Essays on Corporate Debt Structure, Leverage Puzzle, Competition and Trade War

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Abstract

The thesis examines the corporate debt structure and costs of various kinds of debt including the total debt, general bank debt and public debt as well as six types of specific debt components from the perspectives of three independent and related topics. First, I reveal the underlying sources of the leverage puzzle in terms of the unrated firms' components of corporate debt structure. For the unrated firms, the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as the bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with high profits increase the two types of debt. For robustness, I consider another two factors that might impose effects on the relationship between profitability and debt: banks' credit supplies and monetary policy. Second, I investigate how product market competition affects specific components of corporate debt and the costs of six types of debt. The analyses of various types of debt in fine detail reveal that product market competition generally reduces most of the debt. Nevertheless, competition usually mitigates the leverage puzzle of the negative relationship between profitability and specific types of debt. Besides, competition raises the credit spreads of all types of debt due to the bank monitoring of bank debt and the need for public debt for reducing external monitoring pressure. Third, I take the trade war between the U.S. and China intensified by Section 301 in 2018 as an exogenous shock and study a quasi-natural experiment of firms affected by the trade war. Using causal inference, I investigate the impact of the trade war on, competition, the corporate debt structure, and costs. I contribute to the debate on the benefits and losses due to the trade war by showing that although credit spreads decrease, the trade war did not alleviate competition, but rather it intensified competition and hampered debt financing.

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Author's Declaration

I declare that, except where explicit reference is made to the contribution of others, this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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Chapter 1 Introduction

Firms usually have to choose different types of debt for financing their business activities according to their corporate characteristics and economic environment. Six specific types of corporate debt include revolving credit, term loans, bonds and notes, commercial papers, capital leases, and other borrowings (Rauh and Sufi, 2010; Colla et al., 2013; Choi et al., 2018). More broadly, the first two types of debt are categorized into bank (or private) debt whose debt holders are banks. The rest types of debt can be referred to as public (or market) debt that are issued in the financial market. Bank debt and public debt are sub-total debt and together they form a firm's total debt which is measured by leverage. Given various types of debt for financing, firms make decisions and adjustments to their debt structures in response to the changes in the firm characteristics and the economic environment.

There are distinct features and benefits of the private debt market (e.g., bank loans) and public debt market (e.g., bonds). First, private debt is tailored to borrowing companies' specific needs and banks almost always impose particular forms of financial covenants. Banks would be alerted and be allowed to intervene if the levels of debt or profitability breach covenants. Second, almost all types of private debt are secured while most public debt issuances are unsecured and therefore in the event of default, the recovery values of private debt are usually larger than those of public debt. Third, public market debt can be sold to numerous market participants but private debt involves a small group of banks, which allow flexibility in the negotiation of accommodating the needs of both parties.

Given the above features, most public debt bonds require ratings given by professional rating agencies, which allow investors to assess the quality and riskiness of bonds. On the contrary, there is no quality rating for most private debt. Banks have the onus to undertake their credit assessment and rating analysis according to their privileged

access to firms' confidential information and their private channels of communication with firms' managers. Therefore, banks can privately investigate unrated firms while the small investors of public debt have a greater demand for the ratings.

Previous studies have examined the capital structure of equity and debt. Recent theoretical and empirical studies find some relationships between the debt structure and business activities. However, a detailed breakdown study of debt structure under particular firm characteristics and the economic environment is not clear. Firms adjust their debt structures when their internal firm characteristics, e.g., their sizes of total assets, cash, and the external economic environment, e.g., GDP growth, change.

Given the importance of the corporate debt structure and the research gap, the research question is to examine three independent and related topics about the debt structure and costs of various kinds of debt in three chapters. In the first topic (Chapter 2), I examine the underlying sources of the leverage puzzle in terms of the unrated firms' components of corporate debt structure. About the second topic (Chapter 3), I investigate how product market competition affects specific components of corporate debt and the costs of six types of specific debt and three types of general (sub-)total debt. About the third topic (Chapter 4), I take the trade war between the U.S. and China intensified by Section 301 in 2018 as an exogenous shock and study a quasi-natural experiment of firms' debt structures and costs that are affected by the trade war.

In the first topic (Chapter 2), the leverage puzzle means that there is a negative relationship between firms' leverages and profits observed by many empirical studies. This relationship is referred to as a puzzle because it is counterfactual to the model implication of the classic trade-off theory of optimal capital structure. This puzzle has been attracting growing research interest since it is the largest challenge of the trade-off theory, see the survey in DeMarzo (2019).

The leverage puzzle of the negative relationship is documented in two aspects. On the one hand, the trade-off theory of capital structure predicts that when firms' profits rise, they would raise their leverages correspondingly in the theory. Most empirical studies find that many firms with high profits adopt conservative financing policies of low debt ('debt conservatism', Strebulaev and Yang, 2013) rather than increasing leverages according to the trade-off theory of capital structure. On the other hand,

empirical research reveals that a number of firms incurring declining profits raise their leverages by new debt issuance ('leverage ratchet', Admati et al., 2018) instead of reducing their leverages correspondingly.

In the first topic, I disassemble the leverage puzzle by investigating the relationships between firms' profits and the components of their debt structures, which are further affected by firms' rating status. Indeed, unrated borrowing firms, which do not have a Standard and Poor's (S&P) long-term issuer credit rating status, show preferences for debt sources that are different from those rated firms due to their different informational opacity and various accesses to public debt markets. For instance, Schwert (2018) discovers that unrated firms prefer borrowing from stable banks with large capital to smooth shocks. In contrast, the rated firms choose the banks with less capital and substitute bank loans with bonds during the period with a reduced credit provision.

The innovation of the chapter is to make contributions to the literature by investigating the leverage puzzle through the inside details of the debt. There have been prior studies tackling the leverage puzzle and most of the papers examine the quantity of leverage that measures the corporate capital structure of equity and debt, see, e.g., Lemmon et al. (2008), Strebulaev and Yang (2013), and Eckbo and Kisser (2020). The chapter contributes to the literature by revealing the underlying mechanism that explains the leverage puzzle through the joint effects of the corporate debt structure and firms' unrated status under different firm characteristics.

To examine the leverage puzzle, I focus on the innovative channel of the debt structure affected by unrated status. The fine details of the corporate debt structure allow us to disassemble the leverage puzzle to the six specific relationships between particular types of debt and profitability. For this purpose, I examine the effects of unrated status on the leverage puzzle of the relationships between the six types of debt and profitability. As a result, identifying the distinctive contributions of different types of debt to the leverage puzzle provides new insights into the puzzle. Specifically, the chapter finds the underlying sources of the leverage puzzle in terms of corporate debt structures. The leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with profits increase the two types of debt.

Hence, the first topic presents new insights into the leverage puzzle through the

lens of debt structure and its interaction with unrated status. The results answer why firms adopt conservative levels of leverage when firms have large profits and reveal the importance of unrated firms' selections of debt types. For robustness, I also consider the effects of different economic situations including banks' credit supplies and monetary policy on the link between firms' unrated status, debt components, and profits. Overall, the chapter is important for firms and decision makers to understand the leverage puzzle from the fine details of the corporate debt structure and firms' unrated status. Then unrated firms can make corresponding choices of debt issuances to obtain capital under different economic situations of banks' credit supplies and monetary policy.

In the second topic (Chapter 3), I study firms' debt structure and the costs of nine kinds of debt (six specific types and three general categories) under the effect of product market competition. Firms adjust their pressure by changing their ways of obtaining debt according to economic conditions and firm characteristics. On the one hand, firms might be willing to pay credit spreads to debt holders for the benefits of external monitoring. On the other hand, firms reduce the external pressure of bank monitoring by substituting private bank debt with public debt, e.g., bonds and notes, from the debt market when the firms encounter external pressure that is imposed by intense product market competition.

The literature reports that a firm's financing policy is determined by financing frictions as well as internal and external pressures. The relationship between firms' internal pressure and the corporate capital structure has been discussed by prior studies (Morellec et al., 2012; Nicodano and Regis, 2019) but there is a limited string of literature on firms' debt structure under the impact of the external pressure imposed by product market competition (Nini et al., 2012; Bharath and Hertzel, 2019). The existing work discusses the relationship between competition and general debt choices or costs while the effects of competition on the details of specific debt are unclear.

Different from the prior studies on firms' internal pressure (Nicodano and Regis, 2019) and external pressure of market competition on general debt choices (Bharath and Hertzel, 2019), I contribute to the literature by examining the effects of product market competition on the details of nine types of corporate debt and costs and meanwhile accounting for a range of firm characteristics and economic conditions. My contribution to the identification of the effect of product market competition is to

disassemble firms' total debt into the components of bank debt and public debt first. Then, I investigate six types of specific debt to provide details about the effects of product market competition. The underlying mechanism is that firms balance their pressure through adjusting different debt components with different creditors' monitoring pressures in response to the varying external pressure from product market competition.

Therefore, a comprehensive analysis of detailed corporate debt structure and the costs of these types of debt is the contribution of the second topic, which casts light on the effect of product market competition. When firms experience intense competition in the product market, the findings reveal how they select particular types of debt after considering firm characteristics and economic situations. In addition, the joint effect of product market competition and profitability implies that the firms with profits in an intensive competition environment could issue more bonds and notes as well as capital leases to the public debt market for raising their leverages. Meanwhile, the results on the costs of debt indicate that firms will pay higher fees for their debt under a higher level of competition.

About the third topic (Chapter 4), I carry out a quasi-natural experiment to study the debt structure and costs of firms that experience an exogenous shock of the trade war between the U.S. and China intensified by Section 301 in 2018. The debtors of firms and the creditors of banks consider the external pressure on firms when the former makes a general debt choice. Prior studies use the causal inference based on large tariff reductions as exogenous shocks to study firms' general debt choices and costs. These studies are feasible since during the past three decades before 2018, global business was a trend and import tariffs were reduced substantially.

However, the U.S. started trade wars with its counterparts, especially the large tariff increases in Section 301 against China intensively in 2018. Since then, there is a debate on the benefits and losses brought by the trade war. The rise of tariff due to the trade war is distinctive to the large tariff deductions studied by the prior studies, see, e.g., Valta (2012), Boubaker et al. (2018), and Bharath and Hertzel (2019). Therefore, the trade war raises the new question that whether the trade war affects market competition, companies' debt choices, and costs of debt. Furthermore, the existing studies discuss companies' general debt choice between bank debt and public

debt as well as the costs of general debt under market competition. Nevertheless, companies make their debt financing decisions in terms of the specific debt types within the two general categories of bank debt and public debt. Therefore, to fill the gap in the prior studies, I investigate the effects of the U.S.-China trade war on various types of specific and general debt as well as their costs. In this way, the chapter contributes to the literature by providing deep explanations of the effect of the shock from the U.S.-China trade war with tariff increases on the details of corporate debt structures and the costs of various types of debt.

To estimate the effect of the trade war on treated firms, I mainly employ the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment indicating the 3-digit SIC industry that experienced rising tariffs during the trade war period, on the outcomes of different debt ratios or credit spreads. In addition, I carry out robustness analyses by using different empirical methods. First, I employ propensity score matching (PSM) methods that compare treatment firms and non-treatment firms. Second, I use the inverse-probability-weighted regression adjustment (IPWRA) method to estimate the ATET as well, which has the double-robust property that entails the advantages of both IPW estimator and the RA estimator. Third, I carry out Placebo tests to exclude the cases in which the results are obtained by chance. Fourth, I investigate whether the product market competition plays a mediation role or makes a moderating effect on the relations between the treatment and the debt structure or costs.

The work is the first one to investigate the specific debt structures and debt costs of companies and industries during the trade war. The contribution is to provide insightful explanations of the effects of the trade war on the debt structures of firms. I find that although there is a decrease in the credit spreads that are paid by the treated firms in the industries targeted by the trade war, the trade war did not alleviate competition and it intensified competition and hampered debt financing. The results show that the product market competition rises for the treated firms during the trade war.

Specifically, I show that the trade war makes treated firms in the industries with the tariff protection of rising import tariffs pay lower credit spreads for borrowing various types of debt from banks or the public market. Furthermore, the treated firms reduce their leverage which comprises bank debt including revolving credit and term loans

as well as public debt from the public market including bonds and notes, commercial papers, and capital leases during the trade war.

Overall, the previous studies show that there is an ongoing research interest in the corporate debt structure due to its popularity and importance in corporate finance. My three independent and related research topics together contribute to the literature on the general capital structure and detailed debt structure in several ways. First, a central research question in the capital structure is the challenge of the leverage puzzle. My research makes a new explanation to the puzzle via investigating the debt structure from a novel perspective of disassembling the leverage puzzle of the total debt by examining the fine details of the corporate debt structure. In this way, I can identify the specific relationships between particular types of debt and profitability, which form a novel explanation for the leverage puzzle.

Second, the literature on the capital structure usually examines firms' debt strategies in response to the varying environment. My research about the effects of the production market competition on debt structure and the costs complements this area by looking at firms' specific debt choices under intense competition. Focusing on the effects of the production market competition on debt structure and the costs of these types of debt, I answer the questions when firms experience intense competition, how do the firms select particular types of debt, and what is the cost change for a particular type of debt?

Third, the impact of policy intervention on firms' financing decisions is another interesting topic in the capital structure with policy impact. My quasi-experimental study on the U.S.-China trade war provides a case about the effects of increasing tariffs on firms' debt choices and costs. I study the impact of government policy on debt structure with the example of the trade war between the U.S. and China. This study is new as it contributes to the debate on the benefits and losses brought by the trade war from the innovative aspect of debt structure and costs. In a word, the main contributions of the three topics are the insightful findings about the leverage puzzle, rating status, product market competition, and the U.S.-China trade war.

Chapter 2 The Decomposition of Leverage Puzzle through Corporate Debt Structure and Unrated Status

2.1 Introduction

The leverage puzzle of the negative relationship between firms' leverages and profits has been attracting growing research interest. The puzzle is observed since many empirical studies find that the main model implication of the static trade-off theory of optimal capital structure is counterfactual, which is the largest challenge of the trade-off theory, see the survey in DeMarzo (2019). In this chapter, I disassemble the leverage puzzle by investigating the relationships between firms' profits and the components of their debt, which are affected by firms' unrated status.

The leverage puzzle of the negative relationship between profitability and leverage can be illustrated from two sides. On the one hand, the trade-off theory of capital structure predicts that when firms' profits rise, they would raise their leverages correspondingly in the theory. Most empirical studies find that despite high profits, many firms adopt conservative financing policies of low debt ('debt conservatism', Strebulaev and Yang, 2013). On the other hand, the static model implies that firms would reduce leverage when their profits decline but empirical researches discover that a number of firms increase their leverages by issuing new debt rather than actively decreasing their leverages ('leverage ratchet', Admati et al., 2018).

In addition, firms' rating status affects their debt choices. Schwert (2018) examines unrated borrowing firms that do not have a Standard and Poor's (S&P) long-term issuer credit rating, following similar concepts that were employed by Kashyap et al.

(1994) and Chava and Purnanandam (2011) to characterize both the borrowing firm's informational opacity and its access to public debt markets. Schwert (2018) discovers that the unrated firms prefer borrowing from stable banks with large capital to smooth the effects of cyclical aggregate credit provision and the effects of bank shocks on the real economy. On the contrary, the rated firms that can issue bonds in the bond market choose the banks with less capital to borrow and these firms tend to substitute bank loans with bonds during the period immediately following the financial crisis when banks reduced credit provision.

The chapter makes contributions to the literature by examining the leverage puzzle from the deep details of debt. The literature in the leverage puzzle focuses on the leverage that is a measure of the corporate capital structure of equity and total debt, see, e.g., Lemmon et al. (2008), Strebulaev and Yang (2013), and Eckbo and Kisser (2020). The chapter contributes to the literature as it is the first to examine the underlying mechanism that explains the leverage puzzle through the joint effects of the corporate debt structure and firms' unrated status under different firm characteristics. Fig. 2.1 depicts the research structure of the leverage puzzle, corporate debt structure, and firms' unrated status.

For the examination of the leverage puzzle, the chapter examines the innovative channel of six specific types of debt under the effects of unrated status. To this end, the chapter investigates whether unrated status affects the leverage puzzle of the relationships between the nine types of debt and profitability. With the fine details of the corporate debt structure, I am able to disassemble the leverage puzzle to the specific relationships between particular types of debt and profitability. Therefore, I provide new insights into the puzzle in terms of identifying the debt components in firms' total debt that contribute to the leverage puzzle. In other words, the chapter explains the underlying sources of the leverage puzzle from the components of the corporate debt structure.

The decomposition of the leverage puzzle through corporate debt structure and unrated status shows two layers of results. First, the coefficient of profit in the regression of each type of debt reveals that the leverage puzzle of the negative relationship between debt and profitability is mainly contributed by the revolving credit of bank debt as well as the bonds and notes of public debt. Second, the interaction items between

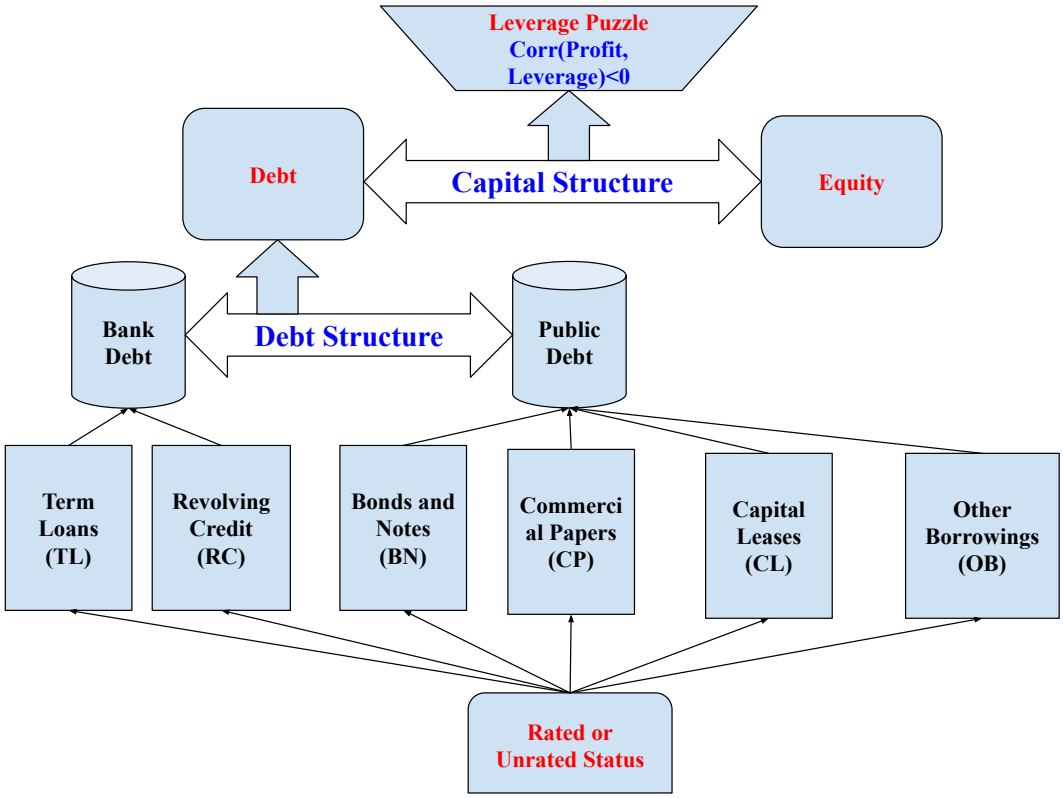


Figure 2.1. Corporate debt structure, leverage puzzle, and unrated status

Notes. The flowchart illustrates the mechanism via which product market competition affects firms' debt structure with the ratios of nine types of debt to book assets as well as their credit spreads. The book leverage (BL) is defined as a firm's total debt divided by the firm's book value of the total asset. The debt structure comprises of revolving credit (RC), term loans (TL), bonds and notes (BN), commercial papers (CP), capital leases (CL), and other borrowings (OB). RC and TL are categorized into bank debt (BD) whose debt holders are banks. BN, CP, CL, and OB can be referred to as public debt (PD) that are issued in the public market.

profitability and unrated status for the two types of debt are significantly positive, which indicates that the puzzle is weakened by unrated status as the two types of debt rise in the unrated firms with profits.

Thus, the chapter delivers new insights into the leverage puzzle through the lens of debt structure and its interaction with unrated status. The implications show the reasons for firms adopting conservative levels of leverage when they earn large profits and emphasize the importance of unrated status for firms' selections of debt. For robustness, the chapter also accounts for the effects of banks' credit supplies and monetary policy on the link between firms' unrated status, debt components, and profits. Overall, the study has an impact on firms and decision makers for the understanding

of the leverage puzzle based on the fine details of the corporate debt structure and firms' unrated status. Then unrated firms can choose appropriate strategies of debt issuances to obtain capital under different economic situations of banks' credit supplies and monetary policy.

To achieve the research objectives, this chapter answers important finance questions regarding the interaction between firms' leverages, profits, debt structures, and firms' unrated status: Which types of debt largely drive the observed and puzzling relations between firms' leverages and profits? Why do firms adopt conservative levels of leverage when firms have large profits and how important is the firms' unrated status for the selection of debt issuances in this context? What are the relations among firms' debt structures, leverages, and profits? Could firms' unrated status attenuate or strengthen the well-documented negative correlation between firms' leverages and profits?

The above questions interact with each other and cannot be answered separately since the debt structure comprises various types of debt. Instead of listing a hypothesis for each question, I propose a series of hypotheses in a hierarchical way. To begin with, I hypothesize that the unrated firms' leverages show a positive relationship with profitability. Then, I focus on the effect of unrated status on the debt structure and the distinctive contributions of different types of debt to the leverage puzzle. This way leads to hypotheses for various types of debt.

About bank debt, its relationship with profitability is insignificant when the moderation effect of the unrated status of firms is considered. Since bank debt comprises revolving credit and term loans, I provide two opposite hypotheses about revolving credit and term loans respectively. I propose that there is a positive (resp. negative) relationship between profitability and revolving credit (resp. term loans) for unrated firms. The reason is that revolving credit can be drawn and repaid a few times over the life of its horizon, which can be viewed as several short-term borrowings. It is often borrowed by firms for funding short-term operations. By contrast, term loans are usually long-term loans and are drawn fully at origination and cannot be redrawn after repayment. Given that the unrated firms are less creditworthy and do not have long-term credit ratings, they usually have to take revolving credit instead of term loans.

With regard to public debt as well as bonds and notes, I hypothesize that there

is a positive relationship between them and profitability for the unrated firms. For commercial papers/capital leases/other borrowings, their relationships between profitability are supposed to be insignificant when the unrated status of firms is considered.

The chapter mainly uses the quarterly data of the corporate debt structure and financial statements for US companies downloaded from the Capital IQ database and Compustat database in the WRDS platform following Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). The dataset about macroeconomic variables is obtained from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis and the aggregate lending dataset is taken from U.S. Flow of Funds Accounts. The data period covers the period of the 2008 financial crisis to assess the effect of monetary policy in response to the financial crisis. The fine details of the corporate debt structure allow us to disassemble the leverage puzzle to the specific relationships between particular types of debt and profitability, which provides new insights into the leverage puzzle.

To answer the research questions and test the hypotheses, I carry out empirical studies of the corporate debt structure and unrated status by applying the following empirical strategy to the data. I mainly use the panel data approach with the fixed effects of firms and years to different specifications of empirical specifications. After defining unrated firms, I study whether the time-varying unrated status contributes to the leverage puzzle and how unrated status affects the leverage puzzle by affecting different components of corporate debt in the corporate debt structure. To identify the effect of unrated status, I first add the item of an unrated status indicator and the interaction item between profitability and unrated status to the traditional empirical model showing the leverage puzzle of the negative relationship between profitability and leverage. Next, I disassemble firms' total debt to bank debt and public debt to reveal how unrated status impacts leverage through the two components. Then, I investigate nine types of debt to provide details on how the debt structure contributes to the leverage puzzle under the effect of unrated status.

The findings discover how unrated status affects the relationship between profitability and leverage as well as firms' debt components. To examine the robustness of the findings, I further consider some factors that might impose effects on the relationship between unrated firms' profitability and debt structure. The factors that indicate dif-

ferent economic situations are banks' credit supplies and monetary policy. The mechanism for banks' credit supplies is the macroeconomic effect arising from supply-side constraints. The mechanism of the monetary policy of central banks' quantitative easing programs during the 2008 financial crisis is that the policy induces firms to prefer issuing public bond debt since the central banks' purchases of corporate bonds push down these bonds' yields.

The empirical study finds that the details of corporate debt structure reveal the underlying sources of the leverage puzzle in terms of the components of firms' corporate debt structures. In short, I conclude that the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with profits increase the two types of debt.

First, I find the leverage puzzle of the negative relationship between profitability and leverage, but there is a positive relationship between profitability and leverage for unrated firms. Unrated status *attenuates* (i.e., weaken the effect) the negative relationship between the unrated firms' profits and leverages by increasing their leverages when these firms' profits are high.

Second, after dissembling firms' leverages to bank debt and public debt, I find that both components contribute to the leverage puzzle as there is a negative relationship between firms' profits and the two components of the leverage. Interestingly, after I consider unrated status, I find that unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt as the negative relationship between bank debt and profitability turns insignificant.

Third, about the part of the leverage puzzle between leverage and public debt, unrated status also attenuates the negative relationship between profitability and public debt by increasing their public debt as well when these firms' profits are high, although, in the case of public debt, unrated status cannot fully attenuate the part of the leverage puzzle between leverage and public debt.

Fourth, I further disassembling total debt to six types of specific debt and find a positive relationship between profitability and revolving credit for the unrated firms. It reveals that unrated status attenuates the leverage puzzle by increasing revolving credit from banks when the firms' profits are high. Specifically, the results show that

the unrated firms reduce the holdings of term loans while they raise revolving credits. The reason is that the unrated firms do not have long-term credit ratings and revolving credit is borrowed for funding short-term operations while term loans are for long terms.

Fifth, within public debt, I also find a positive relationship between profitability and bonds and notes for unrated firms. The finding suggests that the unrated firms with more profits raise their bonds and notes from the public market. Meanwhile, I do not find a significant negative relationship between profits and term loans, commercial papers, capital leases, and other borrowings and therefore these types of debt do not contribute to the leverage puzzle. In addition, the results show that in general for unrated firms whose profitability situations are not specified, they reduce their total debt, public debt, bonds and notes due to their lack of credit rating, but they raise revolving credit for financing their short-term operations due to unrated status.

The remainder of this chapter is organised as follows. Section 2.2 reviews relevant theories and the related literature. Section 2.4 presents the data and Section 2.5 exhibits summary statistics and the features of variables. Section 2.3 describes the empirical strategy. Then, Section 2.6 discusses the results of the analysis of the unrated status and the leverage puzzle. Section 2.7 analyzes the results of the empirical models for robustness tests. Section 2.8 concludes. Finally, appendices gather additional results.

2.2 Related literature and hypothesis development

In this section, I will develop a series of hypotheses to study the interaction between the unrated status and profitability as well as its effect on the corporate debt structure. The hypotheses are related to several strands of literature as follows.

2.2.1 Capital structure and debt structure

The chapter contributes to the literature on the capital structure and debt structure. Lim et al. (2014) discover that the identifiable intangible assets support debt financing, which is similar to the positive relation between tangible assets and financial leverage, and the degree of support is particularly strong in the firms lacking abundant tangible assets. Öztekin (2015) use a large international data to reveal that the reliable

determinants of corporate capital structure are profits, firm size, tangibility, industry leverage, and inflation. They find that the institutions with high-quality can let firms adjust their leverages fast and firms take higher leverage when the laws and traditions are stronger to safeguard debt holders.

Some studies in corporate finance describe the dynamics of the capital structure between equity and debt in response to the business cycle. DeAngelo and Roll (2015) describe that corporate leverage ratios are not stable in a cross-section of firms and they vary markedly over a few years. Graham et al. (2015) distinguish unregulated firms and regulated corporations in the US and find that the former raises debt dramatically usage during the last century, despite the latter keeps stable usage of debt. This phenomenon cannot be explained by varying firm characteristics, but it is significantly affected by the economic conditions of government debt, uncertain macroeconomics, and the development of financial intermediaries. Halling et al. (2016) show that companies borrow more debt in total during recessions, which leads to counter-cyclical leverage ratios that are robust across a variety of data samples, econometric models, and variable definitions. DeMarzo (2019) points out that the optimal dynamic capital structure in a standard trade-off framework fundamentally depends on the commitment and therefore collateral brings values to companies since it provides a low-cost commitment way.

Recent theoretical researches address the importance of studying corporate debt structure and provide theoretical predictions on the bank debt share. For instance, De Fiore and Uhlig (2015) develop a model to account for the phenomenon that firms replace bank debt (loans) by market debt (bonds) during the 2008-2009 financial crisis. The flexible terms of bank loans and firms' access to alternative financing instruments of debt protect the economy from the adverse real effects caused by a financial crisis. Xiao (2016) builds a theoretical model that formulates firms' debt structures and their portfolio allocations between cash holdings and investment. A bank credit contraction during recessions makes firms to use bond issuances to replace bank loans, which brings more risks of financial distress to the firms. Similarly, Crouzet (2017) predicts that firms switch flexible and expensive bank loans to risky and cheaper market bonds during recessions.

Empirical studies on corporate finance examine the relationship between the corporate debt structure and firm characteristics. Rauh and Sufi (2010) show that debt

adversity accounts for substantial variation in the cross-sectional firms' capital structures that are omitted from the traditional literature in the capital structure. They find that firms with low credit ranking adopt a debt structure to decrease incentive conflicts. The adopted debt structures usually comprise secured bank debt with strict covenants and subordinated market debt with fewer covenants.

Colla et al. (2013) study the debt structure of public US firms and find that most of the sample companies employ one out of six types of corporate debt. Small companies prefer fewer types of debt than large companies as they incur larger bankruptcy costs and they are excluded by some debt markets. Becker and Ivashina (2014) report that firms switch to bonds from bank loans during recessions along with the periods of contracting supply of bank credit, stringent regulatory standards, declining aggregate lending, weak bank performance, and contractive monetary policy.

Vig (2013) find that the strengthening of creditor rights makes firms change their debt structures by hoarding more liquid reserves due to a decrease in total debt, secured debt, asset growth, and debt maturity. Badoer and James (2016) report that investment-grade firms have a large proportion of debt that is issued with very long-term maturities since the time variation in the supply of long-term government bonds affects both corporate debt maturity and debt level. Hanssens et al. (2016) find that entrepreneurial firms take a stable debt policy where the policy in the initial year significantly determines debt policies in the future, while the effect of initial debt policies is largely diminished when the founders of firms are replaced. Chiu et al. (2017) report that firms rely on bank financing had a higher default risk than firms that depend mainly on public debt markets during the 2007-2010 financial crisis.

Grjebine et al. (2018) document that companies use bank loans to replace bond issuance during the periods of economic recovery after the recessions. They show that such a feature of corporate debt structure regularly happens in business cycles. This link between business cycles and the substitution of loans for bonds still holds after the regressions include traditional factors that characterize business cycles, e.g., the happening of a bank crisis, credit dynamics, the size distribution of firms, and the quality and the size of financial markets. Schwert (2018) discovers that firms that can issue bonds choose the banks with less capital to borrow. On the contrary, the firms that heavily borrow from banks prefer borrowing from stable banks with large

capital to smooth the effects of cyclical aggregate credit provision and the effects of bank shocks on the real economy.

Badoer et al. (2019) document that companies' choices of debt are affected by the quality of issuer-paid credit rating agencies. The companies that have favorable issuer-paid ratings prefer borrowings from informed intermediaries rather than public bonds to be distinguished from the firms with poor quality ratings. Restrepo et al. (2019) find that when the cost of short-term bank credit increases more than long-term credit, firms switch to the use of cash and trade credit from short-term loans. In the industries with limited provision of trade credit, firms keep more cash holdings and trade credit can provide liquidity to firms when banks incur liquidity shocks.

2.2.2 Static trade-off theory of tax and distress

Corporate finance theory started from the classic capital structure irrelevance theorem of Modigliani and Miller (1958). It states that a firm's value is not affected by the firm's financing decisions in an efficient market that does not consider various market frictions such as tax payments, bankruptcy costs, agency conflicts, and asymmetrical information, see, e.g., Modigliani and Miller (1963) and Miller (1988). These assumptions lead to the theory that the firm value does not depend on its dividend strategy and its financing ways of debt borrowing or issuing stock.

In contrast to Modigliani and Miller theorem in an efficient market without financial frictions, the firm's interest payments of debt are tax deductible in a real economics with taxes. As a result, the firm can add its value by raising its debt borrowing to obtain more exemptions of taxes (Bradley et al., 1984). The additional firm value due to the tax exemption make the levered firm with both equity and debt achieve a higher value than an unlevered firm with all financial resources from equity (Fischer et al., 1989).

There are two popular theorems of corporate capital structure in the real world with financial frictions (Myers, 2001). The first widely examined one is the *trade-off* theorem. It presents that, on one hand, the tax benefits add values to the firm when the firm increases its debt borrowing. On the other hand, the increasing debt issuance raises the financial distress of bankruptcy costs and agency conflict costs between stockholders and bondholders. These financial distress and costs reduce the

firm value (Myers, 1984). Therefore, the firm has to balance tax shields and bankruptcy costs by choosing an optimal capital structure of debt and equity to maximize the firm value.

The literature has been developing the optimal capital structure and trade-off theory. Hackbarth et al. (2007) study the optimal choice and priority structure of bank debt and market debt. They point out that the flexibility of bank debt provides a trade-off between tax shields and bankruptcy costs. Li et al. (2016) illustrate the role of collateral and taxes in firms' decisions of capital structures. They show that under a collateral constraint, the optimal leverage does not hit the constraint and achieves the balance of the tax benefit of debt and the cost of lost financial flexibility.

Graham et al. (2017) demonstrate that using an average tax rate rather than using the theoretically correct marginal tax rate to evaluate a firm' incremental decisions makes the firm take suboptimal leverage choices and investment decisions that are less responsive to investment opportunities. Kumar and Yerramilli (2018) find that a firm's high capacity of investment raises its operating leverage and default probability and meanwhile reduces its ex-post adjustment costs, which produces large tax shields. The underlying reason is that the investment capacity can substitute financial leverage in the debt market equilibrium.

2.2.3 Pecking order theory of internal and external fund

In the economics with financial frictions, a widely known theorem of corporate capital structure is the pecking order theory that focus on information asymmetry and the financing costs for obtaining external funds. The theory believes that firms prefer using their internal cash as the first financing channel due to the low cost of holding cash. After spending cash, the firms issue debt to fund their financing requirements of operations or investments. Only when it is infeasible to borrow more amount of debt, the firms choose equity issuance, which implies managers' inside knowledge.

Bagley et al. (1998) extend the pecking order theory by providing a flexible quantitative framework to facilitate the formulation of additional empirical hypotheses. Their results show that the pecking order theory is consistent with the static trade-off theory. Frank and Goyal (2003) run empirical tests of the pecking order theory of capital structure and find that net equity issues closely indicate the financing deficit and large

firms particularly show pecking order behaviors.

De Jong et al. (2010) discover that small firms do not follow the pecking order theory even small firms usually have asymmetric information. They also show that the explanatory power of the pecking order theory decays over time. De Jong et al. (2011) compare the pecking order theory against the static trade-off theory and find that the former provides a better description of firms' decisions of debt issuance.

In addition, Frank and Goyal (2007) show that equity issuance also implies that firm managers believe the stocks of their firms are overvalued comparing to their inside knowledge about their company's prospects, values, and risks. Cunha and Pollet (2020) reveal that firms add their cash reserves significantly in response to exogenous rises in investment opportunities. Financially constrained firms use their internal sources to save cash earlier while unconstrained firms take external funds to make investment and to develop cash reserves.

Particularly, Baskin (1989) demonstrate that established firms are more likely to avoid issuing new equity and to borrow debt for funding investments. Chua and Woodward (1993) exhibit that private companies' debt structures are predicted by the pecking order theory of corporate debt structure. They show that debt is negatively correlated to internally generated cash flow and is positively related to the need for external funds to finance growth. Private companies are reluctant to issue new equity. Similarly, Minola et al. (2013) study the financing strategies of new technology-based firms by using a method of estimating internal financial gap. Their results show a revised pecking order where new technology-based firms choose equity issuance prior to debt.

2.2.4 Corporate choices of credit rating

In this section, I discuss empirical and theoretical findings on the corporate choices of credit ratings through corporate activities. These facts potentially lead to the endogeneity problems and motive the instrumental-variable (IV) regressions that I take.

Bhojraj and Sengupta (2003) document that corporate governance mechanisms with stronger outside control of the board and greater institutional ownership can achieve higher credit ratings. This governance mechanism reduces default risk by decreasing agency costs and information asymmetry between the firm and the lenders. Furthermore, Ashbaugh-Skaife et al. (2006) and Weber (2006) report that firms' credit ratings

could be affected by corporate governance including the number of blockholders with more than a 5% corporate ownership, weak shareholder rights in defending takeover, the level of financial transparency, board stock ownership, board independence, board expertise, and CEO power.

Hovakimian et al. (2009) find that when firms' credit ratings are below (above) their targets, the firms tend to reduce (increase) leverage by making repurchase decisions and security issuance. Similarly, when they have ratings that are below (above) their targets, they prefer decreasing (increasing) their dividend payouts and making fewer (more) acquisitions. Similarly, Alissa et al. (2013) discover that when firms' credit ratings are above (below) their expected credit rating predicted by an empirical model, they engage in income-decreasing (income-increasing) earnings management activities. These actions of earnings management succeed in helping firms move their credit ratings toward their expected credit ratings.

Jeon and Lovo (2013) present a survey of stylized facts in the credit rating industry. One of the facts is that debt issuers first pay credit rating agencies upfront fees for assessing their default risk and receiving 'shadow' ratings. If the issuers would like to ask the credit rating agencies to publicize the rating, they need to pay additional fees. This fee structure allows the issuers to shop for ratings by asking multiple credit rating agencies for ratings and then only pay for publicizing the most favorable announced ratings. As a result, credit rating agencies probably are tempted to provide debt issuers with favorable ratings for obtaining additional charges by publicizing their ratings. This stylized fact is further analyzed by Bolton et al. (2012) who build a theoretic model of competition among multiple credit rating agencies.

Besides, Mathis et al. (2009) and Fulghieri et al. (2010) point out the effect of contingent fees on credit rating. The fee charged by credit rating agencies is larger for delivering a high rating than the fee paid for delivering a low rating. Hence, a credit rating agency would opt for inflating ratings when the short-term gain from untruthful ratings is stronger than the loss from truthful ratings. Moreover, Kraft (2015) shows evidence that credit rating agencies cater to borrowers by using rating-based performance-priced loan contracts, in which a decrease in the borrowers' credit ratings leads to a rise in loan interest rates or an early payment of principal.

At the same time, there are feedback effects of credit ratings from rating agencies

on borrowers' downgrades and defaults. Using a theoretic model that considers credit-rating feedback effects, Manso (2013) illustrates that when rating agencies focus on the accuracy of their ratings, their ratings affect the probability of a borrower surviving. Even credit rating agencies pursue a policy of accurate rating, borrowers could incur multi-notch downgrades or immediate default due to small shocks to fundamentals. The increase in the competition between rating agencies can lead to rating downgrades, higher probabilities of default, and welfare reduction.

2.2.5 The leverage puzzle

The leverage puzzle of the negative relationship between firms' profits and leverages is observed as empirical studies find that the main model implication of the static trade-off theory of optimal capital structure is counterfactual to the negative relationship. There have been prior studies tackling the leverage puzzle and the most of papers examine the quantity of leverage that measures the corporate capital structure of equity and debt, see, e.g., Lemmon et al. (2008) and Begenau and Salomao (2019).

Aggarwal and Zhao (2007) controls for industry leverage effects and discover that firm value has a negative relationship with leverage for firms with both high and low growth opportunities. Using panel data and a two-step system-GMM procedure, Antoniou et al. (2008) document that firms have target leverage ratios and firms' leverages are positively related to the asset tangibility, the firm size, but are negatively related to profitability, growth opportunities, and share price performance in both in capital market-oriented economies (the U.K. and the U.S.) and bank-oriented economies (France, Germany, and Japan).

Frank and Goyal (2015) examine the leverage puzzle from the perspective that profitability affects both the numerator and the denominator of the leverage ratio. Firms with profits issue debt and repurchase equity while firms with losses retire debt and issue equity. Nevertheless, the leverage puzzle exists because these financing adjustments are not sufficient to offset profitability shocks due to variable transactions costs. Chen et al. (2019) find evidence that operating leverage affect firms' profitability and financial leverage, which leads to a negative relation between profitability and financial leverage.

Heath and Sertsios (2019) design a novel quasi-natural experiment where they increase a subset of firms' profits by raising the firms' market power that imposes spillovers on their suppliers. They show that the leverage puzzle only exists in the supplier firms but does not appear in the subset of firms treated. because the rise in profitability is transitory and risky for suppliers but it is permanent and riskless for treated firms. This finding implies the unobserved components of profitability variation explain the leverage puzzle.

Eckbo and Kisser (2020) demonstrate that the relation between profitability and leverage is conditionally negative when firms actively rebalance leverage by issuing new debt to fund their shareholder distribution is financed with new debt issues. The relation is conditionally positive when the firms draw down their cash-balances to finance distribution internally.

Although the prior studies provide diverse ways of illustrating and interpreting the leverage puzzle, the literature has been largely silent on how the fine details of the corporate *debt* structure contribute to the leverage puzzle. There is a growing research interest in firms' debt choices considering firms' heterogeneous characteristics and the relationship with creditors and outside environments, see Prilmeier (2017), Choi et al. (2018), Badoer et al. (2019), Badoer et al. (2020), and Restrepo et al. (2019). For example, Grosse-Rueschkamp et al. (2019) find that central banks' quantitative easing programs of purchasing firms' bonds reduces the yields of these firms' bonds. The monetary policy induces the firms to issue bond debt while decreasing the borrowing of term loans from banks, which forms a capital structure channel of monetary policy.

Nevertheless, the extant studies do not evaluate the leverage puzzle from the interaction between the corporate debt structure and firms' unrated status under the effects of banks' credit supplies and monetary policy. Given the critical roles of these factors, this chapter is the first to develop hypotheses for empirically testing that firms' unrated status affect firms' choices of specific debt, which further explain the leverage puzzle.

2.2.6 Hypotheses on the leverage puzzle and unrated status

The leverage puzzle states that there is a negative relationship between profitability and leverage. In this study, the leverage is decomposed into the ratios of the various

types of debt over the total asset. Using the corporate debt structure, I investigate whether there are negative relationships between profitability and these types of debt (leverage/bank debt/public debt/revolving credit/term loans/bonds and notes / commercial papers/capital leases/other borrowings). Furthermore, I examine whether a firm's rating status moderates these negative relationships and affects the debt structure.

A firm is defined as an unrated firm if the firm does not obtain a long-term issuer rating from Standard and Poor's (S&P), which is denoted by a *time-varying* indicator $Unrated_{f,t} = 1$ like Schwert (2018), who finds that unrated firms borrow heavily from stable banks with large capital to smooth the effects of cyclical aggregate credit provision and the effects of bank shocks on the real economy. Therefore, this chapter examines the leverage puzzle through the innovative channel of unrated status and its effect on the debt structure, which lead to the following hypotheses.

Hypothesis 1, H_1^1: there is a positive relationship between profitability and leverage for the unrated firms.

Counterfactual Hypothesis 1, H_0^1: the relationship between profitability and leverage is negative or insignificant for the unrated firms.

Hypothesis H_1^1 suggests that when the unrated firms produce more profits, they can borrow more amounts of debt to raise their leverages. Namely, unrated status *attenuates* (i.e., weaken the effect) the negative relationship between the unrated firms' profits and leverages by increasing their leverages when these firms' profits are high, although in general they reduce leverage due to their lack of credit rating.

Hypothesis 2, H_1^2: the relationship between profitability and total bank debt is insignificant when the moderation effect of the unrated status of firms is considered.

Counterfactual Hypothesis 2, H_0^2: there is a negative or positive relationship between profitability and total bank debt when the moderation effect of the unrated status of firms is considered.

Hypothesis H_1^2 suggests that the part of the leverage puzzle that the negative relationship between profitability and total bank debt is insignificant when I consider the unrated status as well as the interaction item between profitability and unrated status (the moderation effect). Namely, the part of the leverage puzzle about bank

debt vanishes when I consider unrated status because unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt, see the variable definitions in Fig. 2.1 and Section 2.4.

Hypothesis 3, H_1^3: there is a positive relationship between profitability and revolving credit for the unrated firms.

Counterfactual Hypothesis 3, H_0^3: the relationship between profitability and revolving credit is negative or insignificant for the unrated firms.

Hypothesis H_1^3 suggests that when the unrated firms produce more profits, they can raise their revolving credit from banks. Namely, unrated status attenuates the negative relationship between the unrated firms' profits and revolving credit by increasing their revolving credit from banks when the firms' profits are high, and in general they raise revolving credit, see the variable definitions in Fig. 2.1 and Section 2.4.

Hypothesis 4, H_1^4: there is a negative relationship between profitability and term loans for the unrated firms.

Counterfactual Hypothesis 4, H_0^4: the relationship between profitability and term loans is positive or insignificant for the unrated firms.

Hypothesis H_1^4 together with Hypothesis H_1^3 suggest that the unrated firms reduce the holdings of term loans (H_1^4) while they raise revolving credits (H_1^3). The reason is that revolving credit is often borrowed by firms for funding short-term operations while term loans are usually taken for long terms. Revolving credit can be drawn and repaid a few times over the life of its horizon, which can be viewed as several short-term borrowings. By contrast, term loans are drawn fully at origination and can be prepaid before maturity, but cannot be redrawn after repayment, which are usually long-term loans.

Besides, the unrated firms are less creditworthy and do not have long-term credit ratings. Hence, they have to switch to revolving credit from term loans. Similarly, Schwert (2018) shows that as predicted by the financial commitment hypothesis, unrated firms prefer revolving credit to term loans because there is no commitment element in term loans. As a result, the opposite forces of revolving credit and term loans offset each other and therefore the relationship between profitability and total bank debt, which comprises revolving credit and term loans, is insignificant when the moderation effect of the unrated status of firms is considered (H_1^2), see the variable

definitions in Fig. 2.1 and Section 2.4.

Hypothesis 5, H_1^5: there is a positive relationship between profitability and bonds and notes/public debt for the unrated firms.

Counterfactual Hypothesis 5, H_0^5: the relationship between profitability and bonds and notes/public debt is negative or insignificant for the unrated firms.

Hypothesis H_1^5 suggests that when the unrated firms produce more profits, they can raise their bonds and notes/public debt from the public market. Namely, unrated status attenuates the negative relationship between the unrated firms' profits and bonds and notes/public debt by increasing their bonds and notes/public debt when the firms' profits are high, although in general they reduce bonds and notes/public debt due to the lack of credit rating, see the variable definitions in Fig. 2.1 and Section 2.4.

Hypothesis 6, H_1^6: the relationship between profitability and term loans/commercial papers/capital leases/other borrowings is insignificant when the unrated status of firms is considered.

Counterfactual Hypothesis 6, H_0^6: there is a negative or positive relationship between profitability and term loans/commercial papers/capital leases/other borrowings when the unrated status of firms is considered.

Hypothesis H_1^6 suggests that the part of the leverage puzzle that the negative relationship between profitability and term loans/commercial papers/capital leases/other borrowings turns insignificant when I consider unrated status as well as the interaction item between profitability and unrated status. Namely, the parts of the leverage puzzle about these types of debt vanish when I consider unrated status because unrated status fully attenuate these parts of the leverage, see the variable definitions in Fig. 2.1 and Section 2.4.

2.3 Empirical Strategy

I describe the strategies for the empirical study about the effects of the rating status on firms' debt structure and leverage puzzle. To test hypotheses, the chapter considers the corporate leverage and the *ratio* of a particular type of debt to the book value of total asset as the dependent variable respectively, which are described in Fig. 2.1 and

Section 2.4. The literature studies the corporate capital structure through the *book leverage (BL)* defined as a firm's total debt divided by the firm's book value of total asset. Specifically, the chapter examines particular classes of corporate debt as the corporate debt structure (Rauh and Sufi, 2010; Colla et al., 2013; Choi et al., 2018). They are term loans (TL), revolving credit (RC), commercial papers (CP), bonds and notes (BN), capital leases (CL), and other borrowings (OB).[1] More broadly, TL and RC are categorized into *bank debt (BD)* whose debt holders are banks. CP, BN, CL, and OB can be referred to as *public debt (PD)* that are issued in the financial market.

The main independent variables include firms' profits, the variables characterizing the firm-bank relationship, and the interaction between the profit and firm-bank relationship. In addition, the effects of other factors on financial policies are captured by the one quarter lag control vector $\mathbf{X}_{f,t-1}$. Finally, the equations include firm fixed effects, d_f, to encapsulate time-invariant factors and calendar year fixed effects, d_y, to account for time trends. Therefore, this chapter mainly applies the method of panel data regression absorbing high-dimensional fixed effects with standard errors that are clustered by firms. I formulate the hypotheses described in Section 2.2 in the form of empirical equations as follows.

$$\begin{aligned} Y_{f,i,t} \quad = \quad & \beta_0 + \beta_1 Unrated_{f,t} + \beta_2 Profit_{f,t} + \beta_3 Unrated_{f,t} \times Profit_{f,t} \\ & + \vec{\beta}^T \mathbf{X}_{f,t-1} + d_f + d_y + \varepsilon_{f,i,t}. \end{aligned} \tag{2.1}$$

where Y in (2.1) can be one of $BL/BD/PD/RC/TL/BN/CP/CL/OB$, which denotes the ratio of the amount of one type of debt in the corporate debt structure, to the total asset. The vectors $\vec{\beta}$ and $\mathbf{X}_{t-1}$ capture the effects of other corporate variables and $\varepsilon_{f,i,t}$ is the disturbance term.

The hypotheses study how unrated status affects the relationship between profitability and leverage as well as firms' debt components. To examine the robustness of the findings, I further consider four factors that might impose effects to the relationship between profitability and debt.

First, Grosse-Rueschkamp et al. (2019) suggest that the monetary policy of central banks' quantitative easing programs during the 2008 financial crisis induce firms to

[1] A CP a security that is issued in a money market by large companies to obtain funds to cover expenses for short-term obligations like salaries. A RC is a fund offered by financial institutions to creditworthy customers for dealing with liquidity issues at the customers' discretion. A CL assigns the lease holding company temporary ownership of an asset that carries the asset' economic characteristics.

prefer issuing public bond debt rather than borrowing bank term loans to obtain capital. The mechanism is that the central banks' purchases of corporate bonds push down these bonds' yields. Thus, I run the regressions of unrated status for the pre-2008 and the post-2008 period separately to test whether the findings are robust to the different periods before and after the 2008 financial crisis.

Second, firms may substitute some internal pressure with external pressure from creditors' monitoring. Bharath and Hertzel (2019) illustrate that a more competitive product market that imposes external pressure to firms significantly makes the firms reduce the external pressures of monitoring by reducing debt. Thus, this chapter examines whether the relationship between unrated status and the leverage puzzle is robust to product market competition.

Third, empirical studies (Santos and Winton, 2019) discover that banks as the credit supplier to unrated borrowers play an important role in firms' preferences of debt. Therefore, I examine the robustness of the results to banks' credit supplies. Following Becker and Ivashina (2014), the credit supply from banks, $CreditSup_t^b$, is measured as a four-quarter rolling-window growth in nonfarm, nonfinancial corporate bank loans obtained from U.S. Flow of Funds Accounts.

The mechanism underline industry competition is the external monitoring relationship that some firms might be willing to give to banks under different conditions. The mechanism for banks' credit supplies is the macroeconomic effect arising from supply side constraints. Since the two mechanisms are likely to explain why more profitable unrated firms have higher leverages, I begin with adding the three control variables one by one (industry competition, credit supplies) in the first round. Then in the second round, I add their interactions with profitability. Last in the third round, I add triple interaction terms, between one of these variables, profitability, and unrated status.

2.4 Data and variables

In this section, I describe data sources, sample selection process, and variable definitions.

2.4.1 Data sources and sample selection

The chapter mainly uses the debt structure data and financial statement data of US companies downloaded from Capital IQ and Compustat from the WRDS platform following Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). The data about macroeconomic variables are obtained from the Federal Reserve Economic Data (FRED) of Federal Reserve Bank of St. Louis. Aggregate lending data are from U.S. Flow of Funds Accounts[2]. Quarterly data are collected and the data period is 15 years from 2002 Quarter 1 to 2017 Quarter 1 covering the period of the 2008 financial crisis since more comprehensive data about corporate debt structure are available in the database of Capital IQ after 2002.

This chapter uses debt data from Capital IQ since it provides a more specific profile of diverse types of corporate debt than another widely studied debt database DealScan. Generally, DealScan provides contract details about bank (private) debt like bank loans and public debt such as bonds that are issued to the financial market. Nevertheless, DealScan does not offer data about the specific components of bank debt and public debt, such as revolving credit and commercial papers, which are well organized in Capital IQ data.

I clean Capital IQ data by three steps. First, I drop duplicated items since firms usually record their debt repeatedly at different occasions. The observations with the same information about debt contracts but different filing instances are treated duplicates and are removed. Second, a firm-quarter item may have several contracts of the same type of debt, whose values are summarized together as one record. Third, Capital IQ stacks the properties (e.g., names and values) of all different types of debt in the same columns. I separate each required property of each debt and then I reallocate each property to an individual column.

I carry out the sample selection process as follows. First, I merge debt data from Capital IQ (1,146,389 firm-quarter observations) with the company characteristic data from Compustat (685,760 firm-quarter observations), which produces 1,668,654 firm-quarter observations in total. I keep the observations that match both databases in terms of firms and quarters and delete the observations that do not match from the

[2]See U.S. Flow of Funds Accounts at https://www.federalreserve.gov/releases/z1/.

two databases. Then 1,384,471 observations are deleted and 284,183 are left.

Second, I drop the observations if the total debt in Capital IQ is larger than the total debt in Compustat by more than 10% following the similar procedure in Colla et al. (2013) page 2120 and Choi et al. (2018) page 499. Then, 98,852 observations are deleted and 185,331 are left. This step also removes the high tails of firms' debt components in the Capital IQ data.

Third, I restrict to non-financial and non-utility firms by dropping financial firms with Standard Industrial Classification (SIC) codes 6000 to 6999 (52,213 observations deleted) and utilities including electric, gas & sanitary services with the SIC codes 4900 to 4999 (8,114 observations deleted), follows standard practice in the literature (e.g., Danis et al., 2014; Colla et al., 2013). The final sample comprises of 125,004 firm-quarter observations including 11,993 firms in the sample.

After merging the data, I fill the missing values of debt in Compustat by using information from Capital IQ. Company characteristics are winsorized by using a 1% level, i.e., variable-by-variable replacing extreme outliers below the 1st percentile by the 1st percentile, and outliers above the 99th percentile by the 99th percentile. This process mitigates the effect of outliers and eradicate errors in the data. In addition, the leverage and the ratios of various types of debt to the total asset are limited to the unity similar to Lemmon et al. (2008) and Colla et al. (2013). In the end, 6,070 ratios below zero are set to zero and 2,435 ratios above one are set to one. Regression results are similar when I do not limit the maximum value of these leverage variables.

2.4.2 Variable definitions

The dependent variables, independent variables, and control variables are constructed as follows. The lower-case symbols in brackets are the variable symbols for the variables in Compustat.

To begin with, I define the dependent variables (LHS) in terms of corporate debt structure variables considering current data frameworks in Capital IQ, which are similar to the literature, see, e.g., Colla et al. (2013) and Choi et al. (2018).

1) Revolving Credit (RC) is the Level of RC / book assets (atq).

2) Term Loan (TL) is the Level of TL / book assets (atq).

3) Commercial Paper (CP) is the Level of CP / book assets (atq).

4) Bond and Note (BN) is the Level of BN / book assets (atq).

5) Capital Lease (CL) is the Level of CL / book assets (atq).

6) Other Borrowing (OB) is the Level of OB / book assets (atq).

7) Bank Debt (BD) is the TL + RC.

8) Public Debt (PD) is the CP + BN + OB + CL.

9) Book Leverage is the ratio of book debt (dlcq + dlttq) to book assets (atq).

Next, the following four independent variables correspond to the hypotheses ($Profit$ and $Unrated$) and robustness tests ($CreditSup$ and $Competition$), respectively.

1) $Profit$ is defined as operating profit (oibdpq) divided by book assets (atq). This variable is examined by all hypotheses.

2) $Unrated$ (Schwert, 2018) takes the value 1 for the firms without Standard & Poor's (S&P) domestic long term issuer credit rating. The S&P rating data are obtained from Compustat - Capital IQ database. One possible caveat might arise from the $Unrated$ status based on S&P domestic long-term issuer credit rating. The rating data of other rating agencies are not examined by this study as our institution does not subscribe to data from them. The effect of this data shortage is limited since S&P is one of the largest credit rating agencies. Indeed, there is a triopoly market structure in the credit rating industry comprising three large credit rating agencies: Standard & Poor's, Moody's, and Fitch. The first two agencies dominate 80% market shares of the rating business. Hence, using credit rating data from S&P captures the rating status of the U.S. companies reasonably well.

In addition, it is impossible for an unrated firm to issue bonds with credit ratings and therefore the specific rating of a debt security (e.g., corporate bond) would not influence my analysis. S&P offers "Issuer Credit Ratings" and "Issue Credit Ratings". The former is a forward-looking opinion about a borrower's overall creditworthiness in terms of its willingness and capacity to meet its financial commitments.[3] The latter is a forward-looking assessment of the creditworthiness of a specific class of financial obligations. The assessment considers the creditworthiness of insurers and other forms of credit enhancement on the obligations.[4] Other credit rating agencies provide similar

[3]https://www.spglobal.com/ratings/en/products-benefits/products/issuer-credit-ratings

[4]https://www.spglobal.com/ratings/en/products-benefits/products/issue-credit-ratings

issuer ratings and issue ratings.[5] When corporate debt is assessed, rating agencies carry out both an issue rating and an issuer rating. Thus, a firm issuing rated debt security is rated.

Certainly, a rated firm might issue unrated bonds[6], which are popular[7] during the period with low interest rates after the 2008 financial crisis.[8] Nevertheless, this situation does not affect the analysis of this study that focuses on the mechanism of unrated firms mitigate the leverage puzzle of the negative relationship between leverage and profitability.

3) *CreditSup* (Becker and Ivashina, 2014) is the 4-quarter rolling growth in aggregate nonfarm, nonfinancial corporate bank debt obtained from U.S. Flow of Funds Accounts provided by the Federal Reserve Board. The aggregate bank debt is the sum of the following two items in U.S. Flow of Funds Accounts: (1) the depository institution loans not elsewhere classified (n.e.c.) and (2) other loans and advances.

4) *Competition* (Bharath and Hertzel, 2019) is equal 1 for the firms with Herfindahl-Hirschman Index (HHI) at the three-digit SIC code industry level below the median value of HHI for a given year, where the data are mainly obtained from the Text-based Network Industry Classification (TNIC) from Hoberg and Phillips website (Hoberg and Phillips, 2016).[9] The practice of using the HHI as a proxy for the competition is motivated by the fact that the HHI measures industry concentration. The HHI measures a company's market size relative to the size of the industry that the company belongs to based on the market shares of all companies competing in a market targeted by the industry. A market with high concentration indicates that the market is close to a monopoly and hence the market shows less competition. In other words, a small level of HHI implies low industry concentration that leads to an intense competition industry.

[5]https://www.securityfund.org/credit-rating-definitions

[6]https://www.ft.com/content/fce8049c-4e6e-34f0-885a-ffc4fdc078f2

[7]https://www.reuters.com/article/asian-perpetuals-accounting-idINL1N0B116E20130201

[8]https://citywire.com/wealth-manager/news/income-and-unrated-bonds-a-match-made-in-heaven/a1157403

[9]Similar to Bharath and Hertzel (2019), I mainly use the Text-based Network Industry Classification (TNIC) HHI from Hoberg and Phillips (2016) and fill missing values by using the Text-based Fixed Industry Classifications (TFIC) HHI from Hoberg and Phillips (2010a) and the HHI calculated from Compustat data (e.g., Boubaker et al., 2018).

The following firm characteristics are the corporate controls that are defined in a way similar to the literature (e.g., Strebulaev and Yang, 2013; Danis et al., 2014; Badoer and James, 2016; Prilmeier, 2017; Carvalho, 2018; Choi et al., 2018; Schwert, 2018; Santos and Winton, 2019).

1) Investment (capital expenditure) is capital expenditures (capxy) divided by book assets (atq).

2) Cash is the ratio of cash and short-term investments (cheq) to book assets (atq).

3) Age is the years passing the IPO date (Compustat variable ipodate) or the first year in Compustat if the value of the variable "ipodate" is missed.

4) Net Debt Issuance is the ratio of the change in current and long-term debt to book assets, $(dlcq_t + dlttq_t - dlcq_{t-1} - dlttq_{t-1})/atq_t$.

5) Net Equity Issuance is the Ratio of net equity issuance, which is the sale of common and preferred stock (sstky) minus share repurchases (prstkcy), to book assets, (sstkq-prstkcq)/atq.

6) R&D is the research and development expense scaled by book assets (xrdq/atq), which is set to zero if xrdq is missed.

7) Size is the natural logarithm of total asset adjusted to year 1982 dollars, $log(atq \times CPI_{1982}/CPI_t)$. Consumer Price Index (CPI) for all urban consumers is from the US Bureau of Labor Statistics, which can be obtained from the Federal Reserve Economic Data (FRED) of Federal Reserve Bank of St. Louis.

9) MV/BV (Market to Book) is the ratio of book assets (atq) plus market capitalization (prccq $\times$ cshoq) minus common equity (ceqq) minus deferred taxes and investment credit (txditcq) to book assets (atq).

10) Tangible assets are defined as property/plant/equipment (ppentq) divided by book assets (atq).

11) Tax is defined as taxes (txtq) divided by book assets (atq).

12) Earning volatility (Risk) is the standard deviation of quarterly operating profits (oibdpq) scaled by book assets (atq) over the previous 4 quarters.

13) Share repurchases is the ratio of quarterly share repurchases (prstkcy) to book assets (atq).

2.5 Distributions of debt structure and firm characteristics

In this section, I describe the pattern of corporate debt structure, firm characteristics, and the distribution of unrated firms.

2.5.1 Distribution of corporate debt structure

Capital IQ on WRDS provides the following nine types of debt contracts: "Commercial Paper", "Revolving Credit", "Term Loans", "Bonds and Notes", "Capital Lease", "Other Borrowings", "Trust Preferred", "Adjustments", and "Preferred Securities". Before making any data operations, I observe the distribution of debt structure within the total debt observation in the downloaded raw data. From Table 2.1, I find out that there are a small number of other borrowings and a moderate number of trusts preferred. There is no adjustments and few preferred securities. To keep the analysis in a manageable scale, I focus on the first five types of debt and *other borrowings* gathering the rest types of debt for the ease of presentation. Figure 2.2 demonstrates the distribution of debt structure in the six types of specific debt that I examine, which shows that the two types of bank debt, revolving credit and term loans, take more than half of total debt observation in the raw quarterly data. The framework of debt structure is consistent with the literature in the area that is represented by Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). Indeed, as pointed out by Choi et al. (2018) and shown by the results, most of corporate debt structure are revolving credit, term loans, and bonds and notes.

After the raw data are cleaned by the sample selection procedure in Section 2.4.1, Table 2.2 displays the percentage of firms issuing different types of debt in the final sample. Note that a firm can issue multiple types of debt for which the percentages do not add up to 100. Most of firm prefer term loans of bank debt or bonds and notes of public debt as their ways of issuing debt. Revolving credit of bank debt or capital leases of public debt are also popular choices of debt issuance.

Table 2.1. Distribution of debt structure from Capital IQ raw data

Notes. Table 2.1 displays the distribution of debt structure within the total debt observation in the raw quarterly data downloaded from Capital IQ.

Debt Type	Frequency	Percent (%)	Cumulation
Commercial Paper (CP)	86,860	1.08	1.08
Revolving Credit (RC)	1,443,572	17.87	18.95
Term Loan (TL)	3,426,493	42.43	61.38
Bond and Note (BN)	2,023,806	25.06	86.44
Capital Lease (CL)	463,338	5.74	92.17
Other Borrowing (OB)	50,994	0.63	92.80
Trust Preferred	581,087	7.20	100.00
Preferred Security	2	0.00	100.00
Total raw debt observation	8,076,152	100.00	

Table 2.2. Percentage of firms issuing various types of debt in the final sample

Notes. Table 2.2 displays the percentage of firms that issue six types of specific debt: RC, TL, CP, BN, CL, OB, in the final sample after the sample selection procedure in Section 2.4.1. A firm can issue multiple types of debt for which the percentages do not add up to 100. I focus on the first five types of debt and Other Borrowings (OB) gathering the rest types of debt in Table 2.1 for the ease of presentation.

No. of Firms	RC	TL	CP	BN	CL	OB
11,993	59.41	71.32	3.64	73.54	46.97	38.62

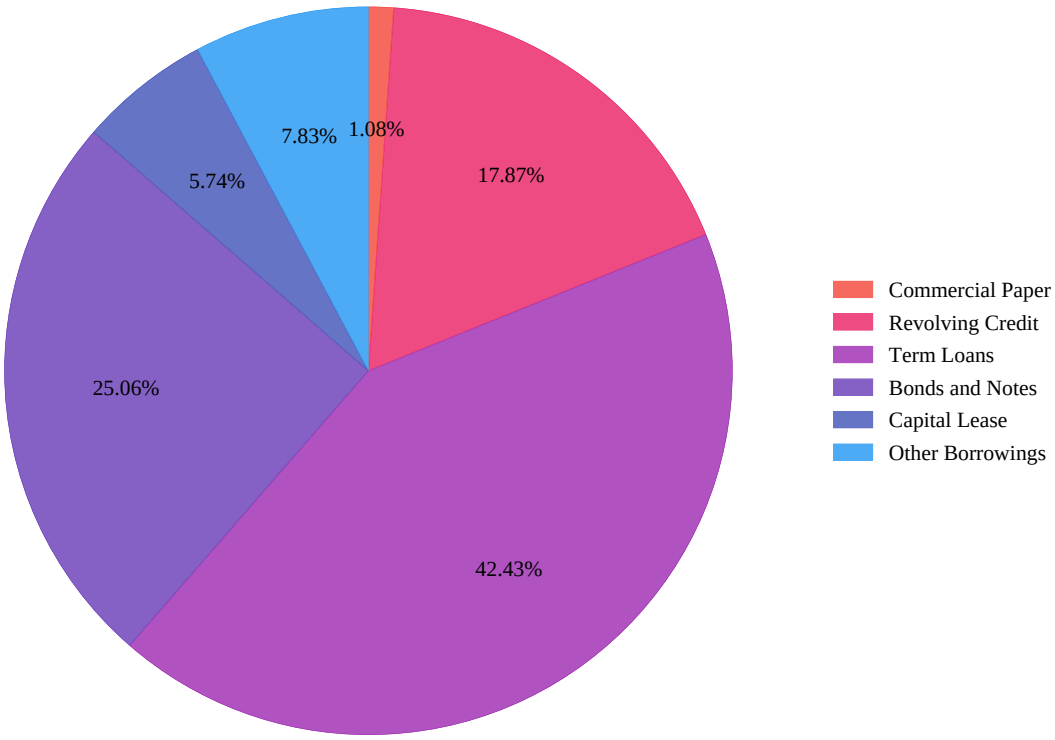


Figure 2.2. Distribution of debt structure

Fig. 2.2 plots the distribution of debt structure within the total debt observation in the raw quarterly data downloaded from Capital IQ, where trust preferred and preferred securities are grouped as other borrowings. No. of raw debt observations: 8,076,152.

2.5.2 Summary statistics of debt structure and firm characteristics

Table 2.3 provides the summary statistics of debt structure and firms' characteristics during the sample period from the U.S. panel data merging Capital IQ Capital Structure - Debt and Compustat Fundamentals Quarterly. Missing values after matching the two databases by firms and quarters are filled by 0. Variables are defined in Section 2.4.

The first six variables are the ratios of six types of specific debt values to the total value of assets. The seventh (eighth) variable is the ratio of total book (market) debt value to the total value of assets. Namely, the eight variables are in the family of 'leverage' variables. The eight rows list the quintiles of firms' various types of debt in terms of the ratios of debt values to the total asset. I do not examine the quantiles of the monetary amount of various types of debt since different sizes of companies might take substantially distinctive values of debt, which might not be tail values in the data sample because their ratios to the total assists could be in a reasonable range. Hence, I display the quintiles of firms' various types of debt in terms of the ratios of debt values to the total asset, which are all in the reasonable range.

On average, bonds and notes from the public market and term loans from banks take the largest mean values of 0.17 and 0.11, followed by the revolving credit of bank debt with the mean of 0.049. Capital leases and other borrowings have the mean values that are about one-tenth of the values of bonds and notes. The last one is the mean of commercial papers, which is about one percent of the values of bonds and notes. The sizes of debt related variables vary as firms do not take some types of debts sometimes. I do not fill missing debt variables by 0 to emphasize the diversity of debt structure.

Table 2.A.2 list the correlation of debt structure and firms' characteristics. As one of bank debt, the revolving credit of bank debt is not only negatively correlated with public debt including the commercial paper at -0.03, the bond and note at -0.05, and the other borrowing at -0.01, but also negatively correlated with another type of bank debt, the term loan at -0.04. The term loan of bank debt is positively correlated with two types of public debt, the bond and note at 0.04 and the other borrowing at 0.02. The commercial paper from the public market is negatively correlated with the revolving credit at -0.03, the term loan at -0.01, and the capital lease at -0.02. Note

Table 2.3. Summary statistics of debt structure and firms' characteristics

Notes. Table 2.3 displays the summary statistics of debt structure and firms' characteristics. Missing values after matching the two databases by firms and quarters are filled by 0. The first six rows are the ratios of six types of specific debt values to the total value of assets.

VARIABLES	mean	sd	min	p25	p50	p75	max	N
Revolving Credit	0.0485	0.116	0	0	0	0.0421	1	125,004
Term Loan	0.108	0.213	0	0	0.00129	0.118	1	125,004
Commercial Paper	0.00146	0.0139	0	0	0	0	1	125,004
Bond and Note	0.172	0.266	0	0	0.0390	0.237	1	125,004
Capital Lease	0.00790	0.0389	0	0	0	0.00153	1	125,004
Other Borrowing	0.0187	0.0941	0	0	0	0	1	125,004
Log(Age)	2.029	1.756	0	0	2.565	3.912	4.007	125,004
Book Leverage	0.338	0.300	0	0.0988	0.260	0.486	1	125,004
Cash	0.116	0.205	0	0	0.0209	0.130	0.959	125,004
Earnings Volatility	0.0883	0.444	0	0	0.00368	0.0156	3.763	125,004
Intangible	0.108	0.193	0	0	0	0.133	0.802	125,004
Investment	0.0217	0.0450	0	0	0.00277	0.0223	0.275	125,004
Net Debt Issue	0.0219	0.143	-0.250	-0.000338	0	0.00100	1.119	125,004
Net Equity Issue	0.0441	0.194	-0.0917	0	0	0.000236	1.382	125,004
Profit	-0.151	0.768	-6.164	-0.0242	0.0181	0.0377	0.157	125,004
R&D Expense	0.0121	0.0415	0	0	0	0.00116	0.301	125,004
Share Repurchase	0.00401	0.0157	0	0	0	0	0.109	125,004
Size	2.888	3.484	-4.662	0	1.991	5.827	10.81	125,004
Tangible	0.194	0.273	0	0	0.0514	0.301	0.964	125,004
Tax	0.00169	0.00652	-0.0262	0	0	0.00201	0.0294	125,004
MV/BV	5.729	29.08	0	0	0.903	1.732	255.2	125,004

that there is no multicollinearity issue among the variables. The correlation coefficients among some types of debt ratios and leverage are expected, e.g., loans and bonds as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

2.5.3 Distribution of unrated status

In this section, I describe the distributions of unrated firms from three aspects. First, Table 2.4 shows observation frequencies in three ways: industry, competition, and unrated status. Comparing the total number of Columns (1) to (4), I find that the largest numbers of observations are unrated firms under intense product market competition (49, 935 observations) and less intense competition (43, 554 observations). The numbers of rated firms with/without competition are lower than half of the number of corresponding unrated firms. In addition, the number of firms in the manufacturing industry is the largest one, followed by the service and agriculture industries. The last two industries with the least number observations are the trade and transportation industries. In short, the table shows the differences of unrated status across various industries and different product market competition, which imply that the following empirical analysis might need to consider the industry and market competition.

Table 2.4. Observation frequencies in the industry, competition, and unrated status

Notes. Table 2.4 displays observation frequencies in three ways: industry, competition, and unrated status.

	(1)	(2)	(3)	(4)	(5)
	Competition 0	Competition 0	Competition 1	Competition 1	
	Unrated 0	Unrated 1	Unrated 0	Unrated 1	
	Freq	Freq	Freq	Freq	
Industry	(Percent)	(Percent)	(Percent)	(Percent)	Total
Agriculture	770	2,994	3,144	14,693	21,601
	(4.794)	(6.874)	(20.34)	(29.42)	
Manufacturing	8,930	22,102	5,643	18,629	55,304
	(55.60)	(50.75)	(36.51)	(37.31)	
Transportation	1,325	2,235	3,008	3,271	9,839
	(8.250)	(5.132)	(19.46)	(6.551)	
Trade	2,297	4,462	1,506	3,552	11,817
	(14.30)	(10.24)	(9.745)	(7.113)	
Service	2,739	11,761	2,153	9,790	26,443
	(17.05)	(27.00)	(13.93)	(19.61)	
Total	16,061	43,554	15,454	49,935	125,004

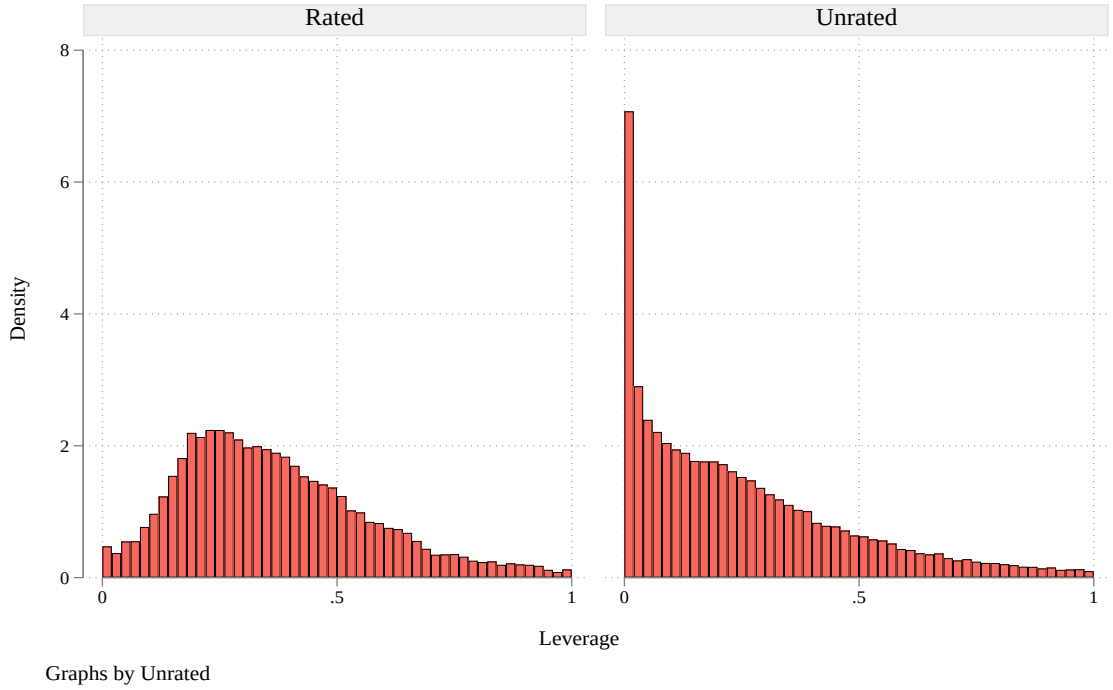


Figure 2.3. Distribution of leverage grouped by the unrated status dummy

Fig. 2.3 plots the distribution of firms' leverages within $(0, 1)$ grouped by the unrated status dummy. No. of observations: 125,004.

Fig. 2.3 plots the distribution of firms' leverages that are categorized into two groups according to the firms' unrated status dummies. The left side figure shows that rated firms take leverages around 0.25 on average. On the contrary, the right-side figure depicts that there are more unrated firms keeping conservative low leverages near 0, except the original missing values that are filled by 0 and the original large values that are cut by 1. The results imply that on average, rated firms with S&P long-term credit rating borrow more amount of debt than unrated firms without S&P long-term credit rating, which only borrow a small amount of debt.

Fig. 2.4 demonstrates the distribution of rated firms' long-term credit rating assigned by S&P. It shows that most of rated firms have the rating around B- to BBB+. A small number of these firms have credit rating during AA to AAA while a few of these firms have the rating below B-. The firms with low credit rating may lose their long-term credit rating and then turn to unrated firms.

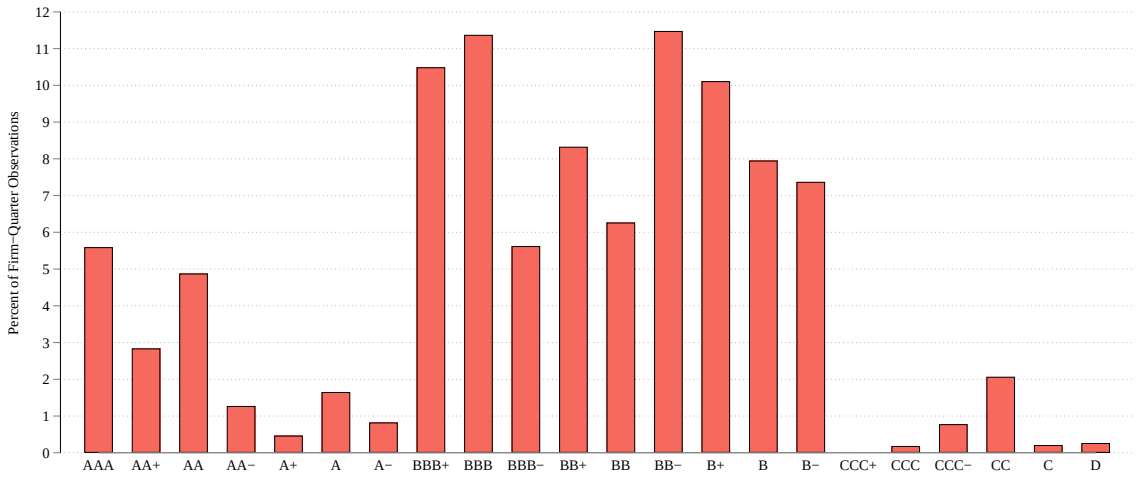


Figure 2.4. Distribution of corporate credit rating

Fig. 2.4 plots the distribution of corporate credit rating only for rated firms that have S&P long-term credit rating. No. of observations for rated firms: 31,515.

2.6 Empirical results on unrated status and leverage puzzle

In this section, I examine the debt structures of unrated firms. Overall, the empirical results are displayed in Tables 2.5, 2.6, and 2.7, which show that all counterfactual hypotheses, H_0^xs, are rejected. Namely, all non-counterfactual hypotheses, H_1^xs, agree with the data, i.e., these hypotheses are not rejected (they are 'accepted'). A detailed discussion that goes through these results and tables is presented as follows.

Following Schwert (2018), an unrated firm is defined as the firm that does not obtain a long-term issuer rating from Standard and Poor's (S&P). A firm's state of unrated status may change overtime and is denoted by a *time-varying* indicator $Unrated_{f,t} = 1$. Schwert (2018) reveals that unrated firms borrow heavily from well-capitalized banks. Given the importance of unrated status in the corporate decisions of debt issuance, I further study whether unrated status contributes to the leverage puzzle and how does unrated status affect the leverage puzzle through affecting different components of corporate debt.

To begin with, I examine the relationship between the leverage, which is defined as a firm's total debt divided by its total book asset, and the profit. Hypothesis H_1^1 states that given Hypothesis c.0 (the puzzle), $\beta_2 < 0$, there is a positive relationship, $\beta_3 > 0$, between profitability and leverage for the unrated firms. Table 2.5 shows that Hypothesis 1, H_1^1, agrees with the results.

Column (1) of Table 2.5 displays that there is a significant negative relationship, $\beta_2 = -0.064 < 0$, between profitability and leverage, which reflects the leverage puzzle in two aspects: (1) The firms with high profits take small leverage positions; (2) The firms whose profits decrease take large leverages.

I am interested in whether the leverage puzzle is affected by unrated status. In Column (2) of Table 2.5, I add the item of unrated status indicator $Unrated_{f,t}$ and the interaction item between profitability and unrated status.

Hypothesis H_1^1 suggests that when the unrated firms produce more profits, they can borrow more amounts of debt to raise their leverages. This hypothesis is in agreement with the result of Column (2) of Table 2.5. Namely, unrated status *attenuates* (i.e.,

weaken the effect) the negative ($\beta_2 = -0.239 < 0$) relationship between the unrated firms' profits and leverages by increasing ($\beta_3 = 0.175 > 0$) their leverages when these firms' profits are high, although in general they reduce ($\beta_1 = -0.112 < 0$) leverages due to their lack of credit rating.

Next, I study the effects of unrated status on two components of the leverage, i.e., the total bank debt divided by the total asset and the total public debt divided by the total asset. In this way, I reveal how unrated status impacts the leverage through the two components.

Columns (3) and (5) of Table 2.5 exhibit that the leverage puzzle exists in both bank debt and public debt components as the relationships between the profits and the two components of the leverage are negative at $\beta_2 = -0.040$ and $\beta_2 = -0.047$ respectively.

Hypothesis H_1^2 states that given Hypothesis c.7, $\beta_2 < 0$, the relationship between profitability and total bank debt, β_2, is insignificant when the moderation effect of the unrated status of firms is considered. This hypothesis agrees with the detailed results in Table 2.5. In Table 2.5 I find that the previous negative relationship between bank debt and profitability in Column (3) turns insignificant in Column (4) when I consider the unrated status as well as the interaction item between profitability and unrated status (the moderation effect). Namely, the part of the leverage puzzle about bank debt vanishes when I consider unrated status because unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt.

Column (6) of Table 2.5 shows that unrated status weakens the negative ($\beta_2 = -0.263 < 0$) relationship between the unrated firms' profits and public debt by increasing ($\beta_3 = 0.216 > 0$) their public debt when these firms' profits are high, although in general they reduce ($\beta_1 = -0.116 < 0$) their public debt due to their lack of credit rating.

Then, I investigate six types of specific debt to provide details on how does the debt structure contribute to the leverage puzzle under the effect of unrated status. Without unrated status, Table 2.6 decomposes the leverage to six types of specific debt and examines whether the leverage puzzle exists in all types of debt. It shows that except commercial papers, all other five types of debt show negative relationships with profits, where the effects of profitability on term loans and bonds are the largest

(-0.037 and -0.044 respectively) at the 99% significant level. To investigate whether unrated status attenuates the negative relationship between the unrated firms' profits and different types of debt, Table 2.7 includes the unrated dummy and its interaction with profitability.

Hypothesis H_1^3 states that given Hypothesis c.1, $\beta_2 < 0$, there is a positive relationship, $\beta_3 > 0$, between profitability and revolving credit for the unrated firms. This hypothesis agrees with the detailed results in Table 2.7. Hypothesis H_1^3 suggests that when the unrated firms produce more profits, they can raise their revolving credit from banks. This hypothesis is in agreement with Column (1) of Table 2.7. Namely, unrated status attenuates the negative ($\beta_2 = -0.055 < 0$) relationship between the unrated firms' profits and revolving credit by increasing ($\beta_3 = 0.05 > 0$) their revolving credit from banks when the firms' profits are high, and in general they raise ($\beta_1 = 0.02 > 0$) revolving credit.

Hypothesis H_1^4 states that given Hypothesis c.2, $\beta_2 < 0$, there is a negative relationship, $\beta_3 < 0$, between profitability and term loans for the unrated firms. This hypothesis agrees with the detailed results in Table 2.7. Hypothesis H_1^4 together with Hypothesis H_1^3 suggest that the unrated firms reduce the holdings of term loans ($\beta_1 = -0.02$ and $\beta_3 = -0.058$ in Column (2) of Table 2.7) while they raise revolving credits ($\beta_1 = 0.02$ and $\beta_3 = 0.05$ in Column (1)). The reason is that revolving credit is often borrowed by firms for funding short-term operations while term loans are usually taken for long terms. Revolving credit can be drawn and repaid a few times over the life of its horizon, which can be viewed as several short-term borrowings. By contrast, term loans are drawn fully at origination and can be prepaid before maturity, but cannot be redrawn after repayment, which are usually long-term loans.

Besides, the unrated firms are less creditworthy and do not have long-term credit ratings. Hence, they have to switch to revolving credit from term loans. The correlation between the revolving credit and the term loan is significantly negative at -0.04 as displayed in Table 2.A.2. Similarly, Schwert (2018) shows that as predicted by the financial commitment hypothesis, unrated firms prefer revolving credit to term loans because there is no commitment element in term loans. As a result, the opposite forces of revolving credit and term loans offset each other and therefore the relationship between profitability and total bank debt, which comprises revolving credit and term

loans, turns insignificant when the unrated status of firms is considered, as stated by Hypothesis H_1^2.

Hypothesis H_1^5 states that given Hypothesis c.4 or c.8, $\beta_2 < 0$, there is a positive relationship, $\beta_3 > 0$, between profitability and bonds and notes/public debt for the unrated firms. The part of the hypothesis about bonds and notes agrees with Column (4) of Table 2.7 and the part about public debt is approved in Column (6) of Table 2.5 discussed above. For instance, Hypothesis H_1^5 suggests that when the unrated firms produce more profits, they can raise their bonds and notes from the public market. Namely, unrated status attenuates the negative ($\beta_2 = -0.257 < 0$) relationship between the unrated firms' profits and bonds and notes by increasing ($\beta_3 = 0.213 > 0$) their bonds and notes when the firms' profits are high, although in general they reduce ($\beta_1 = -0.119 < 0$) bonds and notes due to the lack of credit rating.

Hypothesis H_1^6 states that given Hypothesis c.2 or c.3 or c.5 or c.6, $\beta_2 < 0$, the relationship between profitability and term loans/commercial papers/capital leases/other borrowings, β_2, is insignificant when the unrated status of firms is considered. This hypothesis agrees with the detailed results in Table 2.7. Indeed, Hypothesis H_1^6 suggests that the part of the leverage puzzle that the negative relationship between profitability and term loans/commercial papers/capital leases/other borrowings turns insignificant, the β_2s in Columns (2), (3), (5), and (6) of Table 2.7, when I consider unrated status as well as the interaction item between profitability and unrated status. Namely, the parts of the leverage puzzle about these types of debt vanish when I consider unrated status because unrated status fully attenuate these parts of the leverage. In other words, these types of debt do not contribute to the leverage puzzle and therefore the puzzle of the negative relationship between profits and leverages does not exist in these types of debt.

In short, I conclude that the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, but unrated status weakens the puzzle as the unrated firms raise the two types of debt when they make profits.

Table 2.5. Debt analysis using the unrated dummy for three types of total debt

Notes: The dependent variable is the ratio of the amount of total/bank/public debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Bank Debt	Bank Debt	Public Debt	Public Debt
Unrated	-0.107***	-0.112***	-0.001	-0.001	-0.110***	-0.116***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
Profit	-0.064***	-0.239***	-0.040***	-0.035	-0.047***	-0.263***
	(0.003)	(0.056)	(0.003)	(0.030)	(0.003)	(0.055)
Unrated×Profit		0.175***		-0.005		0.216***
		(0.056)		(0.030)		(0.055)
Cash	-0.050***	-0.050***	-0.019**	-0.019**	-0.038***	-0.038***
	(0.012)	(0.012)	(0.009)	(0.009)	(0.012)	(0.012)
Size	-0.010***	-0.010***	-0.007***	-0.007***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tangible	0.037***	0.037***	0.016	0.016	0.032***	0.031***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
MV/BV	-0.000**	-0.000**	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangible	0.035***	0.035***	0.021*	0.021*	0.020	0.020
	(0.014)	(0.014)	(0.011)	(0.011)	(0.013)	(0.013)
Investment	-0.045	-0.045	-0.004	-0.004	-0.034	-0.034
	(0.028)	(0.028)	(0.024)	(0.024)	(0.025)	(0.025)
Tax	-0.760***	-0.733***	-0.189**	-0.189**	-0.536***	-0.502***
	(0.119)	(0.118)	(0.095)	(0.095)	(0.105)	(0.104)
Log(Age)	0.017***	0.017***	0.011***	0.011***	0.010***	0.010***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)
Net Debt Issue	0.121***	0.121***	0.070***	0.070***	0.091***	0.091***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.011)	(0.011)
Net Equity Issue	-0.036***	-0.036***	-0.008	-0.008	-0.036***	-0.036***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Earnings Volatility	0.017***	0.017***	0.006	0.006	0.025***	0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Share Repurchase	0.062	0.068	-0.067	-0.067	0.114**	0.122**
	(0.058)	(0.058)	(0.044)	(0.044)	(0.057)	(0.057)
Constant	0.399***	0.404***	0.142***	0.142***	0.269***	0.275***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.720	0.720	0.658	0.658	0.702	0.702

Table 2.6. Debt analysis without the unrated dummy for six types of debt

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Profit	-0.005***	-0.037***	-0.000	-0.044***	-0.001*	-0.008***
	(0.001)	(0.003)	(0.000)	(0.003)	(0.000)	(0.001)
Cash	-0.019***	-0.006	0.000	-0.035***	-0.005***	-0.004
	(0.005)	(0.009)	(0.000)	(0.012)	(0.002)	(0.005)
Size	-0.000	-0.006***	-0.000	-0.007***	0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Tangible	-0.005	0.022**	0.001*	0.030***	0.006***	-0.002
	(0.004)	(0.009)	(0.000)	(0.010)	(0.002)	(0.004)
MV/BV	0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangible	-0.004	0.026**	0.001**	0.035***	-0.004***	-0.008*
	(0.005)	(0.011)	(0.001)	(0.013)	(0.001)	(0.004)
Investment	-0.004	-0.009	0.001	-0.015	-0.008	-0.003
	(0.011)	(0.023)	(0.001)	(0.024)	(0.005)	(0.011)
R&D Expense	0.014	0.141***	0.000	0.016	0.004	0.037
	(0.023)	(0.045)	(0.001)	(0.052)	(0.010)	(0.027)
Tax	-0.025	-0.135*	-0.013	-0.573***	0.005	-0.011
	(0.064)	(0.081)	(0.008)	(0.108)	(0.012)	(0.037)
Log(Age)	0.003***	0.007***	-0.000	0.005***	-0.000*	0.004***
	(0.001)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)
Net Debt Issue	0.008*	0.066***	0.000**	0.088***	0.002	0.009*
	(0.004)	(0.010)	(0.000)	(0.011)	(0.002)	(0.005)
Net Equity Issue	0.003	-0.012*	-0.000	-0.033***	0.002**	-0.006*
	(0.003)	(0.007)	(0.000)	(0.008)	(0.001)	(0.004)
Earnings Volatility	0.002	0.006	-0.000	0.025***	-0.000	0.004
	(0.002)	(0.005)	(0.000)	(0.005)	(0.001)	(0.003)
Share Repurchase	0.115***	-0.178***	0.027***	0.105*	0.001	-0.038*
	(0.029)	(0.040)	(0.006)	(0.059)	(0.006)	(0.021)
Constant	0.045***	0.097***	0.001***	0.168***	0.008***	0.010***
	(0.001)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.602	0.654	0.460	0.692	0.612	0.493

Table 2.7. Debt analysis using the unrated dummy for six types of debt

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Unrated Status	0.020***	-0.020***	-0.000	-0.119***	0.000	0.003*
	(0.003)	(0.005)	(0.000)	(0.007)	(0.001)	(0.002)
Profit	-0.055**	0.020	0.001	-0.257***	0.002	-0.007
	(0.024)	(0.025)	(0.002)	(0.054)	(0.002)	(0.008)
Unrated×Profit	0.050**	-0.058**	-0.001	0.213***	-0.002	-0.001
	(0.024)	(0.025)	(0.002)	(0.055)	(0.002)	(0.008)
Cash	-0.020***	-0.006	0.000	-0.033***	-0.005***	-0.004
	(0.005)	(0.009)	(0.000)	(0.012)	(0.002)	(0.005)
Size	-0.000	-0.006***	-0.000	-0.008***	0.000	0.000
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Tangible	-0.004	0.021**	0.001*	0.027***	0.006***	-0.002
	(0.004)	(0.009)	(0.000)	(0.010)	(0.002)	(0.004)
MV/BV	0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Intangible	-0.003	0.025**	0.001**	0.028**	-0.004***	-0.008*
	(0.005)	(0.011)	(0.001)	(0.013)	(0.001)	(0.004)
Investment	-0.004	-0.009	0.001	-0.019	-0.008	-0.003
	(0.011)	(0.023)	(0.001)	(0.024)	(0.005)	(0.011)
R&D Expense	0.013	0.142***	0.000	0.022	0.004	0.037
	(0.023)	(0.045)	(0.001)	(0.052)	(0.010)	(0.027)
Tax	-0.030	-0.131	-0.013	-0.472***	0.005	-0.012
	(0.064)	(0.080)	(0.008)	(0.104)	(0.012)	(0.037)
Log(Age)	0.003***	0.008***	-0.000	0.006***	-0.000*	0.004***
	(0.001)	(0.001)	(0.000)	(0.002)	(0.000)	(0.001)
Net Debt Issue	0.008*	0.065***	0.000**	0.087***	0.002	0.009*
	(0.004)	(0.010)	(0.000)	(0.011)	(0.002)	(0.005)
Net Equity Issue	0.004	-0.012*	-0.000	-0.034***	0.002**	-0.006*
	(0.003)	(0.007)	(0.000)	(0.008)	(0.001)	(0.004)
Earnings Volatility	0.002	0.006	-0.000	0.024***	-0.000	0.004
	(0.002)	(0.005)	(0.000)	(0.005)	(0.001)	(0.003)
Share Repurchase	0.115***	-0.178***	0.027***	0.122**	0.001	-0.039*
	(0.028)	(0.040)	(0.006)	(0.058)	(0.006)	(0.021)
Constant	0.030***	0.112***	0.001***	0.261***	0.007***	0.008***
	(0.002)	(0.004)	(0.000)	(0.006)	(0.001)	(0.001)
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.603	0.654	0.460	0.696	0.612	0.493

2.7 Robustness analyses

In this section, I run a series of analyses and show that the findings are robust to the monetary policy after the 2008 financial crisis, product market competition in the industry, and the credit supplies of banks in the economy.

2.7.1 Robustness analysis on monetary policy

To mitigate the devastative effects of the 2008 financial crisis, central banks adopted the monetary policy of quantitative easing to purchase corporate bonds. Grosse-Rueschkamp et al. (2019) find that the purchases of corporate bonds reduce the yields of these firms' bonds and therefore the firms substitute term loans from banks with bonds from the public market. To examine the robustness of the results of the monetary policy of quantitative easing during the 2008 financial crisis, I run the regressions of unrated status for the pre-2008 and the post-2008 period separately.

Table 2.8 analyzes the effect of unrated status on firms' leverages (total debt) and the two components of total debt, bank debt and public debt using the sub-sample before the last quarter of 2008 inclusive. Table 2.9 reports the effect of unrated status for the sub-sample after the last quarter of 2008. Comparing with Table 2.5, Tables 2.8 and 2.9 confirm that the findings about the effects of unrated status on the leverage puzzle are robust to the monetary policy of quantitative easing.

The columns (1) and (2) of Tables 2.8 and 2.9 show given the leverage puzzle of the negative relationship between profitability and leverage, the positive relationship between profitability and leverage for the unrated firms attenuates the negative relationship as the unrated firms increase their leverages when they have high profits.

Both bank debt and public debt components of leverage contribute to the leverage puzzle (the columns (3) and (5) of Tables 2.8 and 2.9), but unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt as the negative relationship between bank debt and profitability turns insignificant (the column (4) of Tables 2.8 and 2.9). Meanwhile, the part of the leverage puzzle between profitability and public debt is attenuated by unrated status as well (the column (6) of Tables 2.8 and 2.9), although the puzzle is not fully attenuated as the case of bank debt.

Table 2.10 and Table 2.11 analyze the effect of unrated status on firms' debt struc-

tures using two sub-samples that are split by the last quarter of 2008. Comparing with Table 2.7, Table 2.10 and Table 2.11 demonstrate the robustness of the conclusions on the sources of the leverage puzzle in terms of the corporate debt structure, which is affected by unrated status under the periods with different monetary policies.

The robustness results show that unrated status attenuates the leverage puzzle since when the unrated firms without long-term credit ratings make profits, they increase revolving credit from banks (the column (1) of Table 2.10 and Table 2.11) for funding short-term operations and meanwhile they reduce their term loans (the column (2) of Table 2.10 and Table 2.11), which are usually borrowed for long terms.

The column (4) of Table 2.10 and Table 2.11 confirm the finding that unrated firms with more profits raise their bonds and notes from the public market. Meanwhile, Columns (3), (5), and (6) do not show any significant relationships between profits and commercial papers, capital leases, and other borrowings, as shown by Table 2.7.

In addition, comparing the column (6) of Tables 2.8 and 2.9 reveals that when unrated firms make profits, they increase public debt more after 2008. The coefficient β_3 rises up to 0.213 in Table 2.9 (post-2008) from 0.15 in Table 2.8. The rise in the β_3s of public debt reflects the finding in Grosse-Rueschkamp et al. (2019) find that firms issue more bonds to the public market after 2008 because the monetary policy that purchases corporate bonds reduced the bond yields and the firms' financing costs.

Furthermore, the result complements the results of Grosse-Rueschkamp et al. (2019) by revealing that unrated firms with profits issue more bonds and notes but do not increase other types of public debt like commercial papers, capital leases, and other borrowings.

To sum up, the robustness analysis distinguishing the periods before/after 2008 shows the robustness of the finding that the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with profits increase the two types of debt.

Table 2.8. Debt analysis using the unrated dummy for total debt (pre-2008)

Notes: The dependent variable is the ratio of the amount of total/bank/public debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Bank Debt	Bank Debt	Public Debt	Public Debt
Unrated	-0.091***	-0.097***	-0.015*	-0.016*	-0.078***	-0.082***
	(0.010)	(0.010)	(0.008)	(0.008)	(0.009)	(0.009)
Profit	-0.070***	-0.313***	-0.032***	-0.068	-0.058***	-0.208***
	(0.005)	(0.063)	(0.006)	(0.056)	(0.006)	(0.061)
Unrated×Profit		0.243***		0.035		0.150**
		(0.063)		(0.056)		(0.061)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	38,448	38,448	38,448	38,448	38,448	38,448
R-squared	0.781	0.781	0.690	0.690	0.769	0.769

Table 2.9. Debt analysis using the unrated dummy for total debt (post-2008)

Notes: The dependent variable is the ratio of the amount of total/bank/public debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Bank Debt	Bank Debt	Public Debt	Public Debt
Unrated	-0.097***	-0.100***	0.003	0.002	-0.099***	-0.105***
	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)
Profit	-0.060***	-0.224***	-0.040***	-0.050	-0.043***	-0.256***
	(0.003)	(0.077)	(0.004)	(0.036)	(0.004)	(0.083)
Unrated×Profit		0.164**		0.011		0.213**
		(0.077)		(0.036)		(0.083)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	86,556	86,556	86,556	86,556	86,556	86,556
R-squared	0.765	0.765	0.713	0.713	0.754	0.754

Table 2.10. Debt analysis using the unrated dummy for debt structure (pre-2008)

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Unrated Status	0.015***	-0.031***	-0.000	-0.084***	0.001	0.001
	(0.004)	(0.008)	(0.001)	(0.009)	(0.001)	(0.003)
Profit	-0.111***	0.038	0.002	-0.194***	0.005	-0.018
	(0.032)	(0.048)	(0.005)	(0.059)	(0.006)	(0.029)
Unrated×Profit	0.102***	-0.064	-0.002	0.141**	-0.006	0.004
	(0.032)	(0.048)	(0.005)	(0.059)	(0.006)	(0.029)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	38,448	38,448	38,448	38,448	38,448	38,448
R-squared	0.646	0.663	0.610	0.754	0.681	0.563

Table 2.11. Debt analysis using the unrated dummy for debt structure (post-2008)

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Unrated Status	0.024***	-0.021***	0.000	-0.107***	-0.000	0.002
	(0.004)	(0.008)	(0.000)	(0.009)	(0.001)	(0.002)
Profit	-0.052	0.003	-0.000	-0.253***	0.002	-0.002
	(0.034)	(0.027)	(0.001)	(0.083)	(0.001)	(0.003)
Unrated×Profit	0.048	-0.041	0.000	0.214***	-0.002	-0.003
	(0.034)	(0.027)	(0.001)	(0.083)	(0.001)	(0.003)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	86,556	86,556	86,556	86,556	86,556	86,556
R-squared	0.682	0.709	0.490	0.754	0.702	0.581

2.7.2 Robustness analysis of total debt on competition and credit supplies

I examine whether the findings about the effect of unrated status on the leverage (total debt) and its two components (bank debt and public debt) are robust to product market competition in the industry and the credit supplies of banks in the economy.

Bharath and Hertzel (2019) illustrate that a more competitive product market that imposes external pressure to firms makes the firms reduce the external pressure of monitoring from debt holders by reducing debt. The variable *Competition* is one for the firms below the median value of HHI, which are in a more competitive product market. Santos and Winton (2019) discover that banks play an important role in firms' preferences of debt. Following Becker and Ivashina (2014), I use the *aggregate lending growth* of banks as the proxies of aggregate banks' *Credit Supply*, which is measured as a four-quarter rolling-window growth in nonfarm, nonfinancial corporate bank loans obtained from U.S. Flow of Funds Accounts.

In Tables 2.12, 2.13, and 2.14 for the leverages, bank debt, and public debt, I add one of the two variables, *Competition* and *Credit Supply* in Columns (1) and (2) respectively. Then I add their interactions with profitability in Columns (3) and (4) respectively. Finally, I add triple interaction terms between one of the two variables, profitability, and unrated status in Table 2.15. The results confirms that the findings on unrated status and the leverage are robust.

First, all positive β_3 coefficients in Tables 2.12 show that given the leverage puzzle of the negative relationship between profitability and leverage, the positive relationship between profitability and leverage for the unrated firms attenuates the negative relationship as the unrated firms increase their leverages when they have high profits. Second, Table 2.13 implies that unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt as all β_2s coefficients are insignificant. Third, Table 2.14 displays that the part of the leverage puzzle between profitability and public debt is attenuated by unrated status. Finally, Table 2.15 confirms the findings about the leverage (Columns (1) and (2)), bank debt (Columns (3) and (4)), and public debt (Columns (5) and (6)) for unrated firms after adding triple interaction terms between *Competition* or *Credit Supply*, profitability, and unrated status.

Table 2.12. Robustness analysis of the unrated dummy affecting leverage under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
	Leverage	Leverage	Leverage	Leverage
Unrated Status	-0.112***	-0.112***	-0.112***	-0.112***
	(0.007)	(0.007)	(0.007)	(0.007)
Profit	-0.239***	-0.239***	-0.228***	-0.240***
	(0.056)	(0.056)	(0.057)	(0.056)
Unrated×Profit	0.175***	0.176***	0.174***	0.176***
	(0.056)	(0.056)	(0.057)	(0.056)
Competition	0.006*		0.005	
	(0.003)		(0.003)	
Competition×Profit			-0.015***	
			(0.005)	
Credit Supply		0.029**		0.033**
		(0.013)		(0.013)
Credit Supply×Profit				0.033
				(0.023)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.720	0.720	0.720	0.720

Table 2.13. Robustness analysis of the unrated dummy affecting bank debt under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
	Bank Debt	Bank Debt	Bank Debt	Bank Debt
Unrated Status	-0.001	-0.001	-0.001	-0.001
	(0.006)	(0.006)	(0.006)	(0.006)
Profit	-0.036	-0.036	-0.036	-0.037
	(0.030)	(0.030)	(0.030)	(0.030)
Unrated×Profit	-0.004	-0.004	-0.004	-0.004
	(0.030)	(0.030)	(0.030)	(0.030)
Competition	0.004		0.004	
	(0.003)		(0.003)	
Competition×Profit			0.000	
			(0.006)	
Credit Supply		0.001		0.006
		(0.012)		(0.012)
Credit Supply×Profit				0.043
				(0.028)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.658	0.658	0.658	0.658

Table 2.14. Robustness analysis of the unrated dummy affecting public debt under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
	Public Debt	Public Debt	Public Debt	Public Debt
Unrated Status	-0.116***	-0.116***	-0.116***	-0.116***
	(0.007)	(0.007)	(0.007)	(0.007)
Profit	-0.263***	-0.263***	-0.250***	-0.263***
	(0.055)	(0.055)	(0.056)	(0.055)
Unrated×Profit	0.216***	0.216***	0.214***	0.216***
	(0.055)	(0.055)	(0.056)	(0.055)
Competition	0.004		0.002	
	(0.003)		(0.003)	
Competition×Profit			-0.019***	
			(0.006)	
Credit Supply		0.021*		0.020
		(0.012)		(0.012)
Credit Supply×Profit				-0.008
				(0.029)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.702	0.702	0.702	0.702

Table 2.15. Robustness analysis of the unrated dummy affecting three total debt under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Bank Debt	Bank Debt	Public Debt	Public Debt
Unrated Status	-0.111***	-0.112***	-0.001	-0.001	-0.116***	-0.116***
	(0.007)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)
Profit	-0.193***	-0.231***	-0.037	-0.031	-0.230***	-0.258***
	(0.055)	(0.056)	(0.064)	(0.031)	(0.049)	(0.055)
Unrated×Profit	0.139**	0.167***	-0.003	-0.010	0.194***	0.212***
	(0.055)	(0.057)	(0.064)	(0.031)	(0.050)	(0.055)
Competition	0.005		0.004		0.002	
	(0.003)		(0.003)		(0.003)	
	(0.085)		(0.067)		(0.082)	
Unrated×Profit×Competition	-0.015***		0.000		-0.019***	
	(0.005)		(0.006)		(0.006)	
Credit Supply		0.038***		0.009		0.022*
		(0.014)		(0.012)		(0.013)
		(0.359)		(0.286)		(0.365)
Unrated×Profit×Credit Supply		0.035		0.044		-0.007
		(0.024)		(0.028)		(0.029)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.720	0.720	0.658	0.658	0.702	0.702

2.7.3 Robustness analyses of debt structure on competition and credit supplies

I examine the robustness of the findings about the effect of unrated status on the corporate debt structure under different situations of product market competition in the industry and the credit supplies of banks in the economy.

The finding reveals that revolving credit, term loans, as well as bonds and notes contribute to the leverage puzzle for unrated firms. I investigate the robustness of this findings in Tables 2.16, 2.17, and 2.18 respectively. In these tables, I first add one of the two variables, *Competition* and *Credit Supply* respectively. Then I add their interactions with profitability respectively. Finally, I add triple interaction terms between one of the two variables, profitability, and unrated status in Table 2.19 for revolving credit and term loans. Similarly, Table 2.20 compares revolving credit with bonds and notes under the effects of the triple interaction terms. The results confirm the robustness of the findings on the effect of unrated status on the three types of debt that contributes to the leverage puzzle.

The robustness results show that unrated status attenuates the leverage puzzle through the mechanism that the unrated firms without long-term credit ratings increase revolving credit from banks for funding short-term operations when they make profits, which is indicated by the β_3s in Tables 2.16 and Table 2.19 and Table 2.20. Meanwhile, these firms reduce their term loans (Tables 2.17 and Table 2.19), which are usually for long terms, since they do not have long-term credit ratings. Besides, Table 2.18 and Table 2.20 confirm the robustness of the finding that unrated firms raise their bonds and notes from the public market when their profits increase.

In brief, the robustness analyses demonstrate the robustness of the finding that the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with profits increase the two types of debt.

Table 2.16. Robustness analysis of the unrated dummy affecting revolving credit under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	R. Credit	R. Credit	R. Credit	R. Credit	R. Credit
Unrated	0.0197***	0.0197***	0.0194***	0.0197***	0.0197***
	(0.00291)	(0.00291)	(0.00292)	(0.00291)	(0.00291)
Profit	-0.0553**	-0.0541**	-0.0490*	-0.0552**	-0.0552**
	(0.0238)	(0.0238)	(0.0297)	(0.0238)	(0.0241)
Unrated × Profit	0.0501**	0.0516**	0.0464	0.0499**	0.0499**
	(0.0239)	(0.0239)	(0.0298)	(0.0239)	(0.0241)
Competition		-0.000984	-0.000783		
		(0.00144)	(0.00155)		
Competition × Profit		-0.00359	-0.0227		
		(0.00265)	(0.0347)		
Unrated × Competition × Profit			0.0192		
			(0.0347)		
Credit Supply				-0.00960*	-0.00962
				(0.00578)	(0.00673)
Credit Supply × Profit				0.00539	0.00733
				(0.0132)	(0.219)
Unrated × Credit Supply × Profit					-0.00195
					(0.221)
Corporate Controls	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004
R-squared	0.603	0.603	0.603	0.603	0.603

Table 2.17. Robustness analysis of the unrated dummy affecting term loans under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
VARIABLES	Term Loan	Term Loan	Term Loan	Term Loan
Unrated Status	-0.020***	-0.020***	-0.020***	-0.020***
	(0.005)	(0.005)	(0.005)	(0.005)
Profit	0.020	0.020	0.020	0.020
	(0.025)	(0.025)	(0.025)	(0.025)
Unrated×Profit	-0.058**	-0.058**	-0.058**	-0.058**
	(0.025)	(0.025)	(0.025)	(0.025)
Competition	0.002		0.002	
	(0.002)		(0.002)	
Credit Supply		0.000		0.006
		(0.011)		(0.010)
Competition×Profit			0.001	
			(0.006)	
Credit Supply×Profit				0.044
				(0.027)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.654	0.654	0.654	0.654

Table 2.18. Robustness analysis of the unrated dummy affecting bonds and notes under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
VARIABLES	Bond	Bond	Bond	Bond
Unrated Status	-0.119***	-0.119***	-0.119***	-0.119***
	(0.007)	(0.007)	(0.007)	(0.007)
Profit	-0.257***	-0.257***	-0.248***	-0.257***
	(0.054)	(0.054)	(0.055)	(0.054)
Unrated×Profit	0.213***	0.214***	0.212***	0.214***
	(0.055)	(0.055)	(0.055)	(0.055)
Competition	0.003		0.001	
	(0.003)		(0.003)	
Credit Supply		0.026**		0.026**
		(0.012)		(0.012)
Competition×Profit			-0.013**	
			(0.006)	
Credit Supply×Profit				-0.003
				(0.029)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.696	0.696	0.696	0.696

Table 2.19. Robustness analysis of the unrated dummy affecting revolving credit and term loans under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
	R. Credit	R. Credit	T. Loan	T. Loan
Unrated Status	0.019***	0.020***	-0.020***	-0.020***
	(0.003)	(0.003)	(0.005)	(0.005)
Profit	-0.102***	-0.058**	0.067	0.028
	(0.034)	(0.024)	(0.041)	(0.026)
Unrated×Profit	0.097***	0.052**	-0.105**	-0.066**
	(0.034)	(0.024)	(0.041)	(0.026)
Competition	0.001		0.003	
	(0.001)		(0.003)	
Unrated×Competition×Profit	-0.001		0.001	
	(0.003)		(0.006)	
Credit Supply		-0.004		0.010
		(0.007)		(0.011)
Unrated×Profit×Credit Supply		0.003		0.045*
		(0.009)		(0.028)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.603	0.603	0.654	0.654

Table 2.20. Robustness analysis of the unrated dummy affecting revolving credit and bonds under the effect of competition or credit supply

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)
	R. Credit	R. Credit	Bond	Bond
Unrated Status	0.019***	0.020***	-0.119***	-0.119***
	(0.003)	(0.003)	(0.007)	(0.007)
Profit	-0.102***	-0.058**	-0.208***	-0.251***
	(0.034)	(0.024)	(0.046)	(0.054)
Unrated×Profit	0.097***	0.052**	0.172***	0.207***
	(0.034)	(0.024)	(0.046)	(0.054)
Competition	0.001		0.002	
	(0.001)		(0.003)	
Unrated×Profit×Competition	-0.001		-0.013**	
	(0.003)		(0.006)	
Credit Supply		-0.004		0.029**
		(0.007)		(0.013)
Unrated×Profit×Credit Supply		0.003		-0.002
		(0.009)		(0.029)
Corporate Controls	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004
R-squared	0.603	0.603	0.696	0.696

2.7.4 Robustness analyses of continuous *Rating* variable, endogeneity, and IV

As a part of the robustness analyses, I also consider the empirical equations with the continuous variable *Rating* as follows.

$$Y_{f,i,t} = \beta_0 + \beta_1 Rating_{f,t} + \beta_2 Profit_{f,t} + \vec{\beta}^T \mathbf{X}_{f,t-1} + d_f + d_y + \varepsilon_{f,i,t}. \quad (2.2)$$

where Y in (2.2) can be one of $BL/BD/PD/RC/TL/BN/CP/CL/OB$, which denotes the ratio of the amount of one type of debt in the corporate debt structure, to the total asset. The continuous variable *Rating* is the log of the numerical value of S&P domestic long-term issuer credit rating. The vectors $\vec{\beta}$ and $\mathbf{X}_{t-1}$ capture the effects of other corporate variables and $\varepsilon_{f,i,t}$ is the unobservable random error or the disturbance term.

One of the essential assumptions for obtaining a consistent estimate of the parameter β_1 for $Rating_{f,t}$ in the regression equation (2.2) is that the disturbance term $\varepsilon_{f,i,t}$ is uncorrelated with the key explanatory variable $Rating_{f,t}$, i.e., $cov(Rating, \varepsilon) = 0$.

However, the violation of this assumption causes the inference problem of endogeneity. Generally, there are four reasons leading to an endogeneity problem of the key explanatory variable $Rating_{f,t}$: omitted variables, simultaneity, measurement errors, and the selection into sample and/or the selection of treatment (Roberts and Whited, 2013). The last two factors are not relevant here since I focus on the effect of credit rating directly from the S&P data without proxies and I examine the data during my sample period without specific selections. Hence, two particular sources introduce the endogeneity problem to my analysis: omitted variables and simultaneity.

First, omitted variables mean the variables that could affect the dependent variables of leverage and various debt ratios but are not included in the vector of explanatory variables for various reasons such as the difficulty in observation and/or quantification. For example, financing frictions such as asymmetric information and firms' stakeholders' incentive conflicts are important theoretical determinants of corporate financial policies. Nevertheless, it is difficult to observe and quantify these frictions. Likewise, corporate financial decisions consider both public and nonpublic information, which implies many unobservable factors determining corporate financial strategies. These omitted variables are included in the disturbance term ε and as a result, there is an en-

dogeneity problem when the omitted variables and the explanatory variable $Rating_{f,t}$ are correlated.

Second, simultaneity bias occurs when the debt ratios Y in the regression equation and the explanatory variable *Rating* are determined in equilibrium and therefore *Rating* can cause Y or Y can cause *Rating*. Indeed, the literature discussed in Section 2.2.4 describes empirical and theoretical findings on the corporate choices of credit ratings through corporate activities, which result in endogeneity problems. Namely, since Y causes *Rating*, both Y and ε correlate with *Rating* and then the endogeneity problem occurs, see a general discussion in Bascle (2008).

For the concern of the endogeneity issue of the continuous variable *Rating*, I carry out the standard single-equation instrumental-variable (IV) regression with the two-stage least squares (2SLS) estimator as one of the robustness tests. The previous studies on corporate debt, e.g., Lin et al. (2013), Waisman (2013) and Boubaker et al. (2018), use the key variable one period before their sample periods as the instrumental variable. Similarly, I use the log value of credit rating before the beginning of the sample period (the continuous variable *Rating01*) as the instrumental variable for the potential endogenous continuous variable *Rating*. It is feasible to use the historical measure of *Rating* to determine credit rating since it meets both the relevance and exclusion conditions. About the relevance condition, the measure *Rating01* is related to the current value of a firm's credit rating.

With regard to the exclusion criterion, it is reasonable to assume that the IV *Rating01*, which is the log value of credit rating one prior period outside the sample period of this study, is highly unlikely to be directly related to a firm's debt structure, unless through the channel of affecting the log value of the current credit rating of the firm. This assumption is similar to the previous literature in corporate finance (Lin et al., 2013; Waisman, 2013; Boubaker et al., 2018). Indeed, the values of the credit rating one period before the sample period affect leverage and other debt ratios only via their correlation with the current credit rating. Note that the IV *Rating01* is not the lagged values of the endogenous regressor, which might raise a concern about the endogeneity problem, see the critical discussions in Reed (2015), Bellemare et al. (2017), and Wang and Bellemare (2019). Hence, the above arguments conclude that the variable *Rating01* satisfies the necessary conditions for a valid instrument. Meanwhile, I examine typical

diagnostic tests for the validity of the instrumental-variable regression.

As the instrumental variable is the *Rating* before the sample period, I run the instrumental-variable regression with the *Rating* as the key independent variable that measures the credit rating. Since a higher numerical level of *Rating* implies a risky grade of rating that is closer to the unrated status, the signs of the regression coefficients of the *Rating* are expected to be the same as those of the *Unrated* dummy. The results show that the estimated coefficients of the key variable for credit rating are robust after using the IV regression that solves potential endogeneity issues. The first row of Table 2.21 lists the coefficients of *Rating* obtained from the instrumental-variable regression for debt analysis. Except for bank debt and term loans, the coefficients of *Rating* from the IV regression are at the same sign as the coefficients of *Rating* without the IV reported in Section 2.6.

Table 2.22 provides the results of the first-stage IV regression for the debt analysis, where the dependent variable is the *Rating*. In each column, I use the part of the data sample with non-missing values of a particular debt. For example, there are 120,296 observations of leverage in Column (1) and 85,118 observations of bank debt in Column (2) in Table 2.22. I use the 120,296 (resp. 85,118) observations to run the first-stage and second-stage IV regressions for the leverage (resp. bank debt). In this way, Table 2.22 shows the variation of the regression results for different types of debt. The coefficients of *Rating01* for all types of debt on the first row of Table 2.22 are above 0.56 and significantly different from 0 at the 1% level.

The last three rows in Table 2.22 exhibit three typical diagnostic tests for the validity of the instrumental-variable regression. First, under the null hypothesis of the endogeneity test that the endogenous regressor *Rating* can be treated as exogenous, the p-values of the test statistics for various types of debt data exhibit different conclusions. In Table 2.22, the endogeneity of *Rating* is significant at the 0.01 level in the data samples for public debt as well as bonds and notes. For leverage, the significance level is at 0.05. For bank debt, revolving credit, term loans, commercial papers, capital leases, and other borrowings, the null hypothesis of the exogenous *Rating* cannot be rejected.

The second last and the last rows in Table 2.22 reports the tests of underidentification and weak identification, which confirm the relevance of the *Rating01* to the

Rating in the sample. The underidentification test examines whether the regression equation is identified in terms of that the instrument variable *Rating01* is correlated with the endogenous regressor *Rating*. Under the null hypothesis that the equation is underidentified, the p-values for all types of debt (except commercial papers) are almost 0 and reject the null, which means the model is identified. The weak identification F-statistic values are all large in Table 2.22, which excludes the possibility that the instrument *Rating01* is only weakly correlated with the endogenous regressor *Rating*. Therefore, the IV estimator would not perform poorly, see, e.g., Stock and Yogo (2002, 2005) for further discussion.

Table 2.21. Debt analysis using the *Rating* variable - IV results

Notes. The dependent variable is the ratio of the various types of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Rating	-0.062***	0.024**	-0.076***	0.017**	0.015	-0.077***	-0.001	0.002	0.000
	(0.015)	(0.012)	(0.014)	(0.007)	(0.015)	(0.017)	(0.001)	(0.002)	(0.005)
Profit	-0.395***	-0.370***	-0.385***	-0.220***	-0.386***	-0.422***	-0.048	-0.052***	-0.268***
	(0.014)	(0.019)	(0.016)	(0.029)	(0.021)	(0.018)	(0.071)	(0.009)	(0.035)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120,296	85,118	95,754	47,683	62,977	73,450	4,389	41,383	27,469
Adjusted R^2	0.088	0.068	0.070	0.034	0.085	0.081	0.019	0.015	0.050

Table 2.22. Debt analysis using the *Rating* variable - the 1st stage of IV results

Notes. The dependent variable is the *Rating*. Each column uses the data with non-missing values of particular debt. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Rating	Rating	Rating	Rating	Rating	Rating	Rating	Rating	Rating
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Rating01 (IV)	0.611***	0.634***	0.601***	0.584***	0.694***	0.635***	1.063***	0.560***	0.774***
	(0.043)	(0.050)	(0.046)	(0.058)	(0.055)	(0.056)	(0.041)	(0.059)	(0.075)
Profit	0.046***	0.053***	0.040***	0.108***	0.030***	0.030***	-2.343**	0.056***	0.036
	(0.007)	(0.011)	(0.008)	(0.034)	(0.009)	(0.009)	(1.049)	(0.021)	(0.027)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120,296	85,118	95,754	47,683	62,977	73,450	4,389	41,383	27,469
Endogeneity p	0.0309	0.117	0.000816	0.727	0.220	0.00145	0.665	0.768	0.928
Underiden. p	0	0	0	0	1.33e-08	8.23e-10	0.314	1.59e-07	7.92e-05
Weak iden. F	203.5	160.4	167.2	101.5	157.4	129	689.1	91.42	107

2.7.5 Robustness analyses of dummy $Unrated$ variable with interaction, endogeneity, and IV

Another robustness analysis is to use the relevant dummy instrumental variable to solve the endogeneity problem of the dummy explanatory variable $Unrated$ and the interaction of $Unrated \times Profit$ in the regression equation (2.1). In this way, I can instrument/predict the status of an unrated company.

Similar to Section 2.7.4 and the discussion inside, for the concern of the endogeneity issue of the dummy variable $Unrated$, I carry out the 2SLS IV regression by using the dummy unrated status *Unrated01* one period before the beginning of the sample period as the instrumental variable. It is feasible to use the historical measure of *Unrated01* to determine the unrated status since it meets both the relevance and exclusion conditions according to similar discussions in Waisman (2013) and Boubaker et al. (2018). About the relevance condition, the measure *Rating01* is related to the current value of a firm's credit rating.

With regard to the exclusion criterion, it is reasonable to assume that the IV *Unrated01*, which is one prior period outside the sample period of this study, is highly unlikely to be directly related to a firm's debt structure, unless through the channel of affecting the current credit status of the firm. This assumption is similar to the previous literature in corporate finance (Lin et al., 2013; Waisman, 2013; Boubaker et al., 2018). The discussions about the empirical results in Tables 2.23 and 2.24 are similar to those for Tables 2.21 and 2.22 and therefore omitted.

Table 2.23. Debt analysis using the dummy *Unrated* variable - IV results

Notes. The dependent variable is the ratio of the various types of debt to the asset. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Unrated	-0.131***	0.058**	-0.162***	0.040***	0.038	-0.168***	-0.004	0.005	0.012
	(0.028)	(0.023)	(0.030)	(0.015)	(0.029)	(0.035)	(0.007)	(0.005)	(0.012)
Unrated×Profit	-0.015	-0.333***	-0.199*	-0.092	-0.474***	-0.264**	-0.003	-0.055***	-0.282***
	(0.114)	(0.097)	(0.118)	(0.101)	(0.144)	(0.121)	(0.213)	(0.017)	(0.084)
Profit	-0.381***	-0.048	-0.190*	-0.138	0.081	-0.166	-0.045	0.001	-0.001
	(0.111)	(0.093)	(0.115)	(0.087)	(0.141)	(0.116)	(0.081)	(0.014)	(0.074)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120,296	85,118	95,754	47,683	62,977	73,450	4,389	41,383	27,469
Adjusted R-squared	0.096	0.071	0.086	0.035	0.088	0.097	0.018	0.015	0.052

Table 2.24. Debt analysis using the dummy *Unrated* variable - the 1st stage of IV results

Notes. The dependent variable is the *Unrated*. Each column uses the data with non-missing values of particular debt. The fixed effects of firm and year are included. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Unrated	Unrated	Unrated	Unrated	Unrated	Unrated	Unrated	Unrated	Unrated
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Unrated01 (IV)	0.636***	0.646***	0.632***	0.586***	0.712***	0.645***	0.995***	0.621***	0.751***
	(0.041)	(0.046)	(0.044)	(0.051)	(0.052)	(0.051)	(0.014)	(0.058)	(0.068)
Profit	0.026***	0.031***	0.025***	0.067***	0.019***	0.021***	0.186	0.035***	0.034***
	(0.003)	(0.004)	(0.004)	(0.014)	(0.004)	(0.003)	(0.599)	(0.008)	(0.011)
Observations	120,296	85,118	95,754	47,683	62,977	73,450	4,389	41,383	27,469
Endogeneity p	0.168	0.137	0.0106	0.911	0.273	0.00794	0.317	0.687	0.761
Underiden. p	0	0	0	0	3.91e-09	0	0.314	2.94e-08	3.18e-06
Weak iden. F	122.2	98.90	101.5	66.81	92.68	79.01	10333	58.84	61.51

2.7.6 Robustness results using the Tobit model

The above empirical study relies on the panel data model considering the fixed effects of entities and time as the estimator. In this section, I use the Tobit model as an alternative to run the regression of the debt structure on profitability and the unrated status under the assumption that the support of the dependent variables is bounded.

Table 2.25 using the Tobit model shows the robustness of the aforementioned findings to the alternative estimator. First, the leverage puzzle for the unrated firms is significantly contributed by the revolving credit of bank debt as well as the bonds and notes of public debt, but unrated status weakens the puzzle since the unrated firms with high profits increase the two types of debt.

Second, the relationship between profitability and total bank debt is insignificant when the unrated status of firms is considered. Namely, the part of the leverage puzzle about bank debt vanishes when I consider unrated status because unrated status fully attenuates the part of the leverage puzzle between profitability and bank debt.

Third, the underlying reason is that the unrated firms are less creditworthy and do not have long-term credit ratings. Then, they have to switch to revolving credit from term loans. As a result, the opposite forces of revolving credit and term loans offset each other and therefore the relationship between profitability and total bank debt, which comprises revolving credit and term loans, turns insignificant when the unrated status of firms is considered.

Table 2.25. Debt analysis using the unrated dummy for the corporate debt structure using the Tobit model.

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1) Leverage	(2) Bank Debt	(3) Public Debt	(4) R. Credit	(5) T. Loan	(6) Bond	(7) Other
Unrated	-0.146***	0.0253***	-0.226***	0.0477***	-0.00765	-0.308***	-0.0983***
	(0.00733)	(0.00660)	(0.00746)	(0.00551)	(0.00886)	(0.00918)	(0.00788)
Profit	-0.294***	-0.0998*	-0.345***	-0.222***	0.233*	-0.472***	0.109
	(0.112)	(0.0574)	(0.107)	(0.0562)	(0.135)	(0.126)	(0.0769)
Unrated × Profit	0.154	0.0565	0.239**	0.242***	-0.286**	0.355***	-0.136*
	(0.113)	(0.0575)	(0.107)	(0.0564)	(0.135)	(0.126)	(0.0771)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004	125,004	125,004
Pseudo R^2	0.267	0.070	0.150	0.110	0.062	0.125	0.117

2.8 Conclusion

The chapter provides innovative explanations of the well-known leverage puzzle from the perspective of the debt structure and firms' rating status. The leverage puzzle means the negative relationship between profitability and leverage that is the total debt divided by book assets. In practice, the negative relationship is reported as either debt conservatism where high-profit firms hold low debt, or leverage ratchet where low-profit firms issue more amount of debt.

To explain the puzzle from a new perspective, I disassemble the leverage puzzle by investigating the fine details of the corporate debt structure affected by firms' rating status. Therefore, I examine the leverage puzzle through the interaction between firms' profits and unrated status due to the lack of long-term credit rating. Rating status matters since unrated firms without an S&P long-term issuer credit rating heavily depend on stable banks with large capital to obtain bank debt for smoothing adverse shocks, which significantly influences the debt structure and leverage puzzle.

The contribution of the chapter to the literature is to study the leverage puzzle through the fine details of debt structure. The literature in the leverage puzzle focuses on the leverage that is a measure of the corporate capital structure of equity and total debt, see, e.g., Lemmon et al. (2008), Strebulaev and Yang (2013), and Eckbo and Kisser (2020). The chapter is the first to reveal the underlying mechanism for explaining the leverage puzzle via the joint effects of the corporate debt structure and firms' unrated status under different firm characteristics.

The chapter analyzes the leverage puzzle through the innovative channel of six specific types of debt under the effects of unrated status. To do this, the chapter studies how unrated status influences the leverage puzzle of the relationships between the nine types of debt and profitability. Through the way of disassembling the leverage puzzle, the chapter answers firms' financing questions regarding the specific relationships between profitability and the firms' leverages and their debt structures. Hence, the new insight of the chapter is the identification of the firms' debt components that lead to the leverage puzzle. Namely, different types of debt play distinctive roles in the relationship between profitability and leverage. Some types of debt drive the observed and puzzling relations between firms' leverages and firms' profits while some types of

debt offset the leverage puzzle. Specifically, the leverage puzzle is significantly contributed by the revolving credit of bank debt as well as bonds and notes of public debt, nevertheless, the puzzle is weakened by unrated status as the two types of debt rise in the unrated firms with profits.

In conclusion, the first topic presents new insights into the leverage puzzle through the lens of debt structure and its interaction with unrated status. The results illustrate the details that firms take conservative levels of debt when their profits are large and address the importance of unrated status for firms' debt selections. Furthermore, I show that the findings are robust to the monetary policy during the 2008 financial crisis, the mechanism of external pressure caused by product market competition, and the mechanism of banks' credit supplies in the macroeconomics. Overall, the chapter can help firms and decision makers understand the leverage puzzle from the fine details of the corporate debt structure and firms' unrated status. Then unrated firms are able to choose appropriate debt issuances for financing capital under different economic situations of banks' credit supplies and monetary policy.

The limitation of this chapter is that the research is studied from the perspective of borrowing firms as the Capital IQ database only provides information about borrowers. The potential future research direction is to study the leverage puzzle through the effects of lenders' credit supplies on firms' debt structures. The challenge is to obtain related data about the lenders of the specific debt. The DealScan database records contract details about lenders but it only has information about bank loans and bonds instead of the full details of debt structure from Capital IQ. Alternatively, comprehensive texture analysis of company accounts might enrich the debt structure data with lenders' information. This research will provide more insightful interpretations of the leverage puzzle from the source of credit supplies and the debt structure.

2.A Additional results

This appendix collects additional results about the data or using different models.

Table 2.A.1. Summary statistics of debt and characteristics before winsorization

Notes. Table 2.A.1 displays the summary statistics of debt structure and firms' characteristics from the panel data merging Capital IQ Capital Structure - Debt and Compustat Fundamentals Quarterly. Missing values after matching the two databases by firms and quarters are filled by 0. The first six rows are the ratios of six types of specific debt values to the total value of assets. Other variables are defined in Section 2.4.

	mean	sd	min	p25	p50	p75	max	N
Revolving Credit	0.0979	3.107	0	0	0	0.0421	550	125,004
Term Loan	0.534	11.64	0	0	0.00129	0.118	1,527	125,004
Commercial Paper	0.00187	0.0626	0	0	0	0	11.48	125,004
Bond and Note	1.575	36.90	0	0	0.0390	0.237	5,319	125,004
Capital Lease	0.00879	0.107	0	0	0	0.00153	17.81	125,004
Other Borrowing	0.402	31.25	0	0	0	0	9,369	125,004
Log(Age)	2.029	1.756	0	0	2.565	3.912	4.205	125,004
Book Leverage	2.745	69.01	-0.0500	0.0988	0.260	0.486	18,116	125,004
Cash	0.116	0.206	-0.0461	0	0.0209	0.130	1	125,004
Earnings Volatility	0.650	46.44	0	0	0.00368	0.0156	13,903	125,004
Intangible	0.109	0.196	0	0	0	0.133	1	125,004
Investment	0.0256	0.268	-0.926	0	0.00277	0.0223	63.33	125,004
Net Debt Issue	0.0529	5.776	-548.6	-0.000338	0	0.00100	822.3	125,004
Net Equity Issue	0.0931	2.478	-38.46	0	0	0.000236	585.0	125,004
Profit	-0.685	32.55	-9,017	-0.0242	0.0181	0.0377	242.6	125,004
R&D Expense	0.175	35.35	-6.919	0	0	0.00116	8,825	125,004
Share Repurchase	0.00681	0.207	-0.000859	0	0	0	38.46	125,004
Size	2.879	3.534	-7.790	0	1.991	5.827	12.89	125,004
Tangible	0.194	0.274	0	0	0.0514	0.301	2.454	125,004
Tax	0.00132	0.0346	-7.217	0	0	0.00201	1.286	125,004
MV/BV	56.33	3,172	-1,698	0	0.903	1.732	982,769	125,004

Table 2.A.2. Correlation of debt structure and firms' characteristics

Notes. Table 2.A.2 displays the correlation of debt structure and firms' characteristics from the panel data merging Capital IQ Capital Structure - Debt and Compustat Fundamentals Quarterly. The definition of variables are given in Section 2.4. The symbol * means $p < 0.05$. Note that there is no multicollinearity issue among the variables. The correlation coefficients among some types of debt ratios and leverage are expected, e.g., loans and bonds as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

	RC	TL	CP	BN	CL	OB	BL	Prof	Cash	Size	Tan.	M/B	Intan	Inv	R&D	Tax	Age	D. Iss	E. Iss	Vol	Repu
RC	1.00																				
TL	-0.04*	1.00																			
CP	-0.03*	-0.01*	1.00																		
BN	-0.05*	0.04*	0.03*	1.00																	
CL	0.01*	-0.00	-0.02*	0.01*	1.00																
OB	-0.01*	0.02*	0.01*	0.04*	0.03*	1.00															
BL	0.22*	0.53*	0.02*	0.71*	0.10*	0.20*	1.00														
Prof	0.00	-0.24*	0.03*	-0.30*	0.01*	-0.11*	-0.32*	1.00													
Cash	-0.11*	0.05*	-0.03*	0.04*	-0.02*	-0.00	-0.00	-0.18*	1.00												
Size	-0.01*	-0.13*	0.12*	-0.11*	-0.01	-0.01*	-0.12*	0.30*	0.05*	1.00											
Tan.	0.04*	0.05*	0.01*	-0.01*	0.05*	0.00	0.05*	0.06*	-0.05*	0.43*	1.00										
M/B	-0.01*	0.21*	-0.02*	0.22*	-0.02*	0.07*	0.24*	-0.52*	0.26*	-0.27*	-0.02*	1.00									
Intan.	-0.03*	0.03*	0.04*	0.04*	-0.04*	-0.02*	0.05*	0.08*	-0.02*	0.43*	-0.07*	-0.02*	1.00								
Inv.	0.02*	0.01*	0.00	-0.02*	0.01*	-0.01*	0.00	0.04*	0.04*	0.28*	0.56*	0.00	-0.03*	1.00							
R&D	-0.05*	0.07*	-0.01*	0.10*	0.02*	0.04*	0.08*	-0.17*	0.42*	-0.08*	-0.07*	0.18*	0.04*	0.00	1.00						
Tax	-0.01*	-0.07*	0.06*	-0.06*	-0.01*	0.00	-0.09*	0.07*	0.04*	0.29*	0.07*	-0.03*	0.11*	0.08*	-0.04*	1.00					
Age	-0.02*	0.06*	0.04*	0.08*	-0.01*	0.03*	0.08*	-0.06*	0.30*	0.49*	0.50*	0.18*	0.33*	0.29*	0.15*	0.17*	1.00				
D. Iss	0.00	0.20*	-0.01*	0.23*	0.00	0.08*	0.25*	-0.37*	0.18*	-0.19*	0.00	0.49*	-0.01*	0.03*	0.15*	-0.04*	0.14*	1.00			
E. Iss	-0.04*	0.09*	-0.03*	0.10*	0.00	0.00	0.09*	-0.24*	0.36*	-0.17*	0.00	0.27*	-0.03*	0.09*	0.34*	-0.08*	0.14*	0.09*	1.00		
Vol	-0.01*	0.20*	-0.02*	0.24*	-0.02*	0.08*	0.24*	-0.53*	0.27*	-0.27*	-0.00	0.64*	-0.04*	0.02*	0.18*	-0.05*	0.18*	0.47*	0.31*	1.00	
Repu.	-0.00	-0.07*	0.09*	-0.01*	-0.02*	0.00	-0.05*	0.05*	0.07*	0.29*	0.04*	-0.02*	0.16*	0.07*	-0.01*	0.28*	0.17*	-0.01*	-0.10*	-0.03*	1.00

Table 2.A.3. Debt analysis for total debt with the OLS vs FE methods

Notes: The dependent variable is the ratio of the amount of total/bank/public debt to the asset. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	Leverage	Leverage	Bank Debt	Bank Debt	Public Debt	Public Debt
Unrated Status	-0.140***	-0.112***	0.023***	-0.001	-0.169***	-0.116***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.007)
Profit	-0.220***	-0.239***	-0.037	-0.036	-0.264***	-0.263***
	(0.067)	(0.056)	(0.046)	(0.030)	(0.067)	(0.055)
Unrated×Profit	0.130*	0.175***	-0.002	-0.004	0.184***	0.216***
	(0.067)	(0.056)	(0.046)	(0.030)	(0.067)	(0.055)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.181	0.720	0.085	0.658	0.166	0.702
FEs	No	Yes	No	Yes	No	Yes
OLS	Yes	No	Yes	No	Yes	No

Table 2.A.4. Debt analysis without the unrated dummy using the OLS method

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Profit	-0.001	-0.041***	-0.000	-0.075***	-0.000	-0.012***
	(0.002)	(0.003)	(0.000)	(0.003)	(0.000)	(0.002)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.016	0.101	0.025	0.121	0.008	0.021
FEs	No	No	No	No	No	No
OLS	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.A.5. Debt analysis with the unrated dummy using the OLS method

Notes: The dependent variable is the ratio of the amount of one type of debt to the asset. Cluster-robust standard errors are clustered by firms. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
	R. Credit	T. Loan	C. Paper	Bond	C. Lease	Other
Unrated Status	0.030***	-0.007*	-0.003***	-0.163***	0.004***	-0.005***
	(0.003)	(0.004)	(0.000)	(0.006)	(0.001)	(0.002)
Profit	-0.128***	0.091**	0.016**	-0.310***	0.011**	0.018
	(0.030)	(0.045)	(0.006)	(0.073)	(0.005)	(0.015)
Unrated×Profit	0.128***	-0.133***	-0.016**	0.233***	-0.011**	-0.031**
	(0.030)	(0.045)	(0.006)	(0.073)	(0.005)	(0.015)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	125,004	125,004	125,004	125,004	125,004	125,004
R-squared	0.028	0.102	0.036	0.168	0.009	0.022
FEs	No	No	No	No	No	No
OLS	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 3 Corporate Debt Structure, Costs, and Product Market Competition

3.1 Introduction

A central theme in corporate finance is that the financing policy of a firm is determined not only by financing frictions like bankruptcy costs, taxes, and refinancing costs, but also by internal and external pressures. Although both empirical and theoretical literature has discussed the relationship between firms' *internal* pressure and the corporate *capital* structure (Paligorova and Xu, 2012; Morellec et al., 2012; Nicodano and Regis, 2019), there is a limited literature on firms' decisions of *debt* structure and leverage under the impact of the *external* pressure imposed by creditors and product market competition. Indeed, the external pressure of creditors affects the corporate debt structure due to 'the substitution effect', which states that firms substitute internal pressure with external pressure from banks' monitoring (Nini et al., 2012; Bharath and Hertzel, 2019).

Specifically, firms adjust their pressure by changing their ways of obtaining debt in two opposite directions, according to firm characteristics such as firm values and economic conditions in terms of the state of macroeconomic variables including the GDP growth. On the one hand, firms might be willing to pay credit spreads to debt holders for the benefits of external monitoring. On the other hand, firms reduce the external pressure of bank monitoring by substituting private bank debt with public/market debt, e.g., bonds and notes, from the debt market when the firms encounter external pressure that is imposed by intense *product market competition*.

This chapter about the effect of product market competition on firms' financing decisions is relevant to Valta (2012), Boubaker et al. (2018), and Bharath and Hertzel (2019). Valta (2012) finds that market competition affects firms' costs of bank debt. Boubaker et al. (2018) reveal that the product market imposes external pressure on firms through the mechanism of bank debt monitoring. Bharath and Hertzel (2019) show that external pressure is increased by intense product market competition that affects firms' choices of bank debt or public debt. Different from the prior studies, I examine the effects of product market competition on the structure of nice types of corporate debt and their costs. Fig. 3.1.1 illustrates the conceptual relationship between the corporate debt structure and the research problem.

This chapter is different from Chapter 2 about the unrated status in a few aspects. First, this chapter investigates the key explanatory variable of product market competition that a firm encounters in the market while the key independent variable in Chapter 2 is the unrated status of the firm. Second, this chapter examines the firms' debt choices in response to the impact of the external pressure imposed by creditors and product market competition. By contrast, Chapter 2 focuses on the decomposition of the leverage puzzle through corporate debt structure and unrated status. Third, this chapter disassembles the total debt into specific types of debt to reveal the underlying mechanism that firms choose different types of debt according to the varying external pressure from product market competition. In contrast, Chapter 2 uses the interaction items between profitability and unrated status for different types of debt to explain the leverage puzzle through the lens of corporate debt structure and unrated status. Most importantly, this chapter studies the costs for various types of debt, which are important since firms are willing to pay different credit spreads of various types of debt for distinct external pressure and monitoring.

The innovation of the chapter is the contribution of examining the effects of product market competition on the details of nine types of corporate debt and costs and meanwhile accounting for a range of firm characteristics and economic conditions. Different from the prior studies on firms' internal pressure (Nicodano and Regis, 2019) and external pressure of market competition on general debt choices (Bharath and Hertzel, 2019), I contribute to the literature by identifying the effect of product market competition through the disassembly of firms' total debt to the components of debt

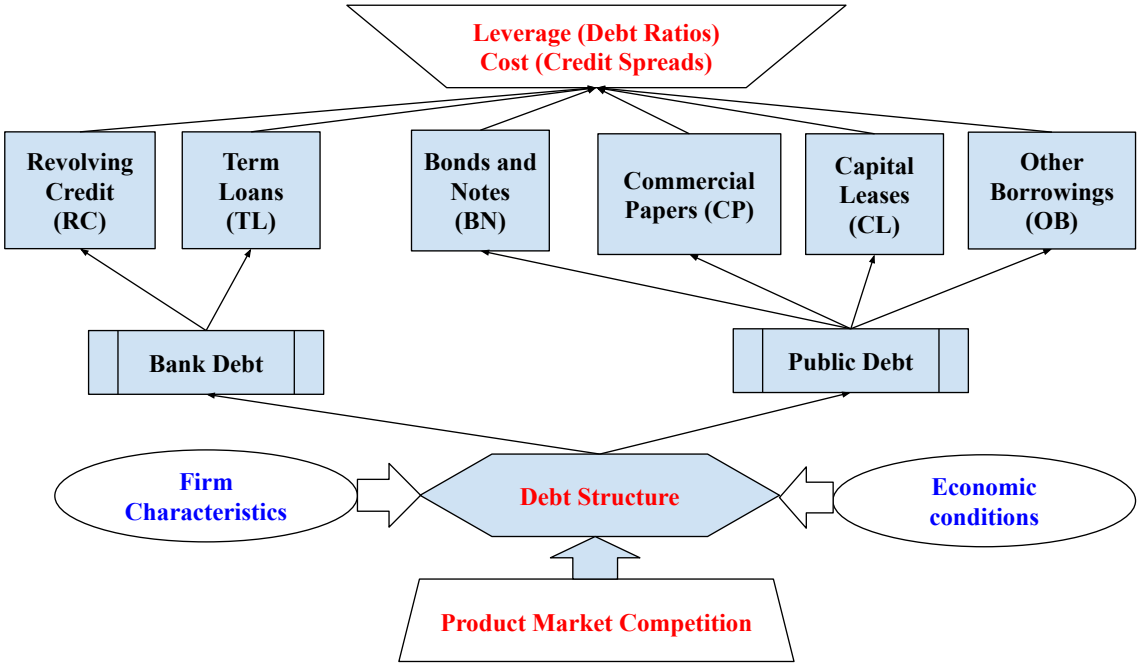


Figure 3.1.1. Debt structure and costs under market competition and economic conditions.

Notes. The flowchart illustrates the mechanism via which product market competition affects firms' debt structure with the ratios of nine types of debt to book assets as well as their credit spreads. The book leverage (BL) is defined as a firm's total debt divided by the firm's book value of the total asset. The debt structure comprises of revolving credit (RC), term loans (TL), bonds and notes (BN), commercial papers (CP), capital leases (CL), and other borrowings (OB). RC and TL are categorized into bank debt (BD) whose debt holders are banks. BN, CP, CL, and OB can be referred to as public debt (PD) that are issued in the public market.

structure. After disassembling the total debt into bank debt and public debt first and then into six types of a specific debt, I am the first to provide details about the effects of product market competition. The underlying mechanism is that firms balance their pressure through adjusting different debt components with different creditors' monitoring pressures in response to the varying external pressure from product market competition.

Therefore, the chapter contributes to the literature by providing insights into the debt structure and its costs under the effects of product market competition and meanwhile accounting for a range of firm characteristics and economic conditions. These insights cast light on firms' debt selection of specific types of debt when they experience intense competition in the product market. In addition, the joint effect of product market competition and profitability suggests that the high-profit firms in an intensive

competition environment are able to raise their debt and leverages. Meanwhile, the study on the costs of debt indicates that firms cannot avoid paying higher fees for their debt under a higher level of competition.

The chapter develops a series of hypotheses to answer the important finance questions regarding the interaction between product market competition, external pressure, the corporate debt structure, and the cost of debt: Does product market competition affect the differences in debt choices and the cost of debt through the underlying channel of substitution effect? Could the product market competition mitigate or complement the leverage puzzle of the negative relationship between the firm's current profit and different types of debt? What are the effects of firm characteristics and economic conditions on the debt structure and costs?

I propose hypotheses to formulate the research questions. To begin with, I hypothesize that product market competition shows a negative relationship with leverage/bank debt/revolving credit/term loans. This hypothesis suggests that a competitive product market reduces firms' leverages through decreasing total bank debt including revolving credit and term loans from banks, through which the firms can decrease the external pressure of bank monitoring.

Then, I hypothesize that there is a positive relationship between product market competition and bonds and notes/other borrowings. The hypothesis suggests that a competitive product market makes firms raise their bonds and notes as well as other borrowings from the public market, through which the firms decrease the external pressure of bank monitoring from bank debt. When the firms issue bonds and notes/other borrowings in the public capital market, the firms are required to disclose a large amount of information to bond investors and regulators in the public market. As a result, the firms have to experience an increasing degree of public monitoring when they intend to decrease bank monitoring from bank debt. Therefore, the firms make their decisions on the debt structure under the product market competition by considering a trade-off between public monitoring and bank monitoring.

In addition, I examine hypotheses about the interaction between profitability and product market competition in order to reveal the contributions of the debt structure to the leverage puzzle when firms incur high product market competition. Regarding the cost of debt, the final hypothesis suggests that when the product market competition

is high, firms have to pay higher credit spreads for borrowing various types of debt from banks or most of the debt from the public market.

The chapter mainly uses the quarterly data of the corporate debt structure and financial statements for US companies from Capital IQ and Compustat databases following Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). The dataset about macroeconomic variables is obtained from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis. The data period covers the period of the 2008 financial crisis to assess the effect of monetary policy in response to the financial crisis. The fine details of the corporate debt structure make it possible to study how product market competition affects the structure of nice types of corporate debt and their costs, which provides new insights into firms' responses to the change in product market competition in terms of the adjustment of corporate debt structure and the credit spreads that the firms are willing to pay for specific types of debt.

To answer the research questions and test the hypotheses, I carry out empirical studies of the corporate debt structure and product market competition by applying the following empirical strategy to the data. I follow the literature to measure the product market competition based on the Herfindahl-Hirschman Index (HHI) of industry concentration. A higher level of HHI implies greater industry concentration and thereby less intense competition pressure. Using product market competition as the proxy, Bharath and Hertzel (2019) illustrate that increasing external pressure makes firms more likely to replace bank debt with public debt due to the substitution mechanism. The degree of substitution depends on how external pressure is relatively stronger than internal pressure. Hence, the exogenous changes in product market competition will affect firms' debt structure and leverage by imposing external pressure.

To identify the effect of product market competition, I first add the product market competition indicator to the traditional empirical models that determine the cost of debt and the leverage puzzle of the negative relationship between profitability and leverage. Next, I disassemble firms' total debt into the components of bank debt and public debt in order to reveal how product market competition impacts credit spreads and leverage through the two components. Then, I investigate six specific types of debt to provide details about the effects of product market competition, firm characteristics, and economic conditions on the debt structure and costs. To this end, I first estimate

the coefficients for the regression of various types of debt ratios in the debt structure on market competition, profitability, the product of competition and profitability, firm characteristics, and economic conditions. Then I estimate the slopes for the regression of various types of debt credit spreads on market competition, firm characteristics, and economic conditions. I assume that these variables are exogenous.

About the empirical method for the debt analysis, I mainly employ the standard censored Tobit method (Tobin, 1958), namely the type I Tobit model (Amemiya, 1985), for censored dependent variables as the corporate leverage and debt ratios are winsorized to the unity, which is similar to the practice of Lemmon et al. (2008) and Colla et al. (2013). I also provide the results of ordinary least squares (OLS) regressions as the benchmarks. Besides, I control for the variables of firm characteristics and economic conditions in model specifications. For the analysis of credit spreads, I use the model with the 3-digit SIC industry and year fixed effects to encapsulate time-invariant factors in industries and calendar year fixed effects to account for time trends.

As a robustness test, I discuss the results obtained from regressions with an Instrumental Variable (IV) for solving the potential endogeneity issue. In the spirit of Waisman (2013) and Boubaker et al. (2018), the instrumental variable for product market competition is the HHI before the beginning of the sample period. Based on this IV, I run the standard single-equation instrumental-variable regression with the two-stage least squares (2SLS) estimator. I also investigate typical diagnostic tests for the validity of the IV. The results show that the regression coefficients of the key variable for the market competition are robust after using the IV regression for the concern of endogeneity issues.

The empirical study reveals the effects of product market competition on the details of nine types of debt in the corporate debt structure and the credit spreads of various types of debt. First, product market competition demonstrates a negative relationship with leverage/bank debt/revolving credit/term loans. This negative relationship implies that a competitive product market makes firms reduce their leverages by reducing bank debt that comprises revolving credit and term loans, through which the firms can decrease the external pressure of bank monitoring.

Second, there is a positive relationship between product market competition and bonds and notes/other borrowings. This result indicates that in a competitive product

market, firms raise their bonds and notes as well as other borrowings from the public market. In this way, the firms cut the external pressure of bank monitoring from bank debt. Meanwhile, the firms that issue bonds and notes/other borrowings in the public capital market have to provide sufficient information disclosure to bond investors and regulators in the public capital market. The information provided by the firms to the public capital market helps the firms increase their competitive advantage in the product market and as a result, it reduces the external pressure from the product market competition.

Third, facing intensive product market competition, firms have to pay higher credit spreads for borrowing various types of debt from banks or most of the debt from the public market. Fourth, the interaction between profitability and product market competition displays how the debt structure contributes to the leverage puzzle in an environment with high product market competition.

The remainder of this chapter is organised as follows. Section 3.2 reviews relevant theories, the literature, and the development of hypotheses. Section 3.3 describes the empirical strategies and a flowchart for the concept relationship of the chapter. Section 3.4 presents the data, variables, summary statistics, and the features of variables. Then, Section 3.5 discusses the analyses of product market competition, the debt structure, and credit spreads. Section 3.6 analyzes the results of the empirical models for robustness tests. Section 3.7 concludes. Finally, appendices gather additional results.

3.2 Related literature and hypothesis development

In this section, I will develop a series of hypotheses to study the interaction between product market competition, the corporate debt structure, and the cost of debt under firm characteristics and economic conditions. The hypotheses are related to several strands of literature as follows.

3.2.1 Competition and debt structure

The chapter links to the stream of literature about the effect of market competition on borrower-creditor conflicts, debt financing, and financing costs.

First, Laksmana and Yang (2015) find that competition reduces opportunities for

sacrificing creditors' interests. Competition forces managers to invest in projects for the long-term survival of the company that avoids bankruptcy losses to creditors. Kjenstad et al. (2018) point out that loan contractual terms mitigate borrower-creditor frictions in financial markets under product market competition. They provide a supplement analysis of three-stage simultaneous equation estimations, where they use the annual GDP growth as the exogenous explanatory variable for the initial spreads of loans. Sheikh (2019) reveal that market competition and corporate characteristics play important roles in affecting a positive association between borrower power and corporate risk such as debt default risk.

Hoberg et al. (2014) use the text descriptions of firm products to construct a new measure of competitive threats for a firm, called product market fluidity, which characterizes the product changes in rival firms relative to the firm's products. They find that fluidity raises firms' cash holdings and reduces firms' payouts to their owners in the way of either dividends or repurchases. The effect of competition on cash holdings is especially significant for firms having less access to debt markets.

Second, Boubaker et al. (2018) reveal the insightful finding that the product market imposes external pressure on firms and provides a mechanism for bank debt monitoring. They find that intense competition in the product market makes firms decrease their bank debt. Using exogenous shocks to the competitive pressure in the product market, they discover that firm financing relies less on bank debt. They further show that competitive pressure impacts firms' debt choices more significantly for firms that experience more intense competition, tighter financial constraints, and weaker management practices.

The impact of market competition on firms' financing decisions is indicated by capital structure and leverage. Guney et al. (2011) examine the relationship between product market competition and the capital structure in both static and dynamic settings by applying several empirical methods. They show cross-industrial differences in the debt ratios and the relationship between leverages and product market competition, which is parabolic or cubic according to different industry types, firms' sizes, and growth opportunities. They use the system-GMM method to reveal that firms adjust the leverages through time.

When the intensity of product market competition is above a certain level, the

competition promotes firms' operating performance, values, equity returns, labor productivity, and value-creative acquisitions, which influence input costs including borrowing costs (Giroud and Mueller, 2011; Beiner et al., 2011). Waisman (2013) shows that product market competition affects the cost of bank loans. Paligorova and Yang (2014) illustrate the role of product market competition in affecting the cost of debt financing and the use of bond covenants.

The literature in corporate finance usually ignores the external influence of creditors such as banks on the process of financing decisions. Recently, Bharath and Hertzel (2019) show that external pressure is increased by intense product market competition while it is decreased by business combination laws such as an anti-take-over law. Their research implies that the pressure of competition affects the type of firms' debt. Namely, an exogenous increase (decrease) in pressure from the product (takeover) market has a significantly negative (positive) impact on the use of bank (public debt) financing over public debt (bank loan) issuance. These findings are consistent with the mechanism of substitution effect that depends on the relative strength of alternative external pressure.

Valta (2012) finds that firms operating in competitive product markets encounter systematically high costs of bank debt. The effect of the competition is more significant in industries where small firms have financially stable rivals, in industries in which firms engage frequent strategic interactions, and in industries lacking liquidity. To show the effect of market competition on the cost of bank debt, the paper examines the proxy of product market competition and the reduction of import tariff rates, which captures exogenous changes to the environment of market competition. The proxy of competition in the paper is a dummy variable taking the value of one if the HHI at the industry level of the three-digit Standard Industrial Classification (SIC) code is in the lowest quartile for a given year.

3.2.2 Economic conditions, bank debt, and financing costs

The literature discovers the effects of economic conditions on the cost of debt. Boubakri and Ghouma (2007) record that firms' internal and external pressure affects their credit ratings and costs of corporate bonds. They show that the difference between voting rights and cash-flow rights of the strength of internal pressure affects bond costs positively and bond ratings negatively. To measure external pressure, the proxies that

they use are the preservation of the creditor rights, the existence of public and private credit registries, the extent of newspapers' circulations, and the number of days to resolve a payment dispute through courts. They show that these proxies determine debt costs and debt ratings.

Ellul et al. (2007) examine the external country-level economic conditions of investor protection environments that influence debt costs. The proxies are legal environment and creditor rights index, where legal environment is obtained from a principal components analysis of the covariance matrix derived from the efficiency of the judiciary system, rule of law, risk of expropriation, corruption, the risk of contract repudiation, and financial development. The proxy of financial development is the ratio of stock market capitalization to GDP. Highly developed markets indicate a high standard of investor protection. The creditor rights index measures how well creditor rights are protected aggregately under bankruptcy and reorganization laws. Recently, Platt (2020) controls for common macroeconomic variables, firm-level factors, and bond-level features to exhibit that corporate bondholders demand significantly larger credit spreads from firms facing increased competition, especially firms with assets that are difficult to redeploy.

The chapter pays particular attention to bank debt and relevant costs since bank monitoring like competition also imposes external pressure on companies. When issuing bank debt, banks deserve premiums for their provisions of monitoring benefits under imperfect competition according to the following four theories of the firm-bank relationship.

First, 'the relationship lending theory' presents that firms are difficult to transfer information about their quality to other banks and hence they pay higher interest rates after bank switch. Likewise, stable banks are able to charge more credit spreads due to their ability to continue to lend during economic downturns (Cornett et al., 2011; Beltratti and Stulz, 2012). Second, 'the equity monitoring theory' suggests that the shareholders of banks' equity capital incentivize banks to monitor borrowing firms (Allen et al., 2011; Mehran and Thakor, 2011). Monitoring adds value to the borrowing firms and therefore the firms are willing to pay more credit spreads.

Third, 'the financial commitment theory' states that firms value banks' ability to maintain banks' loan commitments (Boot et al., 1993; Ivashina and Scharfstein, 2010)

and then firms would like to pay higher credit spreads because switching to other banks is more expensive. Fourth, 'the fragility monitoring theory' claims that the bank fragility of possible running depositors induces the bank to monitor borrowers and facilitates liquidity provision (Calomiris and Kahn, 1991; Diamond and Rajan, 2001; Hubbard et al., 2002), which makes the bank earn a loan spread premium.

Therefore, the relationship lending, equity monitoring, financial commitment, and fragility monitoring theories predict that borrowing firms value bank monitoring and stable future funding provision. Under these theories, firms are willing to pay higher credit spreads for bank monitoring. Admittedly, Feldhütter et al. (2016) find that the corporate bond prices also include premiums due to the control rights under different states. They reveal that the premiums of corporate bonds are implied by the lower bond yields relative to the yields of the corresponding CDSs. Nevertheless, bank loans bring greater control rights to creditors than bonds, hence the bank creditors maintaining stronger covenants and higher seniority in default should obtain a higher premium.

Recently, Schwert (2020) provides direct evidence of firms' willingness to pay premiums for bank debt and highlights the role of competition in the loan market. The paper compares the costs of bank loans with those of capital market debt. After matching a sample of firms' loans with bond spreads on the same date, the paper finds that loan lenders earn a premium that is larger than the credit spreads of bonds. The large loan premium is explained by the differences between bank loans and bonds. Before providing loans, banks screen firms to overcome information asymmetry, and after loan provision, banks monitor firms to ensure their repayments. Besides, banks offer valuable flexibility to firms through the lines of credit and the feasibility of relatively cheap contract renegotiation.

In short, the literature provides several interpretations of bank debt costs based on borrowing firms and banks' relationships but there is not much literature on the relationship between competition and the costs of debt. Hence, one of the main contributions is to discover the effects of market competition on the costs of various types of debt.

3.2.3 Hypotheses on the competition, debt structure and costs

The literature discovers that a more competitive product market that imposes pressure on firms significantly makes the firms reduce the external pressures of bank monitoring. Extending general debt in the references to the specific debt structure, I develop the hypotheses about product market competition, debt choice, and leverage puzzles for different types of debt under the effects of firm characteristics and economic conditions. For an easy exposition, I use the names of various types of debt to denote the ratios of the amount of these types of debt to book assets in hypotheses and following texts, see variables definitions in Fig. 3.1.1 and Section 3.4.2.

Hypothesis 1, H_1^1: there is a negative relationship between product market competition and leverage/bank debt/revolving credit/term loans / capital leases.

Counterfactual Hypothesis 1, H_0^1: the relationship between product market competition and leverage/bank debt/revolving credit/term loans / capital leases is positive or insignificant.

For Hypothesis H_1^1, I estimate Equation (3.3.1) in Section 3.3. Hypothesis H_1^1 suggests that a competitive product market reduces firms' leverages through decreasing total bank debt including revolving credit and term loans from banks, through which the firms can decrease the external pressure of bank monitoring, although the firms reduce their capital leases slightly from the public market as well. Namely, product market competition complements the negative relationship between the firms' profits and leverage/bank debt/revolving credit/term loans/capital leases by decreasing their revolving credit/capital leases in general, see the variable definitions in Fig. 3.1.1 and Section 3.4.2.

Hypothesis 2, H_1^2: there is a positive relationship between product market competition and bonds and notes/other borrowings.

Counterfactual Hypothesis 2, H_0^2: the relationship between product market competition and bonds and notes/other borrowings is negative or insignificant.

For Hypothesis H_1^2, I estimate Equation (3.3.1) in Section 3.3. Hypothesis H_1^2 suggests that a competitive product market makes firms raise their bonds and notes

as well as other borrowings from the public market, through which the firms decrease the external pressure of bank monitoring from bank debt, although the firms increase their term loans from banks as well. Namely, product market competition mitigates the negative relationship between the firms' profits and leverages by increasing their bonds and notes/other borrowings in general, see the variable definitions in Fig. 3.1.1 and Section 3.4.2.

I further investigate the fine details of corporate debt structure under the effects of product market competition, firms' characteristics like profits, and economic conditions. Meanwhile, since all types of corporate debt form the total debt that determines the leverage, the chapter also contributes to the literature on the leverage puzzle, which states that there is a negative relationship between leverage and profitability (e.g., DeMarzo, 2019; Chen et al., 2019; Heath and Sertsios, 2019; Eckbo and Kisser, 2020)

To begin with, I specify the leverage puzzle Hypothesis C as the condition ('C') for the hypotheses about the leverage puzzle and profitability, which are specified to be conditional on the observation that there is a negative relationship between profitability and the ratio of the corresponding type of debt over the total asset. Given the condition of the leverage puzzle, the hypotheses will examine whether the competition attenuates (mitigates) or exaggerates (complements) the leverage puzzle by increasing or decreasing the leverage and the particular types of debt.

Hypothesis c: There is a negative relationship between profitability and the ratios of all types of debt (total debt/revolving credit/term loans/commercial papers/bonds and notes/capital leases/other borrowings/bank debt/public debt) to the total asset.

Hypothesis 3, H_1^3: there is a negative relationship between profitability and bank debt/commercial papers/other borrowings for the firms in a more competitive product market.

Counterfactual Hypothesis 3, H_0^3: the relationship between profitability and bank debt/commercial papers/other borrowings is positive or insignificant for the firms in a more competitive product market.

For Hypothesis H_1^3, I estimate Equation (3.3.1) in Section 3.3. Hypothesis H_1^3 suggests that when the firms are in a more competitive product market and produce more profits, they decrease their bank debt, commercial papers, and other borrowings when

their profits are high. Namely, product market competition exaggerates the negative relationship between the firms' profits and bank debt/commercial papers/other borrowings by decreasing these types of debt when these firms' profits are high, see the variable definitions in Fig. 3.1.1 and Section 3.4.2.

Hypothesis 4, H_1^4: there is a positive relationship between profitability and leverage/public debt/bonds and notes/capital leases for the firms in a more competitive product market.

Counterfactual Hypothesis 4, H_0^4: the relationship between profitability and leverage/public debt/bonds and notes/capital leases is negative or insignificant for the firms in a more competitive product market.

For Hypothesis H_1^4, I estimate Equation (3.3.1) in Section 3.3. Hypothesis H_1^4 suggests that when the firms are in a more competitive product market and produce more profits, they raise their leverages by increasing their public debt of bonds and notes as well as capital leases for weakening the external pressure of bank monitoring. Namely, product market competition attenuates (i.e., mitigates) the negative relationship between the firms' profits and leverage/public debt/bonds and notes/capital leases by increasing these types of debt when these firms' profits are high, see the variable definitions in Fig. 3.1.1 and Section 3.4.2.

The prior studies summarized above motivate this chapter to examine the costs of nine types of debt and combinations by investigating the effect of product market competition on the credit spreads of various types of debt. I capture this effect by regressing credit spreads on competition along with other firm characteristics and economic conditions.

Hypothesis 5, H_1^5: there is a positive relationship between product market competition and the credit spread of total debt/bank debt / public debt/revolving credit/term loans/bonds and notes/capital leases / other borrowings.

Counterfactual Hypothesis 5, H_0^5: the relationship between product market competition and the credit spreads of total debt/bank debt/public debt/revolving credit/term loans/bonds and notes/capital leases/other borrowings is negative or insignificant.

For Hypothesis H_1^5, I estimate Equation (3.3.2) in Section 3.3. Hypothesis H_1^5

suggests that when the product market competition is high, firms have to pay higher credit spreads for borrowing various types of debt from banks or most of the debt from the public market. The credit spreads of bank debt rise since the firms' risks are high in a more competitive environment. The credit spreads of public debt increase in a more competitive environment as the firms have to reduce the external monitoring pressure. Then, the firms shift bank debt with high external pressure to public debt with low external pressure. To this end, the firms pay larger costs for public debt, see the variable definitions in Fig. 3.1.1 and Section 3.4.2.

3.3 Empirical strategies

I describe the strategy for empirical study including the proxy of the key variable and econometrics setting. For the debt analysis, I consider the corporate leverage and the ratio of a particular type of debt to the book value of total asset as the dependent variable respectively, which are described in Fig. 3.1.1 and Section 3.4.2. They are term loans (TL), revolving credit (RC), commercial papers (CP), bonds and notes (BN), capital leases (CL), and other borrowings (OB). More broadly, TL and RC are categorized into *bank debt (BD)* whose debt holders are banks. CP, BN, CL, and OB can be referred to as *public debt (PD)* that are issued in the financial market. For the cost analysis, the corresponding credit spreads of these types of debt are the dependent variables in their regression specifications respectively.

The prior work measures the product market competition by a dummy variable *Competition*, which is equal to one for the firm whose HHI is in the lowest quartile of the HHI for a given year. As pointed out by Valta (2012), the dummy variable *Competition* is considered in the analysis because it is convenient to interpret the coefficient estimates economically in terms of the effect of high or low market competition. The interaction term *Competition*×*Profit* indicates the profitable firms facing high competition while the meaning of the interaction term *HHI*×*Profit* is not clear. Furthermore, using the dummy variable rather than the value of the HHI will mitigate the issue of measurement problems in the HHI. To confirm the results based on the *Competition*, I also report the output of the specification with the HHI instead of the *Competition* as one of the independent variables. The signs of the coefficients from the

regression with the HHI are opposite to those for *Competition* due to the definition of *Competition*. The implications and conclusions with the HHI are thus similar to those using *Competition*.

To test hypotheses about the debt structure and the cost of debt, the chapter considers credit spreads, corporate leverage, and the ratio of a particular type of debt to the book value of the total asset as the dependent variable respectively. The independent variables include the product market competition that imply firms' external pressure, firms' profit, and other characteristics in the vector with one quarter lag, $\mathbf{X}_{t-1} = [\mathbf{X}^T_{1,f,t-1}\mathbf{X}^T_{2,t-1}]^T$, where $\mathbf{X}_{1,f,t-1}$ and $\mathbf{X}_{2,t-1}$ represent other corporate characteristics and economic conditions respectively, see variable definitions in 3.4.2. Among corporate characteristics, I use three variables controlling the effects of executive characteristics similar to the references on the capital structure and executive characteristics (e.g., Morellec et al., 2012). The literature usually uses lagged characteristics as independent variables (e.g., Colla et al., 2013; Strebulaev and Yang, 2013; Valta, 2012; Frank and Goyal, 2015; Badoer et al., 2019; Eckbo and Kisser, 2020). Similar to the literature, I use lagged variables capture the effects of corporate characteristics and economic conditions in previous quarters on current financial policies.

I formulate the hypotheses described in Section 3.2 in the form of empirical equations as follows.

$$\begin{aligned} Y_{f,i,t} \quad = \quad & \beta_0 + \beta_1 Competition_{i,t-1} + \beta_2 Competition_{i,t-1} \times Profit_{f,t-1} \\ & + \beta_3 Profit_{f,t-1} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}, \end{aligned} \tag{3.3.1}$$

where Y in (3.3.1) can be one of $BL/BD/PD/RC/TL/BN/CP/CL/OB$, which denotes the ratio of the amount of one type of debt in the corporate debt structure, to the total asset. The vectors $\vec{\beta}$ and $\mathbf{X}_{t-1} = [\mathbf{X}^T_{1,f,t-1}\mathbf{X}^T_{2,t-1}]^T$ capture the effects of other corporate variables ($\mathbf{X}_{1,f,t-1}$) and economic variables ($\mathbf{X}_{2,t-1}$), and $\varepsilon_{f,i,t}$ is the disturbance term.

$$CS_{f,i,t} = \beta_0 + \beta_1 Competition_{i,t-1} + \vec{\beta}^T \mathbf{X}_{t-1} + d_i + d_y + \varepsilon_{f,i,t}, \tag{3.3.2}$$

where CS in (3.3.2) can be the credit spread of one type of debt in the corporate debt structure. The credit spread is measured by the weighted average interest rate of a specific type of debt over LIBOR. d_i and d_y represent industry and year fixed effects.

There is no interaction term between competition and profitability in Equation (3.3.2) about credit spreads because there is no financial theory supporting this spec-

ification. It might seem like a logical extension of Equation (3.3.1) about debt ratios to include the interaction term, but the interaction term with profitability is only meaningful when I examine the leverage puzzle about the relationship between debt ratios and profitability. Hence, I do not have the interaction between competition and profitability in the model specifications about credit spreads.

About empirical methods, the regressions of debt ratios mainly use the Tobit regression method for censored dependent variables as I winsorize the corporate leverage and debt ratios to the unity, as shown by Tables 3.4.2, 3.A.1 and 3.A.2 for the summary statistics and Fig. 3.4.2 for the leverage. The unity limit is similar to the practice of Lemmon et al. (2008) and Colla et al. (2013). I use the standard censored Tobit model (Tobin, 1958), which is also referred to as the type I Tobit model (Amemiya, 1985).

For the analysis of debt ratios, I use the type I Tobit model as I censor debt ratios to the unity. This is different from the 'truncated regression' with a sample selection based on a response variable, which is named the truncated Tobit model or the type II Tobit model estimated by the Heckit method in Heckman (1976). Likewise, the Tobit model employed by the chapter does not belong to another sample selection problem where the selection equation is in the form of a censored Tobit form either. Namely, the type III Tobit model where the dependent variable is observable only when the dependent variable in the Tobit selection equation meets censorship, see Vella (1992) and Wooldridge (1998). As a benchmark, I provide the results of ordinary least squares (OLS) regressions in each regression table. Besides, I control for the variables of firm characteristics and economic conditions in the most of model specifications. For the analysis of credit spreads, I use the model with the 3-digit SIC industry and year fixed effects to encapsulate time-invariant factors in industries and calendar year fixed effects to account for time trends.

As a robustness test, I provide the results using an Instrumental Variable (IV) for the concern of the endogeneity issue. Similar to Waisman (2013) and Boubaker et al. (2018), the instrumental variable for product market competition is the HHI prior to the beginning of the sample period (*HHI01*). With this IV, I adopt the standard single-equation instrumental-variable regression with the two-stage least squares (2SLS) estimator and I examine typical diagnostic tests for the validity of the IV. The results show that the estimated coefficients of the key variable for the market

competition are robust after using the IV regression that solves potential endogeneity issues.

It is reasonable to use the historical measure of HHI that determines product market competition since it meets both the relevance and exclusion conditions according to similar discussions in Waisman (2013) and Boubaker et al. (2018). On the one hand, the measure *HHI01* is negatively related to the current degree of competition in the industry to which a given firm belongs. On the other hand, the variable *HHI01* is highly unlikely to be directly related to a firm's debt structure and costs of debt, unless through the channel of affecting the current intensity of competition faced by the firm. Hence, these arguments conclude that the variable *HHI01* satisfies the necessary conditions for a valid instrument.

3.4 Data and variables

In this section, I describe data sources, sample selection process, variable definitions, summary statistics, and other data features.

3.4.1 Data sources and sample selection

The chapter mainly uses the debt structure data and financial statement data of US companies downloaded from Capital IQ and Compustat from the WRDS platform following Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). The data measuring executive characteristics are from Compustat Executive Compensation. The data about macroeconomic variables including the 3-Month LIBOR[1] are obtained from the Federal Reserve Economic Data (FRED) of Federal Reserve Bank of St. Louis. Quarterly data are collected and the data period is from 2002 to 2019 covering the period of the 2008 financial crisis since more comprehensive data about corporate debt structure are available in the database of Capital IQ after 2002.[2]

I carry out the sample selection process as follows in detail. First, I merge debt

[1]The London Interbank Offered Rate (LIBOR) is the benchmark rate of interest used in lending between banks on the London interbank market, which is also used as a reference for setting the interest rate on other loans.

[2]Data on "Capital IQ - Capital Structure Debt" are available until 2020 January when I checked the WRDS platform in September 2021.

data from Capital IQ (1,429,031 observations) with all other required data such as the company fundamentals data from Compustat. I keep 349,958 observations that match both databases in terms of firms and quarters and delete the observations that do not match the two databases.

Second, I drop 136,202 observations where the differences between the total debt in Capital IQ and the total debt in Compustat are more than 10%, following Colla et al. (2013, p. 2120) and Choi et al. (2018, p. 499). As a result, I have 213,756 observations left.

I investigate the differences between the two data sources further. I have the variable *Debt* from Compustat and the variable *Debt2* from Capital IQ. A comparison of the two debt variables exhibits a number of large differences. In the second step above, I drop the observations satisfying the condition of "*(Debt2 - Debt) > 0.1 Debt*". Namely, the variable *Debt2* of the deleted observations from Capital IQ is 10% higher than the counterpart variable *Debe* from Compustat.

I define a temporary variable *debt_over = Debt2 / Debt* for the purpose of demonstrating the discrepancies of total debt between the data sources of Compustat and Capital IQ. Table 3.4.1 lists the selected percentiles of *debt_over*. The temporary variable is for illustration and is not one of the dependent variables or independent variables in the models. It is not the defendant variable *Leverage = Debt/Asset*. Hence, it is not necessary to winsorize the temporary *debt_over* and I do not drop *debt* values greater than 1.

I also try the way of keeping the observations with large discrepancies and do not drop observations in the above second step. Then the companies' (total) debt and leverage can be either from Compustat or Capital IQ or the average of values from the two data sources when their differences are larger than 10%. Note that this choice only affects the regressions with the dependent variable *Leverage*. The dependent variables in the regressions for various types of debt such as *Term Loans* always come from Capital IQ. The unreported results show that keeping the observations with large discrepancies leads to worse outputs since the large differences are likely due to problematic samples. Besides, it is not appropriate to give arbitrary criteria in levels (rather than the 10% used above) or to impute debt values by the averages of the two sources because there are many observations with large differences, see the discussions in Appendix B.

Table 3.4.1. The summary statistics of the temporary variable *debt_ over*.

Notes. Table 3.4.1 displays the summary statistics of the temporary variable *debt_ over = Debt2 / Debt*, where *Debt* from Compustat and *Debt2* from Capita IQ. Because the ratio of *Debt2 / Debt* has more missing values than the difference of *Debt2 - Debt* due to some small near zero *Debt* in the denominator of the ratio, I use the difference to drop inappropriate observations.

Variable	N	mean	sd	min	p1	p5	p25	p50	p75	p95	p99	max
debt_over	318,897	10.20	403	-0.44	0.57	0.90	1.00	1.01	1.38	6.04	88.43	149,010

Third, following the common practice in the literature (e.g., Colla et al., 2013; Danis et al., 2014; Badoer et al., 2020; Schwert, 2020), I restrict the data to non-financial and non-utility firms by dropping financial firms with SIC codes 6000 to 6999 (57,108 observations deleted) and regulated utilities including electric, gas & sanitary services with SIC codes 4900 to 4999 (9,465 observations deleted). Then I have 147,183 observations left in the data.

Fourth, I generate lag values of companies' characteristics following the practice of the literature (see Section 3.3), which unavoidably produces a large number of missing values of these characteristics. For example, I compare the frequencies of missing values for the three key variables of *HHI*, *Profit*, and *BL (Book Leverage)* before taking lag operations (the left panel) and after lag operations (the right panel). It is shown that *BL* keeps the numbers of missing observations at 4,502, which come from the original 16,869 missing *Debt* values. These 4,502 *Debt* values still exist irrespective of the operations in the above second step about two data sources of debt because neither *Debt* nor *Debt2* has values in these observations. *HHI* and *Profit* lead to 62,513 and 67,455 missing observations. Note that both *HHI* and *Profit* share 60,275 common missing observations.

Then I delete the observations with the key variables of *HHI*, *Profit*, and *Leverage* being missed, which drops 68,444 observations in total. For other non-key company characteristics, I fill missing values firstly by their lag values that are not missed and then by 0. In the end, the final sample comprises 78,739 firm-quarter observations and 7,097 firms for the period during 2002-2019. In the final sample, company characteristics are winsorized by using a 1% level.

I limit the leverages and debt ratios (the ratios of various types of debt to the total

asset) to the unity similar to Lemmon et al. (2008) and Colla et al. (2013). In the final sample, none ratio is below zero and 25,875 ratios (not observations) above one are set to one, where 8,554 leverages above one are assigned to one, see Appendix A for more details on their percentiles. I use the standard type I Tobit regression model for these censored dependent variables.

3.4.2 Variable definitions

I construct the dependent variables and independent variables as follows. The lower-case symbols in brackets (e.g., 'atq') are the symbols for variables in Compustat.

To begin with, I define the dependent variables (LHS) in terms of corporate debt structure variables considering current data frameworks in Capital IQ, which are similar to prior studies in debt structure, see, e.g., Colla et al. (2013) and Choi et al. (2018). *Term Loan (TL)* is the Level of TL / book assets (atq), where 'atq' is variable name of total asset in Compustat. *Revolving Credit (RC)* is the Level of RC / book assets (atq). *Commercial Paper (CP)* is the Level of CP / book assets (atq). *Bond and Note (BN)* is the Level of BN / book assets (atq). *Capital Lease (CL)* is the Level of CL / book assets (atq). *Other Borrowing (OB)* is the Level of OB / book assets (atq). *Bank Debt (BD)* is the TL + RC. *Public Debt (PD)* is the CP + BN + OB + CL. *Book Leverage (BL)* is the ratio of book debt (dlcq + dlttq) to book assets (atq).

Credit spread (CS) is the credit spread of the weighted average interest rate of a specific type of debt over LIBOR, which is similar to Schwert (2018). Specifically, Capital IQ provides the property of interest rate (high value, %) that is the cost of relevant debt. Since a firm might have several records of the same type of debt with different interest rates, I first take the weighted average of the interest rates for each specific type of debt within the same firm and quarter, where the weight is the proportion of the value of the debt with an interest rate in one specific type of debt for the same firm and quarter. Second, since the data of interest rates in Capital IQ are stacked in one column for all different types of debt, I separate interest rates for specific types of debt and then I reallocate the interest rate for a specific type of debt to an individual column. Third, for the aggregate bank debt, public debt, and total debt, I calculate the weighted average of the interest rates within these types of debt, where the weight is the proportion of the value of one specific type of debt in bank,

public, or total debt respectively. Finally, the difference between the weighted interest rate and LIBOR is the credit spread in the study.

I define the following firm characteristics in a way similar to the literature in corporate finance (e.g., Strebulaev and Yang, 2013; Danis et al., 2014; Badoer and James, 2016; Prilmeier, 2017; Carvalho, 2018; Choi et al., 2018; Schwert, 2018; Santos and Winton, 2019) and product market competition (e.g., Beiner et al., 2011; Valta, 2012; Hoberg et al., 2014; Boubaker et al., 2018; Sheikh, 2019).

About the key variables, *Comp(etition)* is equal 1 for the firm with the HHI at the industry level of the three-digit SIC code in the lowest quartile, which indicates that a competitive product market imposes external pressure on firms (Valta, 2012; Bharath and Hertzel, 2019). The HHI for a particular industry is the sum of squared market shares of sales for all firms in a three-digit SIC industry, where firm i's market share is its sales divided by the total sales in the industry that firm i belongs (e.g., Hoberg and Phillips, 2010b; Boubaker et al., 2018). *Profit* is defined as the operating profit (oibdpq) divided by book assets (atq).

About the corporate controls, *Investment* (capital expenditure) is capital expenditures (capxy) divided by book assets (atq). *Cash* is the ratio of cash and short-term investments (cheq) to book assets (atq). *Age* is the natural logarithm of the number of years passing the IPO date (Compustat variable 'ipodate') or the first year in Compustat if the value of the variable 'ipodate' is missed. *Size* is the natural logarithm of total asset adjusted to year 1982 dollars, $log(atq \times CPI_{1982}/CPI_t)$. Consumer Price Index (CPI) for all urban consumers is from the US Bureau of Labor Statistics, which can be obtained from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis.

MV/BV (Market to Book) is the ratio of market value of assets, which is current debt (dlcq) plus long-term debt (dlttq) plus stock price (prccq) $\times$ stock number (cshoq), to book assets (atq). *Tangible* assets are defined as property/plant/equipment (ppentq) divided by book assets (atq). *Tax* is defined as taxes (txtq) divided by book assets (atq). *Earning volatility (Risk)* is the standard deviation of quarterly operating profits (oibdpq) scaled by book assets (atq) over the previous 4 quarters. *Z-score* measures firm's distress risk as Altman (1968), which is calculated by 1.2 $\times$ (working capital/total assets) + 1.4 $\times$ (retained earnings/total assets) + 0.99 $\times$ (sales/total assets) + 0.6

× (market capital/total liabilities) + 3.3 × (earnings before interest and taxes/total assets). Specifically, in Compustat, the working capital is wcapq, the retained earning is req, the sale is saleq, the market capital is the stock price (prccq) × the number of stock (cshoq). The earning before interest and taxes (EBIT) is equal to the revenue (revtq) minus the sum of the operating costs (xoprq) and the depreciation (dpq). *Current ratio (liquidity)* is defined as total current assets (actq) divided by total current liabilities (lctq).

To control the effects of executive characteristics, I consider three additional variables about executive characteristics similar to the references on the capital structure and executive characteristics (e.g., Morellec et al., 2012). *CEO Tenure* is the difference between the current year and the year of becoming the CEO. I measure *Executive Incentive* by the growth of total compensation (tdc1) for the five executives with the highest paid salary and bonus (execrankann).[3] *Executive Ownership* is the proportion of reported shares (shrown_tot_pct/100) owned by the five highest-paid executives.

Macroeconomic conditions could affect firms' debt structure and the cost of debt and therefore some of the model specifications consider the variables of macroeconomic indicators. The return of the S&P 500 index and the growth of GDP indicate the health of the stock markets and the overall economy (La Porta et al., 1997; Boubakri and Ghouma, 2007; Laksmana and Yang, 2015). Graham et al. (2008) and Valta (2012) among others use the term spread and the credit spread to indicate the state of the economy and therefore of the equity markets. A strong stock market will attract more equity financing rather than debt financing. A positive and large term spread means that interest rates are currently low and are bound to rise. Credit spreads often widen during uncertain or worsening economic conditions such as recessions when credit supplies are decreasing. Therefore, I consider the following variables as the economic controls. *Growth of S&P 500* is the quarterly return of S&P 500 index. *Growth of GDP* is the percent growth in the real gross domestic product from the previous quarter. *Term spread* is the difference between the 10-year Treasury yield and

[3] An executive's total compensation includes salary, bonus, other annual, the total value of restricted stock granted, the total value of stock options granted using Black-Scholes, long-term incentive payouts, and all other totals.

the 3-month Treasury yield. *Credit spread* is the difference between BAA corporate bond yield and AAA corporate bond yield.

3.4.3 Summary statistics

Table 3.4.2 provides the summary statistics of debt structure and firm characteristics in the final sample during the period of 2002 to 2019 from the U.S. panel data merging Capital IQ Capital Structure - Debt and Compustat Fundamentals Quarterly. Variables are defined in Section 3.4.2.

The *Age* is the natural logarithm of the number of years passing the IPO date. The *Tax* can be negative under several circumstances, for example, a business taking advantage of tax breaks and loopholes in the tax system, tax overpayments, and revenue losses. In addition, it is possible that the term spread is negative and is referred to as 'the curve inversion'. For instance, long-term Treasury yields were traded below short-term rates in the 2019 summer, which signaled investors' increasing pessimistic views about the economic outlook and mounting risk of deflation. Similarly, the growths of the stock market and GDP can be negative when there were drops in the stock market and GDP during the period from 2002 to 2019. The CS variables could have negative minimums when the interest rates of corporate debt are lower than the proxies of risk-free rates. These facts are named as 'the negative credit risk premium puzzle' that can be explained by liquidity and limits to arbitrage, see Bhanot and Guo (2011); Godfrey and Brooks (2015), or the fact that markets participants would like to pay for riskless investments during recessions.

Among the ratios of six types of specific debt values to the total asset, bonds and notes from the public market and term loans from banks take the largest mean values of 0.308 and 0.237, followed by the revolving credit of bank debt with the mean value of 0.12 and other borrowings of public debt with the mean value of 0.086. Commercial papers and capital leases have mean values that are about one-tenth of the mean values of bonds and notes. The sizes of debt-related variables vary as firms do not take some types of debts sometimes. I do not fill missing debt variables by 0 to emphasize the diversity of debt structure.

Table 3.4.2. Summary statistics of characteristics, variables, and debt structure

Notes. The sizes of debt-related variables vary as firms do not take some types of debts sometimes.

VARIABLES	Mean	SD	Min	p25	p50	p75	Max	N
HHI	0.154	0.152	0.0279	0.0517	0.0989	0.192	1	78,739
Profit	-0.0673	0.218	-0.840	-0.0485	0.0150	0.0343	0.122	78,739
Size	4.362	3.415	-5.472	2.304	4.756	6.773	11.11	78,739
Tangible	0.309	0.295	0	0.0609	0.199	0.511	0.981	78,739
MV/BV	1.817	1.441	0	0.780	1.255	2.532	4.556	78,739
Investment	0.0325	0.0539	0	0.00316	0.0129	0.0362	0.327	78,739
Z-Score	0.389	4.263	-6.967	-0.947	0.776	2.345	9.784	78,739
Current Ratio	2.006	1.883	0	0.761	1.480	2.553	7.422	78,739
Age	3.225	1.080	0	2.708	3.892	3.989	4.060	78,739
Cash	0.199	0.252	0	0.0273	0.0901	0.259	0.980	78,739
Tax	0.00205	0.00861	-0.0408	0	1.25e-05	0.00446	0.0345	78,739
Earnings Volatility	0.0688	0.153	0	0.00493	0.0119	0.0369	0.635	78,739
Growth (S&P500)	0.0260	0.0436	-0.272	0.00978	0.0310	0.0552	0.116	78,739
Growth (GDP)	0.00557	0.00421	-0.0216	0.00363	0.00566	0.00783	0.0170	78,739
Term Spread	1.869	0.951	-0.437	1.267	1.940	2.590	3.610	78,739
Credit Spread	0.988	0.288	0.603	0.830	0.933	1.133	3.023	78,739
Leverage	0.370	0.308	1.06e-06	0.126	0.292	0.531	1	78,739
Bank Debt	0.248	0.264	3.46e-07	0.0531	0.161	0.337	1	55,771
Public Debt	0.268	0.297	3.98e-07	0.0372	0.172	0.362	1	62,863
Revolving Credit	0.120	0.153	2.88e-07	0.0242	0.0670	0.159	1	28,910
Term Loan	0.237	0.276	3.46e-07	0.0374	0.133	0.321	1	44,268
Bond and Note	0.308	0.305	2.25e-06	0.0854	0.206	0.407	1	47,309
Commercial Paper	0.0361	0.0387	2.45e-05	0.00959	0.0236	0.0488	0.289	3,128
Capital Lease	0.0339	0.0799	3.98e-07	0.00192	0.00793	0.0298	1	29,287
Other Borrowing	0.0862	0.188	7.35e-08	0.00217	0.0123	0.0721	1	17,593
Total Debt CS	6.166	3.632	-5.263	3.585	5.716	8.357	19.27	40,675
Bank Debt CS	5.348	3.707	-5.014	2.711	4.520	7.352	19.27	35,433
Public Debt CS	6.399	3.643	-5.263	3.929	6.081	8.444	19.27	37,929
Revolving Credit CS	3.889	3.050	-4.634	1.993	3.252	4.894	19.27	17,981
Term Loan CS	5.728	3.764	-5.014	3.001	5.022	7.772	19.27	31,443
Bond and Note CS	6.012	3.499	-5.263	3.694	5.743	8.012	19.27	43,857
Commercial Paper CS	0.495	1.752	-5.078	-0.168	0.285	1.293	12.77	1,903
Capital Lease CS	6.500	4.076	-3.358	3.580	5.721	8.400	19.27	17,125
Other Borrowing CS	5.482	4.191	-5.128	2.397	4.958	7.757	19.27	5,121
CEO Tenure	8.031	7.843	0	3	6	11	39	19,608
Incentives	0.200	0.718	-0.800	-0.167	0.0483	0.329	3.925	19,950
Ownership	0.0306	0.0647	0	0.00131	0.00936	0.0285	0.438	20,329

Table 3.4.3 describes the observation frequencies of product market competition in three ways: industry, competition, and firm size. Columns (1) to (5) (resp. Columns (6) to (10)) refer to the observations of firms under low (resp. high) product market competition, according to five quantiles of the firm size. First, comparing the total number of observations under low and high competition, I find that the numbers of observations under high competition are much more than those under low competition. Second, the number of firms in the manufacturing industry is the largest, followed by the agriculture industry (high competition) and the service industry (low competition). The last two industries with the least number of observations are the trade and transportation industries. Third, generally, there are more observations with large firm sizes under low competition, while under high competition, more observations are firms with small sizes. In short, the table shows the differences in product market competition across various industries and firm sizes, which implies that the empirical analysis needs to consider the effects of different industries.

Table 3.4.3. Observation frequencies in the industry, competition, and firm size

Notes. Table 3.4.3 displays observation frequencies in three ways: industry, competition, and firm size.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Competition	Low	Low	Low	Low	Low	High	High	High	High	High
	Size 1	Size 2	Size 3	Size 4	Size 5	Size 1	Size 2	Size 3	Size 4	Size 5
	Freq	Freq	Freq	Freq	Freq	Freq	Freq	Freq	Freq	Freq
Industry	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
Agriculture	325	300	380	327	188	3,925	3,563	2,774	2,228	1,795
	(8.555)	(7.768)	(7.869)	(5.431)	(3.629)	(32.85)	(29.98)	(25.41)	(22.91)	(16.99)
Manufacturing	1,633	1,959	2,277	3,005	2,493	4,816	5,963	4,994	3,169	4,225
	(42.98)	(50.73)	(47.15)	(49.91)	(48.13)	(40.30)	(50.17)	(45.74)	(32.58)	(39.98)
Transportation	243	193	483	492	576	111	122	531	1,238	2,302
	(6.396)	(4.997)	(10.00)	(8.171)	(11.12)	(0.929)	(1.026)	(4.863)	(12.73)	(21.78)
Trade	257	349	762	1,298	934	253	296	748	999	898
	(6.765)	(9.037)	(15.78)	(21.56)	(18.03)	(2.117)	(2.490)	(6.850)	(10.27)	(8.498)
Service	1,341	1,061	927	899	989	2,844	1,942	1,872	2,093	1,347
	(35.30)	(27.47)	(19.20)	(14.93)	(19.09)	(23.80)	(16.34)	(17.14)	(21.52)	(12.75)
Total	3799	3862	4829	6021	5180	11949	11886	10919	9727	10567

Table 3.4.4. Summary statistics of HHI grouped by industries

Notes. Table 3.4.4 displays the summary statistics of HHI grouped by industries.

Industry	Mean	SD	Min	p25	p50	p75	Max	N
Agriculture	0.1188	0.1126	0.0395	0.0519	0.0824	0.1366	1.0	15,805
Manufacturing	0.1646	0.1664	0.0307	0.0539	0.1003	0.2140	1.0	34,534
Transportation	0.1233	0.0855	0.0279	0.0504	0.0992	0.1870	1.0	6,291
Trade	0.2454	0.1845	0.0632	0.1075	0.1795	0.3276	1.0	6,794
Service	0.1377	0.1381	0.0353	0.0425	0.0807	0.1952	1.0	15,315

Fig. 3.4.1 plots the frequency of three-digit Standard Industrial Classification (SIC) code. One might wonder whether it is necessary to cluster observations by three-digit SIC codes in regressions since when I calculate the HHI index using Compustat data, I carry the calculation at the industry level of the three-digit SIC code. The figure shows that the most of observations distribute almost evenly across the range of SIC codes, except for several clusters.

Fig. 3.4.2 plots the frequencies of firms' leverages that are categorized into two groups according to the product market competition dummy. The left side figure shows that low competition firms take leverages around 0.25 on average. On the contrary, the right-side figure depicts that there are more firms under high competition keeping conservative low leverages near 0, except for the original negative leverages cut by 0 and the original large leverages trimmed by 1. The results imply that among the firms taking leverages within the unity, on average the firms under low competition borrow more amount of debt than the firms under high competition, which only borrow a small amount of debt.

I examine the distributions of HHI. Fig. 3.4.3 shows the scatter plot of HHI over 3-digit SIC codes. There are many observations with low HHI, which indicates that the corresponding firms incur high levels of product market competition. Table 3.4.4 displays the summary statistics of HHI grouped by industries. The agriculture industry has the lowest mean of HHI while the trade industry's mean HHI is the highest.

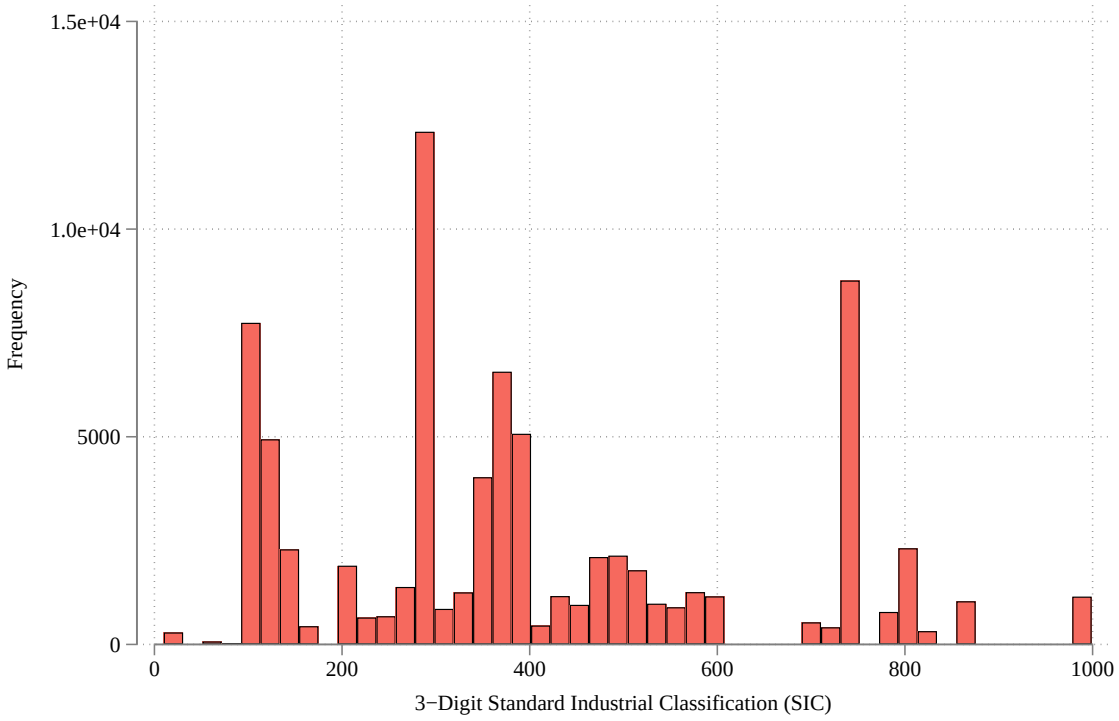


Figure 3.4.1. Frequency of observation based on the 3-digit SIC code

Fig. 3.4.1 plots the frequencies of the observations based on the 3-digit SIC code. One bar collects some industries showing similar frequencies of observations together, which does not necessarily represent one industry. The 3-digit SIC codes of the top 6 industries showing the highest peaks are 700, 393, 328, 254, 323, and 210. No. of industries: 231 (3-digit SIC), 61 (2-digit SIC), and 5 (1-digit SIC). No. of observations: 78,739.

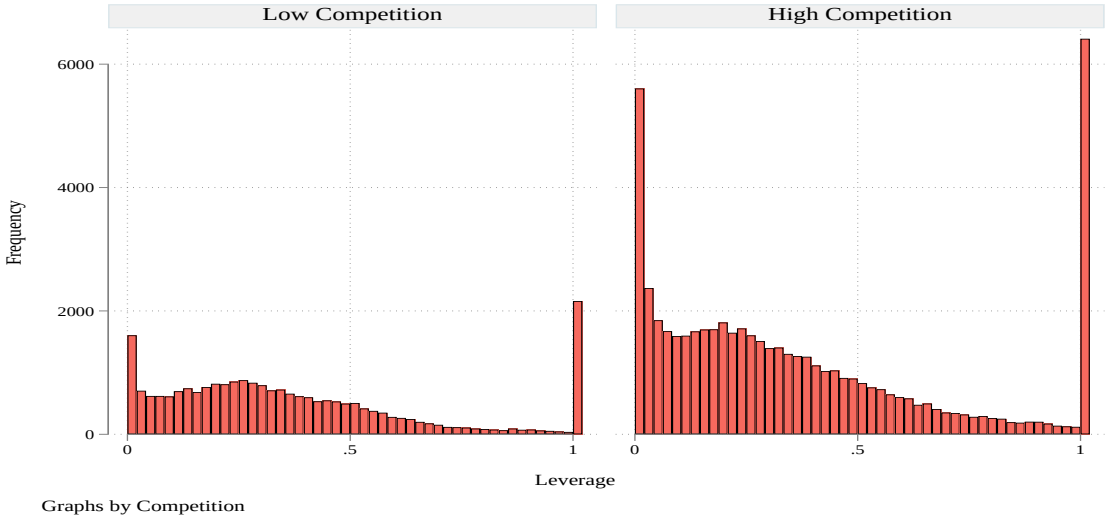


Figure 3.4.2. Frequency of leverage grouped by the product market competition

Fig. 3.4.2 plots the frequencies of firms' leverages within $[0, 1]$ inclusive that are grouped by the product market competition dummy, which is equal to 1 for the firm with the HHI in the first quartile of the HHI for a given year. No. of observations: 78,739, where there are 8,554 leverages over the unity being set to one. The leverages near zero are not zero but some very small values of low leverages near zero, see Table 3.4.2 for the summary statistics.

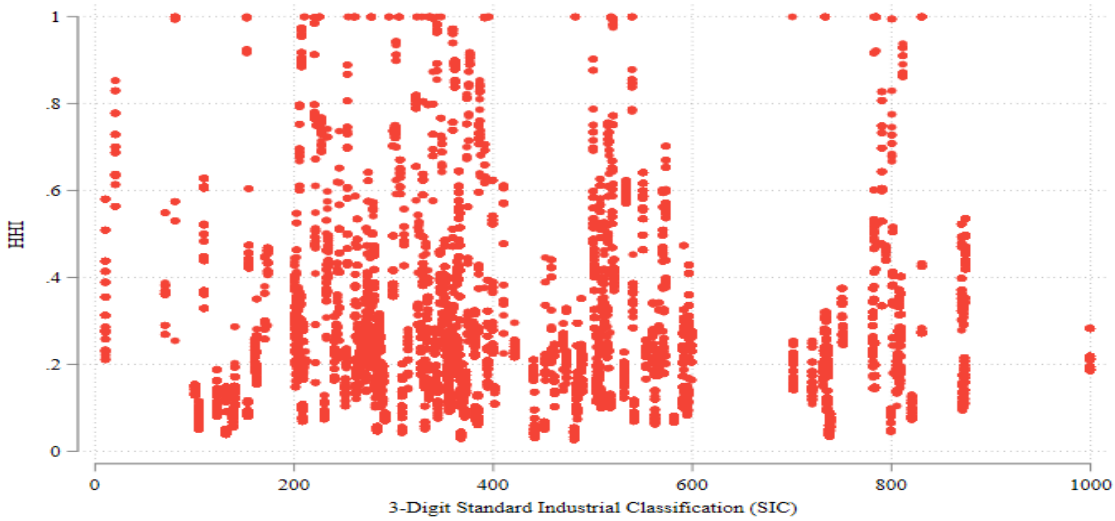


Figure 3.4.3. Scatter plot of HHI over 3-digit SIC codes

Fig. 3.4.3 shows the scatter plot of HHI over 3-digit SIC codes. No. of observations: 78,739.

3.5 Empirical results

In this section, I examine the firms' debt structures and the costs of debt under the effect of product market competition. Overall, the empirical results are displayed in Tables 3.5.1 - 3.5.9 for the corporate debt structure and Tables 3.5.10 - 3.5.18 for credit spreads, which show that all counterfactual hypotheses, H_0^xs, are rejected. Namely, all non-counterfactual hypotheses, H_1^xs, agree with the data, i.e., these hypotheses are not rejected (they are 'accepted'). A detailed discussion that goes through these results and tables is presented as follows.

3.5.1 Product market competition and debt structure

The literature documents the 'substitution effect' that firms substitute some internal pressure with external pressure from banks such as creditors' monitoring. The degree of substitution depends on how the external pressure is relatively stronger than the internal pressure.

For instance, a more competitive product market that imposes pressure on firms significantly makes the firms reduce the external pressures of bank monitoring by cutting the use of bank loans and meanwhile adding the issuance of bonds in the public market (Bharath and Hertzel, 2019). Thus, this chapter examines the debt structure under the effect of product market competition. A competitive product market is indicated by the dummy variable *Competition*, which is one for the firms whose HHIs measuring industry concentration are in the lowest quartile of the HHI for a given year.

Specifically, I examine the effect of product market competition on the relationship between the profit and the ratios of various types of debt to the total book asset, including leverage. In this way, I examine the leverage puzzle through the channel of market competition and debt structure. In the analysis, I mainly focus on the Tobit regression model for censored dependent variables since I limit the corporate leverage and debt ratios to the unity similar to Lemmon et al. (2008) and Colla et al. (2013). As a *benchmark*, I provide the results of ordinary least squares (OLS) regressions in each regression table.

I control for the variables of firm characteristics and economic conditions in model specifications. Besides, I use three additional variables to control the effects of executive

characteristics, which are constructed in a way similar to the references on the capital structure and executive characteristics (e.g., Morellec et al., 2012). I consider these control variables in one specification only since the sample sizes of these variables are much smaller than the sizes of company fundamentals.

To sum up, in Tables 3.5.1 to 3.5.8, I provide 6 columns for 6 regression settings for debt ratios, see the equations in Section 3.3. Column (1) is the benchmark Tobit model without *Competition* and its interaction with *Profit*. Including *Competition* and its interaction with *Profit*, Column (2) lists the main results using the Tobit model since dependent variables are censored. Column (3) is the benchmark with the OLS regression. As a comparison, Column (4) or (5) presents results with fewer control variables and Column (5) uses the HHI indicating the product market competition. Finally, Column (6) is the Tobit model controlling the effects of three additional variables about executive characteristics.

3.5.1.1 The reduction of leverage, bank debt, revolving credit, term loans, and capital leases caused by product market competition

To begin with, Hypothesis H_1^1 states that there is a negative relationship, $\beta_1 < 0$, between product market competition and leverage/bank debt/revolving credit/term loans/capital leases. Tables 3.5.1, 3.5.2, 3.5.3, 3.5.4, and 3.5.5 show that Hypothesis 1 agrees with the results. For example, Columns (2), (3), (4), and (6) of Table 3.5.1 display that there is a significantly negative relationship, such as $\beta_1 = -0.025 < 0$ in the main result of the Tobit regression, between the leverage and the *Competition* dummy. When the *Competition* dummy is 1, it indicates the firms that encounter intense product market competition, where the HHI is in the lowest quartile since a low level of HHI implies weak industry concentration and thereby strong competition pressure. Hence, when the product market competition is measured by the HHI in Column (5), the significant positive coefficient of the HHI is consistent with the empirical results with the *Competition* dummy in Columns (2), (3), (4), and (6).

To reveal how the product market competition impacts leverage through different types of debt, I study the effects of the product market competition on different components of leverage. Through decomposing the leverage into the ratios of bank debt and public debt to the asset, I run similar analyses and obtain the results of bank debt

in Table 3.5.2. It shows that the relationship between market competition and bank debt is significantly negative at about $\beta_1 = -0.02$.

Furthermore, after investigating the details of bank debt and public debt from the perspective of six types of specific debt, I find that the relationships between the market competition and the revolving credit and term loans of bank debt or the relationships between the market competition and the capital leases of public debt are significantly negative at about $\beta_1 = -0.014$ in Table 3.5.3 for revolving credit and $\beta_1 = -0.008$ in Table 3.5.4 and Table 3.5.5 for term loans the capital leases.

The underlying mechanism for the above regression results is that a competitive product market reduces firms' leverages by decreasing total bank debt of revolving credit and term loans from banks, through which the firms can decrease the external pressures of bank monitoring, meanwhile the firms reduce their capital leases slightly from the public market as well.

In addition, the decrease in the three types of debt in a competitive product market complements the leverage puzzle. Tables 3.5.1, 3.5.2, 3.5.3, 3.5.4, and 3.5.5 exhibit that the leverage puzzle exist in bank debt, revolving credit, and term loans as the relationships between the profit and these types of debt are negative at about $\beta_3 = -0.251$, $\beta_3 = -0.117$, $\beta_3 = -0.196$, $\beta_3 = -0.14$, and $\beta_3 = -0.049$ respectively. Hence, the product market competition complements the negative ($\beta_3 < 0$) relationship between the firms' profits and leverage/bank debt/revolving credit/capital leases by decreasing ($\beta_1 < 0$) their revolving credit in general.

Table 3.5.1. Market competition and leverage

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Leverage	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.025***	-0.024***	-0.034***		-0.039***
		(0.002)	(0.001)	(0.002)		(0.004)
Comp×Profit		0.075***	0.034***	0.075***		1.041***
		(0.015)	(0.010)	(0.015)		(0.117)
HHI					0.048***	
					(0.006)	
Profit	-0.192***	-0.251***	-0.150***	-0.371***	-0.312***	-0.188
	(0.018)	(0.020)	(0.015)	(0.018)	(0.015)	(0.121)
Size	0.010***	0.011***	0.011***	0.009***	0.009***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tangible	0.020***	0.028***	0.029***	0.049***	0.044***	0.103***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.010)
MV/BV	0.058***	0.059***	0.051***	0.056***	0.055***	0.090***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.226***	-0.214***	-0.179***	-0.191***	-0.202***	-0.396***
	(0.029)	(0.029)	(0.026)	(0.030)	(0.030)	(0.073)
Z-Score	-0.030***	-0.030***	-0.028***	-0.030***	-0.030***	-0.062***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.025***	-0.024***	-0.024***	-0.035***	-0.036***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.013***	-0.013***	-0.013***			-0.020***
	(0.001)	(0.001)	(0.001)			(0.002)
Cash	-0.165***	-0.155***	-0.124***			-0.240***
	(0.008)	(0.008)	(0.007)			(0.015)
Tax	-0.825***	-0.888***	-1.100***			-1.472***
	(0.133)	(0.132)	(0.130)			(0.235)
Earnings Vol.	0.366***	0.361***	0.264***			0.805***
	(0.021)	(0.021)	(0.016)			(0.125)
Gr. (S&P500)	-0.036	-0.037	-0.036			-0.018
	(0.041)	(0.041)	(0.040)			(0.057)
Gr. (GDP)	-0.139	-0.148	-0.154			-0.497
	(0.440)	(0.439)	(0.427)			(0.707)
Term Spread	-0.002	-0.002	-0.002			-0.008**
	(0.002)	(0.002)	(0.002)			(0.004)
Credit Spread	0.003	0.003	0.000			-0.005
	(0.007)	(0.007)	(0.006)			(0.009)
CEO Tenure						-0.000
						(0.000)
Exe. Incentive						0.001
						(0.002)
Exe. Ownership						0.085***
						(0.014)
Constant	0.341***	0.353***	0.350***	0.269***	0.297***	0.293***
	(0.002)	(0.013)	(0.012)	(0.007)	(0.002)	(0.015)
Observations	78,739	78,739	78,739	78,739	78,739	19,505
Pseudo/Adj. R^2	0.575	0.578	0.383	0.553	0.549	-3.842

Table 3.5.2. Market competition and bank debt

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Bank D.	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.020***	-0.019***	-0.020***		0.007
		(0.002)	(0.001)	(0.001)		(0.005)
Comp×Profit		-0.031*	-0.036**	-0.032*		-0.092
		(0.018)	(0.014)	(0.017)		(0.132)
HHI					0.033***	
					(0.006)	
Profit	-0.139***	-0.117***	-0.082***	-0.181***	-0.203***	0.611***
	(0.020)	(0.023)	(0.019)	(0.019)	(0.016)	(0.111)
Size	-0.015***	-0.015***	-0.014***	-0.015***	-0.015***	-0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tangible	0.025***	0.031***	0.029***	0.028***	0.025***	-0.019***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)
MV/BV	0.029***	0.030***	0.028***	0.031***	0.031***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.179***	-0.171***	-0.152***	-0.148***	-0.152***	-0.272***
	(0.025)	(0.025)	(0.024)	(0.025)	(0.026)	(0.035)
Z-Score	-0.017***	-0.017***	-0.016***	-0.017***	-0.017***	-0.028***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.020***	-0.020***	-0.018***	-0.020***	-0.020***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	-0.026***	-0.026***	-0.026***			-0.043***
	(0.001)	(0.001)	(0.001)			(0.001)
Cash	-0.048***	-0.040***	-0.040***			-0.249***
	(0.008)	(0.008)	(0.007)			(0.010)
Tax	-0.258*	-0.300**	-0.408***			-1.605***
	(0.140)	(0.139)	(0.134)			(0.307)
Earnings Vol.	0.175***	0.174***	0.136***			0.290**
	(0.020)	(0.020)	(0.018)			(0.124)
Gr. (S&P500)	-0.069	-0.069	-0.069			-0.056
	(0.051)	(0.051)	(0.051)			(0.046)
Gr. (GDP)	-0.213	-0.207	-0.226			-0.777
	(0.469)	(0.468)	(0.462)			(0.548)
Term Spread	-0.007***	-0.007***	-0.007***			-0.007***
	(0.002)	(0.002)	(0.002)			(0.002)
Credit Spread	-0.004	-0.004	-0.005			-0.007
	(0.007)	(0.007)	(0.007)			(0.007)
CEO Tenure						0.000
						(0.000)
Exe. Incentive						0.005***
						(0.002)
Exe. Ownership						0.118***
						(0.017)
Constant	0.410***	0.418***	0.415***	0.312***	0.296***	0.473***
	(0.011)	(0.002)	(0.011)	(0.005)	(0.002)	(0.015)
Observations	55,771	55,771	55,771	55,771	55,771	13,216
Pseudo/Adj. R^2	0.885	0.889	0.320	0.849	0.846	-0.352

Table 3.5.3. Market competition and revolving credit

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
R. Credit	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.014***	-0.014***	-0.015***		-0.031***
		(0.002)	(0.002)	(0.002)		(0.005)
Comp×Profit		0.051	0.042	0.057		0.889***
		(0.039)	(0.036)	(0.039)		(0.138)
HHI					0.055***	
					(0.004)	
Profit	-0.158***	-0.196***	-0.183***	-0.232***	-0.192***	-0.680***
	(0.028)	(0.036)	(0.034)	(0.040)	(0.026)	(0.103)
Size	-0.017***	-0.017***	-0.017***	-0.017***	-0.017***	-0.021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Tangible	0.052***	0.056***	0.056***	0.059***	0.060***	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
MV/BV	0.016***	0.016***	0.016***	0.017***	0.017***	0.012***
	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Investment	-0.071**	-0.063**	-0.061**	-0.055*	-0.056*	-0.047*
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)
Z-Score	-0.006***	-0.006***	-0.006***	-0.006***	-0.006***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.005***	-0.005***	-0.005***	-0.006***	-0.007***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.005***	-0.005***	-0.005***			0.003***
	(0.001)	(0.001)	(0.001)			(0.001)
Cash	-0.057***	-0.050***	-0.052***			-0.139***
	(0.009)	(0.009)	(0.009)			(0.010)
Tax	0.351***	0.332***	0.321***			0.365**
	(0.077)	(0.076)	(0.076)			(0.182)
Earnings Vol.	0.111**	0.106**	0.097**			0.363***
	(0.049)	(0.049)	(0.047)			(0.105)
Gr. (S&P500)	-0.025	-0.025	-0.024			-0.013
	(0.025)	(0.025)	(0.025)			(0.019)
Gr. (GDP)	-0.067	-0.068	-0.070			-0.212
	(0.219)	(0.219)	(0.217)			(0.165)
Term Spread	-0.000	0.000	0.000			-0.001
	(0.001)	(0.001)	(0.001)			(0.001)
Credit Spread	-0.004	-0.003	-0.003			-0.001
	(0.004)	(0.004)	(0.004)			(0.003)
CEO Tenure						0.001***
						(0.000)
Exe. Incentive						-0.002*
						(0.001)
Exe. Ownership						0.100***
						(0.017)
Constant	0.219***	0.223***	0.223***	0.136***	0.136***	0.242***
	(0.001)	(0.001)	(0.005)	(0.001)	(0.004)	(0.007)
Observations	28,910	28,910	28,910	28,910	28,910	9,032
Pseudo/Adj. R^2	-0.318	-0.321	0.234	-0.316	-0.317	-0.116

Table 3.5.4. Market competition and term loans

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
T. Loan	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.008***	-0.007***	-0.007***		0.037***
		(0.002)	(0.002)	(0.002)		(0.006)
Comp×Profit		-0.008	-0.014	-0.010		-0.744***
		(0.018)	(0.014)	(0.018)		(0.174)
HHI					-0.011*	
					(0.006)	
Profit	-0.146***	-0.140***	-0.104***	-0.227***	-0.234***	1.318***
	(0.023)	(0.027)	(0.023)	(0.023)	(0.019)	(0.154)
Size	-0.012***	-0.012***	-0.011***	-0.012***	-0.012***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Tangible	0.027***	0.029***	0.028***	0.017***	0.015***	-0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)
MV/BV	0.034***	0.035***	0.032***	0.037***	0.037***	0.032***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.135***	-0.131***	-0.111***	-0.112***	-0.117***	-0.213***
	(0.029)	(0.029)	(0.027)	(0.031)	(0.031)	(0.051)
Z-Score	-0.017***	-0.018***	-0.017***	-0.018***	-0.018***	-0.032***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.020***	-0.020***	-0.018***	-0.018***	-0.018***	0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	-0.024***	-0.024***	-0.024***			-0.049***
	(0.001)	(0.001)	(0.001)			(0.002)
Cash	0.002	0.005	0.004			-0.165***
	(0.009)	(0.008)	(0.007)			(0.012)
Tax	-0.127	-0.144	-0.281**			-1.965***
	(0.147)	(0.146)	(0.137)			(0.451)
Earnings Vol.	0.208***	0.207***	0.166***			0.253**
	(0.023)	(0.023)	(0.020)			(0.126)
Gr. (S&P500)	-0.066	-0.066	-0.064			-0.043
	(0.043)	(0.043)	(0.042)			(0.044)
Gr. (GDP)	-0.114	-0.112	-0.140			-0.655
	(0.379)	(0.380)	(0.373)			(0.554)
Term Spread	-0.006***	-0.006***	-0.006***			-0.004*
	(0.002)	(0.002)	(0.002)			(0.002)
Credit Spread	0.004	0.004	0.002			-0.002
	(0.006)	(0.006)	(0.006)			(0.006)
CEO Tenure						-0.000
						(0.000)
Exe. Incentive						0.008***
						(0.002)
Exe. Ownership						0.012
						(0.023)
Constant	0.336***	0.238***	0.336***	0.257***	0.257***	0.409***
	(0.011)	(0.011)	(0.010)	(0.002)	(0.002)	(0.016)
Observations	44,268	44,268	44,268	44,268	44,268	9,043
Pseudo/Adj. R^2	0.767	0.768	0.342	0.737	0.737	-0.409

Table 3.5.5. Market competition and capital leases

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
C. Lease	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.008***	-0.008***	-0.007***		-0.006*
		(0.002)	(0.002)	(0.002)		(0.003)
Comp×Profit		0.048***	0.048**	0.041***		0.003
		(0.006)	(0.019)	(0.008)		(0.071)
HHI					0.009*	
					(0.005)	
Profit	-0.010	-0.049***	-0.049***	-0.059***	-0.027***	0.014
	(0.007)	(0.009)	(0.017)	(0.014)	(0.010)	(0.072)
Size	-0.003***	-0.003***	-0.003***	-0.003***	-0.003***	-0.006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Tangible	0.075***	0.078***	0.078***	0.078***	0.077***	0.078***
	(0.005)	(0.004)	(0.007)	(0.004)	(0.005)	(0.017)
MV/BV	0.006***	0.006***	0.006***	0.008***	0.008***	0.006***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Investment	-0.176***	-0.173***	-0.172***	-0.187***	-0.190***	-0.197**
	(0.020)	(0.020)	(0.032)	(0.031)	(0.032)	(0.079)
Z-Score	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current Ratio	-0.003***	-0.003***	-0.003***	-0.001***	-0.001***	-0.004***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)
Age	-0.003***	-0.003***	-0.003***			-0.002
	(0.001)	(0.001)	(0.001)			(0.001)
Cash	0.003	0.008**	0.008***			0.023***
	(0.003)	(0.004)	(0.003)			(0.004)
Tax	0.070	0.060	0.060			-0.171**
	(0.049)	(0.050)	(0.052)			(0.083)
Earnings Vol.	0.037***	0.033***	0.033***			0.031
	(0.006)	(0.007)	(0.012)			(0.053)
Gr. (S&P500)	0.051*	0.051*	0.051*			0.062*
	(0.028)	(0.028)	(0.030)			(0.036)
Gr. (GDP)	-0.177	-0.183	-0.183			-0.271
	(0.317)	(0.318)	(0.329)			(0.374)
Term Spread	-0.014***	-0.014***	-0.014***			-0.015***
	(0.002)	(0.002)	(0.002)			(0.004)
Credit Spread	0.003	0.003	0.003			0.002
	(0.004)	(0.004)	(0.004)			(0.004)
CEO Tenure						-0.000***
						(0.000)
Exe. Incentive						-0.000
						(0.001)
Exe. Ownership						-0.003
						(0.005)
Constant	0.062***	0.074***	0.065***	0.030***	0.076***	0.085***
	(0.001)	(0.008)	(0.009)	(0.001)	(0.001)	(0.019)
Observations	29,287	29,287	29,287	29,287	29,287	8,272
Pseudo/Adj. R^2	-0.0644	-0.0660	0.135	-0.0458	-0.0447	-0.0653

3.5.1.2 The rise of bonds, notes, and other borrowings caused by product market competition

Next, Hypothesis 2 H_1^2 states that there is a positive relationship, $\beta_1 > 0$, between product market competition and bonds and notes/other borrowings. Tables 3.5.6 and 3.5.7 show that Hypothesis 2 agrees with the results. For example, the 'Competition' row of Table 3.5.6 (or 3.5.7) displays that there is a significantly positive relationship between the bonds and notes (or other borrowings) of public debt and the market competition at about $\beta_1 = 0.004$ (or 0.011) in Table 3.5.6 (or 3.5.7). The underlying mechanism for the above regression results is that a competitive product market makes firms raise their bonds and notes as well as other borrowings from the public market, through which the firms decrease the external pressures of bank monitoring from bank debt.

In addition, the increase in the two types of debt in a competitive product market mitigates the leverage puzzle. Tables 3.5.6 and 3.5.7 exhibit that the leverage puzzle exists in bonds and notes, and other borrowings as the relationships between the profit and these types of debt are negative at about $\beta_3 = -0.289$ and $\beta_3 = -0.097$ respectively. Hence, the product market competition mitigates the negative ($\beta_3 < 0$) relationship between the firms' profits and bonds and notes/other borrowings by increasing ($\beta_1 > 0$) their bonds and notes/other borrowings in general.

Table 3.5.6. Market competition and bonds and notes

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Bond	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		0.002	0.004**	0.003		-0.030***
		(0.002)	(0.002)	(0.002)		(0.005)
Comp×Profit		0.088***	0.053***	0.098***		1.037***
		(0.020)	(0.013)	(0.020)		(0.140)
HHI					-0.029***	
					(0.005)	
Profit	-0.222***	-0.289***	-0.194***	-0.456***	-0.381***	-0.293**
	(0.018)	(0.020)	(0.015)	(0.018)	(0.013)	(0.120)
Size	0.005***	0.005***	0.005***	0.003***	0.003***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tangible	-0.019***	-0.020***	-0.015***	-0.026***	-0.027***	0.035***
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.009)
MV/BV	0.056***	0.057***	0.052***	0.061***	0.061***	0.083***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.116***	-0.117***	-0.087**	-0.094**	-0.096**	0.080
	(0.043)	(0.044)	(0.040)	(0.043)	(0.042)	(0.077)
Z-Score	-0.028***	-0.028***	-0.026***	-0.028***	-0.028***	-0.054***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Current Ratio	-0.013***	-0.013***	-0.011***	-0.014***	-0.014***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	0.001	0.000	0.000			0.006***
	(0.001)	(0.001)	(0.001)			(0.002)
Cash	0.020*	0.019*	0.020**			0.019
	(0.011)	(0.010)	(0.008)			(0.017)
Tax	0.095	0.107	-0.148			-0.684***
	(0.137)	(0.138)	(0.121)			(0.170)
Earnings Vol.	0.377***	0.375***	0.276***			0.685***
	(0.022)	(0.022)	(0.017)			(0.130)
Gr. (S&P500)	-0.009	-0.009	-0.008			0.001
	(0.035)	(0.035)	(0.034)			(0.038)
Gr. (GDP)	0.164	0.159	0.144			-0.005
	(0.288)	(0.288)	(0.283)			(0.443)
Term Spread	0.004***	0.004***	0.004***			0.002
	(0.001)	(0.001)	(0.001)			(0.002)
Credit Spread	0.007	0.007	0.005			-0.006
	(0.006)	(0.006)	(0.005)			(0.006)
CEO Tenure						-0.000
						(0.000)
Exe. Incentive						0.000
						(0.002)
Exe. Ownership						-0.051**
						(0.022)
Constant	0.164***	0.162***	0.163***	0.205***	0.214***	0.096***
	(0.003)	(0.012)	(0.011)	(0.007)	(0.007)	(0.017)
Observations	47,309	47,309	47,309	47,309	47,309	14,387
Pseudo/Adj. R^2	0.676	0.677	0.427	0.658	0.657	-0.691

Table 3.5.7. Market competition and other borrowings

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Other	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		0.011***	0.011***	0.014***		-0.017***
		(0.002)	(0.002)	(0.002)		(0.006)
Comp×Profit		-0.129***	-0.117***	-0.137***		0.277
		(0.047)	(0.044)	(0.048)		(0.178)
HHI					-0.052***	
					(0.006)	
Profit	-0.203***	-0.097*	-0.093*	-0.250***	-0.363***	-0.537***
	(0.035)	(0.052)	(0.050)	(0.046)	(0.022)	(0.179)
Size	-0.007***	-0.007***	-0.007***	-0.008***	-0.008***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tangible	0.012*	0.008	0.009	-0.002	-0.001	0.091***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)
MV/BV	0.014***	0.013***	0.013***	0.019***	0.019***	0.028***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.035	-0.043	-0.038	-0.009	-0.009	-0.166**
	(0.043)	(0.044)	(0.043)	(0.046)	(0.046)	(0.079)
Z-Score	-0.009***	-0.009***	-0.009***	-0.008***	-0.008***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.017***	-0.017***	-0.016***	-0.016***	-0.015***	-0.007***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.003**	-0.003**	-0.003**			0.014***
	(0.001)	(0.001)	(0.001)			(0.002)
Cash	0.064**	0.061**	0.059**			0.053***
	(0.025)	(0.025)	(0.024)			(0.016)
Tax	1.247***	1.213***	1.164***			0.867***
	(0.196)	(0.204)	(0.197)			(0.186)
Earnings Vol.	0.329***	0.327***	0.309***			-0.349***
	(0.037)	(0.037)	(0.035)			(0.101)
Gr. (S&P500)	-0.039	-0.039	-0.039			-0.057
	(0.071)	(0.071)	(0.070)			(0.079)
Gr. (GDP)	0.416	0.421	0.424			0.687
	(0.808)	(0.808)	(0.804)			(0.915)
Term Spread	0.000	0.000	0.000			0.002
	(0.003)	(0.003)	(0.003)			(0.003)
Credit Spread	0.020*	0.020*	0.019*			0.023**
	(0.011)	(0.011)	(0.011)			(0.011)
CEO Tenure						-0.000
						(0.000)
Exe. Incentive						0.001
						(0.002)
Exe. Ownership						-0.157***
						(0.021)
Constant	0.156***	0.156***	0.099***	0.131***	0.148***	-0.050**
	(0.002)	(0.019)	(0.019)	(0.007)	(0.002)	(0.020)
Observations	17,593	17,593	17,593	17,593	17,593	7,784
Pseudo/Adj. R^2	-1.238	-1.248	0.343	-1.174	-1.169	-0.0486

3.5.1.3 Profitability, product market competition, and the leverage puzzle

I am interested in whether product market competition affects the leverage puzzle directly via its interaction with profitability. To answer this question, I examine the interaction item between the profit and the competition indicator, $Profit \times Competition$.

Hypothesis 3 H_1^3 states that there is a negative relationship, $\beta_2 < 0$, between profitability and bank debt/other borrowings/commercial papers for the firms in a more competitive product market. Tables 3.5.2, 3.5.7 and 3.5.8 show that Hypothesis 3 agrees with the results. For example, Table 3.5.2 or 3.5.7 displays that there is a significantly negative relationship at about $\beta_2 = -0.031$ or $\beta_2 = -0.129$ between the ratio of bank debt or other borrowings to assets and the interaction term. Similarly, Table 3.5.8 displays a significantly negative relationship between the ratio of commercial papers to assets and the interaction term.

Table 3.5.8. Market competition and commercial papers

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
C. Paper	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		0.090	0.429	0.097		-0.038
		(0.071)	(0.293)	(0.070)		(0.088)
Comp×Profit		-6.821***	-10.980	-6.952***		-4.666**
		(1.874)	(7.956)	(1.851)		(2.273)
HHI					0.328***	
					(0.121)	
Profit	-2.161	2.551	-4.598	2.692	-1.805	-0.781
	(1.402)	(2.024)	(8.196)	(1.882)	(1.271)	(2.219)
Size	-0.118***	-0.111***	-0.925***	-0.105***	-0.111***	-0.140***
	(0.016)	(0.016)	(0.077)	(0.016)	(0.016)	(0.020)
Tangible	-0.302***	-0.254***	-2.202***	-0.282***	-0.281***	-0.326***
	(0.085)	(0.084)	(0.328)	(0.081)	(0.081)	(0.115)
MV/BV	0.208***	0.205***	1.160***	0.225***	0.229***	0.127**
	(0.056)	(0.056)	(0.207)	(0.054)	(0.054)	(0.062)
Investment	1.216***	1.440***	2.540	1.504***	1.340***	1.481**
	(0.447)	(0.446)	(2.059)	(0.442)	(0.449)	(0.728)
Z-Score	0.025	0.030	-0.233**	0.023	0.015	0.085**
	(0.030)	(0.030)	(0.098)	(0.028)	(0.028)	(0.034)
Current Ratio	-0.220***	-0.222***	-1.619***	-0.205***	-0.208***	-0.257***
	(0.035)	(0.034)	(0.150)	(0.031)	(0.032)	(0.043)
Age	-0.035	-0.031	0.080			-0.051
	(0.036)	(0.035)	(0.091)			(0.059)
Cash	0.199	0.393	3.187**			0.976***
	(0.303)	(0.296)	(1.336)			(0.356)
Tax	1.530	0.645	42.830***			1.270
	(2.715)	(2.679)	(12.064)			(2.824)
Earnings Vol.	2.728	0.888	-3.496			-1.632
	(2.441)	(2.387)	(8.081)			(3.353)
Gr. (S&P500)	-0.415	-0.372	-4.001***			-0.228
	(0.290)	(0.297)	(1.387)			(0.369)
Gr. (GDP)	-1.217	-1.455	-0.005			-1.594
	(3.108)	(3.125)	(14.516)			(3.805)
Term Spread	-0.030**	-0.027**	-0.139*			-0.022
	(0.013)	(0.014)	(0.071)			(0.016)
Credit Spread	-0.016	-0.009	-0.149			-0.020
	(0.037)	(0.036)	(0.165)			(0.046)
CEO Tenure						0.006*
						(0.004)
Exe. Incentive						-0.079***
						(0.030)
Exe. Ownership						-2.369***
						(0.574)
Constant	0.683***	2.607***	13.572***	2.367***	2.445***	3.152***
	(0.236)	(0.013)	(0.928)	(0.191)	(0.188)	(0.367)
Observations	3,128	3,128	3,128	3,128	3,128	2,261
Pseudo/Adj. R^2	0.0663	0.0734	0.194	0.0713	0.0660	0.0938

On the contrary, Hypothesis 4, H_1^4, states that there is a positive relationship, $\beta_2 > 0$, between profitability and leverage/bonds and notes/capital leases/public debt for the firms in a more competitive product market. Tables 3.5.1, 3.5.5, 3.5.6, and 3.5.9 demonstrate that Hypothesis 4 agrees with the results. The results suggest that when the firms are in a more competitive product market and produce more profits, they raise their leverages by increasing their public debt of bonds and notes as well as capital leases for weakening the external pressures of bank monitoring.

To reveal how the product market competition impacts the leverage puzzle through different types of debt, I decompose the leverage into the ratios of bank debt and public debt to the asset. I discover that the relationship between public debt and the interaction term is positive at $\beta_2 = 0.078$ in Table 3.5.9. Furthermore, after investigating the details of public debt, I find that the relationships between the bonds and notes or capital leases of public debt and the interaction item are significantly positive at about $\beta_2 = 0.048$ or $\beta_2 = 0.088$ in Table 3.5.5 or Table 3.5.6.

The underlying mechanism for the above regression results is that when the firms are in a more competitive product market and produce more profits, they raise their leverages by increasing their total public debt from the public market for weakening the external pressures of bank monitoring. Namely, product market competition attenuates (i.e., mitigates) the negative ($\beta_3 < 0$) relationship between the firms' profits and leverage/public debt/bonds and notes/capital leases by increasing ($\beta_2 > 0$) these types of debt when these firms' profits are high. In fact, the firms that make profits in an intense competition environment are in an advantageous position to borrow higher debt and take higher leverage.

In brief, the results exhibit that the firms in a more competitive product market significantly reduce the external pressures of bank monitoring by raising bonds and notes as well as capital leases in the public market. The final effect is that product market competition attenuates the leverage puzzle of the negative relationship between profitability and leverage.

Table 3.5.9. Market competition and public debt

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
Public D.	Tobit	Tobit	OLS	Tobit	Tobit	Tobit
Comp		-0.003*	-0.003	-0.008***		-0.036***
		(0.002)	(0.002)	(0.002)		(0.004)
Comp×Profit		0.078***	0.049***	0.087***		0.902***
		(0.017)	(0.012)	(0.018)		(0.125)
HHI					-0.005	
					(0.008)	
Profit	-0.248***	-0.308***	-0.225***	-0.500***	-0.432***	-0.265**
	(0.017)	(0.021)	(0.016)	(0.019)	(0.014)	(0.113)
Size	0.012***	0.012***	0.013***	0.010***	0.009***	0.027***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Tangible	0.014***	0.014***	0.018***	0.023***	0.021***	0.100***
	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.010)
MV/BV	0.055***	0.055***	0.051***	0.058***	0.057***	0.079***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Investment	-0.191***	-0.189***	-0.166***	-0.176***	-0.181***	-0.130*
	(0.035)	(0.035)	(0.033)	(0.034)	(0.034)	(0.073)
Z-Score	-0.025***	-0.025***	-0.024***	-0.025***	-0.025***	-0.048***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current Ratio	-0.017***	-0.017***	-0.016***	-0.023***	-0.024***	0.004**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Age	0.010***	0.010***	0.010***			0.015***
	(0.001)	(0.001)	(0.001)			(0.002)
Cash	-0.046***	-0.045***	-0.033***			0.051***
	(0.013)	(0.013)	(0.011)			(0.014)
Tax	0.316***	0.314***	0.099			-0.485***
	(0.119)	(0.120)	(0.108)			(0.164)
Earnings Vol.	0.462***	0.459***	0.367***			0.854***
	(0.021)	(0.021)	(0.017)			(0.122)
Gr. (S&P500)	-0.019	-0.019	-0.016			0.001
	(0.026)	(0.026)	(0.024)			(0.029)
Gr. (GDP)	0.185	0.179	0.165			0.232
	(0.221)	(0.222)	(0.209)			(0.283)
Term Spread	0.005***	0.005***	0.005***			-0.002
	(0.001)	(0.001)	(0.001)			(0.002)
Credit Spread	0.008**	0.008**	0.006*			0.003
	(0.004)	(0.004)	(0.003)			(0.004)
CEO Tenure						-0.000
						(0.000)
Exe. Incentive						-0.000
						(0.002)
Exe. Ownership						-0.070***
						(0.023)
Constant	0.250***	0.081***	0.080***	0.254***	0.161***	-0.064***
	(0.003)	(0.003)	(0.008)	(0.006)	(0.007)	(0.013)
Observations	62,863	62,863	62,863	62,863	62,863	17,675
Pseudo/Adj. R^2	0.679	0.680	0.388	0.645	0.643	-0.943

3.5.2 Product market competition and the costs of debt

Valta (2012) finds that competitive product markets systematically affect firms' costs of bank debt, especially in industries with small firms, stable rivals, frequent strategic interactions, and liquidity shortages. Bharath and Hertzel (2019) illustrate that in a more competitive product market, firms encounter high external pressure and therefore the firms reduce the external pressures of bank monitoring by shifting debt from bank loans to bonds in the public market. Platt (2020) reveals that corporate bondholders demand significantly larger credit spreads from firms facing increased competition.

The previous studies motivate this chapter to examine the costs of nine types of debt and combinations by investigating the effect of product market competition on the credit spreads of various types of debt. I capture this effect by regressing credit spreads on competition along with other firm characteristics and economic conditions. In this section about credit spreads, there is no interaction term between competition and profitability because there is no financial theory supporting this specification. It might seem like a logical extension of the aforementioned Section 3.5.1 to include the interaction term here, but the interaction term with profitability is only meaningful when I examine the leverage puzzle about the relationship between debt ratios and profitability. Hence, I do not have the interactions between credit spreads and profitability in the model specifications about credit spreads. I measure the credit spread by the variable $CS_{f,i,t}$, which is the credit spread of the weighted average interest rate of a specific type of debt over LIBOR.

Hypothesis 5, H_1^5, states that there is a positive relationship, $\beta_1 > 0$, between product market competition and the credit spread of total debt/bank debt/public debt / revolving credit/term loans/bonds and notes/capital leases/other borrowings. Tables 3.5.10, 3.5.11, 3.5.12, 3.5.13, 3.5.14, 3.5.15, 3.5.17, and 3.5.18 show that Hypothesis 5 agrees with the results. An exception is a negative coefficient in Table 3.5.16 for commercial papers.

In Tables 3.5.10 to 3.5.18, I provide 6 columns for 6 regression settings for the costs of debt, see the equations in Section 3.3. Column (1) is the benchmark model with the 3-digit SIC industry and year fixed effects without *Competition*. Including *Com-*

petition, Column (2) lists the main results using the industry-year fixed-effect model. Column (3) is the benchmark with the OLS regression. As a comparison, Column (4) or (5) presents results with fewer control variables, and Column (5) uses the HHI indicating the product market competition. Finally, Column (6) is the model controlling the effects of three additional variables about executive characteristics. For example, Columns (2) of Table 3.5.10 displays that there is a significant positive relationship, about $\beta_1 = 0.683 > 0$, between the credit spread of total debt and competition, in the panel-data regression models with the industry and year fixed effects.

To reveal how the product market competition impacts the debt costs through different types of debt, I decompose the credit spread of total debt into the credit spreads of bank debt and public debt firstly. I discover that the relationship between the credit spread of bank debt (resp. the credit spread of public debt) and competition is significantly positive at $\beta_2 = 0.453$ (resp. $\beta_2 = 0.633$) in Table 3.5.11 (resp. Table 3.5.12). Furthermore, after investigating the details of bank debt and public debt from the prospective of six types of specific debt, I find that the relationships between product market competition and the credit spread of revolving credit/term loans/bonds and notes/capital leases/other borrowings are all significantly positive in Tables 3.5.13, 3.5.14, 3.5.15, 3.5.17, and 3.5.18.

The underlying mechanism is that when the product market competition is high, firms have to pay higher credit spreads for both bank debt and public debt. The credit spreads of bank debt rise since the firms' risks are high in a more competitive environment. The credit spreads of public debt increase in a more competitive environment as the firms have to reduce the external monitoring pressure. Then, the firms shift bank debt with high external pressure to public debt with low external pressure. To this end, the firms pay larger costs for public debt.

Table 3.5.10. Analysis about the credit spread of total debt

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of TD	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.683***	0.437***	0.684***		0.277***
		(0.107)	(0.029)	(0.109)		(0.084)
HHI					-3.222***	
					(0.430)	
Profit	0.120	0.117	-0.015	0.188	0.193*	-0.269
	(0.137)	(0.137)	(0.150)	(0.115)	(0.115)	(0.751)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	40,675	40,675	40,675	40,675	40,675	8,121
Adjusted R^2	0.303	0.304	0.228	0.301	0.302	0.396

Table 3.5.11. Analysis about the credit spread of bank debt

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of BD	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.453***	0.606***	0.453***		0.422***
		(0.094)	(0.043)	(0.094)		(0.140)
HHI					-1.301***	
					(0.329)	
Profit	-0.018	-0.020	0.012	0.018	0.021	-0.068
	(0.190)	(0.190)	(0.201)	(0.153)	(0.152)	(1.461)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	35,433	35,433	35,433	35,433	35,433	8,096
Adjusted R^2	0.322	0.322	0.249	0.319	0.319	0.339

Table 3.5.12. Analysis about the credit spread of public debt

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of PD	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.633***	0.166***	0.635***		-0.040
		(0.101)	(0.041)	(0.103)		(0.096)
HHI					-3.816***	
					(0.550)	
Profit	0.472**	0.466**	0.357*	0.578***	0.579***	0.368
	(0.178)	(0.178)	(0.199)	(0.145)	(0.145)	(0.730)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	37,929	37,929	37,929	37,929	37,929	9,062
Adjusted R^2	0.309	0.310	0.240	0.307	0.308	0.436

Table 3.5.13. Analysis about the credit spread of revolving credit

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of RC	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.183**	0.282***	0.190**		0.265*
		(0.081)	(0.040)	(0.082)		(0.140)
HHI					0.158	
					(0.490)	
Profit	-0.673	-0.674	-1.345**	-1.527***	-1.527***	-5.086***
	(0.558)	(0.558)	(0.541)	(0.363)	(0.363)	(1.630)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	17,981	17,981	17,981	17,981	17,981	5,918
Adjusted R^2	0.344	0.344	0.239	0.342	0.342	0.361

Table 3.5.14. Analysis about the credit spread of term loan

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of TL	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.353***	0.543***	0.343***		0.526***
		(0.094)	(0.056)	(0.092)		(0.166)
HHI					-0.754**	
					(0.301)	
Profit	0.188	0.184	0.422*	0.296*	0.299**	0.448
	(0.201)	(0.201)	(0.213)	(0.150)	(0.149)	(1.709)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	31,443	31,443	31,443	31,443	31,443	6,047
Adjusted R^2	0.303	0.303	0.226	0.299	0.299	0.405

Table 3.5.15. Analysis about the credit spread of bond and note

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of BN	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.232***	0.142***	0.235***		-0.169***
		(0.068)	(0.025)	(0.068)		(0.062)
HHI					-1.224***	
					(0.231)	
Profit	0.445**	0.444**	0.419**	0.394**	0.394**	1.081
	(0.175)	(0.175)	(0.177)	(0.149)	(0.149)	(0.759)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	43,857	43,857	43,857	43,857	43,857	13,823
Adjusted R^2	0.417	0.417	0.338	0.411	0.411	0.541

Table 3.5.16. Analysis about the credit spread of commercial paper

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of CP	FEs	FEs	OLS	FEs	FEs	FEs
Comp		-0.396**	-0.448***	-0.383**		-0.405**
		(0.165)	(0.064)	(0.167)		(0.186)
HHI					2.659***	
					(0.956)	
Profit	-10.682***	-10.999***	-22.735***	-9.340***	-9.809***	-15.934***
	(2.631)	(2.611)	(4.168)	(2.284)	(2.348)	(3.705)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	1,903	1,903	1,903	1,903	1,903	1,490
Adjusted R^2	0.662	0.663	0.295	0.655	0.656	0.565

Table 3.5.17. Analysis about the credit spread of capital lease

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of CL	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.571***	0.130	0.572***		-0.258
		(0.114)	(0.095)	(0.115)		(0.201)
HHI					-5.661***	
					(0.764)	
Profit	-1.318***	-1.332***	-2.189***	-1.634***	-1.627***	5.143**
	(0.393)	(0.391)	(0.351)	(0.294)	(0.293)	(2.334)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	17,125	17,125	17,125	17,125	17,125	4,783
Adjusted R^2	0.253	0.254	0.166	0.253	0.255	0.435

Table 3.5.18. Analysis about the credit spread of other borrowings

Notes. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
CS of OB	FEs	FEs	OLS	FEs	FEs	FEs
Comp		0.561**	0.352***	0.496**		-0.126
		(0.224)	(0.099)	(0.227)		(0.359)
HHI					-4.335***	
					(1.303)	
Profit	-1.122*	-1.127*	-1.201*	0.974*	0.943*	2.557
	(0.645)	(0.645)	(0.638)	(0.560)	(0.560)	(3.180)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Executive Controls	No	No	No	No	No	Yes
Observations	5,121	5,121	5,121	5,121	5,121	2,191
Adjusted R^2	0.439	0.439	0.237	0.429	0.430	0.527

3.6 Robustness analyses

In this Section, I carry out three robustness analyses of the instrumental-variable (IV) regression with different key endogenous explanatory variables and instrumental variables. This first analysis studies the continuous HHI variable, the second subsection employs an instrumental variable based on industry growth rates, and the last robustness analysis focuses on the dummy *Competition* variable and its interaction with $Profit$. All these robustness analyses follow the same specifications for the main results.

3.6.1 Robustness analyses of continuous HHI variable, endogeneity, and IV

For the concern of the endogeneity issue, I carry out the standard single-equation IV regression with the two-stage least squares (2SLS) estimator as robustness tests. Following the literature, I use the HHI prior to the beginning of the sample period (*HHI01*) as the instrumental variable for product market competition. It is reasonable to use the historical measure of HHI to determine product market competition since it meets both the relevance and exclusion conditions according to similar discussions in Waisman (2013) and Boubaker et al. (2018). On the one hand, the measure *HHI01* is related to the current degree of competition in the industry to which a given firm belongs. On the other hand, the variable *HHI01* is highly unlikely to be directly related to a firm's debt structure and costs of debt, unless through the channel of affecting the current intensity of competition faced by the firm. Hence, these arguments conclude that the variable *HHI01* satisfies the necessary conditions for a valid instrument. Meanwhile, I examine typical diagnostic tests for the validity of the instrumental-variable regression.

As the instrumental variable is the HHI before the sample period, I run the instrumental-variable regression with the HHI as the key independent variable that measures the product market competition. This IV regression with the continuous HHI variable follows the same specification of Column (5) in Tables 3.5.1 to 3.5.18. The robustness results show that the estimated coefficients of the key variable HHI for the market competition are robust after using the IV regression that solves potential endogeneity

issues. The first row of Table 3.6.1 lists the coefficients of HHI obtained from the instrumental-variable regression for debt analysis. Except for commercial papers and capital leases, the coefficients of HHI from the IV regression are significant at the same sign as the coefficients of HHI without the IV reported in Section 3.5. Similarly, Table 3.6.3 shows that the coefficients of HHI from the IV regression significantly have the same sign as the coefficients of HHI without the IV reported in Section 3.5, except capital leases and other borrowings. In Section 3.6.3, I run the IV regression with the dummy *Competition* variable (and its interaction with $Profit$ for the debt structure), following the same specification of Columns (2), (3), (4), and (6) in Tables 3.5.1 to 3.5.9 for the debt structure and Tables 3.5.10 to 3.5.18 for the costs of debt.

The robustness results show that the estimation coefficients of the key variable for market competition are robust after using the IV regression that solves potential endogeneity issues. The first row of Table 3.6.1 lists the coefficients of HHI obtained from the instrumental-variable regression for debt analysis. Except commercial papers and capital leases, the coefficients of HHI from the IV regression are significant at the same sign of the coefficients of HHI without the IV reported in Section 3.5. Similarly, Table 3.6.3 shows that the coefficients of HHI from the IV regression significantly have the same sign to the coefficients of HHI without the IV reported in Section 3.5, except capital leases and other borrowings.

Table 3.6.2 and Table 3.6.4 provide the results of the first-stage IV regression for the debt analysis and cost analysis respectively, where the dependent variable is the HHI. In each column, I use the part of the data sample with non-missing values of particular debt. For example, there are 78,739 observations of leverage in Column (1) and 55,771 observations of bank debt in Column (2) in Table 3.6.2. I use the 78,739 (resp. 55,771) observations to run the first-stage and second-stage IV regressions for the leverage (resp. bank debt). In this way, Table 3.6.2 and Table 3.6.4 show the variation of the regression results for different types of debt. The coefficients of *HHI01* for all types of debt and costs on the first row of Table 3.6.2 and Table 3.6.4 are above 0.74 and significantly different to 0 at the 1% level.

The last three rows in Table 3.6.2 and Table 3.6.4 exhibit three typical diagnostic tests for the validity of the instrumental-variable regression. First, under the null hypothesis of the endogeneity test that the endogenous regressor HHI can be treated

as exogenous, the p-value of the test statistic for various types of debt data exhibit different conclusions. In Table 3.6.2, the endogeneity of HHI is significant at the 0.01 level in the data samples for revolving credit and capital leases. For bonds and notes, the significance level is at 0.05. The significance is at the 0.1 level for leverage, public debt, and almost for other borrowings. For bank debt, term loans, commercial papers, and other borrowings, the null hypothesis of the exogenous HHI cannot be rejected. For the cost analysis in Table 3.6.4, the null of the endogeneity test cannot be rejected for revolving credit and commercial papers.

The second last and the last rows in Table 3.6.2 and Table 3.6.4 report the tests of underidentification and weak identification, which confirm the relevance of the *HHI01* to the HHI in the sample. The underidentification test examines whether the regression equation is identified in terms of that the instrument variable *HHI01* is correlated with the endogenous regressor HHI. Under the null hypothesis that the equation is underidentified, the p-values for all types of debt are almost 0 and reject the null, which means the model is identified. The weak identification F-statistic values are all very large in Table 3.6.2 and Table 3.6.4, which exclude the possibility that the instrument *HHI01* is only weakly correlated with the endogenous regressor HHI. Therefore, the IV estimator would not perform poorly, see, e.g., Stock and Yogo (2002, 2005) for further discussion.

Table 3.6.1. Market competition and debt structure with HHI01 as IV

Notes. The dependent variable is the ratio of the various types of debt to the asset. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI	0.015***	0.036***	-0.029***	0.072***	-0.014*	-0.040***	0.001	-0.005	-0.040***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.005)	(0.005)	(0.007)
Profit	-0.123***	-0.109***	-0.187***	-0.151***	-0.114***	-0.153***	-0.114**	-0.010	-0.189***
	(0.014)	(0.017)	(0.014)	(0.027)	(0.019)	(0.014)	(0.055)	(0.007)	(0.033)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
Adjusted R^2	0.382	0.320	0.388	0.234	0.342	0.427	0.194	0.132	0.342

Table 3.6.2. Market competition and debt structure with HHI01 as IV - the 1st stage

Notes. The dependent variable is the HHI. Each column uses the data with non-missing values of particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI01 (IV)	0.880***	0.855***	0.879***	0.785***	0.880***	0.859***	0.781***	0.913***	0.886***
	(0.008)	(0.009)	(0.009)	(0.012)	(0.010)	(0.008)	(0.027)	(0.012)	(0.013)
Profit	0.016***	0.017***	0.014***	0.007	0.017***	0.013***	0.821***	0.004	0.023***
	(0.003)	(0.003)	(0.004)	(0.007)	(0.003)	(0.003)	(0.157)	(0.008)	(0.006)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
Endogeneity p	0.0791	0.120	0.0731	0.000684	0.192	0.0212	0.362	5.98e-05	0.105
Underiden. p	0	0	0	0	0	0	0	0	0
Weak iden. F	12176	9721	10325	3990	8294	10369	833.7	5868	4824

Table 3.6.3. Market competition and credit spreads with HHI01 as IV

Notes. The dependent variable is the credit spread (CS) of the various types of debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI	-0.241**	-1.050***	-0.122	-0.727***	-0.995***	-0.229***	1.275***	-0.186	-0.001
	(0.102)	(0.131)	(0.120)	(0.186)	(0.151)	(0.086)	(0.335)	(0.346)	(0.479)
Profit	-0.021	-0.009	0.354*	-1.402***	0.410*	0.417**	-22.351***	-2.190***	-1.208*
	(0.151)	(0.198)	(0.197)	(0.541)	(0.211)	(0.176)	(4.164)	(0.352)	(0.632)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,675	35,433	37,929	17,981	31,443	43,857	1,903	17,125	5,121
Adjusted R^2	0.226	0.247	0.240	0.238	0.224	0.337	0.290	0.166	0.235

Table 3.6.4. Market competition and credit spreads with HHI01 as IV - the 1st stage

Notes. The dependent variable is the HHI. Each column uses the data with non-missing credit spreads of a particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI01 (IV)	0.878***	0.839***	0.866***	0.747***	0.872***	0.854***	0.640***	0.909***	0.898***
	(0.009)	(0.009)	(0.010)	(0.016)	(0.010)	(0.009)	(0.034)	(0.012)	(0.022)
Profit	0.010***	0.007**	0.011***	-0.012	0.009**	0.014***	0.954***	-0.010	0.001
	(0.003)	(0.003)	(0.003)	(0.010)	(0.004)	(0.003)	(0.227)	(0.010)	(0.011)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,675	35,433	37,929	17,981	31,443	43,857	1,903	17,125	5,121
Endogeneity p	6.01e-09	0.00774	5.53e-07	0.308	0.0487	0.0235	0.981	0.0315	0.000951
Underiden. p	0	0	0	0	0	0	0	1.43e-08	0
Weak iden. F	8794	8286	7993	2284	7027	9874	355.5	5632	1637

3.6.2 Robustness analyses of continuous HHI variable with an IV based on industry growth rates

In this subsection, employs an instrumental variable based on industry growth rates for the continuous HHI variable, following the same specifications of Column (5) in Tables 3.5.1 to 3.5.18. Specifically, the IV is the base-year value of the HHI multiplied by the aggregate growth in the HHI at the 3-digit SIC industry level, which is denoted by $HHIext$.

Table 3.6.5 and Table 3.6.7 show the results of the IV regression for the debt analysis and cost analysis respectively, where the key exploratory variable is the dummy $HHIext$. Table 3.6.6 and Table 3.6.8 provide the results of the first-stage IV regression for the debt analysis and cost analysis respectively, where the dependent variable is the dummy $HHIext$. The discussion is similar to that in Section 3.6.1 and is omitted due to the page limit.

Table 3.6.5. Market competition and debt structure with HHIext as IV

Notes. The dependent variable is the ratio of the various types of debt to the asset. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI	0.016***	0.036***	-0.029***	0.072***	-0.014*	-0.040***	0.001	-0.005	-0.040***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.005)	(0.005)	(0.007)
Profit	-0.123***	-0.109***	-0.187***	-0.151***	-0.114***	-0.153***	-0.114**	-0.010	-0.189***
	(0.014)	(0.017)	(0.014)	(0.027)	(0.019)	(0.014)	(0.055)	(0.007)	(0.033)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,737	55,769	62,861	28,909	44,267	47,308	3,128	29,285	17,593
Adjusted R-squared	0.382	0.320	0.388	0.234	0.342	0.427	0.194	0.132	0.342

Table 3.6.6. Market competition and debt structure with HHIext as IV - the 1st stage

Notes. The dependent variable is the HHIext. Each column uses the data with non-missing values of particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	HHIext	HHIext	HHIext	HHIext	HHIext	HHIext	HHIext	HHIext	HHIext
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHIext (IV)	0.878***	0.853***	0.878***	0.784***	0.877***	0.858***	0.782***	0.911***	0.883***
	(0.008)	(0.009)	(0.009)	(0.012)	(0.010)	(0.008)	(0.027)	(0.012)	(0.013)
Profit	0.015***	0.017***	0.014***	0.007	0.017***	0.013***	0.823***	0.004	0.023***
	(0.003)	(0.003)	(0.004)	(0.007)	(0.003)	(0.003)	(0.157)	(0.008)	(0.006)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,737	55,769	62,861	28,909	44,267	47,308	3,128	29,285	17,593
Endogeneity p	0.0961	0.108	0.0726	0.000686	0.203	0.0185	0.357	7.06e-05	0.112
Underiden. p	0	0	0	0	0	0	0	0	0
Weak iden. F	11964	9792	10209	4105	8070	10272	846.3	6022	4831

Table 3.6.7. Market competition and credit spreads with HHIext as IV

Notes. The dependent variable is the credit spread (CS) of the various types of debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHI	-0.237**	-1.043***	-0.109	-0.710***	-0.995***	-0.219**	1.279***	-0.155	0.006
	(0.102)	(0.134)	(0.121)	(0.187)	(0.152)	(0.086)	(0.334)	(0.350)	(0.480)
Profit	-0.021	-0.009	0.353*	-1.402***	0.410*	0.417**	-22.352***	-2.188***	-1.208*
	(0.151)	(0.198)	(0.197)	(0.541)	(0.211)	(0.176)	(4.163)	(0.352)	(0.632)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,674	35,431	37,928	17,980	31,442	43,856	1,903	17,124	5,121
Adjusted R-squared	0.226	0.247	0.240	0.238	0.224	0.337	0.290	0.166	0.235

Table 3.6.8. Market competition and credit spreads with HHIext as IV - the 1st stage

Notes. The dependent variable is the HHIext. Each column uses the data with non-missing credit spreads of a particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
HHIext (IV)	0.877***	0.838***	0.865***	0.747***	0.869***	0.853***	0.642***	0.908***	0.891***
	(0.010)	(0.009)	(0.010)	(0.015)	(0.011)	(0.009)	(0.034)	(0.012)	(0.023)
Profit	0.010***	0.007**	0.010***	-0.012	0.009**	0.014***	0.956***	-0.010	0.001
	(0.003)	(0.003)	(0.003)	(0.010)	(0.004)	(0.003)	(0.227)	(0.010)	(0.011)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,674	35,431	37,928	17,980	31,442	43,856	1,903	17,124	5,121
Endogeneity p	5.12e-09	0.00741	4.31e-07	0.347	0.0509	0.0151	0.994	0.0205	0.000903
Underiden. p	0	0	0	0	5.09e-11	0	0	1.55e-08	0
Weak iden. F	8271	8366	7518	2415	6753	9795	360	5874	1534

3.6.3 Robustness analyses of dummy *Comp* variable with interaction, endogeneity, and IV

In this robustness analysis, I run the IV regression with the dummy *Comp* variable (and its interaction with $Profit$ for the debt structure), following the same specification of Columns (2), (3), (4), and (6) in Tables 3.5.1 to 3.5.9 for the debt structure and Tables 3.5.10 to 3.5.18 for the costs of debt.

Table 3.6.9 and Table 3.6.11 show the results of the IV regression for the debt analysis and cost analysis respectively, where the key exploratory variable is the dummy *Comp*. Table 3.6.10 and Table 3.6.12 provide the results of the first-stage IV regression for the debt analysis and cost analysis respectively, where the dependent variable is the dummy *Comp*. The discussion is similar to that in Section 3.6.1 and is omitted due to the page limit.

Table 3.6.9. Market competition and debt structure with Comp01 as IV

Notes. The dependent variable is the ratio of the various types of debt to the asset. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Comp	-0.028***	-0.051***	0.018***	-0.034***	-0.031***	0.030***	0.005	0.002	0.017***
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)	(0.004)
Comp×Profit	0.067***	0.026	0.162***	0.037	0.088***	0.158***	-0.256*	0.017	-0.008
	(0.015)	(0.028)	(0.019)	(0.044)	(0.030)	(0.020)	(0.140)	(0.031)	(0.080)
Profit	-0.175***	-0.131***	-0.312***	-0.182***	-0.184***	-0.273***	0.044	-0.024	-0.182**
	(0.018)	(0.024)	(0.023)	(0.035)	(0.027)	(0.020)	(0.121)	(0.023)	(0.072)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
Adjusted R-squared	0.383	0.317	0.387	0.230	0.339	0.425	0.190	0.132	0.341

Table 3.6.10. Market competition and debt structure with Comp01 as IV - the 1st stage

Notes. The dependent variable is the Comp. Each column uses the data with non-missing values of particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Comp01 (IV)	0.597***	0.595***	0.611***	0.632***	0.588***	0.605***	0.713***	0.620***	0.648***
	(0.009)	(0.009)	(0.010)	(0.008)	(0.009)	(0.010)	(0.030)	(0.010)	(0.011)
Profit	-0.021**	-0.025*	-0.020*	-0.201***	-0.004	-0.015	-2.370***	-0.009	-0.044*
	(0.010)	(0.013)	(0.011)	(0.020)	(0.013)	(0.011)	(0.636)	(0.019)	(0.024)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
Endogeneity p	0.0186	1.85e-08	5.67e-05	6.81e-08	3.17e-07	7.53e-07	0.000120	7.65e-05	0.0345
Underiden. p	1.30e-10	6.84e-10	2.36e-10	0	7.60e-10	2.26e-10	0	0	8.99e-09
Weak iden. F	1093	449.1	1367	3000	340.3	1594	216.2	1703	173.7

Table 3.6.11. Market competition and credit spreads with Comp01 as IV

Notes. The dependent variable is the credit spread (CS) of the various types of debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Comp	0.170***	0.181***	0.134**	0.187***	0.227***	0.210***	-0.539***	0.585***	-0.420***
	(0.048)	(0.049)	(0.057)	(0.058)	(0.064)	(0.039)	(0.101)	(0.085)	(0.148)
Profit	-0.020	0.004	0.356*	-1.359**	0.418**	0.421**	-22.916***	-2.217***	-1.216*
	(0.150)	(0.199)	(0.197)	(0.538)	(0.211)	(0.175)	(4.057)	(0.351)	(0.634)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,675	35,433	37,929	17,981	31,443	43,857	1,903	17,125	5,121
Adjusted R-squared	0.227	0.247	0.240	0.239	0.225	0.337	0.294	0.163	0.230

Table 3.6.12. Market competition and credit spreads with Comp01 as IV - the 1st stage

Notes. The dependent variable is the Comp. Each column uses the data with non-missing credit spreads of a particular debt. Clustered standard errors are in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp	Comp
Data	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
Comp01 (IV)	0.578***	0.596***	0.593***	0.650***	0.595***	0.606***	0.648***	0.645***	0.591***
	(0.009)	(0.011)	(0.008)	(0.010)	(0.010)	(0.009)	(0.020)	(0.012)	(0.015)
Profit	-0.005	-0.008	-0.019	-0.136***	0.003	-0.029***	-2.769***	0.007	-0.115***
	(0.014)	(0.017)	(0.012)	(0.035)	(0.017)	(0.011)	(0.846)	(0.030)	(0.036)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	40,675	35,433	37,929	17,981	31,443	43,857	1,903	17,125	5,121
Endogeneity p	5.40e-06	1.79e-09	0.398	0.0316	4.04e-08	0.0165	0.208	1.94e-08	1.11e-07
Underiden. p	0	0	0	0	0	0	0	2.47e-10	0
Weak iden. F	4492	3147	5416	3957	3533	4642	1062	2897	1597

3.7 Conclusion

The literature documents the relationship between the corporate capital structure and firms' pressure from both internal side (Morellec et al., 2012; Nicodano and Regis, 2019) and the external side (Nini et al., 2012; Bharath and Hertzel, 2019). Internal pressure has been well studied but research on external pressure is limited. Two typical sources of external pressure are bank lenders' monitoring and product market competition. The prior studies discuss the relationship between competition and the choices of general debt (Boubaker et al., 2018) or costs (Valta, 2012) while there is no study examining the effects of competition on the details of specific debt and costs of various types of debt.

The chapter is different from the existing work and contributes to the literature as it is the first study on the investigation of firms' decisions in debt structure, leverage, and costs under the effect of the external pressure that is imposed by exogenous product market competition. Using the details about nine types of corporate debt and costs and meanwhile accounting for a range of firm characteristics and economic conditions. I disassemble firms' total debt into the components of bank debt, public debt, and six types of specific debt. My contribution to the literature is to provide details about the effects of product market competition.

The underlying mechanism is that firms balance their pressure through adjusting different debt components with different creditors' monitoring pressures in response to the varying external pressure from product market competition. Firms adjust their pressure by changing their ways of obtaining debt according to economic conditions and firm characteristics. On the one hand, firms have to pay credit spreads for the benefits of external bank monitoring. On the other hand, firms reduce the external pressure of bank monitoring by switching private bank debt to public debt such as bonds and notes from the debt market when the firms have to face the external pressure imposed by intense product market competition.

To discover the effects of product market competition, the chapter employs the empirical methods of the Tobit regression, panel data regression with industry and year fixed effects, and standard single-equation instrumental-variable regression with the two-stage least squares (2SLS) estimator. Based on these methods and the Capital

IQ data, the contribution of this chapter is a comprehensive analysis of the detailed corporate debt structure and the costs of these types of debt. It provides guidance to firms that when experiencing intense competition in the product market, the firms adjust their debt structure in two connected ways to decrease the external pressure of bank monitoring. First, the firms should reduce their leverages by reducing bank debt which comprises revolving credit and term loans. Second, the firms could raise their bonds and notes as well as other borrowings from the public market.

In addition, the joint effect of product market competition and profitability implies that the firms with high profits in an intensive competition environment could raise their leverages and borrow more from the public debt market by increasing the issuance of bonds and notes as well as capital leases. Hence, the joint effect of product market competition and profitability implies the way that the debt structure contributes to the leverage puzzle in an environment with high product market competition. Meanwhile, the results on the costs of debt indicate that firms need to pay higher fees for various types of debt from banks or most of the debt from the public market under a higher level of competition in order to reduce the external monitoring pressure by shifting bank debt to public debt and paying larger costs for public debt.

The limitation of the study is that competition comes from the domestic product market and does not consider international competition and its effects on financing. International product market competition is rising and the literature records its effects on firms' performance and financing. For example, Zhou et al. (2013) illustrate that globalization and import competition make firms reduce dividend payments. Huang and Kim (2019) show that upstream industries' capital structures are affected by downstream industries due to international import competition. A future research topic is to study whether import competition in a downstream industry has an impact on the upstream suppliers' debt structures and costs. The findings will show whether the upstream industries prefer conservative financial policies by reducing their leverages under different customer-supplier relationships and downstream shocks.

3.A Additional results

This appendix collects additional results. Tables 3.A.1 and 3.A.2 display the detailed summary statistics for various types of debt ratios in the corporate debt structure before and after winsoring the tails by limiting the ratios to the unit.

Table 3.A.3 lists the correlation of debt structure and firm characteristics. Commercial papers from the public market are negatively correlated with the revolving credit and term loans of bank debt as well as the bonds and notes and capital leases of public debt. As one of bank debt, revolving credit is positively correlated with the other four types of debt, except for commercial papers. The term loans of bank debt are positively correlated with the three types of public debt: bonds and notes, capital leases, and other borrowings. Note that there is no multicollinearity issue among the variables. Some large correlation coefficients among the first 13 variables are expected, e.g., loans and bonds that are highly correlated with leverage as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

Figs. 3.A.1, 3.A.2, and 3.A.3 demonstrate the frequencies of credit spreads for six types of specific debt. The histograms display descriptive statistics in the upper right corner. At the bottom of each histogram, it displays the mean and points away from the mean by three different standard deviations. The left end and right end show the minimum and maximum points. The credit spreads of revolving credit, commercial papers, and capital leases exhibit large peaks. Capital leases and other borrowings have large right-tail values of credit spreads. The credit spreads of term loans and bonds and notes fit the normal distribution better than the credit spreads of other types of debt.

Table 3.A.1. Summary statistics of the debt structure before winsoring the tails

Notes. This table displays the summary statistics of the debt structure before winsoring the tails.

Stats	Leverage	BankDebt	Public Debt	Credit	Loan	Bond	Paper	Lease	Other
N	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
mean	4.60838	1.46766	3.92206	0.24929	1.68622	3.80739	0.03611	0.03556	3.71025
sd	1.3e+02	24.01809	1.1e+02	3.11404	26.56892	58.14064	0.03865	0.15538	1.3e+02
min	0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.0	0.0
p1	0.00066	0.00049	0.00016	0.00026	0.00033	0.00071	0.00043	0.00004	0.00002
p5	0.00683	0.00454	0.00132	0.00266	0.00302	0.00593	0.00220	0.00022	0.00015
p25	0.12612	0.05312	0.03721	0.02425	0.03744	0.08540	0.00959	0.00192	0.00217
p50	0.29246	0.16109	0.17188	0.06700	0.13327	0.20599	0.02363	0.00793	0.01234
p75	0.53113	0.33742	0.36221	0.15916	0.32053	0.40653	0.04880	0.02980	0.07210
p95	3.55360	1.19677	2.70617	0.38481	1.47186	4.16088	0.11620	0.15322	0.40036
p99	47.66666	17.20930	38.34550	0.94176	20.80385	50.26611	0.19586	0.41519	5.18945
max	2.4e+04	2.7e+03	1.6e+04	1.7e+02	2.7e+03	4.9e+03	0.28926	14.85159	1.2e+04

Table 3.A.2. Summary statistics of the debt structure after winsoring the tails

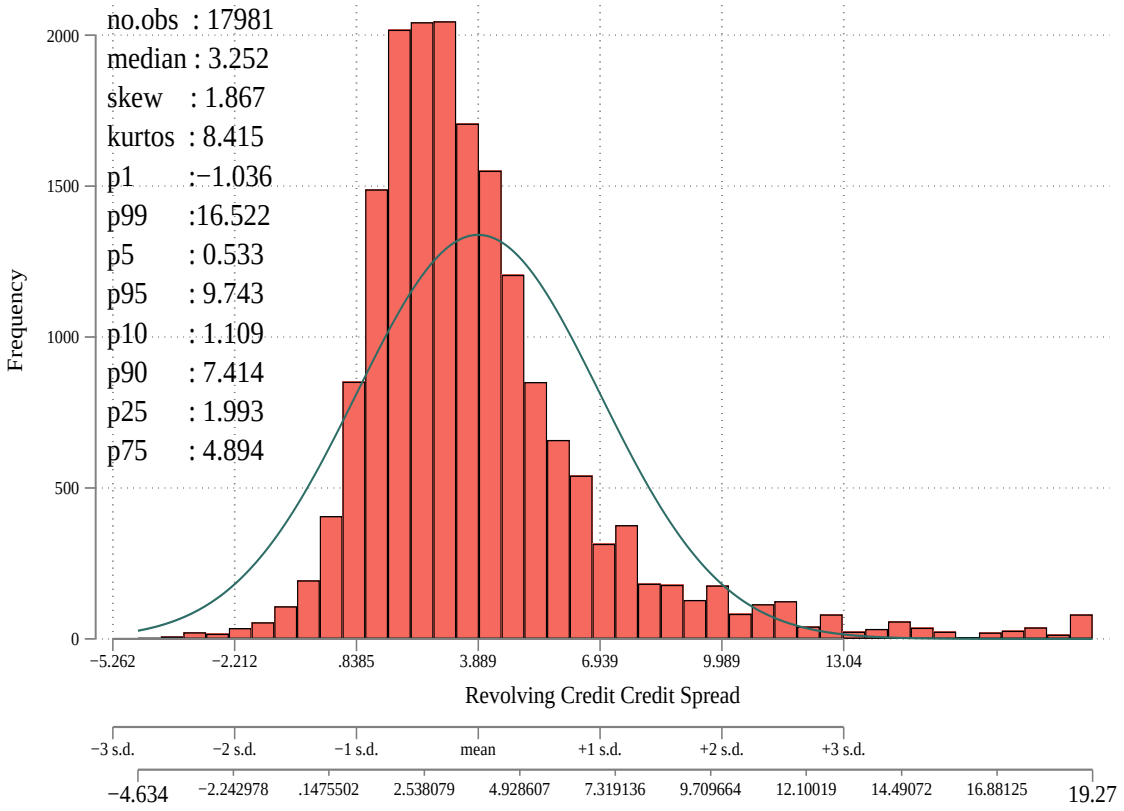
Notes. This table displays the summary statistics of the debt structure before winsoring the tails.

Stats	Leverage	BankDebt	Public Debt	Credit	Loan	Bond	Paper	Lease	Other
N	78,739	55,771	62,863	28,910	44,268	47,309	3,128	29,287	17,593
mean	0.37050	0.24770	0.26783	0.11959	0.23673	0.30809	0.03611	0.03386	0.08622
sd	0.30787	0.26443	0.29671	0.15326	0.27602	0.30468	0.03865	0.07994	0.18806
min	0.0	0.0	0.0	0.0	0.0	0.0	0.00002	0.0	0.0
p1	0.00066	0.00049	0.00016	0.00026	0.00033	0.00071	0.00043	0.00004	0.00002
p5	0.00683	0.00454	0.00132	0.00266	0.00302	0.00593	0.00220	0.00022	0.00015
p25	0.12612	0.05312	0.03721	0.02425	0.03744	0.08540	0.00959	0.00192	0.00217
p50	0.29246	0.16109	0.17188	0.06700	0.13327	0.20599	0.02363	0.00793	0.01234
p75	0.53113	0.33742	0.36221	0.15916	0.32053	0.40653	0.04880	0.02980	0.07210
p95	1.0	1.0	1.0	0.38481	1.0	1.0	0.11620	0.15322	0.40036
p99	1.0	1.0	1.0	0.94176	1.0	1.0	0.19586	0.41519	1.0
max	1.0	1.0	1.0	1.0	1.0	1.0	0.28926	1.0	1.0

Table 3.A.3. Correlation of debt structure, credit spreads, and firm characteristics

Notes. Table 3.A.3 displays the correlation of debt structure, credit spreads, and firm characteristics during 2002 to 2019. Section 3.4.2 gives the definition of the variables. The symbol * means $p < 0.05$. Note that there is no multicollinearity issue among the variables. Some large correlation coefficients among the first 13 variables are expected, e.g., loans and bonds that are highly correlated with leverage as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

	Credit	Loan	Bond	Paper	Lease	Other	Credit CS	Loan CS	Bond CS	Paper CS	Lease CS	Other CS	Leverage	HHI	Profit	Cash	Size	Tangible	MV/BV	Investment	Tax	Age	Earn. Vol.	Z-Score	Current R.
Credit	1.00																								
Loan	0.07*	1.00																							
Bond	0.14*	0.38*	1.00																						
Paper	-0.07*	-0.16*	0.07*	1.00																					
Lease	0.08*	0.08*	0.09*	-0.05*	1.00																				
Other	0.21*	0.36*	0.35*	0.09*	0.28*	1.00																			
Credit CS	0.20*	0.17*	0.20*	0.02	0.02	0.25*	1.00																		
Loan CS	0.22*	0.23*	0.20*	0.19*	0.06*	0.21*	0.54*	1.00																	
Bond CS	0.17*	0.25*	0.27*	-0.17*	0.02*	0.16*	0.34*	0.45*	1.00																
Paper CS	0.38*	0.04	0.01	0.01	-0.03	0.01	0.37*	0.34*	0.44*	1.00															
Lease CS	0.06*	0.09*	0.10*	-0.18*	-0.00	0.20*	0.38*	0.40*	0.37*	0.21*	1.00														
Other CS	0.19*	0.11*	0.07*	-0.06	0.16*	0.24*	0.36*	0.47*	0.48*	0.42*	0.31*	1.00													
Leverage	0.35*	0.73*	0.83*	0.20*	0.26*	0.46*	0.22*	0.17*	0.28*	0.01	0.09*	0.15*	1.00												
HHI	0.02*	-0.06*	-0.09*	0.05*	-0.01	-0.10*	-0.07*	-0.10*	-0.04*	0.09*	-0.06*	-0.09*	-0.03*	1.00											
Profit	-0.37*	-0.47*	-0.54*	0.15*	-0.16*	-0.52*	-0.31*	-0.25*	-0.28*	-0.23*	-0.15*	-0.19*	-0.41*	0.09*	1.00										
Size	-0.41*	-0.45*	-0.46*	-0.28*	-0.16*	-0.44*	-0.38*	-0.40*	-0.43*	-0.17*	-0.23*	-0.36*	-0.29*	0.07*	0.68*	1.00									
Tangible	0.05*	-0.04*	-0.14*	-0.11*	0.16*	-0.04*	0.03*	0.07*	0.04*	0.02	0.06*	0.07*	-0.00	-0.06*	0.17*	0.14*	1.00								
MV/BV	0.22*	0.37*	0.46*	0.27*	0.10*	0.33*	0.08*	0.15*	0.11*	-0.19*	0.02*	0.11*	0.28*	-0.12*	-0.55*	-0.51*	-0.26*	1.00							
Investment	0.01*	-0.02*	-0.07*	-0.05*	-0.01*	0.01	-0.00	0.03*	0.01	-0.05*	0.06*	0.05*	-0.03*	-0.07*	0.05*	0.05*	0.43*	-0.05*	1.00						
Z-Score	-0.30*	-0.45*	-0.53*	0.11*	-0.15*	-0.40*	-0.37*	-0.29*	-0.36*	-0.16*	-0.13*	-0.24*	-0.52*	0.06*	0.47*	0.45*	0.00	-0.12*	0.06*	1.00					
Current R.	-0.14*	-0.26*	-0.27*	-0.14*	-0.08*	-0.22*	-0.14*	-0.10*	-0.20*	0.05*	-0.05*	0.04*	-0.40*	-0.03*	0.20*	0.11*	-0.21*	0.00	-0.08*	0.45*	1.00				
Age	-0.00	0.00	0.08*	0.00	-0.01	-0.00	0.05*	0.04*	0.06*	0.03	0.01	-0.05*	0.07*	0.05*	-0.10*	-0.12*	0.11*	0.02*	0.01*	-0.12*	-0.20*	1.00			
Cash	0.05*	0.12*	0.21*	-0.01	0.00	0.19*	0.08*	0.11*	0.00	0.02	0.03*	0.16*	-0.05*	-0.17*	-0.32*	-0.33*	-0.40*	0.41*	-0.14*	-0.00	0.47*	-0.18*	1.00		
Tax	-0.06*	-0.10*	-0.10*	0.16*	-0.04*	-0.07*	-0.12*	-0.14*	-0.17*	-0.10*	-0.04*	-0.10*	-0.11*	0.06*	0.18*	0.19*	-0.04*	0.02*	0.01	0.20*	0.03*	0.01	-0.06*	1.00	
Earn. Vol.	0.35*	0.44*	0.52*	0.02	0.14*	0.51*	0.27*	0.22*	0.27*	0.12*	0.14*	0.14*	0.40*	-0.06*	-0.79*	-0.64*	-0.14*	0.51*	-0.03*	-0.41*	-0.22*	0.13*	0.27*	-0.10*	1.00



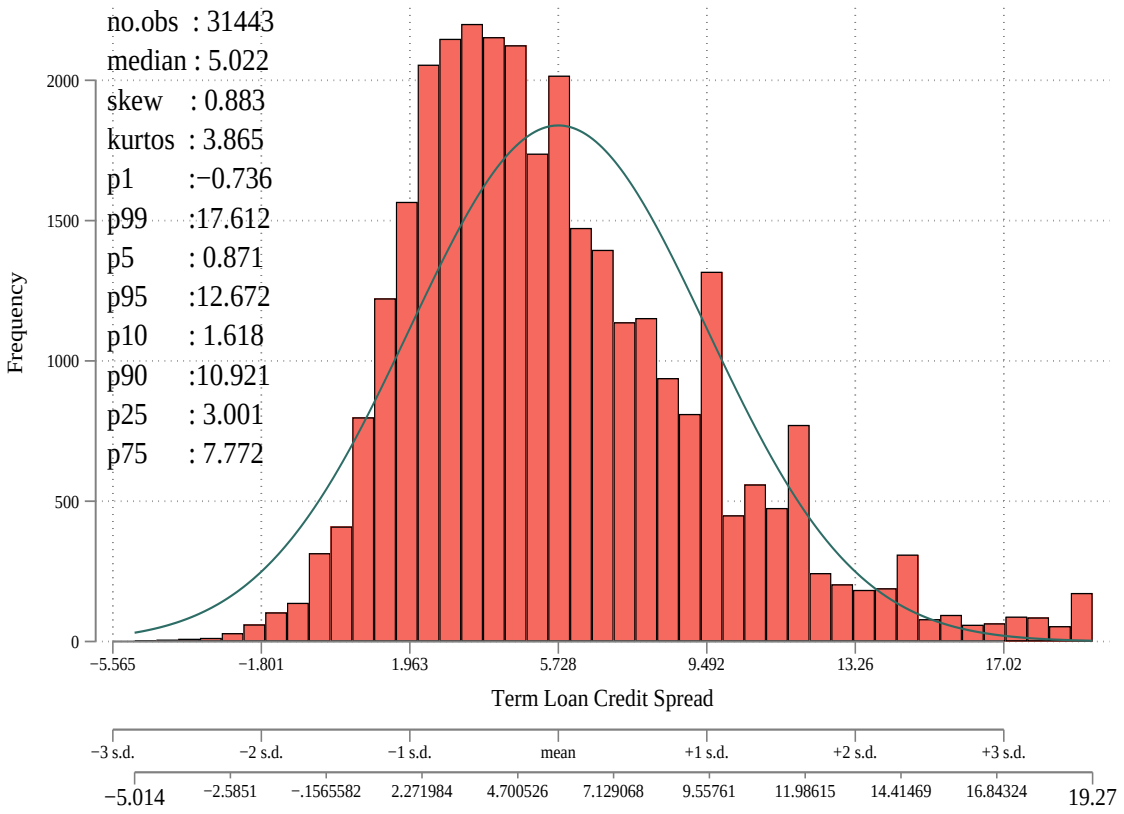


Figure 3.A.1. Frequency of credit spreads for six types of debt - Part 1/3

Fig. 3.A.1 plots the frequencies of credit spreads for revolving credit, term loans. The number of observations varies as firms do not take some types of debts sometimes.

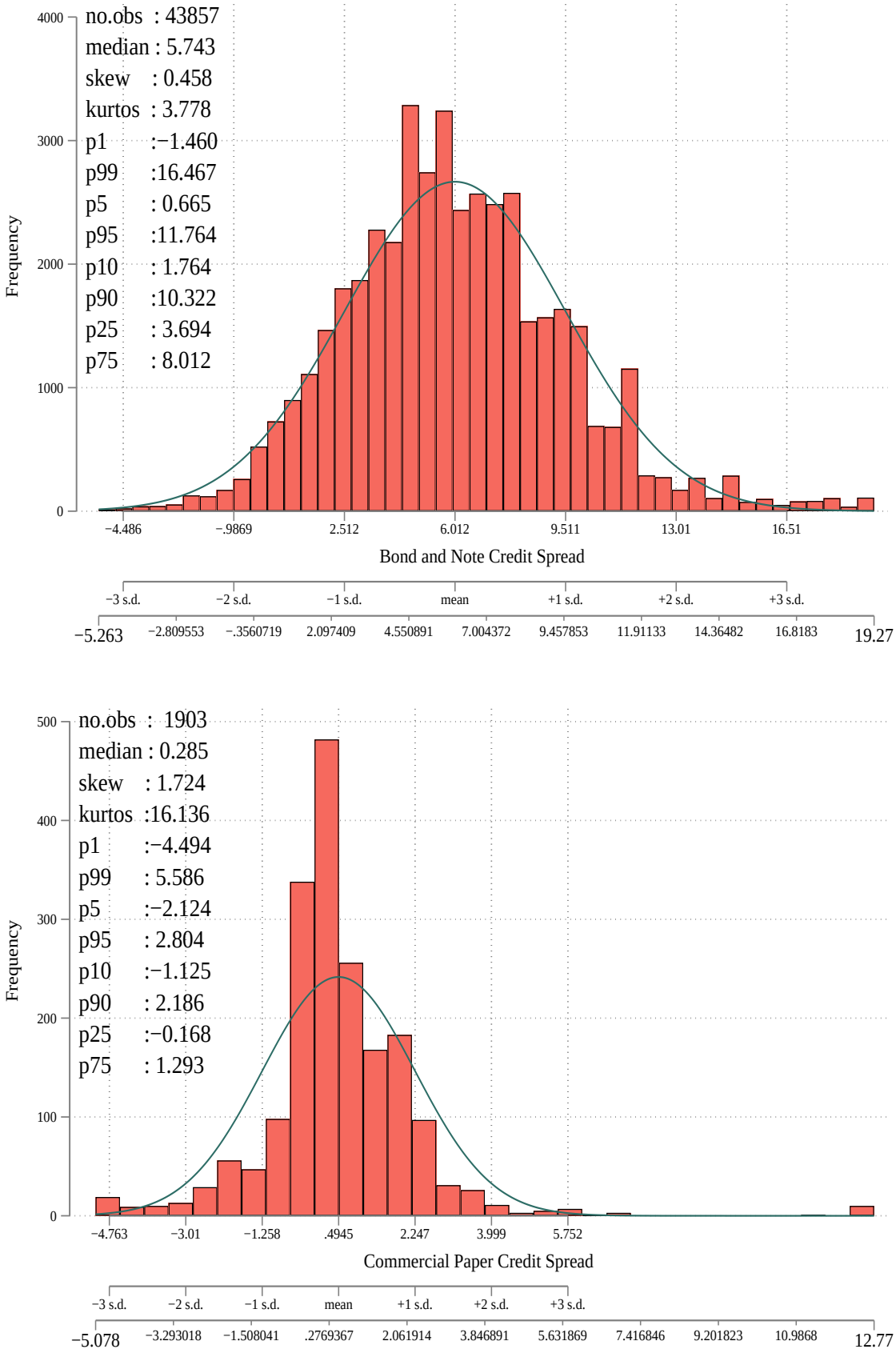


Figure 3.A.2. Frequency of credit spreads for six types of debt - Part 2/3

Fig. 3.A.2 plots the frequencies of credit spreads for bonds and notes, commercial papers. The number of observations varies as firms do not take some types of debts sometimes.

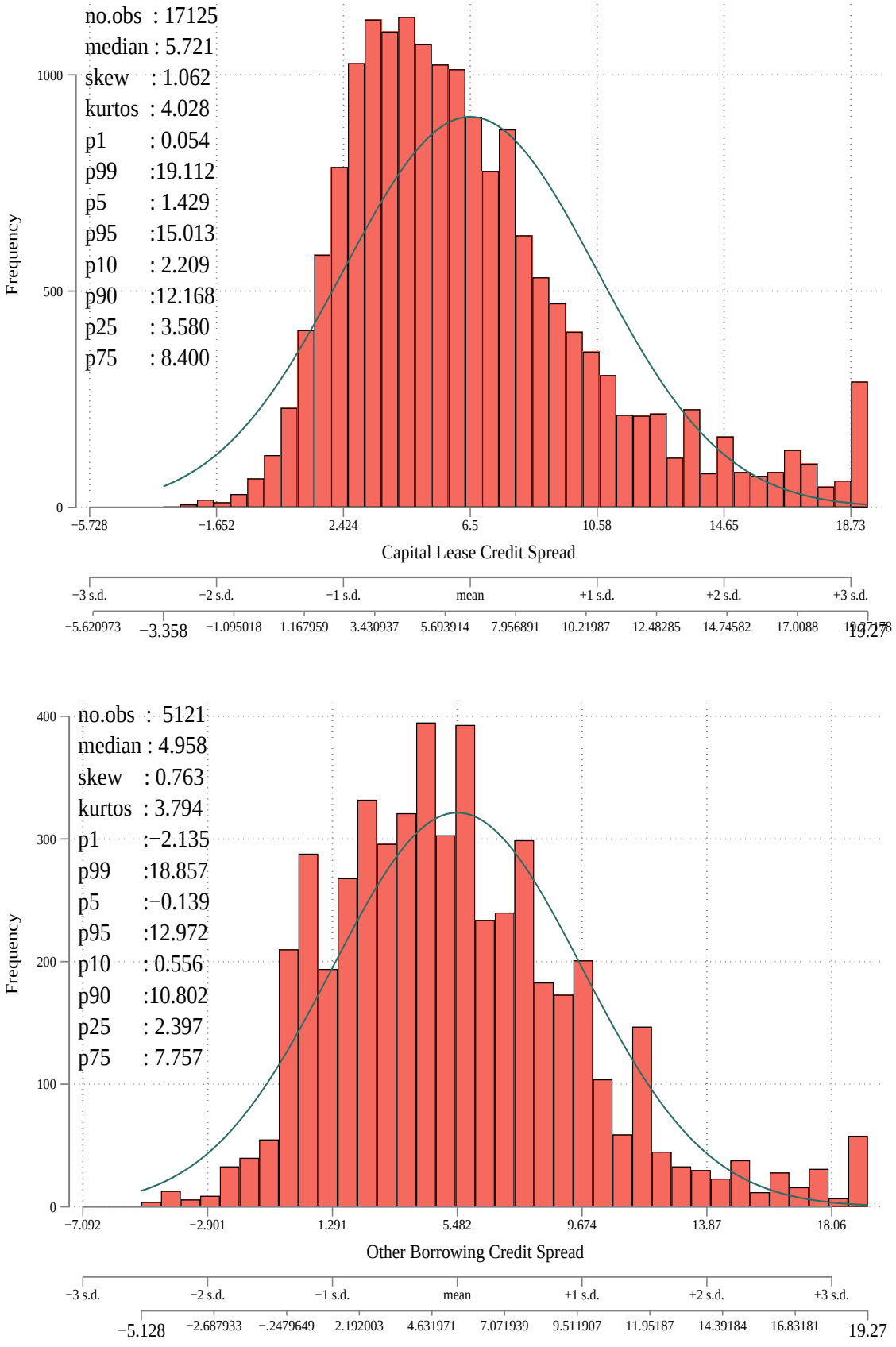


Figure 3.A.3. Frequency of credit spreads for six types of debt - Part 3/3

Fig. 3.A.3 plots the frequencies of credit spreads for capital leases, and other borrowings. The number of observations varies as firms do not take some types of debts sometimes.

3.B Econometric tests of panel data

Before I choose econometric methods of panel data analysis for credit spreads, I run some econometric tests to identify the appropriate econometric methods. I use the regressions for the credit spread of capital lease ($leaseCS$) as examples to report the results.

3.B.1 Lagrangian multiplier test for OLS

I start with the Lagrangian multiplier test (Stata command `xttest0`) introduced by Breusch and Pagan to find out whether there are significant differences in panel effects across the data. If the test result shows a significant 0 probability to the H0 hypothesis that there is no difference across the panel, a simple way of ordinary least squares (OLS) is misspecified and some methods of panel data regression should be applied to analyze the data.

The result rejects Breusch and Pagan Lagrangian multiplier test for OLS.

leaseCS[gvkey,t] = Xb + u[gvkey] + e[gvkey,t]

Estimated results:

	Var	sd = sqrt(Var)
leaseCS	16.61412	4.076043
e	1.849497	1.359962
u	10.78624	3.284242

Test: Var(u) = 0

$\bar{\chi}^2(1) = 1.0e+05$

$[Prob > \bar{\chi}^2] = 0.0000$

3.B.2 Hausman test for random effects

To identify whether the fixed effect model or the random effect model should be appropriate for the panel data, I use the Hausman test to test the H0 hypothesis that the difference in the panel data regression coefficients is not systematic. If the probability based on this hypothesis is significantly 0, the H0 hypothesis is rejected and the fixed effect method should be employed to analyze the data.

The result rejects the Hausman test for random effects.

H0: difference in coefficients not systematic.

$\chi^2(16) = (b-B)'[(V_b - V_B)^{-1}](b-B) = 486.60$

$[Prob > \chi^2] = 0.0000$

3.B.3 Test of time-fixed effects

In addition to panel-fixed effects, I also examine whether there are time-fixed effects on the data. I use Stata command testparm to do a joint test of the H0 hypothesis that all time dummies are equal to 0, which indicates that there are no time-fixed effects. If the test results show that this hypothesis is rejected, then I account for time and panel fixed effects in my panel data regression. The result is as follows and the null hypothesis is rejected. Therefore, I include time-fixed effects.

$F(17, 2663) = 142.41$

$[Prob > \chi^2] = 0.0000$

3.B.4 Homoskedasticity test

I test the robustness of standard errors to heteroskedasticity and autocorrelation from the fixed effect estimation. To test groupwise heteroskedasticity, I run the modified Wald test (Stata command xttest3) to the H0 hypothesis that the standard errors have homoskedasticity, $\sigma^2(i) = \sigma^2$ for all i.

The result rejects the modified Wald test for groupwise homoskedasticity in the fixed effect regression model.

H0: $\sigma^2(i) = \sigma^2$ for all i

$\chi^2(2410) = 7.1e + 35$

$[Prob > \chi^2] = 0.0000$

3.B.5 Autocorrelation test

To test autocorrelation in the standard errors of the fixed effect panel regression, I use the Wooldridge test (Stata command xtserial). If the H0 hypothesis of no first-order autocorrelation is significantly rejected, I perform panel data regressions analysis by making the corresponding variance-covariance matrix (VCE) for the parameter estimates robust to autocorrelation in the time series within the panel as well as heteroskedasticity in the cross section. To this end, I use cluster-robust standard errors.

The result rejects the hypothesis of the Wooldridge test for autocorrelation in the panel data.

H0: no first-order autocorrelation.

$F(1, 1340) = 122.593$

$[Prob > F] = 0.0000$

3.B.6 Unit-root test

It is necessary to exclude the case of all the panels in the data are non-stationarity. It is essential to examine whether the data can be viewed as stationary or not for three reasons (e.g., Brooks, 2019). First, the stationarity of a series affects its behaviour, e.g., a shock will not die away for a nonstationary series. Second, non-stationary data might result in spurious regressions that have a high R-square value but the dependent variable and the independent variables are in fact unrelated. Third, the standard assumptions for asymptotic analysis are invalid if the data are not stationary. In this case, the usual t-ratios do not follow a t-distribution, which makes it impossible to carry out hypothesis tests about the regression parameters.

I take a unit-root test on the data for examining whether there is at least one panel on the data that is stationary. I use a Fisher-type test developed by Phillips and Perron with 3 Newey-West lags (Stata command xtfisher). If the statistical results show that the H0 hypothesis of all panels having unit roots is significantly rejected then there is at least one stationary panel of data.

Fisher Test for panel unit root using an augmented Dickey-Fuller test (3 lags)

H0: unit root.

$\chi^2(1416) = 1909.2562$

$[Prob > \chi^2] = 0.0000$

Chapter 4 The Effects of Trade War on Corporate Debt Structure and Costs

4.1 Introduction

Corporate finance research reveals that the debtors of firms and the creditors of banks consider the external pressure of firms when the former makes general debt choices and the latter charge the costs of debt. There is a strand of academic literature in the framework of debt choice between bank loans borrowed from banks privately versus debt issues in the public market. A popular explanation for the benefits and costs of bank debt and public debt is that bank debt brings the external pressure of banks that is lacked in public debt. The strong external effect makes firms decrease the external effect of banks and increase the issue of debt publicly traded in the market. To examine such substitution effects, quasi-natural experiments are usually carried out to demonstrate exogenous variation in external pressure from the market. The literature usually uses large reductions in import tariffs as the exogenous shocks of external pressure to study the causal effects on companies' general choices of debt or relevant credit spreads.

During the past three decades before 2018, global business was a trend and trade barriers were softened. For example, Canada and U.S signed a free trade agreement in 1989 and the North American Free Trade Agreement in 1994. These international trade agreements led to substantial declines in import tariff rates paid by foreign firms for entering U.S. markets. As a result, import penetration in U.S. markets rises sharply due to the reductions in import tariff rates and causes an exogenous increase in U.S.

firms' external pressure.

However, the trend of tariffs changed in 2018. The former president Trump started trade wars with their counterparts in early 2018, especially the substantial tariff increase in Section 301 (lists 1-3) against China intensively since the third quarter of 2018. Although the U.S. and China signed an Economic and Trade Agreement including tariff reductions and exemptions on January 15, 2020, there is a debate on the benefits and losses that were brought by the trade war to the companies from 2018 to the end of 2019. The rise of tariffs due to the trade war is distinctive to the large tariff deductions studied by the prior studies and therefor the trade war raises the new question that whether the trade war affects market competition, companies' debt choices, and costs of debt.

The former president Trump's trade war significantly escalated the risk and uncertainty of hampering trade and investment while it might generally alleviate U.S. market competition according to intuition. The trade war has affected competition among U.S. firms in some specific industries, for example, the industries doing international business related to the products and markets about washing machines, solar panels, steel, aluminum, and food. The particularly affected sectors include, e.g., America's energy sector, automakers, food, agribusiness, and tractor manufacturers (Morris, 2020).[1] Therefore, the former president Trump's trade war constitutes exogenous policy changes as the high tariff impositions are beyond expectation even though they were parts of the former president Trump's election manifesto. The trade war and affected industries serve as a quasi-natural experiment for the impact of competition on corporate debt structure.

Furthermore, the existing studies discuss companies' general debt choice between bank debt and public debt as well as the costs of debt under the product market competition, see Valta (2012), Boubaker et al. (2018), and Bharath and Hertzel (2019). However, companies make their debt financing decisions in terms of the specific debt types within the two general categories of bank debt and public debt. To provide companies with financing guidance with more details under external policy shocks, I focus on various types of debt and their costs under the U.S.-China trade war. Following the categories and terminology in Capital IQ, I study six types of specific debt "Commer-

[1] https://www.globaltrademag.com/most-affected-industries-by-us-china-trade-war/.

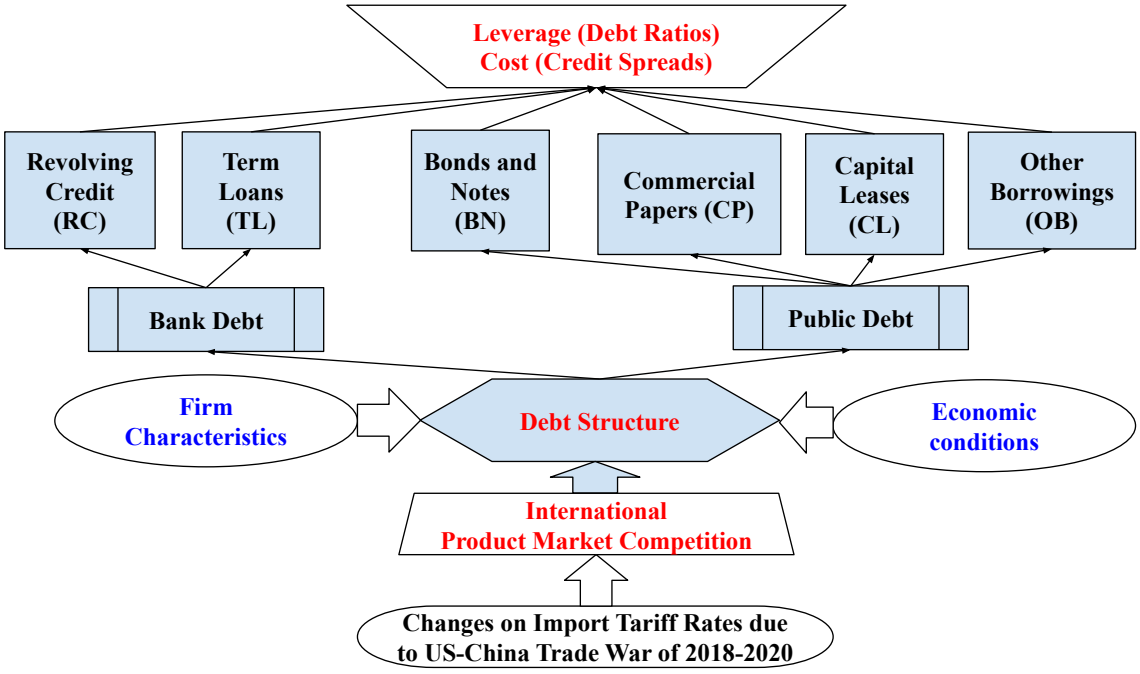


Figure 4.1.1. Debt structure and costs under the trade war and tariff changes

Notes. The flowchart illustrates the mechanism via which the trade war and tariff changes affect product market competition, firms' debt structure with the ratios of nine types of debt to book assets as well as their credit spreads. The book leverage (BL) is defined as a firm's total debt divided by the firm's book value of the total asset. The debt structure comprises revolving credit (RC), term loans (TL), bonds and notes (BN), commercial papers (CP), capital leases (CL), and other borrowings (OB). RC and TL are categorized into bank debt (BD) whose debt holders are banks. BN, CP, CL, and OB can be referred to as public debt (PD) that are issued in the public market.

cial Paper", "Revolving Credit", "Term Loans", "Bonds and Notes", "Capital Lease", and "Other Borrowings" that gather the rest of debt. This debt structure is consistent with represented prior works in Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). In addition, I examine three types of overall debts: bank debt comprising revolving credit and term loans, public debt including the other four types of specific debt, and total debt. I illustrate the concept relationship between the corporate debt structure and the research problem by a flowchart Fig. 4.1.1.

The work is the first one to investigate the specific debt structures and debt costs of companies and industries during the trade war. The contribution is to provide insightful explanations of the effects of the trade war on the debt structures of firms. I find that the sectors affected by the trade war show some significant changes in debt structure compared with the industries that are not hit by the trade war. Meanwhile, the affected sectors incur costs of debt that are different from the control industries'

costs of debt. The findings have implications for corporate decisions, market stability, and government policies.

Specifically, I find that although credit spreads decrease, the trade war did not alleviate competition and it intensified competition and hampered debt financing. I show that the trade war makes firms in the industries with the tariff protection of rising import tariffs pay lower credit spreads for borrowing various types of debt from banks or the public market. Furthermore, the treated firms reduce their leverages which comprise bank debt including revolving credit and term loans as well as public debt from the public market including bonds and notes, commercial papers, and capital leases during the trade war. The literature records that both bank debt and market competition bring external pressure to firms and when the external pressure is high, firms reduce bank debt to decrease the external effect. Therefore, the reduction of bank debt during the trade war implies that the competition is accelerated rather than alleviated by the trade war. Indeed, the results show that the product market competition indicated by HHI rises for the treated firms during the trade war. In addition, the trade war affects bank debt especially revolving credit, and the credit spreads of the total debt, public debt, and capital leases through HHI. In a *highly competitive market* with low HHI, the treated firms during the trade war reduce various types of debt and incur more costs of debt.

To achieve the research objective above, I carry out empirical studies of the corporate debt structure and related costs under the trade war by applying the following empirical strategy to the data. I use the U.S.-China trade war as an exogenous event to test whether the debt structures and costs of debt for treatment firms are significantly affected by the trade war that increases import tariffs and brings exogenous shocks to the U.S. market. I mainly employ the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment indicating the 3-digit SIC industry that experienced rising tariffs during the trade war period, on the outcomes of different debt ratios or credit spreads.

I carry out robustness analyses by using different empirical methods. First, I employ propensity score matching (PSM) methods that compare treatment firms and non-treatment firms to identify the effect of the U.S.-China trade war on the U.S. firms' debt structure and costs. I use PSM methods to mitigate asymptotic biases arising from

endogeneity or self-selection. Specifically, PSM methods provide the counterfactual outcomes of treatment firms by using the outcomes from a subsample of non-treatment firms whose covariates are matched to the covariates of the treatment firms in terms of property scores. With the estimates of the potential outcomes, the PSM estimator of the ATET can be obtained by taking the average of the difference between the observed and potential outcomes for each treated observation.

Second, I use the inverse-probability-weighted regression adjustment (IPWRA) method to estimate the ATET as well. It first computes the estimated inverse probabilities of treatment. Then it employs the weights to construct weighted regression coefficients for calculating the averages of predicted outcomes at the treatment level. Finally, the treatment effects are estimated by contrasting these averages.

There are reasons for using the IPWRA method to estimate the ATET. Generally, the IPWRA method has the double-robust property that entails the advantages of both the inverse-probability weighting (IPW) estimator and the regression adjustment (RA) estimator. First, simply using the sample means of outputs for the treated and untreated subjects to estimate the effect of treatment will conflate distinctive effects of various covariates. Second, instead of simple unweighted means, the IPW estimator uses weighted means to disentangle the effects of treatment and other confounders. It uses weights to get more correct estimates of the treated and untreated sample means for the missing data. The weighting scheme will pull up the estimated mean in an appropriate direction by applying more weight to it. These weights are the inverse (reciprocal) of the probability of being in the observed treatment group, which are estimated by fitting a function of subject characteristics that determine the treatment group.

Third, the RA estimator extends the basic way of using sample means to estimate treatment effects by using a regression model to predict potential outcomes that are adjusted for covariates. The RA method also can fit separate regression lines for different covariates to handle the differential effects of the covariates on treatment. Nevertheless, the RA estimator builds regression models to predict the outcomes of each subject but does not consider the way of treatment arising. The IPW estimator builds a regression model to predict treatment status but did not fit a model of the outcome. To solve these problems, the IPWRA estimator combines the benefits of

RA outcome modeling and the benefits of IPW treatment modeling. As a result, the IPWRA estimator is a doubly robust estimator with the remarkable property that the correct estimate of the treatment effect can be obtained as long as one of the two models is specified correctly.

Furthermore, I carry out Placebo tests to exclude the cases in which the results are obtained by chance. Fourth, I investigate whether the product market competition works as a mediation role, through which the trade war affects firms' debt structure and costs of debt. To this end, I compare the estimates of DID equations without HHI with those of corresponding equations with HHI. Through the comparison, I can decompose the total effect (TE) of the trade war into the direct effect (DE) and the indirect effect (IE). Furthermore, I examine whether there is a moderating effect of *HHI* that the relations between the treatment and the debt structure or costs vary with the values of *HHI*.

The chapter is related to the literature that employs quasi-experimental studies to examine the effects of tariff reduction on corporate debt and costs. Fresard (2010) runs a difference-in-difference analysis based on shifts in import tariffs to discover the causal impact of cash on market performance, which is markedly different from the strategic effect of debt. Valta (2012) uses the reductions of import tariff rates to capture exogenous changes to a firm's competitive environment and finds that competition has a significantly positive effect on the cost of bank debt. Boubaker et al. (2018) perform a natural experiment with the exogenous change of large import tariff reductions to show that external pressure from the market acts as an alternate mechanism for bank debt monitoring. Bharath and Hertzel (2019) address endogeneity concerns by taking the large changes in tariff rates during 1982 - 2010 as the exogenous source of variation in firms' competitive environment, with which they reveal that firms demand high creditor monitoring in bank debt when external pressure is weak. Feng et al. (2021) finds that the U.S.-China trade war raises the overall cost of debt by approximately 4.95% for a Chinese firm that is directly affected because of international trade friction operational risk, information risks, and default risk.

Overall, the literature discovers that the import tariff reduction produces an exogenous source of the rise in firms' competitive environment, which imposes pressure on firms and makes the firms reduce the external pressures of bank monitoring. I extend

the tariff reduction to the tariff rises of products targeted by the recent trade war and investigate the effects of exogenous shocks from the trade war on market competition. More importantly, I specify general debt to the debt structure and evaluate the effects of the exogenous policy variations on the corporate debt structure and the costs of debt under the effects of firm characteristics and economic conditions. Though the literature provides interpretations of bank debt costs there is not much literature on the relationship between the shocks of the trade war and the costs of various types of debt.

The chapter complements to debate on the benefits and losses that are brought to firms by the former president Trump's trade war under the modern structure of business internationalism. Benguria (2019) discover that the U.S-China trade war largely reduced the revenue and profits of the public Chinese firms in industries with a large measure of export exposures to the U.S., where the firms produce consumers' and industrial durables, as well as larger firms, were hurt most. Benguria et al. (2020) report that the rises in U.S. tariffs and Chinese retaliatory tariffs increase firms' trade policy uncertainty, where the time-varying and heterogeneous tariffs affected subsequent firm performance. Fajgelbaum et al. (2020) show that U.S. consumers and firms that purchased the imports targeted by the high tariffs incurred a large loss equivalent to 0.27% of GDP. Amiti et al. (2020) theoretically and empirically demonstrate that investment rates decline because the tariff policy in the trade war induces declines in the stock market and returns to capital. Liu et al. (2020) find that the Chinese SMEs with high export exposures to the U.S. customers are resilient to the rises in tariffs, although they experienced losses in the first year of the trade war. Ding et al. (2021) show that the U.S.-China trade war makes Chinese listed firms with American managers display smaller announcement returns than their counterparts. In short, the literature points out that the increases in import tariff rates and duties due to the Trump administration's trade war significantly affect income, investment, and markets. Meanwhile, the increasing tariffs bring exogenous shocks to competition in the product market, which will be discussed in the following sections.

The remainder of this chapter is organized as follows. Section 4.2 reviews relevant theories, the literature, and the development of hypotheses. Section 4.3 describes the empirical strategies and a flowchart for the concept relationship of the chapter. Section

4.4 presents the data, variables, summary statistics, and the features of variables. Sections 4.5 carries out quasi-experimental studies on the trade war. Section 4.6 provide the robustness results by using different empirical methods. Section 4.7 concludes. Finally, appendices gather additional results.

4.2 Related literature and hypothesis development

In this section, I survey the related literature and propose a series of hypotheses to study the interaction between the trade war, tariff changes, competition, the corporate debt structure, and the cost of debt under firm characteristics and economic conditions.

4.2.1 The U.S.-China trade war with higher tariffs across sectors

The Trump administration took a trade war with a number of battles against the U.S. allies, China, and other regions in the world, which started from particular the U.S. legal rationales and then imposed tariffs and/or quotas on imports in early 2018. Following these battles, the U.S. trading partners, e.g., China, made subsequent retaliation, especially after the U.S. intensified the trade war with China by Section 301 (lists 1-3) in the third quarter of 2018.

The trade war developed gradually through the introduction of various high tariffs across different sectors, which are emphasized in the timing of these introductions as follows. Former president Trump's trade war initially started in the first quarter of 2018. On *January 22, 2018*, the former president Trump imposed relatively rare global safeguard tariffs on $1.8 billion of *washing machines* and $8.5 billion in the imports of *solar panels*.

On *March 1, 2018*, the former president Trump made an announcement of forthcoming tariffs of 10% on *aluminum* and 25% on *steel* based on the argument of national security. These tariffs cover an estimated $48 billion of imports, where only 6% from China and the majority from allies such as the European Union, Mexico, Canada, and South Korea. Nevertheless, more tariff exemptions are granted to U.S. allies. The former president Trump exempted *steel* and *aluminum* tariffs from Canada, Mexico, the European Union, South Korea, Brazil, Argentina, and Australia.

On *March 23, 2018*, the former president Trump's 25% *steel* tariff covers $10.2 billion in imports and his 10% *aluminum* tariff applies to imports valued $7.7 billion. In return, On April 2, 2018, China imposed retaliatory tariffs on *aluminum* waste, *farm* products, and other U.S. products, which were valued at $2.4 billion (Bown and Kolb, 2021).[2]

On *July 24, 2018*, the Trump administration declared that it would provide up to $12 billion in subsidies to support domestic *farmers* who have suffered losses in export sales due to the president's various tariff measures, including tariffs on Chinese products, utilizing the Commodity Credit Corporation (CCC) that was originally established by the Agricultural Adjustment Act (AAA) of 1933 to assist farmers during the Great Depression. The target of AAA was to stabilize the prices of farm products by reducing surpluses and providing loans to farmers, which effectively limits the supply and raises prices. As a result, a wide range of agricultural products, such as soybeans, corn, nuts, fruit, and beef, were impacted by the tariffs, with a total of $27 billion in American agricultural exports.

The trade war between the U.S. and China intensified in the third quarter of 2018 when Section 301 (lists 1-3) was effective on three lists of products valued at $250 billion in total. Then the U.S. and China continued the trade war with increasing tariffs on higher values of imports until 2019 December. On January 15, 2020, the U.S. and China signed an Economic and Trade Agreement including tariff reductions and exemptions. Therefore, I investigate the effect of the trade war on the industries that were targeted by the three lists of Section 301 during the trade war period between the third quarter of 2018 and the last quarter of 2019, because the U.S.-China trade war intensified during this period and Section 301 (lists 1-3) was the main battlefield of the war.

As a result of the trade war, many import tariff rates and duties increase due to the Trump administration trade war, which significantly affects related industries' imports, firms' income, investment, and stock markets. Meanwhile, the increasing tariffs bring exogenous shocks to competition in the product market. In the following sections, I describe previous studies on the effects of the trade war.

[2] https://www.piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide.

4.2.2 Industries affected by the trade war

There are a few waves of tariff increases during the trade war and they affect a number of industries. Lovely et al. (2018) and Bown (2018) study the effect of the tariff increase backed by the investigation launched by the Office of the US Trade Representative (USTR) under Section 301 of the Trade Act of 1974. On the proposed tariff list, there are 1,333 products classified. Most of the products subject to the administration's tariff proposal are intermediate inputs and capital equipment.

Furthermore, they map the Harmonized System (HS) codes covered by tariff growths to the North American Industry Classification System (NAICS) industry classification code by using the concordance developed by Pierce and Schott (2012b). They identify that four-fifth of targeted trade value matches the sectors identified as patent-intensive in the 2012 Department of Commerce. The most affected sectors are NAICS 334 for computer and electronic products, NAICS 333 for nonelectrical machinery, NAICS 335 for electrical equipment, appliances, and components, and NAICS 336 for transportation equipment. Similar results are found by Guo et al. (2020) who use the tariff data until 2020.

Flaaen and Pierce (2019) use tariff data during 2018-2019 to find out the top ten NAICS industries from their cumulative measure of new import protection, top ten NAICS industries from their cumulative measure of new tariff export share of output, and top ten NAICS industries from their cumulative measure of new tariff import share of costs. They report that in addition to steel, aluminum, washing machines, and solar panels, the industries primarily affected include electric lighting equipment (NAICS 3351), household and institutional furniture and kitchen cabinets (NAICS 3371), and other electrical equipment and component (NAICS 3359). Similarly, Benguria et al. (2020) document the top ten 3-digit SIC industries in terms of their firm tariff exposure measures on the imports of Chinese goods that are most affected by the trade war.

More studies reveal the effects of the trade war on sectors and institutions. Huang et al. (2018) examine the market responses to the trade war and show that for U.S. firms depending on exports to and imports from China, they demonstrate lower stock returns, bond returns, and higher default risks in the short event window around the tariff announcement date. The trade war also affects the responses of firms with indirect

exposure to U.S.-China trade through the channel of domestic input-output linkages. Amiti et al. (2019) show that the Trump administration's trade policy substantially increases the prices of intermediates and final goods, which lead to dramatic changes to the supply-chain network. Imported varieties are reduced and the tariffs are passed into domestic prices of imported goods. This negative effect is equivalent to a decrease in U.S. real income of $1.4 billion per month in 2018. Similar patterns are found in other countries that take retaliated against the U.S.

Cigna et al. (2020) apply a difference-in-differences framework to estimate the effect of a binary variable that takes one in the month when the U.S. raises a new tariff on products imported from China. They confirm that these new tariffs impose a strong negative direct effect on U.S. imports from China. There is no significant evidence for short-run trade diversion effects towards other countries caused by tariff shocks. Fetzer and Schwarz (2021) use individual and aggregate voting data to find out that retaliation is politically targeted to hurt Trump. They quantify the level of political targeting and study potential trade-offs by constructing a simulation approach for counterfactual retaliation responses. They show that China places great effort on making maximal political targeting. The EU maximizes political targeting and meanwhile minimizes economic damage.

In brief, some industries were severely hit by Trump administration's trade war and these industries could be taken as the treatment group. Correspondingly, the remaining industries that are not directly affected by the tariff rises in the trade war will be taken as the control group to study the effects of the trade war.

4.2.3 Impact of the trade war on firms

Former president Trump's trade war brought a debate on the benefits and losses to firms due to the trade war under the modern business structure with internationalism. The literature started to investigate the impact of the trade war on firms from different aspects.

Benguria (2019) studies the impact of the U.S-China trade war on more than two thousand public Chinese firms by using quarterly data. The authors discover that since the beginning of the trade war, the trade war largely reduced the revenue and profits of the firms in industries with a large measure of export exposure to the U.S. Furthermore,

the trade war and U.S. tariffs hurt mostly the firms producing consumer and industrial durables and larger firms but Chinese tariffs equally benefited Chinese firms with all sizes. Benguria et al. (2020) use customs trade data and tariff changes to quantify the impact of the U.S.-China trade war on Chinese firms facing anxiety and pain. They report that the rises in U.S. tariffs and Chinese retaliatory tariffs increased firms' trade policy uncertainty. The impact of tariffs was time-varying and heterogeneous, which further affected subsequent firm performance including investment, R&D expenditures, and profits.

Fajgelbaum et al. (2020) discuss the short-run impact of protectionism in the form of the U.S. 2018 tariff rise and major trade partners' retaliation. They show that this trade war resulted in large decreases in imports and exports. U.S. consumers and firms that purchased the imports targeted by the high tariffs incurred a large loss equivalent to 0.27% of GDP. The domestic producers of the products targeted by the high tariffs experienced a loss of aggregate real income at the value of 0.04% of GDP. Amiti et al. (2020) study the effects of U.S.-China tariff announcements and actions through 2018 and 2019 on investment rates of listed U.S. firms. They theoretically and empirically demonstrate that investment rates decline because the tariff policy induces declines in the stock market and returns to capital.

Liu et al. (2020) study the effects of the U.S.-China trade war on the performance of Chinese SMEs with high export exposures to U.S. customers. Using a unique dataset, they derive information about SMEs' American customers from annual reports by textual analysis and they apply matched pairs analysis to identify the abnormal performance of the SMEs with U.S. customer concentration before and after the trade war. They find that these SMEs are resilient to the rises in tariffs, although they experienced losses in the first year of the trade war. Ding et al. (2021) use an event study methodology to show that the U.S.-China trade war makes Chinese listed firms with American managers display smaller announcement returns than their counterparts. This negative effect is more serious for Chinese firms exporting to the U.S. market but the effect is mitigated by foreign shareholders and overseas direct investments.

Pencea (2019) describes the evolution of the U.S.-China economic relations and links the trade war to the background of international production in global value chains and production networks. The study addresses that the consequences would be negative to

not only the two countries but also to the economies, companies, and populations of the U.S., China, South-East Asia, and the EU. Kashyap and Bothra (2019) explain why the U.S. increased tariffs on Chinese goods in 2018 and illustrate the effects of the trade war on the international supply chain, India, and EU countries. Lai (2019) predicts that in the final assembly stage of the trade war, many industries might leave China, although parts of the production process would remain. Then Hong Kong could be hurt significantly by the trade war if it escalates. Goulard (2020) evaluates European policy towards the USA and China in the U.S.-China trade war and its consequences on the exchanges between Europe. The study points out the possible diversion of the European market due to the trade war.

Hossain and Hosain (2019) provide a descriptive study that discusses the reasons for the trade war, and its effects, and suggests measures based on the sources of the published news, articles, and information on the web. Ovuakporaye (2020) examine the U.S.-China trade war from the issues surrounding the U.S.-China trade relation including the trade deficit, intellectual property rights, cyber theft, industrial policies, foreign direct investment, as well as the impact on the market, companies, and currencies. Xu and Lien (2020) study the effect of the U.S.-China trade war on the dynamic dependence of the Chinese Yuan and the currencies of its major trading countries. They find that the possible factors driving changes in exchange rates and dependence are the appreciations in the USD and the downside risk of the global economy caused by the trade war.

The chapter is also related to the literature about the effect of U.S.-China trade and the Trump administration. Hombert and Matray (2018) discover that although the increasing imports from China reduce the sales growth, profitability, capital expenditures, and employment of U.S. firms, the negative effects are significantly weaker for U.S. firms with large R&D stocks. The reason is that R&D increases firms' product differentiation. Child et al. (2021) investigate the former president Trump's surprise election victory without political background and reveal that firms with presidential ties had larger abnormal returns around the 2016 election. These connected firms achieved better performance, more government contracts, and fewer unfavorable regulatory actions.

In short, the literature points out that the Trump administration's trade war in-

creases import tariff rates and duties, which significantly affect imports, firm income, investment, stock markets, capital returns, and trade policy, as documented by previous studies. Meanwhile, the increasing tariffs bring exogenous shocks to competition in the product market, which will be discussed in the following sections.

4.2.4 International competition and the effects on financing

The literature in international business studies records the rise of international product market competition and the effects on firms' performance, production, and innovation. Doyle et al. (1992) study the competition among American subsidiaries and Japanese subsidiaries in the British market. During this global market competition, American subsidiaries show less ambitious strategies of focusing on short-term profit performance. With these strategies, American subsidiaries are less adapted to market changes in Britain than their Japanese competitors. The proportion of U.S. subsidiaries achieving successful profit and market performance is one in three while the fraction of Japanese subsidiaries that are successful is three out of four during the sample of a five-year period.

Clougherty (2001) uses the data of the airline industry to show that the autonomy of domestic competition policy is undermined by globalization with increasing international trade and capital flows. Meanwhile, globalization's impact is mediated by government institutions. Hutzschenreuter and Gröne (2009) examine the effects of two types of international competition, imports and foreign direct investment (FDI), on the geographic scope and product of multinational enterprises (MNEs). They found that the growth of imports results in scope reduction but increasing FDI raises the scope. The change in scope relies on the ability and motivation of an MNE to respond to international competition.

Furthermore, import competition has an influence on the strategies of corporate finance. Zhou et al. (2013) demonstrate that globalization and import competition increase the risk and uncertainty in the future performance of U.S. firms, which makes the firms replace cash dividend payments with share repurchases. They find significant explanatory power of import penetration through a risk channel, which is robust to a variety of controls suggested in the literature. Xia and Liu (2017) identify the important role of foreign and domestic competition in the innovation of private high-tech new

ventures. They show that the effects of foreign and domestic competition on innovation performance depend on the different types of resources and learning gains. For private high-tech new ventures, they discover a U-shaped relationship between foreign competition and innovation performance, although domestic competition from state-owned enterprises exerts a positive effect on private firms' innovation performance.

Rahaman (2016) examines the impact of Chinese import competition on the costs and contracts of bank-loan for U.S. manufacturing firms. They analyze a quasi-natural experiment of China's WTO entry and show that the increase in Chinese import competition makes import-competing U.S. manufacturing firms obtain external bank financing with lower credit spreads, more amounts, longer maturity, smaller collateral, and looser covenants. They reveal that the underlying reason for lower financing premiums is the gains from trade-induced productivity increases and the reallocation of capital to technologically advanced firms.

Huang and Kim (2019) report that import competition in downstream industries has a spillover effect on upstream industries' capital structures. They document that a reduction in import tariffs in a downstream industry makes the upstream suppliers prefer more conservative financial policies. The upstream industries reduce their leverages more and issue more equity when they have a more valuable customer-supplier relationship and when the suppliers are more vulnerable to the downstream shock. Finally, firms mainly issue more amount of equity for their leverage adjustments.

To sum up, previous international business studies find that firms' performance, production, and innovation are related to the rise of international product market competition. In the next section, I examine the literature about the product market competition affected by tariff changes, which further determine firms' debt and costs.

4.2.5 Tariff changes, competition, debt, and costs

The literature employs quasi-experimental studies to examine the effects of tariff changes on competition, corporate debt, and costs.

Fresard (2010) discovers that competitors with large cash reserves gain market share at the expense of industry rivals. A difference-in-difference analysis based on shifts in import tariffs indicates the causal impact of cash on product market performance. Further, the analysis suggests that cash has a competitive effect on product market

outputs, where the effect is markedly different from the strategic effect of debt. The competitive effect is stronger if the rivals face more financial constraints and there are more interactions between them. In general, the results suggest that the cash policy relates to a significant strategic dimension.

Valta (2012) uses the reductions of import tariff rates to capture exogenous changes to a firm's competitive environment and finds that competition has a significantly positive effect on the cost of bank debt. The quasi-experimental study shows that the cost of bank debt is systematically higher for firms that operate in competitive product markets. These findings suggest that banks price financial contracts by taking into account the risk that arises from product market competition.

Boubaker et al. (2018) examine how competitive pressure affects firms' choice between bank debt and public debt, considering the informational and monitoring role of product market competition in prior research. The authors use a sample of 3,675 U.S. firms over the period 2001 - 2013 to show that competitive pressure from the product market leads firms to rely less on bank debt financing. They perform a natural experiment with the exogenous change of large import tariff reductions. With the experiment, they show that after large import tariff reductions, firms decrease their reliance on bank debt. Their findings provide the implication that external pressure from the product market acts as an alternate mechanism for bank debt monitoring.

Bharath and Hertzel (2019) show that intense product market competition exogenously increases external pressure, which makes the firms prefer issuing public debt rather than bank financing. They use quasi-natural experiments to address endogeneity concerns and to capture two types of exogenous variation in external pressure: the decrease in import tariffs at the industry level and the enactment of business combination laws. In the former experiment, the exogenous source of variation in firms' competitive environment is the large changes in industry-level import tariff rates during the period of 1982 - 2010 as trade barriers were softened by free trade agreements signed between the U.S. and its counterparts. When external pressure is weak, firms demand high creditor monitoring in bank debt, which is consistent with the effect of mechanism substitution.

Feng et al. (2021) finds that international trade friction such as the U.S.-China trade war raises the cost of debt by approximately 4.95% for a Chinese firm directly affected

because international trade friction significantly rises both operational and information risks, which increases the default risk perceived by debtholders. Their cross-sectional analysis reveals that the effect is stronger for non-state-owned companies, companies without policy support, and companies with heavy exports.

4.2.6 Hypotheses on the trade war, debt structure, and costs

Overall, the literature discovers that the import tariff reduction, i.e., the negative import tariff change, produces an exogenous source of the rise in firms' competitive environment, which imposes pressure on firms significantly and makes the firms reduce the external pressures of bank monitoring. By extending the tariff reduction to the tariff rises of products targeted by the trade war, I study the effects of exogenous shocks that are brought by the increasing tariffs of the trade war on competition in the product market. Based on the trade war and competition mechanism, I specify general debt to the debt structure and then develop the hypotheses.

Considering the influence of the trade war and rising tariffs on product market competition, I make the hypotheses to investigate the effects of the exogenous policy variations on product market competition, the corporate debt structure, and the costs of debt under the effects of firm characteristics and economic conditions. The literature provides some interpretations of bank debt costs but there is not much literature on the relationship between the shocks to product market competition during the trade war and the costs of various types of debt.

For an easy exposition I use the names of various types of debt to denote the ratios of the amount of these types of debt to book assets in hypotheses and following texts, see the debt structure and relevant definitions in Fig. 4.1.1 and Section 4.4.2. I define a dummy variable ***TreatTWar*** taking 1 for the industries that experience rising tariffs during the trade war period and taking 0 otherwise, see the variable definition and empirical equations in Section 4.3.1, where I denote the coefficient of *TreatTWar* in equations (4.3.1) and (4.3.2) by β_3. In addition, I follow the literature to measure product market competition based on the Herfindahl-Hirschman Index (HHI) of industry concentration. A higher level of HHI implies greater industry concentration and thereby less intense competition pressure. I denote the coefficient of *HHI* in equations (4.3.1) and (4.3.2) by β_4.

Hypothesis 1, H_1^1: there is a negative relationship between *TreatTWar* and total debt/bank debt/public debt/revolving credit/term loans/bonds and notes/commercial papers/capital leases.

Counterfactual Hypothesis 1, H_0^1: the relationship between *TreatTWar* and total debt/bank debt/public debt/revolving credit/term loans/bonds and notes/commercial papers/capital leases is positive or insignificant.

For Hypothesis H_1^1, I estimate equation (4.3.1) in Section 4.3.1. Hypothesis H_1^1 suggests that the trade war makes treated firms reduce their leverages that comprise bank debt from banks and public debt from the public market during the trade war with the tariff protection of rising import tariffs. Namely, the trade war complements the negative relationship between the firms' profits and leverages by decreasing their total debt/bank debt/public debt/revolving credit/term loans/bonds and notes/commercial papers / capital leases in general, see the variable definitions in Fig. 4.1.1 and Section 4.4.2.

Hypothesis 2, H_1^2: there is a negative relationship between *TreatTWar* and the credit spread of total debt/bank debt/public debt / revolving credit/term loans/bonds and notes/commercial papers/capital leases/other borrowings.

Counterfactual Hypothesis 2, H_0^2: the relationship between *TreatTWar* and the credit spread of total debt/bank debt/public debt/revolving credit / term loans/bonds and notes/commercial papers/capital leases/other borrowings is positive or insignificant.

For Hypothesis H_1^2, I estimate equation (4.3.2) in Section 4.3.1. Hypothesis H_1^2 suggests that during the trade war with the tariff protection of rising import tariffs, firms can pay lower credit spreads for borrowing various types of debt from banks or the public market, see the variable definitions in Fig. 4.1.1 and Section 4.4.2.

4.3 Empirical strategy - Quasi-experimental studies

I describe the strategies for the empirical study of the effects of the former president Trump's trade war on firms' debt structure and costs of debt. I focus on various types of debt and their costs. I follow the categories and terminology in the data source of

Capital IQ, which is generally consistent with represented prior works in Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). First, I study six types of specific debt "Commercial Paper", "Revolving Credit", "Term Loans", "Bonds and Notes", "Capital Lease", and "Other Borrowings" that gather the rest of the debt. Second, I examine three types of overall debts: bank debt comprising revolving credit and term loans, public debt including other four types of specific debt, and total debt.

To test hypotheses about the debt structure and the cost of debt, the chapter considers the ratio of a particular type of debt to the book value of the total asset, the corporate leverage, and credit spreads as the dependent variable respectively. I formulate the hypotheses described in Section 4.2 in the form of empirical equations in the following subsections. In the equations, Y can be one of $BL/BD/PD/RC/TL/BN/CP/CL/OB$, which denotes the amount of one type of debt in the corporate debt structure, to the total asset. CS in the equations can be the credit spread of one type of debt in the corporate debt structure. I measure the credit spread by the weighted average interest rate of a specific type of debt over LIBOR.

More importantly, I introduce three dummy variables for evaluating the effects of the trade war on treated industries. First, I define a binary variable ***TradeWar*** that indicates the trade war of raising import tariff rates. The dummy is 1 during the period starting in the *third* quarter of 2018 when the war was intensified by Section 301 tariff action on three lists of products valued at $250 billion in total, and ending in the last quarter of 2019 when the trade war was going to diminish. This time period is the '*Follow-up*' period. The variable is 0 before the trade war and indicates the '*Baseline*' period.

Second, I use a dummy variable ***Treat*** identifying the specific industries that were affected by the three lists of Section 301 that was the main battlefield intensifying the trade war. The firms in these industries are the treatment firms (the '*Treated*' group) while the rest of firms are the non-treatment control firms (the '*Control*' group).

Third, I produce the dummy variable $\boldsymbol{TreatTWar} = TradeWar \times Treat$ indicating the industries that experienced shocks to product market competition due to rising tariffs during the trade war. Therefore, I consider a posttreatment effect, a treatment-group effect, and the interaction term to identify whether debt or costs of debt for the treatment group was significantly affected during the trade war compared to the

control group. Fig. 4.3.1 portrays the timeline for the former president Trump's trade war that is intensive in 2018.

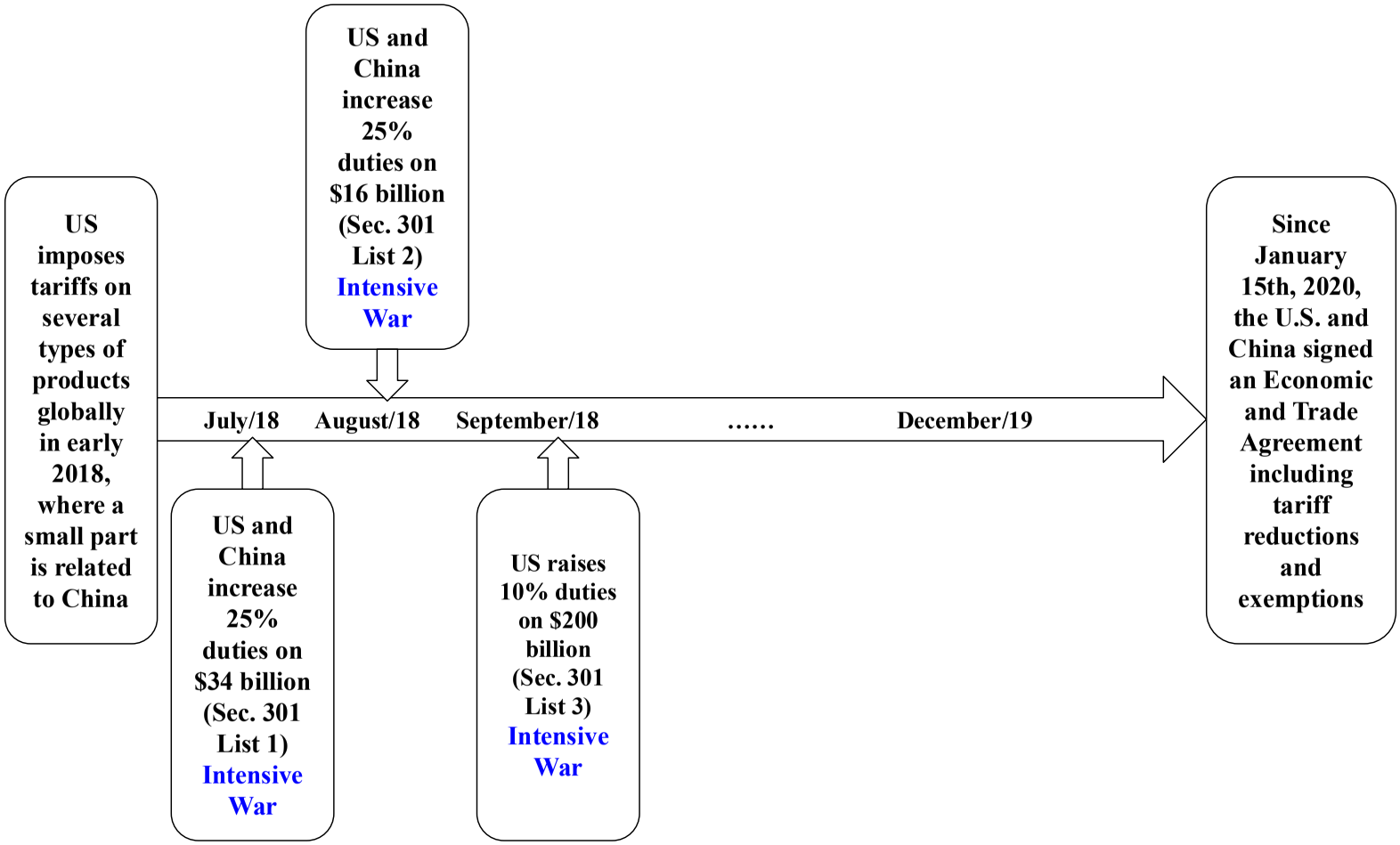


Figure 4.3.1. A timeline of U.S.-China trade war

Notes. The flowchart depicts the timeline of the U.S.-China trade war during 2018 - 2019, which was intensified in 2018 Q3 when Section 301 (lists 1-3) was effective on three lists of products valued at $250 billion in total. Until January 15th, 2020, the U.S. and China signed an agreement including tariff reductions and exemptions. Source: Everstream Analytics, Hinrich Foundation, and Peterson Institute for International Economics.

In addition to the three dummy variables for the trade war and treated industries, the independent variables include the *HHI* indicating the product market competition, firms' profits, and other characteristics in the vector with one quarter lag, $\mathbf{X}_{t-1} = [\mathbf{X}^T_{1,f,t-1}\mathbf{X}^T_{2,t-1}]^T$, where $\mathbf{X}_{1,f,t-1}$ and $\mathbf{X}_{2,t-1}$ represent other corporate characteristics and economic conditions respectively, see variable definitions in 4.4.2. The literature usually uses lagged characteristics as independent variables (e.g., Colla et al., 2013; Strebulaev and Yang, 2013; Valta, 2012; Frank and Goyal, 2015; Badoer et al., 2019; Eckbo and Kisser, 2020). Similar to the literature, I use lagged variables capture the effects of corporate characteristics and economic conditions in previous quarters on current financial policies.

4.3.1 DID for the trade war, competition, and debt structure

The U.S.-China trade war since 2018 has increased import tariff rates and duties, which bring exogenous shocks to product market competition in the U.S. I use the U.S.-China trade war as an exogenous event to test whether the debt structures and costs of debt for treatment firms are significantly affected by the trade war. Specifically, I employ the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment $TreatTWar = TradeWar \times Treat$, which indicates the 3-digit SIC industry i that experienced rising tariffs during the trade war period, on the continuous outcomes of different debt ratios or credit spreads by fitting linear equations to identify the change in debt ratios or credit spreads.

I use a version of the two-period and two-group DID specification (the 2-by-2 DID) that is usually discussed in the literature.

$$\begin{aligned} Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.1}$$

$$\begin{aligned} CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.2}$$

In the two equations, subscripts f, i, and t represent the firm, industry, and quarter, respectively. The vectors β and $\mathbf{X}_{t-1} = [\mathbf{X}^T_{1,f,t-1}\mathbf{X}^T_{2,t-1}]^T$ capture the effects of other corporate variables ($\mathbf{X}_{1,f,t-1}$) and economic variables ($\mathbf{X}_{2,t-1}$), and $\varepsilon_{f,i,t}$ is the disturbance term. The DID result about the ATET of $TreatTWar = TradeWar \times Treat$ is

obtained through three differences. The first two differences are the difference between the treated group and the control group in the baseline period and their difference in the follow-up period. Then the DID result is the difference between the two differences between the two groups in the two time periods.

In addition to the 2-by-2 DID specification in terms of two binary indicators $TradeWar$, $Treat$ and their product $TradeWar \times Treat$, I also consider general DID equations with the variable $TreatTWar$ that is defined by the product $TradeWar \times Treat$ along with the two-way fixed effects (TWFE) of industry and quarter. This is also a DID specification since the $TreatTWar$ with 1 indicates the treated entities during the treatment period. The generalized DID can be applied to a wider range of cases that are not feasible within the 2-by-2 framework. The general DID equations with quarter (d_t) fixed effects and 3-digit SIC code industry (d_i) fixed effects are specified as follows.

$$Y_{f,i,t} = \beta_0 + \beta_1 TreatTWar_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + d_i + d_t + \varepsilon_{f,i,t}. \tag{4.3.3}$$

$$CS_{f,i,t} = \beta_0 + \beta_1 TreatTWar_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + d_i + d_t + \varepsilon_{f,i,t}. \tag{4.3.4}$$

In brief, the main results come from the estimation of equations (4.3.1) and (4.3.2). Furthermore, I carry out a series of robustness analyses by using the empirical methods described in the following sections.

4.3.2 The PSM estimator for the trade war, competition, and debt structure

I employ the propensity score matching (PSM) method to compare treatment firms and non-treatment firms to identify the effect of the U.S.-China trade war on the U.S. firms' debt structure and costs.

The PSM method imputes the unobservable potential outcomes for each subject by using the outcomes of similar subjects that receive the other treatment level, where the similarity between subjects is based on estimated propensity scores that are the probabilities of subjects receiving a treatment given other observed control variables. By this way, PSM methods mitigate asymptotic biases arising from endogeneity or self-selection.

Based on the PSM processed data, I am able to estimate the effect of treatment,

accounting for the control variables predicting the treatment. Taking the average of the difference between the observed and potential outcomes for each subject leads to the treatment effect. As a result, the PSM estimator obtains an unbiased estimation of the treatment effect by creating a sample receiving the treatment that is comparable to a sample that did not receive the treatment after accounting for the control variables.

4.3.3 The IPWRA estimator for the trade war, competition, and debt structure

I use the inverse-probability-weighted regression adjustment (IPWRA) method to estimate the average treatment effect on the treated (ATET) as well. Meanwhile, IPWRA provides the potential-outcome means (POMs) from observational data. It first computes the estimated inverse probabilities of treatment. Then it employs the weights to construct weighted regression coefficients for calculating the averages of predicted outcomes at the treatment level. Finally, the treatment effects are estimated by contrasting these averages. The IPWRA method has the double-robust property that entails the advantages of both the inverse-probability weighting (IPW) estimator and the regression adjustment (RA) estimator.

4.3.4 Placebo tests for the trade war, competition, and debt structure

To examine the extent to which the results are influenced by the trade war and tariff treatment, I conduct placebo tests to exclude the cases, in which the results are obtained by chance. I follow typical falsification tests that are employed by the economics literature, for example, a taxation and consumption study in Chetty et al. (2009), a population work in La Ferrara et al. (2012). Feng et al. (2021) is a recent application of the Placebo test to the trade war study.

First, following the literature, I randomly assign the target of the trade war to 3-digit SIC industries and the trade war to different quarters. Specifically, I perform permutation tests by permuting the variable $TreatTWar = TradeWar \times Treat$. General permutation tests are implemented by Stata, see, e.g., Kaiser and Lacy (2009), Ängquist (2010), and Gallis et al. (2018). Then I obtain the treated group which is a random sample and the control group which is the rest of the observations.

Second, using the false treatment variable $TreatTWar$, I carry out placebo analy-

sis. I mainly use the IPWRA method to estimate the coefficient of $TreatTWar$. Given the random data generation process, a false treatment variable should have produced an insignificant estimate with a magnitude close to zero. To increase the identification power of this placebo test, I repeat the above regression 100 times and store the coefficients of *TreatTWar*.

Third, I display the distribution of the coefficients from the simulated sample by plotting the kernel density estimate. For a significant treatment effect, the simulated distribution of the coefficients of *TreatTWar* follows a normal distribution with the mean close to 0 while the coefficient of *TreatTWar* in a regression with real data will be significantly away from 0. Such a result indicates that for the significant treatment effect, randomly assigning a treatment of the trade war does not affect the dependent variable of the particular type of debt or credit spread.

4.3.5 Mediation of competition mechanism

I investigate whether the product market competition works as a mediation role, through which the trade war affects firms' debt structure and costs of debt. Causal mediation analysis has been developed in social science, e.g., psychology and economics, and several variants turn to popular including the product method of Baron and Kenny (1986), the structural equation modeling (SEM) of VanderWeele (2012), the parametric regression models and the Stata command *paramed* of Emsley and Liu (2013), and a more flexible simulation-based approach of Imai et al. (2010) as well as the Stata command *medeff* of Hicks and Tingley (2011).

For an easy illustration, I describe the causal mediation analysis in a classic three steps approach. First, I estimate the equations (4.3.5) and (4.3.6) of debt structure and costs without the variable HHI that indicates the product market competition. The coefficient β_3 in (4.3.5) and (4.3.6) is the total effect (TE) of $TradeWar \times Treat$. Second, I examine whether HHI can be explained by the trade war in terms of equation (4.3.7). Third, I compare the estimates of equations (4.3.5) and (4.3.6) without HHI in the first step with those of corresponding equations (4.3.1) and (4.3.2) with HHI as one of independent variables, where the coefficient β_3 in (4.3.1) and (4.3.2) is the direct effect (DE) of $TradeWar \times Treat$. The difference between the total effect and the direct effect is the indirect effect (IE) of $TradeWar \times Treat$ that go through the

mediation of HHI.

$$\begin{aligned} Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.5}$$

$$\begin{aligned} CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.6}$$

$$\begin{aligned} HHI_{i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.7}$$

4.3.6 Moderation of competition mechanism

I examine the possible mechanism that the product market competition works as a moderator that modifies the relations between the trade war and firms' debt structure as well as the costs of debt. There would be a moderating effect of *HHI* if the relations between *TreatTWar* and the debt structure or costs vary with the values of *HHI*.

To model the moderation role of *HHI* that makes the relations between *TreatTWar* and the debt structure or costs differ by the *HHI*, I add an interaction term between *TreatTWar* and *HHI* as the predictor of the debt structure or costs in the equations (4.3.8) and (4.3.9). A significant regression coefficient of this interaction term suggests that *HHI* modifies the relations between *TreatTWar* and the debt structure or costs.

$$\begin{aligned} Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 TreatTWar_{i,t} \times HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.8}$$

$$\begin{aligned} CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 TreatTWar_{i,t} \times HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned} \tag{4.3.9}$$

4.4 Data and variables

In this section, I describe data sources, sample selection process, variable definitions, summary statistics, and other data features.

4.4.1 Data sources and sample selection

The chapter mainly uses the debt structure data and financial statement data of US companies downloaded from Capital IQ and Compustat from the WRDS platform following Rauh and Sufi (2010), Colla et al. (2013), and Choi et al. (2018). The data about macroeconomic variables are obtained from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis. Quarterly data are collected and the data period is from 2015 to 2019 covering the period of the former president Trump's trade war that is intensive in 2018.

I obtain the U.S. HS-level merchandise import data from the U.S. Census Bureau. The HS stands for the Harmonized System, which is an international numerical system that is used by customs authorities to classify traded products. Using the updated concordance between HS codes and SIC/NAICS codes as well as the match of various versions of HS codes provided by Pierce and Schott (2012b,a), I map the HS-level data to a dataset at the industry-level of SIC codes. The import products with HS codes affected by the trade war of "China Section 301 - Tariff Actions and Exclusion Process"[3] are listed in the Federal Register.

I carry out the sample selection process as follows in detail. First, I merge debt data from Capital IQ (580,853 observations) with all other required data such as the company fundamentals data from Compustat (272,629 observations). I delete the observations that do not match the two databases and therefore I keep 134,300 observations left, which match both databases in terms of firms and quarters. Second, I drop 60,767 observations (73,533 observations left) where the differences between the total debt in Capital IQ and the total debt in Compustat are more than 10%, following Colla et al. (2013, p. 2120) and Choi et al. (2018, p. 499).

I investigate the differences between the two data sources further. I have the variable *Debt* from Compustat and the variable *Debt2* from Capital IQ. A comparison of the two debt variables exhibits a number of large differences. In the second step above, I drop the observations satisfying the condition of "*(Debt2 - Debt) > 0.1 Debt*". Namely, the variable *Debt2* of the deleted observations from Capital IQ is 10% higher than the counterpart variable *Debe* from Compustat.

[3] https://ustr.gov/issue-areas/enforcement/section-301-investigations/section-301-china

For the convenience of presentation, I define a temporary variable *debt_over = Debt2 / Debt*. I do not drop *debt* values greater than 1. Likewise, the temp variable *debt_over* is not the variable of *Leverage = Debt/Asset*. It is only used for demonstrating the large discrepancies between the two data sources and it is not one of the dependent variables or independent variables in the models. Hence, it is not necessary to winsorize the temporary *debt_over* as it will not be used later.

I also try the way of keeping the observations with large discrepancies and do not drop observations in the above second step. Then the companies' (total) debt and leverage can be either from Compustat or Capital IQ or the average of values from the two data sources when their differences are larger than 10%. Note that this choice only affects the regressions with the dependent variable *Leverage*. The dependent variables in the regressions for various types of debt such as *Term Loans* always come from Capital IQ. Keeping the observations with large discrepancies leads to worse outputs since the large differences are likely due to problematic samples. Besides, it is not appropriate to give arbitrary criteria in levels (rather than the 10% used above) or to impute debt values by the averages of the two sources because there are many observations with large differences.

Third, following the common practice in the literature (e.g., Colla et al., 2013; Danis et al., 2014; Badoer et al., 2020; Schwert, 2020), I restrict the data to non-financial and non-utility firms by dropping financial firms with SIC codes 6000 to 6999 (19,683 observations deleted and 53,850 observations left) and regulated utilities including electric, gas & sanitary services with SIC codes 4900 to 4999 (3,179 observations deleted and 50,671 observations left).

Fourth, I generate lag values of companies' characteristics following the practice of the literature (see Section 4.3), which unavoidably produces a large number of missing values of these characteristics. For example, *BL* has the numbers of missing observations at 1,314, *HHI* and *Profit* lead to 14,251 and 15,889 missing observations. Note that both *HHI* and *Profit* share 13,608 common missing observations.

Then I delete the observations where the key variables of *HHI*, *Profit*, and *Leverage* are missed, which drops 16,207 observations in total (34,464 observations left). For other non-key company characteristics, I fill missing values firstly by their lag values that are not missed and then by 0. In the end, the final sample comprises 34,464

firm-quarter observations and 4,639 firms for the period during 2015-2019. In the final sample, company characteristics are winsorized by using a 1% level.

4.4.2 Variable definitions

I construct the dependent variables and independent variables as follows. The lower-case symbols in brackets (e.g., 'atq') are the symbols for variables in Compustat.

To begin with, I define the dependent variables (LHS) in terms of corporate debt structure variables considering current data frameworks in Capital IQ, which are similar to prior studies in debt structure, see, e.g., Colla et al. (2013) and Choi et al. (2018). *Term Loan (TL)* is the Level of TL / book assets (atq), where 'atq' is variable name of total asset in Compustat. *Revolving Credit (RC)* is the Level of RC / book assets (atq). *Commercial Paper (CP)* is the Level of CP / book assets (atq). *Bond and Note (BN)* is the Level of BN / book assets (atq). *Capital Lease (CL)* is the Level of CL / book assets (atq). *Other Borrowing (OB)* is the Level of OB / book assets (atq). *Bank Debt (BD)* is the TL + RC. *Public Debt (PD)* is the CP + BN + OB + CL. *Book Leverage (BL)* is the ratio of book debt (dlcq + dlttq) to book assets (atq). *Credit spread (CS)* is the credit spread of the weighted average interest rate of a specific type of debt over LIBOR, which is similar to Schwert (2018).

I construct the variables related to the trade war and the industry-level measures of tariffs and trades similar to the literature. I introduce the dummy *TreatTWar* indicating the SIC industries that experiencing shocks to product market competition due to rising tariffs during the trade war. *Trade War* is equal to 1 for the periods when the former president Trump took the trade war by raising import tariff rates. The dummy is 1 starting in the *third* quarter of 2018 when Section 301 tariff action was effective on three lists of products valued at $250 billion in total. In addition, *tariff rate* is the ad valorem tariff rate measured as the ratio of the *duties* collected by U.S. Customs from each industry to the *dutiable value* of imports using the 3-digit SIC industry.

I define the following firm characteristics in a way similar to the literature in corporate finance (e.g., Strebulaev and Yang, 2013; Danis et al., 2014; Badoer and James, 2016; Prilmeier, 2017; Carvalho, 2018; Choi et al., 2018; Schwert, 2018; Santos and Winton, 2019) and product market competition (e.g., Beiner et al., 2011; Valta, 2012;

Hoberg et al., 2014; Boubaker et al., 2018; Sheikh, 2019).

Competition is equal to 1 for the firm with the HHI at the industry level of the three-digit SIC code in the lowest quartile, which indicates that a competitive product market imposes external pressure on firms (Valta, 2012). The *HHI* for a particular industry is the sum of squared market shares of sales for all firms in a three-digit SIC industry, where firm i's market share is its sales divided by the total sales in the industry that firm i belongs (e.g., Hoberg and Phillips, 2010b; Boubaker et al., 2018). *Profit* is defined as the operating profit (oibdpq) divided by book assets (atq).

Investment (capital expenditure) is capital expenditures (capxy) divided by book assets (atq). *Cash* is the ratio of cash and short-term investments (cheq) to book assets (atq). *Age* is the natural logarithm of the number of years passing the IPO date (Compustat variable 'ipodate') or the first year in Compustat if the value of the variable 'ipodate' is missed. *Size* is the natural logarithm of total asset adjusted to year 1982 dollars, $log(atq \times CPI_{1982}/CPI_t)$. Consumer Price Index (CPI) for all urban consumers is from the U.S. Bureau of Labor Statistics, which can be obtained from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis.

MV/BV (Market to Book) is the ratio of market value of assets, which is current debt (dlcq) plus long-term debt (dlttq) plus stock price (prccq) $\times$ stock number (cshoq), to book assets (atq). *Tangible* assets are defined as property/plant/equipment (ppentq) divided by book assets (atq). *Tax* is defined as taxes (txtq) divided by book assets (atq). *Earning volatility (Risk)* is the standard deviation of quarterly operating profits (oibdpq) scaled by book assets (atq) over the previous 4 quarters.

Macroeconomic conditions could affect firms' debt structure and the cost of debt and therefore some of the model specifications consider the variables of macroeconomic indicators. The return of the S&P 500 index and the growth of GDP indicate the health of the stock markets and the overall economy (La Porta et al., 1997; Boubakri and Ghouma, 2007; Laksmana and Yang, 2015). Graham et al. (2008) and Valta (2012) among others use the term spread and the credit spread to indicate the state of the economy and therefore of the equity markets. A strong stock market will attract more equity financing rather than debt financing. A positive and large term spread means that interest rates are currently low and are bound to rise. Credit spreads often widen during uncertain or worsening economic conditions such as recessions when credit supplies are

decreasing. Therefore, I consider the following economic variables. *Growth of S&P 500* is the quarterly return of S&P 500 index. *Growth of GDP* is the percent growth in the real gross domestic product from the previous quarter. *Term spread* is the difference between the 10-year Treasury yield and the 3-month Treasury yield. *Credit spread* is the difference between BAA corporate bond yield and AAA corporate bond yield.

4.4.3 Summary statistics and industries affected

I compare treatment firms and non-treatment firms during the five years around the trade war to examine the direct effect of the trade war on the debt structure. The fine details of the corporate debt structure allow us to disassemble the relationships between the leverage, costs, competition, firm characteristics, and economic conditions to the specific relationships between particular types of debt and these factors, which provide new insights into the corporate debt structure.

Table 4.4.1 provides the summary statistics of debt structure and firm characteristics in the final sample during the period of 2015 Quarter 1 to 2019 Quarter 4 from the U.S. panel data merging Capital IQ Capital Structure - Debt and Compustat Fundamentals Quarterly. Variables are defined in Section 4.4.2. I obtain the summary statistics after carefully observing the percentiles of variables and winsorizing their tail values at a 1% level or a 5% level, see Section 4.4.1. The sizes of debt-related variables vary as firms do not take some types of debts sometimes. I do not fill missing debt variables by 0 to emphasize the diversity of debt structure.

Table 4.4.2 displays the 2-digit SIC sectors affected by Section 301-China in the sample. I add NAICS according to the updated concordance between HS codes and SIC/NAICS codes Pierce and Schott (2012b) and naics.com. NAICS on each row is the one that matches the first 4-digit SIC within the 2-digit SIC. The column "Entry" is the number of commodities targeted by Section 301 within the 2-digit SIC industry. Observation is the number of firm-quarter observations within the 2-digit SIC industry on the row. Tariff is the ratio of duties to imports. Target (%) is the share of targeted commodities within a 2-digit SIC in the total imports targeted. It shows that the sectors with the 2-digit SIC ranging from 30 - 38 are affected the most. The industries that are severely affected include machinery, equipment, appliances, computer, and electronic products, which are consistent with prior studies.

Table 4.4.1. Summary statistics of characteristics, variables, and debt structure

Notes. The sizes of debt variables vary as firms do not take some types of debts. The two-sample t-test on the equality of the two groups' means is reported. ***: p<0.01, **: p<0.05, *: p<0.1.

	Total Sample			Control Sample (TreatTWar=0)			Treated Sample (TreatTWar=1)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	mean	sd	N	mean	sd	N	mean	sd	N	t-test
Duties (M $)	37.99	106.7	6,876	35.02	103.9	5,976	57.74	122.4	900	-5.97***
Imports (M $)	4,809	7,758	6,876	4,717	7,359	5,976	5,420	9,998	900	-2.54**
Tariff	0.0334	0.0320	6,876	0.0281	0.0219	5,976	0.0685	0.0567	900	-39.06***
HHI	0.151	0.155	34,464	0.157	0.157	30,353	0.108	0.136	4,111	18.94***
Profit	-0.0835	0.225	34,464	-0.0798	0.226	30,353	-0.111	0.214	4,111	8.23***
Size	4.071	3.386	34,464	4.093	3.435	30,353	3.907	2.997	4,111	3.31***
Tangible	0.308	0.307	34,464	0.322	0.311	30,353	0.204	0.250	4,111	23.30***
MV/BV	1.919	1.483	34,464	1.868	1.470	30,353	2.298	1.518	4,111	-17.55***
Investment	0.0287	0.0507	34,464	0.0298	0.0518	30,353	0.0208	0.0413	4,111	10.70***
Age	3.251	1.138	34,464	3.281	1.110	30,353	3.031	1.311	4,111	13.23***
Cash	0.219	0.275	34,464	0.197	0.257	30,353	0.383	0.336	4,111	-41.71***
Tax	0.00114	0.00805	34,464	0.00118	0.00823	30,353	0.000819	0.00652	4,111	2.69**
Earnings Vol.	0.0761	0.160	34,464	0.0764	0.162	30,353	0.0745	0.143	4,111	0.70
Gr. (S&P500)	0.0219	0.0349	34,464	0.0216	0.0345	30,353	0.0240	0.0375	4,111	-4.20***
Gr. (GDP)	0.00580	0.00215	34,464	0.00588	0.00221	30,353	0.00522	0.00147	4,111	18.68***
Term Spread	1.223	0.719	34,464	1.358	0.643	30,353	0.227	0.398	4,111	109.84***
Credit Spread	0.950	0.210	34,464	0.945	0.221	30,353	0.987	0.0818	4,111	-12.18***
Leverage	0.395	0.315	34,464	0.404	0.315	30,353	0.328	0.306	4,111	14.70***
Bank Debt	0.274	0.272	24,976	0.277	0.274	22,515	0.244	0.253	2,461	5.77***
Public Debt	0.279	0.309	27,103	0.288	0.311	23,560	0.225	0.288	3,543	11.25***
R. Credit	0.125	0.158	12,713	0.126	0.159	11,749	0.110	0.147	964	3.07***
Term Loan	0.260	0.284	20,448	0.262	0.286	18,382	0.241	0.262	2,066	3.20***
Bond and Note	0.331	0.317	19,728	0.330	0.317	17,890	0.337	0.323	1,838	-0.84
C. Paper	0.0351	0.0350	1,151	0.0358	0.0360	960	0.0317	0.0295	191	1.47
Capital Lease	0.0474	0.0980	14,346	0.0460	0.102	11,604	0.0532	0.0795	2,742	-3.48***
Other B.	0.0800	0.195	6,123	0.0785	0.194	5,578	0.0959	0.208	545	-1.98**
Total Debt CS	5.828	3.532	18,658	5.977	3.569	16,198	4.843	3.103	2,460	14.94***
Bank Debt CS	5.274	3.714	15,588	5.371	3.734	14,008	4.421	3.413	1,580	9.66***
Public Debt CS	5.763	3.454	17,527	5.908	3.477	15,065	4.872	3.167	2,462	13.87***
R. Credit CS	3.626	3.028	7,620	3.719	3.026	7,056	2.469	2.799	564	9.49***
Term Loan CS	5.542	3.759	14,336	5.651	3.778	12,884	4.574	3.439	1,452	10.39***
Bond CS	5.447	3.361	18,295	5.606	3.333	16,592	3.899	3.236	1,703	20.19***
C. Paper CS	0.588	1.634	680	0.764	1.684	580	-0.435	0.709	100	7.01***
C. Lease CS	5.649	3.712	9,467	5.824	3.791	7,321	5.050	3.364	2,146	8.52***
Other B. CS	4.942	3.970	1,779	5.059	3.936	1,679	2.989	4.036	100	5.10***

Table 4.4.2. The 2-digit SIC sectors affected by the trade war

Notes. This table displays the 2-digit SIC sectors affected by Section 301-China in the sample. Entry is the number of the commodities. Observation is the number of firm-quarter observations. A tariff is the ratio of duties to imports. Target (%) is the share of commodities in the total imports targeted.

2-Digit SIC	NAICS	Entry	Observation	Duties	Imports	Tariff	Target %
01	111140	247	47	14.06461	514.7141	0.027325	0.2944
02	112112	15	35	0.861245	102.6679	0.008389	0.08263
08	113210	5	16	0.668399	50.76135	0.013167	0.000185
10	212299	2	4027	0.264549	22.28184	0.011873	0.017939
13	211120	3	2449	31.83228	27803.61	0.001145	22.38409
14	212311	9	317	0.215763	15.75268	0.013697	0.002081
20	311611	962	661	231.5891	6077.384	0.038107	3.371129
21	312230	22	13	6.058781	88.75885	0.068261	0.070316
22	313210	1258	66	211.8807	2262.134	0.093664	1.309706
23	315220	1768	203	3475.02	22703.35	0.153062	0.397357
24	321999	123	152	34.58471	853.9461	0.0405	0.473664
25	337910	17	85	22.06399	551.938	0.039975	0.305998
26	322110	32	308	38.55298	795.8267	0.048444	0.640703
27	323111	3	241	0.183758	5.479845	0.033533	0.000792
28	325180	1372	6126	475.5726	9159.416	0.051922	6.464625
29	325194	27	284	4.465911	396.523	0.011263	0.318326
30	326211	330	245	578.3467	9598.036	0.060257	4.545821
31	316110	393	35	787.1329	7327.001	0.107429	2.313242
32	327211	303	169	210.6187	3157.492	0.066704	1.826619
33	331110	980	299	1736.339	11561.15	0.150187	2.120213
34	332431	435	330	409.0343	8721.327	0.0469	5.267776
35	333611	1004	1341	716.6783	10250	0.06992	7.654588
36	335311	578	1825	1057.406	19172.2	0.055153	11.28081
37	336120	235	733	1015.479	30990.59	0.032767	24.89646
38	334511	539	1862	287.2935	5345.667	0.053743	2.558066
39	339910	312	184	308.3052	5671.328	0.054362	0.884578
99	990000	2	451	20.22275	40.52251	0.49905	0.03256
Total Firm-Quarter Observations			34,464		Total No. of Firms		4,639

4.5 Empirical results of quasi-experimental studies

The empirical results show that the counterfactual hypotheses, H_0^xs, are rejected. Namely, non-counterfactual hypotheses, H_1^xs, agree with the data, i.e., these hypotheses are not rejected.

4.5.1 DID results for the trade war, debt structure, and costs

I formulate the hypotheses described in Section 4.2 in the form of empirical equations. In the equations, Y can be one of $BL/BD/PD/RC/TL/BN/CP/CL/OB$, which denotes the amount of one type of debt in the corporate debt structure, to the total asset. CS in the equations can be the credit spread of one type of debt in the corporate debt structure.

I use the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment $TreatTWar = TradeWar \times Treat$, which indicates the industry i that experiences rising tariffs during the trade war period, on the continuous outcomes of different debt ratios or credit spreads.

$$\begin{aligned} Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned}$$

$$\begin{aligned} CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned}$$

In the two equations, subscripts f, i, and t represent the firm, industry, and quarter, respectively. The vectors β and $\mathbf{X}_{t-1} = [\mathbf{X}_{1,f,t-1}^T \mathbf{X}_{2,t-1}^T]^T$ capture the effects of other corporate variables ($\mathbf{X}_{1,f,t-1}$) and economic variables ($\mathbf{X}_{2,t-1}$), and $\varepsilon_{f,i,t}$ is the disturbance term. I present the main results based on the above DID estimation.

The total number of observations drops in Columns (2) and (3), compared to Column (1) in regression tables because the sizes of debt-related variables vary as firms do not take some types of debts sometimes. For example, in Observation 1, the firm only takes revolving credit and then only the observations of leverage, bank debt, and revolving credit are 1, and no observation for the remaining types of debt. Next, in Observation 2, the firm only issues bonds and then only the observation for leverage adds up to 2 while the observations for bank debt, revolving credit, public debt, and bond are 1. Specifically, I ensure that *BankDebt* has a value as long as either revolving

credit or loan has a value. Nevertheless, *BankDebt* is missing if both revolving credit and loan are missing. I believe that such a way is reasonable as in this case, the firm does not have any bank debt at all and therefore *BankDebt* should be missing instead of 0. In unreported results, I fill all missing debt variables by 0 and obtain similar results. I do not fill missing debt variables by 0 to emphasize the diversity of debt structure.

Hypothesis 1, H_1^1, states that there is a negative relationship, $\beta_3 < 0$, between $TreatTWar$ and total debt/public debt/term loans/commercial papers/capital leases. Table 4.5.1 shows that Hypothesis H_1^1 agrees with the results. The coefficients of the interaction term $TreatTWar = TradeWar \times Treat$ in Table 4.5.1 suggest that the trade war negatively affects the firms in the treated industries with the tariff protection of rising import tariffs. The treated firms during the trade war decrease their ratios of total debt, public debt, term loans, commercial papers, and capital leases to the total asset.

Column (1) of Table 4.5.1 displays that there is a significant negative relationship, $\beta_3 = -0.0306 < 0$, between leverage and the treated firms during the trade war, which reflects the total debt deduction during the trade war. I am interested in whether the total debt deduction is due to bank debt or public debt or both. Next, I study how the trade war impacts leverage through the two components of leverage: bank debt and public debt. Columns (2) and (3) of Table 4.5.1 exhibit that the debt reduction due to treatment largely comes from the public debt component as the coefficient of $TreatTWar$ for public debt is significant while the coefficient for bank debt is not.

Then, I investigate specific types of debt to provide details on how the treatment $TreatTWar$ affects firms' debt through the debt structure. Columns (4) or (5) of Table 4.5.1 show that there is a significant relationship between $TreatTWar$ and revolving credit or term loans as two specific types of bank debt. Columns (7) and (8) of Table 4.5.1 report that the coefficients of $TreatTWar$ for commercial papers and capital leases are significantly negative and therefore they lead to the deduction of public debt and the total leverage among the treated firms during the trade war.

The coefficients of *TradeWar* indicate that during the trade war, all firms on average decrease their bank debt including revolving credit and term loans that entail external pressure from banks, and meanwhile increase their public debt including bonds and

notes and capital leases. As a result, the leverage of all firms is increased on average. Similarly, the coefficients of *Treat* displays that the treated firms during the overall sample period on average decrease their bank debt including revolving credit and term loans that entails external pressure from banks, and meanwhile increase their public debt including bonds and notes and capital leases.

I examine the effects of the trade war and the production market competition on the debt structure via the HHI and tariff in Table 4.5.2. I estimate the model specifications for leverage, bank debt, and public debt 3 times: Columns (1) - (3) with the HHI, Columns (4) - (6) with the tariff, and Columns (7) - (9) with the HHI and tariff. The results show that the treated firms during the trade war reduce their leverages and public debt significantly across all specifications. The HHI has negative relationships with leverage and bank debt. A higher tariff lets firms issue more amount of public debt and leverage.

I turn to study the effects of the trade war and tariff treatment on the costs of various types of debt in Table 4.5.3. The coefficients of *TradeWar* show that during the trade war, all firms on average pay smaller costs for various types of debt including all bank debt and public debt. Similarly, the coefficients of *Treat* indicate that the treated firms during the overall sample period on average experience lower credit spreads for different types of debt except for revolving credit. Finally, the coefficients of $TreatTWar = TradeWar \times Treat$ show that there is a significant negative relationship between $TreatTWar$ and the credit spreads of bonds and notes as well as all bank debt including revolving credit and term loans. This implies that the firms in the treated industries targeted by the trade war spend less on the costs of debt.

Table 4.5.1. Debt analysis using the DID regression

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Leverage	Bank D.	Public D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease
T.War	0.0652***	-0.123***	0.176***	-0.0597***	-0.0650***	0.0729***	-0.0279**	0.174***
	(0.00985)	(0.00526)	(0.0141)	(0.00709)	(0.00416)	(0.00747)	(0.0104)	(0.0149)
Treat	-0.00250	-0.247***	0.238***	-0.0515**	-0.164***	0.140*	0.0427*	0.112***
	(0.0322)	(0.0210)	(0.0301)	(0.0192)	(0.0172)	(0.0734)	(0.0238)	(0.0169)
T.War×Treat	-0.0306***	-0.00487	-0.0420***	0.00782**	-0.00930*	-0.00497	-0.00813**	-0.0326***
	(0.00938)	(0.00539)	(0.0115)	(0.00355)	(0.00502)	(0.00500)	(0.00340)	(0.00560)
HHI	-0.0893*	-0.103**	0.0313	-0.0709	-0.0436	0.0203	0.0279	-0.0327*
	(0.0446)	(0.0443)	(0.0337)	(0.0418)	(0.0424)	(0.0405)	(0.0258)	(0.0174)
Profit	-0.254***	-0.164***	-0.301***	-0.147***	-0.169***	-0.243***	0.0364	-0.0278**
	(0.0210)	(0.0188)	(0.0247)	(0.0288)	(0.0189)	(0.0206)	(0.0715)	(0.0117)
Size	-0.00606***	-0.0238***	-0.00328***	-0.0185***	-0.0213***	-0.00875***	-0.00162	-0.00581***
	(0.000384)	(0.000489)	(0.000455)	(0.000548)	(0.000510)	(0.000434)	(0.00142)	(0.000707)
Tangible	0.0223***	-0.00416	0.0155	0.0412***	-0.0199*	-0.0229***	-0.00548	0.161***
	(0.00693)	(0.0110)	(0.0112)	(0.00944)	(0.0105)	(0.00787)	(0.00643)	(0.0144)
MV/BV	0.0422***	0.0283***	0.0441***	0.0151***	0.0324***	0.0500***	0.00789***	0.00336***
	(0.00167)	(0.00135)	(0.00183)	(0.00167)	(0.00139)	(0.00165)	(0.00137)	(0.000409)
Investment	-0.238***	-0.0889**	-0.341***	-0.0637	-0.0657*	-0.293***	0.0544	-0.199***
	(0.0327)	(0.0337)	(0.0637)	(0.0456)	(0.0371)	(0.0916)	(0.0519)	(0.0440)
Age	0.000466	-0.0209***	0.0213***	-0.000873	-0.0199***	0.0112***	0.001000	-0.00157***
	(0.00159)	(0.00172)	(0.00133)	(0.00113)	(0.00201)	(0.00181)	(0.00284)	(0.000256)
Cash	-0.249***	-0.131***	-0.139***	-0.0257*	-0.104***	-0.0378***	0.0390*	-0.0168***
	(0.0116)	(0.00840)	(0.0149)	(0.0133)	(0.00924)	(0.00831)	(0.0196)	(0.00365)
Tax	-1.227***	-0.906***	-0.0237	0.197*	-0.829***	-0.179	0.0592	0.0149
	(0.291)	(0.281)	(0.195)	(0.0972)	(0.239)	(0.201)	(0.109)	(0.0631)
Earnings Vol.	0.305***	0.151***	0.352***	0.212***	0.157***	0.274***	-0.164*	0.0891***
	(0.0217)	(0.0241)	(0.0280)	(0.0415)	(0.0237)	(0.0246)	(0.0901)	(0.0155)
Gr. (S&P500)	-0.0782***	-0.393***	0.167***	-0.182***	-0.257***	0.0266	-0.0610***	0.560***
	(0.0260)	(0.0160)	(0.0353)	(0.0170)	(0.0138)	(0.0214)	(0.0184)	(0.0403)
Gr. (GDP)	5.518***	-3.814***	7.470***	-2.130***	-1.387***	3.895***	-0.219	8.756***
	(0.521)	(0.279)	(0.711)	(0.336)	(0.180)	(0.445)	(0.488)	(0.560)
Term Spread	0.0242***	-0.0557***	0.0794***	-0.0189***	-0.0369***	0.0370***	-0.0123***	0.0402***
	(0.00526)	(0.00290)	(0.00772)	(0.00306)	(0.00179)	(0.00334)	(0.00409)	(0.00689)
Credit Spread	0.140***	0.133***	0.00202	0.0767***	0.0929***	-0.00766	0.0307***	-0.0692***
	(0.00787)	(0.00637)	(0.0124)	(0.00742)	(0.00503)	(0.00760)	(0.00572)	(0.0189)
Constant	0.0708**	0.520***	-0.334***	0.209***	0.349***	-0.0599	-0.0143	-0.163***
	(0.0296)	(0.0315)	(0.0262)	(0.0288)	(0.0245)	(0.0601)	(0.0180)	(0.0127)
Observations	34464	24976	27103	12713	20448	19728	1151	14346
Adjusted R^2	0.324	0.308	0.392	0.370	0.331	0.427	0.451	0.305

Table 4.5.2. Analysis for 3 types of total debt via the HHI and tariff

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Lev.	Bank D.	Pub. D.	Lev.	Bank D.	Pub. D.	Lev.	Bank D.	Pub. D.
HHI	-0.0893*	-0.103**	0.0313				-0.0969**	-0.103**	0.0250
	(0.0446)	(0.0443)	(0.0337)				(0.0442)	(0.0442)	(0.0338)
Tariff				0.623***	0.0377	0.502***	0.625***	0.0390	0.501***
				(0.143)	(0.0575)	(0.0762)	(0.142)	(0.0577)	(0.0762)
T.War	0.0652***	-0.123***	0.176***	0.0565***	-0.126***	0.171***	0.0582***	-0.123***	0.170***
	(0.00985)	(0.00526)	(0.0141)	(0.0102)	(0.00604)	(0.0141)	(0.0102)	(0.00530)	(0.0138)
Treat	-0.00250	-0.247***	0.238***	0.00679	-0.219***	0.218***	-0.0207	-0.248***	0.225***
	(0.0322)	(0.0210)	(0.0301)	(0.0248)	(0.0154)	(0.0294)	(0.0316)	(0.0213)	(0.0298)
T.War×Treat	-0.0306***	-0.00487	-0.0420***	-0.0426***	-0.00498	-0.0517***	-0.0434***	-0.00584	-0.0515***
	(0.00938)	(0.00539)	(0.0115)	(0.00990)	(0.00548)	(0.0110)	(0.0100)	(0.00539)	(0.0111)
Profit	-0.254***	-0.164***	-0.301***	-0.256***	-0.164***	-0.303***	-0.256***	-0.164***	-0.303***
	(0.0210)	(0.0188)	(0.0247)	(0.0210)	(0.0188)	(0.0246)	(0.0210)	(0.0188)	(0.0246)
Size	-0.00606***	-0.0238***	-0.00328***	-0.00589***	-0.0238***	-0.00318***	-0.00591***	-0.0238***	-0.00318***
	(0.000384)	(0.000489)	(0.000455)	(0.000381)	(0.000485)	(0.000459)	(0.000378)	(0.000488)	(0.000460)
Tangible	0.0223***	-0.00416	0.0155	0.0236***	-0.00408	0.0168	0.0236***	-0.00405	0.0168
	(0.00693)	(0.0110)	(0.0112)	(0.00700)	(0.0110)	(0.0113)	(0.00700)	(0.0110)	(0.0113)
MV/BV	0.0422***	0.0283***	0.0441***	0.0421***	0.0284***	0.0440***	0.0420***	0.0283***	0.0440***
	(0.00167)	(0.00135)	(0.00183)	(0.00174)	(0.00136)	(0.00187)	(0.00174)	(0.00135)	(0.00187)
Investment	-0.238***	-0.0889**	-0.341***	-0.242***	-0.0896**	-0.345***	-0.242***	-0.0891**	-0.345***
	(0.0327)	(0.0337)	(0.0637)	(0.0328)	(0.0336)	(0.0635)	(0.0328)	(0.0337)	(0.0635)
Age	0.000466	-0.0209***	0.0213***	0.000196	-0.0209***	0.0209***	0.000207	-0.0209***	0.0209***
	(0.00159)	(0.00172)	(0.00133)	(0.00155)	(0.00172)	(0.00137)	(0.00155)	(0.00172)	(0.00137)
Cash	-0.249***	-0.131***	-0.139***	-0.244***	-0.131***	-0.134***	-0.244***	-0.130***	-0.134***
	(0.0116)	(0.00840)	(0.0149)	(0.0102)	(0.00840)	(0.0139)	(0.0102)	(0.00843)	(0.0139)
Tax	-1.227***	-0.906***	-0.0237	-1.215***	-0.906***	-0.0163	-1.214***	-0.904***	-0.0160
	(0.291)	(0.281)	(0.195)	(0.291)	(0.281)	(0.196)	(0.291)	(0.282)	(0.195)
Earnings Vol.	0.305***	0.151***	0.352***	0.303***	0.151***	0.351***	0.303***	0.151***	0.351***
	(0.0217)	(0.0241)	(0.0280)	(0.0216)	(0.0241)	(0.0279)	(0.0216)	(0.0241)	(0.0279)
Gr. (S&P500)	-0.0782***	-0.393***	0.167***	-0.0622***	-0.401***	0.183***	-0.0572**	-0.393***	0.182***
	(0.0260)	(0.0160)	(0.0353)	(0.0207)	(0.0175)	(0.0335)	(0.0207)	(0.0162)	(0.0325)
Gr. (GDP)	5.518***	-3.814***	7.470***	5.476***	-3.807***	7.374***	5.444***	-3.807***	7.381***
	(0.521)	(0.279)	(0.711)	(0.471)	(0.284)	(0.674)	(0.477)	(0.278)	(0.677)
Term Spread	0.0242***	-0.0557***	0.0794***	0.0203***	-0.0561***	0.0761***	0.0201***	-0.0559***	0.0761***
	(0.00526)	(0.00290)	(0.00772)	(0.00527)	(0.00302)	(0.00738)	(0.00534)	(0.00291)	(0.00740)
Credit Spread	0.140***	0.133***	0.00202	0.135***	0.136***	-0.00494	0.133***	0.133***	-0.00435
	(0.00787)	(0.00637)	(0.0124)	(0.00637)	(0.00664)	(0.0119)	(0.00638)	(0.00639)	(0.0114)
Constant	0.0708**	0.520***	-0.334***	0.0410**	0.470***	-0.306***	0.0888***	0.520***	-0.318***
	(0.0296)	(0.0315)	(0.0262)	(0.0158)	(0.0167)	(0.0178)	(0.0300)	(0.0315)	(0.0262)
Observations	34464	24976	27103	34464	24976	27103	34464	24976	27103
Adjusted R^2	0.324	0.308	0.392	0.326	0.308	0.393	0.326	0.308	0.393

Table 4.5.3. Cost analysis using the DID regression

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CS of	Total Debt	Bank D.	Public D.	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	-3.105***	-2.353***	-3.610***	-0.684***	-3.746***	-2.167***	-0.485	-4.871***
	(0.137)	(0.154)	(0.155)	(0.186)	(0.157)	(0.105)	(0.304)	(0.305)
Treat	-0.752***	-0.941**	-0.899**	1.227***	-1.733***	-0.486	-3.348***	-0.534
	(0.188)	(0.422)	(0.373)	(0.298)	(0.422)	(0.838)	(0.302)	(0.449)
T.War×Treat	0.0143	-0.216**	0.343***	-0.359**	-0.185***	-0.171***	0.0451	0.00389
	(0.0658)	(0.0782)	(0.113)	(0.144)	(0.0618)	(0.0368)	(0.0868)	(0.115)
HHI	-1.913***	0.530	-3.451***	0.0919	0.794	-0.673	0.0607	-6.020***
	(0.446)	(0.710)	(0.727)	(0.837)	(0.584)	(0.424)	(0.891)	(1.319)
Profit	-0.379**	-0.633**	-0.233	-0.838	-0.624**	-0.218	-5.461	-2.219***
	(0.156)	(0.243)	(0.231)	(0.719)	(0.257)	(0.225)	(3.293)	(0.513)
Size	-0.415***	-0.420***	-0.475***	-0.390***	-0.415***	-0.509***	-0.0783	-0.314***
	(0.0106)	(0.00988)	(0.0152)	(0.0232)	(0.0125)	(0.0118)	(0.0520)	(0.0210)
Tangible	0.807***	0.519***	0.663***	0.877***	0.562***	0.677***	3.019***	1.448***
	(0.0981)	(0.0958)	(0.126)	(0.163)	(0.0994)	(0.137)	(0.319)	(0.395)
MV/BV	-0.151***	-0.212***	-0.237***	-0.159***	-0.230***	-0.275***	0.0818	-0.218***
	(0.0120)	(0.0201)	(0.0203)	(0.0359)	(0.0220)	(0.0261)	(0.0751)	(0.0288)
Investment	0.363	-0.740	0.673	-1.427	-0.672	-0.253	-2.591***	-1.148
	(0.373)	(0.613)	(0.534)	(1.022)	(0.608)	(0.444)	(0.673)	(0.902)
Age	-0.0250	-0.0591**	-0.0754**	-0.0227	-0.0757***	0.0404**	-0.144**	-0.0671**
	(0.0315)	(0.0215)	(0.0328)	(0.0332)	(0.0223)	(0.0186)	(0.0614)	(0.0274)
Cash	-0.381**	-0.130	-0.849***	-0.550	-0.153	-1.492***	-1.141**	-0.259
	(0.136)	(0.133)	(0.204)	(0.373)	(0.112)	(0.136)	(0.520)	(0.271)
Tax	-13.96***	-20.93***	-9.650***	-17.33***	-21.67***	-11.69***	7.250	-12.23***
	(3.093)	(4.658)	(2.861)	(5.551)	(4.340)	(3.458)	(5.232)	(4.178)
Earnings Vol.	-0.568**	-0.868**	-0.171	4.056***	-1.259***	-0.0817	-12.40***	1.233
	(0.208)	(0.360)	(0.303)	(0.938)	(0.351)	(0.238)	(3.357)	(1.074)
Gr. (S&P500)	-1.787***	-2.572***	-1.150***	1.692***	-5.221***	-0.0253	2.341***	-8.767***
	(0.296)	(0.337)	(0.281)	(0.413)	(0.368)	(0.255)	(0.708)	(0.840)
Gr. (GDP)	-0.515	17.69**	-2.603	75.85***	-30.57***	28.26***	71.14***	-72.05***
	(6.062)	(7.093)	(7.832)	(9.971)	(7.794)	(4.651)	(10.73)	(13.12)
Term Spread	-0.653***	-0.503***	-0.737***	0.344***	-1.037***	-0.00380	0.445***	-0.871***
	(0.0678)	(0.0630)	(0.0931)	(0.0910)	(0.0739)	(0.0423)	(0.107)	(0.104)
Credit Spread	-1.736***	-2.165***	-1.148***	-2.727***	-1.257***	-2.377***	-1.580***	0.110
	(0.0938)	(0.0989)	(0.129)	(0.131)	(0.105)	(0.0635)	(0.168)	(0.313)
Constant	10.34***	9.195***	12.09***	6.112***	10.45***	10.52***	3.656***	11.85***
	(0.278)	(0.354)	(0.435)	(0.415)	(0.354)	(0.931)	(0.601)	(0.932)
Observations	18658	15588	17527	7620	14336	18295	680	9467
Adjusted R^2	0.299	0.342	0.300	0.396	0.325	0.403	0.886	0.258

4.5.2 PSM results for the trade war, debt structure, and costs

The above 2by2 DID results about the ATET of $TreatTWar = TradeWar \times Treat$ are obtained through estimating the difference between the differences of treated and control groups in the follow-up and baseline periods based on the original data. The DID method might not be able to reduce the bias that a difference between treated and untreated groups is caused by a variable predicting the treatment. Thus, I carry out additional analyses by using different empirical methods to estimate the ATET of *TreatTWar*. To obtain an unbiased estimation of the treatment effect, I process the data with the PSM method by creating a sample receiving the treatment that is comparable to a sample that did not receive the treatment after accounting for the control variables. After PSM, I compare treatment and non-treatment firms to identify the effect of the trade war on firms' debt structure and costs.

Table 4.5.4 shows that Hypothesis H_1^1 agrees with the results. H_1^1, states that there is a negative relationship, $\beta_3 < 0$, between $TreatTWar$ and total debt/bank debt/public debt/term loans/bonds and notes. The coefficients of $TreatTWar$ in Table 4.5.4 suggest that the trade war negatively affects the firms in the treated industries with the tariff protection of rising import tariffs. The treated firms reduce their leverages that comprise bank debt especially term loans from banks and public debt especially bonds and notes from the public market during the trade war.

Column (1) of Table 4.5.4 displays that there is a significant negative β_3 relationship between leverage and the treated firms during the trade war, which reflects the total debt deduction during the trade war. I am interested in whether the total debt deduction is due to bank debt or public debt or both. Next, I study how the trade war impacts leverage through the two components of leverage: bank debt and public debt. Columns (2) and (3) of Table 4.5.4 exhibit that the debt reduction due to treatment largely comes from the public debt component as the coefficient of $TreatTWar$ for public debt is significant while the coefficient for bank debt is not.

Then, I investigate specific types of debt to provide details on how the treatment $TreatTWar$ affects firms' debt through the debt structure. Column (5) of Table 4.5.4 shows that there is a significant relationship between $TreatTWar$ and term loans as two specific types of bank debt. Column (6) of Table 4.5.4 reports that the coefficient

of $TreatTWar$ for bonds and notes is significantly negative and leads to the deduction of public debt and the total leverage among the treated firms during the trade war.

Panel B in Tables 4.5.4 and 4.5.5 display the results for the first step of estimating the propensity score, namely the probability of receiving treatment indicated by $TreatTWar$, for debt structure and costs respectively. I use a specification of probit regression for the binary variable $TreatTWar$. Each column corresponds to the probit regression for each type of debt or its credit spread by using the data with non-missing values of such type of debt or credit spread. For instance, Column (2) of Panel B is the first step of PSM analysis for the effect of the trade war on bank debt based on the sample of data with non-missing values of bank debt.

I examine the effects of the production market competition with the proxy of HHI on the propensity scores, namely the probability of receiving treatment indicated by $TreatTWar$. Almost all columns of Panel B in both tables exhibit significant and negative coefficients of HHI. Since a lower value of HHI indicates a stronger competition industry, the coefficients of HHI here imply that the firms in the industries with intense product market competition experience a higher chance of being targeted by the trade war. Hence, the treatment of import tariff rise is more likely to happen in the firms facing high product market competition.

I turn to study the effects of the trade war and tariff treatment on the costs of various types of debt in Table 4.5.5. The coefficients of $TreatTWar$ show that there is a significant negative relationship between $TreatTWar$ and the credit spreads of all bank debt including revolving credit and term loans as well as all public debt including bonds and notes, commercial papers, capital leases, and other debt. This implies that the firms in the treated industries targeted by the trade war spend less on the costs of debt.

Table 4.5.4. Debt analysis using the PSM method

Notes. Robust standard errors are estimated in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1) Leverage	(2) Bank Debt	(3) Public Debt	(4) R. Credit	(5) Term Loan	(6) Bond	(7) C. Paper	(8) C. Lease
Panel A: ATET								
TreatTWar	-0.0561***	-0.0388***	-0.0789***	-0.00876	-0.0178**	-0.0306***	-0.000985	0.0117***
	(0.00716)	(0.00784)	(0.00788)	(0.00715)	(0.00855)	(0.0107)	(0.00341)	(0.00259)
Panel B: Coefficients from Propensity Score regression								
HHI	-0.902***	-0.848***	-0.901***	-0.255**	-0.851***	-0.951***	-0.427	-0.858***
	(0.0859)	(0.104)	(0.0917)	(0.119)	(0.118)	(0.122)	(0.332)	(0.109)
Profit	-0.312***	-0.221**	-0.271***	0.0301	-0.244**	-0.277***	10.09***	-0.646***
	(0.0688)	(0.0941)	(0.0778)	(0.225)	(0.0986)	(0.0856)	(3.911)	(0.124)
Size	0.0269***	0.0218***	0.0197***	0.00464	0.0199***	0.0361***	0.0881**	0.00632
	(0.00405)	(0.00507)	(0.00440)	(0.00832)	(0.00554)	(0.00522)	(0.0445)	(0.00608)
Tangible	-0.329***	-0.282***	-0.346***	-0.0199	-0.475***	-0.362***	-0.297	-0.394***
	(0.0393)	(0.0462)	(0.0444)	(0.0671)	(0.0529)	(0.0529)	(0.253)	(0.0630)
MV/BV	0.0311***	0.0489***	0.0215***	0.0701***	0.0551***	0.0763***	-0.0534	0.0124
	(0.00713)	(0.00929)	(0.00808)	(0.0172)	(0.0102)	(0.0109)	(0.0769)	(0.0107)
Investment	-0.432*	-0.253	-0.503*	0.365	-0.336	0.564*	-1.751	-1.964***
	(0.235)	(0.263)	(0.279)	(0.411)	(0.304)	(0.295)	(2.050)	(0.416)
Age	0.00839	0.0108	0.0114	0.0839***	-0.00616	0.110***	0.126	0.0575***
	(0.00789)	(0.00970)	(0.00889)	(0.0167)	(0.0103)	(0.0148)	(0.109)	(0.0110)
Cash	0.917***	0.780***	1.148***	0.583***	0.717***	0.395***	-0.145	1.573***
	(0.0384)	(0.0497)	(0.0445)	(0.136)	(0.0513)	(0.0592)	(0.536)	(0.0616)
Tax	-1.006	0.251	-0.602	-1.310	1.100	1.164	-12.30*	-0.884
	(1.066)	(1.332)	(1.173)	(1.719)	(1.543)	(1.463)	(6.358)	(1.608)
Earnings Vol.	-0.768***	-0.737***	-0.882***	-0.689**	-0.787***	-0.513***	-27.73***	-0.652***
	(0.0907)	(0.121)	(0.106)	(0.341)	(0.126)	(0.113)	(7.758)	(0.197)
Constant	-1.372***	-1.436***	-1.301***	-1.826***	-1.328***	-1.866***	-2.113***	-1.201***
	(0.0453)	(0.0568)	(0.0506)	(0.0928)	(0.0618)	(0.0748)	(0.614)	(0.0676)
Observations	34464	24976	27103	12713	20448	19728	1151	14346

Table 4.5.5. Cost analysis using the PSM method

Notes. Robust standard errors are estimated in parentheses. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Total D.	Bank D.	Public D.	R. Credit	Term Loan	Bond	C. Paper	C. Lease	Other B.
Panel A: ATET									
TreatTWar	-1.027***	-1.171***	-0.870***	-1.215***	-1.244***	-1.484***	-1.001***	-1.340***	-3.094***
	(0.104)	(0.127)	(0.112)	(0.172)	(0.134)	(0.110)	(0.126)	(0.165)	(0.463)
Panel B: Coefficients from Propensity Score regression									
HHI	-0.905***	-1.014***	-0.947***	-0.547***	-0.922***	-0.922***	0.559	-0.834***	-0.530
	(0.115)	(0.137)	(0.113)	(0.161)	(0.142)	(0.123)	(0.446)	(0.123)	(0.461)
Profit	-0.263***	-0.203*	-0.167*	0.142	-0.200*	-0.240***	5.548	-0.977***	-1.475***
	(0.0851)	(0.118)	(0.0908)	(0.334)	(0.120)	(0.0881)	(5.122)	(0.161)	(0.390)
Size	0.0281***	0.0117*	0.0186***	-0.0289***	0.0104	0.0328***	0.147**	0.0185**	0.123***
	(0.00583)	(0.00667)	(0.00560)	(0.0112)	(0.00686)	(0.00544)	(0.0597)	(0.00755)	(0.0216)
Tangible	-0.365***	-0.287***	-0.412***	0.0000546	-0.475***	-0.390***	0.161	-0.658***	-0.804***
	(0.0518)	(0.0581)	(0.0542)	(0.0903)	(0.0627)	(0.0554)	(0.322)	(0.0786)	(0.230)
MV/BV	0.0242***	0.0300***	0.0238**	0.0224	0.0461***	0.0710***	0.180*	0.0275**	0.289***
	(0.00905)	(0.0115)	(0.00962)	(0.0238)	(0.0119)	(0.0114)	(0.0984)	(0.0128)	(0.0491)
Investment	-0.478	-0.0284	-0.523	0.0120	0.153	0.751**	-4.066	-2.030***	-0.271
	(0.309)	(0.320)	(0.332)	(0.555)	(0.342)	(0.304)	(2.496)	(0.526)	(1.100)
Age	-0.0267**	0.00257	-0.0345***	0.0697***	-0.00863	0.103***	0.337**	0.0456***	0.0242
	(0.0105)	(0.0121)	(0.0111)	(0.0203)	(0.0124)	(0.0155)	(0.145)	(0.0135)	(0.0663)
Cash	0.925***	0.837***	1.196***	0.770***	0.775***	0.383***	-0.561	1.697***	0.0181
	(0.0495)	(0.0612)	(0.0535)	(0.173)	(0.0614)	(0.0630)	(0.660)	(0.0764)	(0.302)
Tax	-1.483	0.921	-1.403	-2.278	1.994	1.076	-19.42**	-2.196	9.214
	(1.426)	(1.691)	(1.433)	(2.189)	(1.840)	(1.513)	(8.421)	(1.895)	(6.307)
Earnings Vol.	-0.761***	-0.908***	-0.896***	-1.335**	-0.957***	-0.471***	-44.65***	-0.786***	-1.046**
	(0.108)	(0.150)	(0.119)	(0.544)	(0.152)	(0.117)	(10.19)	(0.249)	(0.510)
Constant	-1.213***	-1.314***	-1.105***	-1.477***	-1.271***	-1.811***	-3.866***	-1.082***	-2.685***
	(0.0616)	(0.0717)	(0.0633)	(0.117)	(0.0741)	(0.0786)	(0.800)	(0.0822)	(0.322)
Observations	18658	15588	17527	7620	14336	18295	680	9467	1779

4.5.3 IPWRA results for the trade war, debt structure, and costs

I use the inverse-probability-weighted regression adjustment (IPWRA) method to estimate the average treatment effect on the treated (ATET) as well. Meanwhile, IPWRA provides the potential-outcome means (POMs) from observational data. It first computes the estimated inverse probabilities of treatment. Then it employs the weights to construct weighted regression coefficients for calculating the averages of predicted outcomes for the untreated and treated observations. Finally, the treatment effects are estimated by contrasting these averages. The IPWRA method has the double-robust property that entails the advantages of both the inverse-probability weighting (IPW) estimator and the regression adjustment (RA) estimator.

Tables 4.5.6 and 4.5.7 provide the results produced by all steps of the IPWRA estimator. In the IPWRA output table, labeled OME0 and OME1 represent the linear regression coefficients for the potential-outcome equations of the untreated and treated observations, respectively. Label TME1 represents the coefficients of the probit equation for predicting treatment status.

Table 4.5.6 shows that Hypothesis H_1^1 agrees with the results. Hypothesis 1, H_1^1, states that there is a negative relationship, $\beta_3 < 0$, between $TreatTWar$ and total debt/bank debt/public debt/revolving credit/term loans/bonds and notes. The coefficients of $TreatTWar$ in Table 4.5.6 suggest that the trade war negatively affects the firms in the treated industries with the tariff protection of rising import tariffs. The treated firms reduce their leverages that comprise bank debt including revolving credit and term loans from banks and public debt especially bonds and notes from the public market during the trade war.

Column (1) of Table 4.5.6 displays that there is a significant negative β_3 relationship between leverage and the treated firms during the trade war, which reflects the total debt deduction during the trade war. I am interested in whether the total debt deduction is due to bank debt or public debt or both. Next, I study how the trade war impacts leverage through the two components of leverage: bank debt and public debt. Columns (2) and (3) of Table 4.5.6 exhibit that the debt reduction due to treatment largely comes from the public debt component as the coefficient of $TreatTWar$ for public debt is significant while the coefficient for bank debt is not.

Then, I investigate specific types of debt to provide details on how the treatment $TreatTWar$ affects firms' debt through the debt structure. Columns (4) and (5) of Table 4.5.6 show that there is a significant relationship between $TreatTWar$ and revolving credit as well as term loans in bank debt. Column (6) of Table 4.5.6 reports that the coefficient of $TreatTWar$ for bonds and notes is significantly negative and leads to the deduction of public debt and the total leverage among the treated firms during the trade war.

I turn to study the effects of the trade war and tariff treatment on the costs of various types of debt in Table 4.5.7. The coefficients of $TreatTWar$ show that there is a significant negative relationship between $TreatTWar$ and the credit spreads of all bank debt including revolving credit and term loans as well as all public debt including bonds and notes, commercial papers, capital leases, and other debt. This implies that the firms in the treated industries targeted by the trade war spend less on the costs of debt.

Table 4.5.6. Debt analysis using the IPWRA method

	(1) Leverage	(2) Bank D.	(3) Public D.	(4) R. Credit	(5) T. Loan	(6) Bond	(7) C. Paper	(8) C. Lease
ATET								
TreatTWar	-0.0482***	-0.0301***	-0.0601***	-0.0153*	-0.0260***	-0.0245**	-0.00169	0.0146*
	(0.0104)	(0.00853)	(0.0104)	(0.00874)	(0.00907)	(0.0114)	(0.00308)	(0.00845)
POmean								
TreatTWar=0	0.376***	0.274***	0.285***	0.125***	0.267***	0.361***	0.0334***	0.0386***
	(0.0187)	(0.0133)	(0.0125)	(0.0117)	(0.0156)	(0.0214)	(0.00431)	(0.00465)
OME0								
HHI	-0.000248	0.0125	-0.0440	0.0587	-0.0458	-0.0778	0.00327	0.0159
	(0.0770)	(0.0563)	(0.0622)	(0.0393)	(0.0594)	(0.0550)	(0.0137)	(0.0172)
Profit	-0.314***	-0.227***	-0.312***	-0.168**	-0.239***	-0.241***	-0.370**	-0.00000411
	(0.0421)	(0.0436)	(0.0542)	(0.0795)	(0.0419)	(0.0413)	(0.153)	(0.0147)
Size	-0.00382	-0.0251***	-0.00276	-0.0187***	-0.0240***	-0.00803**	-0.00677***	-0.00493***
	(0.00366)	(0.00270)	(0.00543)	(0.00246)	(0.00308)	(0.00341)	(0.00186)	(0.00134)
Tangible	0.0680	0.0613	0.0334	0.0648***	0.0549	0.0144	-0.0206**	0.122***
	(0.0596)	(0.0374)	(0.0442)	(0.0250)	(0.0393)	(0.0326)	(0.0100)	(0.0402)
MV/BV	0.0251***	0.0154**	0.0291***	0.0119***	0.0156**	0.0395***	0.00971***	0.00618***
	(0.00852)	(0.00761)	(0.00834)	(0.00415)	(0.00734)	(0.00830)	(0.00349)	(0.00162)
Investment	-0.324**	-0.182	-0.349*	-0.0802	-0.173	-0.287	0.149*	-0.284***
	(0.164)	(0.123)	(0.212)	(0.0778)	(0.150)	(0.180)	(0.0763)	(0.0706)
Age	0.00575	-0.0151***	0.0230***	-0.00329	-0.0138***	0.00870	-0.00550	-0.00529***
	(0.00428)	(0.00572)	(0.00464)	(0.00423)	(0.00518)	(0.00633)	(0.00600)	(0.00113)
Cash	-0.247***	-0.145***	-0.127***	-0.0762**	-0.120***	-0.0914**	0.0187	-0.0271***
	(0.0246)	(0.0163)	(0.0310)	(0.0346)	(0.0192)	(0.0424)	(0.0249)	(0.00899)
Tax	-0.493	-0.723	0.748	0.297	-0.653	0.0875	0.399***	0.00199
	(0.752)	(0.802)	(0.590)	(0.239)	(0.963)	(0.796)	(0.0989)	(0.169)
Earnings Vol.	0.355***	0.201***	0.424***	0.321***	0.205***	0.332***	-0.129	0.0565
	(0.0375)	(0.0609)	(0.0447)	(0.0912)	(0.0669)	(0.0368)	(0.444)	(0.0461)
Constant	0.337***	0.394***	0.142***	0.194***	0.369***	0.243***	0.117***	0.0492***
	(0.0329)	(0.0243)	(0.0547)	(0.0264)	(0.0290)	(0.0357)	(0.0308)	(0.00987)
OME1								
HHI	-0.0238	-0.0296	-0.0291	0.00313	-0.0743	0.0310	0.0418	0.0117
	(0.0720)	(0.0677)	(0.0498)	(0.0319)	(0.0804)	(0.0746)	(0.0320)	(0.0163)
Profit	-0.335***	-0.306***	-0.364***	-0.0143	-0.354***	-0.154*	-0.108	-0.0994***
	(0.0517)	(0.0478)	(0.0689)	(0.128)	(0.0567)	(0.0804)	(0.235)	(0.0148)
Size	-0.00629	-0.0214***	-0.00327	-0.0206***	-0.0178***	-0.0174***	-0.00452	-0.00705***
	(0.00464)	(0.00420)	(0.00464)	(0.00633)	(0.00457)	(0.00434)	(0.00308)	(0.00166)
Tangible	-0.0297	-0.0642	-0.0242	0.0582	-0.0856	-0.0458	0.00987	0.0879
	(0.0322)	(0.0577)	(0.0513)	(0.0433)	(0.0838)	(0.0304)	(0.0119)	(0.0742)
MV/BV	0.0242***	0.00528	0.0301***	0.00619	0.00590	0.0324***	0.00636*	0.00564***
	(0.00718)	(0.00710)	(0.00540)	(0.00785)	(0.00721)	(0.00633)	(0.00356)	(0.00126)
Investment	-0.198	-0.0930	-0.192	-0.0377	-0.0627	-0.356	-0.0393	-0.348**
	(0.354)	(0.310)	(0.338)	(0.192)	(0.356)	(0.369)	(0.0826)	(0.148)
Age	0.00109	-0.0136	0.0155***	0.0120**	-0.0137	-0.00839	0.00711	-0.00250***

Notes. This table displays debt analysis using IPWRA and the ATET of *TreatTWar* for the data during 2015 - 2019. Cluster-robust standard errors are computed at the 3-digit SIC industry level. ***: p<0.01, **: p<0.05, *: p<0.1.

Table 4.5.6. Debt analysis using the IPWRA method

	(1) Leverage	(2) Bank D.	(3) Public D.	(4) R. Credit	(5) T. Loan	(6) Bond	(7) C. Paper	(8) C. Lease
	(0.00426)	(0.00854)	(0.00534)	(0.00479)	(0.00908)	(0.0104)	(0.00661)	(0.000791)
Cash	-0.333***	-0.147***	-0.274***	-0.0573	-0.127***	-0.142***	0.0438	-0.0257**
	(0.0224)	(0.0337)	(0.0228)	(0.0611)	(0.0329)	(0.0493)	(0.0569)	(0.0102)
Tax	1.483*	0.242	2.253***	0.832	0.273	2.898**	-0.320	0.0762
	(0.824)	(0.832)	(0.790)	(0.747)	(1.040)	(1.301)	(0.559)	(0.123)
Earnings Vol.	0.242***	0.0968	0.313***	0.278	0.0797	0.350***	-3.057***	0.0176
	(0.0838)	(0.0876)	(0.0656)	(0.305)	(0.106)	(0.0610)	(0.908)	(0.0480)
Constant	0.372***	0.398***	0.168***	0.156***	0.369***	0.358***	0.0465	0.0683***
	(0.0345)	(0.0251)	(0.0469)	(0.0342)	(0.0291)	(0.0639)	(0.0395)	(0.00572)
TME1								
HHI	-0.902	-0.848	-0.901	-0.255	-0.851	-0.951	-0.427	-0.858
	(0.763)	(0.666)	(0.791)	(0.513)	(0.702)	(0.735)	(0.734)	(0.771)
Profit	-0.312**	-0.221	-0.271	0.0301	-0.244	-0.277	10.09	-0.646***
	(0.154)	(0.177)	(0.169)	(0.361)	(0.173)	(0.176)	(8.059)	(0.197)
Size	0.0269	0.0218	0.0197	0.00464	0.0199	0.0361**	0.0881	0.00632
	(0.0180)	(0.0209)	(0.0183)	(0.0230)	(0.0205)	(0.0176)	(0.0843)	(0.0259)
Tangible	-0.329	-0.282	-0.346	-0.0199	-0.475	-0.362	-0.297	-0.394
	(0.368)	(0.371)	(0.392)	(0.355)	(0.348)	(0.355)	(0.559)	(0.518)
MV/BV	0.0311	0.0489**	0.0215	0.0701*	0.0551***	0.0763***	-0.0534	0.0124
	(0.0204)	(0.0192)	(0.0250)	(0.0402)	(0.0158)	(0.0225)	(0.183)	(0.0311)
Investment	-0.432	-0.253	-0.503	0.365	-0.336	0.564	-1.751	-1.964***
	(0.451)	(0.370)	(0.554)	(0.471)	(0.408)	(0.386)	(2.730)	(0.761)
Age	0.00839	0.0108	0.0114	0.0839**	-0.00616	0.110***	0.126	0.0575**
	(0.0255)	(0.0264)	(0.0329)	(0.0359)	(0.0247)	(0.0310)	(0.214)	(0.0255)
Cash	0.917***	0.780***	1.148***	0.583**	0.717***	0.395***	-0.145	1.573***
	(0.152)	(0.158)	(0.163)	(0.247)	(0.173)	(0.119)	(1.309)	(0.221)
Tax	-1.006	0.251	-0.602	-1.310	1.100	1.164	-12.30	-0.884
	(2.770)	(3.528)	(2.382)	(3.521)	(3.518)	(2.739)	(9.459)	(2.374)
Earnings Vol.	-0.768***	-0.737***	-0.882***	-0.689	-0.787***	-0.513**	-27.73**	-0.652**
	(0.198)	(0.253)	(0.202)	(0.673)	(0.257)	(0.212)	(11.35)	(0.270)
Constant	-1.372***	-1.436***	-1.301***	-1.826***	-1.328***	-1.866***	-2.113*	-1.201***
	(0.337)	(0.305)	(0.399)	(0.289)	(0.315)	(0.345)	(1.187)	(0.434)
Observations	34464	24976	27103	12713	20448	19728	1151	14346

Notes. This table displays debt analysis using IPWRA and the ATET of *TreatTWar* for the data during 2015 - 2019. Cluster-robust standard errors are computed at the 3-digit SIC industry level. ***: p<0.01, **: p<0.05, *: p<0.1.

Table 4.5.7. Cost analysis using the IPWRA method

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Total	Bank D.	Pub. D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
ATET									
TreatTWar	-0.996***	-1.184***	-0.766**	-1.365***	-1.226***	-1.543***	-0.910***	-1.128***	-2.112***
	(0.257)	(0.189)	(0.339)	(0.157)	(0.172)	(0.109)	(0.130)	(0.315)	(0.425)
POmean									
TreatTWar=0	5.839***	5.605***	5.639***	3.834***	5.799***	5.441***	0.475***	6.178***	5.102***
	(0.287)	(0.446)	(0.184)	(0.235)	(0.419)	(0.282)	(0.124)	(0.506)	(0.515)
OME0									
HHI	-1.724*	-3.242**	-1.096	-1.040	-3.429***	-1.336*	0.0520	-2.522*	-0.519
	(1.004)	(1.344)	(0.906)	(0.774)	(1.264)	(0.729)	(0.571)	(1.474)	(1.784)
Profit	-0.408	-0.765	-0.302	-2.003	-0.428	-0.359	-19.48**	-2.830***	-0.184
	(0.695)	(0.589)	(0.705)	(1.358)	(0.578)	(0.383)	(9.590)	(0.717)	(2.709)
Size	-0.509***	-0.489***	-0.551***	-0.436***	-0.506***	-0.542***	-0.190	-0.288***	-0.238
	(0.0491)	(0.0710)	(0.0437)	(0.0823)	(0.0730)	(0.0273)	(0.156)	(0.0614)	(0.186)
Tangible	1.499***	1.333**	0.978***	0.942	1.071	0.639**	1.186***	1.333**	0.812
	(0.466)	(0.672)	(0.332)	(0.590)	(0.702)	(0.305)	(0.414)	(0.643)	(2.001)
MV/BV	-0.171	-0.132	-0.293***	-0.181**	-0.132	-0.305***	0.0700	-0.499***	0.353
	(0.108)	(0.139)	(0.0663)	(0.0838)	(0.140)	(0.0699)	(0.161)	(0.186)	(0.363)
Investment	0.290	-0.0812	1.223	-1.720	0.0816	-0.0801	0.140	1.415	-1.826
	(1.121)	(1.720)	(1.179)	(1.961)	(1.819)	(0.899)	(3.006)	(2.851)	(3.937)
Age	-0.0607	-0.154***	-0.0388	0.0888	-0.214***	0.102	0.194	-0.0856	-0.163
	(0.0935)	(0.0572)	(0.167)	(0.0823)	(0.0527)	(0.123)	(0.304)	(0.169)	(0.480)
Cash	0.326	0.804***	-0.644*	-0.0410	0.409	-1.397***	1.323	1.161	2.141*
	(0.340)	(0.264)	(0.351)	(0.668)	(0.288)	(0.366)	(1.003)	(0.717)	(1.101)
Tax	-14.05*	-32.64***	-1.666	-15.82**	-33.63***	-9.988*	26.11***	-0.635	30.65
	(7.551)	(5.760)	(6.990)	(6.746)	(4.726)	(5.982)	(7.700)	(7.318)	(23.60)
Earnings Vol.	-0.805*	-0.979	-0.258	3.844**	-1.287*	-0.323	8.281	2.466**	-2.736
	(0.463)	(0.667)	(0.530)	(1.542)	(0.693)	(0.481)	(27.06)	(1.012)	(4.411)
Constant	7.956***	8.062***	8.705***	5.990***	8.735***	8.604***	1.522	8.043***	5.774***
	(0.498)	(0.394)	(0.655)	(0.618)	(0.365)	(0.557)	(2.019)	(0.752)	(1.673)
OME1									
HHI	-3.384***	-3.945***	-3.012***	-0.142	-3.151**	-0.939	-0.769*	-3.527***	-2.920*
	(1.265)	(1.268)	(1.137)	(0.923)	(1.466)	(0.822)	(0.418)	(1.195)	(1.747)
Profit	-1.152**	-2.687***	-0.342	-2.979*	-2.516***	0.272	7.741	-3.717***	-5.613***
	(0.549)	(0.702)	(0.728)	(1.739)	(0.599)	(0.733)	(8.612)	(0.730)	(1.228)
Size	-0.352***	-0.312***	-0.460***	-0.275**	-0.293***	-0.545***	-0.0769	-0.320***	0.166
	(0.0603)	(0.0791)	(0.0459)	(0.127)	(0.101)	(0.0433)	(0.0778)	(0.0703)	(0.250)
Tangible	1.225**	1.168	1.443***	1.026***	1.186	1.959***	1.873***	1.336*	-1.384
	(0.575)	(0.931)	(0.389)	(0.387)	(1.687)	(0.467)	(0.524)	(0.695)	(2.202)
MV/BV	-0.109*	-0.0228	-0.198***	-0.0411	-0.0532	-0.215***	0.125	-0.163***	0.450
	(0.0659)	(0.107)	(0.0437)	(0.173)	(0.130)	(0.0604)	(0.152)	(0.0507)	(0.490)
Investment	-0.821	-1.858	-0.113	-1.765	-2.418	0.106	-12.12**	-1.078	-15.13
	(1.465)	(2.163)	(2.492)	(3.705)	(1.907)	(1.647)	(5.079)	(5.252)	(11.25)
Age	-0.242***	-0.180***	-0.233***	-0.302*	-0.168**	0.0119	-0.201	-0.0835**	0.00556

Notes. This table displays cost analysis using IPWRA and the ATET of *TreatTWar* for the data during 2015 - 2019. Cluster-robust standard errors are computed at the 3-digit SIC industry level. ***: p<0.01, **: p<0.05, *: p<0.1.

Table 4.5.7. Cost analysis using the IPWRA method

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CS of	Total	Bank D.	Pub. D.	R. Credit	T. Loan	Bond	C. Paper	C. Lease	Other B.
	(0.0542)	(0.0695)	(0.0436)	(0.177)	(0.0693)	(0.0973)	(0.241)	(0.0424)	(0.632)
Cash	1.093***	1.402*	0.966***	0.551	1.350*	-0.463	1.334	0.887	6.530***
	(0.346)	(0.786)	(0.242)	(1.136)	(0.798)	(0.287)	(1.573)	(0.564)	(2.259)
Tax	-17.04***	-26.68	-19.62***	-94.52**	-17.62	-19.52***	-8.459	-19.88***	-96.49***
	(5.834)	(19.80)	(5.554)	(42.74)	(15.26)	(7.481)	(6.419)	(5.516)	(25.69)
Earnings Vol.	-2.099***	-4.701***	-1.103	-0.253	-4.896***	0.102	39.78*	-1.499***	-5.272**
	(0.516)	(1.105)	(0.980)	(2.748)	(1.714)	(1.207)	(22.54)	(0.540)	(2.596)
Constant	6.697***	6.025***	7.487***	4.830***	6.052***	6.622***	0.187	6.703***	0.566
	(0.600)	(0.784)	(0.494)	(1.032)	(0.764)	(0.660)	(0.987)	(0.922)	(2.099)
TME1									
HHI	-0.905	-1.014	-0.947	-0.547	-0.922	-0.922	0.559	-0.834	-0.530
	(0.843)	(0.682)	(0.904)	(0.546)	(0.674)	(0.733)	(0.906)	(0.780)	(1.171)
Profit	-0.263*	-0.203	-0.167	0.142	-0.200	-0.240	5.548	-0.977***	-1.475**
	(0.151)	(0.199)	(0.162)	(0.452)	(0.202)	(0.166)	(8.775)	(0.204)	(0.616)
Size	0.0281*	0.0117	0.0186	-0.0289	0.0104	0.0328**	0.147	0.0185	0.123***
	(0.0169)	(0.0215)	(0.0152)	(0.0217)	(0.0213)	(0.0166)	(0.110)	(0.0228)	(0.0391)
Tangible	-0.365	-0.287	-0.412	0.0000546	-0.475	-0.390	0.161	-0.658	-0.804*
	(0.367)	(0.356)	(0.401)	(0.363)	(0.333)	(0.367)	(0.665)	(0.503)	(0.460)
MV/BV	0.0242	0.0300	0.0238	0.0224	0.0461***	0.0710***	0.180	0.0275	0.289***
	(0.0209)	(0.0205)	(0.0248)	(0.0395)	(0.0171)	(0.0235)	(0.173)	(0.0339)	(0.0662)
Investment	-0.478	-0.0284	-0.523	0.0120	0.153	0.751*	-4.066	-2.030*	-0.271
	(0.556)	(0.450)	(0.556)	(0.501)	(0.412)	(0.387)	(2.612)	(1.079)	(1.725)
Age	-0.0267	0.00257	-0.0345	0.0697*	-0.00863	0.103***	0.337	0.0456*	0.0242
	(0.0196)	(0.0242)	(0.0277)	(0.0366)	(0.0231)	(0.0296)	(0.295)	(0.0261)	(0.0734)
Cash	0.925***	0.837***	1.196***	0.770***	0.775***	0.383***	-0.561	1.697***	0.0181
	(0.166)	(0.180)	(0.140)	(0.273)	(0.192)	(0.114)	(1.390)	(0.243)	(0.361)
Tax	-1.483	0.921	-1.403	-2.278	1.994	1.076	-19.42**	-2.196	9.214*
	(2.676)	(3.419)	(2.379)	(3.379)	(3.548)	(2.763)	(9.151)	(2.685)	(5.294)
Earnings Vol.	-0.761***	-0.908***	-0.896***	-1.335**	-0.957***	-0.471**	-44.65***	-0.786***	-1.046
	(0.210)	(0.224)	(0.189)	(0.651)	(0.236)	(0.231)	(13.81)	(0.230)	(0.651)
Constant	-1.213***	-1.314***	-1.105***	-1.477***	-1.271***	-1.811***	-3.866**	-1.082***	-2.685***
	(0.312)	(0.283)	(0.403)	(0.294)	(0.296)	(0.349)	(1.722)	(0.388)	(0.581)
Observations	18658	15588	17527	7620	14336	18295	680	9467	1779

Notes. This table displays cost analysis using IPWRA and the ATET of *TreatTWar* for the data during 2015 - 2019. Cluster-robust standard errors are computed at the 3-digit SIC industry level. ***: p<0.01, **: p<0.05, *: p<0.1.

4.6 Robustness results and competition mechanism

In this section, I present additional results and analyses. I examine the parallel-trends assumption for all types of debt by showing the coefficient estimates at the periods around the treatment time and focusing on the pre-treatment coefficients. I carry out Placebo tests to exclude the cases where the results are obtained by chance. I assess the covariate balance in the (un)matched samples and the overlap assumption through some statistics and density plots for the PSM method. In addition, I investigate whether the product market competition works as a mediation role and whether there is a moderating effect of *HHI* that the relations between the treatment and the debt structure or costs vary with the values of *HHI*.

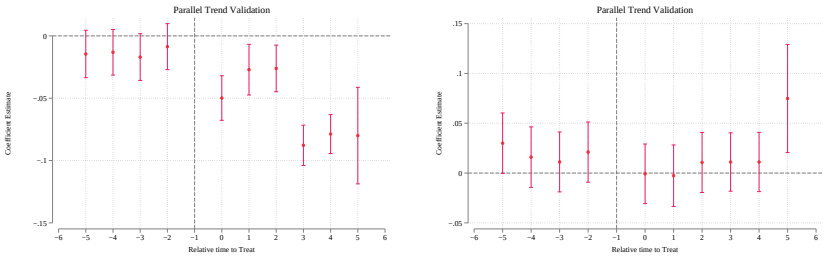
4.6.1 Parallel trend validation

I examine the parallel trend assumption for all types of debt by showing the coefficient estimates at the periods around the treatment time and focusing on the pre-treatment coefficients.

The parallel-trends assumption states that if the treatment group had not received the treatment, the potential outcomes of the treatment group and control group would have the same trends. Following the typical ways in the literature (Freyaldenhoven et al., 2019; Callaway and Santąŕ Anna, 2021; Rambachan and Roth, 2023), I follow widely-used graphical diagnostics for parallel trends by drawing time-specific treatment effects. The graph assesses whether treatment effects are observed before the treatment by estimating an augmenting DID model with counterfactual treatment-time indicators for the periods before the treatment, which are referred to as leads in the DID literature. For identification purposes, one lead is set as the base and this is usually one period before treatment, which is indicated by -1 (Baker et al., 2022; Armstrong et al., 2022).

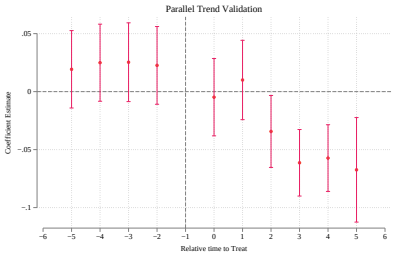
Based on the generalization of the DID model augmented by lead periods and lag periods, the graph plots the estimated coefficients of the interactive items between the treated group indicator and the leads/lags from the model together with their 95% confidence intervals against the relative periods to the treatment time. If the 95% confidence intervals for the leads include 0, then there is no treatment effect before the treatment time. In other words, the parallel trend assumption is satisfied (Roth et al.,

2022; Borusyak et al., 2022). Figure 4.6.1 shows that the parallel trend assumption is valid for all types of debt in the data of the corporate debt structure.

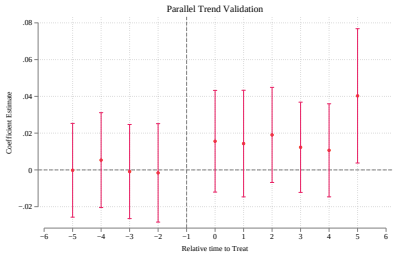


(a) Effect on leverage

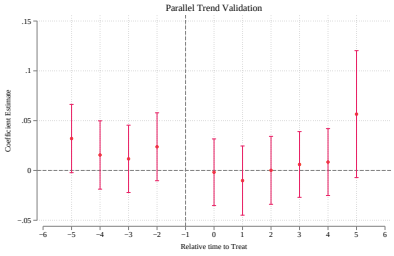
(b) Effect on bank debt



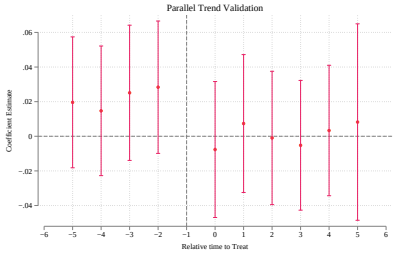
(c) Effect on public debt



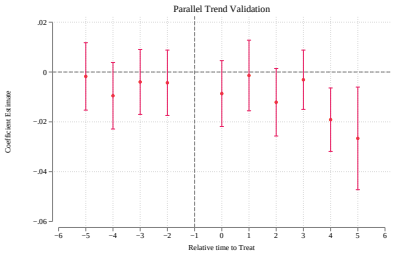
(d) Effect on revolving credit



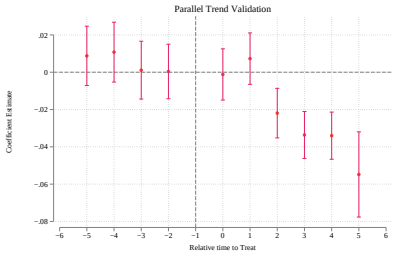
(e) Effect on term loans



(f) Effect on bonds and notes



(g) Effect on commercial papers



(h) Effect on capital leases

Figure 4.6.1. The estimated coefficients of time-specific treatment effects for the parallel-trends assumption

Notes. The figure validates the parallel-trends assumption by plotting time-specific treatment effects. The period with one period prior to treatment is the basement period. The graph plots the estimated coefficients of the leads and lags against the relative time periods to the treatment time. The parallel trend assumption is satisfied if the 95% confidence intervals for the leads include 0.

4.6.2 Placebo results for the trade war, debt structure, and costs

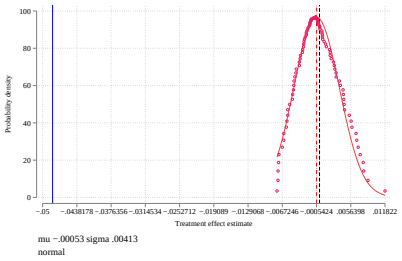
To examine the extent to which the results are influenced by the trade war and tariff treatment, I conduct placebo tests to exclude the cases where the results are obtained by chance. I follow typical falsification tests in the literature, e.g., a recent application to the trade war study in Feng et al. (2021). First, I randomly assign the target of the trade war to 3-digit SIC industries and the trade war to different quarters. Specifically, I perform permutation tests by permuting the variable $TreatTWar$. Then I obtain the treated group which is a random sample and the control group which is the rest of the observations.

Second, using the false treatment variable $TreatTWar$, I carry out placebo analysis. I mainly use the IPWRA method to estimate the coefficient of $TreatTWar$, except that the commercial paper and capital lease in the debt structure are estimated by the DID method and (4.3.1). Given the random data generation process, a false treatment variable should have produced an insignificant estimate with a magnitude close to zero. To increase the identification power of this placebo test, I repeat the above regression 100 times and store the coefficients of $TreatTWar$ from the simulation.

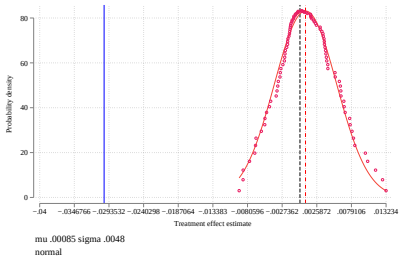
Third, I display the distribution of the coefficients from the simulated sample by plotting the kernel density estimate. For a significant treatment effect, the simulated distribution of the coefficients of $TreatTWar$ obeys a normal distribution with the mean being close to 0 while the coefficient of $TreatTWar$ in the regression with real data will be significantly away from 0. Such a result indicates that for the significant treatment effect, randomly assigning a treatment of the trade war does not affect the dependent variable of the particular type of debt or credit spread.

Fig. 4.6.2 and Fig. 4.6.3 show the distributions of the coefficient estimates from the 100 runs along with the corresponding benchmark estimates from real data, which are indicated by the vertical solid blue lines, for different debt structures and costs of debt. The dash-dot red line presents the mean of the simulations and the dash black line presents 0. I can observe that the distributions of estimates from random assignments are clearly centered around zero and the standard deviations of the estimates are small, suggesting that there is no effect from the randomly constructed trade war treatment. Meanwhile, the benchmark estimates are located near the tails of the distributions or

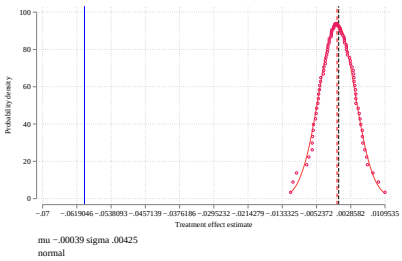
far outside the entire distributions. Combining these observations suggest that the significant effects of the trade war treatment on the debt structure and costs are not obtained by chance and are not driven by unobserved factors.



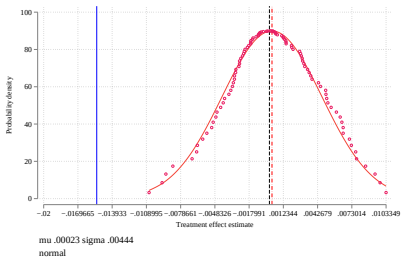
(a) Effect on leverage



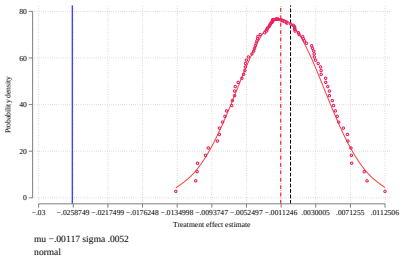
(b) Effect on bank debt



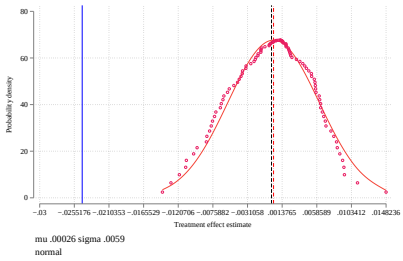
(c) Effect on public debt



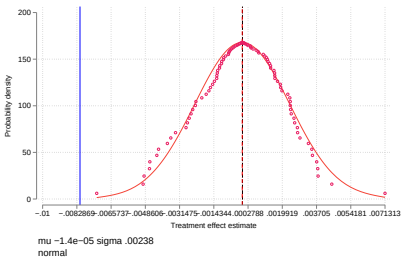
(d) Effect on revolving credit



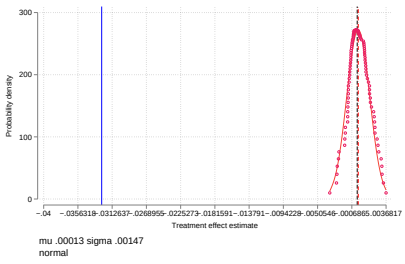
(e) Effect on term loans



(f) Effect on bonds and notes



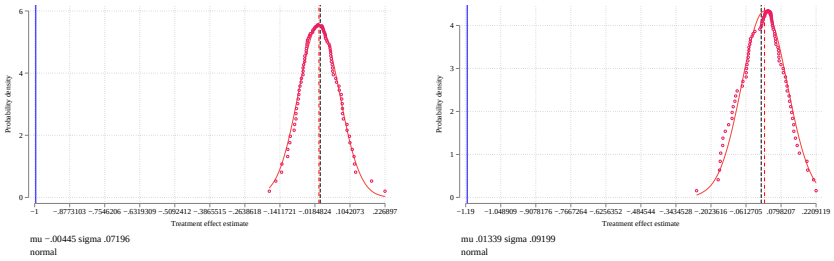
(g) Effect on commercial papers



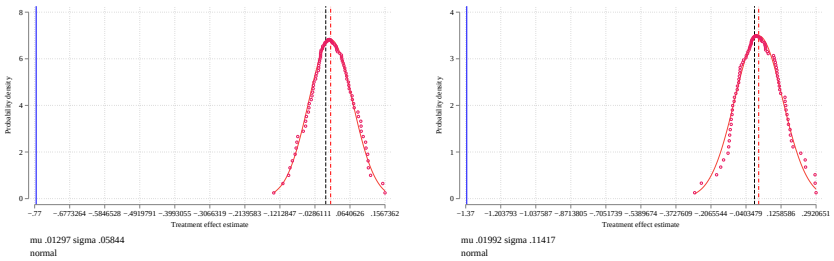
(h) Effect on capital leases

Figure 4.6.2. The probability densities of coefficients for debt analysis

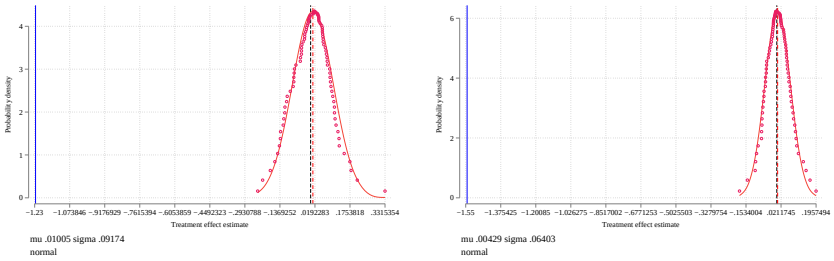
Notes. The figure portrays the probability densities of the estimated coefficients for debt analysis from 100 simulations randomly assigning the treatment of the trade war to 3-digit SIC industries. The vertical solid blue line presents the corresponding coefficients of $TreatTWar$ estimated from real data. The dash-dot red line presents the mean of the simulations and the dash black line presents 0.



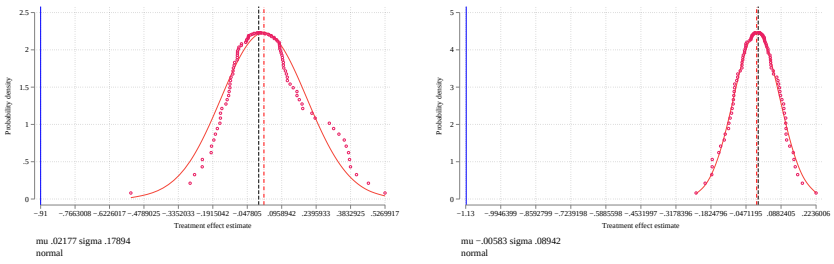
(a) Effect on credit spreads (b) Effect on bank debt CS



(c) Effect on public debt CS (d) Effect on revolving credit CS



(e) Effect on term loans CS (f) Effect on bonds and notes CS



(g) Effect on commercial paper CS (h) Effect on capital lease CS

Figure 4.6.3. The probability densities of coefficients for cost analysis

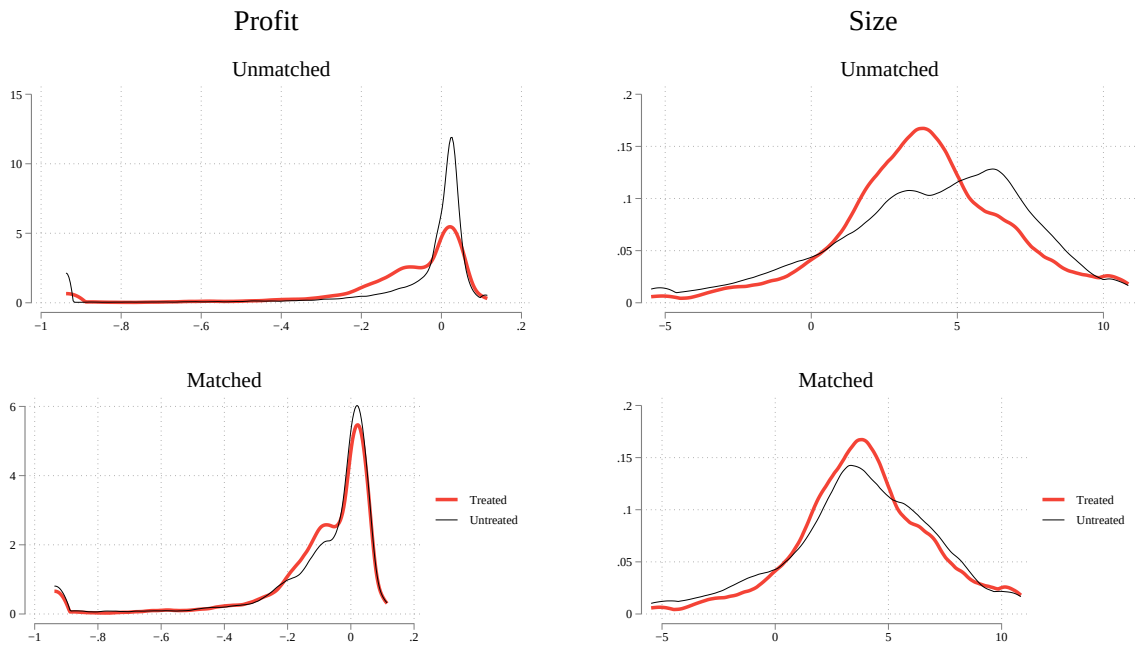
Notes. The figure portrays the probability densities of the estimated coefficients for cost analysis from 100 simulations randomly assigning the treatment of the trade war to 3-digit SIC industries. The vertical solid blue line presents the corresponding coefficients of $TreatTWar$ estimated from real data. The dash-dot red line presents the mean of the simulations and the dash black line presents 0.

4.6.3 Validation of assumptions for PSM

To validate the application of the PSM method, I assess the covariate balance in the matched samples through some statistics and density plots. Rubin (2001) proposes the measure of Rubin's B ("the absolute standardized difference of the means of the linear index of the propensity score in the treated and matched non-treated group") and Rubin's R ("the ratio of treated to matched non-treated variances of the propensity score index") and recommends that B should be less than 25 and that R should be between 0.5 and 2 for sufficiently balanced samples. The unreported results show that the data and covariates meet these balance requirements.

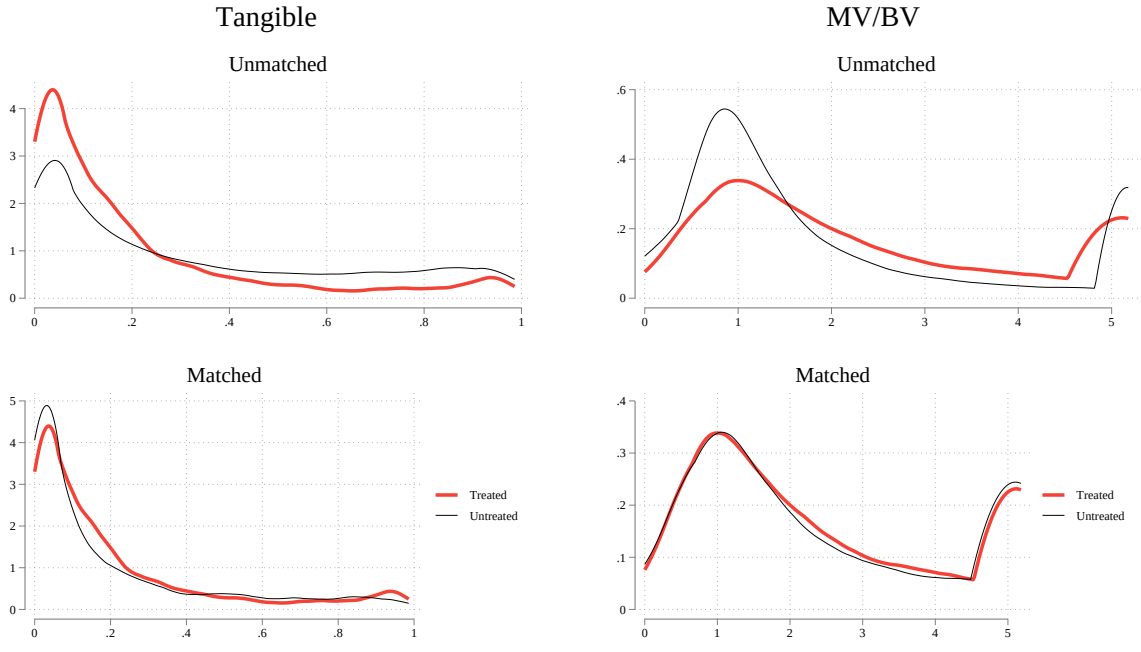
In addition, I take a closer inspection of the extent of balancing of continuous covariates by plotting their densities for treated and untreated groups. I take the data for the analysis of the book leverage (Fig. 4.6.4) and the credit spreads of total debt (Fig. 4.6.5) as examples and demonstrate the estimated densities of four selected firm characteristics under (un)matched observations, which imply the balance of the covariates. Similar balance results for the IPWRA estimator can be obtained and are omitted.

Next, I check the overlap assumption for the PSM method: each individual has a positive probability of receiving treatment. Fig. 4.6.6 and Fig. 4.6.7 depict the estimated distributions of the probabilities of receiving treatment for the data that are used to analyze different types of debt and their costs respectively. Neither plot displays too much probability mass near 0 or 1 and the two estimated densities on each graph have most of their respective masses in regions where they overlap each other. All of these graphs show that the overlap assumptions are met by using the PSM method to study the debt structure and costs.



(a) Density of profit

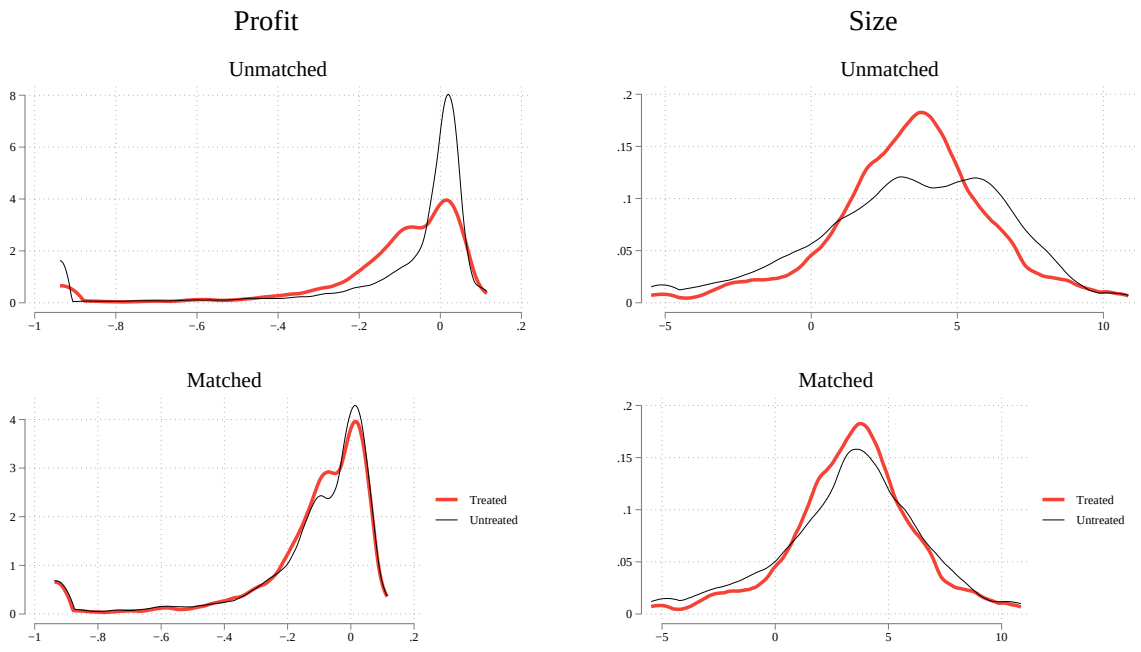
(b) Density of size



(c) Density of tangible assets

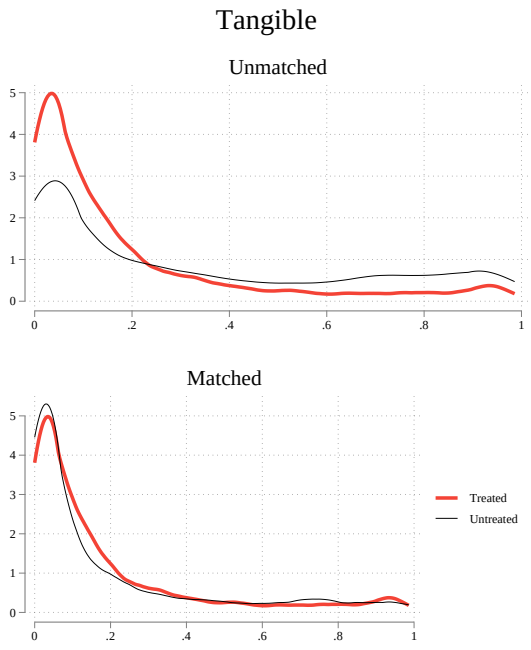
(d) Density of MV/BV

Figure 4.6.4. The densities of variables under (un)matched samples for debt analysis

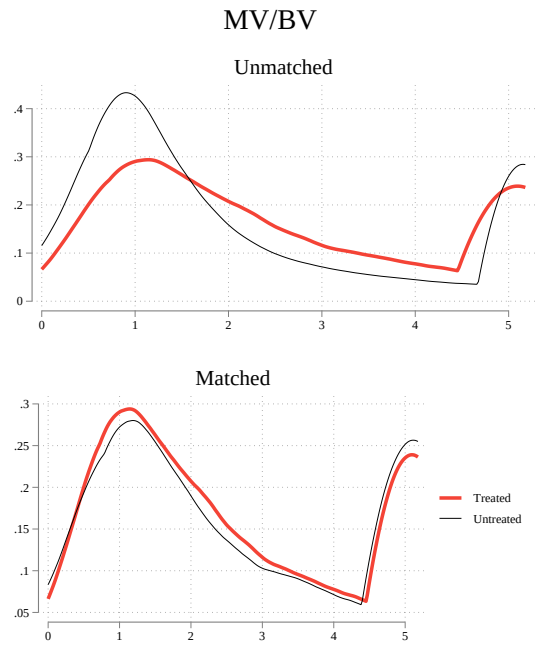


(a) Density of profit

(b) Density of size

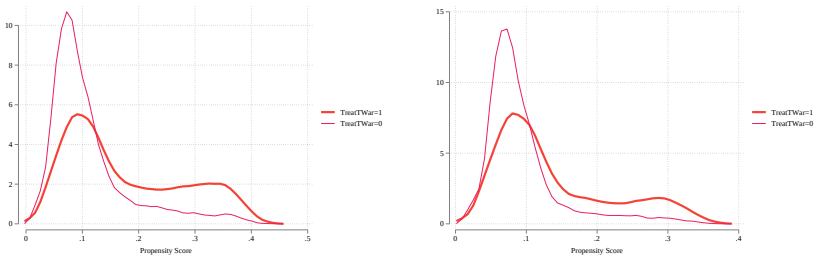


(c) Density of tangible assets

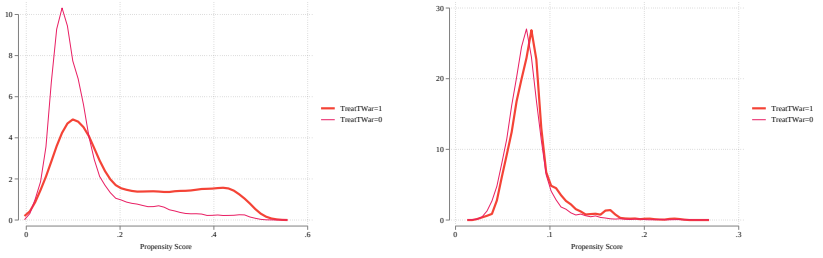


(d) Density of MV/BV

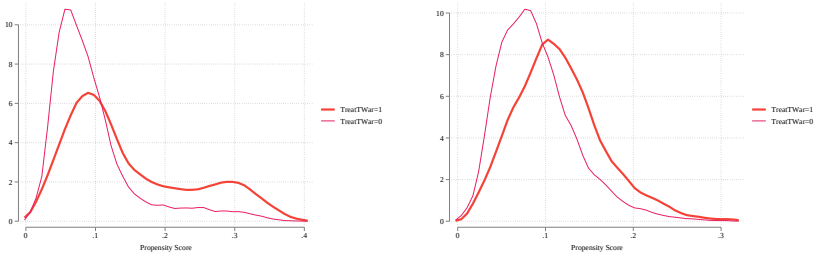
Figure 4.6.5. The densities of variables under (un)matched samples for cost analysis



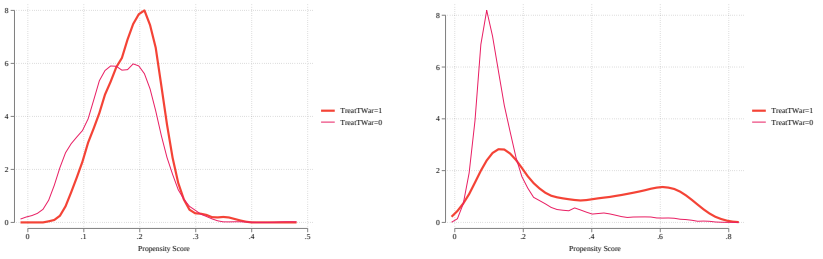
(a) PS density for leverage (b) PS density for bank debt



(c) PS density for public debt (d) PS density for revolving credit



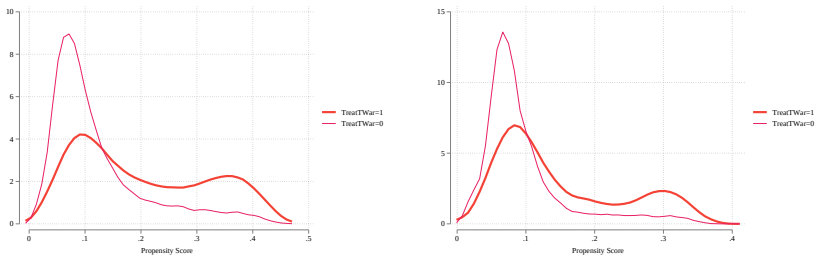
(e) PS density for term loans (f) PS density for bonds and notes



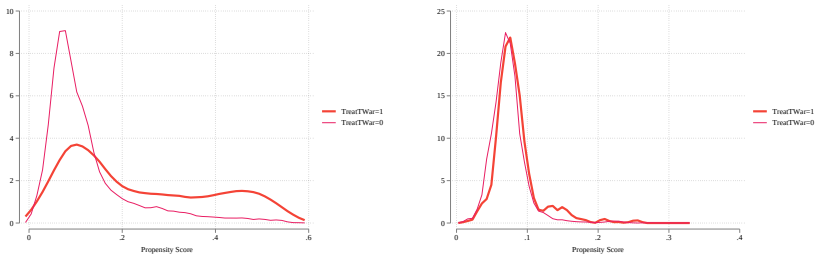
(g) PS density for commercial papers (h) PS density for capital leases

Figure 4.6.6. The densities of receiving treatment for debt analysis

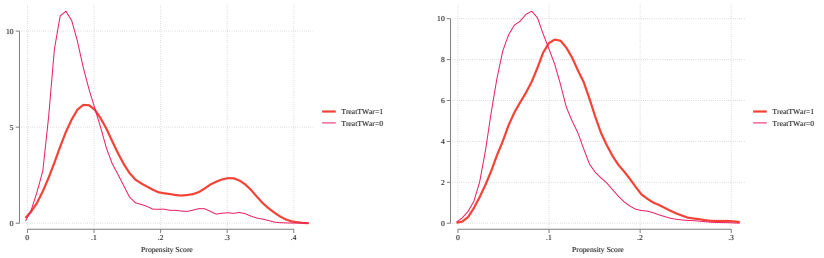
Notes. The estimated distributions of the probability of receiving treatment are for checking the overlap assumption: each individual has a positive probability of receiving treatment.



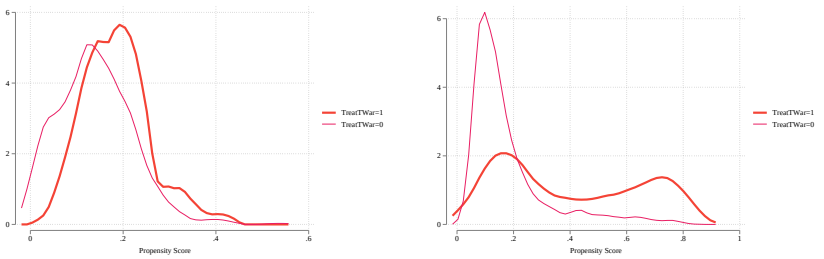
(a) PS density for credit spreads (b) PS density for bank debt CS



(c) PS density for public debt CS (d) PS density for revolving credit CS



(e) PS density for term loan CS (f) PS density for bonds and note CS



(g) PS density for comm. paper CS (h) PS density for capital lease CS

Figure 4.6.7. The densities of receiving treatment for cost analysis

Notes. The estimated distributions of the probability of receiving treatment are for checking the overlap assumption: each individual has a positive probability of receiving treatment.

4.6.4 Mediation results for the trade war, debt structure, and costs

I investigate whether the product market competition works as a mediation role, through which the trade war affects firms' debt structure and costs of debt. Causal mediation analysis has been developed in social science and there are several variants. For easy illustration, I describe the causal mediation analysis in a classic three steps approach. First, I estimate the equations (4.3.5) and (4.3.6) of debt structure and costs without the variable HHI that indicates the intensity of product market competition. The coefficient β_3 in (4.3.5) and (4.3.6) is the total effect (TE) of $TradeWar \times Treat$. Second, I examine whether HHI can be explained by the trade war in terms of equation (4.3.7). Third, I compare the estimates of equations (4.3.5) and (4.3.6) without HHI in the first step with those of corresponding equations (4.3.1) and (4.3.2) with HHI as one of independent variables, where the coefficient β_3 in (4.3.1) and (4.3.2) is the direct effect (DE) of $TradeWar \times Treat$. The difference between the total effect and the direct effect is the indirect effect (IE) of $TradeWar \times Treat$ that go through the mediation of HHI.

$$
\begin{aligned}
Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\
&\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \\
CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\
&\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \\
HHI_{i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\
&\quad + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}.
\end{aligned}
$$

Table 4.6.1 shows whether the trade war affects firms' debt structure through the mediation of the product market competition indicated by the variable HHI. The regressions in the table do not include the HHI and thus the coefficients of $TradeWar \times Treat$ are the total effect (TE). At the end of the table, I list the results of the direct effect (DE) of $TradeWar \times Treat$ and the indirect effect (IE) of $TradeWar \times Treat$ that go through the mediation of HHI. The last row provides the percentage of TE that is mediated. The results show that the HHI plays a role in mediation for the effect of the trade war on the bank debt especially revolving credit of the firms in the treated industries.

In Table 4.6.3, I examine whether there is a mediation effect of the product market competition measured by the variable HHI, through which the trade war affects

firms' costs of debt. The regressions without the HHI provide the total effect (TE) of $TradeWar \times Treat$, which might be decomposed to the direct effect (DE) and the indirect effect (IE) of $TradeWar \times Treat$ via the HHI's mediation role. The percentage of TE in the last row indicates that there is a causal mediation effect of the HHI on the credit spreads of the total debt, public debt, and capital leases.

Tables 4.6.2 and 4.6.4 display the results for the second step of mediation analysis for debt and costs respectively. The dependent variables in the two tables are the HHI that potentially provides a mediation function to the effect of the trade war on the debt structure and costs. Each column corresponds to the regression of the HHI for each type of debt or its credit spread by using the data with non-missing values of such type of debt or credit spread. For instance, Column (2) of Tables 4.6.2 is the second step of causal mediation analysis for the effect of the trade war on bank debt based on the sample of data with non-missing values of bank debt. All columns of both tables exhibit significant and negative coefficients of $TradeWar \times Treat$, implying that the firms in the industries targeted by the trade war incur a higher degree of product market competition. Hence, the treatment of import tariff rise during the trade war does not alleviate the competition instead it does intensify competition.

Table 4.6.1. Causal mediation analysis for debt

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1. TE mediated represents the proportion (%) of the total effect that is mediated.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Leverage	Bank Debt	Public Debt	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	0.0636	-0.126**	0.177***	-0.0620	-0.0660	0.0734	-0.0269	0.173***
	(0.0625)	(0.0523)	(0.0587)	(0.0420)	(0.0582)	(0.0543)	(0.0258)	(0.0369)
Treat	0.0228	-0.218***	0.229***	-0.0317**	-0.151***	0.134***	0.0324**	0.121***
	(0.0233)	(0.0167)	(0.0204)	(0.0148)	(0.0191)	(0.0249)	(0.0133)	(0.0180)
T.War×Treat	-0.0299***	-0.00404	-0.0422***	0.00836	-0.00898	-0.00510	-0.00847*	-0.0324***
	(0.0112)	(0.00931)	(0.0114)	(0.00698)	(0.0104)	(0.0105)	(0.00439)	(0.00911)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34464	24976	27103	12713	20448	19728	1151	14346
Adjusted R^2	0.324	0.308	0.392	0.369	0.331	0.427	0.452	0.305
Direct Effect	-0.0306***	-0.00487	-0.0420***	0.00782	-0.00930	-0.00497	-0.00813**	-0.0326***
	(0.00640)	(0.00681)	(0.00659)	(0.00567)	(0.00769)	(0.00826)	(0.00401)	(0.00294)
Indirect Effect	0.000720	0.000829*	-0.000252	0.000572*	0.000351	-0.000164	-0.000225	0.000264
	(0.000493)	(0.000490)	(0.000499)	(0.000343)	(0.000567)	(0.000582)	(0.000345)	(0.000232)
TE mediated	-2.41	-20.52*	0.60	6.81*	-3.93	3.19	2.69	-0.82

Table 4.6.2. HHI regressions for debt analysis

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI
Data	Leverage	Bank Debt	Public Debt	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	0.0180***	0.0275***	0.0182***	0.0329***	0.0241***	0.0237***	0.0366***	0.0209***
	(0.00167)	(0.00233)	(0.00181)	(0.00329)	(0.00168)	(0.00132)	(0.00565)	(0.00274)
Treat	-0.283***	-0.282***	-0.273***	-0.279***	-0.292***	-0.272***	-0.370***	-0.274***
	(0.0204)	(0.0214)	(0.0210)	(0.0215)	(0.0213)	(0.0256)	(0.00417)	(0.0207)
T.War×Treat	-0.00806***	-0.00807***	-0.00783***	-0.00759***	-0.00741***	-0.00643***	-0.0119***	-0.00761***
	(0.00212)	(0.00218)	(0.00193)	(0.00162)	(0.00234)	(0.00173)	(0.00338)	(0.00169)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34464	24976	27103	12713	20448	19728	1151	14346
Adjusted R^2	0.978	0.977	0.978	0.974	0.977	0.977	0.987	0.979

Table 4.6.3. Causal mediation analysis for cost

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1. TE mediated represents the proportion (%) of the total effect that is mediated.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CS of	Total Debt	Bank D.	Public D.	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	-3.121***	-2.336***	-3.640***	-0.680***	-3.723***	-2.182***	-0.484	-4.958***
	(0.135)	(0.146)	(0.153)	(0.181)	(0.157)	(0.105)	(0.301)	(0.289)
Treat	-0.215	-1.091***	0.0263	1.201***	-1.967***	-0.302	-3.357***	1.031***
	(0.147)	(0.301)	(0.290)	(0.171)	(0.369)	(0.844)	(0.279)	(0.214)
T.War×Treat	0.0295	-0.221**	0.368***	-0.359**	-0.192***	-0.167***	0.0442	0.0603
	(0.0693)	(0.0816)	(0.121)	(0.145)	(0.0640)	(0.0359)	(0.0880)	(0.114)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18658	15588	17527	7620	14336	18295	680	9467
Adjusted R^2	0.299	0.342	0.299	0.396	0.325	0.403	0.886	0.257
Direct Effect	0.0143	-0.216*	0.343***	-0.359**	-0.185	-0.171*	0.0451	0.00389
	(0.0991)	(0.115)	(0.0987)	(0.140)	(0.123)	(0.0930)	(0.120)	(0.146)
Indirect Effect	0.0154*	-0.00427	0.0278***	-0.000741	-0.00641	0.00543	-0.000490	0.0486***
	(0.00887)	(0.00907)	(0.00829)	(0.00900)	(0.00938)	(0.00652)	(0.00907)	(0.0123)
TE mediated	51.91*	1.94	7.50***	0.21	3.35	-3.27	-1.10	92.58***

Table 4.6.4. HHI regressions for cost analysis

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	HHI	HHI	HHI	HHI	HHI	HHI	HHI	HHI
CS Data of	Total Debt	Bank D.	Public D.	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	0.00866***	0.0322***	0.00864***	0.0402***	0.0298***	0.0231***	0.0213**	0.0145***
	(0.00114)	(0.00242)	(0.00133)	(0.00502)	(0.00187)	(0.00154)	(0.00784)	(0.00237)
Treat	-0.281***	-0.283***	-0.268***	-0.275***	-0.294***	-0.273***	-0.161***	-0.260***
	(0.0218)	(0.0212)	(0.0225)	(0.0218)	(0.0209)	(0.0278)	(0.00724)	(0.0209)
T.War×Treat	-0.00792***	-0.00945***	-0.00708***	-0.00848***	-0.00893***	-0.00597***	-0.0151***	-0.00938***
	(0.00207)	(0.00210)	(0.00202)	(0.00153)	(0.00238)	(0.00158)	(0.00441)	(0.00201)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18658	15588	17527	7620	14336	18295	680	9467
Adjusted R^2	0.984	0.982	0.981	0.979	0.980	0.977	0.985	0.981

4.6.5 Moderation results for the trade war, debt structure, and costs

I examine whether there is a moderating effect of *HHI* that the relations between *TreatTWar* and the debt structure or costs vary with the values of *HHI*. I add an interaction term between *TreatTWar* and *HHI* as the predictor of the debt structure or costs in the equations (4.3.8) and (4.3.9).

$$\begin{aligned} Y_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 TreatTWar_{i,t} \times HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \\ CS_{f,i,t} &= \beta_0 + \beta_1 TradeWar_t + \beta_2 Treat_i + \beta_3 Treat_i \times TradeWar_t \\ &\quad + \beta_4 TreatTWar_{i,t} \times HHI_{i,t} + \vec{\beta}^T \mathbf{X}_{t-1} + \varepsilon_{f,i,t}. \end{aligned}$$

In Tables 4.6.5 and 4.6.6, I examine whether there is a moderating effect of the product market competition measured by the variable *HHI* that modifies the relations between the trade war and firms' debt structure as well as the costs of debt. A significant regression coefficient of the interaction term between *TreatTWar* and *HHI* suggests that *HHI* modifies the relations between *TreatTWar* and the debt structure or costs differ.

Table 4.6.5 displays that the *HHI* plays a role of moderation for the relations between the treated firms during the trade war and the total debt, bank debt especially term loans, public debt including bonds and notes as well as capital leases. Since a low value of *HHI* implies a high level of product market competition, the positive coefficients of the interaction term suggest that in a highly competitive market, the treated firms during the trade war reduce these types of debt.

Table 4.6.6 shows that the *HHI* makes a moderating effect on the relations between the treated firms during the trade war and the credit spreads of total debt, bank debt, public debt including bonds and notes as well as commercial papers. Since a low value of *HHI* implies a high level of product market competition, the negative coefficients of the interaction term suggest that in a highly competitive market, the treated firms during the trade war incur more costs of these types of debt.

Table 4.6.5. Debt analysis using the DID regression with HHI moderation

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Leverage	Bank Debt	Public Debt	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	0.0602***	-0.125***	0.173***	-0.0598***	-0.0669***	0.0710***	-0.0275**	0.173***
	(0.00987)	(0.00528)	(0.0137)	(0.00710)	(0.00445)	(0.00730)	(0.0105)	(0.0147)
Treat	-0.0173	-0.251***	0.225***	-0.0524**	-0.167***	0.134*	0.0439*	0.107***
	(0.0308)	(0.0204)	(0.0286)	(0.0194)	(0.0164)	(0.0740)	(0.0239)	(0.0163)
TreatTWar	-0.0471***	-0.0122**	-0.0559***	0.00469	-0.0142**	-0.0129*	-0.00659*	-0.0370***
	(0.0122)	(0.00560)	(0.0137)	(0.00501)	(0.00533)	(0.00699)	(0.00324)	(0.00609)
TreatTWar×HHI	0.146***	0.0619***	0.118***	0.0194	0.0435**	0.0665**	-0.00988	0.0333***
	(0.0286)	(0.0115)	(0.0225)	(0.0147)	(0.0190)	(0.0297)	(0.00943)	(0.00640)
HHI	-0.126**	-0.112**	0.000560	-0.0729*	-0.0503	0.00508	0.0313	-0.0435**
	(0.0494)	(0.0444)	(0.0410)	(0.0418)	(0.0435)	(0.0434)	(0.0261)	(0.0186)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34464	24976	27103	12713	20448	19728	1151	14346
Adjusted R^2	0.324	0.308	0.392	0.370	0.331	0.427	0.451	0.306

Table 4.6.6. Cost analysis using the DID regression with HHI moderation

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CS of	Total Debt	Bank D.	Public D.	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	-3.063***	-2.316***	-3.557***	-0.684***	-3.734***	-2.141***	-0.459	-4.875***
	(0.130)	(0.151)	(0.152)	(0.186)	(0.152)	(0.102)	(0.304)	(0.307)
Treat	-0.578***	-0.872*	-0.691*	1.229***	-1.710***	-0.405	-3.323***	-0.638
	(0.190)	(0.441)	(0.337)	(0.299)	(0.430)	(0.839)	(0.299)	(0.505)
TreatTWar	0.150*	-0.122	0.528***	-0.353*	-0.150*	-0.0674	0.142	-0.0951
	(0.0857)	(0.0905)	(0.155)	(0.180)	(0.0832)	(0.0574)	(0.0870)	(0.182)
TreatTWar×HHI	-1.294***	-0.840**	-1.649***	-0.0385	-0.322	-0.860**	-0.518**	0.710
	(0.270)	(0.361)	(0.433)	(0.514)	(0.413)	(0.386)	(0.245)	(0.574)
HHI	-1.425***	0.669	-2.880***	0.0963	0.842	-0.463	0.287	-6.253***
	(0.428)	(0.730)	(0.641)	(0.831)	(0.585)	(0.419)	(0.874)	(1.446)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18658	15588	17527	7620	14336	18295	680	9467
Adjusted R^2	0.299	0.342	0.300	0.396	0.325	0.403	0.886	0.258

4.7 Conclusion

The existing study using causal inferences with large tariff reductions as exogenous shocks reveals that external pressure resulting from product market competition affects firms' general debt choice and costs. The globalization trend in the past three decades and the reduction of import tariffs led to increased competition among U.S. firms. However, the U.S. started trade wars with its counterparts in 2018, especially by extending tariffs against China according to Section 301 (lists 1-3) in an intense manner. It has been debated whether the trade war has brought gains or losses. In this paper, I investigate whether the trade war affects product market competition, businesses' debt decisions, and debt costs. The paper uses the trade war and affected industries as a quasi-natural experiment to examine how competition affects corporate debt structure and costs. Despite the decrease in credit spreads, the trade war did not ease competition but intensified it, making debt financing difficult.

I examine various types of debt and their costs since companies make their debt financing decisions in terms of the specific debt types within the two general categories of bank debt and public debt, which are discussed by the prior studies. The work is the first one to investigate the specific debt structures and debt costs of companies and industries during the trade war. As a contribution, I provide insightful explanations about how the trade war affects the debt structures of firms with intense competition in a product market. In comparison with the industries that are not affected by the trade war, the sectors that are affected by the trade war show significant changes in the debt structure. Meanwhile, the debt costs incurred by these sectors are different from those of the control industries. The results of this chapter have implications for decision-making, market stability, and government policies.

I employ the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment indicating the 3-digit SIC industry that experienced rising tariffs during the trade war period, on the outcomes of different debt ratios or credit spreads. In addition, I carry out robustness analyses. First, I use propensity score matching (PSM) methods that compare treatment and non-treatment firms to identify the effect of the trade war based on PSM. Second, I use the inverse-probability-weighted regression adjustment (IPWRA) method to esti-

mate the ATET, which has the double-robust property that entails the advantages of both IPW and RA estimators. Third, I carry out Placebo tests to exclude the cases in which the results are obtained by chance. Furthermore, I investigate whether the product market competition potentially works as a mediation role, through which the trade war affects firms' debt structure and costs of debt. I decompose the total effect (TE) of the trade war into the direct effect (DE) and the indirect effect (IE). Finally, I examine whether there is a moderating effect of competition that the relations between the treatment and the debt structure or costs vary with the levels of competition.

Specifically, I find that although credit spreads decrease, the trade war did not alleviate competition and it intensified competition and hampered debt financing. I show that the trade war makes firms in the industries with the tariff protection of rising import tariffs pay lower credit spreads for borrowing various types of debt from banks or the public market. Furthermore, the treated firms reduce their leverages which comprise bank debt including revolving credit and term loans as well as public debt from the public market including bonds and notes, commercial papers, and capital leases during the trade war. The literature records that bank debt brings the external pressure of banks to firms and the external effect is affected by the product market competition, which makes firms decrease the external effect of banks. Therefore, the reduction of bank debt during the trade war implies that the competition is accelerated rather than alleviated by the trade war. Indeed, the results show that the product market competition indicated by HHI rises for the treated firms during the trade war. In addition, the trade war affects bank debt especially revolving credit, and the credit spreads of the total debt, public debt, and capital leases through HHI. In a highly competitive market with low HHI, the treated firms during the trade war reduce various types of debt.

4.A Additional results and tables

This appendix collects additional results. I consider two dummy variables (*Trade-War* and *Treat*) in Table 4.A.1. Table 4.A.2 lists the correlation of debt structure, industry tariff, and firm characteristics. Note that there is no multicollinearity issue among the variables. Some large correlation coefficients among the first 13 variables are expected, e.g., loans and bonds that are highly correlated with leverage as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

Table 4.A.2 lists the correlation of debt structure, industry tariff, and firm characteristics. Commercial papers from the public market are negatively correlated with the revolving credit and term loans of bank debt as well as the bonds and notes and capital leases of public debt. As one of bank debt, revolving credit is positively correlated with the other four types of debt, except for commercial papers. The term loans of bank debt are positively correlated with the three types of public debt: bonds and notes, capital leases, and other borrowings. Note that there is no multicollinearity issue among the variables. Some large correlation coefficients are expected, e.g., loans and bonds that are highly correlated with leverage as parts of debt. These correlations are not multicollinear since they are dependent variables in their own regressions and are not part of independent variables.

Table 4.A.1. Debt analysis using the *TradeWar* and *Treat* dummies

Notes. Estimates are adjusted for 3-digit SIC and quarter effects. ***: p<0.01, **: p<0.05, *: p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Leverage	Bank Debt	Public Debt	R. Credit	Term Loan	Bond	C. Paper	C. Lease
T.War	0.0653***	-0.123***	0.174***	-0.0574***	-0.0658***	0.0721***	-0.0311***	0.169***
	(0.0111)	(0.00531)	(0.0168)	(0.00740)	(0.00394)	(0.00765)	(0.00989)	(0.0172)
Treat	-0.00434	-0.248***	0.232***	-0.0492**	-0.164***	0.139*	0.0468*	0.1000***
	(0.0316)	(0.0207)	(0.0295)	(0.0189)	(0.0173)	(0.0731)	(0.0240)	(0.0143)
HHI	-0.0670	-0.0998**	0.0602*	-0.0742*	-0.0378	0.0228	0.0390	-0.00906
	(0.0446)	(0.0442)	(0.0297)	(0.0423)	(0.0415)	(0.0405)	(0.0267)	(0.0170)
Corporate Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34464	24976	27103	12713	20448	19728	1151	14346
Adjusted R^2	0.324	0.308	0.391	0.369	0.331	0.427	0.450	0.299

Table 4.A.2. Correlation of debt structure, credit spreads, and firm characteristics

Notes. Table 4.A.2 displays the correlation of debt structure, credit spreads, industry tariffs, and firm characteristics during 2015 to 2019. Section 4.4.2 gives the definition of the variables. The symbol * means $p < 0.05$. Note that there is no multicollinearity issue among the variables. Some large correlation coefficients among the first 13 variables are expected, e.g., loans and bonds that are highly correlated with leverage as parts of debt. These correlations are acceptable and are not multicollinear since all of them are dependent (LHS) variables in their own regression specifications only. They are not part of independent (RHS) variables.

	Credit	Loan	Bond	Paper	Lease	Other	Credit CS	Loan CS	Bond CS	Paper CS	Lease CS	Other CS	Leverage	HHI	Profit	Tariff	Size	Tangible	MV/BV	Investment	Age	Cash	Tax	Earn. Vol.
Credit	1.00																							
Loan	0.09*	1.00																						
Bond	0.20*	0.38*	1.00																					
Paper	0.03	-0.19*	0.07*	1.00																				
Lease	0.08*	0.08*	0.07*	-0.09*	1.00																			
Other	0.18*	0.40*	0.38*	-0.12*	0.27*	1.00																		
Credit CS	0.21*	0.21*	0.27*	0.09	0.01	0.19*	1.00																	
Loan CS	0.25*	0.26*	0.19*	0.43*	0.08*	0.29*	0.58*	1.00																
Bond CS	0.26*	0.26*	0.27*	-0.13*	0.04*	0.19*	0.40*	0.47*	1.00															
Paper CS	0.34*	0.21*	-0.10*	0.04	-0.07	0.05	0.38*	0.43*	0.53*	1.00														
Lease CS	0.11*	0.13*	0.10*	-0.18*	0.01	0.20*	0.38*	0.47*	0.42*	0.37*	1.00													
Other CS	0.12*	0.07*	0.03	-0.10	0.16*	0.32*	0.25*	0.53*	0.50*	0.56*	0.28*	1.00												
Leverage	0.34*	0.74*	0.83*	0.10*	0.28*	0.47*	0.23*	0.19*	0.26*	-0.01	0.13*	0.15*	1.00											
HHI	0.03*	-0.07*	-0.10*	0.14*	-0.01	-0.13*	-0.06*	-0.14*	-0.08*	0.06	-0.10*	-0.17*	-0.03*	1.00										
Profit	-0.40*	-0.44*	-0.54*	0.16*	-0.15*	-0.57*	-0.31*	-0.24*	-0.31*	-0.14*	-0.18*	-0.22*	-0.38*	0.10*	1.00									
Tariff	-0.13*	-0.03	-0.00	-0.01	-0.05*	0.01	-0.12*	-0.15*	-0.14*	-0.13	-0.08*	-0.26*	-0.02	0.11*	-0.03*	1.00								
Size	-0.43*	-0.44*	-0.47*	-0.32*	-0.17*	-0.52*	-0.39*	-0.40*	-0.48*	-0.35*	-0.24*	-0.34*	-0.28*	0.09*	0.68*	-0.01	1.00							
Tangible	0.04*	-0.03*	-0.16*	-0.16*	0.16*	-0.07*	0.07*	0.11*	0.05*	0.10*	0.09*	0.08*	0.00	-0.06*	0.19*	-0.42*	0.14*	1.00						
MV/BV	0.24*	0.39*	0.50*	0.25*	0.11*	0.43*	0.10*	0.14*	0.16*	-0.10*	-0.01	0.13*	0.30*	-0.12*	-0.57*	0.15*	-0.54*	-0.30*	1.00					
Investment	0.01	-0.01	-0.08*	-0.03	-0.03*	0.03*	0.00	0.03*	0.00	0.04	0.05*	0.05*	-0.02*	-0.06*	0.05*	-0.20*	0.06*	0.40*	-0.08*	1.00				
Age	0.02*	0.02*	0.10*	-0.01	-0.01	0.01	0.03*	0.05*	0.09*	-0.07	-0.02	-0.04	0.10*	0.05*	-0.10*	-0.13*	-0.14*	0.14*	0.03*	0.03*	1.00			
Cash	0.09*	0.12*	0.23*	0.05	-0.00	0.23*	0.12*	0.11*	0.04*	-0.00	0.06*	0.18*	-0.06*	-0.19*	-0.33*	0.22*	-0.33*	-0.43*	0.42*	-0.16*	-0.22*	1.00		
Tax	-0.04*	-0.08*	-0.05*	0.18*	-0.02*	-0.06*	-0.11*	-0.12*	-0.13*	0.01	-0.07*	-0.04	-0.05*	0.06*	0.13*	0.04*	0.14*	-0.04*	0.02*	-0.01	0.02*	-0.06*	1.00	
Earn. Vol.	0.40*	0.42*	0.52*	0.03	0.15*	0.55*	0.30*	0.21*	0.29*	0.17*	0.15*	0.16*	0.38*	-0.06*	-0.79*	-0.04*	-0.64*	-0.14*	0.52*	-0.03*	0.15*	0.26*	-0.08*	1.00

4.B 3-Digit SIC industries affected

Table 4.B.1. The 3-digit SIC sectors affected by the trade war

Total Firm-Quarter Observations			34,464		Total No. of Firms		4,639
3-Digit SIC	NAICS	Entry	Observation	Duties	Imports	Tariff	Target %
131	211120	2	1886	31.76726	27760.82	0.001144	12.85078
201	311611	93	70	8.265677	481.4616	0.017168	0.012118
202	311512	120	33	41.96173	421.2546	0.099611	0.048757
203	311422	336	86	75.03882	1038.981	0.072223	0.43365
204	311211	81	33	8.953421	503.4446	0.017784	0.205448
206	311314	95	56	25.86962	478.0465	0.054115	0.095136
207	311224	71	38	11.58751	528.0485	0.021944	0.035831
208	311942	49	184	19.61898	2057.497	0.009535	0.917158
209	311710	116	134	40.14404	565.3324	0.07101	0.190262
211	312230	3	9	3.490788	50.05134	0.069744	0.023169
221	313210	366	7	14.96536	183.5121	0.08155	0.079197
225	315110	130	3	105.8558	781.7588	0.135407	0.086649
227	314110	37	27	18.78387	357.0088	0.052615	0.165263
242	321999	2	29	0.120928	3.487791	0.034672	0.001615
243	321911	31	54	8.089352	183.1328	0.044172	0.084774
251	337910	12	46	12.51666	292.8372	0.042743	0.135557
261	322110	1	19	0.00074	0.02	0.037	9.26E-06
267	326113	31	133	38.55224	795.8067	0.048444	0.368387
278	323111	3	13	0.183758	5.479845	0.033533	0.000455
281	325180	213	206	41.54182	1044.678	0.039765	0.469943
282	325211	178	143	147.2821	2318.762	0.063518	1.04872
283	325412	33	5096	6.652055	135.1722	0.049212	0.062573
284	325611	44	144	16.48099	319.2651	0.051622	0.147031
285	325510	13	62	6.736061	171.9932	0.039165	0.079617
286	325194	772	159	210.0202	4152.465	0.050577	1.548439
287	325199	21	170	20.69786	336.591	0.061493	0.155812
289	325520	98	115	26.16157	680.4892	0.038445	0.204948

Notes. This table displays the 3-digit SIC sectors affected by Section 301-China in the sample.
NAICS is added according to Pierce and Schott (2012b) and naics.com.
NAICS on each row is the one that matches to the first 4-digit SIC within the 3-digit SIC.
Entry is the number of commodities. Observation is the size of firm-quarter observation.
Duties and imports are in millions of dollars.

Table 4.B.1. The 3-digit SIC sectors affected by the trade war

Total Firm-Quarter Observations			34,464		Total No. of Firms		4,639
3-Digit SIC	NAICS	Entry	Observation	Duties	Imports	Tariff	Target %
291	325194	17	223	1.894128	42.99673	0.044053	0.019382
299	324110	8	61	2.563472	353.2185	0.007257	0.163509
301	326211	32	49	94.72315	2295.845	0.041259	1.062759
306	326299	37	19	13.6991	462.7584	0.029603	0.176401
308	326113	129	173	226.8598	4699.159	0.048277	0.89898
322	327213	99	38	49.70542	552.1069	0.090029	0.135285
323	327211	31	2	28.53065	485.2637	0.058794	0.224634
325	327120	43	1	38.95393	439.395	0.088654	0.203401
327	327120	6	66	0.698481	13.42755	0.052018	0.006216
329	327910	26	57	6.233252	174.2845	0.035765	0.072894
331	331110	714	147	1242.088	5562.665	0.22329	0.156451
333	331410	34	34	214.821	2394.671	0.089708	0.081188
334	331410	4	17	11.91574	97.13694	0.122669	0.044966
335	331420	193	94	258.3176	3304.698	0.078167	0.849042
339	332618	17	7	5.155069	142.7826	0.036104	0.060048
341	332431	3	32	0.887318	15.23478	0.058243	0.007052
342	332216	138	60	124.5239	2528.353	0.049251	0.764919
343	332999	15	2	19.52056	479.7462	0.040689	0.203818
344	332312	33	90	31.12156	299.4315	0.103935	0.113389
346	336370	5	55	3.794547	142.3754	0.026652	0.065907
349	332911	179	80	179.6732	4354.375	0.041263	1.591948
351	333611	62	107	42.79883	1253.799	0.034135	0.580397
352	333618	51	75	13.53661	216.7958	0.062439	0.100357
353	333923	113	264	92.61778	428.1682	0.216312	0.198204
354	333517	276	46	168.7688	2975.143	0.056726	1.275982
355	333249	175	210	63.88729	1307.513	0.048862	0.567364
356	333618	231	199	258.6935	3049.42	0.084834	1.4102
357	334112	14	308	15.58346	77.30831	0.201575	0.035787
358	333415	47	94	31.52056	777.7464	0.040528	0.157039
359	333995	35	38	29.27151	164.108	0.178367	0.075967

Notes. This table displays the 3-digit SIC sectors affected by Section 301-China in the sample.
NAICS is added according to Pierce and Schott (2012b) and naics.com.
NAICS on each row is the one that matches to the first 4-digit SIC within the 3-digit SIC.
Entry is the number of commodities. Observation is the size of firm-quarter observation.
Duties and imports are in millions of dollars.

Table 4.B.1. The 3-digit SIC sectors affected by the trade war

Total Firm-Quarter Observations			34,464		Total No. of Firms		4,639
3-Digit SIC	NAICS	Entry	Observation	Duties	Imports	Tariff	Target %
361	335311	28	67	28.24368	581.0623	0.048607	0.247603
362	335312	101	221	143.0124	2412.376	0.059283	1.116714
363	335220	77	43	163.6775	3178.391	0.051497	0.21705
364	336320	85	82	186.1584	3705.269	0.050242	1.393428
365	334310	21	90	13.03765	957.4891	0.013617	0.142568
366	334210	18	363	11.04573	270.1135	0.040893	0.125038
367	334419	171	738	299.0295	3698.746	0.080846	1.51792
369	335911	77	219	213.201	4368.758	0.048801	1.726007
371	336120	138	509	913.7642	29698.01	0.030769	13.74753
372	336411	20	179	31.42309	153.9658	0.204091	0.071272
373	336611	21	3	3.956091	274.3366	0.014421	0.126993
374	336510	20	14	11.99401	149.0002	0.080497	0.068974
375	336991	27	3	50.35744	600.6056	0.083844	0.255846
379	336999	7	25	3.96256	114.5574	0.03459	0.044504
381	334511	29	121	20.41687	169.317	0.120584	0.078379
382	334512	174	476	149.674	2737.314	0.054679	1.150134
384	339112	36	1222	53.13538	320.3012	0.165892	0.143231
385	339114	9	24	23.22155	1055.862	0.021993	0.003322
386	325992	51	14	6.800177	237.1903	0.02867	0.090023
387	334519	240	5	34.04558	825.682	0.041233	0.005767
391	339910	64	24	100.0214	1885.548	0.053046	0.033869
394	339930	64	98	60.57306	1361.687	0.044484	0.01154
399	339994	84	62	87.24631	1573.602	0.055444	0.427004

Notes. This table displays the 3-digit SIC sectors affected by Section 301-China in the sample. NAICS is added according to Pierce and Schott (2012b) and naics.com.

NAICS on each row is the one that matches to the first 4-digit SIC within the 3-digit SIC.

Entry is the number of commodities. Observation is the size of firm-quarter observation.

Duties and imports are in millions of dollars.

Chapter 5 Conclusion

The thesis extends the literature by examining three independent and related topics about the corporate debt structure and costs of various kinds of debt including the total debt, general bank debt and public debt as well as six types of specific debt components. First, I reveal the underlying sources of the leverage puzzle in terms of the unrated firms' components of corporate debt structure. Second, I investigate how product market competition affects specific components of corporate debt and the costs of six types of debt. Third, I take the trade war between the U.S. and China intensified by Section 301 in 2018 as an exogenous shock and study a quasi-natural experiment of firms affected by the trade war.

To begin with, the first topic (Chapter 2) provides innovative explanations to the well-known leverage puzzle from the perspective of the debt structure and firms' rating status. The leverage puzzle means the negative relationship between profitability and leverage that is the total debt divided by book assets. To explain the puzzle from a new perspective, I am the first to disassemble the leverage puzzle through investigating the fine details of the corporate debt structure. Through this way, this thesis answers firms' financing questions regarding the firms' leverages and their debt structures. Different types of debt play distinctive roles in the relationship between profitability and leverage. Some types of debt drive the observed and puzzled relations between firms leverages and firms profits while some types of debt offset the leverage puzzle.

Meanwhile, I examine the leverage puzzle through the interaction between firms profits and unrated status due to the lack of long-term credit rating. Rating status matters since unrated firms heavily depend on banks to obtain bank debt, which significantly influences the debt structure and leverage puzzle. Furthermore, I show that the findings are robust to the monetary policy during 2008 financial crisis, the mechanism of external pressure caused by product market competition, and the mechanism

of banks' credit supplies in the macroeconomics.

Therefore, the first topic presents new insights into the leverage puzzle through the lens of debt structure and its interaction with unrated status. The results answer why firms adopt conservative levels of leverage when firms have large profits and reveal the importance of unrated firms' selections of debt types under different economic situations. The potential future research direction is to study the leverage puzzle through the effects of banks' credit supplies on firms' debt structures. This research will provide more insightful interpretations to the leverage puzzle from the source of credit supplies and the debt structure.

In the second topic (Chapter 3), I am the first to investigate firms' decisions of detailed debt structure and costs under the impact of the external pressure that is imposed by exogenous product market competition and bank debt. Using the details of corporate debt structure, I illustrate the effects of product market competition on the details of nine types of corporate debt and their credit spreads. On the one hand, a competitive product market makes firms reduce their leverages through reducing bank debt that comprises of revolving credit and term loans, through which the firms can decrease the external pressure of bank monitoring. On the other hand, the firms in a more competitive product market significantly raises the public debt of bonds and notes as well other borrowings in the public market. Through the switch from bank debt to public debt, the firms cut the external pressure of bank monitoring from bank debt. Furthermore, the interaction between profitability and product market competition displays that when the firms are in a more competitive product market and produce more profits, they raise their leverages through increasing their total public debt especially bonds and notes for weakening the external pressures of bank monitoring from bank debt.

In addition, I find that the relationships between product market competition and the credit spreads of bank debt and most of public debt are significantly positive. When the product market competition is high, firms have to pay higher credit spreads for borrowing various types of debt from banks or from the public market. The credit spreads of bank debt rise due to the bank monitoring imposed by banks in a more competitive environment. The credit spreads of public debt also increase in a more competitive environment. The underlying mechanism is that the firms have to reduce

the external monitoring pressure by shifting bank debt to public debt and paying larger costs for public debt.

Hence, the second topic sheds light on the effect of product market competition through a comprehensive analysis of detailed corporate debt structure and the costs of these types of debt. The findings reveal how firms select particular types of debt when firms incur intensive competition environment coming from the product market after controlling different firm characteristics and economic situations. Particularly, the join effect of product market competition and profitability provide the implication to firms that the firms with profits in an intensive competition environment in fact has the advantage to borrowing higher debt and taking higher leverages. Meanwhile, the results about the costs of debt inform that firms have to pay more costs for their debt under a higher level of competition, irrespective of the type of debt that they choose.

The third topic (Chapter 4) shows that tariff increases do not necessarily lead to an opposite implication of tariff reductions that have been studied by prior studies. The literature reports that tariff reductions increase U.S. firms' external pressure during the past three decades before 2017 when global business was a trend. The U.S. started trade wars with its counterparts in 2018, especially by extending tariffs against China pursuant to Section 301 (lists 1-3) in an intense manner. It has been debated whether the trade war has brought gains or losses. I use the trade war and affected industries as a quasi-natural experiment to examine how competition affects corporate debt structure and costs. In spite of the decrease in credit spreads, the trade war did not ease competition but rather intensified it, making debt financing difficult.

The work here is the first one to investigate how the trade war affects the specific debt structures and debt costs of companies and industries. I employ the difference-in-differences (DID) method to estimate the average treatment effect on the treated (ATET) of the binary treatment indicating the 3-digit SIC industry that experienced rising tariffs during the trade war period, on the outcomes of different debt ratios or credit spreads. I perform a series of robustness analyses with the propensity score matching (PSM) method, the inverse-probability-weighted regression adjustment (IPWRA) method, Placebo tests, mediation analysis, and moderation analysis. In comparison with the industries that are not affected by the trade war, the sectors that are affected by the trade war show significant changes in debt structure. Meanwhile, the

debt costs incurred by these sectors are different from those of the control industries.

Specifically, I find that although credit spreads decrease, the trade war did not alleviate competition rather it intensified competition and hampered debt financing. First, the trade war makes treated firms pay lower credit spreads for borrowing various types of debt from banks or from the public market. Second, the treated firms reduce their leverages that comprise of bank debt including revolving credit and term loans as well as public debt including bonds and notes, commercial papers, and capital leases during the trade war. Third, since the literature documents that firms decrease the external pressure of banks due to a high product market competition, the reduction of bank debt during the trade war implies that the competition is accelerated rather than alleviated by the trade war. Indeed, the results show that the product market competition indicated by HHI rises for the treated firms during the trade war, which affects revolving credit and the credit spreads of the total debt and public debt through HHI.

To sum up, my three independent and related research topics make three main contributions to the literature on the capital structure and debt structure. First, my research provides a novel explanation to the leverage puzzle through investigating the debt structure from a new perspective. I disassemble the leverage puzzle of the total debt by examining the fine details of the corporate debt structure. Through this new channel, I identify the specific relationships between particular types of debt and profitability, which explain the leverage puzzle in a novel way.

Second, the literature examines firms' capital structures in response to the varying environment. My study about the effects of the production market competition on debt structure and the costs contributes to this field by discussing firms' specific debt choices under intense competition. Analyzing on the effects of the production market competition on debt structure and the costs of these types of debt, I illustrate that when facing intense competition, firms select particular types of debt and relevant changes in the costs.

Third, my quasi-experimental study on the U.S.-China trade war provides a case about the effects of increasing tariff on firms' debt choices and costs. I study the impact of policy intervention to firms' financing decisions with the example of the trade war between U.S. and China. This study is new and it complements the debate on the

benefits and losses brought by the trade war from the innovative aspect of debt structure and costs. In short, studying the three topics about the fine details of corporate debt structure and costs of debt contributes to the literature by revealing insightful findings about the leverage puzzle, rating status, product market competition, and the U.S.-China trade war.

References

Admati, A. R., DeMarzo, P. M., Hellwig, M. F., and Pfleiderer, P. (2018). The leverage ratchet effect. *Journal of Finance*, 73(1):145–198.

Aggarwal, R. and Zhao, X. (2007). The leverage–value relationship puzzle: An industry effects resolution. *Journal of Economics and Business*, 59(4):286–297.

Alissa, W., Bonsall Iv, S. B., Koharki, K., and Penn Jr, M. W. (2013). Firms' use of accounting discretion to influence their credit ratings. *Journal of Accounting and Economics*, 55(2-3):129–147.

Allen, F., Carletti, E., and Marquez, R. (2011). Credit market competition and capital regulation. *Review of Financial Studies*, 24(4):983–1018.

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *Journal of Finance*, 23(4):589–609.

Amemiya, T. (1985). Advanced econometrics. *Harvard University Press, Cambridge, Massachusetts*.

Amiti, M., Kong, S. H., and Weinstein, D. (2020). The effect of the US-China trade war on US investment. Technical report, National Bureau of Economic Research.

Amiti, M., Redding, S. J., and Weinstein, D. E. (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives*, 33(4):187–210.

Ängquist, L. (2010). Stata tip 92: Manual implementation of permutations and bootstraps. *The Stata Journal*, 10(4):686–688.

Antoniou, A., Guney, Y., and Paudyal, K. (2008). The determinants of capital structure: capital market-oriented versus bank-oriented institutions. *Journal of financial and quantitative analysis*, pages 59–92.

Armstrong, C., Kepler, J. D., Samuels, D., and Taylor, D. (2022). Causality redux: The evolution of empirical methods in accounting research and the growth of quasi-experiments. *Journal of Accounting and Economics*, page 101521.

Ashbaugh-Skaife, H., Collins, D. W., and LaFond, R. (2006). The effects of corporate governance on firmsą́ credit ratings. *Journal of Accounting and Economics*, 42(1-2):203–243.

Badoer, D. C., Demiroglu, C., and James, C. M. (2019). Ratings quality and borrowing choice. *Journal of Finance*, 74(5):2619–2665.

Badoer, D. C., Dudley, E., and James, C. M. (2020). Priority spreading of corporate debt. *Review of Financial Studies*, 33(1):261–308.

Badoer, D. C. and James, C. M. (2016). The determinants of long-term corporate debt issuances. *Journal of Finance*, 71(1):457–492.

Bagley, C. N., Ghosh, D. K., and Yaari, U. (1998). Pecking order as a dynamic leverage theory. *European Journal of Finance*, 4(2):157–183.

Baker, A. C., Larcker, D. F., and Wang, C. C. (2022). How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics*, 144(2):370–395.

Baron, R. M. and Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, 51(6):1173.

Bascle, G. (2008). Controlling for endogeneity with instrumental variables in strategic management research. *Strategic organization*, 6(3):285–327.

Baskin, J. (1989). An empirical investigation of the pecking order hypothesis. *Financial Management*, pages 26–35.

Becker, B. and Ivashina, V. (2014). Cyclicality of credit supply: Firm level evidence. *Journal of Monetary Economics*, 62:76–93.

Begenau, J. and Salomao, J. (2019). Firm financing over the business cycle. *Review of Financial Studies*, 32(4):1235–1274.

Beiner, S., Schmid, M. M., and Wanzenried, G. (2011). Product market competition, managerial incentives and firm valuation. *European Financial Management*, 17(2):331–366.

Bellemare, M. F., Masaki, T., and Pepinsky, T. B. (2017). Lagged explanatory variables and the estimation of causal effect. *The Journal of Politics*, 79(3):949–963.

Beltratti, A. and Stulz, R. M. (2012). The credit crisis around the globe: Why did some banks perform better? *Journal of Financial Economics*, 105(1):1–17.

Benguria, F. (2019). The negative impact of the US-China trade war on Chinese firms. *Available at SSRN 3440292*.

Benguria, F., Choi, J., Swenson, D. L., and Xu, M. (2020). Anxiety or pain? The impact of tariffs and uncertainty on Chinese firms in the trade war. Technical report, National Bureau of Economic Research.

Bhanot, K. and Guo, L. (2011). Negative credit spreads: Liquidity and limits to arbitrage. *Journal of Fixed Income*, 21(1):32–41.

Bharath, S. T. and Hertzel, M. (2019). External governance and debt structure. *Review of Financial Studies*, 32(9):3335–3365.

Bhojraj, S. and Sengupta, P. (2003). Effect of corporate governance on bond ratings and yields: The role of institutional investors and outside directors. *journal of Business*, 76(3):455–475.

Bolton, P., Freixas, X., and Shapiro, J. (2012). The credit ratings game. *Journal of Finance*, 67(1):85–111.

Boot, A. W. A., Greenbaum, S. I., and Thakor, A. V. (1993). Reputation and discretion in financial contracting. *American Economic Review*, pages 1165–1183.

Borusyak, K., Jaravel, X., and Spiess, J. (2022). Revisiting event study designs: Robust and efficient estimation. *Available at SSRN 2826228*.

Boubaker, S., Saffar, W., and Sassi, S. (2018). Product market competition and debt choice. *Journal of Corporate Finance*, 49:204–224.

Boubakri, N. and Ghouma, H. (2007). The impact of internal and external governance on debt financing costs and ratings: International evidence. *Les Cahiers du CREF ISSN*, 1707:410X.

Bown, C. and Kolb, M. (2021). Trump's trade war timeline: An up-to-date guide. *The Peterson Institute for International Economics*, https://www.piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide.

Bown, C. P. (2018). The element of surprise is a bad strategy for a trade war. *Harvard Business Review*, https://piie.com/commentary/op-eds/element-surprise-bad-strategy-trade-war.

Bradley, M., Jarrell, G. A., and Kim, E. H. (1984). On the existence of an optimal capital structure: Theory and evidence. *Journal of Finance*, 39(3):857–878.

Brooks, C. (2019). *Introductory econometrics for finance*. Cambridge university press.

Callaway, B. and SantąŕAnna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Calomiris, C. W. and Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *American Economic Review*, pages 497–513.

Carvalho, D. (2018). How do financing constraints affect firms' equity volatility? *Journal of Finance*, 73(3):1139–1182.

Chava, S. and Purnanandam, A. (2011). The effect of banking crisis on bank-dependent borrowers. *Journal of Financial Economics*, 99(1):116–135.

Chen, Z., Harford, J., and Kamara, A. (2019). Operating leverage, profitability, and capital structure. *Journal of Financial and Quantitative Analysis*, 54(1):369–392.

Chetty, R., Looney, A., and Kroft, K. (2009). Salience and taxation: Theory and evidence. *American economic review*, 99(4):1145–77.

Child, T. B., Massoud, N., Schabus, M., and Zhou, Y. (2021). Surprise election for Trump connections. *Journal of Financial Economics*, 140(2):676–697.

Chiu, W.-C., Wang, C.-W., and Peña, J. I. (2017). Does the source of debt financing affect default risk? *Review of Financial Economics*.

Choi, J., Hackbarth, D., and Zechner, J. (2018). Corporate debt maturity profiles. *Journal of Financial Economics*, 130(3):484–502.

Chua, J. and Woodward, R. (1993). The pecking order hypothesis and capital structures of private companies. *Financial Management*, 22(1):18.

Cigna, S., Meinen, P., Schulte, P., and Steinhoff, N. (2020). The impact of US tariffs against China on US imports. Technical report, ECB.

Clougherty, J. A. (2001). Globalization and the autonomy of domestic competition policy: An empirical test on the world airline industry. *Journal of International Business Studies*, 32(3):459–478.

Colla, P., Ippolito, F., and Li, K. (2013). Debt specialization. *Journal of Finance*, 68(5):2117–2141.

Cornett, M. M., McNutt, J. J., Strahan, P. E., and Tehranian, H. (2011). Liquidity risk management and credit supply in the financial crisis. *Journal of Financial Economics*, 101(2):297–312.

Crouzet, N. (2017). Aggregate implications of corporate debt choices. *Review of Economic Studies*, 85(3):1635–1682.

Cunha, I. and Pollet, J. (2020). Why do firms hold cash? Evidence from demographic demand shifts. *Review of Financial Studies*, 33(9):4102–4138.

Danis, A., Rettl, D. A., and Whited, T. M. (2014). Refinancing, profitability, and capital structure. *Journal of Financial Economics*, 114(3):424–443.

De Fiore, F. and Uhlig, H. (2015). Corporate debt structure and the financial crisis. *Journal of Money, credit and Banking*, 47(8):1571–1598.

De Jong, A., Verbeek, M., and Verwijmeren, P. (2010). The impact of financing surpluses and large financing deficits on tests of the pecking order theory. *Financial Management*, 39(2):733–756.

De Jong, A., Verbeek, M., and Verwijmeren, P. (2011). Firms' debt-equity decisions when the static tradeoff theory and the pecking order theory disagree. *Journal of Banking & Finance*, 35(5):1303–1314.

DeAngelo, H. and Roll, R. (2015). How stable are corporate capital structures? *Journal of Finance*, 70(1):373–418.

DeMarzo, P. M. (2019). Presidential address: Collateral and commitment. *Journal of Finance*, 74(4):1587–1619.

Diamond, D. W. and Rajan, R. G. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy*, 109(2):287–327.

Ding, H., Pu, B., Qi, T., and Wang, K. (2021). Valuation effects of the US-China trade war: The effects of foreign managers and foreign exposure. *Journal of Economic Surveys*.

Doyle, P., Saunders, J., and Wong, V. (1992). Competition in global markets: A case study of American and Japanese competition in the British market. *Journal of International Business Studies*, 23(3):419–442.

Eckbo, B. E. and Kisser, M. (2020). The leverage-profitability puzzle revisited. *Tuck School of Business Working Paper No. 3166707*.

Ellul, A., Guntay, L., and Lel, U. (2007). External governance and debt agency costs of family firms. Technical report, Board of Governors of the Federal Reserve System.

Emsley, R. and Liu, H. (2013). PARAMED: Stata module to perform causal mediation analysis using parametric regression models. *Boston College Department of Economics*.

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., and Khandelwal, A. K. (2020). The return to protectionism. *Quarterly Journal of Economics*, 135(1):1–55.

Feldhütter, P., Hotchkiss, E., and Karakaş, O. (2016). The value of creditor control in corporate bonds. *Journal of Financial Economics*, 121(1):1–27.

Feng, X., Li, W., Peng, Y., and Tan, Y. (2021). International trade friction and the cost of debt: Evidence from China. *Pacific-Basin Finance Journal*, 67:101550.

Fetzer, T. and Schwarz, C. (2021). Tariffs and politics: Evidence from Trump's trade wars. *The Economic Journal*, 131(636):1717–1741.

Fischer, E. O., Heinkel, R., and Zechner, J. (1989). Dynamic capital structure choice: Theory and tests. *Journal of Finance*, 44(1):19–40.

Flaaen, A. and Pierce, J. (2019). Disentangling the effects of the 2018-2019 tariffs on a globally connected us manufacturing sector. *Washington: Board of Governors of the Federal Reserve System*, Finance and Economics Discussion Series, no. 2019-086.

Frank, M. Z. and Goyal, V. K. (2003). Testing the pecking order theory of capital structure. *Journal of Financial Economics*, 67(2):217–248.

Frank, M. Z. and Goyal, V. K. (2007). Trade-off and pecking order theories of debt. *Handbook of Empirical Corporate Finance*, 2:135–202.

Frank, M. Z. and Goyal, V. K. (2015). The profits–leverage puzzle revisited. *Review of Finance*, 19(4):1415–1453.

Fresard, L. (2010). Financial strength and product market behavior: The real effects of corporate cash holdings. *Journal of Finance*, 65(3):1097–1122.

Freyaldenhoven, S., Hansen, C., and Shapiro, J. M. (2019). Pre-event trends in the panel event-study design. *American Economic Review*, 109(9):3307–38.

Fulghieri, P., Strobl, G., and Xia, H. (2010). The economics of unsolicited credit ratings. Technical report, working paper, University of North Carolina.

Gallis, J. A., Li, F., Yu, H., and Turner, E. L. (2018). cvcrand and cptest: Commands for efficient design and analysis of cluster randomized trials using constrained randomization and permutation tests. *The Stata Journal*, 18(2):357–378.

Giroud, X. and Mueller, H. M. (2011). Corporate governance, product market competition, and equity prices. *Journal of Finance*, 66(2):563–600.

Godfrey, C. and Brooks, C. (2015). The negative credit risk premium puzzle: A limits to arbitrage story. *Available at SSRN 2661232*.

Goulard, S. (2020). The impact of the US-China trade war on the European Union. *Global Journal of Emerging Market Economies*, 12(1):56–68.

Graham, J. R., Hanlon, M., Shevlin, T., and Shroff, N. (2017). Tax rates and corporate decision-making. *Review of Financial Studies*, 30(9):3128–3175.

Graham, J. R., Leary, M. T., and Roberts, M. R. (2015). A century of capital structure: The leveraging of corporate America. *Journal of Financial Economics*, 118(3):658–683.

Graham, J. R., Li, S., and Qiu, J. (2008). Corporate misreporting and bank loan contracting. *Journal of Financial Economics*, 89(1):44–61.

Grjebine, T., Szczerbowicz, U., and Tripier, F. (2018). Corporate debt structure and economic recoveries. *European Economic Review*, 101:77–100.

Grosse-Rueschkamp, B., Steffen, S., and Streitz, D. (2019). A capital structure channel of monetary policy. *Journal of Financial Economics*, 133(2):357–378.

Guney, Y., Li, L., and Fairchild, R. (2011). The relationship between product market competition and capital structure in Chinese listed firms. *International Review of Financial Analysis*, 20(1):41–51.

Guo, Z., Reyes, L. S., Naseem, M. A., Ramanadham, M., and Petri, P. (2020). Goods trade under siege: Early indications of industry shifts in global sourcing during the US-China trade war. *Brandeis University International Business School*.

Hackbarth, D., Hennessy, C. A., and Leland, H. E. (2007). Can the trade-off theory explain debt structure? *Review of Financial Studies*, 20(5):1389–1428.

Halling, M., Yu, J., and Zechner, J. (2016). Leverage dynamics over the business cycle. *Journal of Financial Economics*, 122(1):21–41.

Hanssens, J., Deloof, M., and Vanacker, T. (2016). The evolution of debt policies: New evidence from business startups. *Journal of Banking & Finance*, 65:120–133.

Heath, D. and Sertsios, G. (2019). Not all profits are created equal: New evidence on the profits-leverage relation. Technical report, University of Utah Working paper.

Heckman, J. J. (1976). The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models. 5(4):475–492.

Hicks, R. and Tingley, D. (2011). Causal mediation analysis. *The Stata Journal*, 11(4):605–619.

Hoberg, G. and Phillips, G. (2010a). Product market synergies and competition in mergers and acquisitions: A text-based analysis. *Review of Financial Studies*, 23(10):3773–3811.

Hoberg, G. and Phillips, G. (2010b). Real and financial industry booms and busts. *Journal of Finance*, 65(1):45–86.

Hoberg, G. and Phillips, G. (2016). Text-based network industries and endogenous product differentiation. *Journal of Political Economy*, 124(5):1423–1465.

Hoberg, G., Phillips, G., and Prabhala, N. (2014). Product market threats, payouts, and financial flexibility. *Journal of Finance*, 69(1):293–324.

Hombert, J. and Matray, A. (2018). Can innovation help US manufacturing firms escape import competition from China? *Journal of Finance*, 73(5):2003–2039.

Hossain, S. and Hosain, S. (2019). US-China trade conflict: The bottom line. *Journal of Business and Economic Management*, 7(6):243–249.

Hovakimian, A., Kayhan, A., and Titman, S. (2009). Credit rating targets. *Available at SSRN 1098351*.

Huang, Q. and Kim, R. (2019). Capital structure decisions along the supply chain: Evidence from import competition. *Journal of International Business Studies*, 50(6):873–894.

Huang, Y., Lin, C., Liu, S., and Tang, H. (2018). Trade linkages and firm value: Evidence from the 2018 US-China trade war. Technical report, Graduate Institute of International and Development Studies.

Hubbard, R. G., Kuttner, K. N., and Palia, D. N. (2002). Are there bank effects in borrowers' costs of funds? Evidence from a matched sample of borrowers and banks. *Journal of Business*, 75(4):559–581.

Hutzschenreuter, T. and Gröne, F. (2009). Product and geographic scope changes of multinational enterprises in response to international competition. *Journal of International Business Studies*, 40(7):1149–1170.

Imai, K., Keele, L., and Tingley, D. (2010). A general approach to causal mediation analysis. *Psychological methods*, 15(4):309.

Ivashina, V. and Scharfstein, D. (2010). Bank lending during the financial crisis of 2008. *Journal of Financial economics*, 97(3):319–338.

Jeon, D.-S. and Lovo, S. (2013). Credit rating industry: A helicopter tour of stylized facts and recent theories. *International Journal of Industrial Organization*, 31(5):643–651.

Kaiser, J. and Lacy, M. G. (2009). A general-purpose method for two-group randomization tests. *The Stata Journal*, 9(1):70–85.

Kashyap, A. K., Lamont, O. A., and Stein, J. C. (1994). Credit conditions and the cyclical behavior of inventories. *Quarterly Journal of Economics*, 109(3):565–592.

Kashyap, U. and Bothra, N. (2019). Sino-US trade and trade war. *Management and Economics Research Journal*, 5(2019):10173.

Kjenstad, E. C., Su, X., and Xia, H. (2018). Product market threats and performance-sensitive debt. *University of Texas at Dallas, SSRN 2410568*.

Kraft, P. (2015). Do rating agencies cater? evidence from rating-based contracts. *Journal of Accounting and Economics*, 59(2-3):264–283.

Kumar, P. and Yerramilli, V. (2018). Optimal capital structure and investment with real options and endogenous debt costs. *Review of Financial Studies*, 31(9):3452–3490.

La Ferrara, E., Chong, A., and Duryea, S. (2012). Soap operas and fertility: Evidence from brazil. *American Economic Journal: Applied Economics*, 4(4):1–31.

La Porta, R., Lopez-de Silanes, F., Shleifer, A., and Vishny, R. W. (1997). Legal determinants of external finance. *Journal of Finance*, 52(3):1131–1150.

Lai, E. L.-C. (2019). The US-China trade war, the American public opinions and its effects on China. *Economic and Political Studies*, 7(2):169–184.

Laksmana, I. and Yang, Y.-w. (2015). Product market competition and corporate investment decisions. *Review of Accounting and Finance*, 14(2):128.

Lemmon, M. L., Roberts, M. R., and Zender, J. F. (2008). Back to the beginning: persistence and the cross-section of corporate capital structure. *Journal of Finance*, 63(4):1575–1608.

Li, S., Whited, T. M., and Wu, Y. (2016). Collateral, taxes, and leverage. *Review of Financial Studies*, 29(6):1453–1500.

Lim, S. C., Macias, A. J., and Moeller, T. (2014). Intangible assets and capital structure. *SSRN Electronic Journal*.

Lin, C., Ma, Y., Malatesta, P., and Xuan, Y. (2013). Corporate ownership structure and the choice between bank debt and public debt. *Journal of Financial Economics*, 109(2):517–534.

Liu, F., Liu, Z. F., and Fleming, G. (2020). SME performance and the US-China trade war: Evidence of China. *Available at SSRN 3722539*.

Lovely, M. E., Liang, Y., et al. (2018). Trump tariffs primarily hit multinational supply chains, harm US technology competitiveness. *The Peterson Institute for International Economics*, https://www.piie.com/publications/policy-briefs/trump-tariffs-primarily-hit-multinational-supply-chains-harm-us.

Manso, G. (2013). Feedback effects of credit ratings. *Journal of Financial Economics*, 109(2):535–548.

Mathis, J., McAndrews, J., and Rochet, J.-C. (2009). Rating the raters: Are reputation concerns powerful enough to discipline rating agencies? *Journal of monetary economics*, 56(5):657–674.

Mehran, H. and Thakor, A. (2011). Bank capital and value in the cross-section. *Review of Financial Studies*, 24(4):1019–1067.

Miller, M. H. (1988). The Modigliani-Miller propositions after thirty years. *Journal of Economic perspectives*, 2(4):99–120.

Minola, T., Cassia, L., and Criaco, G. (2013). Financing patterns in new technology-based firms: An extension of the pecking order theory. *International Journal of Entrepreneurship and Small Business*, 19(2):212–233.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *American Economic Review*, 48(3):261–297.

Modigliani, F. and Miller, M. H. (1963). Corporate income taxes and the cost of capital: a correction. *American Economic Review*, 53(3):433–443.

Morellec, E., Nikolov, B., and Schürhoff, N. (2012). Corporate governance and capital structure dynamics. *Journal of Finance*, 67(3):803–848.

Morris, S. (2020). Most affected industries by US-China trade war. *The Global Trade*, https://www.globaltrademag.com/most-affected-industries-by-us-china-trade-war/.

Myers, S. C. (1984). The capital structure puzzle. *Journal of Finance*, 39(3):574–592.

Myers, S. C. (2001). Capital structure. *Journal of Economic perspectives*, 15(2):81–102.

Nicodano, G. and Regis, L. (2019). A trade-off theory of ownership and capital structure. *Journal of Financial Economics*, 131(3):715–735.

Nini, G., Smith, D. C., and Sufi, A. (2012). Creditor control rights, corporate governance, and firm value. *Review of Financial Studies*, 25(6):1713–1761.

Ovuakporaye, V. A. (2020). The United States-China trade war: Empirical assessment. *South Asian Journal of Social Studies and Economics*, pages 35–45.

Öztekin, O. (2015). Capital structure decisions around the world: Which factors are reliably important? *Journal of Financial and Quantitative Analysis*, 50(3):301–323.

Paligorova, T. and Xu, Z. (2012). Complex ownership and capital structure. *Journal of Corporate Finance*, 18(4):701–716.

Paligorova, T. and Yang, J. (2014). Corporate governance, product market competition and debt financing. Technical report, Bank of Canada Working Paper.

Pencea, S. (2019). The looming USA-China trade war and its consequences. *Global Economic Observer*, 7(1):283–298.

Pierce, J. and Schott, P. (2012a). Concording US harmonized system codes over time. *Journal of Official Statistics*, 28(1):53–68.

Pierce, J. R. and Schott, P. K. (2012b). A concordance between ten-digit US harmonized system codes and SIC/NAICS product classes and industries. *Journal of Economic and Social Measurement*, 37(1-2):61–96.

Platt, K. (2020). Corporate bonds and product market competition. *Journal of Financial Research*, 43(3):615–647.

Prilmeier, R. (2017). Why do loans contain covenants? Evidence from lending relationships. *Journal of Financial Economics*, 123(3):558–579.

Rahaman, M. M. (2016). Chinese import competition and the provisions for external debt financing in the US. *Journal of International Business Studies*, 47(8):898–928.

Rambachan, A. and Roth, J. (2023). A more credible approach to parallel trends. *Review of Economic Studies*, page forecoming.

Rauh, J. D. and Sufi, A. (2010). Capital structure and debt structure. *Review of Financial Studies*, 23(12):4242–4280.

Reed, W. R. (2015). On the practice of lagging variables to avoid simultaneity. *Oxford Bulletin of Economics and Statistics*, 77(6):897–905.

Restrepo, F., Cardona-Sosa, L., and Strahan, P. E. (2019). Funding liquidity without banks: Evidence from a shock to the cost of very short-term debt. *Journal of Finance*, (In Press).

Roberts, M. R. and Whited, T. M. (2013). Endogeneity in empirical corporate finance1. In *Handbook of the Economics of Finance*, volume 2, pages 493–572. Elsevier.

Roth, J., Sant'Anna, P. H., Bilinski, A., and Poe, J. (2022). What's trending in difference-in-differences? a synthesis of the recent econometrics literature. *arXiv preprint arXiv:2201.01194*.

Rubin, D. B. (2001). Using propensity scores to help design observational studies: Application to the tobacco litigation. *Health Services and Outcomes Research Methodology*, 2(3):169–188.

Santos, J. A. C. and Winton, A. (2019). Bank capital, borrower power, and loan rates. *Review of Financial Studies*, 32(11):4501–4541.

Schwert, M. (2018). Bank capital and lending relationships. *Journal of Finance*, 73(2):787–830.

Schwert, M. (2020). Does borrowing from banks cost more than borrowing from the market? *Journal of Finance*, 75(2):905–947.

Sheikh, S. (2019). CEO power and corporate risk: The impact of market competition and corporate governance. *Corporate Governance: An International Review*, 27(5):358–377.

Stock, J. H. and Yogo, M. (2002). Testing for weak instruments in linear iv regression. Working Paper 284, National Bureau of Economic Research.

Stock, J. H. and Yogo, M. (2005). Testing for weak instruments in linear iv regression. *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, page 80.

Strebulaev, I. A. and Yang, B. (2013). The mystery of zero-leverage firms. *Journal of Financial Economics*, 109(1):1–23.

Tobin, J. (1958). Estimation of relationships for limited dependent variables. *Econometrica: Journal of the Econometric Society*, pages 24–36.

Valta, P. (2012). Competition and the cost of debt. *Journal of Financial Economics*, 105(3):661–682.

VanderWeele, T. J. (2012). Invited commentary: Structural equation models and epidemiologic analysis. *American journal of epidemiology*, 176(7):608–612.

Vella, F. (1992). Simple tests for sample selection bias in censored and discrete choice models. *Journal of Applied Econometrics*, 7(4):413–421.

Vig, V. (2013). Access to collateral and corporate debt structure: Evidence from a natural experiment. *Journal of Finance*, 68(3):881–928.

Waisman, M. (2013). Product market competition and the cost of bank loans: Evidence from state antitakeover laws. *Journal of Banking & Finance*, 37(12):4721–4737.

Wang, Y. and Bellemare, M. F. (2019). Lagged variables as instruments. Technical report, Working Paper, Department of Applied Economics, University of Minnesota ąŋ.

Weber, J. (2006). Discussion of the effects of corporate governance on firmsąŕ credit ratings. *Journal of accounting and economics*, 42(1-2):245–254.

Wooldridge, J. (1998). Selection corrections with a censored selection variable. Technical report, mimeo, Michigan State University Department of Economics.

Xia, T. and Liu, X. (2017). Foreign competition, domestic competition and innovation in Chinese private high-tech new ventures. *Journal of International Business Studies*, 48(6):716–739.

Xiao, J. (2016). Corporate debt structure, precautionary savings, and investment dynamics. *Working paper, University of Notre Dame*.

Xu, Y. and Lien, D. (2020). Dynamic exchange rate dependences: The effect of the US-China trade war. *Journal of International Financial Markets, Institutions and Money*, 68:101238.

Zhou, J., Booth, L., and Chang, B. (2013). Import competition and disappearing dividends. *Journal of International Business Studies*, 44(2):138–154.