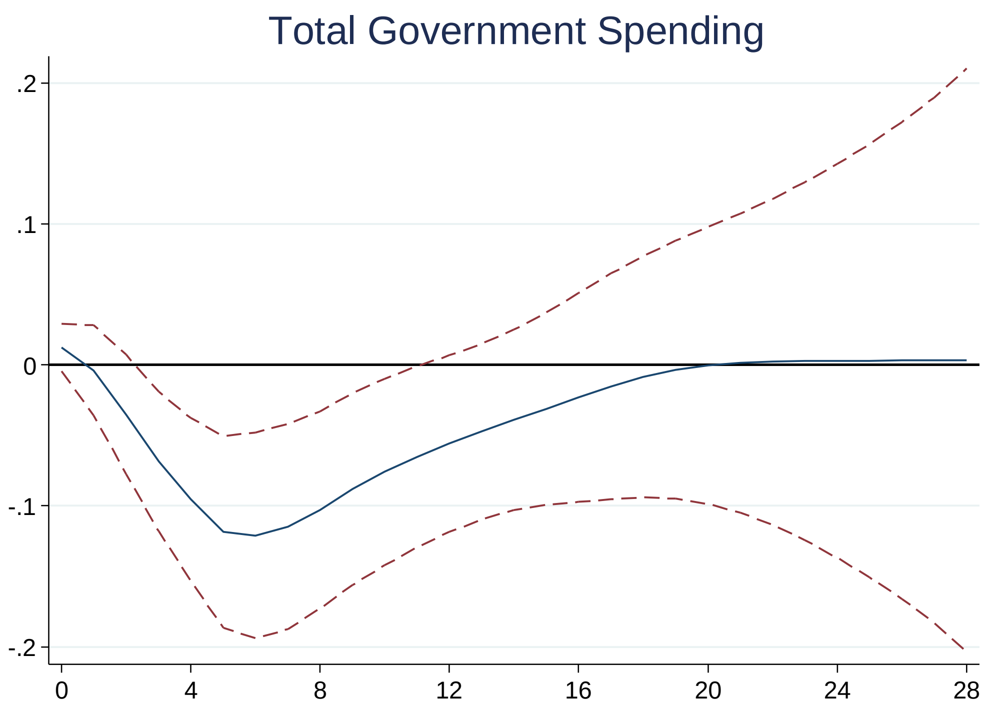


Figure 18: Responses to a Forwarded Defense News Shock, 1939-1947

This figure presents the 28 steps impulse responses to a one-standard-deviation innovation to the forwarded defense news. The quarterly VAR is evaluated over the sample of 1939:Q1 to 1947:Q4 with 4 lags. The VAR includes the forwarded defense news, the log of total government spending, and the log of real GDP, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

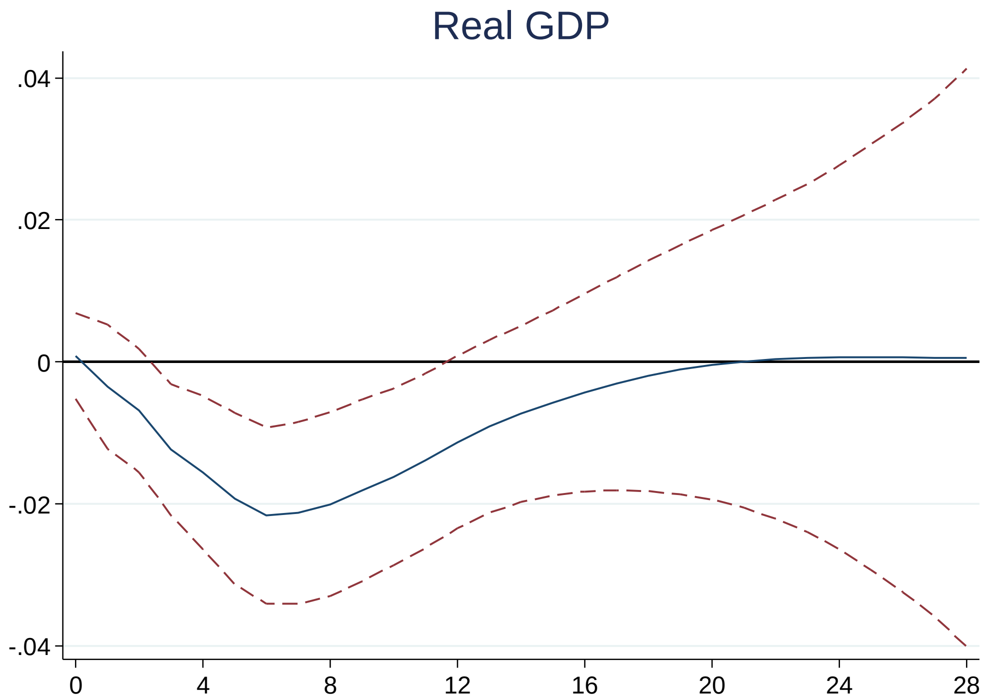
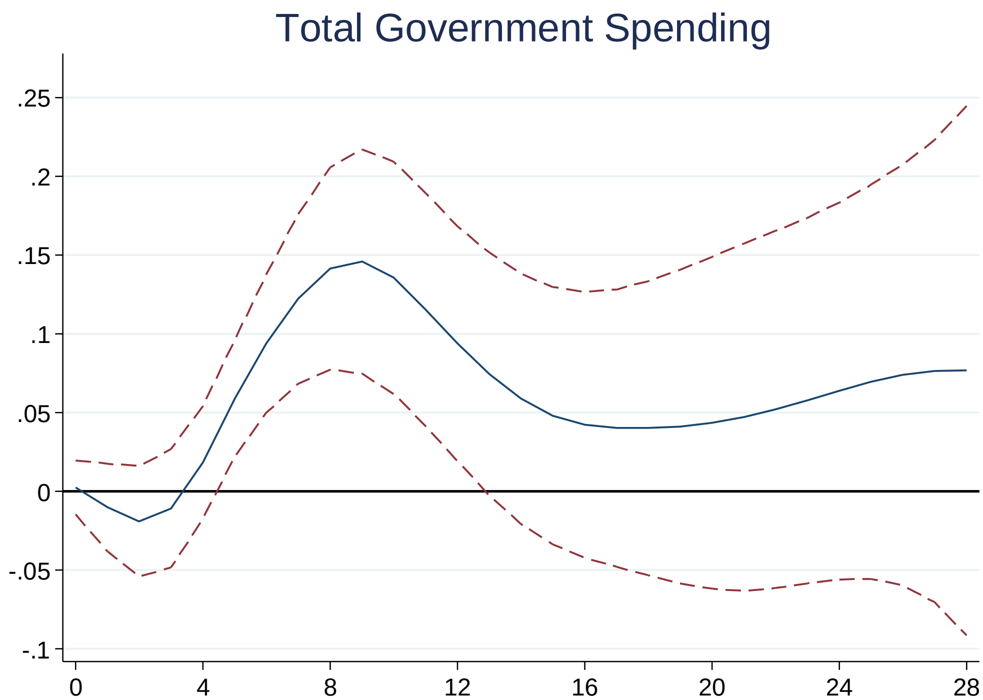


Figure 19: Responses to a Lagged Excess Return Shock, 1939-1947

This figure presents the 28 steps impulse responses to a one-standard-deviation innovation to the lagged accumulated excess returns of the defense sector. The quarterly VAR is evaluated over the sample of 1939:Q1 to 1947:Q4 with 4 lags. The VAR includes the lagged excess returns of the aircraft and shipbuilding companies, the log of total government spending, and the log of real GDP, in that order, with a timing restriction and a linear trend term. The dashed lines demarcate the 95% confidence intervals based on the bootstrapped standard errors with 500 replications.

Panel A: Total Government Spending Responses



Panel B: Real GDP Responses

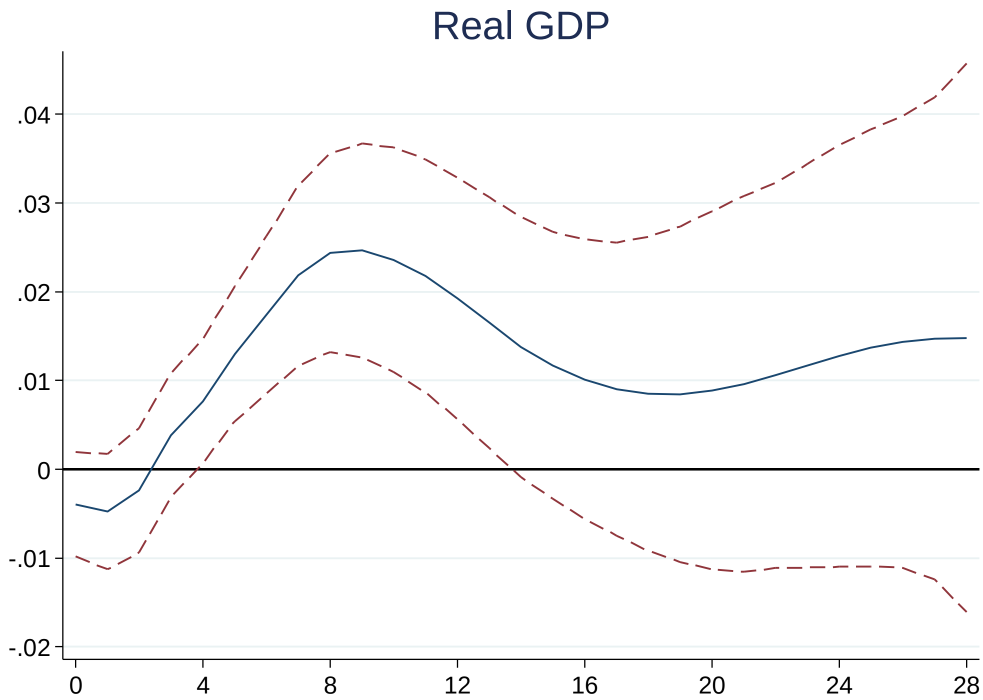


Table 1: Explanatory Power of the Excess Returns

	(1) Awarded Contracts	(2) Open Contracts	(3) Real Expenditures	(4) Output
Aircrafts & Ships	0.31	0.34	0.35	0.35
Automobile	0.26	0.22	0.20	0.18
Top 5	0.23	0.31	0.25	0.15
Top 10	0.26	0.31	0.26	0.19
Dow Firms	0.19	0.11	0.27	0.36

Note: Columns (1)-(4) display the R-squared values of the performance tests. The performance tests in Columns (1) and (2) are conducted by regressing the growth of the log nominal values of the supply contracts on the current value and 15 lags of the growth of the log excess returns. The dependent variable in Column (1) is the log awarded contracts. The dependent variable in Column (2) is the log open contracts. The performance tests in Columns (3) and (4) are conducted by regressing the growth of the log values of the IPI and federal expenditures on the current value and 36 lags of the growth of the log excess returns. The dependent variable in Column (3) is the log IPI. The dependent variable in Column (4) is the log federal expenditures.

Appendix

Figure A1: Top 1-55 Prime Contractors

This table lists the top 1-55 prime war supply contractors from the 1946 congressional report.

Corporation	Millions of dollars [1]	Percent of total	Cumulative percent of total
All companies—Total	175,062.9	100.0	100.0
100 specified corporations—Total	117,634.4	67.2	67.2
1. General Motors Corp	13,812.7	7.9	7.9
2. Curtiss-Wright Corp	7,001.0	4.1	11.9
3. Ford Motor Co	5,269.6	3.0	15.0
4. Consolidated Vultee Aircraft Corp	4,875.4	2.8	17.7
5. Douglas Aircraft Co., Inc	4,431.3	2.5	20.3
6. United Aircraft Corp	3,923.0	2.2	22.5
7. Bethlehem Steel Co	3,789.3	2.2	24.7
8. Chrysler Corp	3,394.8	1.9	26.6
9. General Electric Co	3,300.1	1.9	28.5
10. Lockheed Aircraft Corp	3,246.2	1.9	30.4
11. North American Aviation, Inc	2,768.5	1.6	32.0
12. Boeing Airplane Co	2,700.2	1.5	33.5
13. American Telephone & Telegraph Co	2,562.7	1.5	34.9
14. Martin, Glenn L., Co	2,344.8	1.3	36.3
15. du Pont, E. I., de Nemours Co., Inc	2,186.2	1.2	37.5
16. United States Steel Corp	1,974.0	1.1	38.7
17. Bendix Aviation Corp	1,869.2	1.1	39.7
18. Packard Motor Car Co	1,783.8	1.0	40.7
19. Sperry Corp	1,531.5	.9	41.6
20. Kaiser, Henry J., Co	1,384.4	.8	42.4
21. Westinghouse Electric & Manufacturing Co	1,375.7	.8	43.2
22. Grumman Aircraft Engineering Corp	1,330.4	.8	44.0
23. Newport News Shipbuilding & Drydock Co	1,245.8	.7	44.7
24. Republic Aviation Corp	1,231.5	.7	45.4
25. Bell Aircraft Corp	1,228.3	.7	46.1
26. Todd Shipyards Corp	1,191.9	.7	46.8
27. Nash-Kelvinator Corp	1,162.6	.7	47.4
28. Studebaker Corp	1,143.8	.7	48.1
29. Consolidated Steel Corp., Ltd	1,097.4	.6	48.7
30. Goodyear Tire & Rubber Co	1,091.2	.6	49.3
31. Standard Oil Co. of New Jersey	1,053.1	.6	49.9
32. Aviation Corp	1,045.6	.6	50.5
33. International Harvester Co	1,035.8	.6	51.1
34. American Locomotive Co	889.2	.5	51.6
35. Western Cartridge Co	880.5	.5	52.1
36. American Car & Foundry Co	854.9	.5	52.6
37. United States Rubber Co	798.0	.5	53.1
38. Continental Motors Corp	782.9	.4	53.5
39. Sun Oil Co	712.5	.4	53.9
40. Baldwin Locomotive Works	712.3	.4	54.3
41. Pressed Steel Car Co., Inc	664.3	.4	54.7
42. Permanente Metals Corp	635.4	.4	55.1
43. Radio Corp. of America	610.0	.3	55.4
44. Caterpillar Tractor Co	602.7	.3	55.8
45. Allis-Chalmers Manufacturing Co	585.7	.3	56.1
46. Norden, Carl L., Inc	555.2	.3	56.4
47. Diamond T. Motor Car Co	535.7	.3	56.7
48. Willys-Overland Motors, Inc	522.2	.3	57.0
49. California Shipbuilding Corp	503.5	.3	57.3
50. Bath Iron Works	498.6	.3	57.6
51. American Woolen Co., Inc	493.9	.3	57.9
52. Emerson Electric Manufacturing Co	487.1	.3	58.1
53. Consolidated Builders, Inc	478.1	.3	58.4
54. White Motor Co	471.6	.3	58.7
55. Firestone Tire & Rubber Co	455.2	.3	59.0

Figure A2: Top 56-100 Prime Contractors

This table lists the top 56-100 prime war supply contractors from the 1946 congressional report.

Corporation	Millions of dollars [1]	Percent of total	Cumulative percent of total
56. Pullman, Inc.	455.0	0.3	59.2
57. Philco Corp.	452.8	.3	59.5
58. Anaconda Copper Mining Co.	446.8	.3	59.7
59. Federal Cartridge Corp.	439.1	.3	60.0
60. Fairbanks, Morse Co.	414.1	.2	60.2
61. Northern Pump Co.	411.1	.2	60.4
62. Eastman Kodak Co.	407.6	.2	60.7
63. Mack Trucks, Inc.	396.1	.2	60.9
64. Food Machinery Corp.	392.2	.2	61.1
65. Hercules Powder Co.	366.6	.2	61.3
66. Remington Rand, Inc.	359.8	.2	61.5
67. Goodrich, B. F., Co.	359.6	.2	61.8
68. Brown Shipbuilding Co.	357.1	.2	62.0
69. Beech Aircraft Corp.	351.3	.2	62.2
70. Higgins Industries, Inc.	349.6	.2	62.4
71. Raytheon Manufacturing Co.	348.8	.2	62.6
72. Dravo Corp.	343.7	.2	62.8
73. Fairchild Engine & Airplane Corp.	334.1	.2	62.9
74. Smith, A. O., Corp.	329.6	.2	63.1
75. Standard Oil Co. of California	327.6	.2	63.3
76. General Cable Corp.	325.6	.2	63.5
77. Electric Boat Co.	324.1	.2	63.7
78. Jack & Heintz, Inc.	312.2	.2	63.9
79. Royal Dutch Co.	308.1	.2	64.0
80. Crucible Steel Co. of America	300.5	.2	64.2
81. American Shipbuilding Co.	294.0	.2	64.4
82. Moore Drydock Co.	292.2	.2	64.5
83. Hudson Motor Car Co.	290.0	.2	64.7
84. Brewster Aeronautical Corp.	281.8	.2	64.9
85. Autocar Co.	279.5	.2	65.0
86. Socony-Vacuum Oil Co., Inc.	276.5	.2	65.2
87. Jacobs Aircraft Engine Co.	269.4	.2	65.3
88. Ingalls Iron Works	265.6	.2	65.5
89. Western Pipe Steel Co. of California	264.3	.2	65.6
90. American Can Co.	261.8	.1	65.8
91. General Machinery Corp.	261.7	.1	65.9
92. Chicago Bridge & Iron Co.	260.2	.1	66.1
93. Texas Co.	260.1	.1	66.2
94. Galvin Manufacturing Corp.	243.8	.1	66.4
95. Stewart-Warner Corp.	242.6	.1	66.5
96. Revere Copper & Brass, Inc.	241.6	.1	66.7
97. New England Shipbuilding Corp.	235.5	.1	66.8
98. Missouri Valley Bridge & Iron Co.	233.8	.1	66.9
99. Colt's Patent Fire Arms Manufacturing Co.	233.8	.1	67.1
100. Northrop Aircraft, Inc.	232.3	.1	67.2

[1] Represents the total face value, as of Sept. 30, 1944, of all prime war supply contracts of $50,000 and over exclusive of food, reported to the War Production Board in the period June 1940 through September 1944