

Crowded out from the Beginning: Impact of Government Debt on Corporate Financing*

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March 22, 2021

Abstract

Using hand-collected data on corporate bond and stock offerings, we identify the impact of government debt on corporate financing during World War I. The early twentieth century provides a unique opportunity to identify the impact of government debt on private financing because during this period (1) firms announced the amount they wanted to raise before each security offering and (2) the Treasury issued debt in discrete intervals. We identify the impact of Treasury issues by comparing differences in the amount firms offered to the amount they actually raised when the Treasury was borrowing to when the Treasury was not in the market. We find that long-term government bond offerings negatively affect both amount of long-term corporate bonds and dividend paying stocks issued. In contrast, we find no effect of government bond offerings on short-term debt issue. Our findings suggest that investors view stable dividend paying stocks as a close substitute for relatively safe long-term bonds.

JEL Classification: E44, G20, N42

Keywords: Government Debt, Crowding Out, Capital Structure, Dividends

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How do government deficits impact corporate financing decisions? With the Great Recession and the Covid-19 pandemic, this question has received renewed attention as government borrowing relative to GDP has increased from 67% of GDP in 2008 to 136% of GDP as of April 1, 2020.¹ The increase in government borrowing has raised questions concerning the impact of government borrowing on corporate finance and which securities investors view as close substitutes for government debt.² For example, most studies examine the impact of government debt on corporate leverage based on the idea that government bonds are close substitutes for investment-grade corporate debt issues. However, much less is known about the relationship between government debt and corporate equity. Several recent studies suggest that investors view stable dividend paying stocks as bond like investments.³ Thus, focusing on the impact of government borrowing on a narrowly defined set of corporate debt securities may understate impact of government deficits on corporate financial policy.

In this study, we focus on financial markets in the U.S. during World War I, when the methods of offering government and corporate securities provide a unique opportunity to address the empirical challenges in the identification. By using novel hand-collected data on individual corporate bond and stock offerings, we are able to identify the impact of unexpected changes in the supply of Treasury bonds on investor demand for various corporate security issuances (e.g., corporate bonds and stocks). The early twentieth century provides a unique opportunity to identify the impact of government debt on private financing because during this period (1) firms announced the amount they wanted to raise before each security offering (2) securities were frequently offered directly to shareholders or underwritten without a firm commitment from investment banks and (3) the Treasury issued debt in discrete

¹ See Federal Reserve Economic Data (FRED) at Federal Reserve Bank of St. Louis.

² For example, Krishnamurthy and Vissing-Jorgensen (2015) argue that safe and liquid government debt crowds out financial sector lending financed with short-term debt whilst Greenwood et al. (2010) argue that government debt impacts investment-grade corporate debt with maturities similar to government debt being issued.

³ See for example, Baker and Wurgler (2012), Jiang and Sun (Forthcoming), and Hartzmark and Solomon (2019).

intervals without a regular and predictable pattern.⁴

We identify the impact of Treasury bond issues on investor demand for securities by examining differences in the amount firms offered to the amount they actually raised when the Treasury was borrowing to when the Treasury was not in the market. First, consistent with previous work, we find long-term government bonds crowded out long-term corporate bonds, but not short-term corporate notes.⁵ Second, we find that that crowding out extended to corporate equity, which constitutes the novel contribution of this paper. Treasury offerings crowded out preferred stocks and stable dividend paying common stocks; a security not typically considered a close substitute for long-term government bonds.

Our analysis is motivated by recent work on market segmentation and the effect of changes in the supply of Treasury bonds on corporate debt issues and leverage (Greenwood and Vayanos (2010); Greenwood et al. (2010), hereafter (GHS); Krishnamurthy and Vissing-Jorgensen (2011, 2012) hereafter (KVJ)). This literature is based in part on the idea that bond markets are segmented, and segmentation arises from investors' demand for fixed income securities with specific attributes. Thus, assuming segmentation, the immediate impact of changes in the supply of Treasury securities is expected to be limited to corporate securities with risk and maturity characteristics similar to Treasuries being issued. More broadly, as Friedman (1984) argues, changes in Treasury supply in each segment of the bond market will affect required returns in that segment which, in turn, affects the relative attractiveness of other forms of financing. For example, financing government deficits by issuing short-term treasury securities raises short-term rates but lowers the relative return on long-term debt

⁴ The U.S. treasury started *regular* and *predictable* offerings in the 1980s. Garbade (2007) explains: "In 1975, the U.S. Treasury had to finance a rapidly growing federal deficit with sales of new notes and bonds on an offering-by-offering basis. Because the timing and maturities of these tactical offerings did not follow a predictable pattern, the issuances sometimes caught investors off guard and disrupted the market. By 1982, the Treasury had abandoned tactical issuance and was following a regular and predictable schedule of new note and bond offerings. The move to regular and predictable issuance was widely credited with reducing market uncertainty, facilitating investor planning, and lowering the Treasury's borrowing costs."

⁵ See Greenwood et al. (2010) and Badoer and James (2016).

and equity, leading corporations to substitute long-term debt and equity for short-term debt financing. Similarly, government financing deficits with long-term debt raises the return on long-term debt leading firms to substitute equity and short-term financing for long-term debt.

Past studies generally find a negative relation between increases in the supply of Treasuries and private sector use of debt financing. For example, Graham et al. (2014, 2015 hereafter GLR) and Demirci et al. (2019) find negative relation between corporate leverage and government debt to GDP (a measure of the use of debt by the public sector). Recent research by GHS (2010) and Badoer and James (2016) find evidence that maturity composition of government debt affects the maturity choice of corporate issuers. Specifically, they find evidence that high grade corporate issuers substitute out of the maturity segment in which the Treasury is most active.

The impact of government borrowing on corporate financial policy generally focuses on the impact of government bond issues on corporate debt financing. This focus is motivated by the assumption that investors view Treasury securities as close substitutes for high grade corporate bonds or in the case of KVJ short-term liquid debt issued by financial institutions.⁶ According to this same assumption, investors should view dividends differently from interest payments on corporate bonds and thus view common stocks as a poor substitute for interest payments on a government bond. But suppose, as Shefrin and Statman (1984) and more recently Hartzmark and Solomon (2019) argue, investors do not view capital gains and dividends as substitutes and instead think of dividends as a relatively safe hedge against price fluctuations and ignore the fact that dividends have a direct effect on stock prices. If investors suffer from what Hartzmark and Solomon (2019) refer to as a *free dividend fallacy*, then changes in government borrowing may have a direct effect on demand for and issuance of dividend paying stocks. Note that if behavioral biases lead investors to view

⁶ Greenwood and Vayanos (2010), GLR (2014, 2015).

stable dividend paying stocks as a close substitute for government bonds then the changes in the supply of government bonds should lead to a reduction in demand by investors for dividend paying stocks and thus a reduction in common stock issues by dividend paying firms. This behavioral based explanation leads to prediction that is exactly the opposite of prediction of models such as Friedman (1984); in which an increase in government debt leads to substitution of equity for debt by corporate issuers.

Determining a causal linkage between government debt issuances and private financing is difficult since, as KVJ (2015) and other point out, the supply of Treasury securities is potentially endogenous. Specifically, the negative correlation between government borrowing and corporate debt issues could be driven by other factors that comove with increases in government debt. For example, government debt increases during recessions, when investment opportunities deteriorate and firms' demand for external finance declines. In addition, volatility may rise during recessions leading to a reduction in leverage at a time when government deficits are rising.

Ideally, to identify the impact of government borrowing on corporate finance, one would like to observe a large unexpected increase in government borrowing and changes in corporate financing decisions in direct response to the increase in government borrowing. World War I (WWI) financing comes close to meeting these conditions. Specifically, during WWI and shortly after the armistice, the government issued so called "Liberty" and "Victory" bonds in five discrete intervals. The amount raised in these offerings was large, ranging from around \$2 billion to \$7 billion, compared to GDP at the time of approximately \$60 billion.⁷ Subscriptions for these offerings occurred over a relatively short time period following an announcement. As we discuss later, there was considerable uncertainty as to the size and terms of each offering as well as how much of offering would be subscribed. In part, this uncertainty arose because (1) the Treasury did not provide details concerning the size and

⁷ See Table 8 of Rockoff (2004).

terms of the offering prior to announcing an offering and (2) each offering had a fixed coupon rate and requirement that the offering be sold at par.⁸

The way in which corporate securities were typically offered in the early twentieth century also facilitates identification of the impact of government borrowing. Specifically, established firms often issued securities directly to shareholders or through investment banks on what we would now call a best efforts basis.⁹ For each security offering, firms would announce the amount and terms of the offering and then collect subscriptions from investors. Depending on investor interest, either the offering was fully subscribed, or some portion of offering would remain unsold. As a result, we can compare the amount sought to the amount actually sold as a measure of changes in investor demand for specific types of securities.

To measure the impact of government borrowing on investor demand, we collect data on individual corporate securities offering during WWI and shortly after the armistice. We measure the difference between the demand by firms for funding and the amount of funding investors were willing to supply by the “unsold ratio”; calculated as the difference between amount sought and the amount subscribed divided by the amount sought. The frequency of our data allows us to compare the unsold ratio in treated months to the unsold ratio in non-treated months in a given year. Specifically, to identify the impact of government borrowing on investor demand for various types of securities, we conduct a difference-in-differences analysis by comparing the unsold ratio for securities offered in months when Liberty Bonds were being issued to the unsold ratio of securities offered in months when no government

⁸ For example, on August 14, 1917 the New York Times published an article reporting on Treasury Secretary’s McAdoo’s inability or unwillingness to provide information concerning future Liberty Bond issues: “Secretary McAdoo today again denied reports in regard to the character of the next issue of the Liberty Loan. He made the statement repeatedly that none of the details of the next issue had been decided, and the date of the offer has not been fixed even tentatively.” The article goes on to state that “The Secretary has under considerations various suggestions in regard to the next issue, but it is not certain that the character of the bonds of the first issue will be improved upon or that an attempt will be made to improve upon the terms of those bonds.”

⁹ See Dewing (1920) who refers to the offering process as a promotion and describes the role of investment bankers and syndicate members in the offering process.

bonds were offered. We account for differences in the size of the government bond offering by including in the regression the size of each offering relative to nominal GDP one month before and in the months during the offering. Thus, the coefficient estimate of this regression measures the impact of an increase in government debt to GDP on corporate fund raising. In our base regression, we include controls for monthly economic activity as well as controls for firm characteristics and rating fixed effects. To account for potentially unobserved changes in the demand for funding by various industries, we include industry-year fixed effects in our difference-in-differences analysis.

Overall, we find a significant impact of government borrowing on the ability of firms to raise capital. In particular, we find that a 1 percentage point increase in government debt to GDP leads to an increase in the unsold ratio of all types of securities offered of .79 percentage points. More important, we find significant differences in the impact of government borrowing across corporate securities. Specifically, we find that long-term government bond issues are associated with a significant decrease in long-term bonds and preferred stock purchases by investors. For example, we find that a 1 percentage point increase in government debt to GDP is associated with about a 1.19 percentage points increase in the unsold ratio for long-term bonds and 1.18 percentage points increase in the unsold ratio of preferred stock. We find no significant effect of government bond issues on investor demand for either long-term speculative grade bonds or short-term borrowing. Surprisingly, we find the greatest impact of government borrowing on the demand for stable dividend paying common stock. In particular, we find that a 1 percentage point increase in new government debt to GDP is associated with a 2.74 percentage points increase in the unsold ratio for common stocks offered by firms with a stable dividend history. We find no significant impact of government bond issues on the demand for common stocks without stable dividends. This suggests that investors viewed long-term government bonds as a close substitute for dividend paying common stock.

Given our finding of an increase in the unsold ratio for long-term corporate securities but not short-term securities, one potential question is whether firms adjusted their securities offerings in response to a shift in investor demand. We address this question in two ways. First, we estimate a multinomial logit model, relating the likelihood of issuing bonds in five maturity bins, preferred stock and common stock during the war years relative to security issuances before the war. Overall, we find a decrease in the likelihood of issuing long-term bonds during the war years and an increase in the likelihood of issuing short-term bond. Consistent with the gap filling hypothesis proposed by GHS (2010) (in which investment-grade corporate issuers respond to shifts in the maturity composition of government borrowing), we find that the change in the maturity of corporate issues is most pronounced among investment-grade issuers. Second, we examine corporate issuers' response to government borrowing by estimating a linear model of maturity choice. We use this model to examine changes in the maturity composition of corporate bond issues during the war relative to the maturity composition before the war. Overall, we find a significant decrease in the maturity of bonds offered during the war years relative to the maturity of bonds offered in 1916.

This study contributes to the literature on the impact of government borrowing on corporate financing choice by using WWI as a laboratory to examine how government financing impacts investors' demand for various types of corporate securities and corporate issuers' response. Using a novel data set and exploiting the unique way in which both government and corporate securities were issued, we are able to mitigate endogeneity problems to clearly separate the impact of government borrowing on investor demand for and corporate supply of various securities. Consistent with previous studies, we find evidence that government borrowing affects both the demand and supply of long-term investment-grade corporate bonds (see KVJ (2011), GHS (2010), and Badoer and James (2016)).

We also contribute to the behavioral literature on how investors view dividends. Specifically, consistent with work by Hartzmark and Solomon (2019) and Shefrin and Statman

(1984), we find evidence that investors behave as if dividend paying stocks are a close substitute for long-term fixed income securities. We find no evidence that investors view stocks without a stable dividend stream as close substitutes for government bonds. Thus, our finding suggests that investors view dividends and capital gains as disconnected attributes. Our finding also helps explain Baker and Wurgler (2012) finding that government bond returns strongly comove with bond-like stocks; stock of large mature and stable dividend paying firms.

The rest of the paper is organized as follows: In section 1, we discuss how the U.S. financed WWI and describe the way in which government bonds and corporate securities were sold in the early 20th century. This section serves to motivate our strategy for identifying the effect of government funding on investor demand for corporate securities and corporate financial policies. In section 2, we describe our data and identification strategy. Section 3 and 4 describe our findings concerning the effect of government borrowing on investor demand for different types of corporate securities. In section 5, we investigate the corporate response to government borrowing in terms of changes in the types of securities that were offered during the war. In section 6, we discuss the external validity of our findings. Section 7 provides a brief summary of our findings and conclusions.

1 War Finance and the Securities Issuance Process during the Early Twentieth Century

1.1 War financing and the Issuance of Liberty Bonds

Immediately prior to the United States's entry into the war, the U.S. economy was rapidly expanding, and unemployment was relatively low. As Rockoff (2004) explains, the robust economy preceding the U.S. entry to the war was due in part to relatively long period of

U.S. neutrality before entering the war and the U.S.'s role as a key supplier to Allied powers. The war began in Europe in July of 1914 and the U.S. entered 31 months later. From the end of 1914 to the end of 1916, nominal GNP grew by almost 13% per year and real GNP grew by just over 6%.¹⁰ The U.S. entry into the war led to a rapid increase in government expenditure. In 1916, just before the U.S. entered the war, federal government spending was 3% of GDP. Spending peaked at 35% of GDP on an annual basis in January 1919 (Bohn, 2008).

There was an active debate among economists, as well as policy makers, concerning how to finance the large anticipated increase in Federal expenditures associated with the war. The main concern among economists with relying heavily on government borrowing does not appear to be with potential crowding out of private investment. Instead, the primary concern appeared to be with fairness, the idea being that given relatively flat personal income tax rates at the start of the war, the wealthy would purchase government bonds and benefit disproportionately from the interest paid.¹¹ In the end, about 25% of government war-related spending was financed through taxes and about 60% was financed through borrowing from the public.¹² Consequently, government debt increased from 3% in 1917 to almost 35% in 1919, as shown in Figure 1.¹³

¹⁰ See Balke and Gordon (1986) Appendix B. Unemployment at the start of WWI was about 6%. By way of contrast, in 1940, before the start of WWII (the next episode of large government borrowing), unemployment was 14.6%, and the U.S. economy was still trying to recover from the Great Depression.

¹¹ Sprague (1917) expressed this concern at the annual meetings of the American Economic Association in 1917: "The injustice of treating those who furnish the funds for war more generously than those who risk life itself will not be questioned. Consider for a moment the contrast under the borrowing method of war finance of a soldier in receipt of an income before a war and his neighbor who remains at home in continued receipt of a similar amount. The civilian reduces his expenditure in every possible way and subscribes a total of \$4000 to war loans. He is rewarded with a high rate of interest to which his soldier neighbor must contribute his quota in higher taxes if he is fortunate enough to return from the front." Rockoff (2004) estimates an average tax rate of 1.5% for income up to \$50,000 (about \$1.2 million in 2018 dollars). Personal income taxes were raised significantly during the war, with the top bracket rising from 6% in 1915 to 70.3% in 1918.

¹² See Table 3 of Rockoff (2004) that estimated that 15% of federal spending was through increases in the money supply through Federal Reserve purchases of bonds from banks.

¹³ By way of comparison, Federal government debt to GDP has increased by a similar ratio between 2009 and 2018, from 77% to 105% (Federal Reserve Economic Data (FRED) at Federal Reserve Bank of St. Louis).

Rather than borrowing continuously, Treasury Secretary McAdoo chose to offer Liberty Bonds in separate blocks. As discussed earlier, the size and terms of each offering were not disclosed before the start of the Liberty Bond campaign.¹⁴ Moreover, instead of holding an auction, as is done today, to determine the coupon or discount rate for the bonds, the Treasury set the coupon rate based on its assessment of the market and then marketed the offering over a fixed period of time.¹⁵ Investment banks were not used to market the bonds. Instead, the Federal Reserve (Fed) served as the distribution agent for bond.¹⁶ The Fed in turn, encouraged member banks to buy bonds and to market them to their customers.¹⁷ Sales were required to be at par and purchasers were discouraged from selling bonds after purchased in the primary market.¹⁸

The motivation behind this unusual way of offering securities appears to have been to create a broad market for the bonds and to lower borrowing costs by appealing to investor patriotism; as the name Liberty Bond suggests.¹⁹ Another motivation for a series of smaller, discrete bond offerings was to gauge demand for the bonds. As Sutch (2018) explains, “The worry expressed by bankers and bond dealers at the time was unanimous: the bonds might not sell . . . Moreover, the critics pointed out, only a few Americans had any direct knowledge about bonds, fewer still actually owned any.”²⁰

While most of the Liberty Bonds issued were long term, certain features of the bonds changed over time. Table I shows the amount of each bond offering and the properties of

¹⁴ August 14, 1917 the New York Times.

¹⁵ See Sutch (2018) and Liberty Bonds section of Federal Reserve History (https://www.federalreservehistory.org/essays/liberty_bonds)

¹⁶ See 1917 Annual Report of the Federal Reserve Board pp. 2-3.

¹⁷ See 1917 Annual Report of the Federal Reserve Board p.6.

¹⁸ See Rockoff (2004).

¹⁹ See Hilt and Rahn (2016) and Sutch (2018) for a description of the marketing of liberty bonds. Kang and Rockoff (2006) attempt to estimate the effect of “capitalizing on patriotism” on the cost of government borrowing. They find little evidence that capitalizing on patriotism resulted in lower borrowing costs for the federal government.

²⁰ Sutch (2018) on p.14: “Prior to the creation of the Federal Reserve System Treasury Bonds were primarily held by commercial banks to back bank note issues.”

each bond issued. In addition, the first Liberty Bond issue was exempt from federal income tax while the later issues were not fully exempt (all Liberty Bond and Victory Bond issues were exempt from state and local income taxes). The maturity of the first Liberty Bond was 30 years with later issues having shorter maturities.²¹

The fact that each issue was oversubscribed suggests that the strategy of fixing the coupon rate before the offering and issuing at par led to the Treasury leaving some money on the table.²² Notice that the first issue was oversubscribed by over 52%, while oversubscription rates declined for later issues. Overall, the novel way in which the Treasury issued and marketed bonds during WWI created considerable uncertainty regarding the amount and timing of government bond issues.

1.2 The Corporate Security Issuance Process in the Early 20th Century

A method commonly used by public firms to issue securities in the early 20th century was to first offer the security to shareholders and then, if any securities remain unsold, have their investment bankers solicit other potential investors.²³ As Dewing (1920) explains, an advantage of using an investment bank was potentially broader distribution and economies of scale in terms of advertising and client lists.²⁴ In the case of bonds and preferred stock,

²¹ See Table 6 of Rockoff (2004)

²² The secondary market for Liberty bonds was limited. The Treasury accused those who sold their Liberty Bonds when they did not have to as “quitters” and “unpatriotic.” McAdoo condemned merchants who accepted bonds in payment as “reprehensible” [New York Times 23 August 1918].

²³ Dewing (1920, Chapter VIII, p. 148) provides the following example of a direct placement: “In 1917, a large local rubber manufacturing company became embarrassed by too much business. As a result, it had too little working capital and too many salesmen. The bankers demanded that the company reduce its bank loans by the sales of stocks. Accordingly, the company’s rubber salesmen were turned temporarily into stock salesmen who sold large amounts of the company’s 7 per cent preferred stock among its rubber customers.”

²⁴ See Chapter VIII and IX of Dewing (1920) and Galston (1925) for a description of the securities issuance process. As Dewing (1920, Chapter VIII, p. 129) explains: “The underwriting of stocks, notes, and bonds is merely an intermediate step between their issue by the corporation and their sale to the public...the syndicate is an instrument of the bankers for distributing the risk incident to the sale. And it is not a necessary incident, for many securities are sold which have not been underwritten. It is a means to an end,

the coupon rate or dividend rate would typically be set before the offering and a sales force used to market securities. Depending on the demand, some or all the offering would be sold or in some cases withdrawn and alternative security offered (see Moody's Daily Digest of corporate news October-December 1917). As a result, to gauge investor demand for a given securities offering, we can compare the amount offered to the amount of securities actually sold. The amounts offered are reported in Moody's News and as discussed in the next section, the amount sold can be calculated using information from Moody's Manual.

2 Data and Empirical Specification

2.1 Data

We collect information on corporate bond and stock offerings from two main sources. The first source is Moody's Daily Digest of Corporation News (Moody's News). Moody's News collected and aggregated information for industrial companies and public utilities from public sources, such as reports submitted to regulating institutions, newspapers, and financial magazines. From this periodical, we collect all bond and stock offerings larger than \$40,000 between July 1916 and December 1919.²⁵

Moody's News only includes security offerings announced publicly. We are likely to underestimate the impact of government borrowing on the demand for corporate securities because some firms may have withdrawn plan offerings in anticipation of government bond offerings. Moreover, for offerings with commitment, we do not know whether or how much the underwriter was required to purchase due to insufficient demand from investors. To partly

and the end is the final absorption by the investing public". Unfortunately, while best efforts and direct securities offerings were common during the early 20th century, to our knowledge there is no data on the proportion of offerings conducted using a firm underwriting, best efforts or direct placement.

²⁵ \$40,000 in July 1916 is just under \$1,000,000 in 2018 dollars. Aside from offering amount, Moody's News includes information about offering terms such as interest rate and maturity for corporate bonds. If terms are not given in Moody's News, we fill in missing information from a book called Fitch Bond Descriptions.

address this problem, we collect data from archival records of the Capital Issues Committee, which was established by government to control private security offerings in 1918.²⁶ The main advantage of these records is that they included not only publicly announced securities, but also security offerings belonging to firms that got permission from the committee to issue the security but withdrew afterward.

We use information from Moody's Manual to compute the amount of each security sold.²⁷ In addition to security offerings, we hand collect several security-, firm-, and macro-level control variables from multiple sources.²⁸ Table II summarizes the basic security-level (issue) and firm-level information. Panel A provides information on the characteristics of the issuance and Panel B provides summary statistics concerning the issuing firms in our sample. As shown in Table II, most of the securities offered were below investment grade with almost 84% of common stock and preferred stock offerings made by firms with speculative grade ratings. Panel B shows that both the size and tangibility of median firm offering bonds and notes is larger than the size and tangibility of median firm offering preferred and common stock. These observations indicate that larger firms with high tangible capital, such as public utilities, were more active in corporate debt (bond and notes) markets, while industrial firms were more active issuers of common and preferred stock.

2.2 Empirical Specification

As discussed earlier, the way government and corporate securities were offered around WWI provides an opportunity for us to examine the impact of government borrowing on investor demand for certain types of securities.

²⁶ Records of the Washington Office, 1917-1919; Records of the Capital Issues Committee, Record Group 158; National Archives, College Park, MD.

²⁷ If a firm offered the same maturity multiple times within a year, we obtained from Moody's Manual the amount of each bond sold. If Moody's does not provide information on the amount of each bond sold, we assign the amount sold on a FIFO basis.

²⁸ Appendix A includes detailed variable definitions.

To measure the impact of government bond issues on investor demand for corporate securities, we compare the amount of securities offered to the amount of securities sold. We use this comparison to calculate the unsold ratio defined as:

$$\text{unsold ratio}_{ijmt} = \frac{\text{announced amount}_{ijmt} - \text{sold amount}_{ijmt}}{\text{announced amount}_{ijmt}}$$

where unsold ratio is defined for security i belonging to firm j in month m in year t . Figure 2 shows the monthly average unsold ratio for corporate bonds over the period July 1916 through December 1919. The unsold ratio was relatively low before the U.S. entered the war. After it had entered and Liberty Bonds were being offered, the unsold ratio increased dramatically. After the war ended, the unsold ratio returned to its pre-war level. Shaded regions in the figure correspond to months when Liberty Bonds were issued. Figure 2 shows that the unsold ratio is generally higher during the months around Liberty Bond campaigns.

To test whether government bond issues affected investor demand for corporate securities, we compare the unsold ratio in treatment months to the unsold ratio in control months. Specifically, we define treatment periods as one month before through two months after each Liberty Bond issue (from $t - 1$ to $t + 2$ where t stands for the starting month of the issue). We start each treatment period one month before each offering because information was publicly available one month before the offering. In addition, although Liberty Bond campaigns lasted for a month, we include the month after the offering closed because payment for Liberty Bonds could be made up to one month after the closing of the offering.²⁹

We define our treatment variable as the amount of Liberty Bonds offered relative to our estimate of monthly GDP during the treatment period. We estimate GDP at a monthly frequency using monthly industrial production index.³⁰ Specifically, we start with the yearly nominal GDP and estimate a monthly GDP based on the weight of each month in the indus-

²⁹ Our results are robust to the length of the treatment window. In Appendix IA.VII, we define treatment periods as one month before through one month after the announcement, and obtain similar results.

³⁰ See Miron and Romer (1990).

trial production index, which we then reannualize.³¹ As shown in Figure 3, our treatment variable is the ratio of new government debt to GDP in each month of the treatment period and zero otherwise. Using this treatment variable, we estimate the following regression model to measure the impact of new government bond offerings on each security i belonging to firm j offered in month m of year t :

$$\begin{aligned} \text{unsold ratio}_{ijmt} = & \delta \times \frac{\text{New Federal Debt Issue}_{mt}}{\text{Nominal GDP}_{mt}} + \text{firm controls}_{jt} \\ & + \text{security controls}_i + \text{industry} \times \text{year FE} + \epsilon_{ijmt} \end{aligned} \quad (1)$$

where the dependent variable takes values between 0 and 1. The coefficient of interest, δ , measures the crowding-out effect. We include firm-level controls such as firm size, leverage, profitability, tangibility, and war contract dummy as well as security-level controls, such as issue size and credit rating, that could impact the unsold ratio (Badoer and James, 2016; Benmelech, 2008; Graham et al., 2014).

As shown in Table I, all of the Liberty Bond Issues were oversubscribed; with oversubscription rates varying from 17% to 54%. The significant level and variation in oversubscription rates suggest that the investor demand for Liberty Bonds was difficult to estimate. To the extent that certain securities are viewed by investors as close substitutes for Treasury Bonds, we expect the coefficient on δ to be positive.

One concern with our empirical setting is that entering the war could benefit war-related industries more than other industries. To illustrate, public utilities, which benefited from the war less relative to the heavy metal industry, could have a higher unsold ratio. This could contaminate our findings, since our treatment window mostly spans the months after entry. To address this, we use industry-year fixed effects which fully control for unobserved

³¹ Our results are similar when we use nominal GDP of the year before the Liberty Bond issue in consideration.

annual variation across industries.³² An additional advantage of industry-year fixed effects is that they allow us to also control for yearly tax rate changes that could affect industries differentially.

One other concern with the empirical specification is that there could be a correlation across errors within each month that could deflate standard errors. To address this, we cluster standard errors by month (Cameron et al., 2011).³³

3 Findings

3.1 Baseline Specification

We first estimate equation (1) to measure the impact of new government debt offerings on the unsold ratio of new corporate security offerings including long-term bonds (with maturity longer than 5 years), short-term notes (with maturity shorter than 5 years), common stocks, and preferred stocks. Column (1) of Table III reports the results for the pooled regression, which includes all four types of securities. The estimated coefficient of interest is 0.79 and statistically significant at the 1% level, and implies that a 1 percentage point increase in the government debt to GDP ratio increases the unsold ratio by 0.79 percentage points from its mean of 27.43%. Given that the average size of corporate security offerings was \$2.11 million in our sample, a Liberty bond offering crowded out approximately \$0.13 million of corporate securities on average (i.e., $6.16\% = 0.13/2.11$ of the offering amount).³⁴

After measuring the overall impact, we estimate the crowding-out impact separately for each security type. We start with long-term bonds, which are the most similar securities to

³² We group firms into seven industry groups: Heavy manufacturing, light manufacturing, mining and oil, public utilities, distribution, railway, railroads, and other.

³³ We perform robustness checks by doing bootstrap and clustering at industry-year-, firm-, and firm-year level.

³⁴ $\$0.13 \text{ million} = 0.79 \times \$2.11 \text{ million} \times 7.69\%$ where 7.69% is the average of our treatment variable, which is the ratio of Liberty Bond Offerings to Nominal GDP.

government bonds in terms of payment schedule and maturity (Greenwood et al., 2010). In the presence of segmented financial markets, in which investors such as pension funds and insurance companies are seeking long-term securities, the crowding-out impact on long-term corporate bonds should be strong. In column (2), the estimated coefficient for long-term bonds is 1.19 and statistically significant at the 1% level, which is in line with segmented financial markets.

Another implication of the segmented financial markets hypothesis is that the impact on short-term notes should be limited, since, with the exception of the last offering, Liberty Bonds had maturities longer than 10 years (Greenwood et al., 2010). In line with this, column (3) shows that the estimated coefficient for short-term notes is 0.16 and not statistically significant. To sum up, the findings in columns (2) and (3) lend support to the presence of segmented financial markets.

In column (4), we investigate the impact of government borrowing on common stock, the direction of which is not obvious on the theoretical front. On the one hand, financing government deficits with issuing long-term securities will increase long-term rates, which can lead corporations to substitute long-term debt for short-term debt and equity (Friedman, 1984). On the other hand, if investors do not view capital gains and dividends as substitutes and view dividends as a relatively safe hedge against price fluctuations, as argued by Hartzmark and Solomon (2019), then financing government deficits with issuing long-term securities might lead to a reduction in demand by investors for dividend paying stocks. In column (4), the estimated coefficient for common stock is 1.06 and statistically significant at the 5% level, suggesting a strong crowding-out effect.

Finally, we investigate the impact on preferred stock. Given that preferred stock offers fixed payments (dividends) as long as the firm survives, it resembles long-term government bonds in terms of payment schedule and maturity.³⁵ Table II shows that industrial com-

³⁵ Supporting this view, Graham et al. (2015) consider the preferred stock to be debt rather than equity.

panies, which had less tangible capital relative to public utilities, used preferred stock for long-term financing. Although preferred stock promises fixed payments, firms may fail to deliver those payments. In the case of such a failure, preferred stock gains voting rights. In that sense, preferred stock diverges from long-term government bonds. Column (5) indicates that Liberty Bonds crowded out preferred stock even in the presence of dissimilarities noted.³⁶

3.2 Robustness Checks and Alternative Explanations

Next, we conduct several tests to ensure the robustness of the results in Table III as well as to test alternative explanations. One potential problem is related to the predictability of the government debt issues. Corporate issuers could still predict the government demand although there was considerable uncertainty as to the size and terms of each Liberty Bond offering. To address this concern, we use the oversubscription rates in Table I as another plausibly exogenous source of variation serving to identify unanticipated shocks to the demand for private securities. The idea is that demand for government bonds was difficult to forecast and corporate issuers, even with knowledge or correct prediction of the terms of the offering, would have no way of knowing how much investor demand would be soaked up in each offering. To operationalize this idea, in Appendix IA.I, we multiply the main independent variable in equation (1) with one plus oversubscription rate as a measure of how much investor demand was absorbed in each offering. Estimated coefficients of interest are very close to the ones in Table III in terms of both economic and statistical significance.

One other concern relates to underwriters (and investment bankers), some of which had extensive knowledge about the financial markets and relationship with the U.S. government. Underwriters' knowledge and connections could help corporate issuers learn about govern-

³⁶ Using F-tests, we test whether estimated coefficients for each security type in Table III are significantly different from each other. First, we find that estimated coefficients for long-term bonds, common stock, and preferred stock are not statistically different from each other. Second, we find that estimated coefficients for long-term bonds, common stock, and preferred stock are statistically different from the estimated coefficient for short-term notes at 5% confidence level.

ment plans as well as predict the potential demand for corporate securities more correctly. To address this concern and test the extent of underwriters' impact, we collect data on underwriters for each security offering. First, we document that nearly 47% of offerings either does not have (a) an underwriter (e.g., for offerings made by the firm itself, which is common for public utilities) or (b) has an underwriter which only made one security offering in our data set, corresponding to small underwriters (as opposed to large underwriters such as Harris, Forbes & Co.). In Appendix IA.IX, we augment equation (1) with *Underwriter*, an indicator variable equaling one if the corporate security offering has an underwriter that made more than one security offering in our data set. First, we see that including access to underwriters as a control does not affect our main findings. Second, negative coefficients on *Underwriter* show that having access to underwriters decreases the unsold amount.

Next, we conduct a dynamic analysis to see when effects materialize, and firms begin to anticipate crowding-out effects. For this analysis, we replace the treatment variable in equation (1) with month dummies and plot the coefficients in Figure 4. Figure 4 confirms the finding in Figure 2: unsold ratio is generally higher during the months around Liberty Bond Campaigns after controlling for other factors that could explain the unsold ratio. Furthermore, sharp increase in unsold ratio in 1917 confirms the uncertainty around Liberty Bond campaigns, discussed in Section 1.

Furthermore, we account for heterogeneity between treated and non-treated samples. A potential problem with results in Table III is that treated firms that offered securities during Liberty Bond campaigns might be different from non-treated firms that offered their securities during the remaining months. Therefore, increases in the unsold ratio during the Liberty Bond campaigns could be coming from selection bias rather than crowding out. To address this, we compare two groups in terms of observable characteristics and use econometric techniques to correct potential biases in sample selection.

Appendix IA.II compares issue- and firm-level characteristics for treated and non-treated

periods. Panel A shows that treated and non-treated issues were similar in number. Moreover, we see that interest rate and maturity are two statistically different variables between treated and non-treated issues. However, these differences are likely to mitigate the crowding-out effects we observe. Specifically, higher interest rates should decrease crowding out during treatment periods. A parallel argument applies for maturity: shorter maturity corporate bonds should be crowded out less, according to the gap-filling theory, since Liberty Bonds had long maturity (Greenwood et al., 2010).

Panel B of Appendix IA.II shows that treated and non-treated firms were similar in all characteristics except profitability. If less profitable firms were offering their securities during Liberty Bond campaigns and investors had lower demand for their securities, then the coefficients in Table III would be upward biased. To address this, we use the econometric methodology discussed by Imbens (2004). We first estimate a probit model using natural logarithms of issue size, firm size, and profitability.³⁷ Next, we calculate propensity scores for each corporate security offering using the estimated coefficients.³⁸ Then, we run a weighted OLS for the basic specification by using inverse propensity scores as weights. Estimated coefficients in Appendix IA.III are close to the estimates from the baseline specification reported in Table III, with the exception that estimated coefficient for common stock increases considerably. The basic difference comes from reduction in sample size, since the profitability variable is not available for all firms.³⁹

Contemporaneous shocks might constitute an alternative explanation for our findings. To be more specific, uncertainty shocks contemporaneous with but unrelated to the issuance of Liberty Bonds might lead investors to be more cautious, making them switch to government bonds. To test this alternative explanation, we compare the industrial production in months

³⁷ If we include other firm characteristics in the probit model, the corresponding coefficients are not statistically significant. Therefore, we dropped all statistically insignificant coefficients except firm size.

³⁸ Calculated propensity scores for treated and non-treated firms share common support.

³⁹ When we include profitability as a new control variable in the basic specification, estimated coefficients become identical to the ones in Appendix IA.III.

when the Treasury was borrowing to the one in months when the Treasury was not borrowing. If increased uncertainty is driving our results, then we should see a decrease in the industrial production in months when the government was borrowing (Bloom, 2009). In Appendix IA.IV, we use two industrial production indices from Miron and Romer (1990) to test this conjecture. We see that the average industrial production index in treated and non-treated months are statistically indistinguishable from each other.

Furthermore, firms could inflate the issue amounts with the expectation of selling more securities to reach their target sales amount. Such a strategy would confound our conclusions by leading to artificially higher unsold amounts. However, this was a highly risky and unlikely to be undertaken strategy for firms since not being able to sell securities was a source of reputation loss at the time (as today). We test this conjecture in Appendix IA.X using firms' announced issue amounts as the dependent variable. Estimated coefficients are statistically indistinguishable from zero, which shows that federal debt issues did not have a significant effect on corporations' issue amounts.

Another concern we address relates to data coverage. We collected data on individual corporate security offerings from two sources: *Moody's News* and the archival records of the Capital Issues Committee. However, the archival records only cover 1918, and include security offerings for discouraged firms that never publicly announced their offerings. One concern with using discouraged firms is that the estimated crowding-out impact could be biased, since information on discouraged firms is not available for the other years. To address this concern, in Appendix IA.V, we estimate crowding out by using security offerings only included in *Moody's News*. Estimated coefficients are in line with the estimates reported in Table III.

Next, we address the concern of omitted variable bias by including profitability and tangibility as additional firm-level controls (Benmelech, 2008). However, these variables are not available for some of the firms in our sample. Although sample size drops from 1,354

to 716 after adding profitability and tangibility, findings in Appendix IA.VI are in line with the findings reported in Table III.

The last robustness check we conduct uses a shorter treatment window. In the basic specification, we set the treatment window as 1 month before and 2 months after announcement of Liberty Bond offerings. In this exercise, we follow a more conservative approach and set the window size as 1 month before and 1 month after the announcement. Appendix IA.VII displays the results with the new treatment variable. We see that the estimated effects are significant for both corporate bonds and common stocks. The only difference is that the estimated coefficient on preferred stocks is not statistically significant, but the magnitude is close to Table III, 1.03 vs. 1.18.

4 Mechanism

This section exploits the differences between security types to investigate how crowding out works.

4.1 Impact on Corporate Debt Offerings

Our analysis in this section is based on the idea that bond markets are segmented, and segmentation arises from investors' demand for fixed income securities with specific attributes (Greenwood and Vayanos, 2010; GHS, 2010; KVJ, 2011). According to market segmentation, changes in the supply of Treasury securities should primarily affect corporate securities with risk and maturity characteristics similar to Treasury securities.

To test this, we first investigate the effect of government bond issues on long-term corporate bonds having maturity more than 5 years. Column (1) and column (2) of Table IV show that only long-term investment-grade bonds experience a significant increase in unsold ratio. The estimated coefficients of interest in columns (1) and (2) are statistically distinct from

each other. In column (3), we exploit the heterogeneity in maturity across Liberty Bond offerings, and see that the effect is more pronounced for offerings with longer maturities (Campaigns 1, 2, and 4).

After documenting the heterogenous response of the long-term bonds, we focus on short-term notes. The segmented market hypothesis does not predict a significant crowd-out for corporate notes since maturity characteristics of notes and Liberty Bonds were different (Greenwood et al., 2010). In line with this, we see that estimated coefficients in columns (4) and (5) are statistically insignificant for both investment-grade and speculative notes.

Our findings in Table IV show that government debt crowded out corporate debt obligations with long maturity and low default risk, in line with the presence of segmented financial markets.

4.2 Impact on Preferred Stock Offerings

Preferred stock promises fixed payments during the lifetime of the firm and is often considered to be a type of fixed-income security. However, firms may fail to pay promised payments (dividends). In that case, preferred stockholders gain voting rights. Therefore, long-term government debt is similar to preferred stock with low risk of missing dividend payments.

To test this argument, we use firm size as a proxy for financial constraints and missing dividend payments.⁴⁰ We classify firms as low (high) risk of missing dividends if their lagged size is above (below) the median. Columns (3) and (4) of Table V show that government debt mainly crowded out preferred stocks of larger firms. By using an F-test, we confirm that the difference between coefficients in columns (3) and (4) is significantly different from zero. Again, this finding is consistent with theories that emphasize that corporate securities, which are close substitutes for government bonds, should be affected more.

⁴⁰ Combining rating data with preferred stocks leaves us with very few observations.

Furthermore, in column (5), like in column (3) of Table IV, we exploit the heterogeneity in maturity across Liberty Bond offerings. We see that the effect is concentrated around campaigns with longer maturities, which suggests that investors view preferred stocks of large firms similar to long-term bonds.

4.3 Impact on Common Stock Offerings

Up to this point, we have grouped corporate bonds and preferred stock according to their similarity to long-term government bonds. However, common stock is the security most different from government debt in terms of risk, maturity, and payment schedule. Specifically, common stockholders are residual claimants and the most risky group in case of bankruptcy. Moreover, common stock has no maturity, but is traded frequently by arbitrageurs seeking short-term returns.

Dividends add another layer of complexity to the possible effect of government debt on common stock, since investors may view dividends as a hedge against price fluctuations (Hartzmark and Solomon, 2019), as discussed in the Introduction and Section 3.1.

We exploit differences in dividend payment schedules to test the effect of government on common stocks. In particular, using firm-level data from 1925 to 2005, Leary and Michaely (2011) find that young firms with more volatile earnings have more volatile dividend payments, whereas firms with low growth prospects smooth their dividends. Based on this evidence, we separate our sample into two groups: (i) utilities and city railways that had low growth prospects and smoothed their dividends; (ii) industrial firms that had volatile earnings and did not smooth their dividends.

Table VI presents the results. Columns (3) and (4) show that government borrowing has a significant effect on common stocks with smooth dividends. In particular, a 1 percentage point increase in new government debt to GDP leads to a 2.74 percentage points increase in the unsold ratio for common stocks with a stable dividend history. We see no significant

effect for common stocks without stable dividends. Again, using an F-test, we see that estimated coefficients in columns (3) and (4) are statistically distinct from each other.

Furthermore, in column (5), we repeat the analysis based on maturity variation across different Liberty Bond offerings. A result similar to Table IV and Table V emerges: Liberty Bond campaigns with longer maturity are the main drivers of the crowding-out effect.

Our results suggest that investors viewed long-term government bonds as a close substitute for dividend paying common stocks, in line with Hartzmark and Solomon (2019). As further support, we analyze how stock market performance affects the relationship between government debt and common stocks. Hartzmark and Solomon (2019) argue that investors consider dividends as more valuable and compare them to bonds when market performance has been lower. According to this argument, crowding-out of stable dividend paying common stocks should be stronger when market performance has been lower.

To test this idea, in Table VII, we augment equation (1) with the market return over the last three months. We find evidence consistent with this hypothesis: in column (2), we see that past market returns have a statistically significant negative effect on the unsold ratio of stable dividend paying common stocks.

5 Maturity Choice

In Section 4, we showed that government bonds crowded out long-term corporate securities but not short-term securities. Then, a potential question is whether firms were shifting from long-term securities to short-term securities following Liberty Bond campaigns. In this section, we investigate the presence of a such response to understand the impact of government bonds from a wider perspective. Moreover, such analyses allow us to see whether the firms in our sample are comparable to modern firms in terms of response to fluctuations in government debt maturity (Badoer and James, 2016).

Previous studies document that firms prefer to issue short-term debt when the government offers long-term bonds (GHS, 2010; Badoer and James, 2016). The basic explanation for this behavior is that certain types of investors, such as pension funds and insurance companies, demand long-term fixed-income securities. If long-term government bond offerings are absorbed by these investors, then the funds available for long-term corporate securities are reduced, which drives up the cost of issuing long-term securities relative to short-term securities. As a result, firms shift to short-term securities and fill the gap left by government debt. However, micro frictions could limit this gap-filling behavior. For instance, speculative-grade firms could prefer to stay away from short-term debt to avoid inefficient liquidation (Diamond, 1991; Guedes and Opler, 1996).

To test gap-filling behavior and its extent, we first estimate a linear regression model. Table VIII documents how firms' maturity preference changed over years. Columns (1) and (2) show that the average maturity of corporate bonds decreased significantly during the war following Liberty Bond campaigns. Specifically, column (2) shows that the average maturity decreased by 4.31 years relative to its 1916 mean of 21.04 years.

In columns (3)-(6), we divide the sample into two parts and test whether speculative-grade and investment-grade firms were differentiated in their responses. We see that there was no significant change in maturity for speculative-grade firms, whereas investment-grade firms significantly decreased the maturity of their debt offerings relative to 1916.

To address the concern that firms' maturity responses to government bonds could be nonlinear and to compare our findings with Badoer and James (2016), we follow a similar approach and estimate a multinomial logit model. To estimate the model, we divide our sample into five maturity bins: (0,1] years, (1,5] years, (5,10] years, (10,20] years, and (20,...] years. Table IX summarizes security characteristics across these maturity bins. Panel A shows that investment-grade securities were more common at the very short and very long ends of the maturity spectrum.

Next, we estimate the model and report marginal effects in Table X. Findings in Panel C show that investment-grade firms moved away from long-term bonds to short-term notes. In particular, column (5) shows that the likelihood of offering bonds with maturity more than 20 years decreased by 31% in war period compared to non-war period. Moreover, column (1) shows that the likelihood of offering notes with maturity less than 1 year increased significantly in the same period.

However, the response of speculative-grade firms was not as flexible. Panel B of Table X shows no change in the maturity structure of speculative-grade firms. Furthermore, they did not switch to short-term securities. Our findings are consistent with the argument that speculative-grade firms do not use the very short end of the maturity spectrum, to avoid refinancing risk (Diamond, 1991).

Tables IX and X confirm that firms exhibited gap-filling behavior in response to long-term treasury offerings. Moreover, the gap-filling behavior was driven by investment-grade firms, which could take the refinancing risk, rather than speculative-grade firms. Our findings are in line with those of Badoer and James (2016) who document modern firms' response to variation in the maturity of government debt.

In addition to adjusting the maturity of debt, firms could switch from long-term bonds to other security types, such as common stock and preferred stock. To measure the impact of Liberty Bonds on the security-type choice, we estimate a multinomial logit model in Appendix IA.VIII. Results indicate that neither speculative-grade nor investment-grade firms switched to common stock or preferred stock.

6 External Verification

We find that government debt crowded out not just what are generally considered to be close substitutes for government debt such as corporate bonds but also preferred and common

stock. One obvious question that arises is the extent to which these findings inform us of how government borrowing affects corporate financial policy in more recent times. Today, while the size and depth of the financial sector has changed substantially since the early twentieth century, we find evidence of gap filling behavior by corporate bond issuers during WWI that is consistent with the findings of GHS (2010).⁴¹ Specifically, we find that during WWI, investment-grade corporate borrowers substituted to short-term debt for long-term debt corporate bond offerings in response to a large increase in long-term government borrowing. Our methodology allows us to observe both shifts in investor demand for corporate bonds and issuing firms' behavior that result in changes in the maturity composition of corporate borrowing in response to a change in government debt.

While we find a qualitatively similar response of corporate bond issues to government bonds, the magnitude of the response to government borrowing is likely to be different today than in 1917-1919. There are several reasons we expect the magnitude of the response to be different. First, interest on Liberty Bond offering was in whole or in part exempt for individual income taxes. Thus, Liberty Bonds were tax advantaged relative to corporate bonds. In contrast, today, interest on both government bonds and corporate bonds are taxed at the same rate. Second, unlike how Treasury Bonds are issued today, an auction was not used to determine the coupon rate on Liberty Bonds, leading to all Liberty Bond issues to be oversubscribed. As a result, during the marketing of Liberty Bonds, the short-term decrease in demand for corporate bonds is likely to be greater than the decrease in demand if Liberty Bonds were offered at market determined rates.⁴² Third, during WWI, both Treasury bonds and corporate securities were held almost entirely by domestic investors. In contrast, today,

⁴¹ According to Philippon (2015), the size of the financial sector relative to GDP was about twice as large in 2012 as it was in 1919. The growth in the financial sector has occurred primarily through the growth of intermediated assets. Philippon (2015) finds that gross corporate bond and equity issuances relative to GDP fluctuate over time but corporate bond issues declined during WWI relative to the volume of pre- and post-war issues.

⁴² As Garbade (2012) discusses, the Treasury did not use an auction to market government bonds until 1936.

foreign investment is an important source of demand for Treasury and corporate securities.⁴³ Demirci et al. (2019) find that the effect of government borrowing on corporate leverage is greater when government debt is funded domestically, which suggests crowding out may have been greater during WWI.

A fourth reason there may be a difference in the response to government borrowing during WWI concerns how Liberty Bonds were marketed. Specifically, the issuances of Liberty Bonds were accompanied by campaigns to promote savings by appealing to investor patriotism. As a result, nearly half of government bonds were purchased by middle- and low-income households; households who prior to the war had not invested in government or corporate bonds (Sutch, 2018).⁴⁴ To the extent that the campaigns created a new investor based by increasing savings rates, crowding out would be expected to be less during WWI than in recent years.

A final reason for a difference in the quantitative response to government borrowing is that in recent years government debt is a much larger share of GDP than during WWI. In particular, while the growth rate of government borrowing relative to GDP was greater during WWI (an increase of 34 percentage points over a 3-year period) than during the 2009 to 2018 time period (34 percentage point increase over 9 years), government borrowing is a much larger percentage of GDP now than before WWI.

Identifying the effect of government borrowing on the demand for stable dividend paying stocks is difficult using modern data, since the Treasury now borrows almost continuously, and seasoned issues are typically offered using a firm underwriting agreement.⁴⁵ However,

⁴³ In contrast to the WWI era, in 2016, the share of U.S. Treasury bonds, corporate bonds, and equity held by foreign investors are 44.5%, 30.0%, and 14.1%, respectively. See the Secretary of Treasury, U.S. Portfolio Holdings of Foreign Securities, June 30, 2017.

⁴⁴ Hilt and Rahn (2016) estimate that participation in rate in the Liberty Bond campaigns was over 36% for households with \$1,020 or less in income and over 86% for households with income between \$2,110 and \$3,470.

⁴⁵ See Gao and Ritter (2010) for a description of how seasoned equity offerings have been marketed since the mid 1990's

we are unaware of any reason investors would view dividends differently today than they did during WWI. Like the current personal income tax code, the tax code in the WWI favored dividends over interest income.⁴⁶ Specifically, before 1917, dividends were exempt for the “normal” individual income tax while interest income was taxed at the normal income tax rate, leading to a tax advantage of dividends over interest income at personal level.⁴⁷ The tax code changed in March 1917, with the introduction of surtax assessed on certain higher income brackets.⁴⁸ However, while both interest and dividends were subject to the surtax, dividends remained exempt from the “normal tax.”⁴⁹ As a result, after March 1917, dividends continued to be tax advantaged relative to interest income. In short, there is no tax-based reason for investors to view dividends differently today relative to interest income than during WWI.⁵⁰

7 Conclusion

The U.S. federal debt is a large share of investors’ portfolios and fluctuates over time. Although how government debt impacts corporate financing has long been discussed, there is no consensus regarding the existence of the crowding-out impact in the literature (Hubbard, 2012). In this study, we use several unique features of the World War I period to cleanly

⁴⁶ There are however potential differences between the two time periods in the degree to which dividends are tax advantaged at the personal level relative interest income.

⁴⁷ Unlike today, the tax rate on capital gains was higher than the tax rate on dividends during WWI. Specifically, capital gains were taxed at the same rate as regular income. As a result, dividends were tax advantaged relative to capital gains at the personal level.

⁴⁸ The War Revenue Act of 1917 mandated a 2% normal tax on incomes over \$1,000 (\$2,000 for married couples). It featured graduated surtaxes reaching as high as 63% on income over \$1,000,000.

⁴⁹ For description of the history dividend taxation see: Congressional Research Service: The Taxation of Dividends: Background and Overview March 2014.

⁵⁰ At the corporate level, WWI lead to a sharp increase in corporate income taxes (from 2% in 1916 to 6% in 1917 and 12% in 1918). The increases in corporate taxes combined with the deductibility of interest expense but not dividends would by themselves suggest an increased benefit from debt financing. However, as Barger et al. (2018) show, the introduction of an excess profit tax in 1917 created an even stronger incentive for equity financing. Specifically, a graduated excess profits tax was accessed when a firm’s return on invested capital exceeded an 8% threshold. Invested capital was defined to include only equity and not debt. Thus, a firm could reduce its exposure to the excess profits tax by substituting equity for financing.

identify the crowding-out effect. Consistent with gap-filling and portfolio-rebalancing theories, we find that government bonds crowded out long-term corporate bond and preferred stock, especially those with high investment ratings. However, there was no crowding out of short-term note. Government bonds also crowded out common stock that paid stable dividends, similar to fixed-income securities.

Our first goal in this study is to show the existence of crowding out rather than giving a point estimate for the size; the size of the crowding-out effect could be larger or smaller than we estimate, due to changes in financial markets in the last 100 years. For instance, higher external finance dependence of modern firms would imply larger crowding out, whereas increasing foreign demand for U.S. securities would imply smaller crowding out. Moreover, our findings are more relevant for the U.S., in which corporate bonds (public debt) are a more popular source of financing compared to other countries, in which firms primarily depend on bank financing (private debt).

Our second goal is to exploit the unique way in which government and corporate bonds were issued during WWI to examine how changes in government borrowing affect investor demand for various types of corporate securities. We provide new evidence that investors view stable dividend paying stocks as a close substitute for long-term government bonds.

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Figure 1
The U.S. Federal Debt between 1910 and 1920

This figure shows the ratio of government (federal) debt to gross domestic product between 1910 and 1920. Government debt was very low before the U.S. entered the war in April 1917, nearly 3 years after the war began, July 1914. Following its entry, the U.S. government offered large amounts of bonds to finance the war; hence, the government debt to gross domestic product ratio jumped to 35% within 2 years. *Source: Bohn (2008)*

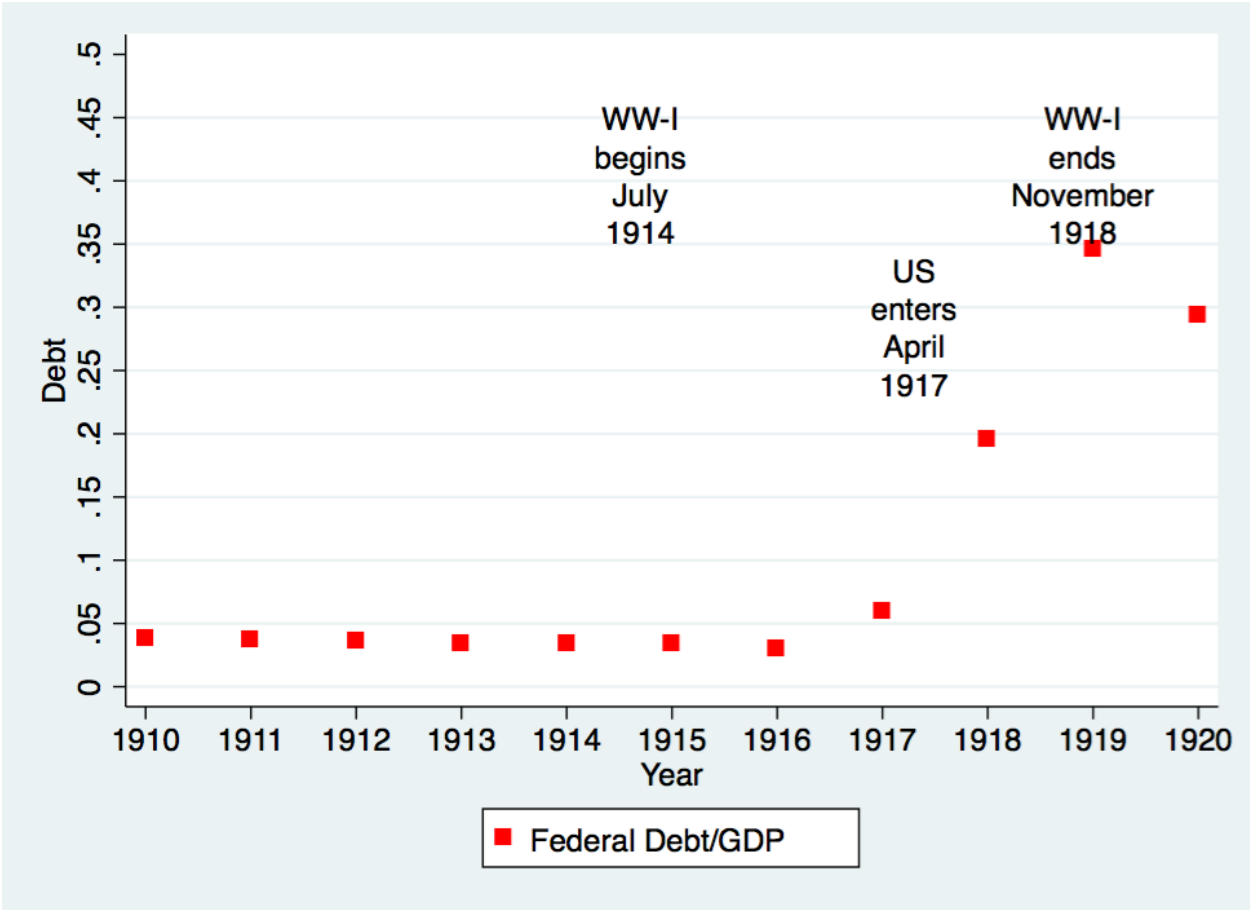


Figure 2
Unsold Ratio

This figure shows the average unsold ratio at monthly frequency for corporate bond offerings between July 1916 and December 1919. Shaded regions correspond to times around Liberty and Victory Bond offerings. The unsold ratio is defined as the difference between the the announced amount and the sold amount divided by the announced amount for each corporate security offering. Announced amounts are collected from *Moody's Daily Digest of Corporation News* and the archival records of the Capital Issues Committee. The sold amount for a particular security is calculated using the outstanding amounts of the security at balance sheets. Moreover, maturing bond and note information is taken into account. Vertical dashed lines show timings of Liberty and Victory Bond offerings. *Source: Author's own calculations.*

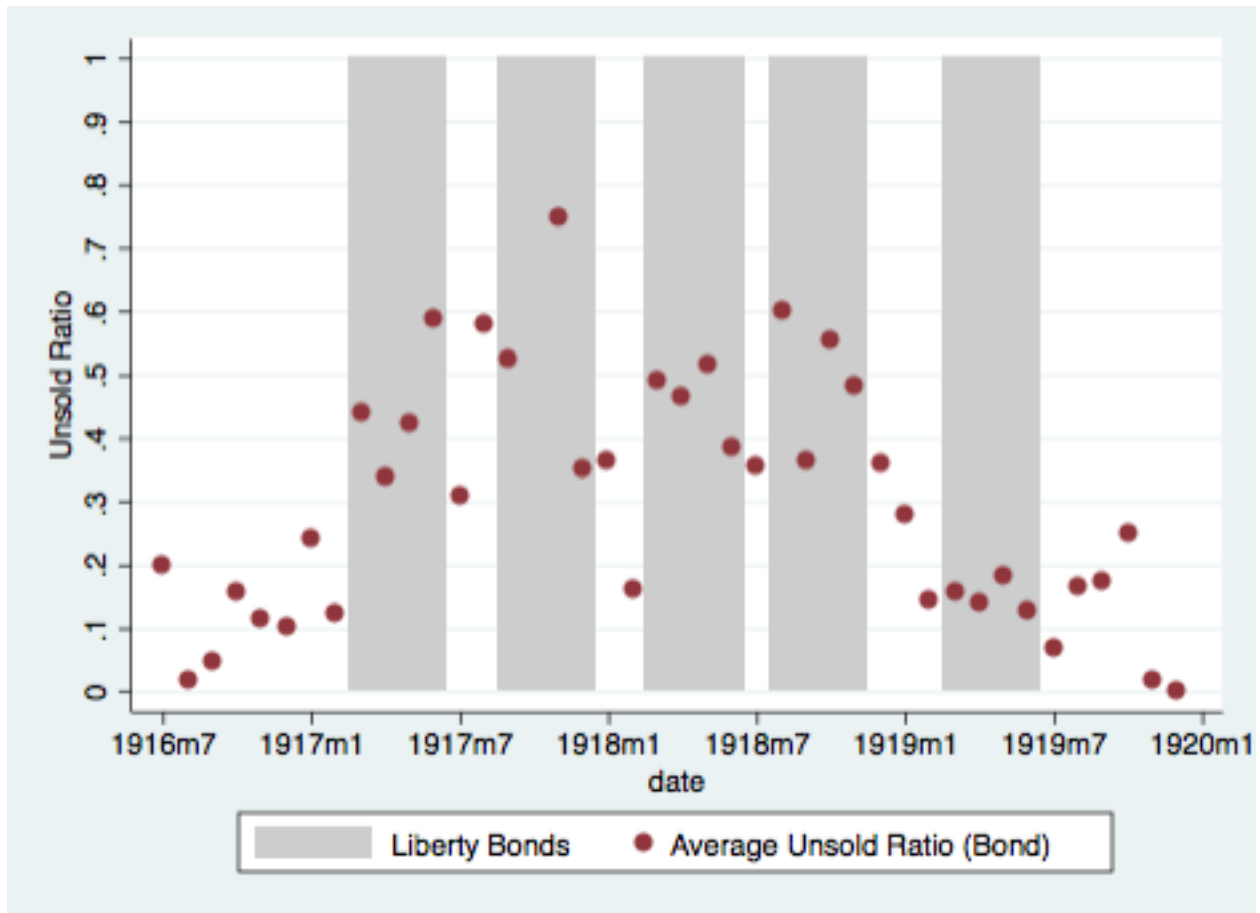


Figure 3
Treatment Variable

This figure shows the treatment variable at monthly frequency during the sample period between July 1916 and December 1919. The treatment variable is defined as the ratio of the amount of the *new federal debt offering* to the the annual gross domestic product (GDP) for the period that covers 1 month before and 3 months after the public declaration of Liberty Bond offerings. For the remaining months, it takes value 0 under the assumption that Liberty Bonds affected the corporate security market only around the public announcement.

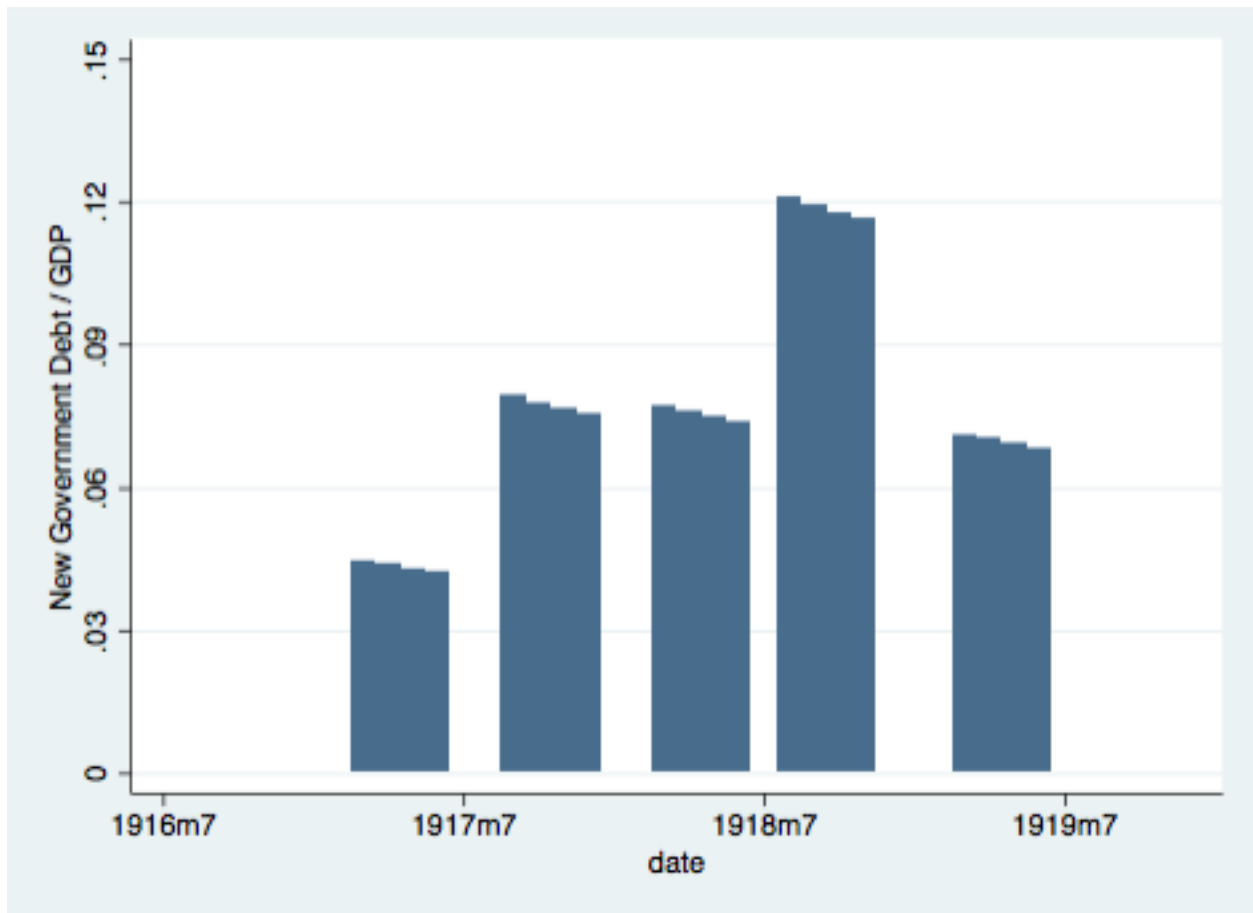


Figure 4
Dynamic Response

This figure shows the dynamic responses of the unsold ratio over the sample period. To estimate dynamic coefficients, we replace the treatment variable in the basic specification for long-term corporate bonds, equation (1), with month dummies. The figure shows that the estimated coefficients decrease over time, which suggests that firms were learning about the crowding-out impact. *Source: Author's own calculations.*

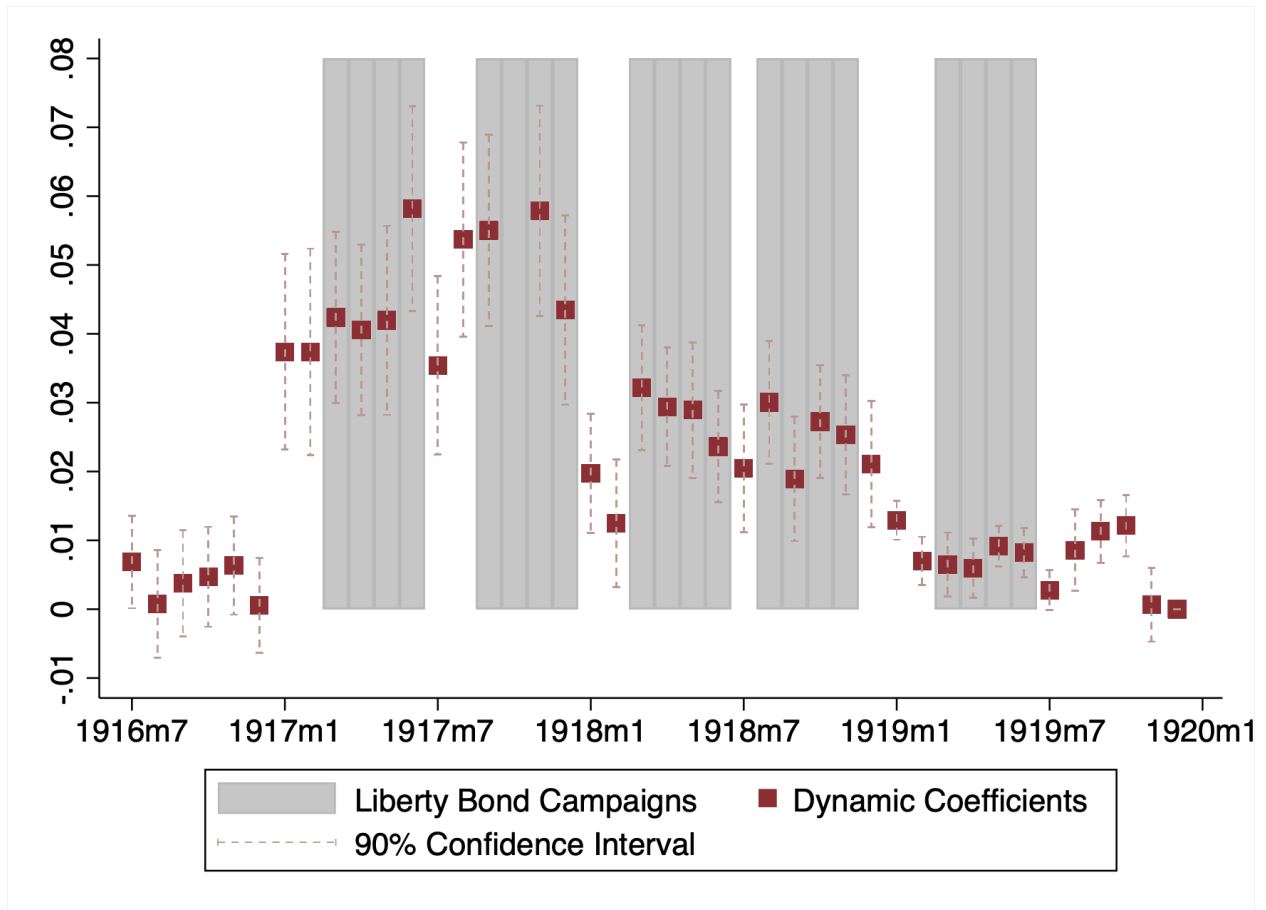


Table I
Liberty and Victory Bond Offerings

This table summarizes the terms of Liberty and Victory Bond offerings during World War I to finance the war effort. *Date* refers to the public announcement date of the offerings. The Federal Reserves acted as distributing agents for the bonds and took subscriptions. Amounts of the offerings were large, given that the annual gross domestic product was around \$60 billion in 1918. Maturities of the bonds varied from 4 years to 30 years, and the bonds were callable at face value after a certain number of years, given in the last column. *Source: Annual Report of the Secretary of the Treasury, 1921.*

<i>Issue</i>	<i>Date</i>	<i>Amount</i>	<i>Interest</i>	<i>Maturity</i>	<i>Callable</i>	<i>Oversubscription Rate</i> (percent)
First Liberty Bond	April 24, 1917	\$2.18 billion	3.5%	30 years	after 15 years	52
Second Liberty Bond	October 1, 1917	\$3.81 billion	4%	25 years	after 10 years	54
Third Liberty Bond	April 5, 1918	\$4.18 billion	4.15%	10 years	-	40
Fourth Liberty Bond	September 28, 1918	\$6.87 billion	4.25%	20 years	after 15 years	17
Victory Bond	April 24, 1919	\$4.50 billion	4.75%	4 years	after 3 years	17

Table II
Summary Statistics

This table summarizes issue- and firm-level statistics for four types of securities: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The sample covers securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. Panel A presents summary statistics for issue-level characteristics. Panel B displays summary statistics for firm-level characteristics. † refers to variables that have been winsorized at the 10th and 90th percentiles. All variables are defined in Appendix A.

	<u>Long-Term Bond</u>			<u>Short-Term Note</u>			<u>Common Stock</u>			<u>Preferred Stock</u>		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
Panel A: Issue Characteristics												
Amount (\$ million)	480	2.01	0.71	380	2.28	1	199	2.17	0.75	306	1.86	0.75
Maturity	309	19.26	17	299	3.01	3	n/a	n/a	n/a	n/a	n/a	n/a
Interest Rate (%)	326	5.93	6	304	6.63	6.75	n/a	n/a	n/a	213	7.13	7
Investment Grade Share	480	0.43	0	380	0.35	0	199	0.16	0	306	0.14	0
# of issues per firm	480	1.78	1	380	1.67	1	199	1.23	1	306	1.29	1
Panel B: Firm Characteristics												
Long-term liability (\$ million)	368	13.8	5.21	292	17.8	7.5	178	16.3	4.9	266	7.9	3.0
Log(long-term liability)	368	15.37	15.47	292	15.85	15.83	178	15.33	15.41	266	14.74	14.90
Log(asset)	210	16.13	16.03	203	16.51	16.44	125	16.21	16.11	176	15.79	15.60
Leverage	366	0.48	0.49	292	0.41	0.43	176	0.13	0	262	0.13	0
Tangibility	210	0.69	0.82	200	0.69	0.82	122	0.51	0.46	174	0.41	0.33
Profitability† (%)	216	10.19	8.47	200	11.91	8.57	100	15.20	11.12	143	25.94	16.41

Table III
Crowding Out: Basic Specification

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. Ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents estimated coefficients for the pooled sample including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond (> 5)	Short-Term Note (≤ 5)	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}}$	0.79*** (0.27)	1.19*** (0.41)	0.16 (0.46)	1.06** (0.51)	1.18** (0.54)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Industry \times Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	1354	478	380	197	299
R^2	0.13	0.24	0.14	0.33	0.22

Table IV

Crowding Out: Long-Term Bonds and Short-Term Notes

This table presents a linear model of the crowding-out effect on long-term bonds (with maturity more than 5 years) and short-term notes (with maturity less than or equal to 5 years). The dependent variable is the unsold ratio for the securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. LBC_{1,2,4} and LBC_{3,5} are indicator variables equaling one for the first, second, fourth, and third and fifth Liberty Bond Campaigns, respectively. Ratings are obtained from *Moody's Analysis of Investment*. Columns (1) and (2) present, respectively, findings for long-term bonds with maturity more than 5 years with speculative-grade and investment-grade securities. Columns (3) and (4) present, respectively, the results for the short-term notes with speculative-grade and investment-grade securities. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio Bond maturity > 5 & Low-rated	Unsold Ratio Bond & High-rated	Unsold Ratio Bond & High-rated	Unsold Ratio Notes maturity ≤ 5 & Low-rated	Unsold Ratio Notes maturity ≤ 5 & High-rated
	[1]	[2]	[3]	[4]	[5]
New Federal Debt Issue Nominal GDP	0.12 (0.48)	1.35** (0.56)		-0.11 (0.55)	-0.13 (0.77)
New Federal Debt Issue Nominal GDP			1.51*** (0.55)		
New Federal Debt Issue Nominal GDP			0.55 (1.27)		
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	138	165	165	152	114
R ²	0.35	0.25	0.25	0.18	0.22

Table V
Crowding Out: Preferred Stock

This table presents a linear model of the crowding-out effect on preferred stock offerings. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. $LBC_{1,2,4}$ and $LBC_{3,5}$ are indicator variables equaling one for the first, second, fourth, and third and fifth Liberty Bond Campaigns, respectively. The ratings are obtained from *Moody's Analysis of Investment*. Columns (1) and (2) present findings for the whole sample. Columns (3) and (4) show, respectively, the impact on small and large firms' preferred stocks. A firm is considered small (large) if its lagged size is below (above) the median. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var. Sample	Unsold Ratio		Unsold Ratio		Unsold Ratio	
	All	All	Small	Large	Small	Large
	[1]	[2]	[3]	[4]	[5]	[5]
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}}$	1.18** (0.47)	0.22 (0.89)	-1.18 (1.51)	1.67* (0.87)		
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}} \times LBC_{1,2,4}$					2.93*** (0.84)	
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}} \times LBC_{3,5}$					-0.90 (1.35)	
Issue Size	Y	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y	Y
Profitability	N	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y	Y
N	299	163	81	82	82	82
R^2	0.19	0.30	0.31	0.44	0.48	0.48

Table VI
Crowding Out: Common Stock

This table presents a linear model of the crowding-out effect on common stock offerings. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The coefficient of interest is the coefficient for the treatment variable. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. $LBC_{1,2,4}$ and $LBC_{3,5}$ are indicator variables equaling one for the first, second, fourth, and third and fifth Liberty Bond Campaigns, respectively. Ratings are obtained from *Moody's Analysis of Investment*. Columns (1) and (2) present the findings for the whole sample. Columns (3) and (4), respectively, show the impact on the common stock of industrial firms that did not smooth their dividends and the common stock of public utilities and railways that smoothed their dividends. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var. Sample	Unsold Ratio		Unsold Ratio		Unsold Ratio		Unsold Ratio	
	All	All	Not Smooth	Smooth	Not Smooth	Smooth	Not Smooth	Smooth
	[1]	[2]	[3]	[4]	[3]	[4]	[5]	[5]
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}}$	0.99* (0.55)	1.40*** (0.37)	0.19 (0.61)	2.74*** (0.90)				
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}} \times LBC_{1,2,4}$							2.77*** (0.87)	
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}} \times LBC_{3,5}$							1.06 (1.92)	
Issue Size	Y	Y	Y	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y	Y	Y	Y
Profitability	N	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y	Y	Y	Y
N	197	117	68	49	68	49	49	49
R^2	0.27	0.45	0.37	0.45	0.37	0.45	0.46	0.46

Table VII
Crowding Out: Common Stock Dividends and Market Return

This table presents a linear model of the crowding-out effect on common stock offerings. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. The second variable of interest, *Market Return*, represents the market return in the previous three months. Ratings are obtained from *Moody's Analysis of Investment*. Columns (1) and (2), respectively, show the impact on the common stock of industrial firms that did not smooth their dividends and the common stock of public utilities and railways that smoothed their dividends. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var. Sample	Unsold Ratio Not Smooth	Unsold Ratio Smooth
	[1]	[2]
New Federal Debt Issue Nominal GDP	0.27 (0.70)	3.19** (1.16)
Market Return	-0.17 (0.33)	-1.04* (0.58)
Issue Size	Y	Y
Firm Size	Y	Y
Leverage	Y	Y
Profitability	Y	Y
Industry FE	Y	Y
Year FE	Y	Y
Rating FE	Y	Y
War Contract	Y	Y
N	68	49
R^2	0.37	0.46

Table VIII
Maturity Choice: Linear Model

This table presents a linear model of maturity choice. The dependent variable is the maturity (in years) of debt securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News*. *War Dummy* is an indicator variable equaling one from March 1917 to June 1919 and zero otherwise. Ratings are obtained from *Moody's Analysis of Investment*. Columns (1) and (2) present the findings for the whole sample. Columns (3) and (4) present the same specification for speculative-grade securities, and Columns (5) and (6) present the findings for investment-grade securities. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var. Sample	Maturity All	Maturity All	Maturity Speculative	Maturity Speculative	Maturity Investment Grade	Maturity Investment Grade
	[1]	[2]	[3]	[4]	[5]	[6]
War Dummy	-3.26*** (1.05)	-4.31*** (1.39)	-1.50 (0.92)	-1.06 (1.35)	-5.86*** (2.25)	-6.95*** (2.34)
Aaa-Baa Spread	Y	Y	Y	Y	Y	Y
Issue Size	Y	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y	Y
Profitability	N	Y	N	Y	N	Y
Industry FE	Y	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y	Y
N	606	395	370	196	236	199
R^2	0.14	0.13	0.19	0.21	0.18	0.17

Table IX
Descriptive Statistics

This table summarizes issue-level statistics for five maturity intervals: (0,1] years, (1,5] years, (5,10] years, (10,20] years, and (20-...) years. The sample is collected from *Moody's Daily Digest of Corporation News* and covers corporate debt offerings, both long-term bonds and short-term notes, for the period between July 1916 and December 1919. Panel A presents summary statistics for issue-level characteristics. Panel B displays summary statistics of the firms offering these securities. † refers to variables that have been winsorized at the 10th and 90th percentiles. All variables are defined in Appendix A.

	(0,1] years			(1,5] years			(5,10] years			(10,20] years			(20-...) years		
	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median	N	Mean	Median
Panel A: Issue Characteristics															
Maturity	49	0.94	1	250	3.42	3	122	8.95	10	78	17.15	17.5	109	32.30	30
Amount (\$ million)	49	2.05	0.70	250	2.71	1.25	122	2.51	0.98	78	1.93	0.78	109	2.80	1.00
Interest Rate (%)	49	6.67	6.75	250	6.64	6.75	122	6.29	6.00	78	5.84	6.00	105	5.49	5.38
Investment Grade Share	49	0.45	0	250	0.38	0	122	0.26	0	78	0.29	0	109	0.61	1
Panel B: Firm Characteristics															
Long-term asset (\$ million)	43	16.4	6.47	205	20.2	10.0	114	15.7	4.77	75	10.5	4.11	88	25.0	9.34
Leverage	43	0.44	0.46	205	0.44	0.45	114	0.45	0.43	74	0.49	0.50	87	0.54	0.54
Tangibility	35	0.73	0.79	141	0.67	0.81	62	0.55	0.56	47	0.75	0.82	59	0.80	0.87
Profitability† (%)	33	9.09	6.73	139	14.25	9.21	55	15.11	9.78	44	10.40	8.57	64	10.40	9.28

Table X
Maturity Choice: Multinomial Logit Model

This table presents a multinomial logit model of maturity choice. The sample is collected from *Moody's Daily Digest of Corporation News* for the period between July 1916 and December 1919. The dependent variable consists of five maturity categories: (0,1] years, (1,5] years, (5,10] years, (10,20] years, and (20-...) years. The model is estimated using (1,5] years as the base category. *War Dummy* is an indicator variable equaling one from March 1917 to June 1919 and zero otherwise. Marginal effects for *War Dummy* are estimated at the mean values and measure the change in likelihood of offering a security in the given category with respect to the non-war period. Ratings are obtained from *Moody's Analysis of Investment*. Panel A, Panel B, and Panel C show, respectively, the estimates for the whole sample, speculative-grade securities, and investment-grade securities, respectively. All variables are defined in Appendix A. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Marginal Effect	(0,1] years [1]	(1,5] years [2]	(5,10] years [3]	(10,20] years [4]	(20-...) years [5]
Panel A: All					
War Dummy	0.08*** (0.02)	0.17*** (0.06)	-0.00 (0.04)	-0.03 (0.04)	-0.22*** (0.05)
N = 395, Pseudo $R^2 = 0.13$					
Panel B: Speculative					
War Dummy	0.04 (0.05)	0.12 (0.09)	-0.02 (0.06)	-0.07 (0.05)	-0.07 (0.06)
N = 196, Pseudo $R^2 = 0.24$					
Panel C: Investment Grade					
War Dummy	0.10*** (0.02)	0.17** (0.08)	0.04 (0.04)	0.01 (0.06)	-0.31*** (0.07)
N = 199, Pseudo $R^2 = 0.14$					
Aaa-Baa Spread	Y	Y	Y	Y	Y
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y

Appendix A: Variable Definitions

This appendix presents definitions for variables used throughout the paper.

Variable	Definition	Source
Panel A: Security Characteristics		
<i>Type</i>	Corporate security types classified into four categories: (i) bonds (with maturity more than 5 years), (ii) notes (with maturity less than or equal to 5 years), (iii) preferred stock, (iv) common stock	<i>Moody's Daily Digest of Corporation News</i> and archival records of the Capital Issues Committee
<i>Maturity</i>	Years until the final maturity of corporate debt, only for bonds and notes	<i>Moody's Daily Digest of Corporation News</i> and <i>Fitch Bond Book</i>
<i>Rating</i>	Credit ratings based jointly on security type, general earning power back of the security, and general marketability	<i>Moody's Analysis of Investment</i> , 1918
<i>Issue Size</i>	Initial announced dollar (\$) amount of the offering	<i>Moody's Daily Digest of Corporation News</i> and archival records of the Capital Issues Committee
<i>Sold Amount</i>	Calculated sold amount out of the initial announced amount by using balance sheet and maturing bond and note information	<i>Moody's Manual of Railroads and Corporation Securities</i> and <i>Moody's Complete List of Securities</i>
<i>Unsold Amount</i>	Difference between announced amount and sold amount	Author's calculations
<i>Unsold Ratio</i>	Difference between announced amount and sold amount divided by announced amount	Author's calculations
<i>Underwriter</i>	An indicator variable that equals one if the underwriter of the corporate security offering made more than one security offering in our data set and zero otherwise	<i>Moody's Daily Digest of Corporation News</i> and archival records of the Capital Issues Committee
Panel B: Firm Characteristics		
<i>Firm Size</i>	Sum of the outstanding value of bonds, notes, common stock, and preferred stock	<i>Moody's Manual of Railroads and Corporation Securities (Moody's Manual)</i>
<i>Leverage</i>	Ratio of corporate debt (bonds and notes) to firm size	<i>Moody's Manual</i>
<i>Profitability</i>	Ratio of net earnings after deducting tax, interest, and preferred dividends to outstanding common stock	<i>Moody's Manual</i>
<i>Tangibility</i>	Ratio of property, plant, and equipment to total assets	<i>Moody's Manual</i>
<i>War Contract</i>	Dummy variable that takes value 1 if the firm is under a war contract or contracted with a firm under a war contract	Archival records of the War Finance Corporation
Panel C: Macro Controls		
<i>Aaa-Baa Spread</i>	Average monthly return difference for the bonds traded on the New York Stock Exchange with ratings Aaa and Baa	<i>New York Times</i>
<i>Industrial Production</i>	Monthly industrial production index, seasonally adjusted	Miron and Romer (1990)
<i>Consumer Price Index</i>	Monthly consumer price index	U.S. Bureau of Labor Statistics, retrieved from FRED

Internet Appendix for
“Crowded out from the Beginning: Impact of
Government Debt on Corporate Financing”

Huseyin Cagri Akkoyun

Nuri Ersahin

Christopher James

March 22, 2021

Appendix IA.I: Alternative Treatment Variable Using Oversubscription Rates

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings multiplied by the oversubscription rate for each offering, and it takes value zero for the rest of the sample period. Ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents estimated coefficients for the pooled sample including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond (> 5)	Short-Term Note (≤ 5)	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}}$	0.64*** (0.22)	1.05*** (0.33)	0.08 (0.37)	0.89** (0.42)	0.97** (0.44)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Industry \times Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	1354	478	380	197	299
R^2	0.13	0.24	0.14	0.33	0.22

Appendix IA.II: Summary Statistics for Non-Treated versus Treated

This table compares issue characteristics offered during (treated) Liberty Bond campaigns versus (non-treated) the other months and firm characteristics of the firms offering these securities. The sample covers securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. Panel A presents summary statistics for issue-level characteristics. Panel B displays summary statistics for the firm-level characteristics. † refers to variables that have been winsorized at the 10th and 90th percentiles. All variables are defined in Appendix A.

	<u>Non-Treated</u>			<u>Treated</u>			Difference [2] versus [5] [7]
	N [1]	Mean [2]	Median [3]	N [4]	Mean [5]	Median [6]	
Panel A: Issue Characteristics							
Unsold Ratio	707	0.22	0	658	0.33	0	-0.11***
Issue Amount (\$ million)	707	2.20	0.99	658	1.94	0.66	0.26
Maturity	351	12.54	9.00	257	9.54	5	3.00***
Interest Rate (%)	490	6.41	6.25	357	6.59	7.00	-0.18***
Investment Grade Share	707	0.31	0	658	0.30	0	0.01
Panel B: Firm Characteristics							
Long-term liabilities (\$ million)	541	14.30	5.00	484	13.50	5.09	0.80
Log(long-term liabilities)	541	15.36	15.42	484	15.34	15.44	0.02
Log(asset)	364	16.20	16.12	306	16.18	16.14	0.02
Leverage	537	0.33	0.33	481	0.32	0.32	0.01
Tangibility	361	0.59	0.64	300	0.61	0.73	-0.02
Profitability† (%)	329	0.17	0.11	277	0.13	0.09	0.04***
Cash ratio	345	0.05	0.02	291	0.04	0.02	0.00
Investment ratio	293	0.07	0.04	244	0.07	0.04	0.00

Appendix IA.III: Weighted OLS

This table presents a weighted linear model of the crowding-out effect to address selection bias, the concern that (treated) firms that offered their securities during Liberty Bond campaigns were different from (non-treated) firms that offered their securities in other months. The weight for each security is calculated by using propensity scores that proxy for the likelihood of being treated or non-treated as a function of observable characteristics (Imbens (2004)). Specifically, we focus on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. Ratings are obtained from Moody's Analysis of Investment. Column (1) presents estimated coefficients for the pooled sample including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond	Short-Term Note	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
<u>New Federal Debt Issue</u> Nominal GDP	0.77*** (0.23)	0.71* (0.40)	-0.35 (0.44)	1.88*** (0.56)	1.44** (0.69)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Tangibility	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	716	249	228	103	136
R^2	0.18	0.32	0.21	0.46	0.33

Appendix IA.IV: Industrial Production for Treated and Non-Treated Months

This table compares average industrial production during Liberty Bond campaigns (treated) with the remaining months (non-treated) of the sample. MRIPS stands for Miron-Romer Index of Industrial Production, and MRIPSW stands for Miron-Romer Index of Industrial Production with Adjustment for Wool Receipts.

	Non-Treated	Treated	Difference
	Mean	Mean	[1] - [2]
	[1]	[2]	P-value
MRIPS	153.47	152.73	0.71
MRIPSW	158.65	162.33	0.41

Appendix IA.V: Basic Specification—Moody’s News

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for the securities issued between July 1916 and December 1919. The sample is collected from *Moody’s Daily Digest of Corporation News*. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. Ratings are obtained from *Moody’s Analysis of Investment*. Column (1) presents the estimated coefficient for the sample, including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. $*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond	Short-Term Note	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
<u>New Federal Debt Issue</u> Nominal GDP	1.19*** (0.38)	1.69** (0.80)	-0.17 (0.55)	2.70*** (0.73)	1.46* (0.87)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Tangibility	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	543	175	186	69	113
R^2	0.14	0.33	0.19	0.58	0.29

Appendix IA.VI: Basic Specification with Extra Firm Controls

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for the securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. Ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents the estimated coefficient for the pooled sample, including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond	Short-Term Note	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
<u>New Federal Debt Issue</u> Nominal GDP	0.73*** (0.24)	0.74* (0.40)	-0.36 (0.45)	1.94*** (0.56)	1.21* (0.69)
Macro Controls	Y	Y	Y	Y	Y
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Tangibility	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	716	249	228	103	136
R^2	0.18	0.32	0.20	0.46	0.33

Appendix IA.VII: Basic Specification with Shorter Treatment Window

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the unsold ratio for the securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 1 month after Liberty Bond offerings, and it takes value zero for the rest of the sample period. The ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents the estimated coefficient for the pooled sample, including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond	Short-Term Note	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
<u>New Federal Debt Issue</u> Nominal GDP	0.85*** (0.26)	0.86* (0.51)	0.20 (0.46)	1.33** (0.61)	1.03 (0.79)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Profitability	Y	Y	Y	Y	Y
Tangibility	Y	Y	Y	Y	Y
Industry \times Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	716	249	228	103	136
R^2	0.18	0.32	0.20	0.44	0.32

Appendix IA.VIII: Multinomial Logit Model

This table presents a multinomial logit model of security-type choice. The sample is collected from *Moody's Daily Digest of Corporation News* for the period between July 1916 and December 1919. The dependent variable consists of four security type categories: long-term bonds (with maturity more than 10 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The model is estimated using bonds with maturity from 5 to 10 years as the base category. *War Dummy* is an indicator variable equaling one from March 1917 to June 1919 and zero otherwise. Marginal effects for War Dummy are estimated at the mean values and measure the change in likelihood of offering a security in the given category with respect to the non-war period. Ratings are obtained from *Moody's Analysis of Investment*. Panel A, Panel B, and Panel C show estimates for the whole sample, speculative-grade securities, and investment-grade securities, respectively. All variables are defined in Appendix A. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Marginal Effect	Long-Term Bonds [1]	Short-Term Notes [2]	Common Stock [3]	Preferred Stock [4]
Panel A: All				
War Dummy	-0.12*** (0.04)	0.14*** (0.04)	0.03 (0.02)	-0.03 (0.04)
N = 543, Pseudo $R^2 = 0.22$				
Panel B: Speculative				
War Dummy	-0.04 (0.04)	0.09* (0.05)	0.04 (0.04)	-0.06 (0.05)
N = 312, Pseudo $R^2 = 0.29$				
Panel C: Investment Grade				
War Dummy	-0.19*** (0.07)	0.16** (0.07)	0.00 (0.03)	0.01 (0.05)
N = 231, Pseudo $R^2 = 0.22$				
Aaa-Baa Spread	Y	Y	Y	Y
Issue Size	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y
Leverage	Y	Y	Y	Y
Profitability	Y	Y	Y	Y
Tangibility	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
War Contract	Y	Y	Y	Y

Appendix IA.IX: Control for Underwriter Effect

This table presents a linear model of the crowding-out effect on the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock, controlling for the underwriter effect. The dependent variable is the unsold ratio for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. *Underwriter* is an indicator variable equaling zero either if the security offering does not have an underwriter or has an underwriter that only made one security offering in our data set. Ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents estimated coefficients for the pooled sample including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio	Unsold Ratio
Sample	All	Long-Term Bond (> 5)	Short-Term Note (\leq 5)	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
$\frac{\text{New Federal Debt Issue}}{\text{Nominal GDP}}$	0.69*** (0.25)	1.04** (0.43)	0.06 (0.41)	1.03** (0.51)	1.16** (0.52)
Underwriter	-0.12*** (0.04)	-0.09* (0.05)	-0.17*** (0.05)	-0.09 (0.09)	-0.05 (0.05)
Issue Size	Y	Y	Y	Y	Y
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Industry \times Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	1354	478	380	197	299
R^2	0.15	0.25	0.18	0.34	0.22

Appendix IA.X: Basic Specification with Announced Issue Amounts

This table estimates the effect of Federal debt issuances on the corporate issuers' announced issue amounts for the four security types: long-term bonds (with maturity more than 5 years), short-term notes (with maturity less than or equal to 5 years), common stock, and preferred stock. The dependent variable is the announced issue amount for securities issued between July 1916 and December 1919. The sample is collected from *Moody's Daily Digest of Corporation News* and from archival records of the Capital Issues Committee. The treatment variable is equal to the amount of Liberty Bond offerings to the nominal gross domestic product for the period spanning 1 month before to 3 months after Liberty Bond offerings, and it takes value zero for the rest of the sample period. Ratings are obtained from *Moody's Analysis of Investment*. Column (1) presents estimated coefficients for the pooled sample including all security types. Columns (2), (3), (4), and (5) show the impact on long-term bonds, short-term notes, common stock, and preferred stock, respectively. All variables are defined in Appendix A. Standard errors (in parentheses) are clustered by month. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Dep. Var.	Announced Amount	Announced Amount	Announced Amount	Announced Amount	Announced Amount
Sample	All	Long-Term Bond (> 5)	Short-Term Note (≤ 5)	Common Stock	Preferred Stock
	[1]	[2]	[3]	[4]	[5]
<u>New Federal Debt Issue</u> Nominal GDP	-1.59 (0.95)	-1.62 (1.15)	-1.41 (1.27)	-0.77 (1.65)	-2.46 (1.67)
Firm Size	Y	Y	Y	Y	Y
Leverage	Y	Y	Y	Y	Y
Industry \times Year FE	Y	Y	Y	Y	Y
Rating FE	Y	Y	Y	Y	Y
War Contract	Y	Y	Y	Y	Y
N	1354	478	380	197	299
R^2	0.45	0.43	0.56	0.56	0.60