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Abstract

The thesis consists of two essays in corporate finance. In the first Chapter, I study China's trade liberalization and its impact on manufacturing firms' capital structure and debt structure. Moreover, I examine how the trade shock affects banks' sectoral loan allocation. In my second chapter, I study how firms' cash policies and debt structure are connected, by both documenting some new stylized facts and building a theoretical model of firm liquidity management.

In the first chapter, I study how China's trade liberalization affects manufacturing firms' capital structure and subsequently banks' sectoral loan allocation in the U.S. Using a difference-in-differences approach, I find that firms with higher import penetration from China decrease their short-term leverage only after China's entry into the WTO in 2001, but not before. The effect is caused by the huge drops in industry inventory and domestic shipments after 2001. The reduction in leverage is more pronounced for firms with bond ratings and financially unconstrained firms, suggestive of lower demand for credit. Exposed firms take fewer new short-term loans from banks, have lower spreads of credit lines, and hoard more cash. Next, I investigate how the decrease in loan demand affects banks' sectoral lending decisions. After 2001, banks with a larger fraction of C&I loans to exposed manufacturing firms decrease commercial lending and increase mortgage lending, especially for residential purposes. The economic mechanism is banks' financial constraints: The reallocation to mortgage lending is concentrated in banks that are small and have a low capital ratio. My results show that China's trade liberalization crowds in household debt during 2001-2005.

In the second chapter of my PhD thesis, I empirically examine how corporate cash holdings relate to debt structure, that is, the fraction of bond financing. I find that the relation between cash

holdings and bond financing is U-shaped in the cross-section of firms. That is, firms that do not use bond financing or those that are entirely bond financed exhibit the highest cash holdings. The differential in cash holdings due to heterogeneity in bond financing is substantial and amounts up to 20% of assets. Moreover, the intensity of bond financing is also non-linearly related to market-to-book assets, firm size and leverage. I present a model of financial constraints to rationalize these patterns.

Chapter 1

Chinese Import Penetration and the Crowding-in of Mortgage Loans

1.1 Introduction

There are two salient features in the US economy at the beginning of the 21st century. One is the acceleration of imports from China in the manufacturing sector from 2001 when China joined the World Trade Organization. China's entry into the WTO significantly lowers trade barriers and further increases productivity growth in its manufacturing sector. Figure 1-1 shows that the increasing speed of US imports from China nearly doubled after 2001. The other is the dramatic expansion in the household debt market, accompanied by the negative growth in non-financial corporate credit. As shown in the lower panel of Figure 1-2, household credit growth and non-financial corporate credit growth are negatively correlated during 2001-2007. As a comparison, the upper panel shows a positive correlation during 1991-2000.

One plausible explanation for the negative relation between household debt growth and corporate debt growth during 2001-2007 is the housing price booms. Chakraborty, Goldstein, and MacKinlay (2018) show that commercial loans in the U.S. are crowded out by banks responding to profitable opportunities in mortgage lending caused by housing price booms. Martin, Moral-Benito, and Schmitz (2018) show that the Spanish housing boom crowds out non-housing credit in the beginning and later stimulates it as banks' net worth increases.

However, housing price is not exogenous. Especially, high credit supply could inflate house prices (Favara and Imbs, 2015). In this paper, I connect China's trade liberalization with the surge in household debt by examining how China's trade liberalization affects manufacturing firms' demand for credit and how banks reallocate credit facing the China trade shock. I show that China's entry into the WTO in 2001 negatively affects the credit demand of exposed manufacturing industries, due to structural changes in domestic shipments and inventory. Exposed manufacturing firms experience a decrease in short-term debt and an increase in cash. Facing a lower credit demand from exposed manufacturing firms, financially constrained banks that used to lend to exposed manufacturing firms decrease commercial and industrial lending and increase residential mortgage lending after 2001. Therefore, China's trade liberalization indirectly increases the credit supply in the household debt market after 2001.

China's entry into the WTO is a turning point of China's integration into the world trade. It dramatically removes both tariff and non-tariff barriers and extends direct trading rights to more firms (Brandt, Van Biesebroeck, Wang, and Zhang, 2017). Moreover, the US granting the Permanent Normal Trade Relations (PNTR) to China became effective after 2001, which reduces tariff-rate uncertainty (Pierce and Schott, 2016). China's trade liberalization is more relevant for industries where China has a comparative advantage. These industries include apparel, leather, and textile manufacturing, as well as telecoms, electrical machinery, and office machinery, in which final products need processing from various inputs.[1] Figure 1-3 shows that Chinese imports in the U.S. have a diverging pattern across industries. The industries with high growth in Chinese imports before 2000 have even faster growth of Chinese imports after 2001.

More importantly, the most affected industries have significantly lower growth in domestic shipments during 2001-2007, as shown in Figure 1-4. These industries also have slower growth in total industry absorption. Although US imports from China have been growing since the early 1990s, only after 2001 the domestic shipments in the exposed (to China) US manufacturing industries start to decline. This pattern suggests that China's trade liberalization has changed

[1]Around 47% to 55% of the exports in China are processing exports, in which practice China is assembling imported inputs for export (Amiti and Freund, 2010).

the way US firms do trade with China. More US manufacturing firms could shift the production process to China and import goods made in China back to the U.S. For example, Fort, Pierce, and Schott (2018) show that the share of manufacturing firms directly importing goods from China increased after 2001. The negative growth in domestic shipments is also consistent with the huge drop in US manufacturing employment after 2001 (Among others, see Autor, Dorn, and Hanson, 2013; Acemoglu, Autor, Dorn, Hanson, and Price, 2016).

Therefore, China's trade liberalization serves as a plausibly exogenous shock to study the structural change in the US manufacturing sector after 2001. In this paper, I use the difference-in-differences approach to study the impact of China's trade liberalization on manufacturing firms' financial decisions and bank loan allocation in the U.S. Firms' exposure to China's trade liberalization is the industry-level growth in Chinese imports (Chinese import penetration) before 2000. The key assumption of my identification strategy is that China's trade liberalization is more relevant for industries in which China has a comparative advantage and economies of scale. Presumably, these industries are the ones in which Chinese imports already have grown before 2000. To separate growth in Chinese imports due to China's productivity growth and comparative advantage from that due to factors related to the U.S., I borrow from the international trade literature (Acemoglu, Autor, Dorn, Hanson, and Price, 2016; Autor, Dorn, and Hanson, 2013) to use growth in Chinese imports in 8 other high-income countries as an instrument for growth in Chinese imports in the U.S.

I start by examining the impact of Chinese import competition on manufacturing firms' demand for credit. I estimate the difference-in-differences regressions on Compustat manufacturing firms' financial leverage over the period 1995-2005. Firms' exposure to China's trade liberalization is measured using the 3-digit NAICS level growth in Chinese imports in 8 other high-income countries during 1995-2000. I find that manufacturing firms with high Chinese import penetration have a larger decrease in financial leverage after 2001 (first difference) than firms with low Chinese import penetration (second difference). The effect is both statistically and economically significant. A one-standard-deviation increase in instrumented Chinese import penetration before 2000 would lead to a decrease of 1.4% (2.2%) in book (market) leverage, which is 7% (11.6%) of the mean book (market) leverage and 7% (10.2%) of the standard deviation of book (market) leverage in the sample period. Firms in the top quartile of Chinese import penetration have a reduction of 5% in their book leverage ratio after 2001. While the leverage of firms in the bottom quartile stays the same before and after 2001.

Importantly, the dynamic diff-in-diff results show that the negative effect on leverage only exists after 2001. Moreover, the decrease in leverage of exposed industries is not accompanied by the shrinkage of industry total assets. In fact, industries with high Chinese import penetration have a larger growth in total assets after 2001. Together with the drop in domestic shipments, the results suggest that US manufacturing firms shift manufacturing processes to China and grow with China's trade liberalization.

To understand the economic mechanism of leverage reduction, I dig into the debt structure of manufacturing firms and find that the reduction in leverage is driven almost entirely by short-term debt rather than long-term debt. Studies on corporate debt maturity structure find that a firm's liability maturity matches its asset maturity (Stohs and Mauer, 1996). For manufacturing firms, short-term assets such as receivables and inventory capture a major fraction of their balance sheets. Therefore, a reduction in receivables and inventory could lead to a decrease in the demand for short-term debt. Indeed, using industry-level data from the NBER-CES database, I find that the inventory of exposed manufacturing industries drops dramatically in the year 2002 and stays at a low level ever since. The difference-in-difference analysis shows that the inventory to industry absorption ratio of exposed industries significantly decreases after 2001. The decrease in inventory is also found using firm-level data from Compustat. Firm inventory ratio is negatively related to the growth in Chinese imports after 2001, but not before. At the firm-level, I find that short-term leverage is positively associated with firm inventory ratio at the 1% level. The relationship is robust to various measures of inventory ratio. Therefore, the structural drop in industry inventory results in a decrease in short-term debt.

The decrease in short-term credit demand is supported by cross-sectional analysis based on firms' bond ratings and financial constraints. I find that the decrease in leverage is more pronounced for exposed manufacturing firms with credit ratings and firms that are not financially constrained. A supply-side contraction of loans to the exposed manufacturing firms would yield the opposite results (Leary, 2009). The results point to the idea that bigger, older, and financially unconstrained firms are better able to shift manufacturing overseas. Moreover, I find that exposed manufacturing firms increase their cash holdings after 2001. While profitability is negatively associated with growth in Chinese imports during 1991-2000, but not during 2001-2007. Hombert and Matray (2018) find that Chinese import penetration has an adverse effect on the profitability of US manufacturing firms. I find that the negative effect only exists before 2000, which is consistent with the idea that China's trade liberalization changes the way of trade. Therefore, growth in Chinese imports could not properly measure Chinese import "penetration" after 2001. Moreover, my results differ from Xu (2012), who argues that import competition results in lower leverage because of lower profitability.

Next, I examine whether and how the corporate loan market is affected by the China trade shock. As bank loans on average have shorter maturities than corporate bonds, the lower demand for short-term debt may affect the corporate loan market as well. Using Dealscan data on syndicated loans, I find that firms exposed to the China trade shock are less likely to borrow new short-term loans from banks. While there is no effect on the amount of new loans. In other words, the China trade shock affects the extensive margin but not the intensive margin regarding firms borrowing from banks.[2] Exposed manufacturing firms' lower demand for short-term debt from banks is also reflected in the loan prices. Estimating the baseline DID regressions on loan spreads, I find that firms exposed to China's trade liberalization have lower spreads for new loans taken after 2001. Importantly, the effect is significant after controlling for firm leverage and default probability. Splitting the loan facilities by loan types and by maturity, I find that the decrease in loan spread comes from short-term credit lines. The decrease in the amount of new short-term loans and the decrease in the loan spreads indicate that banks face lower demand for short-term credit from exposed manufacturing firms.

Given that banks face a negative demand shock from exposed manufacturing firms, in the second part of my paper, I investigate how China's trade liberalization affects banks through firm-bank relationships. The idea is that there is matching between firms and banks in the loan

[2]There are two shortcomings regarding the analysis using Dealscan. One is I don't observe the repayment of existing loans. The other is the facility amount of credit lines refers to the maximum funds that a firm can tap. Therefore, the actual usage is not observed.

market and banks differ in their relationships with firms (Schwert, 2018). Banks that have more relationships with manufacturing firms in high-China-imports industries are more affected by the China trade shock. Using lender-firm-loan pairs data from Dealscan and the linking table between Dealscan lenders and their ultimate bank holding companies (BHCs) from Chakraborty, Goldstein, and MacKinlay (2018), I construct the BHC-level Chinese import penetration over time.[3] Bank-level Chinese import penetration captures the extent to which the bank is lending to firms with high Chinese import penetration relative to firms with low Chinese import penetration. After matching Dealscan, Compustat, and bank holding companies' data (FR Y-9C reports) from the Federal Reserve Bank of Chicago, I get BHC-year level data of 118 bank holding companies over 1995-2005. These are the largest bank holding companies in the U.S. with an average of $62.9 billion of total assets and $33.9 billion of total loans. Bank holding companies vary in their lendings to manufacturing firms. That is, there is a substantial variation in the bank-level import penetration measure.

Using the average bank-level measure of Chinese import penetration over 1995-2000 as the exposure to China's trade liberalization, I perform the baseline difference-in-differences regressions on bank characteristics. First, I find that affected banks and unaffected banks don't differ in their asset growth, loan growth, capital ratio, profitability, non-performing loan ratio, and interest income to total income after 2001. The findings on profitability and non-performing loan ratio show that banks are not negatively affected by their lending to exposed manufacturing firms, which is consistent with the firm-level results. Next, I turn to examine the effects of import penetration on credit allocation.[4] I find that bank-level Chinese import penetration has a negative effect on the net issuance of C&I loans and a positive effect on the net issuance of real estate loans, especially for residential purposes. Economically, a one-standard-deviation increase in bank-level Chinese import penetration will lead to a decrease of $0.0059 in net C&I loan issuance and an increase of $0.0073 in net residential real estate loan issuance out of $1 of total

[3] Bank holding company is the top-tier entity that owns a controlling interest in one or more banks. There could be substitution or complementation in loan making among the subsidiary banks owned by the same bank holding company.

[4] From bank holding companies' balance sheet data, I can get data on commercial and industrial loans, real estate loans, real estate loans for residential purpose, personal loans, and agricultural loans.

assets. These effects translate to a decrease of $59 million per year in net C&I loan issuance and an increase of $73 million per year in net residential real estate loans for a bank holding company with $10 billion of total assets.

One concern is that banks' exposure to the China trade shock is correlated with lending opportunities in the mortgage loan market or household demand for mortgage loans. To mitigate the concern, I include in the baseline regression interaction terms of pre-shock bank-level growth rate in real estate loans and the fraction of real estate loans in total loans with the China trade shock dummy. These interaction terms capture bank-level differences in the exposure to and trend in the mortgage loan market. Moreover, I add interaction terms of deposit growth, loan to assets ratio, securities to assets ratio, C&I loan ratio, and C&I loan growth with the China trade shock dummy. The results on net loan issuance are robust when I add these interaction terms. The results are also robust when I use the yearly growth of C&I (real estate) loans and the ratio of C&I (real estate) loans to total loans as dependent variables.

What are the economic mechanisms that drive the reallocation from the corporate sector to the household sector? Theory suggests that banks' financial constraints may play a role here. Financially unconstrained banks make lending decisions in isolation so that shocks to the manufacturing sector may not spill over to other non-manufacturing industrial sectors or the household sector. While financially constrained banks would over extrapolate the lending opportunities by contracting loans from sectors that have a low credit demand and lending more to the sectors which banks deem more profitable. By splitting the sample by capital ratio and bank size, which I use as proxies for banks' financial constraints, I find support for this mechanism. The effects of Chinese import penetration on C&I loans and real estate loans are only significant for banks with a low capital ratio and small banks. Banks with abundant capital and large banks don't reallocate loans from the corporate sector to the household sector. The results suggest that financial constraints distort banks' lending decisions.

The credit reallocation to the mortgage loan market has contributed to the surge in the supply of household debt from the beginning of the 21st century. By 2005, there is a decrease of around $150 billion in the credit used by the exposed manufacturing firms, suppose in a counterfactual world without China's trade liberalization the exposed firms would have had a similar path of financial leverage as unexposed firms. This number translates to around 10% of the incremental increase in household debt during 2001-2005. It is important to note that my paper does not indicate that China's trade liberalization results in the dramatic rise in household debt after 2001, but that China's trade liberalization increases the credit that could be allocated to the household sector. It is also important to note the premises underlying the crowding-in behavior. The first premise is that the funding of banks has not decreased. Had exposed banks suffered from a funding shock or a profitability shock, they would decrease the credit supply to all sectors and we would not observe an increase in mortgage loan growth (See Federico, Hassan, and Rappoport, 2020, for a negative spillover of trade shocks in Italy). The second premise is that banks differ in their financial constraints and risk-taking behavior. We see that financially constrained banks react to the lower demand in the manufacturing sector by expanding extra loans to the household sector.

1.1.1 Literature Review

This paper contributes to several strands of the literature. First, the paper adds to the literature on the impacts of Chinese import penetration on manufacturing firms in high-income economies. Previous studies have focused on investment (Gutiérrez and Philippon, 2017; Pierce and Schott, 2018), innovation (Autor, Dorn, Hanson, Pisano, Shu, et al., 2016; Bloom, Draca, and Van Reenen, 2016), profitability (Hombert and Matray, 2018), and firm-level employment (Bloom, Handley, Kurman, and Luck, 2019; Ashournia, Munch, and Nguyen, 2014). Studies on capital structure include Xu (2012), who finds that overall import competition negatively affects firm leverage as it decreases expected profitability. My paper focuses on the structural change caused by China's trade liberalization and shows that exposed firms decrease their demand for short-term debt as domestic shipments and inventory decrease after China's trade liberalization. To the best of my knowledge, this is the first paper linking the change in manufacturing firms' capital structure to their inventory dynamics. Moreover, I contribute to the international trade literature by documenting the structural change in inventory and domestic shipments in the US manufacturing sector after 2001. One implication is that growth in Chinese imports could not properly measure Chinese import penetration after 2001.

Second, the transmission of the China trade shock to banks is related to recent studies on the impact of trade shocks on credit reallocation. In this line of literature, two papers are closely related to mine. Federico, Hassan, and Rappoport (2020) find that Italian banks exposed to the China trade shock suffer from higher non-performing loans. As a result, they reduced lending to both exposed manufacturing firms and other non-exposed firms. Mayordomo and Rachedi (2019) find that Spanish banks are also negatively affected by Chinese import penetration and reallocate credit away from manufacturing firms to local construction firms. My paper is different in two aspects. First, I show that exposed firms have a lower credit demand by conducting careful firm-level and loan-level analyses. Second, the profitability of exposed firms and banks are not negatively affected by China's trade liberalization. Therefore, the implications for bank loan reallocation are different. I find that banks that face lower credit demand from exposed manufacturing firms increase mortgage lending to households. The crowding-in of mortgage loans from the trade shock in the manufacturing sector is a novel finding.

Finally, the paper is related to studies that link the household credit market with the corporate credit market. Chakraborty, Goldstein, and MacKinlay (2018) show that housing booms could induce banks to increase mortgage lending and decrease commercial lending. Martin, Moral-Benito, and Schmitz (2018) show that housing booms first crowd out commercial lending and later stimulate it. These studies usually assume house prices as exogenous. By using China's trade liberalization as a plausibly exogenous shock, I differ from these studies by showing shocks to the credit demand in the corporate sector could affect household credit supply. The findings on banks' reallocation to mortgage loans add to the understanding of the surge in household debt during 2001-2005 (Mian and Sufi, 2009), other than loose lending standards (Dell'Ariccia, Igan, and Laeven, 2012) and household demand (Barrot, Loualiche, Plosser, and Sauvagnat, 2018).

The rest of the paper is organized as follows. In section 2, I discuss the data used in this paper in detail. Section 3 describes the structural changes in the US manufacturing sector after 2001 and the empirical strategy. Section 4 examines the impact of China's trade liberalization on firms' capital structure and the syndicated loan market. In section 5, I use bank-level data and examine how financial intermediaries react to import competition in household and corporate lending. Section 6 concludes.

1.2 Data

The data for this study come from a variety of sources, such as firm-level data from the Compustat database, loan-level data from the Dealscan database, and bank holding company level data from the FR Y-9C reports. The following subsections describe the data used in this study in detail.

1.2.1 Industry-level data on import competition and trading costs

The industry-level data on international trade come from Peter Schott's website.[5] Specifically, I take the NAICS-level U.S. import and export data from 1989 to 2005. The data contains import and export between the U.S. and all its trade partners at the 6-digit NAICS level. It also contains cost insurance and freight (CIF) charges and duties collected, which can be used to estimate shipping costs and tariffs as in Bernard, Jensen, and Schott (2006). Moreover, to control for the United States granting Permanent Normal Trade Relations (PNTR) to China in October 2000, which serves as a shock to tariff rate uncertainty relating to the bilateral US-China trade, I collect data on the Normal Trade Relations (NTR) tariff gap, defined as the difference in tariffs between the non-NTR rates if annual renewal of NTR fails and the NTR tariff rates, as in Pierce and Schott (2016). I get industry-level control variables, such as employment, domestic shipments, total value-added, total capital expenditure, total real capital stock, and total factor productivity, from the NBER-CES Manufacturing Industry Database from Becker, Gray, and Marvakov (2013).

Following Acemoglu, Autor, Dorn, Hanson, and Price (2016), the baseline measure of import penetration from China is the change in the Chinese import penetration ratio for a US manufacturing industry j over the period 1991-2005, defined as

$$IP\_China_{j,t} = \frac{\Delta M^{UC}_{j,t}}{Y_{j,91} + M_{j,91} - E_{j,91}}, \tag{1.1}$$

[5] https://faculty.som.yale.edu/peterschott/international-trade-data/

where the numerator $\Delta M_{j,t}^{UC}$ is the change in imports from China to the U.S. from 1991 to year t in industry j and the denominator is the industry absorption in year 1991, defined as industry shipments $Y_{j,91}$ plus total industry imports $M_{j,91}$ minus industry exports $E_{j,91}$.[6] Similarly, we can define the overall import penetration as

$$IP\_Total_{j,t} = \frac{\Delta M_{j,t}}{Y_{j,91} + M_{j,91} - E_{j,91}}, \tag{1.2}$$

where the numerator is total imports to the U.S. in industry j in year t. Since we get the industry imports and exports at the 6-digit NAICS level, we can aggregate the data and get the import penetration at the 4-digit and 3-digit NAICS level. We can also aggregate the 6-digit level granular data on duties and Cost-Insurance-Freight and get the average tariff and shipping cost at the 4-digit and 3-digit NAICS level. For NTR gaps, we use shipments as weights to get the average NTR gap at the 4-digit and 3-digit NAICS level.

The measure in equation (1.1) reflects both import penetration from Chinese factors, such as Chinese manufacturing productivity and comparative advantage, and from factors related to US manufacturing industries. To isolate import penetration from the factors related to China, I borrow from the international trade literature (Acemoglu, Autor, Dorn, Hanson, and Price, 2016; Autor, Dorn, and Hanson, 2013) to use imports from China to 8 other high-income economies as an instrument for imports from China to the U.S.[7] The instrument works if productivity shocks in the U.S. and other high-income countries are not highly correlated. Bilateral trade data at the 6-digit HS level are downloaded from the UN Comtrade database.[8] Then I apply the crosswalk in Pierce and Schott (2012) to get the NAICS level trade data. The instrumented import penetration from China can be expressed as

$$IP\_China\_IV_{j,t} = \frac{\Delta M_{j,t}^{OC}}{Y_{j,91} + M_{j,91} - E_{j,91}}, \tag{1.3}$$

[6] Another way of measuring import penetration from China is to use total employment in industry j in year 1991 as the demoninator in equation (1.1). My empirical results are robust to this alternative measure of Chinese import penetration.

[7] These countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland.

[8] https://comtrade.un.org/db/default.aspx

where $\Delta M^{OC}_{j,t}$ is the change in imports from China to 8 other high-income countries in industry j from 1991 to year t. Evidence suggests that the dramatic increase in China exports are mainly driven by the transition to a market-oriented economy since the early 1990s and the comparative advantage of cheap labor due to migration from rural areas to the cities.

Table 1.1 reports the industry-level summary statistics of total and Chinese import penetration, tariffs, shipping costs, and NTR gaps from 1991 to 2005. Panel A, B, and C show the summary statistics at the 3-digit, the 4-digit, and the 6-digit NAICS level, respectively. The data on $NTRgap$ are from 1991 to 2001, which leads to a lower number of observations. We find substantial variation in total and Chinese import penetration, as well as in tariffs, shipping costs, and NTR gaps. At the 3-digit NAICS level, the average import penetration from China is 0.049 and the standard deviation is 0.096, with a 1st percentile of 0.000 and a 99th percentile of 0.465. The instrumented Chinese import penetration has a mean of 0.034 and a lower standard deviation of 0.057. At the 3-digit NAICS level, IP_China_IV and IP_China has a positive correlation of 0.83, significant at the 1% level, which shows the relevance of the instrument. Other than conventional summary statistics, I show in the last two columns of the table the AR(1) coefficient and the R-squared of the regression $y_{j,t} = \rho y_{j,t-1} + \varepsilon_{j,t}$. We find that import penetration, tariff, shipping cost, and NTR gap are all highly persistent, with AR(1) coefficients close to 1 and high R^2s. Therefore, the variation in import penetration and trade costs mainly comes from cross-sectional heterogeneity. Tariff and shipping cost related to US-China bilateral trade is less persistent, especially at a more granular level. Importantly, we find that Chinese import penetration is diverging over time, with the AR(1) coefficient larger than 1 at all industry levels.[9] The growing import penetration from China is driven by a few industries such as apparel manufacturing, leather and allied product manufacturing, audio and video equipment manufacturing, and computer and peripheral manufacturing. Amiti and Freund (2010) show that most of China's export growth was in existing varieties rather than new varieties from 1997 to 2005, which justifies the diverging pattern.

[9]The divergence of Chinese import penetration increased after China's accession to the WTO in 2001 when the granting of Permanent Normal Trade Relations (PNTR) to China by the U.S. became effective. Cross-sectionally, NTR gap and Chinese import penetration are positively correlated, as shown in Table A.1

I report the correlation matrix of import penetration, trade costs, as well as NTR gaps in Table A.1. We find that Chinese import penetration and total import penetration is highly positively correlated. The correlation ranges from 0.48 at the 6-digit NAICS level to 0.73 at the 3-digit NAICS level. Moreover, imports from China to other high-income countries are highly correlated with imports to the U.S., justifying the relevance of the instrument. Chinese import penetration is positively correlated with the average tariff rate and Chinese tariff rate, with a higher correlation between Chinese import penetration and average tariff, suggesting that lower tariffs from China comparing to other trading partners of the U.S. could increase Chinese import penetration. Chinese import penetration and shipping cost of the US-China trade is negatively correlated. A lower shipping cost from China could increase Chinese imports. Finally, the NTR gap and Chinese import penetration are positively correlated. Therefore, after the U.S. granted the Permanent Normal Trade Relations to China in 2000, Chinese imports boosted in industries that already had high Chinese import competition before 2000.[10] Since the distribution of Chinese import penetration is highly right-skewed, I report in Table A.2 summary statistics of the industries with top-5 Chinese import penetration from 1991 to 2005 at both the 3-digit and the 4-digit NAICS level. At the 3-digit NAICS level, leather and allied product manufacturing have the highest Chinese import penetration of 0.315, followed by miscellaneous manufacturing (0.139), furniture and related product manufacturing (0.124), computer and electronic product manufacturing (0.086), and electronic equipment, appliance, and component manufacturing (0.076). These industries play a major role in growing import competition and trade deficit after 2000 in the US economy.

1.2.2 Firm-level and loan-level data in the U.S.

To examine the impact of Chinese import penetration on firms' real and financial decisions, I collect data on U.S. manufacturing firms from Compustat. My firm-level sample is all Compustat U.S. manufacturing firms from 1995 to 2005. I use the historical NAICS code to identify the industries in which the manufacturing firms operate. I drop firm-years with missing or zero total

[10] A more detailed discussion of the U.S. granting the Permanent Trade Normal Relations (PNTR) status to China could be found in Pierce and Schott (2016)

assets (AT), with negative sales (SALE), and with total debt more than total assets, where total debt is defined as debt in current liabilities (DLC) plus long-term debt (DLTT). The final firm-level sample consists of 32,040 firm-year observations with non-missing values of total assets for 5,083 manufacturing firms from 1995 to 2005. Firm-level summary statistics are provided in panel A of Table 1.2. The manufacturing firms in my sample have average total assets of 1355.7 million dollars and an average book (market) leverage ratio of 22% (19%). The average short-term debt to assets, which are defined as the ratio of debt in current liabilities (DLC) to total assets, is 0.06, while the average of long-term debt to assets is 0.16. The average Tobin's q is 2.51 and the average tangibility is 0.22 during my sample period. Firms hold 23% of total assets in cash on average and the average asset growth in my sample is 12%. CAPX investment is measured as capital expenditure scaled by lagged property, plant, and equipment. We find that CAPX investment has a mean of 0.44 and a median of 0.21. The average return on assets (ROA) in my sample is -0.11 as there are firms with extremely negative ROA values.

As many big Compustat firms simultaneously operate in many sub-industries, I rely on Compustat Segment data to construct a measure of firm-level market concentration. Specifically, I use sale data from different industries that the firm operates in to construct the Herfindahl-Hirschman Index (HHI). An HHI equal to 1 means that the firm operates in a single industry. During the sample period, the average market concentration for manufacturing firms is 0.82, with a 25th percentile of 0.63. Firms operate in one single industry in more than 50% of firm-years. I use capital to labor ratio, measured as property, plant, and equipment scaled by total employment, to capture the capital intensity of the firm. The average capital to labor ratio is \$50 thousand per person and the standard deviation is \$70 thousand per person. Moreover, I aggregate firm-level data to get 3-digit NAICS level industry data on the growth of total assets, total debt, and market capitalization. The average growth rate of industry-level assets and debt is 5% and 4%, respectively. While industry market capitalization grows at 9% on average. Industry-level data aggregated from Compustat only cover big public firms. To capture the trend in both private and public manufacturing firms, I also use the NBER-CES database from Becker, Gray, and Marvakov (2013) to get other industry characteristics at the national level, such as capital to value added, production workers to value added, growth of production workers' wages, and total factor productivity (TFP).

I use the Dealscan database to get loan-level information for the manufacturing firms when they borrow from banks. Dealscan contains contract data on each loan facility including the loan amount, price, maturity, and lenders in the facility. I use the link table from Chava and Roberts (2008) to link the Dealscan loan facilities to Compustat firms.[11] Loan-level data is used to study whether loans from manufacturing firms exposed to the trade shock have different characteristics from loans taken by less affected firms after 2001. I focus on facilities that have non-missing all-in-drawn loan spread, facility amount, and maturity. After filtering, the final loan-level sample consists of 10,306 loan facilities by 2,301 Compustat firms from 1995 to 2005. Loan-level summary statistics are provided in panel B of Table 1.2. The average loan facility amount in my sample is $234.1 million and the standard deviation is $552.3 million. The facilities have an average maturity of 44.2 months and the standard deviation is 24.4 months. The all-in-drawn spread of the facility has a mean of 205.3 basis points, with a standard deviation of 135.1 basis points. Note that only around 60% of the facilities have all-in-undrawn spread data, which relies on the facility being a revolver/credit line. We find that almost all facilities are senior in payment, which reflects the seniority of bank debt compared to other sources of debt. 80% of the facilities are secured by firms' assets. As for loan types, 30% of the facilities are term loans and among them, 2/3 are term loans from banks (Term loan A). Revolvers with maturity longer than 1 year account for 52% of the facilities while 364-day facility captures 12% of total facilities. 65% of the loan facilities have primary purposes of "Corporate Purposes", "Debt repayment", and "Working capital". Loans for takeover and LBO purposes account for 13% and 3% of total facilities, respectively. 14% of the facilities have a single lender while 85% of the facilities have multiple lenders.

[11] http://finance.wharton.upenn.edu/ mrrobert/styled-9/styled-12/index.html. I thank Michael Roberts for making the link publicly available.

1.2.3 Bank holding company level data on commercial and household lending

To examine how banks reallocate loans when facing increasing import penetration from China, I utilize both the Dealscan data and FR Y-9C reports on U.S. bank holding companies (BHC) from the Federal Reserve Bank of Chicago. FR Y-9C report contains balance sheet data, income statements, and other financial data on a consolidated basis for domestic BHCs. The unit of observation is the consolidated top-tier domestic bank holding company. For the matching between Dealscan lenders and ultimate bank holding companies, I use the matching table from Chakraborty, Goldstein, and MacKinlay (2018). The linking table connects the most active lenders from DealScan with the identifiers (RSSD ID) of their respective bank holding companies (BHC) from the Federal Reserve. Many Dealscan lenders share the same parent bank. It is plausible that there could be substitutions or complements in loan making among the subsidiary banks owned by the same parent bank. Therefore, I conduct the analysis at the bank holding company level. After matching Dealscan, Compustat, and FR Y-9C reports, I get BHC-firm-year level data of 118 bank holding companies from 1995 to 2005. In the next step, I construct the BHC-level import penetration measure by taking the value-weighted average of firm-level import penetration, using loan amount as weights.

$$IP\_China\_IV_{b,t} = \sum_{i \in I(b)} \frac{LoanAmount_{b,i,t}}{\sum_{i \in I(b)} LoanAmount_{b,i,t}} IP\_China\_IV_{i,t}, \tag{1.4}$$

where $I(b)$ is the set of *manufacturing firms* that have actual loan contracts with bank b in year t. Therefore, $IP\_China_{b,t}$ measures the extent to which a bank holding company is linked to manufacturing firms exposed to the China trade shock through loan contracts, within the manufacturing sector.[12] Moreover, $IP\_China_{b,t}$ is set to 0 if there are new C&I loans issued but no manufacturing loans in year t, and set to NaN if there are no C&I loans issued in year t.

[12]It is worth mentioning that one can also construct the measure using loans to all industrial sectors, assuming the import penetration to non-manufacturing sector is zero. I don't use this approach since import penetration is well defined and comparable only within manufacturing sector. While other sectors may or may not face competition from China and other countries from outsourcing or offshoring, data on these aspects are not observed.

Summary statistics at the bank holding company level are reported in Table 1.3. In total, we get 952 bank-year observations for 118 unique bank holding companies from 1995 to 2005. Banks have an average of 62.9 billions of total assets, 33.9 billions of total loans, and 57.7 billions of total liabilities, suggesting that the sample consists of the largest bank holding companies in the U.S. Loans to total assets ratio has an average of 0.62, ranging from 0.12 at the 1st percentile to 0.81 at the 99th percentile, suggesting that bank holding companies in my sample are doing a range of activities other than loan making. As a result, we find that interest income to total income ratio varies from 0.31 to 0.94. Cash and balances at other depository institutions capture 5% of total assets on average and the average capital ratio is 9%. Banks could take deposits and issue short-term and long-term debt from the capital market, and we find deposits account for 77% of total liabilities on average. Among the loans that banks make, 25% are C&I loans, 50% are real estate loans, and 14% are consumer loans. The rest of the loans consists of agricultural loans and loans made to depository and non-depository financial institutions. Residential real estate loans, secured by 1-4 family properties and multifamily properties, account for 68% of total real estate loans and 34% of total loans on average. During my sample period, the average asset growth is 12%. C&I loans grow at 12% on average and real estate loans grow on average at a slightly high rate of 13%. Among 952 bank-years in the sample, new C&I loans are issued in 685 bank-years, of which I can construct the import penetration measure. Instrumented Chinese import penetration at the bank holding company level has an average of 0.03, with a standard deviation of 0.04.

1.3 Empirical strategy

In this section, I describe the empirical strategy in detail. I first show that there are significant changes after 2001 in the manufacturing industries most affected by China's trade liberalization. These changes suggest that China's trade liberalization serves as a shock to the US manufacturing sector and makes the landscape different from the 1990s. The evidence also justifies the difference-in-differences approach used in this paper, which is covered in the second subsection.

1.3.1 Structural changes in the US manufacturing sector after 2001

Before presenting the empirical strategy, it is necessary to show that there are significant changes in the US manufacturing sector after China's entry into the WTO. I sort manufacturing industries according to their instrumented Chinese import penetration during 1991-2000 (see Equation (1.3)). Then I plot in Figure 1-4 the nominal and real industry absorption and domestic shipments of the 5 industries that have the highest Chinese import penetration and the rest of manufacturing industries.[13] To disentangle trade from technology, I exclude Computer and electronic product manufacturing (NAICS code 334) when plotting the figure. Since it experienced the most rapid growth in technology and real value-added (Baily and Bosworth, 2014) as well as high Chinese import penetration. Both the industry absorption and the domestic shipments of the top-5 industries have a slower growth after 2001. In fact, the average growth of real domestic shipments of the top-5 industries during 2001-2007 is negative. Importantly, the changes in industry absorption and domestic shipments are permanent and not driven by the recession during 2000-2001. Industry absorption experienced a smaller decline in growth after 2001 since it was partially offset by the increase in growth in imports, especially from China. One caveat is that I use the deflator for domestic shipments to calculate real industry absorption since the NBER-CES database doesn't contain data on the deflator for imports or the deflator for exports. It is plausible that prices differ among domestic products, imported goods, and exported goods.

I also show the decline in industry absorption and domestic shipments after 2001 using cross-section regressions, shown in Table 1.4. During 1991-2000, industries with high Chinese import penetration have lower growth of domestic shipments than industries with low Chinese import penetration. The coefficient of Chinese import penetration is significant at the 5% (10%) level for the growth of nominal (real) shipments. After 2001, we see a much stronger negative association between Chinese import penetration and the growth of domestic shipments. The coefficient is significant at the 1% level. Chinese import penetration is not related to the growth rate of nominal and real industry absorption during 1991-2000. However, it is negatively related to the growth of nominal industry absorption after 2001 at the 5% level. In all specifications, I control for the

[13] Industries are measured at the 3-digit NAICS level. There are in total 21 manufacturing industries at the 3-digit NAICS level.

removal of tariff rate uncertainty by including the NTR gap (Pierce and Schott, 2016).

Although US imports from China have been growing since the early 1990s, domestic shipments start to decline only after China's trade liberalization, as shown in Figure 1-4. The decline in domestic shipments after 2001 is so huge that it can hardly be attributed to pure Chinese import penetration alone. It is plausible that US firms in the most affected industries significantly increase offshoring and outsourcing in China, as the entry into the WTO significantly removes the barriers in FDI in China (Brandt, Van Biesebroeck, Wang, and Zhang, 2017). These patterns are also consistent with the decline in domestic manufacturing employment after 2001 (Among others, see Autor, Dorn, and Hanson, 2013; Acemoglu, Autor, Dorn, Hanson, and Price, 2016).

1.3.2 Identification Strategy

Having shown that the dynamics of the manufacturing sector change after China's entry into the WTO in 2001, I use the difference-in-differences approach to examine the impact of China's trade liberalization on manufacturing firms' financial decisions and bank loan allocation in the U.S. Specifically, I compare firms (banks) with high exposure to China's trade liberalization and firms (banks) with low exposure to China's trade liberalization (first difference), before and after 2001 (second difference). The exposure to China's trade liberalization is the average growth at the industry level in Chinese imports from 1995 to 2000, denoted as $IP\_China\_IV_{j,before}$[14]

$$IP\_China\_IV_{j,before} = \frac{1}{6}\sum_{t=1995}^{2000} IP\_China\_IV_{j,t} \tag{1.5}$$

Imports from China to 8 other high-income countries are used to capture the exogenous variation due to China's productivity growth and comparative advantage. The key identification assumption is that China's trade liberalization is more relevant for industries in which China has a comparative advantage and high productivity growth. These industries are the ones whose imports from China have already grown before 2000 and therefore have a high value of $IP\_China\_IV_{j,before}$.

[14]All the results are robust if the exposure to China's trade liberalization is measured in other ways, e.g., the average Chinese import penetration during 1991-2000, or Chinese import penetration at any particular year during 1995-2000.

With this identification strategy in mind, I estimate the following difference-in-differences (DID) regression at the firm level or the bank level

$$Y_{i,t} = \beta Chinashock_t * IP\_China\_IV_{i,before} + Controls_{i,t-1} + \alpha_t + \alpha_i + \varepsilon_{i,t}, \tag{1.6}$$

where $Y_{i,t}$ is an outcome variable of interest at the firm level or the bank level. The first term on the right-hand side is the DID term of interest. $Chinashock_t$ is equal to 0 before 2001 and equal to 1 after 2001. $IP\_China\_IV_{i,before}$ measures the exposure to China's trade liberalization. A firm's exposure is measured using the average Chinese import penetration of the 3-digit NAICS industry to which the firm belongs.[15] A bank's exposure to the China trade shock is the value-weighted Chinese import penetration of the firms to which the bank lends during 1995-2000 (see equation (1.4)). Control variables include firm-level or bank-level lagged characteristics that could be correlated with the outcome variable $Y_{i,t}$. Moreover, in firm-level regressions, industry-level control variables sourcing from the NBER-CES database are also included since a firm's industry could be uniquely identified. α_t denotes year fixed effects, which absorb the common time trend in the data, such as the recession during 2000-2001. α_i denotes firm (bank) fixed effects, which absorb the time-invariant determinants of the outcome variable.

1.4 China's trade liberalization and US manufacturing firms' capital structure

1.4.1 Changes in US manufacturing firms' capital structure

I first estimate equation (1.6) using firm leverage as the dependent variable. Table 1.5 reports the results. In column 1, I use US level import penetration from China over the period 1995-2000 as the exposure to the China trade shock. Firm-level controls, industry-level controls, firm fixed ef-

[15] I use historical NAICS code to identify a firm's industry. Most Compustat firms are large firms that operate in multiple industry groups. Measuring import penetration at the 3-digit NAICS level captures the overall import penetration from multiple industry groups and allows me to gauge both direct effects and indirect effects through input-output linkages. Moreover, firms may change their product mix within a broad subsector.

fects, and year fixed effects are included in the regression. We find that the coefficient of the DID term is negative and significant at the 1% level, suggesting Chinese import penetration negatively impacts firm book leverage after 2001. To address the potential endogenous import penetration in the U.S., in columns 2 and 3 I use the average instrumented Chinese import penetration during 1995-2000 as the exposure to the China trade shock. In column 2, I only control for firm-level characteristics, while in column 3 industry controls are added. The coefficient of the DID term is negative and significant at the 5% level. Results in columns 1-3 confirm that China's import penetration has a negative impact on book leverage, and the effect is causal. The point estimate in column 3 implies that a one-standard-deviation increase in $IP\_China\_IV_{j,before}$ would lead to a decrease of 1.4% in book leverage (0.029*0.48), which is 7% (0.014/0.20) of the mean book leverage and 7% (0.014/0.20) of the standard deviation of book leverage in the sample period.[16] For firms in the top quartile of Chinese import penetration, the average (median) book leverage has decreased from 24.2% (20.0%) during 1995-2000 to 19.1% (12.8%) during 2001-2005. While firms in the bottom quartile of Chinese import penetration have a mean (median) book leverage of 23.4% (19.0%) during 1995-2000 and 23.2% (17.0%) during 2001-2005.

In columns 4-6, I use market leverage as the dependent variable. We find the negative effect on market leverage is larger. A one-standard-deviation increase in $IP\_China\_IV_{j,before}$ would lead to a decrease of 2.2% in market leverage (0.029*0.76), which is 11.6% (0.022/0.19) of the mean market leverage and 10% (0.022/0.22) of the standard deviation of market leverage in the sample period. Consistent with prior studies on firms' capital structure, I find that firm size and tangibility are positively correlated with firm leverage and that profitability and Tobin's q is negatively correlated with firm leverage. Since Compustat firms are large and can operate in different industries, I use Compustat Segment data to calculate firms' market concentration and control for it in the regression. I find that more concentrated firms are associated with lower financial leverage. Moreover, MacKay and Phillips (2005) find that a firm's financial leverage depends on its natural hedge, which can be proxied by the proximity to the median industry capital-labor ratio. Therefore, I also control for the capital-labor ratio and find that firm's capital-

[16] I take the cross-sectional standard deviation of $IP\_China\_IV_{j,before}$ to calculate the economic significance. Using US level Chinese import penetration (column 1) yields a slightly larger economic magnitude.

labor ratio is positively correlated with financial leverage.

To show that the dynamic effect of China's trade liberalization on industry leverage, I aggregate firm-level data to get industry-level book leverage and run the following dynamic difference-in-differences regression

$$Bookleverage_{j,t} = \sum_{\tau \in T \setminus 2000} \beta_\tau \cdot 1_\tau \cdot IP\_China\_IV_{j,before} + \sum_{\tau \in T \setminus 2000} \gamma_\tau \cdot 1_\tau \cdot NTRgap_{j,1999} + Control_{j,t-1} + \alpha_j + \alpha_t + \varepsilon_{j,t} \quad (1.7)$$

where j denotes 3-digit level NAICS industry and t denotes year; α_j and α_t are industry and year fixed effects. $T = \{1991, \ldots, 2006\}$, and the year 2000 is used as the benchmark year and is excluded from the regression. To control for the effects of tariff rate uncertainty, as documented in Pierce and Schott (2016), I include the interaction terms of year dummies and NTR gap in the year 1999. Moreover, lagged industry characteristics, such as capital to value added, production workers to value added, logarithm of industry absorption, tariff and shipping cost, are included as control variables.

The coefficients β_τ are plotted in Figure 1-5. We find that Chinese import penetration is not associated with either a higher or lower leverage ratio before 2000. After 2001, the coefficients of Chinese import penetration are negative and significant. The results suggest that Chinese import penetration negatively affects leverage only after China's trade liberalization. I don't draw the coefficients on NTR gaps as they are not significantly different from zero.

Since large public manufacturing firms borrow from a variety of sources and at different maturities, it is important to understand which part of debt contributes more to the decrease in corporate leverage. I decompose firm leverage by debt maturity to understand whether long-term debt or short-term debt has a larger response to the trade shock. Table 1.6 reports the results. In columns 1 and 2, I use debt within 1 year divided by total assets and debt more than 1 year divided by total assets as the dependent variable, respectively. I find a significant effect of Chinese import penetration on debt within 1 year at the 1% level. While the effect on debt that matures in more than 1 year is not significant. Similarly, I examine debt within and more than 3 (5) years in columns 3-4 (5-6). Again, the effect of Chinese import penetration on short-term debt is significant at the 1% level while there is no impact on long-term debt. Comparing the coefficients in columns 1-6, I find that Chinese import penetration mainly affects debt within 3 years. The results that short-term leverage responds to the trade shock is consistent with the idea that short-term leverage can be adjusted more easily than long-term debt. Moreover, since bank loans have on average shorter maturity than corporate bonds, the results suggest that firms decrease mainly short-term bank debt rather than long-term corporate bonds. One caveat is that firms with high credit ratings frequently use commercial papers as a source of short-term debt.[17] I estimate the same equation on firms with low credit ratings or no credit ratings.[18] I find that the point estimates of DID term are -0.32, -0.50, and -0.45 and significant at the 1% level for debt within 1, 3, and 5 years, respectively. Splitting leverage by debt maturity also reveals important firm-level and industry-level determinants of financial leverage. For example, we find that tangibility, profitability, and firm diversification are correlated with short-term leverage rather than long-term leverage.

The decrease in exposed manufacturing firms' financial leverage is an equilibrium outcome that could reflect both a supply-side contraction of funds or a lower credit demand. Specifically, to study the transmission of the China trade shock to banks, we need to understand whether banks face a lower credit demand from exposed manufacturing firms or banks decrease the credit supply to these firms. I split firms according to their bond market access to examine the issue. The idea is that firms with bond market access could substitute bank loans with bonds when there is a negative bank loan supply shock. Leary (2009) finds that firms without bond market access have a larger increase (decrease) in leverage ratios when there is an expansion (contraction) in the availability of bank loans. Moreover, I compare the impact of China's trade liberalization on the leverage ratios of financially constrained and unconstrained firms. A supply-side contraction would negatively affect financially constrained firms more than unconstrained firms. Table 1.7 reports the results. In columns 1 and 2, I split firms by their credit ratings. The negative impact

[17]For example, see Colla, Ippolito, and Li (2013a), the usage of commercial papers increases with credit ratings. Firms with a credit rating of BBB, A, AA, AAA have around 2%, 8%, 17%, and 19% of commercial paper in total debt.

[18]Low credit rating is defined as rating equal to or lower than BBB+.

of Chinese import penetration on leverage is more pronounced for firms with credit ratings, suggesting that the effect is not due to negative bank loan supply shocks. In columns 3-8, I use firm size, firm age, and the size-age index (SA index) from Hadlock and Pierce (2010) as measures of financial constraints and split the firms in the sample.[19] Again, the decrease in leverage ratios is more pronounced in large and old firms, which are less likely to be financially constrained. These results indicate that the reduction in leverage is driven by lower demand for debt, not a contraction of loans on the supply side.

Other firm characteristics How do other firm characteristics react to China's trade liberalization? Table 1.8 reports the results of the baseline DID regressions. I find that the effect of China's trade liberalization on cash holdings is positive and significant at the 1% level. The results are consistent with the decrease in short-term leverage and suggest that firms rely less on external debt financing for liquidity management. In column 2, I investigate firms' asset growth. I find that manufacturing firms exposed to China's trade liberalization is not shrinking but expanding after 2001. Although exposed industries have lower domestic shipments and industry absorption, firms in these industries are instead growing faster. The results suggest that China's trade liberalization changes the way US firms trade with China. Before China's trade liberalization, Chinese products penetrate the US market and compete with US products. While after China's entry into the WTO, massive US firms start to shift their manufacturing process to China and import the goods made in China back to the U.S.

I further examine capital expenditure, Tobin's q, and profitability in columns 3-5. I do not find these characteristics are significantly affected by China's trade liberalization. It is worth to note that both Xu (2012) and Hombert and Matray (2018) find that import competition negatively affects firms' profitability. In the next subsection, I examine firms' profitability in detail and find that the negative effect is concentrated during the early 1990s. The idea that higher imports hurt profitability relies on the assumption that foreign products compete with domestic products. Growth in Chinese imports could not properly measure real "penetration" or "competition" once

[19] SA index is $-0.737 * size + 0.043 * size^2 - 0.04 * age$, see Hadlock and Pierce (2010) for the details of the construction of the index. A larger SA index means that the firm is more financially constrained.

US firms start to make products in China and import them back to the U.S. My results are consistent with Bloom, Handley, Kurman, and Luck (2019), who find that large publicly traded US firms do not seem to have been negatively impacted by the rise in Chinese imports.

Robustness I conduct a set of robustness tests to check the impact of Chinese import penetration on firm leverage. First, to allow for the changes in financial leverage reacting to these industry characteristics in the post-2001 period, I add interaction terms of the China shock dummy with other industry characteristics. These industry characteristics include tariff rate, shipping cost, tariff rate uncertainty, and total import penetration. Table A.3 reports the results. We find that Chinese import penetration remains significant in explaining the dynamics of leverage after 2001. Second, I conduct the baseline firm leverage regression on different sub-samples. Specifically, I estimate the DID regression for 1) firms that have more than 8 years of data during 1995-2005; 2) firms that enter the Compustat database before 1995; 3) firms that exit the Compustat database after 2005. The idea is to tease out the compositional effects that entry and exit firms bring. The results are shown in Table A.4. We find that the results are robust to different subsamples. Third, some firms in the sample, especially firms that are listed in NASDAQ and belong to the computer manufacturing industry, have gone through the internet bubble boom and bust around 2000. I construct a dummy variable that is equal to 1 if a firm has experienced a boom and bust in its stock price and interact the bubble dummy with $Chinashock_t$. My main result on Chinese import penetration is not affected by adding the new interaction term.

1.4.2 The economic mechanism of short-term debt reduction

I rely on theories on the determinants of corporate debt maturity structure to explore the economic mechanism of reduction in short-term leverage. Stohs and Mauer (1996) argue that firms' debt maturity structure should match its asset maturity structure. Firms use short-term debt to manage short-term assets, especially working capital. Therefore, a decrease in working capital could result in a reduction in short-term leverage. Indeed I find that there is also a structural break in industry inventories around 2001. Figure 1-6 plots nominal and real inventory for the top-5 industries in terms of Chinese import penetration and the rest industries. Again, computer and electronic product manufacturing (NAICS code 334) is excluded from the analysis. We find that the top-5 industries' inventory dramatically drops in the year 2002 and stays at a low level thereafter. The decline in inventory after 2001 is due to the decline in domestic shipments shown in Figure 1-4, but appears more abrupt.

Using regression analysis, I confirm the decreasing pattern in industry inventory. I run the dynamic difference-in-difference regression as in equation (1.7), using the inventory to industry absorption ratio as the dependent variable. The coefficients β_τ are plotted in Figure 1-7. We find that before 2000 the coefficients are not significantly different from 0. While after 2000, the coefficients are negative and significant. In other words, industries with high Chinese import penetration decrease their inventory ratio only after China's trade liberalization. Moreover, these coefficients are highly similar to those for the leverage regressions shown in Figure 1-5, suggesting that the decrease in leverage could be due to the decline in inventory.

Indeed, at the firm-level, I find that a firm's short-term leverage is positively associated with its inventory ratio both in the cross-section and dynamically at the 1% level. The relationship is robust to different measures of inventory ratio, such as inventory to total assets, inventory to total sales, and days inventory outstanding (DIO).[20] I examine the impact of China's trade liberalization on firm inventory. The results are shown in Table 1.9. In columns 1-3, I run the second-stage of the IV regressions for different periods, using lagged instrumented Chinese import penetration as the explanatory variable. Using various measures of firm inventory, we find that firm inventory is negatively correlated with Chinese imports after 2001 but not before. Difference-in-differences analysis in column 4 shows that firms with high Chinese import penetration have a larger reduction in their inventory ratio. These results suggest that firms that are exposed to China's trade liberalization experience a lower inventory after 2001. As a result, they require lower short-term debt to manage inventory.

Note that Xu (2012) argues that import competition has a negative effect on profitability and firms delever according to the trade-off theory of capital structure. In Panel A of Table

[20] Days inventory outstanding (DIO) is 365 times average inventory to costs of good. It measures the time a firm takes to sell its inventory.

1.10, I show the results of the effects of Chinese import penetration on profitability. I find that the negative effect of Chinese import penetration on profitability is concentrated during 1991-2000 when Chinese import penetration first started to grow in the U.S. While after 2001, firms' profitability is not negatively associated with even faster growth in Chinese imports.[21] Another important aspect related to the trade-off theory of capital structure is the tax rate. Since large multinationals could operate in the U.S. and foreign countries, I examine the effective domestic and foreign tax rates.[22] The results are shown in Panel B and C. The results in column 4 show that there are no differences in tax rates before and after China's entry into the WTO. Therefore, neither profitability nor tax rate could explain the decrease in leverage after 2001. Moreover, the trade-off theory could not explain why the decrease in leverage is in short-term debt but not long-term debt.

1.4.3 China's trade liberalization and the syndicated loan market

As China's trade liberalization has a negative effect on firms' short-term leverage, it may also affect the corporate loan market. In this section, I use loan-level data from Dealscan to examine whether the syndicated loan market is affected by China's trade liberalization. As bank loans on average have a lower maturity than corporate bonds, I expect that there is a decline in new loans taken by the exposed manufacturing firms. Moreover, since the decline in short-term debt is driven by the demand side rather than the supply side, a lower spread of loans taken by the exposed manufacturing firms after 2001 is also expected.

I conduct the baseline difference-in-differences estimation of the likelihood and the amount of new loans. The results are shown in Table 1.11. The sample consists of firms that take at least a new loan during 1995-2005 and loans are aggregated to firm-year level.[23] In panel A, I use

[21] The reason that firms' profitability does not suffer from Chinese import penetration after 2001 could be due to offshoring in China and utilizing Chinese cheap labor, which is consistent with the decline of manufacturing labor after 2001. If US firms start to make products in China and import them back to the U.S., then growth in imports couldn't properly measure import competition.

[22] Compustat contains data on domestic and foreign pre-tax income, as well as federal and foreign income taxes. The federal tax rate is the ratio of federal income taxes (TXFED) to domestic pre-tax income (PIDOM). The foreign tax rate is the ratio of foreign income taxes (TXFO) to foreign pre-tax income (PIFO). I drop observations with tax rates smaller than 0 and larger than 0.7.

[23] A firm could take multiple loan facilities in the same year.

dummy variables regarding new loans as dependent variables to examine the likelihood of new loans. For example, the dependent variable in column 1 of panel A is a dummy variable that is equal to 1 if there is any kind of new loan taken by firm i in year t. We find that the effect is not statistically significant. In columns 2-5, I examine the likelihood of short-term facilities, long-term facilities, credit lines, and term loans respectively. Consistent with the decrease in short-term leverage, I find that the likelihood of new short-term loan facilities is significantly lower for exposed manufacturing firms. While the likelihood of new long-term facilities is not affected. Firms with high Chinese import penetration take both fewer new credit lines and term loans (significant at 10% level). In panel B of Table 1.11, I turn to the intensive margin by using the loan amount scaled by lagged total assets as the dependent variable. I find no effects on the amount of new loans. Note that there are two shortcomings in using the Dealscan database. First, one only observes new loans but not the repayment of existing loans. Second, the loan amount for a credit line/revolver is the maximal amount of funds that a firm can tap and the actual usage is not observed. Nevertheless, the results show that firms affected by China's trade liberalization are less likely to take new short-term credit lines and term loans from banks.

I go on to examine the effect of China's trade liberalization on loan prices. The dynamics of loan prices can give further insights on whether the decrease in firm leverage is coming from the demand side or the supply side. Lower demand would imply that the new loans taken by affected manufacturing firms are cheaper after 2001. On the other hand, loan prices will respond positively to Chinese import penetration if there is a contraction of loans to exposed manufacturing firms. I estimate the baseline difference-in-differences regression on facility-level loan spreads. The sample is facilities with full information of facility amount, maturity, and all-in-drawn spread during 1995-2005. Other than firm-level control variables that are directly or indirectly associated with credit risk, contractual terms of the facility such as facility type, main purpose, seniority, security, and sole lender dummy are also included in the regression.

Table 1.12 reports the results of loan spreads. In all specifications, I include firm-level and loan-level control variables, as well as year and industry fixed effects. Column 1 reports the result of all-in-drawn spreads for all loan types. We find that Chinese import penetration negatively affects all-in-drawn spreads and the coefficient is significant at the 1% level. I split loans by types and examine term loans and credit lines in columns 2 and 3, respectively.[24] I find that the negative effect on loan spreads is driven by credit lines rather than term loans. Economically, a one-standard-deviation in Chinese import penetration would lead to a difference-in-differences of 10.8 bps (0.029*371.53) in the all-in-drawn spread of credit lines, which translates to 6.2% of the mean and 8.7% of the standard deviation of the all-in-drawn spread of credit lines in my sample.[25] As credit lines serve as a source of liquidity and a substitute for cash (Sufi, 2009; Acharya, Almeida, and Campello, 2013), the results suggest that exposed manufacturing firms rely less on banks for liquidity. I further split credit lines by their maturity in columns 4 and 5. Consistent with firm-level results, I find that the spread of short-term credit lines (maturity ≤ 3 years) is more affected than that of long-term credit lines (maturity > 3 years).

Columns 6-8 show the results of the all-in-undrawn spread of credit lines. We find that all-in-undrawn spreads are also negatively affected by the China trade shock and that the effect is driven by short-term credit lines. Note that the sign and significance of firm-level control variables are in line with results in related studies (Chava, Livdan, and Purnanandam, 2009). We find that firm size, tangibility, profitability, Tobin's q, and z-score are negatively correlated with loan spread, and that leverage is positively correlated with loan spread. As for loan characteristics, we find that facilities have a lower spread if they are credit lines rather than term loans and that facilities that are used for LBO have a significantly higher spread. Moreover, sole-lender facilities have a higher price than syndicated loans on average.

The negative impact of China's trade liberalization on loan spreads of short-term credit lines suggests that firms have a lower demand for external funds from banks for liquidity. The results are consistent with the firm-level reduction of inventory and short-term leverage. Moreover, the results are consistent with the lower likelihood of new short-term loans after 2001. To sum, I show that the syndicated loan market faces a lower demand for short-term loans from exposed manufacturing firms. Therefore, banks can also be affected by China's trade liberalization.

[24] I define a facility as a credit line/revolver if its loan type in Dealscan is "364-day facility", "Revolver/Line shorter than 1 year", "Revolver/Line longer than 1 year", or "Revolver/Term Loan". The average maturity of a credit line (term loan) is 39 (60) months in my sample.

[25] The average all-in-drawn spread of credit lines from 1995 to 2005 is 172.9 bps and the standard deviation is 123.9 bps.

1.5 China's trade liberalization and the crowding-in of mortgage loans

I show that exposed manufacturing firms to the China trade shock have lower short-term leverage after 2001. Moreover, the exposed firms also take fewer short-term loans and have lower loan spreads after 2001. In this section, I go on to ask whether financial intermediaries who issue loans to manufacturing firms are affected by the China trade shock. The idea is that banks do not lend to all firms in the economy and that there is a matching of firms and banks in the corporate loan market. For example, Schwert (2018) finds that bank-dependent firms borrow from well-capitalized banks and the endogenous matching mitigates the effects of bank shock on the real economy. In a similar vein, certain banks may lend more to some manufacturing industries. If these industries are exposed to the China trade shock after 2001, then the banks lending to them face lower demand for corporate loans, as I show in the previous section. In other words, banks lending to highly exposed (to the China trade shock) manufacturing industries are affected as well. For affected banks, the overall lower demand for manufacturing loans will result in slower growth of manufacturing loans and a smaller share of manufacturing loans in their commercial and industrial loan portfolio, driven mainly by the exposed manufacturing industries. The affected banks' balance sheet will also shrink due to the lower demand. These effects are plausible only if there are no spillover effects, that is, the affected banks don't increase or decrease credit to other non-manufacturing industries or the household sector. However, there could be spillover effects: banks could channel the extra funds freed from the exposed manufacturing industries to other industries, or the mortgage loan market and the consumer loan market of the household sector. In this section, I study how banks are affected by the China trade shock and the implications of credit reallocation.

The empirical strategy is still the generalized difference-in-differences approach. I examine differences in bank characteristics and bank lending between affected and unaffected banks at the bank holding company level before and after 2001. The model specification is as follows,

$$Y_{b,t} = c + \alpha Chinashock_t * IP\_China\_IV_{b,before} + X'_{b,t-1}\beta + Year_t + Bank_b + \varepsilon_{b,t}, \quad (1.8)$$

where $Y_{b,t}$ is the variable of interest at the bank holding company level. $IP\_China\_IV_{b,before}$ is the instrumented average bank-level Chinese import penetration over 1995-2000 period, constructed from equation (1.4). I control for time-varying bank-level characteristics such as logarithm of total assets, capital ratio, the proportion of deposits in total liabilities, the ratio of total loans to total assets, the liquidity ratio, the ratio of C&I loans, real estate loans, personal loans to total loans, and interest income to total assets ratio. These bank-level control variables are lagged by 1 year. Bank fixed effects and year fixed effects are included in the regression to control for time-invariant bank features and macroeconomic trends in bank lending.

First I examine whether the affected banks and unaffected banks are different in their asset growth, loan growth, capital ratio, profitability, non-performing loan ratio, and interest income to total income. Table 1.13 reports the results. We find that affected banks don't have a higher non-performing loan ratio or lower profitability, which indicates that banks are not having trouble from manufacturing loans they have before 2000. The results are also consistent with the firm-level results that exposed manufacturing firms' profitability doesn't go down. Moreover, other bank characteristics are not affected by the fraction of manufacturing loans in banks' loan portfolios. Then I go on to examine the effects of import penetration on credit allocation. For ease of interpretation, in the main analysis, I use the net issuance of different types of loans scaled by lagged total assets as the dependent variable. For example, the net issuance of C&I loans is defined as the dollar increase in C&I loans scaled by lagged total assets, $(CIloan_{b,t} - CIloan_{b,t-1})/Totalassets_{b,t-1}$. Table 1.14 reports the impact of Chinese import penetration on the net issuance of different types of loans. Since I am using net issuance of different types of loans as the dependent variable, it is important to control for total loan issuance, which is defined as the dollar increase in total loans scaled by lagged total assets. In column 1, the dependent variable is net C&I loan issuance. We find that for 1 dollar of total loan issuance, 22 cents are going into C&I loans on average. Moreover, we find that bank holding companies with higher Chinese import penetration have a lower issuance of C&I loans after 2001. The effect is significant at the 5% level. Economically, a one-standard-deviation increase in bank-level Chinese import penetration will lead to a decrease of 0.0059 (0.017*0.35) dollar in net C&I loan issuance out of 1 dollar of total assets, which translates to a decrease of 59 million dollars per year in net

C&I loan issuance for a bank holding company with 10 billion of total assets.[26] In columns 2-4, the results of the net issuance of real estate loans, residential real estate loans, and personal loans are reported. Chinese import penetration has a positive impact on the net issuance of mortgage loans. The point estimate for real estate loan issuance is similar in magnitude with that of C&I loans. Since real estate loans can be secured by farmland, nonfarm nonresidential properties, or family residential properties (1-4 people and multifamily), I subtract mortgage loans secured by farmland and nonfarm nonresidential properties from total mortgage loans, to get residential real estate loans.[27] We find a stronger impact of Chinese import penetration on residential mortgage loans in column 3. A one-standard-deviation increase in the bank-level Chinese import penetration leads to an increase of 73 million dollars per year in net residential mortgage loan issuance for a bank with 10 billion total assets. In column 4, we don't find a significant effect of Chinese import penetration on personal loans.

We see that the reallocation of loans is from the corporate sector to the household sector, rather than from the manufacturing sector to other industrial sectors. One potential reason is the difference in the elasticities of bank credit demand between corporations and households since firms have alternative sources of debt financing other than banks, such as the corporate bond market. Another reason is the macro-economy environment during the period. Internet-related companies suffer from the bust of the dot-com bubble in 2000. While financial deregulation throughout the 1990s allows banks to get additional sources of funds, which spurs the mortgage credit growth and house prices (Favara and Imbs, 2015). These aspects may induce banks to reallocate more loans to households. Overall, we find that banks with a large share of exposed manufacturing firms in their portfolio reallocate loans to the mortgage loan market after 2001, contributing to the dramatic increase in household debt.

Although I use instrumented import penetration from China to ensure the exogeneity, one might be concerned that bank-level import penetration is correlated with lending opportunities in the mortgage loan market. While fully capturing lending opportunities in the mortgage market is

[26] In my sample, the mean total assets is $63 billion and the median is $13 billion.

[27] Loans secured by real estate also includes construction, land development, and other land loans. However, the data on this is missing. Fortunately, construction and land development loans usually capture around 10% of real estate loans and will not significantly affect the results.

difficult, I use bank-level growth in mortgage loans as well as the fraction of mortgage loans to total loans during 1995-2000 as proxies for lending opportunities in the mortgage loan market. I include in the baseline regression interaction terms of the China shock dummy with these pre-shock bank characteristics. I also include interaction terms of the China shock dummy with other pre-shock bank characteristics, such as deposit growth, C&I loan growth, the fraction of C&I loans to total loans, loans to assets ratio, and securities to assets ratio. Table 1.15 reports the results. We find that the effect of Chinese import penetration remains significant at the 1% level for C&I loans and residential mortgage loans. The point estimates of Chinese import penetration become slightly smaller once I control for other interaction terms. Moreover, we find that there is a mean-reverting of banks' portfolio management. That is, banks with a high C&I (real estate) loan ratio before 2000 decrease net C&I (real estate) loan issuance after 2001. Furthermore, high real estate loan growth before 2000 is associated with higher C&I loan issuance and lower personal loan issuance after 2001.

As robustness checks, I use the yearly growth rate of different types of loans and the ratio of these loans to total loans as the dependent variables. The results are reported in Table A.5. In the regressions, lagged bank-level controls, interaction terms of the China shock with bank characteristics during 1995-2000, bank fixed effects, and year fixed effects are included. Columns 1-4 show the results of the yearly growth of different types of loans. In loan growth regressions, I also control for total loan growth rate. The results are consistent with the main findings. A one-standard-deviation increase in Chinese import penetration results in a 2.5% (0.017*1.50) decrease in the growth rate of C&I loans and a 3.8% (0.017*2.30) increase in the growth rate of residential mortgage loans. The economic magnitude is huge, considering the average 13.8% growth rate of residential mortgage loans over 1995-2005. Columns 5-8 show the results on the ratio of different types of loans to total loans. Banks with high Chinese import penetration have a lower fraction of C&I loans and a higher fraction of real estate loans after 2001.

Economic mechanism What are the economic mechanisms that drive the credit reallocation? Theory suggests that banks' financial constraints may play a role here. Financially unconstrained banks make lending decisions in isolation so that the shock to the manufacturing sector may not spill over to other non-manufacturing industrial sectors or the household sector. While financially constrained banks would over extrapolate the lending opportunities by contracting loans from sectors that have a low credit demand and lending more to the sectors which banks deem more profitable. To show the mechanism is at work, I split the sample by banks' capital ratio and bank size, which I use as proxies of financial constraints.[28] Banks with a higher capital ratio and larger banks are less financially constrained. Table 1.16 shows the results. In Panel A, I split banks by their capital ratio. Columns 1 and 2 show that the effect of Chinese import penetration on C&I loans is significant only in banks with a low capital ratio. For banks with a high capital ratio, the point estimate of Chinese import penetration is negative but not significant. For real estate loans, The results are similar. The significant positive effect exists in low-capital banks but not in high-capital banks. For residential mortgage loans, we also find a positive and significant effect for low-capital banks. In Panel B, banks are split according to their total assets. We find that the decrease in commercial lending and the increase in residential mortgage lending is significant in small banks but not large banks. If it is more difficult for small banks to expand firm-bank relationships or switch borrowers in their C&I lending business, a negative shock to the demand of the manufacturing industries would lead small banks to decrease their commercial lending. The results also suggest that small banks react by increasing credit supply to the household sector. These results show that financial constraints distort banks' lending decisions. Banks with abundant capital and larger banks do not reallocate loans from the corporate sector to the household sector.

The results indicate that banks which have relationships with manufacturing firms exposed to the China trade shock decrease their corporate lending and increase mortgage lending, especially for residential purposes. Therefore, after 2001, there is a reallocation from commercial and industrial loans to real estate loans, contributing to the surge in mortgage loans starting from 2001. Therefore, I document a "crowding-in" effect of the China trade shock on mortgage loans: the China trade shock decreases the loan demand of the exposed manufacturing industries, and

[28]Papers using capital ratio as a proxy for financial constraints include Chakraborty, Goldstein, and MacKinlay (2018), Martin, Moral-Benito, and Schmitz (2018), and Mayordomo and Rachedi (2019), among others.

banks react to the lower corporate loan demand by reallocating loans from the corporate sector to the household sector, increasing mortgage loan supplies. In other words, the China trade shock has contributed to the increase in mortgage loans after 2001 in an indirect way. Therefore, international trade could have an impact on credit markets and credit cycle by affecting the industry dynamics and how firms use credit. I document one potential reason behind the huge increase in the mortgage loan market during 2002-2005 and it is distinct from explanations based on low lending standards (Dell'Ariccia, Igan, and Laeven, 2012) and household demand (Barrot, Loualiche, Plosser, and Sauvagnat, 2018).

It is important to differentiate my results from other studies that examine trade shock and credit reallocation. Federico, Hassan, and Rappoport (2020) find that Italian banks that are exposed to the China trade shock reduced lending to both exposed manufacturing firms and other non-exposed firms. The mechanism is related to the reduction of the core capital of banks and the rise in non-performing loans. In my setting, this mechanism is less likely to be at work. If banks suffer from a rise in non-performing loans and a reduction of capital, they will reduce lending to both the corporate sector and the household sector. Indeed, I find that banks' profitability, non-performing loan ratio, and total lending are not affected by the trade shock, while there is a reallocation of credit from the corporate sector to the household sector after 2001. The reallocation of bank loans to the household sector is similar to the results in Mayordomo and Rachedi (2019), who find that Spanish banks reallocate credit away from manufacturing firms to local construction firms. However, they also find that banks' profitability is negatively affected by the manufacturing loan in their portfolio. I show that the reduction of exposed manufacturing firms' use of external debt financing is due to demand-side since the reduction of credit is associated with a decrease in loan spread. Banks that are affected by the lower demand channel funds to the household sector, contributing to the surge of mortgage loans at the beginning of the 2000s.

The crowding-in effect I document in this study has important implications on the credit market. Gorton and Ordonez (2019) document that the US economy has been in the credit boom over the period 1985-2010. The overall growing credit supply in the US economy could be due to global trade imbalances (Bernanke et al., 2005; Justiniano, Primiceri, and Tambalotti, 2014), the savings glut of the rich (Mian, Straub, and Sufi, 2020), deregulation of the banking system since the middle of 1990s (Favara and Imbs, 2015; Rice and Strahan, 2010), among the reasons. In an environment where the total credit supply is high, low demand in some sectors may spill over to other sectors. My results point out that the corporate credit market and household credit market are not isolated and that they can be linked through the financial intermediaries (Chakraborty, Goldstein, and MacKinlay, 2018).

1.6 Conclusion

This paper studies the effect of China's trade liberalization on manufacturing firms' financial leverage and bank loan allocation during 1995-2005. Defining the timing of the China shock to be 2001 when China entered the WTO and using DID regressions, I find that firms with a higher Chinese import penetration have a larger decrease in leverage after 2001. Moreover, the reduction in leverage is concentrated in short-term debt, and exposed firms increase their cash holdings. Financially unconstrained firms, characterized by having bond market access, being big and old, decrease leverage more than financially constrained firms. Examining the loan-level data, I find that firms with higher Chinese import penetration take fewer short-term loans from banks and have lower loan spreads of credit lines after 2001. The results suggest that the reduction in financial leverage is caused by a decrease in demand for short-term debt from banks rather than a contraction of loans to the exposed manufacturing firms.

I further examine the transmission of the trade shock to banks via firm-bank relationships. I identify affected banks as the banks lending more to exposed manufacturing firms before 2000. The affected banks do not show a decline in their asset growth or loan growth after 2001. Nor do they have a higher non-performing loan ratio or lower profitability. However, affected banks are affected by the lower demand from the exposed manufacturing industries. As a result, they decrease commercial lending and increase mortgage lending, especially for residential purposes. I find that the reallocation of loans are concentrated in banks with a low capital ratio and small banks, suggesting that financial constraints of banks distort their lending decisions. As banks channel funds to both the corporate sector and the household sector, shocks to one sector could have spillover effects on the other sector. My results show that a demand shock in the manufacturing sector crowds in mortgage loans during 2001-2005 in the U.S., which provides a novel explanation for the surge in the supply of household debt during that period.

Figures and tables

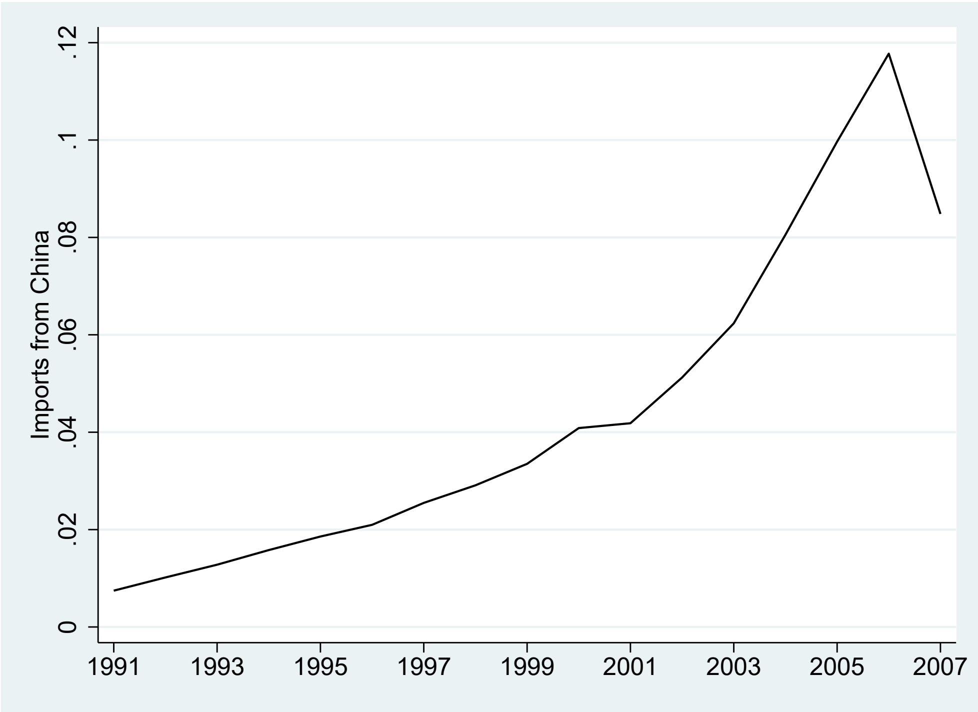


Figure 1-1: Imports from China in the U.S. over 1991-2007

The figure shows imports from China in the manufacturing sector in the US economy. Imports from China are scaled by total shipments plus total imports minus total exports in 1991.

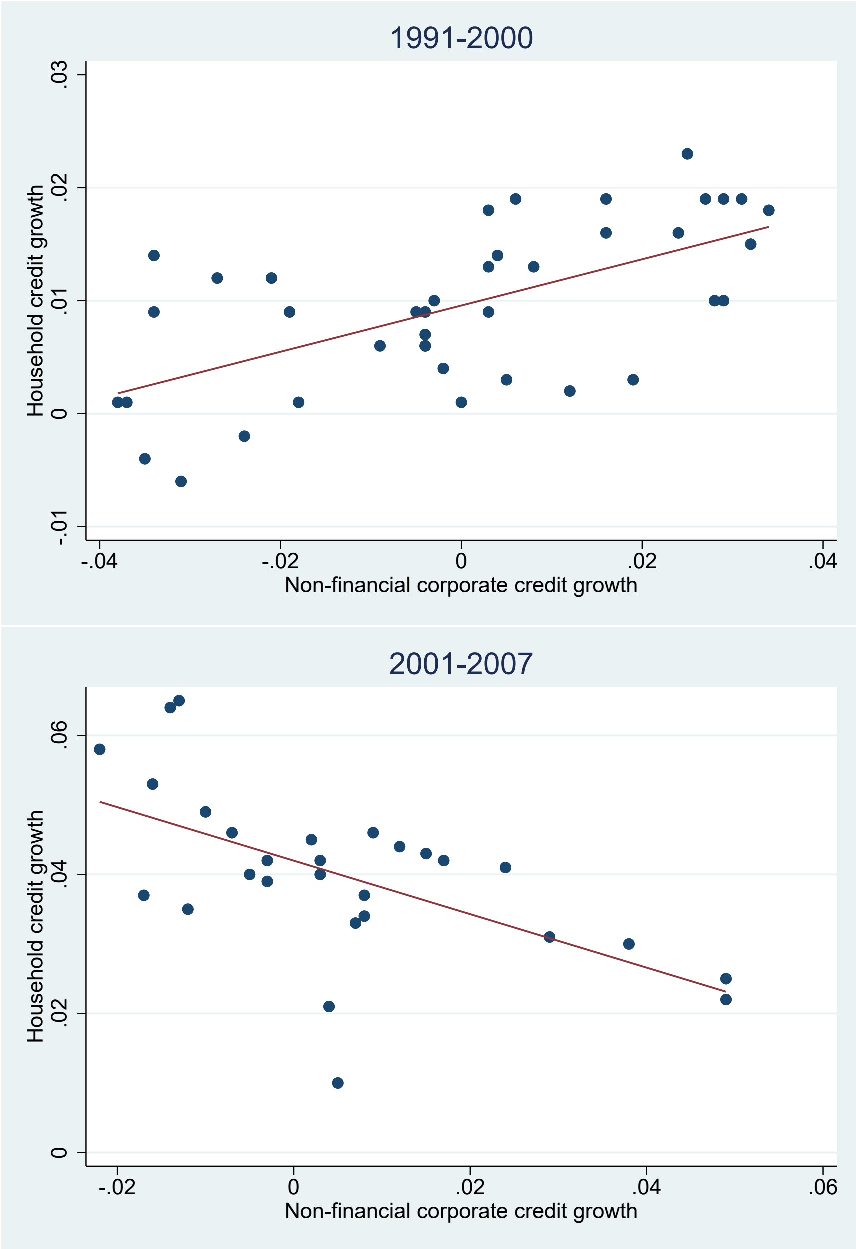


Figure 1-2: Credit growth of the household and non-financial corporate sector in the U.S.

The figure shows the scattered plot of household credit growth and non-financial corporate credit growth in the U.S. The data are from the Bank for International Settlements (BIS) and at the quarterly frequency. Credit growth at quarter t is defined as $\frac{Credit_t}{GDP_t} - \frac{Credit_{t-4}}{GDP_{t-4}}$. The upper and lower panel cover the period 1991q1-2000q4 and 2001q1-2007q4, respectively.

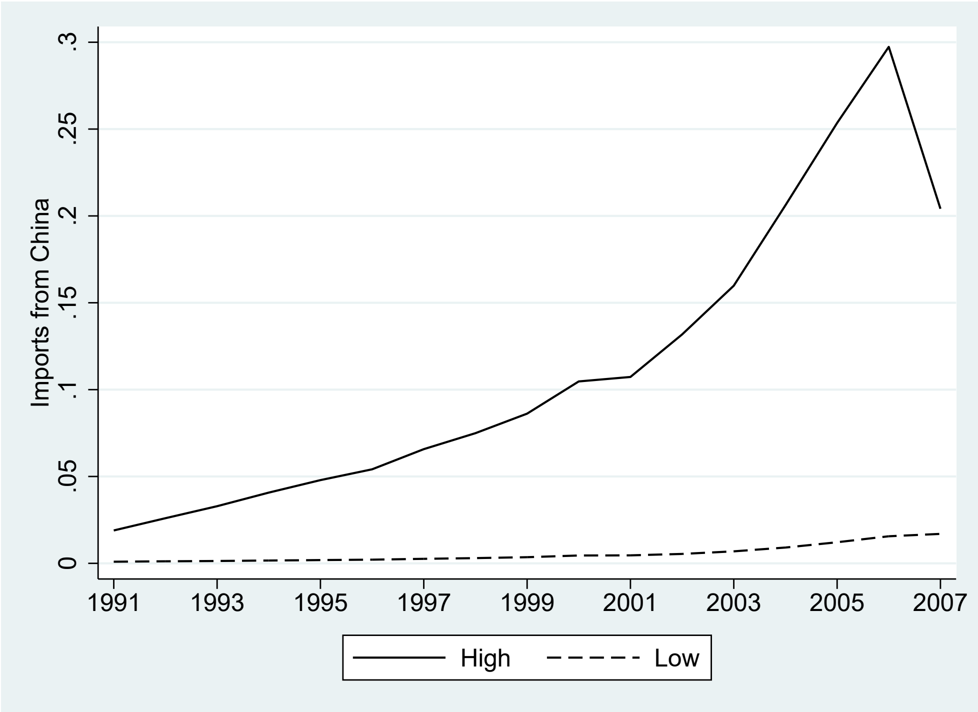


Figure 1-3: Imports from China in the U.S. over 1991-2007: high vs low

Industries are divided into above-median and below-median groups, based on their average import penetration from China. US imports from China are scaled by total shipments plus total imports minus total exports in 1991.

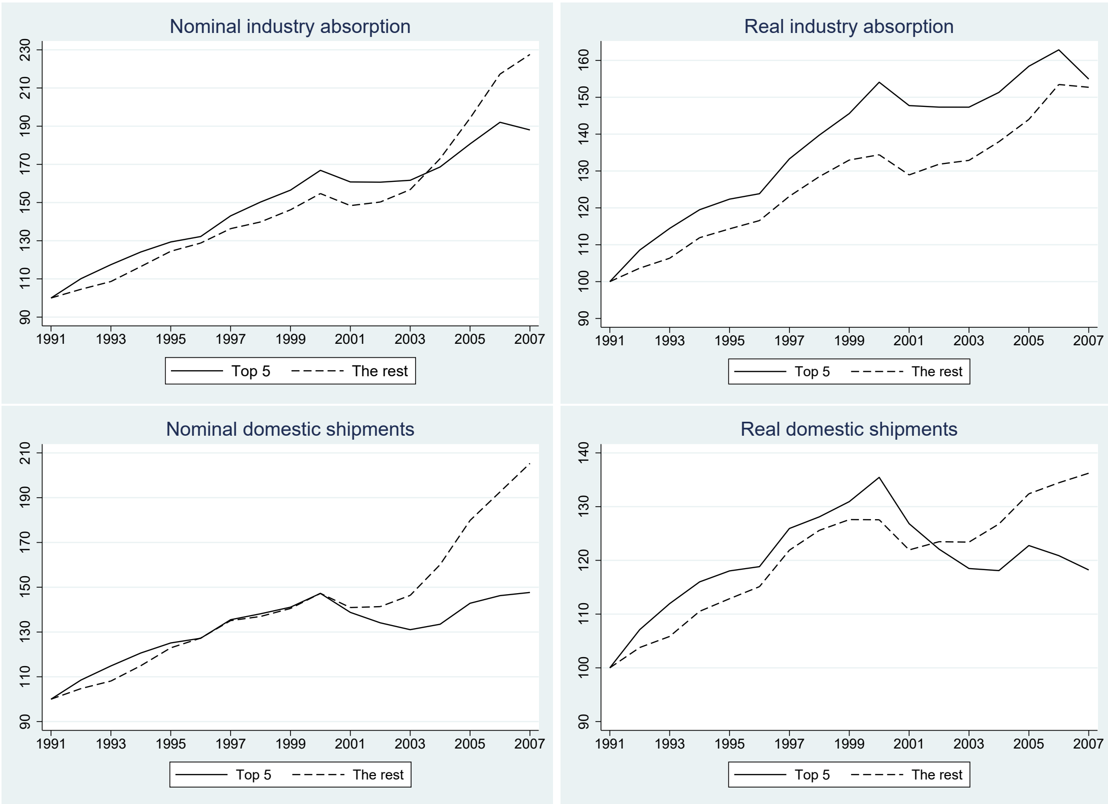


Figure 1-4: Industry absorption and domestic shipments in the U.S. over 1991-2007: Top-5 vs the rest

The figure plots the nominal and real industry absorption and domestic shipments in the U.S. during 1991-2007 for two groups: Top-5 industries (3-digit NAICS) in terms of instrumented Chinese import penetration before 2000 and the rest industries. The top-5 industries include Textile Product Mills (314), Apparel Manufacturing (315), Leather and Allied Product Manufacturing (316), Electrical Equipment, Appliance, and Component Manufacturing (335), and Miscellaneous Manufacturing (339). Industry absorption is domestic shipments plus total imports minus total exports. I use the deflator for shipments in the NBER-CES database to calculate the real value for industry absorption and domestic shipments. All time-series are rescaled to make the level in the year 1991 equal to 100.

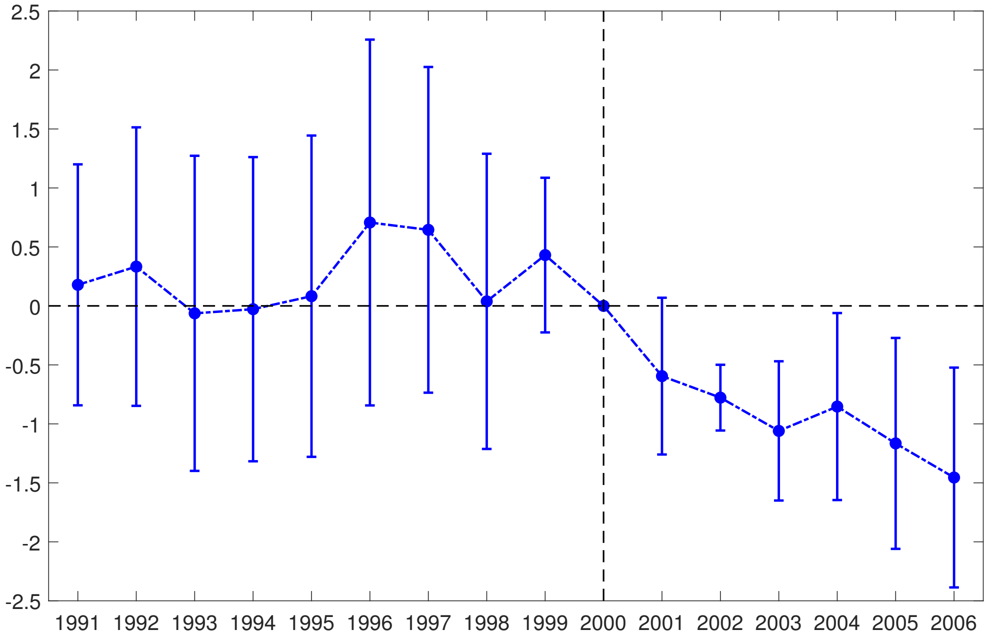


Figure 1-5: Effects of China's trade liberalization on industry book leverage

This figure plots the year-by-year coefficients along with the 95% confidence intervals for the IV regression of Chinese import penetration during 1995-2000 on the industry book leverage ratio. Firm-level data from Compustat are aggregated to get the industry book leverage. Industry fixed effects, year fixed effects, the interaction terms of year dummies and NTR gaps, and control variables are included in the regressions. Control variables include capital to value added, production workers to value added, TFP, production worker wage, non-production worker wage, tariff, shipping cost, and logarithm of industry absorption, all lagged by 1 year. Standard errors clustered by industry are used to calculate the confidence intervals.

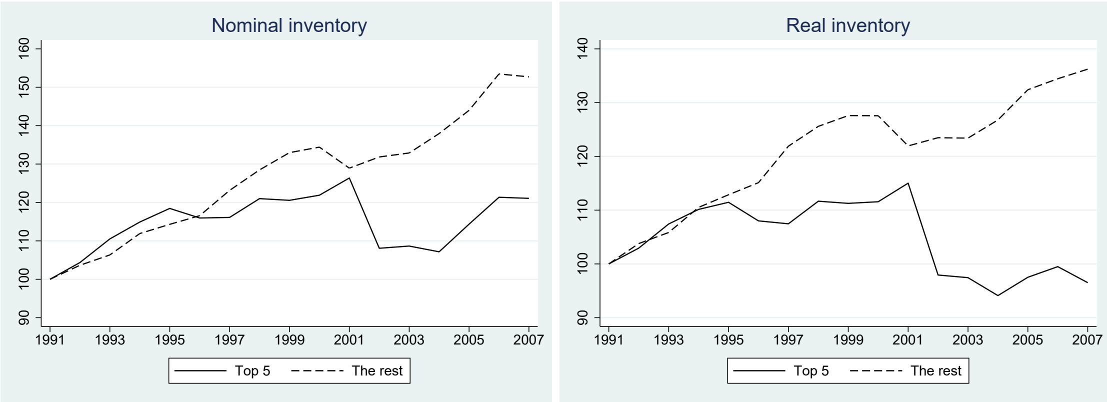


Figure 1-6: Industry inventory in the U.S. over 1991-2007: Top-5 vs the rest

The figure plots the nominal and real industry inventory in the U.S. during 1991-2007 for two groups: Top-5 industries (3-digit NAICS) in terms of instrumented Chinese import penetration before 2000 and the rest industries. The top-5 industries include Textile Product Mills (314), Apparel Manufacturing (315), Leather and Allied Product Manufacturing (316), Electrical Equipment, Appliance, and Component Manufacturing (335), and Miscellaneous Manufacturing (339). I use the deflator for shipments in the NBER-CES database to calculate the real value for industry inventory. All time-series are rescaled to make the level in the year 1991 equal to 100.

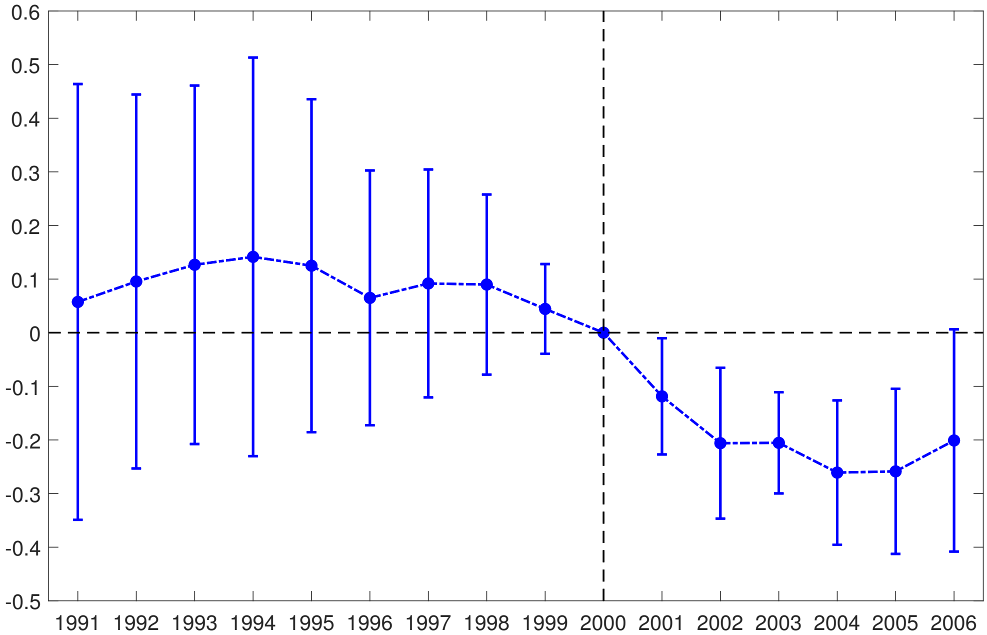


Figure 1-7: Effects of China's trade liberalization on industry inventory

This figure plots the year-by-year coefficients along with the 95% confidence intervals for the IV regression of Chinese import penetration during 1995-2000 on the industry inventory ratio. Inventory ratio is defined as the ratio of inventory to industry absorption, which is shipments plus total imports minus total exports. Industry fixed effects, year fixed effects, the interaction terms of year dummies and NTR gaps, and control variables are included in the regressions. Control variables include capital to value added, production workers to value added, production workers to total workers, TFP, production worker wage, non-production worker wage, tariff, shipping cost, and logarithm of industry absorption, all lagged by 1 year. Standard errors clustered by industry are used to calculate the confidence intervals.

Table 1.1: Industry level summary of import penetration and trade costs

This table reports the industry level import penetration and trade costs from 1991 to 2005. The data on NTR gaps are from 1991 to 2001 so the number of observations is smaller. *IP_China* is import penetration from China as in Equation (1.1). *IP_China_IV* is the instrumented Chinese import penetration using 8 other high-income countries' imports, as in Equation (1.3). *IP_Total* is total import penetration as in Equation (1.2). *Tariff* is the average tariff rate of the industry and *Tariff_China* is the tariff rate of US-China bilateral trade. *SC* is the average shipping cost, calculated as the percentage difference of the Cost-Insurance-Freight value with the Free-on-Board value of imports. *SC_China* is the shipping cost of the US-China bilateral trade. *NTRgap* is the difference in tariffs between the non-NTR rates if annual renewal of NTR fails and the NTR tariff rates, as in Pierce and Schott (2016). The last two columns show the AR(1) coefficient and the R-squared of the regression $y_{j,t} = \rho y_{j,t-1} + \varepsilon_{j,t}$. Panel A, B, and C report the summary statistics at the 3-digit, 4-digit, and 6-digit NAICS level, respectively.

Panel A: 3-digit NAICS level, 21 industries

	p1	p25	p50	p75	p99	Mean	s.d.	Obs.	Persistence ρ	R^2
IP_China	0.000	0.001	0.010	0.048	0.465	0.049	0.096	315	1.16	0.99
IP_China_IV	-0.001	0.002	0.010	0.037	0.275	0.034	0.057	315	1.14	0.95
IP_Total	-0.010	0.035	0.105	0.247	0.701	0.168	0.175	315	1.09	0.96
Tariff	0.001	0.008	0.021	0.039	0.143	0.032	0.035	315	0.98	1.00
Tariff_China	0.002	0.021	0.037	0.057	0.121	0.044	0.032	315	0.98	0.96
SC	0.015	0.038	0.049	0.061	0.125	0.051	0.022	315	1.01	0.95
SC_China	0.030	0.061	0.084	0.117	0.301	0.096	0.054	315	0.82	0.70
NTRgap	0.026	0.205	0.308	0.360	0.521	0.296	0.122	231	1.00	0.99

Panel B: 4-digit NAICS level, 85 industries

	p1	p25	p50	p75	p99	Mean	s.d.	Obs.	Persistence ρ	R^2
IP_China	0.000	0.001	0.005	0.032	0.610	0.043	0.105	1,265	1.18	0.98
IP_China_IV	-0.002	0.001	0.007	0.028	0.530	0.037	0.092	1,265	1.10	0.95
IP_Total	-0.027	0.025	0.086	0.224	0.932	0.166	0.212	1,265	1.09	0.95
Tariff	0.000	0.007	0.017	0.035	0.128	0.026	0.028	1,265	0.97	0.98
Tariff_China	0.000	0.015	0.031	0.049	0.138	0.040	0.064	1,264	0.62	0.38
SC	0.007	0.029	0.044	0.062	0.183	0.050	0.032	1,265	0.99	0.96
SC_China	0.021	0.056	0.081	0.120	0.252	0.092	0.052	1,264	0.80	0.64
NTRgap	0.028	0.201	0.295	0.370	0.660	0.290	0.128	929	1.00	0.98

Panel C: 6-digit NAICS level, 389 industries

	p1	p25	p50	p75	p99	Mean	s.d.	Obs.	Persistence ρ	R^2
IP_China	-0.001	0.000	0.003	0.024	0.678	0.044	0.131	5,659	1.15	0.96
IP_China_IV	-0.002	0.000	0.005	0.030	0.572	0.041	0.116	5,498	1.14	0.95
IP_Total	-0.124	0.011	0.073	0.225	1.619	0.183	0.333	5,659	1.10	0.92
Tariff	0.000	0.004	0.015	0.034	0.166	0.027	0.036	5,775	0.93	0.90
Tariff_China	0.000	0.010	0.031	0.050	0.184	0.039	0.048	5,466	0.82	0.68
SC	0.005	0.027	0.041	0.058	0.186	0.048	0.035	5,775	0.95	0.91
SC_China	0.015	0.052	0.075	0.115	0.378	0.094	0.079	5,466	0.64	0.43
NTRgap	0.021	0.217	0.322	0.380	0.648	0.308	0.138	4,184	1.00	0.98

Table 1.2: Summary statistics of firm-level and bank-level variables

This table reports summary statistics on firm-level and loan-level variables in Panels A and B, respectively. The firm-level sample contains all Compustat manufacturing firm-years with non-missing total assets, non-negative total sales, book leverage smaller than 1 from 1995 to 2005. Variable definitions are listed in the appendix.

Panel A: Firm-level variables	p1	p25	p50	p75	p99	Mean	s.d.	Obs.
Total assets ($million)	0.50	18.70	80.75	407.69	24226.00	1355.74	10454.05	32,040
Total sales ($million)	0.00	12.79	76.43	421.57	20977.00	1217.03	7275.45	31,940
Employment (thousand)	0.00	0.10	0.44	2.36	77.70	4.58	18.60	29,973
Book leverage	0.00	0.01	0.17	0.35	0.87	0.22	0.22	32,040
Market leverage	0.00	0.01	0.10	0.31	0.91	0.19	0.23	28,900
Short-term debt to assets	0.00	0.00	0.02	0.07	0.56	0.06	0.11	32,040
Long-term debt to assets	0.00	0.00	0.08	0.25	0.79	0.16	0.19	32,040
Cash to total assets	0.00	0.02	0.11	0.35	0.94	0.23	0.26	32,038
Asset growth	-1.00	-0.07	0.05	0.21	1.94	0.12	0.49	29,579
CAPX investment	0.00	0.11	0.21	0.43	4.27	0.44	0.75	29,807
Return on assets	-2.59	-0.14	0.05	0.12	0.33	-0.12	0.52	31,843
Tobin's q	0.32	0.84	1.35	2.57	21.05	2.51	3.83	27,884
Tangibility	0.00	0.09	0.18	0.32	0.73	0.22	0.17	32,023
Market concentration	0.00	0.63	1.00	1.00	1.00	0.82	0.28	31,101
Capital to labor ($million/person)	0.00	0.02	0.03	0.06	0.44	0.05	0.07	29,837
Growth of industry market cap	-0.69	-0.03	0.13	0.27	0.58	0.09	0.37	29,579
Growth of industry total assets	-0.64	0.01	0.06	0.13	0.48	0.05	0.26	29,579
Growth of industry total debt	-0.59	-0.03	0.04	0.14	0.62	0.04	0.29	29,579
Capital to value added	0.35	0.68	0.85	1.05	2.43	0.90	0.36	32,040
Production workers to value added	0.00	0.00	0.00	0.01	0.01	0.01	0.00	32,040
Growth of wages (production)	-0.22	-0.01	0.02	0.05	0.16	0.01	0.11	29,579
Change in TFP	-0.08	-0.02	0.01	0.02	0.06	0.00	0.03	32,040

Panel B: Loan-level variables	p1	p25	p50	p75	p99	Mean	s.d.	Obs.
Facility amount ($million)	0.7	17.5	75.0	230.0	2425.0	234.10	552.30	10,306
Maturity (months)	5.0	24.0	46.0	60.0	96.0	44.42	24.42	10,306
All-in-drawn spread (in bps)	17.5	87.5	200.0	287.0	600.0	205.27	135.13	10,306
All-in-undrawn spread (bps)	4.0	12.5	25.0	50.0	100.0	29.17	19.75	5,844
Senior	1	1	1	1	1	1.00	0.04	10,306
Secured	0	1	1	1	1	0.80	0.40	7,941
Term loan A	0	0	0	0	1	0.20	0.40	10,306
Other term loans	0	0	0	0	1	0.10	0.30	10,306
Bridge loan	0	0	0	0	1	0.01	0.11	10,306
Short-term revolver	0	0	0	0	1	0.03	0.18	10,306
Long-term revolver	0	0	1	1	1	0.52	0.50	10,306
364-day facility	0	0	0	0	1	0.12	0.32	10,306
Single lender	0	0	0	0	1	0.14	0.35	10,306
Corporate purposes	0	0	0	0	1	0.24	0.43	10,306
Working capital	0	0	0	0	1	0.17	0.37	10,306
Debt repayment	0	0	0	0	1	0.23	0.42	10,306
Takeover	0	0	0	0	1	0.13	0.34	10,306
Project finance	0	0	0	0	0	0.00	0.05	10,306
Commercial paper backup	0	0	0	0	1	0.08	0.27	10,306
Recapitalization	0	0	0	0	1	0.02	0.12	10,306
LBO	0	0	0	0	1	0.03	0.18	10,306

Table 1.3: Summary statistics of BHC-level variables

The table reports summary statistics of bank holding company (BHC) level characteristics from 1995 to 2005. Variable definitions are listed in the appendix.

	p1	p25	p50	p75	p99	Mean	s.d.	Obs.
Total assets (in billions)	0.21	5.00	13.05	45.41	953.60	62.92	163.54	952
Total loans (in billions)	0.14	2.87	7.92	26.48	448.89	33.93	77.77	952
Total liabilities (in billions)	0.19	4.60	11.89	41.34	857.43	57.67	150.19	952
Loans to total assets	0.12	0.56	0.65	0.71	0.81	0.62	0.13	952
Cash to total assets	0.01	0.03	0.04	0.06	0.28	0.05	0.04	945
Securities to total assets	0.04	0.14	0.21	0.27	0.50	0.21	0.10	951
Capital to total assets	0.05	0.07	0.08	0.10	0.25	0.09	0.03	952
Deposits to total liabilities	0.26	0.71	0.78	0.87	0.99	0.77	0.14	952
Interest income to total assets	0.02	0.05	0.07	0.07	0.09	0.06	0.01	952
Net income to total assets	0.00	0.01	0.01	0.01	0.03	0.01	0.01	952
Interest income to total income	0.31	0.70	0.78	0.84	0.94	0.75	0.13	952
C&I loan ratio	0.03	0.17	0.23	0.31	0.72	0.25	0.13	952
Real estate loan ratio	0.02	0.40	0.52	0.64	0.83	0.50	0.18	952
Residential real estate loan ratio	0.00	0.26	0.34	0.44	0.68	0.34	0.15	952
Personal loan ratio	0.00	0.06	0.13	0.19	0.41	0.14	0.10	952
Non-performing loan ratio	0.01	0.01	0.01	0.02	0.04	0.02	0.01	952
Net C&I loan issuance	-0.05	0.00	0.01	0.03	0.20	0.02	0.04	943
Net real estate loan issuance	-0.08	0.01	0.03	0.07	0.44	0.05	0.08	943
Net residential real estate loan issuance	-0.08	0.00	0.02	0.05	0.30	0.04	0.06	943
Net personal loan issuance	-0.05	0.00	0.00	0.01	0.12	0.01	0.02	943
Growth of total assets	-0.16	0.03	0.09	0.16	0.78	0.12	0.15	943
Growth of total loans	-0.27	0.04	0.09	0.17	0.78	0.12	0.16	943
Growth of C&I loans	-0.43	0.01	0.10	0.20	0.80	0.12	0.19	943
Growth of real estate loans	-0.38	0.03	0.10	0.21	0.90	0.13	0.19	940
Growth of residential real estate loans	-0.42	0.02	0.11	0.23	0.95	0.13	0.22	940
$IP\_China\_IV_{bank}$	0.00	0.01	0.02	0.03	0.19	0.03	0.04	685

Table 1.4: Growth of industry absorption and domestic shipments before and after 2001

The table reports the results of cross-section regressions of yearly growth of industry absorption and domestic shipments on Chinese import penetration before 2000. I use the yearly growth of industry absorption (domestic shipments) as the dependent variable. The explanatory variable is the average Chinese import penetration during 1995-2000. The sample is divided into two periods: 1991-2000 and 2001-2007. Year fixed effects are included. In parentheses are t-statistics based on clustered standard errors at the industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Nominal absorption		Real absorption		Nominal shipments		Real shipments	
	91-00	01-07	91-00	01-07	91-00	01-07	91-00	01-07
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$IP\_China\_IV_{j,before}$	-0.06	-0.29**	0.00	-0.20	-0.41**	-1.24***	-0.34*	-1.15***
	(-0.38)	(-2.37)	(0.02)	(-1.46)	(-2.80)	(-4.75)	(-2.08)	(-3.97)
$NTRgap_{j,1999}$	0.05	-0.15*	0.06	-0.04	0.06	-0.16*	0.07	-0.06
	(0.96)	(-1.86)	(1.29)	(-1.06)	(1.25)	(-1.77)	(1.59)	(-0.89)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	210	147	210	147	210	147	210	147
Adjusted R^2	0.14	0.33	0.19	0.20	0.15	0.46	0.16	0.34
Number of industries	21	21	21	21	21	21	21	21

Table 1.5: The impact of Chinese import penetration on firm leverage

The table reports the results of OLS generalized difference-in-differences regressions of firm-level leverage. The dependent variable is book leverage in columns 1-3, and market leverage in columns 4-6. $Chinashock_t$ is equal to 0 before 2000 and equal to 1 after 2001. $IP\_China_{j,before}$ is the average Chinese import penetration in the U.S. from 1995 to 2000. $IP\_China\_IV_{j,before}$ is the instrumented average Chinese import penetration, constructed from 8 other high-income countries' imports. Firm-level control variables include logarithm of sales, profitability, Tobin's q, tangibility, market concentration, and capital to labor ratio, all lagged by 1 year. Industry-level (3-digit NAICS) control variables include capital to value added, production workers to value added, production workers to total workers, change in TFP, production worker wage, and non-production worker wage, all lagged by 1 year. Year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Book leverage			Market leverage		
	(1)	(2)	(3)	(4)	(5)	(6)
$Chinashock_t * IP\_China_{j,before}$	-0.37***			-0.51***		
	(-3.90)			(-6.54)		
$Chinashock_t * IP\_China\_IV_{j,before}$		-0.61**	-0.48**		-0.74***	-0.76***
		(-2.47)	(-2.82)		(-3.45)	(-3.40)
Lagged logarithm of sales	0.01***	0.01***	0.01***	0.02**	0.02**	0.02**
	(4.33)	(4.68)	(4.26)	(2.37)	(2.45)	(2.38)
Lagged profitability	-0.05***	-0.05***	-0.05***	-0.06***	-0.05***	-0.06***
	(-4.90)	(-5.02)	(-4.91)	(-3.88)	(-3.94)	(-3.87)
Lagged Tobin's q	-0.00***	-0.00***	-0.00***	-0.01***	-0.01***	-0.01***
	(-7.40)	(-7.07)	(-7.36)	(-7.96)	(-7.64)	(-7.87)
Lagged tangiblity	0.12***	0.11***	0.11***	0.09*	0.09*	0.08*
	(3.96)	(3.56)	(3.81)	(2.05)	(1.98)	(1.99)
Lagged market concentration	-0.03***	-0.03***	-0.03***	-0.05***	-0.05***	-0.05***
	(-2.97)	(-2.87)	(-2.95)	(-3.46)	(-3.56)	(-3.51)
Lagged capital to labor ratio	0.11*	0.12*	0.11**	0.23***	0.23***	0.24***
	(2.04)	(1.97)	(2.17)	(4.05)	(3.85)	(4.16)
Lagged capital to value added	-0.01		-0.01	0.01		0.02
	(-0.33)		(-0.27)	(0.83)		(0.97)
Lagged production workers to value added	4.28		3.87	-2.55		-3.49
	(1.42)		(1.13)	(-0.86)		(-1.23)
Lagged produciton workers to total workers	-0.04		-0.04	0.08		0.07
	(-0.60)		(-0.70)	(0.61)		(0.55)
Lagged change in TFP	0.09		0.08	0.27*		0.26
	(1.54)		(1.34)	(1.77)		(1.69)
Lagged production wage	0.00		0.00	-0.00		-0.00**
	(0.55)		(0.27)	(-1.60)		(-2.10)
Lagged non-production wage	0.00		0.00	-0.00		-0.00
	(1.18)		(1.12)	(-0.12)		(-0.13)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23831	23831	23831	23831	23831	23831
Adjusted R^2	0.65	0.65	0.65	0.71	0.71	0.71
Number of firms	4059	4059	4059	4059	4059	4059

Table 1.6: The impact of Chinese import penetration on short-term and long-term leverage

The table reports the results of OLS generalized difference-in-differences regressions of firm-level short-term and long-term leverage. $Chinashock_t$ is equal to 0 before 2000 and equal to 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average import penetration from China from 1995 to 2000, measured at the 3-digit NAICS industry level. Firm-level control variables include logarithm of sales, profitability, Tobin's q, tangibility, market concentration, and capital to labor ratio, all lagged by 1 year. Industry-level (3-digit NAICS) control variables include capital to value added, production workers to value added, production workers to total workers, change in TFP, production worker wage, and non-production worker wage, all lagged by 1 year. Year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Book leverage					
	≤ 1 year (1)	> 1 year (2)	≤ 3 years (3)	> 3 years (4)	≤ 5 years (5)	> 5 years (6)
$Chinashock_t * IP\_China\_IV_{j,before}$	-0.30***	-0.12	-0.49***	0.08	-0.45***	0.03
	(-3.83)	(-0.93)	(-3.93)	(0.66)	(-3.97)	(0.39)
Lagged logarithm of sales	0.00**	0.01***	0.01**	0.01***	0.01***	0.00**
	(2.14)	(3.29)	(2.61)	(3.64)	(3.02)	(2.18)
Lagged profitability	-0.03***	-0.01*	-0.04***	-0.00	-0.05***	-0.00
	(-10.84)	(-1.90)	(-6.50)	(-0.42)	(-5.75)	(-0.23)
Lagged Tobin's q	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***	-0.00***
	(-5.17)	(-9.87)	(-11.38)	(-4.15)	(-10.26)	(-2.88)
Lagged tangiblity	0.06***	0.05*	0.10***	0.01	0.10***	0.01
	(3.32)	(1.86)	(6.09)	(0.20)	(3.50)	(0.56)
Lagged market concentration	-0.01	-0.02**	-0.02**	-0.01	-0.02***	-0.01
	(-0.91)	(-2.82)	(-2.64)	(-1.41)	(-3.09)	(-1.29)
Lagged capital to labor ratio	-0.05	0.19***	-0.02	0.16***	0.08	0.05
	(-1.56)	(3.29)	(-0.68)	(2.92)	(1.72)	(1.05)
Lagged capital to value added	0.00	-0.01	0.01	-0.02	0.01	-0.02
	(0.67)	(-0.50)	(1.11)	(-1.14)	(1.04)	(-1.55)
Lagged production workers to value added	2.69**	-1.05	0.82	1.04	2.62	-0.76
	(2.79)	(-0.32)	(0.55)	(0.32)	(1.25)	(-0.33)
Lagged produciton workers to total workers	-0.07	0.06	-0.03	0.01	-0.02	0.01
	(-1.47)	(1.26)	(-0.46)	(0.28)	(-0.32)	(0.14)
Lagged change in TFP	-0.02	0.07	0.01	0.03	0.04	-0.00
	(-0.61)	(1.13)	(0.25)	(0.62)	(0.90)	(-0.02)
Lagged production wage	-0.00	0.00	-0.00**	0.00	-0.00	0.00
	(-0.74)	(0.35)	(-2.38)	(1.24)	(-1.64)	(1.52)
Lagged non-production wage	-0.00	0.00	0.00	-0.00	0.00*	-0.00
	(-0.14)	(1.17)	(1.70)	(-0.07)	(1.79)	(-0.55)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17641	17641	17641	17641	17641	17641
Adjusted R^2	0.50	0.68	0.54	0.62	0.59	0.55
Number of firms	3659	3659	3659	3659	3659	3659

Table 1.7: The impact of Chinese import penetration on firm leverage: financially constrained vs. financially unconstrained firms

The table reports the different responses of firm leverage to Chinese import penetration by financially constrained and financially unconstrained firms. Every year firms are split according to their credit rating, size, age, and SA index (Hadlock and Pierce, 2010). Firms that are big, with credit ratings, old, and with low SA indices are not financially constrained (NFC). The dependent variable is book leverage in Panel A and market leverage in Panel B. $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average import penetration, measured at the 3-digit NAICS industry level, from China from 1995 to 2000. Firm controls, industry controls, year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	By credit rating		By firm size		By age		By SA index	
	No rating	Rating	Small	Big	Young	Old	FC	NFC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Book leverage regressions								
$Chinashock_t * IP\_China\_IV_{j,before}$	-0.29	-1.07***	-0.19	-0.73***	-0.34*	-0.58***	-0.18	-0.68***
	(-1.65)	(-4.10)	(-1.10)	(-3.02)	(-1.99)	(-2.95)	(-0.85)	(-3.25)
Observations	19888	3943	11336	12495	9223	14608	10800	13031
Adjusted R^2	0.62	0.75	0.61	0.72	0.67	0.65	0.62	0.71
Number of firms	3662	747	2495	2452	2276	2418	2514	2336
Panel B: Market leverage regressions								
$Chinashock_t * IP\_China\_IV_{j,before}$	-0.45**	-1.43***	-0.54*	-0.99**	-0.76***	-0.76***	-0.64*	-0.86***
	(-2.26)	(-4.01)	(-1.93)	(-2.81)	(-3.14)	(-2.85)	(-2.03)	(-2.96)
Observations	19888	3943	11336	12495	9223	14608	10800	13031
Adjusted R^2	0.69	0.79	0.69	0.76	0.71	0.72	0.69	0.75
Number of firms	3662	747	2495	2452	2276	2418	2514	2336
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 1.8: The impact of Chinese import penetration on other firm characteristics

The table reports the impact of Chinese import penetration on cash holdings, investment, and profitability. Dependent variables are cash to total assets ratio in columns 1-2, yearly asset growth in columns 3-4, capital expenditure to lagged property, plant, and equipment ratio in columns 5-6, Tobin's q in columns 7-8, and operating income after depreciation to total assets in columns 9-10. $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China_{j,before}$ is the average Chinese import penetration in the U.S. from 1995 to 2000. $IP\_China\_IV_{j,before}$ is the instrumented average Chinese import penetration, constructed from 8 other high-income countries' imports. Firm controls, industry controls, year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Cash holdings	Asset growth	CAPX investment	Tobin's q	Profitability
	(1)	(2)	(3)	(4)	(5)
$Chinashock_t * IP\_China\_IV_{j,before}$	0.40***	0.76**	-0.67	1.45	0.21
	(2.93)	(2.33)	(-1.31)	(0.99)	(0.82)
Firm-level controls	Yes	Yes	Yes	Yes	Yes
Industry-level controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	23356	23356	23356	23356	23356
Adjusted R^2	0.80	0.24	0.35	0.56	0.71
Number of firms	4025	4025	4025	4025	4025

Table 1.9: The impact of Chinese import penetration on firm inventory

The table reports the impact of Chinese import penetration on firm inventory. Dependent variables are days inventory outstanding, inventory to total assets ratio, and inventory to total sales ratio in Panel A, B, and C, respectively. Days inventory outstanding (DIO) is 365 times average inventory divided by costs of good sold. In columns 1-3, I run simple OLS regressions for different periods, using instrumented Chinese import penetration (lag by 1 year) as the key explanatory variable. In column 4, I run a difference-in-differences regression during 1995-2006. $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average Chinese import penetration during 1995-2000, constructed from 8 other high-income countries' imports. Firm controls, industry controls, year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Second-stage IV			DID
	1991-2006	1991-2000	2001-2006	1995-2006
	(1)	(2)	(3)	(4)
Panel A: Days inventory outstanding				
$IP\_China\_IV_{j,t-1}$	-115.85***	63.30	-138.64***	
	(-5.10)	(1.61)	(-5.68)	
$Chinashock_t * IP\_China\_IV_{j,before}$				-201.19***
				(-3.48)
Observations	33542	22387	11155	23673
Adjusted R^2	0.66	0.72	0.69	0.67
Number of firms	4637	4042	2613	4028
Panel B: Invetory to total assets ratio				
$IP\_China\_IV_{j,t-1}$	-0.19***	0.04	-0.14***	
	(-5.66)	(0.48)	(-2.95)	
$Chinashock_t * IP\_China\_IV_{j,before}$				-0.56***
				(-5.10)
Observations	33542	22387	11155	23673
Adjusted R^2	0.79	0.82	0.86	0.81
Number of firms	4637	4042	2613	4028
Panel C: Inventory to sales ratio				
$IP\_China\_IV_{j,t-1}$	-0.22***	0.01	-0.18**	
	(-7.19)	(0.22)	(-2.54)	
$Chinashock_t * IP\_China\_IV_{j,before}$				-0.48***
				(-3.89)
Observations	33542	22387	11155	23673
Adjusted R^2	0.60	0.66	0.68	0.61
Number of firms	4637	4042	2613	4028

Table 1.10: The impact of Chinese import penetration on profitability and tax rates

The table reports the impact of Chinese import penetration on profitability and tax rates. Dependent variables are profitability, federal tax rate, and foreign tax rate in Panel A, B, and C, respectively. Profitability is measured by operating income after depreciation scaled by total assets. Federal tax rate is the ratio of federal income taxes to domestic pretax income. Foreign tax rate is the ratio of foreign income taxes to foreign pretax income. In columns 1-3, I run simple OLS regressions for different periods, using instrumented Chinese import penetration (lag by 1 year) as the key explanatory variable. In column 4, I run a difference-in-differences regression during 1995-2006. $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average Chinese import penetration during 1995-2000, constructed from 8 other high-income countries' imports. Firm controls, industry controls, year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Second-stage IV			DID
	1991-2006	1991-2000	2001-2006	1995-2006
	(1)	(2)	(3)	(4)
Panel A: Profitability				
$IP\_China\_IV_{j,t-1}$	-0.05	-0.54***	0.15	
	(-1.04)	(-3.72)	(1.55)	
$Chinashock_t * IP\_China\_IV_{j,before}$				0.20
				(0.74)
Observations	33700	22465	11235	23792
Adjusted R^2	0.70	0.71	0.74	0.71
Number of firms	4661	4059	2632	4053
Panel B: Federal tax rate				
$IP\_China\_IV_{j,t-1}$	0.04	0.37	0.02	
	(0.36)	(1.48)	(0.09)	
$Chinashock_t * IP\_China\_IV_{j,before}$				0.41
				(1.44)
Observations	7496	5082	2414	5042
Adjusted R^2	0.30	0.31	0.34	0.30
Number of firms	1472	1171	826	1231
Panel C: Foreign tax rate				
$IP\_China\_IV_{j,t-1}$	0.13	0.68***	-0.07	
	(1.71)	(3.82)	(-0.77)	
$Chinashock_t * IP\_China\_IV_{j,before}$				0.20
				(0.77)
Observations	7487	4723	2764	5212
Adjusted R^2	0.35	0.42	0.38	0.37
Number of firms	1415	1094	851	1212

Table 1.11: The impact of Chinese import penetration on the likelihood and amount of new loans

The table reports the impact of Chinese import penetration on the likelihood and amount of new bank loans. The sample consists of firms that take at least a new loan during 1995-2005. In panel A, I use the dummy variable regarding new loans taken (equal to 1 if the firm takes a new loan) as the dependent variable. In panel B, the dependent variable is new loans taken scaled by lagged total assets. Loans are divided according to maturity (short-term loans with maturity less than 3 years and long-term loans with maturity longer than 3 years) and loan types (credit lines and term loans). $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average import penetration, measured at the 3-digit NAICS industry level, from China from 1995 to 2000. Firm controls, industry controls, year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	All	Short-term	Long-term	Credit lines	Term loans
	(1)	(2)	(3)	(4)	(5)
Panel A: Likelihood of new loans (extensive margin)					
$Chinashock_t * IP\_China\_IV_{j,before}$	-0.80	-1.06**	0.07	-0.85*	-0.64*
	(-1.62)	(-2.48)	(0.19)	(-1.84)	(-1.69)
Observations	16536	16536	16536	16536	16536
Adjusted R^2	0.14	0.12	0.14	0.15	0.11
Number of firms	2492	2492	2492	2492	2492
Panel B: Amount of new loans (intensive margin)					
$Chinashock_t * IP\_China\_IV_{j,before}$	1.19	0.35	-0.47	0.79	-0.81
	(1.55)	(0.49)	(-0.33)	(1.30)	(-0.31)
Observations	5282	3607	2606	4875	1981
Adjusted R^2	0.37	0.44	0.46	0.45	0.29
Number of firms	2013	1699	1293	1905	1161
Firm-level controls	Yes	Yes	Yes	Yes	Yes
Industry-level controls	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes

Table 1.12: The impact of Chinese import penetration on corporate loan spread

The table reports the results of OLS generalized difference-in-differences regressions on corporate loan spread. The dependent variables are all-in-drawn spread in columns 1-5 and all-in-undrawn spread in columns 6-8. $Chinashock_t$ is equal to 0 before 2000 and 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented import penetration from China, measured at the 3-digit NAICS industry level, from 1995 to 2000. Firm-level control variables include lagged logarithm of total assets, profitability, Tobin's q, tangibility, and book leverage and z-score. I control for loan-level characteristics, which include a set of dummy variables that characterize the facility, such as whether the facility is a bridge loan, a term loan A, an other term-loan facility (Term loan B, C, ...), a 364-day facility, a short-term revolver, or a long-term revolver, whether the facility is secured by firms' assets, whether the facility is senior in repayment, and whether the facility's purpose is "corporate purposes", "debt repayment", "working capital", "project finance", "commercial paper backup", "recapitalization", "LBO", or "acquisition line". Year and industry fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	All loans	Term loans	Credit lines					
	All-in-drawn spread					All-in-undrawn spread		
	All	All	All	Short-term	Long-term	All	Short-term	Long-term
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Chinashock_t * IP\_China\_IV_{j,before}$	-281.85*	118.46	-371.53***	-426.86***	-98.83	-71.16***	-75.69**	-39.52
	(-1.96)	(0.23)	(-3.36)	(-2.96)	(-0.68)	(-2.98)	(-2.57)	(-1.10)
Lagged logarithm of total assets	-16.40***	-12.56***	-18.05***	-17.57***	-15.39***	-0.71**	-0.04	-1.48***
	(-10.97)	(-4.91)	(-13.98)	(-10.64)	(-7.88)	(-2.14)	(-0.10)	(-3.25)
Lagged tangibility	-14.53	-36.76	-3.86	-5.38	0.90	-4.05	-6.30	-1.80
	(-1.06)	(-1.54)	(-0.31)	(-0.28)	(0.07)	(-1.55)	(-1.64)	(-0.61)
Lagged profitability	-116.98***	-117.33***	-117.52***	-121.06***	-58.26	-9.03**	-11.81***	2.39
	(-6.22)	(-3.65)	(-5.93)	(-5.68)	(-1.63)	(-2.39)	(-2.59)	(0.31)
Lagged Tobin's q	-4.83***	-7.93***	-4.15***	-3.75**	-8.71***	-0.37	-0.22	-2.04***
	(-3.15)	(-3.26)	(-2.58)	(-2.18)	(-2.65)	(-1.17)	(-0.63)	(-3.54)
Lagged book leverage	106.54***	104.46***	102.94***	113.70***	80.15***	14.13***	14.01***	12.59***
	(9.93)	(5.65)	(10.59)	(8.46)	(6.61)	(6.46)	(4.47)	(4.59)
Lagged Z-score	-4.73***	-6.41**	-4.22**	-3.67**	-12.67***	-1.00***	-0.94***	-2.27***
	(-3.05)	(-2.40)	(-2.53)	(-2.19)	(-4.79)	(-4.53)	(-4.02)	(-4.21)
Loan level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3-digit NAICS fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5855	1950	3905	2197	1708	3291	1736	1555
Adjusted R^2	0.51	0.27	0.58	0.54	0.62	0.39	0.32	0.51
Number of firms	1712	869	1632	1221	894	1404	999	833

Table 1.13: Chinese import penetration and bank characteristics

The table reports the results of OLS generalized difference-in-differences regressions of bank characteristics. $Chinashock_t$ is 0 before 2000 and 1 after 2001. $IP\_China\_IV_{b,before}$ is bank holding company b's average import penetration from China from 1995 to 2000, constructed from firm-bank relationships and instrumented firm-level Chinese import penetration. Bank-level control variables, year and bank fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	(1) Asset growth	(2) Loan growth	(3) NPL	(4) Capital ratio	(5) ROA	(6) Interest income ratio
$Chinashock_t * IP\_China\_IV_{b,before}$	-1.05	-0.06	-0.02	0.11	0.12	-0.32
	(-0.96)	(-0.04)	(-0.40)	(0.79)	(1.34)	(-0.84)
Lagged C&I loans ratio	-0.07	0.13	0.00	0.00	-0.01	0.09
	(-0.56)	(0.68)	(0.29)	(0.12)	(-0.83)	(1.24)
Lagged real estate loans ratio	-0.17	0.00	-0.00	-0.00	-0.00	-0.00
	(-0.90)	(0.00)	(-0.76)	(-0.03)	(-0.19)	(-0.00)
Lagged consumer loans ratio	0.14	0.33	-0.02**	0.01	-0.01	0.18*
	(0.64)	(1.52)	(-2.00)	(0.31)	(-0.79)	(1.84)
Lagged loans to total assets	0.14	-0.26*	-0.02***	0.01	0.01	0.18***
	(1.32)	(-1.97)	(-3.87)	(0.35)	(1.20)	(3.35)
Lagged cash to total assets	-0.76	-1.08***	-0.02	0.00	-0.01	-0.41***
	(-1.53)	(-3.30)	(-0.90)	(0.05)	(-0.22)	(-3.00)
Lagged capital ratio	0.30	0.18	0.02	0.57***	-0.04*	0.15
	(1.08)	(0.52)	(1.44)	(18.39)	(-1.86)	(0.97)
Lagged interest income to total assets	0.01	-1.30	0.10	-0.10	0.03	-0.25
	(0.00)	(-0.96)	(1.54)	(-0.92)	(0.24)	(-0.55)
Lagged deposits to total liabilities	0.08	-0.13	0.00	-0.02	-0.01	0.04
	(0.53)	(-0.73)	(0.82)	(-1.18)	(-0.51)	(0.54)
Lagged logarithm of total assets	-0.20***	-0.19***	0.00	0.00	0.00	0.05***
	(-5.29)	(-5.58)	(0.81)	(1.00)	(0.27)	(3.85)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	835	835	835	835	835	835
Adjusted R^2	0.25	0.24	0.63	0.73	0.10	0.88
Number of banks	102	102	102	102	102	102

Table 1.14: Chinese import penetration and net issuance of different types of loans

The table reports the results of OLS generalized difference-in-differences regressions of net issuance of different types of loans: commercial and industrial (C&I) loans, real estate (RE) loans, residential real estate (RE_HH) loans, and personal (PE) loans. The dependent variable in column 1 is yearly change in C&I loans scaled by lagged total assets, $(CIloan_{b,t} - CIloan_{b,t-1})/Totalassets_{b,t-1}$. The dependent variables in columns 2-4 are constructed in a similar manner. $Chinashock_t$ is 0 before 2000 and 1 after 2001. $IP\_China\_IV_{b,before}$ is bank holding company b's average import penetration from China from 1995 to 2000, constructed from firm-bank relationships and instrumented firm-level Chinese import penetration. Control variables include net total loan issuance and lagged bank characteristics. Year and bank fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Net loan issuance			
	C&I	RE	RE_HH	PE
	(1)	(2)	(3)	(4)
$Chinashock_t * IP\_China\_IV_{b,before}$	-0.35**	0.39**	0.44**	0.00
	(-2.47)	(2.27)	(2.54)	(0.07)
Net total loan issuance	0.22***	0.52***	0.35***	0.13***
	(15.78)	(19.34)	(16.68)	(10.95)
Lagged C&I loan ratio	-0.05**	0.03	0.04	0.00
	(-2.25)	(0.95)	(1.52)	(0.21)
Lagged real estate loan ratio	0.08***	-0.12***	-0.10***	0.00
	(2.66)	(-3.06)	(-2.94)	(0.14)
Lagged consumer loan ratio	0.04	0.02	0.01	-0.03
	(0.98)	(0.34)	(0.24)	(-1.08)
Lagged loans to total assets	-0.01	0.00	0.00	-0.02**
	(-0.48)	(0.23)	(0.23)	(-2.13)
Lagged cash to total assets	-0.03	0.02	0.04	0.01
	(-0.52)	(0.28)	(0.54)	(0.32)
Lagged capital ratio	0.09**	0.13**	0.04	-0.11***
	(2.24)	(2.27)	(0.74)	(-3.72)
Lagged interest income to total assets	0.05	-0.15	-0.17	0.07
	(0.35)	(-0.80)	(-0.78)	(0.55)
Lagged deposits to total liabilities	-0.04	-0.00	0.01	0.04**
	(-1.64)	(-0.12)	(0.40)	(2.39)
Lagged logarithm of total assets	-0.00	0.01	0.01*	0.00
	(-0.57)	(1.40)	(1.69)	(1.09)
Year fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	835	835	835	835
Adjusted R^2	0.70	0.83	0.72	0.56
Number of banks	102	102	102	102

Table 1.15: Chinese import penetration and net issuance of different types of loans: robustness tests

The table reports the results of OLS generalized difference-in-differences regressions of net issuance of different types of loans: commercial and industrial (C&I) loans, real estate (RE) loans, residential real estate (RE_HH) loans, and personal (PE) loans. The dependent variable in column 1 is yearly change in C&I loans scaled by lagged total assets, $(CIloan_{b,t} - CIloan_{b,t-1})/Totalassets_{b,t-1}$. The dependent variables in columns 2-4 are constructed in a similar manner. $Chinashock_t$ is 0 before 2000 and 1 after 2001. $IP\_China\_IV_{b,before}$ is bank holding company b's average import penetration from China from 1995 to 2000, constructed from firm-bank relationships and instrumented firm-level Chinese import penetration. Other interaction terms of the China shock dummy with bank characteristics during 1995-2000 are also included in the regressions, such as C&I loan growth, real estate loan growth, loans to assets ratio, securities to assets ratio. Bank-level control variables include net total loan issuance and lagged bank characteristics. Year and bank fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Net loan issuance			
	C&I	RE	RE_HH	PE
	(1)	(2)	(3)	(4)
$Chinashock_t * IP\_China\_IV_{b,before}$	-0.23***	0.29**	0.38***	-0.04
	(-2.95)	(2.39)	(3.20)	(-0.61)
$Chinashock_t * C\&I\ loan\ growth_{b,before}$	-0.09***	0.07	0.05	0.02
	(-3.56)	(1.53)	(1.10)	(1.10)
$Chinashock_t * RE\ loan\ growth_{b,before}$	0.06**	-0.02	-0.00	-0.07***
	(2.16)	(-0.41)	(-0.08)	(-2.90)
$Chinashock_t * Deposit\ growth_{b,before}$	0.00	-0.06	-0.02	0.06**
	(0.06)	(-1.21)	(-0.30)	(2.26)
$Chinashock_t * C\&I\ loan\ ratio_{b,before}$	-0.08***	0.02	0.02	0.05***
	(-3.58)	(0.46)	(0.51)	(3.73)
$Chinashock_t * RE\ loan\ ratio_{b,before}$	0.01	-0.07**	-0.07**	0.04***
	(0.69)	(-2.52)	(-2.60)	(3.12)
$Chinashock_t * Loans\ to\ assets_{b,before}$	0.01	0.05	0.06*	-0.02
	(0.25)	(1.37)	(1.75)	(-1.17)
$Chinashock_t * Securities\ to\ assets_{b,before}$	0.06*	0.03	-0.00	-0.05**
	(1.96)	(0.50)	(-0.02)	(-2.43)
Bank-level controls	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Observations	835	835	835	835
Adjusted R^2	0.72	0.84	0.73	0.57
Number of banks	102	102	102	102

Table 1.16: Banks' financial constraints and loan reallocation

The table reports the results of OLS generalized difference-in-differences regressions of net issuance of different types of loans: commercial and industrial (C&I) loans, real estate (RE) loans, and residential real estate (RE_HH) loans, for banks with low and high capital in Panel A, as well as for small and large banks in Panel B. Each year, banks are divided according to their capital ratio and total assets into two groups. The dependent variable in columns 1 and 2 is yearly change in C&I loans scaled by lagged total assets, $(CIloan_{b,t} - CIloan_{b,t-1})/Totalassets_{b,t-1}$. The dependent variables in columns 3-6 are constructed in a similar manner. $Chinashock_t$ is 0 before 2000 and 1 after 2001. $IP\_China\_IV_{b,before}$ is bank holding company b's average import penetration from China from 1995 to 2000, constructed from firm-bank relationships and instrumented firm-level Chinese import penetration. Control variables include net total loan issuance and lagged bank characteristics. Year and bank fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Net loan issuance					
	C&I		RE		RE_HH	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: By capital ratio						
	Low	High	Low	High	Low	High
$Chinashock_t * IP\_China\_IV_{b,before}$	-0.57***	-0.22	0.64**	0.27	0.64**	0.27
	(-3.02)	(-1.33)	(2.28)	(1.24)	(2.43)	(1.51)
Observations	420	415	420	415	420	415
Adjusted R^2	0.74	0.70	0.83	0.84	0.74	0.72
Panel B: By bank size						
	Small	Large	Small	Large	Small	Large
$Chinashock_t * IP\_China\_IV_{b,before}$	-0.46***	-0.12	0.39	-0.47	0.55**	-0.01
	(-2.99)	(-0.31)	(1.64)	(-0.64)	(2.45)	(-0.02)
Observations	384	451	384	451	384	451
Adjusted R^2	0.62	0.78	0.86	0.83	0.71	0.74
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 2

Cash Holdings and Debt Structure

2.1 Introduction

Corporate cash holdings and the composition of corporate debt structures are both important financial policies. These two aspects are often considered separately in empirical studies. For example, while Opler, Pinkowitz, Stulz, and Williamson (1999) show that cash holdings depend on a number of firm characteristics such as growth opportunities and firm size, they do not study how cash holdings vary with the composition of debt. Further, Rauh and Sufi (2010) show that there is substantial heterogeneity in debt structures, however, in their analysis they also do not study the relation to corporate cash holdings.

In this paper, we investigate how corporate cash holdings and debt structures are related. We show that they are fundamentally and non-trivially linked. Specifically, cash holdings and the fraction of bond financing exhibit a U-shaped relation. Panel A in Figure 2-1 reveals that firms with a mixed debt structure exhibit low cash-to-assets ratios, while those firms that do not utilize bond financing and those that are entirely bond financed exhibit high cash holdings. The differential in cash holdings due to heterogeneity in the fraction of bond financing is substantial and amounts up to 20% of total assets.

FIGURE 2-1 ABOUT HERE

In our study we use the information about debt structures provided in the Capital IQ database and match it to Compustat. In total, our sample covers 5,286 levered firms over the period from 2002 to 2016 and represents 89% of the levered firm-year observations in the Compustat universe. We find that the intensity of bond financing is informative about cash holdings in several ways. For example, there are huge differentials in cash holdings at the extreme values of the usage of bond financing relative to almost extreme values. To be more precise, the cash holdings of firms that do not use bond financing at all are on average 23.9% of assets, while those of the firms that use little bond financing are 10.4%. Similarly, firms that use only bond financing exhibit cash holdings of 29.6%, while those that are almost fully bond financed exhibit cash holdings of 17.6%. The observed differences at the extreme values of bond financing are highly statistically significant. Further, we find that our uncovered relation between cash holdings and the fraction of bond financing does not reflect the U-shaped relation between cash holdings and credit risk as for Acharya, Davydenko, and Strebulaev (2012). Contrary, our analysis reveals that firms with extreme values of bond financing exhibit the lowest credit risk.

We run simple regressions of the cash-to-assets ratio on the fraction of bond financing and its squared term to illustrate the importance of this non-linearity. Specifically, we find that the incremental adjusted R^2 value of 8% of the squared term of bond financing is substantial. On average, a firm that is 50% financed through bonds has a cash-to-assets ratio that is 17 percentage points lower than a firm that is either totally bond financed or a firm that does not utilize bond financing at all. Moreover, we show that unobservable variation across years, industries and firms does not drive the non-linear relation that links cash holdings to bond financing.

Next, we find that the intensity of bond financing is informative in a non-linear fashion about other firm characteristics as well, as shown in Panels B to D in Figure 2-1. Specifically, the fraction of bond financing also relates in a U-shaped manner to the market-to-book ratio of assets. That is, firms that do not use bond financing or those that are fully bond financed have the highest values of market-to-book ratios. Again, there are stark differentials in market-to-book at the extreme values of the intensity of bond financing. Contrary, we find that firm size and book leverage relate in an inverse U-shaped manner to the usage of bond financing. Again, there are pronounced differentials in size and leverage between the extreme values and almost extreme values of bond financing.

Our novel insights are particularly interesting in light of two common conjectures. First, firms that are entirely bond financed are small, not large. Second, firms that are fully bond financed have low values of leverage, not high values of leverage. Hence, these patterns somewhat question the notion that access to the bond market per se is indicative of being financially unconstrained (for further discussions see, Opler, Pinkowitz, Stulz, and Williamson, 1999; Faulkender and Petersen, 2006). Contrary to this view, firms that are fully bond financed appear to be constrained: they hold a lot of cash, they have high values of market-to-book, they are small and have little leverage.

We further perform simple regressions of market-to-book, size or leverage on the fraction of bond financing and its squared term. The non-linear relation between these three firm characteristics and the usage of bond financing is highly statistically significant and robust to several model specifications, that is, to unobservable variation across years, industries and firms. Overall, we find that the inclusion of the squared term of the fraction of bond financing leads to an incremental adjusted R^2 value of 9% when considering leverage, and to 4% when considering size.

What mechanism can explain why the intensity of bond financing simultaneously informs in a non-linear fashion about cash holdings, market-to-book assets, size and leverage? Previous research (e.g., Faulkender and Wang, 2006; Pinkowitz and Williamson, 2006; Denis and Sibilkov, 2009; Bolton, Chen, and Wang, 2011) suggests that corporate cash holdings are symptomatic of financing frictions. Thus, to understand how cash holdings and debt structure are related due to financing frictions, we introduce a model of liquidity demand similar to that of Almeida, Campello, and Weisbach (2004). In our model, there are two types of debt: a loan that is subject to a rollover freeze as for Acharya, Gale, and Yorulmazer (2011), and a bond that has a higher marginal cost than the loan. Hence, the loan is cheaper but subject to a rollover freeze, which may impede the firm's future investment. Contrary, the bond is more expensive than the loan but matures later. The firm initially raises external finance to meet current as well as future investment needs. Thus, there are incentives to hold cash in the case of valuable future investment opportunities. The key friction to raise external finance is a collateral constraint. That is, the firm can only raise external finance up to a fraction of current assets. This implies that for growth firms – those with more valuable investment opportunities in the future – the collateral constraint is the key impediment to obtain external financing.

In the model it arises that relative investment needs (i.e., the sum of current and future investment needs relative to cash flows) and value-versus-growth (i.e., the relative importance of current versus future investment needs) jointly matter to capture the underlying relations. Specifically, firms that do not use bond financing are growth firms with small investment needs relative to cash flows. Hence, these firms end up being small with little leverage while they have valuable future investment opportunities – thus they hold cash to mitigate the impact of a rollover freeze on future investment. Contrary, firms that are bond-only financed have large investment needs relative to cash flows while having valuable future investment opportunities as well. In choosing to be bond-only financed and simultaneously holding cash, they avoid having to forgo future investment opportunities. Due to the external financing constraint, these firms end up being small and having little leverage as well. Thus, the model generally implies that bond financing increases in relative investment needs, while there is a U-shaped pattern in growth opportunities.

Further, to learn about other deep parameters of the model we calibrate it our data. We can quantitatively reproduce the empirical patterns including the discontinuities at the extreme choices of bond financing that reflect the boundary equilibria. Besides the increasing pattern of relative investment need in bond financing and the U-shaped pattern of growth the calibration provides additional insights. For example, the distribution of future relative to current cash flows is inverse U-shaped in bond financing. This pattern confirms that low relative future cash flows combined with valuable growth opportunities contribute to the large cash holdings of the firms in the extreme bins of bond financing. We further find that asset pledgebility shows an inverse U-shaped pattern in bond financing as well. The low pledgebility combined with the high growth opportunities yield low leverage ratios for firms that are either entirely loan or bond financed.

Our study differs from the existing literature that examines how cash holdings and debt structures are related. Acharya, Almeida, and Campello (2007) show that reducing debt and hoarding cash increases future investment for financially constrained firms. Sufi (2009) shows that credit lines are a substitute for cash for firms with high cash flows, while Acharya, Almeida, and Campello (2013) show that firms with more idiosyncratic cash flows make greater use of credit lines. Harford, Klasa, and Maxwell (2014) elaborate on the relation between cash holdings and refinancing risk. Xiao (2018) argues that after the financial crisis firms issue more bonds and simultaneously hold more cash as bond indentures are harder to renegotiate in financial distress. We provide novel insights into the cross-sectional relation between corporate cash holdings and debt structures. Specifically, we show that in the presence of financing frictions emerges a U-shaped relation that links cash holdings to the fraction of bond financing.

Our paper differs from other studies that examine the determinants of corporate cash holdings. Kim, Mauer, and Sherman (1998) and Harford (1999) find that cash holdings are positively associated with industry cash flow volatility. Foley, Hartzell, Titman, and Twite (2007) provide a tax-based explanation of cash holdings while Harford, Mansi, and Maxwell (2008) examine the role of corporate governance for cash holdings. Bates, Kahle, and Stulz (2009) show that firms increased their cash holdings substantially over time. Duchin (2010) finds that multidivisional firms hold less cash than stand-alone firms. Nikolov and Whited (2014) use a dynamic model to examine how agency problems affect corporate cash policy and Gao, Whited, and Zhang (2018) study the interest rate sensitivity of corporate cash. Recently, Moritzen and Schandlbauer (2018) examine the impact of competition and time-to-finance on cash holdings.

Further, our analysis differs from contributions that investigate corporate debt structures. Barclay and Smith (1995a,b) and Guedes and Opler (1996), examine the priority and maturity structure, respectively, of corporate debt. Houston and James (1996) highlight the importance of asymmetric information for the mix of private and public debt, while Denis and Mihov (2003) focus on the credit quality of the borrower. Faulkender and Petersen (2006) investigate the supply-side effect of access to the bond market on debt structure and Santos and Winton (2008) elaborate on the hold-up problem associated with bank financing. Adrian, Colla, and Shin (2013) discuss how financial frictions affect macroeconomic activity. Colla, Ippolito, and Li (2013b) show that the vast majority of firms borrows predominantly with one type of debt, and Tengulov (2018) finds that borrowing diversity can shield firms against credit supply shocks. Custódio, Ferreira, and Laureano (2013) document that firms' usage of short-term debt has increased over time and Choi, Hackbarth, and Zechner (2018) show that firms actively manage debt maturity to avoid rollover losses.

The remainder of article is organized as follows. Section 2.2 discusses the data and the sample construction. Section 2.3 provides our empirical results and Section 2.4 presents our model. Section 2.5 concludes.

2.2 Data

To examine debt structures of U.S. public firms, we utilize the Standard & Poor's Capital IQ database. This database allows us to distinguish debt into seven different types: commercial paper (CP), drawn credit lines (DC), term loans (TL), senior bonds and notes (SBN), subordinated bonds and notes (SUB), capital leases (CL), and other debt (other). We select our sample as for Colla, Ippolito, and Li (2013b). We start with U.S. firms traded on AMEX, NASDAQ, and NYSE with common ordinary shares and covered by Compustat from 2002 to 2016. We drop financial firms (SIC codes 6000–6999) and utility firms (SIC codes 4900–4999). Further, we drop firm-years with missing or zero total assets (AT), with missing or zero total debt, which we define as for Danis, Rettl, and Whited (2014) as debt in current liabilities (DLC) plus long-term debt (DLTT). We also drop observations with book leverage, defined as total debt relative to total assets (AT), equal to zero or greater than one. We then merge the resulting sample of levered Compustat firms with the Capital IQ database, which results in 35,133 firm-year observations. We exclude firm-year observations for which the difference between total debt in Compustat and total debt in Capital IQ (i.e. sum of the seven debt items) exceeds 10% of total debt in Compustat. We end up with 32,082 firm-year observations with non-missing values of total assets for 5,286 firms from 2002 to 2016. We cross-sectionally winsorize all variables at the 1% percentile. Table 2.1 reports the summary statistics of our sample.

TABLE 2.1 ABOUT HERE

We define the fraction of bond financing, *bond*, as senior bonds and notes (SBN) plus subordinated bonds and notes (SUB) relative to total debt. Correspondingly, the fraction of loan financing, *loan*, is given by drawn credit lines (DC) plus term loans (TL) relative to total debt. The average value of *bond* is 42.8% with a standard deviation of 41.5%. Similarly, the average value of *loan* is 43.9% with a standard deviation of 42.2%. We define *cash* as cash and short-term investments (CHE) relative to total assets. The value of *cash* is 17.7%, on average, and the standard deviation is 20.9%.

Further, the market-to-book ratio of assets, *Q*, is given by the market capitalization of equity (MKVALT) plus total debt relative to total assets (average value is 1.59; standard deviation is 1.27) and *size* is the natural logarithm of total assets (average value is 6.3; standard deviation is 2.1). We follow Harford, Klasa, and Maxwell (2014) and compute short-term debt, *std*, as long-term debt maturing within three years (DD1+DD2+DD3) relative to total long-term debt (DD1+DLTT). The average value of *std* is 47.3% and its standard deviation is 39.1%. We also compute the tangibility, *tang*, of firms' assets given by property, plant and equipment (PPE) relative to total assets. Here, the average value is 26.2% with a standard deviation of 23.5%. Further, we use the Standard & Poor's credit ratings and map them, by excluding the plus and minus signs, to a number from one to ten (i.e., SD=1, D=2,..., AAA=10). We note that this measure, *rat*, is only available for around 40% of the firm-year observations. The average value of the measure is 6.2 and its standard deviation is 1.2. Finally, we estimate a firm's distance to default as for Bharath and Shumway (2008). The measure has an average value of 8.6 and a standard deviation of 1.2. In summary, our sample covers a wide cross-section of firms that exhibit substantial variation in their characteristics.

2.3 Empirical analysis

In this section, we start investigating the empirical relation between bond financing and cash holdings. We then extent the analysis by studying how the usage of bond financing relates to other firm characteristics such as market-to-book ratios, size and leverage. We first provide descriptive evidence and then provide additional insights in regression analyses.

2.3.1 Sorting on bond financing

In every fiscal year, we sort firms into ten bins according to their fraction of bond financing. Specifically, we take out all firms using zero bond financing ($bond = 0$) and assign them to the lowest bin. We also take out all the firms using 100% of bond financing ($bond = 1$) and assign them to the highest bin. Further, we divide the remaining firms that use a mix of bond- and bank financing into eight equally sized groups. Thus, in total we have ten groups per fiscal year. Note that, on average we have 764 firms per year in the lowest bin of bond financing. The second highest frequency of 225 firms, on average, occurs in the highest bin of bond financing, while he intermediate bins contain 144 firms per year, on average. These figures highlight that the extreme choices of bond financing are relatively frequent. We present the relation between bond financing and cash holdings in Panels A of Figure 2-1 and Table 2.2, respectively.

The cash holdings of firms that do not use bond financing are 23.9%, while those of the firms that are in the first bin with non-zero bond financing are 10.4%. The difference in cash holdings between the two groups of 13.5 percentage points is highly significant at the 1%-level. Similarly, firms that use only bond financing exhibit cash holdings of 29.6%, while those that are in the second highest bin of bond usage exhibit cash holdings of 17.6%. Again, the difference of 12 percentage points is highly significant at the 1%-level. The cash holdings of the firms belonging to the bins in the middle are low with an overall mean value of 10.5%. The value of *cash* is slightly falling among the lowest bins but then starts to increase again for the higher bins. The largest differential in *cash* due to variation in *bond* can be up to 20.6 percentage points. Moreover, no other neighboring bins exhibit such a stark contrast in cash holdings than the ones at the extremes of the usage of bond financing. Hence, there are two main takeaways from this discussion. First, cash holdings appear to be U-shaped in the fraction of bond financing. Second, there is a stark contrast in cash holdings at the extreme bins compared to their corresponding neighboring bins. This observation is particularly interesting given that the difference in the value of *bond* between the lowest bin and the second lowest bin is small with only 4.2 percentage points. Similarly, the difference in *bond* between the highest bin and the second highest bin is only 1.1 percentage points. However, as discussed above, the difference in cash holdings to their neighboring bins are 13.5 and 12 percentage points, respectively. In other words, the extreme bins are special in terms of their value of *cash*.

How do firms vary with bond financing in terms of other key firm characteristics such as market-to-book, size and leverage? Panels B to D in Figure 2-1 and Panel A in Table 2.2 provide further insights. First, we examine *Q* and find that firms in the lowest- and highest bins of *bond* exhibit the highest values of *Q* of 1.8 and 1.9, respectively, while those in the middle bins have significantly lower values ranging between 1.3 and 1.5. The largest difference between two bins arises at the extreme groups that differ by around 0.4 (significant at 1%-level) from their immediate neighbors. Overall, *Q* is clearly U-shaped in the usage of bond financing. Focusing on *size* we see that those firms that do not use bond financing are small (*size* is 5.2), while firms that use a mix of bonds- and loans are large (*size* is up to 7.8). Interestingly, the firms that use only bond financing are small as well (*size* is 6.1). In other words, *size* is inverse U-shaped in bond financing. Again, the firms in the extreme bins are significantly different in terms of *size* at the 1%-level from their neighboring bins.

TABLE 2.2 ABOUT HERE

Further, similarly as for *size*, there emerges an inverse U-shaped pattern between leverage and bond financing. Firms that do not use bond financing or those that are fully bond financed exhibit a low value of *lev*. The leverage of the lowest bin is 15.7%, while the one of the second lowest is 28.0%. Similarly, the leverage of the second highest bin is 30.8%, while the leverage of the highest bin is 21.6%. The differences of both neighboring pairs are significant at the 1%-level. In summary, the discussion shows that cash holdings and market-to-book assets are U-shaped in bond financing, while size and leverage are inverse U-shaped in bond financing. Furthermore, the extreme bins appear to be special in that they exhibit substantial differences in their firm characteristics compared to their immediate neighbors.

Panel B in Table 2.2 further presents the relation between the usage of bond financing and other firm characteristics. Specifically, we see that the average debt maturity increases monotonically with the usage of bond financing, that is, *std* decreases from 66.4% in the lowest bin down to 27.4% in the second highest bin. Interestingly, *std* slightly increases again to a value of 41.3%

for the firms that use only bond financing. On average, though, the debt maturity increases and thus refinancing risk decreases as firms can utilize bond financing. Furthermore, we see that either firms that are totally loan financed or totally bond financed exhibit the lowest value of tangible assets of around 21.5%, while the other bins exhibit a value of around 30.2%, on average. The value of *rat* shows no particular pattern, that is, firms in the first or last bin neither exhibit the lowest nor the highest credit ratings. Further, the firms in the extreme bins are the safest in terms of their distance to default, that is, the values of *DD* are 9.7 (lowest bin) and 10.1 (highest bin), respectively. Thus, the U-shaped pattern of *cash* in *bond* is distinct from the credit risk channel as for Acharya, Davydenko, and Strebulaev (2012).

TABLE 2.3 ABOUT HERE

In the last step, we repeat the same procedure by classifying firms by their loan usage instead of bond usage. If the previously uncovered patterns reflect the decomposition of debt in bonds versus loans, then we expect the pattern implied by sorting on *loan* to be the mirror image of the one previously obtained by *bond*. Table 2.3 shows that this is indeed the case. Again, we find that *cash* and *Q* show a U-shaped pattern with respect to *loan*. Furthermore, *size* and *lev* are inverse U-shaped in *loan*.

2.3.2 Regression analyses

In this section, we provide further evidence on the non-linear relation between firm characteristics and bond financing. First, we focus on cash holdings and run variants of the following regression model:

$$cash_{i,t} = \alpha + \beta_1 bond_{i,t} + \beta_2 bond_{i,t}^2 + \varepsilon_{i,t} \tag{2.1}$$

Here, i indicates firms and t indicates time. We cluster standard errors at the 2-SIC industry level. We include the squared term, $bond^2$, to test for a non-linear relation between *cash* and *bond*. Intuitively, *cash* is U-shaped in *bond* if $\beta_1 < 0$ and $\beta_2 > 0$.

TABLE 2.4 ABOUT HERE

We present the results of the regressions in Panel A of Table 2.4 where we show six different model specifications. In Model (1) we do not include the squared term, $bond^2$. We find that the coefficient estimate of β_1 of -0.03 is negative and significant (t-stat of 1.7), however, the adjusted R^2 value is essentially zero. In Model (2), we include the term, $bond^2$, and find that there is indeed a non-linear relation between cash holdings and bond financing. That is, we find that β_1 becomes highly significant (t-stat of 4.7) and negative with an estimate of -0.65, while the estimate of β_2 is highly significant as well (t-stat o 5.1) and exhibits a positive coefficient of 0.66.

Further, the adjusted R^2 increases substantially to a value of 8%. This increase in the explained variation is also reflected in the F-statistic, which increases from a value of 3.0 in Model (1) to a value of 22.8. All these figures show that the non-linearity matters in describing the relation, that is, cash holdings are U-shaped in the fraction of bond financing. For example, the coefficient estimates imply that a firm that does not use bond financing has a 16 percentage points higher value of *cash* compared to a firm with a 50% share of bond financing. Similarly, a firm that is only bond financed has a 17 percentage points higher value of *cash* compared to a firm with 50% of bond financing.

In Models (3)–(4) we include year and industry fixed-effects (2-digit SIC level) and find that the coefficient estimates remain very robust and that the overall obtained patterns are confirmed. Moreover, in Models (5)–(6) we use year and firm fixed-effects, to investigate whether the pattern also appears within firms over time as well. We find in Model (5), where we do not use the term, $bond^2$, that the adjusted R^2 value increases substantially to 81% (F-statistic of 15.4); hence, cash holdings are rather persistent within firms. Nevertheless, in Model (6) we include the squared term and find that both coefficients, β_1 and β_2, are highly significant (at the 1%-level) with estimates of -0.15 and 0.18, respectively, and that the adjusted R^2 value increases to 82% (F-statistic of 129.8). In other words, the non-linear relation between *cash* and *bond* appears within firms over time as well. Further, the coefficient estimates imply that once a firm changes from 50% bond financing to being bond-only financed then cash holdings increase by six percentage points.

In Panel B we provide additional tests where we use indicators instead of the squared term in order to alleviate concerns about multicollinearity. That is, we first define an indicator variable, $1(bond_{i,t} = 0|1)$, that takes the value of one if the firm either does not use bonds at all or if the firm is fully bond financed. We find that firms with an extreme value of bond usage indeed have a cash-to-assets ratio that is, on average, 16 percentage points higher. We also provide tests where we split up the dummy variable into two separate indicators that take the value of one for those firms with no bond usage, $1(bond_{i,t} = 0)$, and those that are fully bond financed, $1(bond_{i,t} = 1)$, respectively. The estimates of both dummies show that the effect is symmetric, that is, loan-only and bond-only firms have a value of *cash* that is, on average, higher by 16 percentage points.

TABLE 2.5 ABOUT HERE

We repeat the same set of tests in Table 2.5 to examine whether market-to-book assets, Q, also relate in a U-shaped manner to the fraction of bond financing. We thus run in Panel A the regression model in Equation (2.1) with Q as the dependent variable. Throughout the various specifications we find that the estimate of β_1 is negative, while the one of β_2 is positive. In Panel B we repeat the tests with the dummy variables instead of the squared bond term. Again, the tests confirm that firms with an extreme bond financing policy have higher values of Q by around 0.5, on average.

TABLE 2.6 ABOUT HERE

Furthermore, Tables 2.6 and 2.7 show the corresponding results with *size* and *lev*, respectively, as the dependent variable. Given the previous descriptive discussion in Section 2.3.1, we expect an inverse U-shaped relation between these firm characteristics and bond financing. That is, we expect in Panel A, where we re-estimate Equation (2.1), that $\beta_1 > 0$ and $\beta_2 < 0$. We find that this is indeed the case in all the various model specifications. In the regressions without any fixed-effects we find that bond financing explains 21% in the variation of *size* and 14% in the variation of *lev*, respectively. The Panels B in Tables 2.6 and 2.7 confirm the overall insights. The observation that leverage relates in an inverse U-shaped manner to bond financing is particularly interesting in light of the notion that firms that have access to the bond market are less financially constrained. For example, Faulkender and Petersen (2006) show that firms that have access to the bond market have higher leverage ratios. Our findings indicate that access to the bond market provides an incomplete picture on how bond financing might relate to financial constraints. That is, as the fraction of bond financing increases, the leverage ratio decreases again. Combined with the high cash holdings, high levels of Q and small size, this observation indicates that firms that rely heavily on bond financing appear to be constrained as well.

TABLE 2.7 ABOUT HERE

2.3.3 Bond financing informs about firm characteristics

In this section, we summarize the main empirical regularities on how the fraction of bond financing informs about key firm characteristics:

1. Corporate cash holdings and market-to-book assets relate in a U-shaped manner to the intensity of bond financing.

2. Firm size and leverage relate in an inverse U-shaped manner to the intensity of bond financing.

3. Firms that do not use bond financing at all or those that are fully bond financed differ sharply in their characteristics from those firms that are closest to them in terms of the intensity of bond financing.

In the subsequent section, we present a model of financial constraints that can simultaneously rationalize these patterns.

2.4 A model of cash holdings and debt structure

In this section, we introduce a model where a firm makes a simultaneous choice on cash holdings and the mix between bond and loan financing. We build on the model of liquidity demand as for Almeida, Campello, and Weisbach (2004). In our setup, though, external financing can take two forms: through a loan and a bond. The loan matures earlier than the bond; however, the marginal cost of the bond is higher compared to the loan.

2.4.1 Model structure

The model has three dates, 0, 1, and 2. At time 0, the firm is an ongoing concern with no pre-existing debt. The cash flow from current operations is c_0. The firm faces an opportunity to invest in a long-term project, which requires at time 0 an initial investment of I_0 and pays off $f(I_0)$ at time 2. Moreover, the firm has also another investment opportunity at time 1, which requires I_1 and pays off $g(I_1)$ at time 2. The functions $f(\cdot)$ and $g(\cdot)$ are increasing, concave, and continuously differentiable. Further, the cash flow from assets in place will generate a certain cash flow of c_1 at time 1.

The current and future cash flows may not be enough to finance the investment opportunities, thus the firm wants to raise external financing. The firm can only raise external financing at time 0, but not at time 1. External financing can take two forms: through a loan, L, and a bond, B. The loan is cheaper but matures at time 1 and can be rolled over to time 2, while the bond matures at time 2. As for Acharya, Gale, and Yorulmazer (2011), there can be a rollover freeze at time 1 with probability p. If the rollover freeze occurs, then the firm cannot roll over the existing loan into the future and must pay it back. Similarly, as for Almeida, Campello, and Weisbach (2004), we allow the firm to hedge for the rollover freeze. Further, we assume a marginal cost of the bond relative to the loan of $\lambda > 1$. There is a collateral constraint when raising external finance at time 0. Specifically, the firm can raise external finance up to τI_0. That is, the firm can only pledge a fraction of existing assets as collateral, where $1-\tau$ is the haircut.

This setup implies that the firm has limitations in the capacity to raise external finance at time 0, and that there is a tradeoff between the bond and the loan. Firms with sufficient cash flows (current and future) and debt capacity borrow through the loan, as it is cheaper. However, those firms that are more constrained will raise some bonds in order to mitigate the effect of a potential rollover freeze at time 1. Moreover, the firm can save cash, C, from time 0 to 1. Cash holdings decrease current investment and facilitate future investment.

2.4.2 Solving the model

The firm maximizes the expected sum of all dividends, d, subject to several financing constraints. Specifically, the optimization problem is given by:

$$\max_{C,h,I,L,B} \quad \left(d_0 + pd_1^F + (1-p)d_1^{NF} + pd_2^F + (1-p)d_2^{NF}\right) \tag{2.2}$$

s.t.

$$\begin{aligned}
d_0 &= c_0 + L + B - I_0 - C \geq 0 \\
d_1^F &= c_1 + h^F + C - I_1^F - L \geq 0 \\
d_1^{NF} &= c_1 + h^{NF} + C - I_1^{NF} \geq 0 \\
d_2^F &= f(I_0) + g(I_1^F) - \lambda B \\
d_2^{NF} &= f(I_0) + g(I_1^{NF}) - \lambda B - L \\
\tau I_0 &\geq L + B \\
0 &= ph^F + (1-p)h^{NF}
\end{aligned}$$

We denote the state with a rollover freeze by F and the other state by NF. At time 0, the firm's external financing can come from both the loan, L, and the bond, B. The first three constraints restrict dividends to be non-negative in times 0 and 1. The firm can hedge for the rollover freeze, where h^F and h^{NF} denote the hedging payoffs. The expected value of the hedging payoff is zero, as shown by the last constraint. In the freeze state, the firm needs to repay the loan at time 1, while the bond is always due at time 2. Contrary, in the non-freeze state, the firm can roll over the loan to the final date. The maximal amount of external financing is bounded by the pledgeable time 0 investment, τI_0.

Unconstrained solution

We label a firm as financially unconstrained if it can invest at the first-best levels. The first-best solutions are given by:

$$f'(I_0^{FB}) = 1 \quad \text{and} \quad g'(I_1^{FB,NF}) = g'(I_1^{FB,F}) = 1 \tag{2.3}$$

The firm can achieve the first-best solution, if cash flows and external financing are sufficient to finance optimal investment. In this case, the firm will choose the cheaper financing source (i.e., the loan). Specifically, if the first-best investment is feasible and the firm pays the same amount of dividends in both states at time 1, the following conditions hold:

$$\begin{aligned}
I_0^{FB} &\leq c_0 + L - C \\
I_1^{FB,NF} = I_1^{FB,F} &\leq c_1 + C - pL \\
L &\leq \tau I_0^{FB} \\
B &= 0 \\
h^F &= (1-p)L \\
h^{NF} &= -pL
\end{aligned}$$

The firm has the same amount of resource of $c_1 + C - pL$ in either state at time 1, because the firm can hedge the rollover freeze. This implies that the firm can choose several financial policies as long as it achieves optimal investment. For example, the firm can increase the loan size, and choose to increase either the dividend at time 0 or at time 1, or both. This discussion shows that the financial policy of the firm is not unique at the first-best investment level. Several different policies enable the firm to invest at the first-best level.

Constrained problem

Next, we turn to the financially constrained case, that is, the firm does not have enough resources to invest at the first-best level. The firm will always choose to borrow the maximal amount, τI_0, and the firm will not pay out any dividends to the shareholders until the final period, that is, $d_0 = d_1^F = d_1^{NF} = 0$. Therefore, the maximization problem becomes:

$$\max_{C,h,L,B} \quad \big(f(c_0 - C + L + B) + pg(c_1 + C - L + h^F) \\ + (1-p)g(c_1 + C + h^{NF}) - \lambda B - (1-p)L\big) \quad (2.4)$$

s.t.

$$L + B = \tau I_0$$
$$ph^F + (1-p)h^{NF} = 0$$

Note that, the first-order condition with respect to h_F yields:

$$h^F = (1-p)L \quad \text{and} \quad h^{NF} = -pL$$

This relation implies that the maximization problem can be written as:

$$\max_{C,L,B} \quad \Pi = (f(c_0 - C + L + B) + g(c_1 + C - pL) - \lambda B - (1-p)L) \quad (2.5)$$

s.t.

$$L + B = \tau I_0$$

Cash holdings only serve to facilitate investment at time 1. Hence, after the firm has made its financing choice, L and B, optimal cash holdings are determined by the first-order condition with respect to C:

$$\frac{\partial \Pi}{\partial C} = -f'(c_0 - C + L + B) + g'(c_1 + C - pL) = 0 \quad (2.6)$$

Equation (2.6) shows that at the optimal level of cash holdings, the marginal benefit of time 0 investment equals the marginal benefit of time 1 investment. The first-order condition shows that cash holdings are fundamentally linked to bonds and loans. More cash holdings can either imply more bond financing or more loan financing. The optimal choice of loans and bonds maximizes the firms' profits. Hence, the debt structure arises endogenously given firm characteristics, that is, it depends on the payoff functions, $f(\cdot)$ and $g(\cdot)$, current and future cash flows, c_0 and c_1, the marginal cost of bonds, λ, and the probability of a rollover freeze, p.

Constrained solution

To shed light on the policies of a financially constrained firm, we impose functional forms on $f(\cdot)$ and $g(\cdot)$ as follows:

$$f(I_0) = \alpha_0 \ln I_0 \quad \text{and} \quad g(I_1) = \alpha_1 \ln I_1$$

The first-best investment levels implied by these specific payoff functions are α_0 and α_1, respectively. We can explicitly solve the problem for financially constrained firms, because they do not pay dividends at times 0 or 1. Given Equation (2.6) and the uses and sources of funds relations, $I_0 = c_0 - C + L + B$, and, $I_1 = c_1 + C - pL$, it follows that:

$$\frac{\alpha_0}{I_0} = \frac{\alpha_1}{I_1}$$

Given L and B, the overall resources are $c_0 + c_1 + (1-p)L + B$, which must be equal to the sum of I_0 and I_1. Therefore, we have:

$$I_0 = \frac{\alpha_0}{\alpha_0 + \alpha_1}\left[c_0 + c_1 + (1-p)L + B\right] \quad \text{and} \quad I_1 = \frac{\alpha_1}{\alpha_0 + \alpha_1}\left[c_0 + c_1 + (1-p)L + B\right] \tag{2.7}$$

Since the uses and sources of funds relation, $C + I_0 = c_0 + L + B$, must hold we have that:

$$C = \frac{\alpha_1 c_0 - \alpha_0 c_1 + (\alpha_1 + \alpha_0 p)L + \alpha_1 B}{\alpha_0 + \alpha_1} \tag{2.8}$$

This implies that the optimization problem of a financially constrained firm becomes:

$$\max_{L,B} \quad \Pi = \Bigg(\alpha_0 \ln \left[\frac{\alpha_0}{\alpha_0+\alpha_1} \left[c_0+c_1+(1-p)L+B\right] \right] + \\ \alpha_1 \ln \left[\frac{\alpha_1}{\alpha_0+\alpha_1} \left[c_0+c_1+(1-p)L+B\right] \right] - \lambda B - (1-p)L \Bigg) \quad (2.9)$$

s.t.

$$L+B = \tau \frac{\alpha_0}{\alpha_0+\alpha_1} \left[c_0+c_1+(1-p)L+B\right]$$

The financing constraint can be rewritten as:

$$\underbrace{\left[1-\frac{\tau\alpha_0}{\alpha_0+\alpha_1}(1-p)\right]}_{A_1} L + \underbrace{\left[1-\frac{\tau\alpha_0}{\alpha_0+\alpha_1}\right]}_{A_2} B = \underbrace{\frac{\tau\alpha_0}{\alpha_0+\alpha_1}(c_0+c_1)}_{A_3} \quad (2.10)$$

Henceforth, we denote $A_1 = 1-\frac{\tau\alpha_0}{\alpha_0+\alpha_1}(1-p)$; $A_2 = 1-\frac{\tau\alpha_0}{\alpha_0+\alpha_1}$; and $A_3 = \frac{\tau\alpha_0}{\alpha_0+\alpha_1}(c_0+c_1)$. Since $p>0$, we have that $A_1 > A_2$. Therefore, moving along the budget line, total external financing increases with bond usage. The intuition is that the loan is subject to the rollover freeze, thus it decreases the investment level at both times, 0 and 1. Moreover, the decrease in time 0 investment affects the pledgeable amount and thus external financing.

A_1 is a function of τ, p and α_1/α_0, and A_2 is a function of τ and α_1/α_0. The growth of the firm, that is, the scale of time 1 investment relative to the scale of time 0 investment, $\frac{\alpha_1}{\alpha_0}$, impacts the debt capacity. To see this, note that both A_1 and A_2 are increasing in growth, while A_3 is decreasing in growth. Hence, other things equal, an increase in growth will decrease the amount of external financing. Furthermore, an increase in the pledgeability, τ, will increase A_3 and decrease A_1 and A_2, resulting in more external financing. Substituting for $B = \frac{A_3}{A_2} - \frac{A_1}{A_2}L$, the firm's maximization problem becomes,

$$\max_{L} \quad \Pi = \Bigg(\alpha_0 \ln \left[\frac{\alpha_0}{\alpha_0+\alpha_1} \left(c_0 + c_1 + (1-p)L + \frac{A_3}{A_2} - \frac{A_1}{A_2} L \right) \right] + \alpha_1 \ln \left[\frac{\alpha_1}{\alpha_0+\alpha_1} \left(c_0 + c_1 + (1-p)L + \frac{A_3}{A_2} - \frac{A_1}{A_2} L \right) \right] - \lambda \left(\frac{A_3}{A_2} - \frac{A_1}{A_2} L \right) - (1-p)L \Bigg), \tag{2.11}$$

and the resulting derivative with respect to L gives:

$$\begin{aligned} \frac{\partial \Pi}{\partial L} &= -\left(\frac{A_1}{A_2} - 1 + p \right) \frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_2} - \left(\frac{A_1}{A_2} - 1 + p \right) L} + \left(\lambda \frac{A_1}{A_2} - 1 + p \right) \\ &= -\left(\frac{A_1}{A_2} - 1 + p \right) \Bigg[\underbrace{\frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_2} - \left(\frac{A_1}{A_2} - 1 + p \right) L}}_{\text{marginal profit}} - \underbrace{\frac{\lambda \frac{A_1}{A_2} - 1 + p}{\frac{A_1}{A_2} - 1 + p}}_{\text{marginal cost}} \Bigg] \end{aligned} \tag{2.12}$$

Since $A_1 > A_2$ and $p > 0$, it follows that, $\lambda \frac{A_1}{A_2} - 1 + p > \frac{A_1}{A_2} - 1 + p > 0$. The term $\frac{\lambda \frac{A_1}{A_2} - 1 + p}{\frac{A_1}{A_2} - 1 + p}$, measures the marginal cost of mixed financing and is a function of λ, p, τ, and α_1/α_0. This cost of mixed financing is decreasing in p and greater than λ since it holds that:

$$\frac{\lambda \frac{A_1}{A_2} - 1 + p}{\frac{A_1}{A_2} - 1 + p} = \lambda + \frac{(\lambda - 1)(1-p)}{\frac{A_1}{A_2} - 1 + p} \geq \lambda \tag{2.13}$$

Moreover, the marginal cost mainly depends on λ and is not sensitive to pledgeability or growth. The term $\frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_2} - \left(\frac{A_1}{A_2} - 1 + p \right) L}$ is the total marginal profit of time 0 and time 1 investment for a given value of L or $B = \frac{A_3}{A_2} - \frac{A_1}{A_2} L$. For a financially constrained firm, the amount of external financing decreases with the usage of loan financing, thus the marginal profit of investment increases with the usage of loan financing. Since $L \in \left[0, \frac{A_3}{A_1} \right]$, we have:

$$\frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_2}} \leq \frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_2} - \left(\frac{A_1}{A_2} - 1 + p \right) L} \leq \frac{\alpha_0+\alpha_1}{c_0 + c_1 + \frac{A_3}{A_1}(1-p)} \tag{2.14}$$

Within this range $\frac{\partial \Pi}{\partial L}$ cannot be zero, implying that the firm chooses the corner solution. If the firm's lowest possible marginal profit, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_2}}$, is higher than the marginal cost, $\frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, then the firm uses only bond financing to maximize external financing and thus the profit. The intuition is that when the marginal benefit is high, the firm will use the highest possible external financing for investment. The firm is not willing to substitute bonds with loans since the marginal loss from lower investment is larger than the benefit associated with less costly loan financing.

Contrary, when the firm's highest possible marginal profit, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_1}(1-p)}$, is lower than the marginal cost, $\frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, the firm uses only loans and no bonds to maximize the profit. When the marginal profit is low, the firm will sacrifice investment and choose financing through loans. Further, the firm does not substitute loans with bonds if the marginal benefit associated with more investment is lower than the marginal cost associated with more external financing.

Indeed, bond-only financing and loan-only financing are corner solutions. When the marginal cost of financing, $\frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, is between the lowest marginal profit, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_2}}$, and the highest marginal profit, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_1}(1-p)}$, the firm will equalize marginal profit and marginal cost by choosing a mixture of loans and bonds. Overall, there are three possible cases:

Corollary 1.1: Bond-only financing. If, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_2}} \geq \frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, then $\frac{\partial \Pi}{\partial L} \leq 0$ for $0 \leq L \leq \frac{A_3}{A_1}$, and the firm chooses the following financing mix to maximize the profit:

$$L^* = 0 \quad \text{and} \quad B^* = \frac{A_3}{A_2}$$

Corollary 1.2: Bond and loan financing. If, $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_2}} < \frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$ and $\frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_1}(1-p)} > \frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, then the firm chooses a mix of loans and bonds according to $\frac{\partial \Pi}{\partial L} = 0$, as follows:

$$L^* = \frac{\frac{A_3}{A_2}+c_0+c_1}{\frac{A_1}{A_2}-1+p} - \frac{\alpha_0+\alpha_1}{\lambda\frac{A_1}{A_2}-1+p} \quad \text{and} \quad B^* = \frac{A_3}{A_2} - \frac{A_1}{A_2}L^*$$

Corollary 1.3: Loan-only financing. If, $1 \leq \frac{\alpha_0+\alpha_1}{c_0+c_1+\frac{A_3}{A_1}(1-p)} \leq \frac{\lambda\frac{A_1}{A_2}-1+p}{\frac{A_1}{A_2}-1+p}$, then $\frac{\partial\Pi}{\partial L} \geq 0$ for $0 \leq L \leq \frac{A_3}{A_1}$, and the firm chooses the following solution:

$$L^* = \frac{A_3}{A_1} \quad \text{and} \quad B^* = 0$$

Corollaries 1.1 to 1.3 show that the debt structure of a financially constrained firm is determined by the magnitude of the marginal profit relative to the marginal cost. Keeping the marginal profit fixed, the cost of bonds plays an important role in determining debt structure: a higher λ will make bonds less preferable and the firm will increase the fraction of loans. While λ is the main determinant of the marginal cost, the marginal benefit depends on both the total investment scale, $\alpha_0+\alpha_1$, and the resources available, $c_0+c_1+(1-p)L+B$. Assume that we fix cash flows, c_0 and c_1, cost of bonds, λ, probability of freeze, p, and pledgeability, τ, and we keep growth, α_1/α_0, fixed so that A_1, A_2, and A_3 do not change. Then it follows that the investment scale matters for debt structure: the firm increases the fraction of bond financing as investment scale increases. Additionally, keeping only investment scale and cash flow fixed, a high growth leads to a decrease in external financing. This effect results in a higher marginal profit and subsequently leads to more bond financing. Overall, there are three main implications for debt structure:

1. For a given growth, α_1/α_0, and keeping other parameters fixed as well, firms with higher investment scale, $\alpha_0+\alpha_1$, use more bond financing.

2. For a given investment scale, $\alpha_0+\alpha_1$, and keeping other parameters fixed as well, firms with more growth, α_1/α_0, use more bond financing.

3. A decline in the marginal cost of bonds, λ, keeping other parameters fixed, leads to more bond financing.

2.4.3 How do cash holdings relate to debt structure?

The relation between cash holdings and debt structure is non-trivial. As discussed above, for financially constrained firms both cash holdings and debt structure are endogenously determined.

We revisit Equation (2.8) and obtain the optimal cash-to-assets ratio, c^*, as cash holdings, C^*, relative to total assets, $S^* = c_0 + L^* + B^*$:

$$\begin{aligned} c^* = \frac{C^*}{S^*} &= \frac{\alpha_1 c_0 - \alpha_0 c_1 + (\alpha_1 + \alpha_0 p)L^* + \alpha_1 B^*}{(\alpha_0 + \alpha_1)(c_0 + L^* + B^*)} \\ &= \frac{\alpha_1}{\alpha_0 + \alpha_1} + \frac{\alpha_0}{\alpha_0 + \alpha_1} \frac{pL^*}{c_0 + L^* + B^*} - \frac{\alpha_0}{\alpha_0 + \alpha_1} \frac{c_1}{c_0 + L^* + B^*} \end{aligned} \tag{2.15}$$

The first term, $\frac{\alpha_1}{\alpha_0+\alpha_1}$, measures the scale of time 1 investment relative to total investment scale and is the main determinant of the cash-to-asset ratio. The second term shows the refinancing channel, that is, the cash ratio increases with the usage of loans. Previous research (Harford, Klasa, and Maxwell, 2014) suggests that firms save more cash because of refinancing risk. The third term shows that the cash ratio decreases with the future cash flow c_1. Our model suggests that refinancing risk can be mitigated through bond financing. However, some firm characteristics lead to more bond financing and at the same time imply more cash holdings. For example, all else equal, a decrease in c_1 increases the fraction of bond financing because the firm has fewer internal resources relative to investment need. At the same time, a decrease in c_1 increases the cash ratio if the third term in Equation (2.15) dominates. Furthermore, assuming that the investment scale, $\alpha_0 + \alpha_1$, and other things are fixed, an increase in growth, α_1/α_0, yields more bond financing as well as a higher cash-to-assets ratio due to the collateral constraint.

Equation (2.15) also shows that some firm characteristics affect the cash ratio directly and/or indirectly, that is, through L^* and B^*. For example, the cost of market debt, λ, and pledgebility, τ, have an effect on the cash-to-assets ratio only indirectly through L^* and B^*. While c_0, c_1, α_0, α_1 and p have an effect on cash holdings both directly and indirectly. This relation implies that if the change in debt structure is caused by characteristics that have no direct impact on the cash-to-assets ratio, then an increase (decrease) in bond financing leads to a decrease (increase) in cash holdings; thus reflecting the refinancing risk channel.

2.4.4 Model calibration

In this section, we infer the latent parameters that render the fraction of bond financing informative for firm characteristics by calibrating our model to the data. To do so, we first define the model-implied measures of the firm characteristics of Panel A of Table 2.2. Equation (2.15) defines the cash-to-assets ratio, c^*, and firm size, S^*, respectively. We define fraction of bond financing, b^*, by:

$$b^* = \frac{B^*}{L^* + B^*} \tag{2.16}$$

The value of future investment relative to current investment is given by:

$$q^* = \frac{g(I_1^*)}{f(I_0^*)} = \frac{\alpha_1 \ln(I_1^*)}{\alpha_0 \ln(I_0^*)} \tag{2.17}$$

Finally, the leverage ratio, l^*, is given by:

$$l^* = \frac{L^* + B^*}{S^*} \tag{2.18}$$

In total we have five empirical firm characteristics, $M := [bond, cash, Q, size, lev]$, and their theoretical counterparts, $m := [b^*, c^*, q^*, S^*, l^*]$. However, there are seven exogenous parameters in the model (α_0, α_1, c_0, c_1, τ, λ, p), implying that we have five equations in seven unknowns. Therefore, we choose to fix $\lambda = 1.05$ and $p = 0.15$ for every firm, that is, bonds are 5% more expensive than loans and there is a 15% probability of a rollover freeze. Firms can differ in their investment needs, α_0 and α_1, cash flows, c_0 and c_1, and pledgeability, τ, but they face the same external financing conditions regarding bonds and loans. For each of the ten bond financing bins, $k \in [1,\ldots,10]$, in Table 2.2 we separately calibrate the exogenous parameters of the model by minimizing the distance between empirical and model-implied firm characteristics:

$$\underset{\alpha_0,\alpha_1,c_0,c_1,\tau}{\operatorname{argmin}} \; ||M_k - m_k|| \quad \text{for} \quad k \in [1,\ldots,10] \tag{2.19}$$

Our model suggests that firms that do not use bond financing could be financially unconstrained and thus they are at their first-best choices. Alternatively, these firms could be financially constrained and therefore choose corner solutions. Note that, this implies that one could not calibrate the model for financially unconstrained firms because their financial policies are not unique. Therefore, in the calibration we implicitly treat all the firms with zero bond financing as if they were financially constrained. For firms that are bond-only financed the model implies that their policies are unique as they are financially constrained. At the corner solutions b^* is either zero or one, which implies that we can only find upper and lower bounds, respectively, for the parameter values. To calibrate the parameters for these two groups of firms we thus impose the restriction that they are on the border of choosing the corner solution. That is, the inequality conditions become equality conditions for bond-only financing in Corollary 1.1, $\frac{\alpha_0+\alpha_1}{c_0+c_1+A_3/A_2} = \frac{\lambda A_1/A_2-1+p}{A_1/A_2-1+p}$, and loan-only financing in Corollary 1.3, $\frac{\alpha_0+\alpha_1}{c_0+c_1+A_3/A_2(1-p)} = \frac{\lambda A_1/A_2-1+p}{A_1/A_2-1+p}$, respectively.

FIGURE 2-2 ABOUT HERE

Figure 2-2 and Panel A of Table 2.8 show the model-implied firm characteristics across the ten bond financing bins. The calibrated model matches the data perfectly, that is, c^* and q^* are U-shaped in b^*, while S^* and l^* are inverse U-shaped in b^*. Further, in Panel B of Table 2.8

we report the calibrated parameters values (α_0, α_1, c_0, c_1, τ) across the ten bond financing bins. As discussed above, for the extreme bins we treat the firms as if they were on the boundaries of corner solutions. In these corner regions α_1/α_0, c_0, c_1, and τ can be well identified by *cash*, *Q*, *size* and *lev*, while $\alpha_0+\alpha_1$ is not directly inferable. According to Corollaries 1.1 and 1.3 what we report is the upper bound (for loan-only financing) and lower bound (for bond-only financing) of α_0 and α_1 in the corner bins.

TABLE 2.8 ABOUT HERE

In Figure 2-3 we plot combinations of the estimated parameters across the ten bond financing bins. Panel A shows total investment scale relative to total cash flows, $\frac{\alpha_0+\alpha_1}{c_0+c_1}$. As the fraction of bond financing increases the relative investment need increases as well.[1] Panel B reports growth, $\frac{\alpha_1}{\alpha_0}$, which shows the expected U-shaped pattern in b^*. Panel C presents the future cash flow relative to current cash flow, $\frac{c_1}{c_0}$. The graph reveals that relative cash flow exhibits an inverse U-shaped pattern in bond financing. That is, the loan-only and bond-only financing firms have low future relative to current cash flows. These low relative future cash flows combined with the high growth opportunities contribute to the large cash-to-assets ratios of the firms in the extreme bins of bond financing. In Panel D we report pledgeability, τ, which shows an inverse U-shaped pattern as well. The low pledgeability combined with the high growth opportunities yield low leverage ratios for the loan-only and bond-only financing firms. Moreover, the model-implied pattern of pledgeability is consistent with the empirical pattern of tangible assets, *tang*, reported in Panel B of Table 2.2.

FIGURE 2-3 ABOUT HERE

2.5 Conclusion

We investigate how corporate cash holdings and debt structures are related. We document a non-trivial link between these two characteristics. Specifically, cash holdings and the fraction of

[1] Note that for the bond-only financing firms the value in Panel A of Figure 2-3 is a lower bound. Thus, the relative investment need could also be very high for bond-only financing firms. We use a "cross" instead of a "circle" to indicate the boundary values for the loan-only and bond-only financing firms.

bond financing exhibit a U-shaped relation in the cross-section of firms. On average, a firm that is 50% bond-financed has a cash-to-assets ratio that is 17 percentage points lower than a firm that is either entirely bond-financed or a firm that does not use bond financing at all.

Further, the intensity of bond financing is informative about the cross-sectional distribution of market-to-book assets, size and leverage as well. Similarly as for cash holdings we find that market-to-book ratios are linked in a U-shaped fashion to bond financing. Contrary, we find that size and leverage are inverse U-shaped in the usage of bond financing. Overall, these patterns suggest that both types of firms with extreme bond financing choices (i.e., no bond financing and entirely bond financed) appear to be financially constrained: they have high cash holdings, high market-to-book ratios, they are small and have low levels of leverage.

We use a model of liquidity demand to rationalize why the usage of bond financing simultaneously informs about several firm characteristics, and why non-linear relations emerge. We calibrate the model to the data to infer the latent parameters. We find that as the fraction of bond financing increases the investment needs relative to cash flows increase as well. Further, growth is U-shaped in bond financing, while future cash flows relative to current cash flows and the fraction of pledgeable assets are inverse U-shaped.

Figures and tables

Table 2.1: Summary statistics.

This table presents summary statistics of the variables used in the empirical analysis. We show the mean; standard deviation; 10%, 25%, 50%, 70% and 90% percentiles, respectively, as well as the number of observations. We show the fraction of bond financing, *bond*; the fraction of loan financing, *loan*; the cash-to-assets ratio, *cash*; the market-to-book ratio of assets, *Q*; the natural logarithm of total assets, *size*; the book leverage, *lev*; the fraction of short-term debt, *std*; the tangibility, *tang*; the Standard & Poor's credit rating, *rat*, mapped to natural numbers (i.e., SD=1, D=2, ..., AAA=10); and the distance-to-default, *DD*. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016.

	mean	sd	p10	p25	p50	p75	p90	N
bond	0.428	0.415	0.000	0.000	0.365	0.886	1.000	32,082
loan	0.439	0.422	0.000	0.000	0.328	0.959	1.000	32,082
cash	0.177	0.209	0.010	0.032	0.097	0.236	0.483	32,080
Q	1.588	1.273	0.605	0.820	1.185	1.862	3.008	30,521
size	6.264	2.056	3.497	4.739	6.299	7.695	8.950	32,082
lev	0.252	0.199	0.015	0.090	0.221	0.367	0.532	32,082
std	0.473	0.391	0.006	0.103	0.366	0.960	1.000	27,639
tang	0.262	0.235	0.034	0.080	0.182	0.379	0.651	32,061
rat	6.185	1.217	5.000	5.000	6.000	7.000	8.000	12,279
DD	8.637	9.582	1.243	3.536	6.956	11.673	17.564	29,406

Table 2.2: Sorting firms on fraction of bond financing.

In every fiscal year we sort firms based on their fraction of bond financing, *bond*, into ten bins. The lowest bin contains all firms that do not use bond financing (*bond*=0), while the highest bin includes all firms that only use bond financing (*bond*=1). All other firms are distributed equally in bins two to nine based on their value of *bond*. For each bin, we report in Panel A the average value of the fraction of bond financing, *bond*; the fraction of loan financing, *loan*; the cash-to-assets ratio, *cash*; the market-to-book value of assets, *Q*; the natural logarithm of total assets, *size*; the book leverage, *lev*. Further, in Panel B we report the fraction of short-term debt, *std*; the tangibility, *tang*; the Standard & Poor's credit rating, *rat*, mapped to natural numbers (i.e., SD=1, D=2, ..., AAA=10); and the distance-to-default, *DD*. We also report the average number of firms in the bins. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016.

	Bond financing bin									
	Low	2	3	4	5	6	7	8	9	High
Panel A: Firm characteristics										
bond	0.000	0.042	0.227	0.434	0.597	0.735	0.850	0.937	0.989	1.000
loan	0.731	0.856	0.677	0.479	0.317	0.190	0.094	0.031	0.004	0.000
cash	0.239	0.104	0.095	0.090	0.095	0.102	0.108	0.140	0.176	0.296
Q	1.811	1.402	1.273	1.305	1.337	1.359	1.366	1.426	1.517	1.919
size	5.184	5.581	6.148	6.791	7.169	7.494	7.755	7.695	7.543	6.059
lev	0.157	0.280	0.326	0.360	0.353	0.329	0.318	0.301	0.308	0.216
Panel B: Other characteristics										
std	0.664	0.556	0.488	0.389	0.345	0.329	0.298	0.285	0.274	0.413
tang	0.214	0.292	0.289	0.291	0.308	0.345	0.325	0.308	0.260	0.215
rat	5.601	5.578	5.711	5.961	6.153	6.389	6.536	6.505	6.476	6.074
DD	9.740	6.541	6.304	6.560	7.310	7.992	8.571	8.757	8.973	10.085
av. N firms	764	144	144	144	144	144	144	144	144	225

Table 2.3: Sorting firms on fraction of loan financing.

In every fiscal year we sort firms based on their fraction of loan financing, *loan*, into ten bins. The lowest bin contains all firms that do not use loan financing (*loan*=0), while the highest bin includes all firms that only use loan financing (*loan*=1). All other firms are distributed equally in bins two to nine based on their value of *loan*. For each bin, we report in Panel A the average value of the fraction of bond financing, *bond*; the fraction of loan financing, *loan*; the cash-to-assets ratio, *cash*; the market-to-book value of assets, *Q*; the natural logarithm of total assets, *size*; the book leverage, *lev*. Further, in Panel B we report the fraction of short-term debt, *std*; the tangibility, *tang*; the Standard & Poor's credit rating, *rat*, mapped to natural numbers (i.e., SD=1, D=2, ..., AAA=10); and the distance-to-default, *DD*. We also report the average number of firms in the bins. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016.

	Loan financing bin									
	Low	2	3	4	5	6	7	8	9	High
Panel A: Firm characteristics										
bond	0.675	0.875	0.788	0.669	0.521	0.334	0.140	0.031	0.003	0.000
loan	0.000	0.022	0.112	0.249	0.410	0.590	0.790	0.936	0.992	1.000
cash	0.276	0.123	0.104	0.098	0.099	0.094	0.109	0.125	0.125	0.226
Q	1.915	1.446	1.285	1.341	1.299	1.306	1.338	1.455	1.465	1.741
size	6.209	8.208	7.574	7.153	6.799	6.442	5.762	5.420	5.614	5.148
lev	0.183	0.322	0.332	0.346	0.359	0.354	0.282	0.241	0.270	0.170
Panel B: Other characteristics										
std	0.515	0.275	0.299	0.334	0.357	0.423	0.548	0.586	0.552	0.601
tang	0.217	0.304	0.348	0.350	0.308	0.290	0.277	0.256	0.232	0.227
rat	6.457	6.826	6.281	6.056	5.808	5.737	5.555	5.552	5.500	5.553
DD	11.342	9.470	7.670	7.067	6.555	6.090	6.456	6.719	6.765	8.867
av. N firms	631	146	146	146	146	146	146	146	146	342

Table 2.4: Cash regressions.

In Panel A we regress the cash-to-assets ratio, $cash_{i,t}$, of firm i at time t against the fraction of bond financing, $bond_{i,t}$, and its squared term, $bond^2_{i,t}$. In Panel B we regress the cash-to-assets ratio, $cash_{i,t}$, against the fraction of bond financing, $bond_{i,t}$, and dummy variables. The dummies take the value of one if the firm has an extreme usage of bond financing, $1(bond_{i,t} = 0|1)$, or if the firm either does not use bonds at all, $1(bond_{i,t} = 0)$, or if it is fully bond-financed, $1(bond_{i,t} = 1)$. The industry fixed-effect is at the two-digit SIC level. We report the number of observations, N, the number of firms, the adjusted R^2 value as well as the F-statistic. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016. In parentheses are t-statistics based on clustered standard errors at the two-digit SIC level.

Panel A: Main specifications	(1)	(2)	(3)	(4)	(5)	(6)
$bond_{i,t}$	-0.03^{*}	-0.65^{***}	-0.02	-0.53^{***}	0.02^{***}	-0.15^{***}
	(-1.73)	(-4.72)	(-0.83)	(-4.49)	(3.92)	(-6.24)
$bond^2_{i,t}$		0.66^{***}		0.54^{***}		0.18^{***}
		(5.05)		(5.13)		(9.05)
Adj. R^2	0.00	0.08	0.23	0.28	0.81	0.82
F-statistic	3.01	22.82	0.69	40.38	15.40	129.76
Panel B: Other specifications	(7)	(8)	(9)	(10)	(11)	(12)
$bond_{i,t}$	0.06^{***}	0.06^{***}	0.05^{***}	0.05^{***}	0.04^{***}	0.04^{***}
	(6.01)	(4.71)	(5.69)	(4.92)	(7.64)	(8.58)
$1(bond_{i,t} = 0\|1)$	0.16^{***}		0.13^{***}		0.04^{***}	
	(5.29)		(5.28)		(8.82)	
$1(bond_{i,t} = 0)$		0.16^{***}		0.13^{***}		0.04^{***}
		(4.55)		(5.01)		(6.93)
$1(bond_{i,t} = 1)$		0.16^{***}		0.13^{***}		0.04^{***}
		(6.41)		(5.50)		(6.96)
Adj. R^2	0.12	0.12	0.30	0.30	0.82	0.82
F-statistic	26.15	26.25	71.86	50.35	106.83	93.26
Year FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Firm FE	No	No	No	No	Yes	Yes
N	32,080	32,080	32,080	32,080	32,080	32,080
N of firms	5,286	5,286	5,286	5,286	5,286	5,286

Table 2.5: Market-to-book regressions.

In Panel A we regress the market-to-book ratio of assets, $Q_{i,t}$, of firm i at time t against the fraction of bond financing, $bond_{i,t}$, and its squared term, $bond^2_{i,t}$. In Panel B we regress the market-to-book ratio of assets, $Q_{i,t}$, against the fraction of bond financing, $bond_{i,t}$, and dummy variables. The dummies take the value of one if the firm has an extreme usage of bond financing, $1(bond_{i,t} = 0|1)$, or if the firm either does not use bonds at all, $1(bond_{i,t} = 0)$, or if it is fully bond-financed, $1(bond_{i,t} = 1)$. The industry fixed-effect is at the two-digit SIC level. We report the number of observations, N, the number of firms, the adjusted R^2 value as well as the F-statistic. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016. In parentheses are t-statistics based on clustered standard errors at the two-digit SIC level.

Panel A: Main specifications						
	(1)	(2)	(3)	(4)	(5)	(6)
$bond_{i,t}$	-0.15^{***}	-2.12^{***}	-0.10^{***}	-1.59^{***}	-0.06	-0.55^{***}
	(-3.59)	(-5.33)	(-4.03)	(-5.55)	(-1.59)	(-5.12)
$bond^2_{i,t}$		2.09^{***}		1.57^{***}		0.51^{***}
		(4.92)		(5.33)		(5.14)
Adj. R^2	0.00	0.02	0.14	0.15	0.64	0.64
F-statistic	12.90	20.30	16.23	17.65	2.53	13.52

Panel B: Other specifications						
	(7)	(8)	(9)	(10)	(11)	(12)
$bond_{i,t}$	0.12^{*}	0.14^{**}	0.10^{**}	0.11^{***}	-0.01	-0.03
	(1.77)	(2.15)	(2.63)	(3.11)	(-0.17)	(-0.90)
$1(bond_{i,t} = 0\|1)$	0.51^{***}		0.39^{***}		0.13^{***}	
	(5.50)		(5.99)		(6.74)	
$1(bond_{i,t} = 0)$		0.52^{***}		0.40^{***}		0.11^{***}
		(5.95)		(7.88)		(4.62)
$1(bond_{i,t} = 1)$		0.49^{***}		0.37^{***}		0.16^{***}
		(4.75)		(4.04)		(5.75)
Adj. R^2	0.03	0.03	0.16	0.16	0.64	0.64
F-statistic	24.10	18.72	21.34	25.60	23.07	15.75
Year FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Firm FE	No	No	No	No	Yes	Yes
N	30,521	30,521	30,521	30,521	30,521	30,521
N of firms	5,201	5,201	5,201	5,201	5,201	5,201

Table 2.6: Size regressions.

In Panel A we regress the natural logarithm of total assets, $size_{i,t}$, of firm i at time t against the fraction of bond financing, $bond_{i,t}$, and its squared term, $bond^2_{i,t}$. In Panel B we regress the natural logarithm of total assets, $size_{i,t}$, against the fraction of bond financing, $bond_{i,t}$, and dummy variables. The dummies take the value of one if the firm has an extreme usage of bond financing, $1(bond_{i,t} = 0|1)$, or if the firm either does not use bonds at all, $1(bond_{i,t} = 0)$, or if it is fully bond-financed, $1(bond_{i,t} = 1)$. The industry fixed-effect is at the two-digit SIC level. We report the number of observations, N, the number of firms, the adjusted R^2 value as well as the F-statistic. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016. In parentheses are t-statistics based on clustered standard errors at the two-digit SIC level.

Panel A: Main specifications						
	(1)	(2)	(3)	(4)	(5)	(6)
$bond_{i,t}$	2.03***	6.22***	1.96***	5.65***	0.11***	0.81***
	(19.53)	(10.81)	(19.64)	(9.99)	(2.83)	(9.26)
$bond^2_{i,t}$		−4.42***		−3.89***		−0.71***
		(−7.77)		(−7.31)		(−10.17)
Adj. R^2	0.17	0.21	0.28	0.31	0.96	0.96
F-statistic	381.58	177.51	385.78	183.53	8.02	51.78

Panel B: Other specifications						
	(7)	(8)	(9)	(10)	(11)	(12)
$bond_{i,t}$	1.44***	2.26***	1.45***	2.19***	0.06	0.04
	(13.45)	(15.22)	(18.00)	(17.34)	(1.40)	(1.02)
$1(bond_{i,t} = 0\|1)$	−1.10***		−0.98***		−0.16***	
	(−8.20)		(−7.71)		(−8.27)	
$1(bond_{i,t} = 0)$		−0.48***		−0.43***		−0.17***
		(−3.76)		(−3.94)		(−8.35)
$1(bond_{i,t} = 1)$		−1.86***		−1.66***		−0.14***
		(−10.66)		(−9.67)		(−5.10)
Adj. R^2	0.23	0.24	0.32	0.34	0.96	0.96
F-statistic	194.90	159.87	219.34	160.91	35.21	26.03
Year FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Firm FE	No	No	No	No	Yes	Yes
N	32,082	32,082	32,082	32,082	32,082	32,082
N of firms	5,286	5,286	5,286	5,286	5,286	5,286

Table 2.7: Leverage regressions.

In Panel A we regress the book leverage, $lev_{i,t}$, of firm i at time t against the fraction of bond financing, $bond_{i,t}$, and its squared term, $bond^2_{i,t}$. In Panel B we regress the book leverage, $lev_{i,t}$, against the fraction of bond financing, $bond_{i,t}$, and dummy variables. The dummies take the value of one if the firm has an extreme usage of bond financing, $1(bond_{i,t} = 0|1)$, or if the firm either does not use bonds at all, $1(bond_{i,t} = 0)$, or if it is fully bond-financed, $1(bond_{i,t} = 1)$. The industry fixed-effect is at the two-digit SIC level. We report the number of observations, N, the number of firms, the adjusted R^2 value as well as the F-statistic. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016. In parentheses are t-statistics based on clustered standard errors at the two-digit SIC level.

Panel A: Main specifications						
	(1)	(2)	(3)	(4)	(5)	(6)
$bond_{i,t}$	0.11***	0.71***	0.10***	0.63***	0.07***	0.34***
	(12.02)	(14.39)	(9.67)	(14.91)	(9.26)	(14.80)
$bond^2_{i,t}$		−0.63***		−0.55***		−0.27***
		(−12.21)		(−12.54)		(−14.75)
Adj. R^2	0.05	0.14	0.17	0.23	0.70	0.71
F-statistic	144.47	150.19	93.54	137.71	85.81	111.52

Panel B: Other specifications						
	(7)	(8)	(9)	(10)	(11)	(12)
$bond_{i,t}$	0.04***	0.01	0.04***	0.01	0.04***	0.03***
	(3.18)	(0.57)	(3.34)	(0.60)	(6.19)	(4.05)
$1(bond_{i,t} = 0\|1)$	−0.14***		−0.12***		−0.08***	
	(−12.87)		(−13.87)		(−22.76)	
$1(bond_{i,t} = 0)$		−0.16***		−0.15***		−0.09***
		(−13.52)		(−13.17)		(−15.92)
$1(bond_{i,t} = 1)$		−0.11***		−0.09***		−0.07***
		(−7.77)		(−8.59)		(−17.70)
Adj. R^2	0.15	0.15	0.24	0.24	0.71	0.71
F-statistic	175.06	133.48	163.63	152.95	259.59	178.35
Year FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	No	No
Firm FE	No	No	No	No	Yes	Yes
N	32,082	32,082	32,082	32,082	32,082	32,082
N of firms	5,286	5,286	5,286	5,286	5,286	5,286

Table 2.8: Model-implied firm characteristics and calibrated parameters.

For each of the ten bond financing bins we calibrate the parameters of our model to match the values of firm characteristics, that is, *cash*, *Q*, *size*, *lev*, and *bond*. We fix the cost of bonds, $\lambda = 1.05$, and the probability of a rollover freeze, $p = 0.15$, for every firm and calibrate the remaining parameters α_0, α_1, c_0, c_1, and τ. Panel A reports the model-implied firm characteristics for the ten bond financing bins, and Panel B reports the calibrated parameters for the ten bond financing bins.

	Bond financing bin									
	Low	2	3	4	5	6	7	8	9	High
Panel A: Model-implied firm characteristics										
b^*	0.000	0.042	0.227	0.434	0.597	0.735	0.850	0.937	0.989	1.000
c^*	0.239	0.104	0.095	0.090	0.095	0.102	0.108	0.140	0.176	0.296
q^*	1.806	1.401	1.273	1.305	1.337	1.359	1.366	1.426	1.517	1.919
S^*	5.156	5.580	6.147	6.791	7.169	7.494	7.755	7.695	7.543	6.059
l^*	0.157	0.280	0.326	0.360	0.353	0.329	0.318	0.301	0.308	0.216
Panel B: Calibrated parameters										
α_0	5.14	6.47	7.15	7.92	8.32	8.66	8.91	8.54	8.01	5.54
α_1	7.35	8.00	8.35	9.44	10.09	10.62	10.99	10.82	10.55	8.30
c_0	4.35	4.02	4.14	4.35	4.64	5.03	5.29	5.37	5.22	4.75
c_1	4.50	5.83	6.14	6.95	7.34	7.59	7.75	7.34	6.87	4.60
τ	0.21	0.31	0.36	0.40	0.39	0.37	0.36	0.35	0.37	0.31

Figure 2-1: Fraction of bond financing and firm characteristics: Data.

This figure shows the relation between the fraction of bond financing, *bond*, and cash holdings, *cash* (Panel A); market-to-book ratio of assets, *Q* (Panel B); firm size given by the natural logarithm of total assets, *size* (Panel C); and book leverage, *lev* (Panel D). In every fiscal year we sort firms based on their fraction of bond financing, *bond*, into ten bins. The lowest bin contains all firms that do not use bond financing (*bond*=0), while the highest bin includes all firms that only use bond financing (*bond*=1). All other firms are distributed equally in bins two to nine based on their value of *bond*. For each bin, we report the average value of the corresponding firm characteristic as well as the 95% confidence interval. The sample comprises information from Compustat and Capital IQ for 5,286 firms over the period from 2002 to 2016.

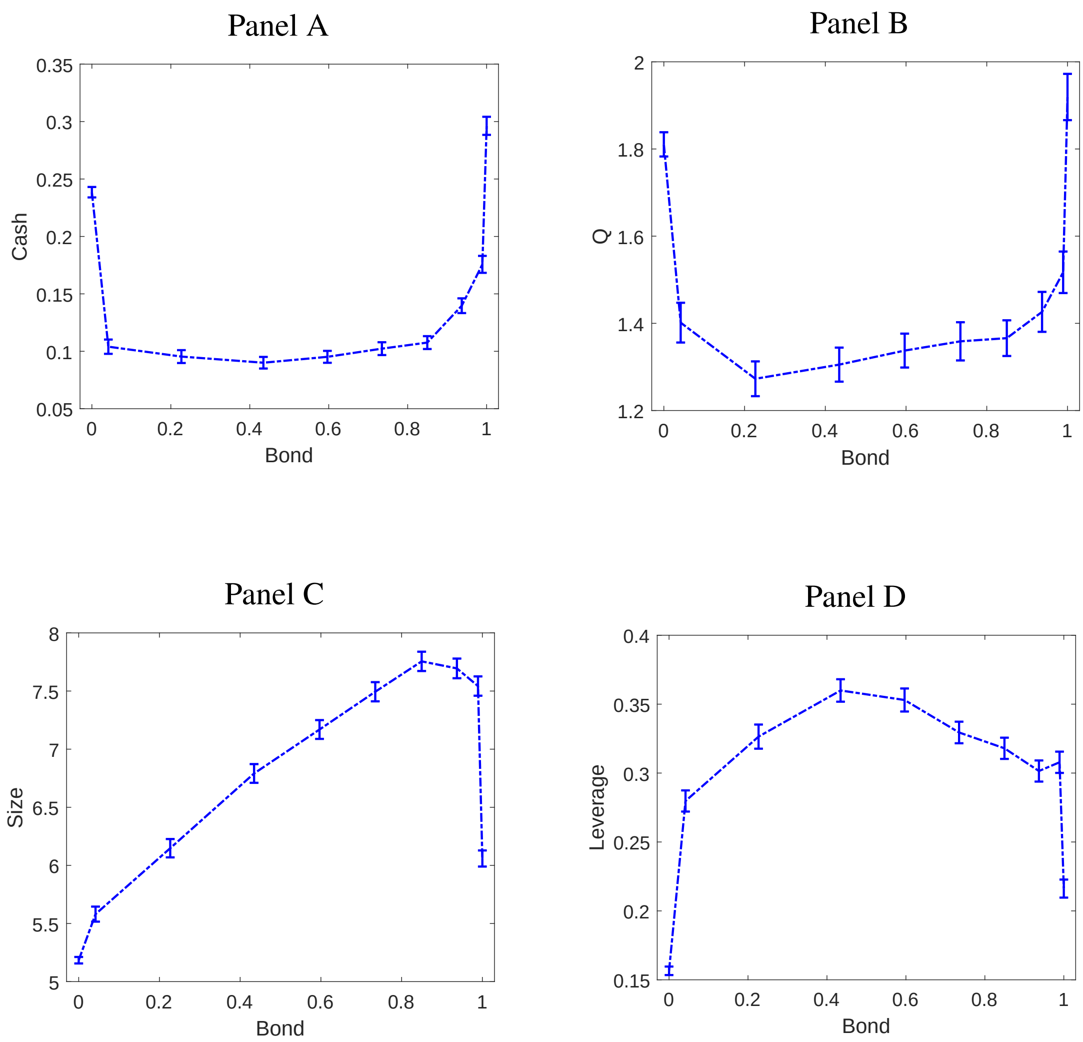


Figure 2-2: Fraction of bond financing and firm characteristics: Model.

For each of the ten bond financing bins we calibrate the parameters of our model to match the values of firm characteristics, that is, *cash*, *Q*, *size*, *lev*, and *bond*. We fix the cost of bonds, $\lambda = 1.05$, and the probability of a rollover freeze, $p = 0.15$, for every firm and calibrate the remaining parameters α_0, α_1, c_0, c_1, and τ. Using the calibrated parameters we obtain the model-implied firm characteristics for the ten bond financing bins. This figure shows the model-implied relation between the fraction of bond financing, b^*, and the cash-to-assets ratio, c^* (Panel A); between b^* and growth opportunities, q^* (Panel B); between b^* and firm size, S^* (Panel C); and between b^* and book leverage, l^* (Panel D).

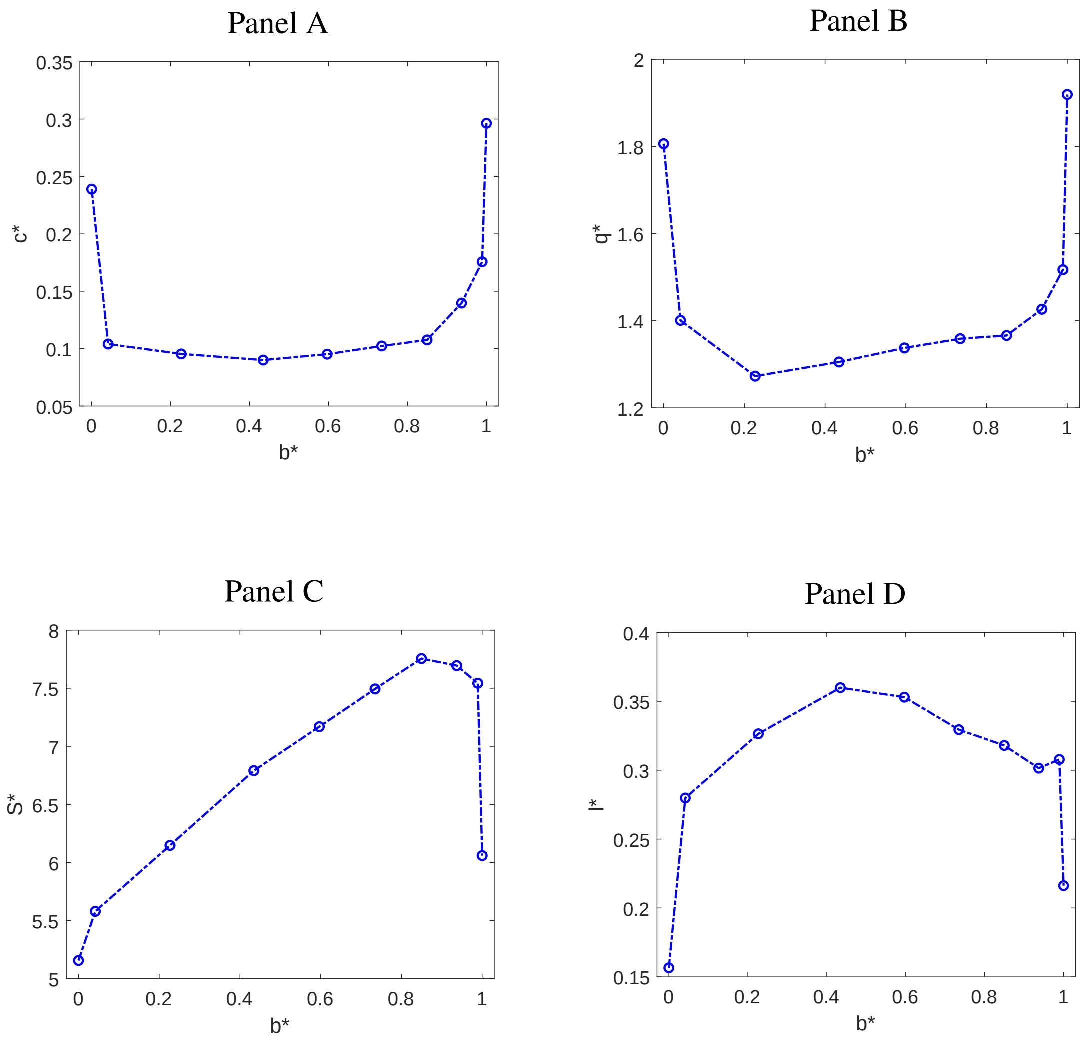
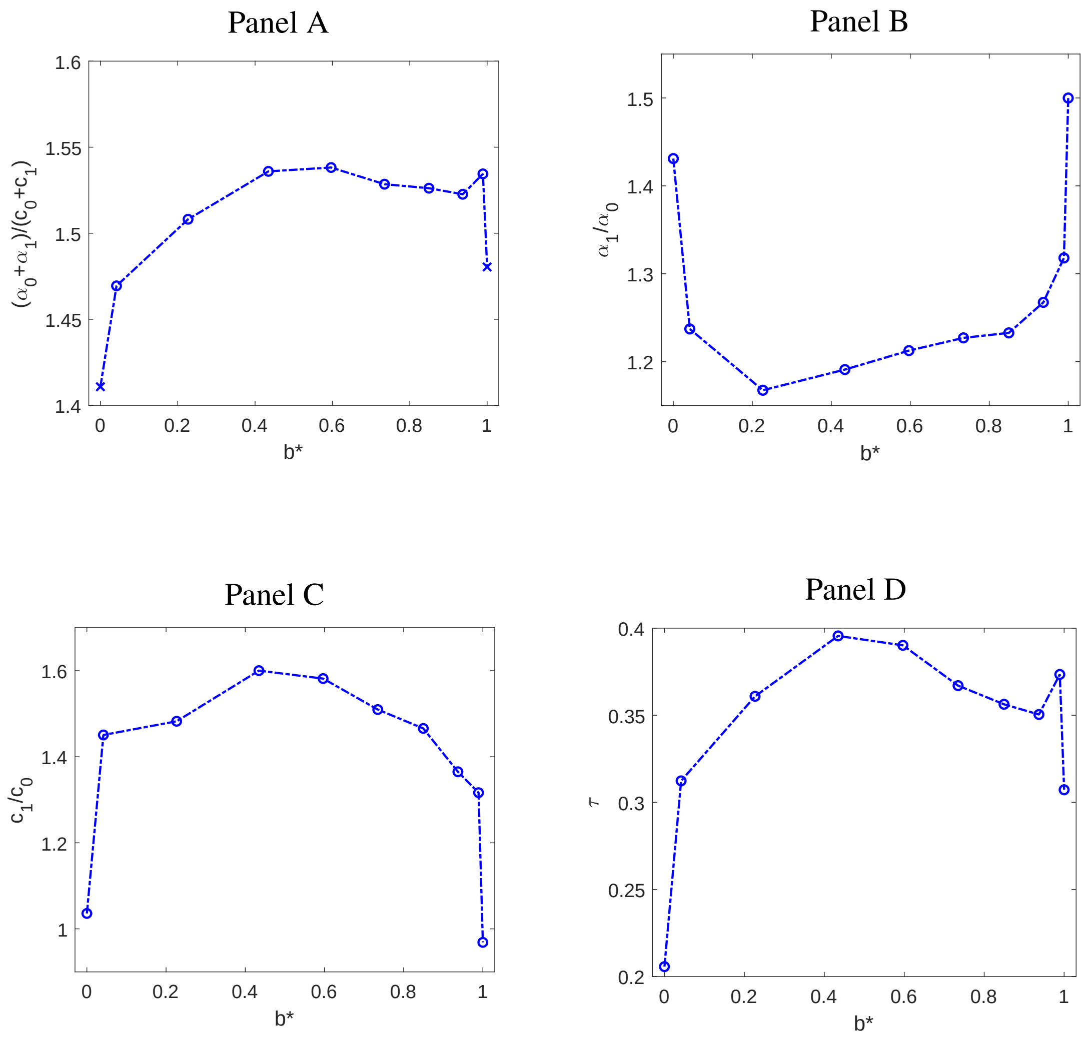


Figure 2-3: Fraction of bond financing and calibrated parameters.

For each of the ten bond financing bins we calibrate the parameters of our model to match the values of firm characteristics, that is, *cash*, Q, *size*, *lev*, and *bond*. We fix the cost of bonds, $\lambda = 1.05$, and the probability of a rollover freeze, $p = 0.15$, for every firm and calibrate the remaining parameters α_0, α_1, c_0, c_1, and τ. This figure shows for the ten bond financing bins, the relative investment scales to total cash flows, $(\alpha_0+\alpha_1)/(c_0+c_1)$ (Panel A); growth, α_1/α_0 (Panel B); the future cash flow relative to current cash flow, c_1/c_0 (Panel C); and pledgibility, τ (Panel D). In Panel A we plot the upper bound $(\alpha_0+\alpha_1)/(c_0+c_1)$ for the firms with no bond financing ($b^* = 0$) and the lower bound of $(\alpha_0+\alpha_1)/(c_0+c_1)$ for the firms that use bond financing ($b^* = 1$).



Appendix A

Appendix to Chapter 1

A.1 Data Appendix

This appendix gives in detail the construction of the variables used in this study.

A.1.1 Firm-level variables

Firm-level variables are constructed from Compustat North America - Fundamentals Annual and Compustat Segments. Numbers in parentheses refer to the annual Compustat item number.

Book debt: Debt in current liabilities (34) + Long-term debt (9)

Book leverage: Book debt / Total assets (6)

Market equity: Stock price (199) * Shares outstanding (54)

Market leverage: Book debt / (Book debt + Market equity)

Short-term debt to assets: Debt in current liabilities (34) / Total assets (6)

Long-term debt to assets: Long-term debt (9) / Total assets (6)

Return on assets: Operating Income After Depreciation (178) / Total assets (6)

Tobin's q: (Market equity + Book debt + Preferred stock liquidating value (10) - Deferred taxes (35)) / Total assets (6)

Tangibility: Net property, plant, and equipment (8) / Total assets (6)

Market concentration: Herfindahl-Hirschman Index (HHI) of firm sales from different segments, constructed from Compustat Segment data.

Capital to labor ratio: Net property, plant, and equipment (8) / Employees (29)

A.1.2 Industry-level control variables

Industry-level variables are from the NBER-CES manufacturing database from Becker, Gray, and Marvakov (2013).

Capital to value added: total real capital stock / total value added

Production workers to value added: total production workers / total value added

Production workers to total workers: total production workers / total workers

Change in TFP: yearly change in 5-factor TFP

Production wage: production worker wages / production workers

Non-production wage: (total payroll - production worker wages) / (total employment - production workers)

A.1.3 Bank holding company-level variables

Bank-holding-company-level variables are constructed from FR Y-9C reports from the Federal Reserve Bank of Chicago.

Loan to total assets: Total loans (BHCK2122) / Total assets (BHCK2170)

Cash to total assets: (Noninterest-bearing balances and currency and coin (BHCK0081) + Interest-bearing balances in U.S. offices (BHCK0395) + Interest-bearing balances in foreign offices, edge and agreement subsidiaries and ibfs (BHCK0397)) / Total assets (BHCK2170)

Securities to total assets: Total investment securities (BHCK0390) / Total assets (BHCK2170) before 1994; (Held-to-maturity securities (BHCK1754) + Available-for-sale securities (BHCK1773)) / Total assets (BHCK2170)

Capital to total assets: Equity (BHCK3210) / Total assets (BHCK2170)

Interest income to total assets: Interest income (BHCK4107) / Total assets (BHCK2170)

Total deposits: domestic non-interest bearing deposits (BHDM6631) + foreign non-interest bearing deposits (BHFN6631) + domestic interest bearing deposits (BHDM6636) + foreign interest bearing deposits (BHFN6636)

Deposits to total liabilities: Total deposits / Total liabilities (BHCK2948)

C&I loan ratio: Commercial and industrial loans (BHCK1766) / Total loans (BHCK2122)

Real estate loan ratio: Real estate loans (BHCK1410) / Total loans (BHCK2122)

Residential real estate loans: Real estate loans (BHCK1410) - Real estate loans secured by farmland (BHDM1420)- Real estate loans secured by nonfarm nonresidential properties (BHDM1480)

Residential real estate loan ratio: Residential real estate loans / Total loans (BHCK2122)

Consumer loan ratio: Loans to individuals for household, family, and other personal expenditures (BHCK1975) / Total loans (BHCK2122)

Non-performing loan ratio: Allowance for loan and lease losses (BHCK3123) / Total loans (BHCK2122)

Return on assets (ROA): Net income (BHCK4340) / Total assets (BHCK2170)

Interest income ratio: Total interest income (BHCK4107) / (Total interest income (BHCK4107) + Total non-interest income (BHCK4079))

A.2 Appendix Tables

Table A.1: Correlation matrix of import penetration and trade costs

This table reports the correlation matrix of import penetration, trade costs, and NTR gaps from 1991 to 2005. Panel A, B, and C show the correlation at the 3-digit, 4-digit, and 6-digit level, respectively. *IP_China* is import penetration from China as in Equation (1.1). *IP_China_IV* is the instrumented Chinese import penetration using 8 other high-income countries' imports, as in Equation (1.3). *IP_Total* is total import penetration as in Equation (1.2). *Tariff* is the average tariff rate of the industry and *Tariff_China* is the tariff rate of US-China bilateral trade. *SC* is the average shipping cost, calculated as the percentage difference of the Cost-Insurance-Freight value with the Free-on-Board value of imports. *SC_China* is the shipping cost of the US-China bilateral trade. *NTRgap* is the difference in tariffs between the non-NTR rates if annual renewal of NTR fails and the NTR tariff rates, as in Pierce and Schott (2016).

Panel A: 3-digit NAICS level, 21 industries							
	IP_China	*IP_China_IV*	*IP_Total*	*Tariff*	*Tariff_China*	*SC*	*SC_China*
IP_China_IV	0.83						
IP_Total	0.73	0.79					
Tariff	0.25	0.45	0.07				
Tariff_China	0.22	0.38	0.01	0.92			
SC	0.09	-0.02	-0.15	0.02	-0.02		
SC_China	-0.14	-0.24	-0.22	-0.32	-0.30	0.63	
NTRgap	0.21	0.37	0.35	0.50	0.41	-0.14	-0.34

Panel B: 4-digit NAICS level, 85 industries							
	IP_China	*IP_China_IV*	*IP_Total*	*Tariff*	*Tariff_China*	*SC*	*SC_China*
IP_China_IV	0.61						
IP_Total	0.69	0.49					
Tariff	0.21	0.23	-0.05				
Tariff_China	0.06	0.03	-0.07	0.43			
SC	0.08	0.00	-0.14	0.04	-0.01		
SC_China	-0.10	-0.17	-0.20	-0.16	-0.06	0.60	
NTRgap	0.19	0.05	0.19	0.35	0.10	-0.29	-0.28

Panel C: 6-digit NAICS level, 389 industries							
	IP_China	*IP_China_IV*	*IP_Total*	*Tariff*	*Tariff_China*	*SC*	*SC_China*
IP_China_IV	0.61						
IP_Total	0.48	0.43					
Tariff	0.13	0.26	-0.03				
Tariff_China	0.06	0.16	-0.04	0.68			
SC	0.11	0.08	-0.06	0.10	0.06		
SC_China	-0.06	-0.08	-0.09	-0.11	-0.03	0.50	
NTRgap	0.19	0.14	0.18	0.26	0.17	-0.25	-0.21

Table A.2: Industries with the highest Chinese import competition

This table reports the summary statistics of the industries with the top-5 Chinese import penetration from 1991 to 2005. Panel A and B report the top-5 industries in Chinese import penetration at the 3-digit and 4-digit level, respectively. IP_China is import penetration from China as in Equation (1.1). IP_Total is total import penetration as in Equation (1.2). $Tariff$ is the average tariff rate of the industry and $Tariff\_China$ is the tariff rate of US-China bilateral trade. SC is the average shipping cost, calculated as the percentage difference of the Cost-Insurance-Freight value with the Free-on-Board value of imports. SC_China is the shipping cost of the US-China bilateral trade. $NTRgap$ is the difference in tariffs between the non-NTR rates if annual renewal of NTR fails and the NTR tariff rates, as in Pierce and Schott (2016).

Panel A: 3-digit NAICS level

NAICS-3	Name	IP_China	IP_Total	$Tariff$	$Tariff\_China$	SC	SC_China	$NTRgap$
316	Leather and Allied Product Manufacturing	0.315	0.326	0.102	0.117	0.052	0.059	0.256
339	Miscellaneous Manufacturing	0.139	0.319	0.020	0.030	0.037	0.077	0.453
337	Furniture and Related Product Manufacturing	0.124	0.269	0.009	0.015	0.093	0.153	0.369
334	Computer and Electronic Product Manufacturing	0.086	0.404	0.010	0.020	0.017	0.034	0.339
335	Electrical Equipment, Appliance, and Component	0.076	0.224	0.025	0.042	0.036	0.072	0.336

Panel B: 4-digit NAICS level

NAICS-4	Name	IP_China	IP_Total	$Tariff$	$Tariff\_China$	SC	SC_China	$NTRgap$
3162	Footwear Manufacturing	0.389	0.311	0.107	0.112	0.049	0.054	0.210
3159	Apparel Accessories and Other Apparel Manufacturing	0.308	0.491	0.074	0.085	0.052	0.065	0.476
3351	Electric Lighting Equipment Manufacturing	0.272	0.387	0.041	0.062	0.066	0.093	0.300
3169	Other Leather and Allied Product Manufacturing	0.255	0.312	0.117	0.135	0.068	0.077	0.408
3343	Audio and Video Equipment Manufacturing	0.252	0.618	0.019	0.024	0.021	0.035	0.278

Table A.3: The impact of Chinese import penetration on firm leverage: adding other industry characteristics

The table reports the results of OLS generalized difference-in-differences regressions of firm-level financial leverage. The dependent variable is book leverage in columns 1-5, and market leverage in columns 6-10. $Chinashock_t$ is equal to 0 before 2000 and equal to 1 after 2001. $IP\_China\_IV_{j,before}$ is the instrumented average import penetration, measured at the 3-digit NAICS industry level, from China from 1995 to 2000. $NTRgap_{j,1999}$ is the NTR gap of industry j in 1999. $SC_{j,before}$, $Tariff_{j,before}$, and $IP\_Total_{j,before}$ is the average shipping cost, tariff, and total import penetration of industry j from 1995 to 2000. Firm-level control variables include logarithm of sales, profitability, Tobin's q, tangibility, market concentration, and capital to labor ratio, all lagged by 1 year. Industry-level (3-digit NAICS) control variables include capital to value added, production workers to value added, production workers to total workers, change in TFP, production worker wage, and non-production worker wage, all lagged by 1 year. Year and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the 3-digit NAICS industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Book leverage					Market leverage				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Chinashock_t * IP\_China\_IV_{j,before}$	-0.48**	-0.44**	-0.79**	-0.48**	-0.63***	-0.76***	-0.82***	-1.02***	-0.77***	-0.77***
	(-2.82)	(-2.18)	(-2.57)	(-2.69)	(-3.52)	(-3.40)	(-3.28)	(-3.14)	(-3.40)	(-3.23)
$Chinashock_t * IP\_Total_{j,before}$		-0.01					0.02			
		(-0.27)					(0.54)			
$Chinashock_t * Tariff_{j,before}$			0.39					0.31		
			(1.29)					(1.24)		
$Chinashock_t * SC_{j,before}$				-0.09					-0.13	
				(-0.44)					(-0.72)	
$Chinashock_t * NTRgap_{j,1999}$					0.07					0.00
					(1.11)					(0.02)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23831	23831	23831	23831	23831	23831	23831	23831	23831	23831
Adjusted R^2	0.65	0.65	0.65	0.65	0.65	0.71	0.71	0.71	0.71	0.71
Number of firms	4059	4059	4059	4059	4059	4059	4059	4059	4059	4059

Table A.4: The impact of Chinese import penetration on firm leverage: results on different subsamples

The table presents the results of generalized DID regressions of firm leverage on Chinese import penetration. The dependent variable is book leverage. The sample in columns 1-2 includes firms that have more than 8 years of data throughout 1995-2005. The sample in columns 3-4 includes firms that enter the Compustat database before 1995. The sample in columns 5-6 includes firms that exit the Compustat database after 2005. Firm-level controls, industry-level controls, year fixed effects, and firm fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Book leverage					
	$\geq$ 8 years in sample		Entry before 1995		Exit after 2005	
	(1)	(2)	(3)	(4)	(5)	(6)
$Chinashock_t * IP\_China_{j,before}$	-0.32***		-0.22***		-0.30***	
	(-3.82)		(-3.54)		(-3.24)	
$Chinashock_t * IP\_China\_IV_{j,before}$		-0.39**		-0.27*		-0.35**
		(-2.46)		(-1.99)		(-2.29)
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17471	17471	19118	19118	17197	17197
Adjusted R^2	0.63	0.63	0.65	0.65	0.63	0.63
Number of firms	2078	2078	2905	2905	2289	2289

Table A.5: Chinese import penetration and the reallocation of loans: robustness

The table reports the results of OLS generalized difference-in-differences regressions of yearly growth rate and ratio to total loans for different types of loans: commercial and industrial (C&I) loans, real estate (RE) loans, residential real estate (RE_HH) loans, and personal (PE) loans. $Chinashock_t$ is 0 before 2000 and 1 after 2001. $IP\_China\_IV_{b,before}$ is bank holding company b's average import penetration from China from 1995 to 2000, constructed from firm-bank relationships and instrumented firm-level Chinese import penetration. Control variables include total loan growth rate and lagged bank characteristics. Year and bank fixed effects are included in all specifications. In parentheses are t-statistics based on clustered standard errors at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Growth rate				Ratio to total loans			
	C&I	RE	RE_HH	PE	C&I	RE	RE_HH	PE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Chinashock_t * IP\_China\_IV_{b,before}$	-1.50***	1.14***	2.30***	0.99	-0.71***	0.80***	1.54***	0.09
	(-3.71)	(3.56)	(3.60)	(0.99)	(-4.60)	(5.10)	(7.66)	(1.35)
Total loan growth rate	0.81***	1.01***	1.05***	0.86***				
	(17.93)	(21.09)	(17.88)	(11.19)				
Lagged bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other interaction terms	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	835	833	833	835	835	835	835	835
Adjusted R^2	0.69	0.75	0.62	0.37	0.94	0.97	0.93	0.96
Number of banks	102	102	102	102	102	102	102	102

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