Collateral Values and Global Production Networks *

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Abstract

Firms are interconnected through global production networks. In this study, I investigate how changes in a firm's collateral value affect its supply chain linkages with international trade partners. I use a plausibly exogenous shock to the real estate market in China, which reduced the value of firms' real estate holdings, and find an 11.1% reduction in exports to trade partners in the US. Financially constrained firms affected by the shock respond by increasing product prices, potentially compromising long-term customer relationships. Connected U.S. customers reallocate their imports to alternative suppliers, thereby inducing a shift to the global production network structure. My findings highlight the role of collateral value fluctuations, interacting with financial frictions, in trade partnership adjustment.

Keywords: Global production networks, collateral, financial constraints, pricing decisions.

JEL classifications: F14, G21, L11, L14.

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1 Introduction

In recent years, the Chinese real estate market has faced significant challenges. In 2021, Evergrande, one of the country's largest real estate companies, defaulted on 131 million US dollars worth of debt with a total debt of 305 billion US dollars. In August 2023, Country Garden, another major real estate developer, delayed bond payments with a total debt of 186 billions US dollars. The real estate industry accounts for about 20% of the Chinese Gross Domestic Product, and its potential collapse has raised concerns about the stability of the Chinese financial system and its potential impact on the global economy.[1]

While the recent policy and media discussions have focused on global financial contagion, real estate fluctuations could also have large cross-border spillovers through international supply chains. Chinese exporters, who contribute to 14.4% of the world's total trade in 2022 (World Trade Organization, 2023), predominantly use real estate as collateral in bank loans (Ayyagari et al. (2010)).[2] The real estate fluctuations brought by recent events may affect exporters' behavior through the collateral channel, with potential negative real effects on their global trading partners and other economies.

My paper assesses the role of real estate collateral for exporters' trade behavior, which has not been studied to date. By using a plausibly exogenous variation from the 2010 Housing Purchase Restriction (HPR) policy in China, I show that a moderate real estate shock - arguably less significant than the potential collapse we are worrying about today - can have far-reaching consequences for global supply chains. In my setting, I find that a 6% drop in collateral value leads to an 11.1% trade drop between Chinese suppliers and U.S. customers. Thus, regulators and policymakers should care about real estate shock's contagion through production networks.

Studying the impact of real estate collateral fluctuations on global supply chain relationships is challenging. First, it is difficult to disentangle collateral value and credit sup-

[1] https://www.wsj.com/finance/investing/investors-fear-chinas-lehman-moment-is-looming-4364855d.

[2] In a survey of Ayyagari et al. (2010) on twenty-four hundred firms in China, most of the collateral posted was in the form of land or buildings (mean = 63.11%, median = 80%)

ply effects during a large real estate market crisis. Second, negative demand shocks from global markets can hurt firms' profits, thus decreasing firms' ability to purchase assets that can also be pledged as collateral (reverse causality). Third, changes in global supply chain relationships may be caused by other firm fundamentals such as productivity or leverage, leading to an omitted variable problem.

In this paper, I leverage granular trade data between U.S. customers and Chinese suppliers and plausibly-exogenous collateral shocks from city-level Housing Purchase Restrictions (HPRs) to study how real estate collateral value affects supply chain relationships. HPR policies were implemented by 46 cities in China in 2010 and 2011. The local government initiated these policies to regulate the housing market boom and protect households' welfare by facilitating homeownership. I argue that due to the high correlation between residential and commercial real estate prices, the policy also affected the value of Chinese firms' real estate holdings, leading to negative collateral shocks.

To identify the trade effects of city-level HPRs, I use granular variation in firm-to-firm international trade data and an identification strategy similar to Khwaja and Mian (2008). Specifically, I examine U.S. customers who import from multiple Chinese suppliers differing in their exposure to the collateral shock. By utilizing fixed effects in a stacked difference-in-differences strategy, I compare differences in trade between Chinese suppliers affected by the HPRs and unaffected suppliers of the same U.S. customer, before and after an HPR is implemented in the supplier's city. The use of within-customer comparisons absorbs firm-specific changes in demand, allowing for a plausible attribution of differences in trade volumes to differences in suppliers' exposure to collateral shocks. The primary hypothesis is that all else equal, firms that suffer from a negative collateral shock face more constraints in obtaining external financing. Under financial constraints, these firms will change their exporting decisions by increasing the product prices to survive in the short run, even sacrificing long-term market shares (Gilchrist, Schoenle, Sim, and Zakrajšek (2017)).

I present three main results. First, I find that the negative collateral shock induced by

the HPRs reduced external financing for firms with high real estate holdings. Firms get 15.5% less short-term loans, hold 18.4% less cash, and pay 21.2% less dividends if they are located in a city that implements an HPR, compared to firms located in other cities. These results indicate that when firms face a negative collateral shock, they find it more difficult to access external financing, rely on internal liquidity for operating the business, and adopt more precautionary dividend policies. These effects jointly suggest that firms become significantly more liquidity-constrained after the housing purchase policy shock and serve as a first-stage validation of how collateral value affects firms' financial constraints. To validate the real estate collateral channel, I also show that the reduction in external financing is only present for suppliers with high real estate holdings, and not for suppliers with little or no real estate on their books. This result also suggests that the reductions in loans, cash holdings, and dividends for firms in my main sample are not driven by a credit supply channel or by changes in the aggregate economy.

Second, the stacked difference-in-differences tests provide evidence that the change in collateral value affects firms' exporting behavior. I find that the probability of trading with a U.S. customer reduces by approximately 11.1% when the Chinese supplier is headquartered in a city with negative real estate shock. Similar to the external financing results, I show that the reduction of trade is only present for suppliers with high real estate holdings and not for suppliers with low/no real estate values. Further, I expand the sample to the U.S. customers' global suppliers and explore what happens when the U.S. customers' previous Chinese trading partners are affected by the HPR policy. I present evidence that after reducing the trade volume with affected Chinese suppliers, U.S. customers reallocate imports to their other suppliers in the production network.

My results survive a battery of robustness tests. I find that after the HPR cancellation in some cities, trade volumes for firms located in these cities increase relative to firms located in the cities that do not remove the HPR. In a covariate balance test, I also show that treated and control firms do not differ systematically in terms of their financial characteristics. I also use Poisson regressions to account for the count-like nature of some of the

outcome variables (Cohn et al., 2022), and show that the results are qualitatively similar to my main results. Finally, I exclude Tier 1 cities and show that the results are not driven by these large economies.

Third, I investigate the channel through which negative collateral shocks affect supply chain linkages in international trade. When firms are more financially constrained, the cost of capital increases, the present value of future profits decreases relative to current profits, and firms find it optimal to boost short-term profits at the expense of long-term market shares (Chevalier and Scharfstein, 1996; Dasgupta and Titman, 1998; Dou and Ji, 2021). Consistent with this channel, I find that following the HPR shock treated Chinese suppliers raise exporting product prices by approximately 8.3%, potentially sacrificing the future customer base. Cross-sectional tests confirm that suppliers are more likely to increase their exporting product prices if they operate in more concentrated industries, where firms leverage their market power and set higher prices. I also find that privately owned enterprises (POEs) are more likely to raise the price compared to state-owned enterprises (SOEs). In China, POEs are considered to be more financially constrained with weaker relationships with banks. A negative collateral shock to POEs is more likely to induce them to set a higher product price.

I explore other potential channels that may affect trade volumes after a drop in collateral values. The first channel is labor cost. Reduction in housing prices could induce homeowners to request higher wages due to the wealth effects. Thus, producers may face higher labor costs after the negative real estate shock, which leads to fewer exports. This hypothesis is consistent with recent concerns about increasing labor costs and loss of comparative advantage in China. However, in my setting, I find that real estate shock leads to lower average wages for the treated cities compared to the control cities, which is opposite to the labor cost story. The second channel is trade credit. Firms might reduce trade credit to their international customers when they are financially constrained, which could lead to trade reduction from the customers. I find that for firms in my sample, there is no significant change in trade credit for the treated firms compared to the control firms.

This is consistent with the evidence in international trade that cash-in-advance payment is widely used relative to trade credit (e.g., Antras and Foley, 2015). Thus, the reduction in trade volume is not driven by the change in labor costs or trade credits after the real estate shock.

My paper contributes to several areas of the literature. First, a large literature studies how financial market imperfections restrict international trade flow. Amiti and Weinstein (2011) find the deterioration in bank health in Japan explains the large drops in exports. During the 2007-2009 financial crisis, the collapse of firms' exports is due to the negative bank credit shock (e.g., Chor and Manova, 2012; Paravisini et al., 2015). Other financial market imperfections could also reduce exports including incomplete information (Feenstra et al. (2014)), limited access to foreign capital markets (Manova et al. (2015)), credit rationing (Minetti and Zhu (2011)), or letter of credit supply (Niepmann and Schmidt-Eisenlohr (2017). My paper complements this literature in three ways. Firstly, while the literature provides strong evidence for the correlation between financial constraints and exports, my paper provides causal evidence on how a financial shock induced by collateral constraints affects firms' export behavior, using a plausibly exogenous shock related to city-level real estate prices.

Secondly, during a financial crisis, bank loans are restricted in multiple dimensions. For example, banks raise their standards for granting loans, excluding small and medium enterprises from the credit market. Even for those firms with access to bank loans, the lending interest rates and collateral requirements are higher.[3] By focusing on a financial crisis, the empirical studies in this literature provide evidence for the impacts of restricted bank loans on exports but they do not evaluate or distinguish the impact through a particular channel that restricts the provision of bank loans. Economic theories indicate that the various ways to weaken the financial sector can generate very different real effects (e.g., Dabla-Norris et al. (2021)), my research setting cleanly identifies how international

[3]For example, an International Monetary Fund Bankers' Association for Trade and Finance (IMF-BAFT) survey of 88 banks in 44 countries revealed that the average spreads on trade-related lending rose by 70 to 107 basis points during the crisis. At the same time, new loans to large borrowers dropped 79% relative to the level of new loans to large borrowers in the credit boom period (Ivashina and Scharfstein, 2010).

trade is affected by tightened collateral constraints, which affects the loan amount but not the cost of capital.

Thirdly, trade reduction due to adverse shocks to firms' credit conditions could come from the channel of higher costs of production or higher fixed costs of entering export market (e.g., Melitz, 2003); Paravisini et al., 2015). Thus a rise in prices of exporting goods could be an equilibrium result of trade reduction (Haddad et al. (2010)).[4] Leveraging the granular data, my paper shows that firms also actively adjust their product prices in response to the negative credit shock, especially for firms with more market power, which indicates that exporting firms are operating in imperfectly competitive product markets. Different from a cost-of-production or cost-of-entry channel, my paper shows financial constraints reduce firms' trade through their strategic pricing decisions.

The strategic pricing decisions of exporters are consistent with the customer market mechanism in the literature. In a multi-period model, firms' financial condition affects the relative present value of firms' current and future profits. Under financial constraints, firms may raise product prices to realize higher profits in the short-term, and sacrifice future market share. (see, e.g., Klemperer, 1987, Chevalier and Scharfstein, 1996, Dasgupta and Titman, 1998, and Dou and Ji, 2021). My paper provides empirical evidence to this literature by presenting the pricing decisions of exporters on intermediate goods in the international market, which has not been documented before.

My paper also contributes to the literature that links the real estate market to the real economy. Prior work has shown that real estate value affects firms' investment decisions in Japan (Gan (2007)), the United States (Chaney, Sraer, and Thesmar (2012)), and China (Chen, Liu, Xiong, and Zhou (2017)).[5] My paper contributes to this literature by showing that real estate collateral could have cross-border spillovers through firms' exporting. While these papers look at the investment channel of real estate assets, I focus on the effect of exporting through a working capital financing channel and show that domestic

[4]On aggregate level, export prices rose relative to domestic prices across a number of countries during the crisis (Ahn et al. (2011)).

[5]Other papers show how real estate affects firms' capital structure (Cvijanović (2014)), debt structure (Lin (2016)), innovation (Mao (2021)), entrepreneurship (Tian and Wang (2022)).

real estate fluctuations could have a large spillover effect on global production networks. Moreover, I contribute to the large literature on the discussion of China's real estate market (See, e.g., Fang, Gu, Xiong, and Zhou (2016); Chen, Liu, Xiong, and Zhou (2017); Glaeser, Huang, Ma, and Shleifer (2017); Liu and Xiong (2018); Rogoff and Yang (2021); Xiong (2023)).

My paper also broadly contributes to the literature on financial shock transmission and global production networks. Peek and Rosengren (1997) and Peek and Rosengren (2000) study Japan's real estate crisis in the early 1990s and its contagion to the banking system from Japan to the U.S. A more recent case of U.S. subprime mortgage default-induced financial crisis led to the reduction of international bank lending (see, e.g., Cetorelli and Goldberg, 2011 and Haas and Horen, 2012). Instead of transmission to the global financial system, my paper focuses on the transmission of financial shocks along the production networks. While other papers have studied the causal effects of multiple factors on global production network structure such as political uncertainty (Charoenwong, Han, and Wu (2023)), suppliers' ESG risks (Bisetti, Žaldokas, and She (2023)), physical climate risks (Pankratz and Schiller (2021)), natural disasters (Barrot and Sauvagnat (2016) and Carvalho, Nirei, Saito, and Tahbaz-Salehi (2021)) among other factors, my paper is one of the first (to my knowledge) to link the collateral value of the real estate to the global production network.

This study provides insights for policymakers regarding the measures they should consider when restraining real estate bubbles or intervening during the collapse of real estate markets. A decline in housing prices may result in credit constraints for an exporting firm that uses real estate assets as collateral. To provide exporters with enough working capital, financial institutions should support more adaptable contract terms such as accepting movable and intangible assets (e.g., inventory, trade credit) as collateral or permitting firms to borrow based on their cash flow.

Although this paper focuses on a specific setting in China, its significance extends beyond the potential real estate risks in a single country. It also carries implications for

other countries where exporting firms operate within a weak contract enforcement environment, characterized by significant fluctuations in the real estate market. Exports are considered more susceptible to financial shocks compared to domestic sales, primarily due to longer time lags associated with international trade, especially in maritime shipping, and a higher probability of default in conditions of information asymmetry (see, e.g., Amiti and Weinstein, 2011; Feenstra et al., 2014). Therefore, comprehending the role of real estate collateral for exporters becomes crucial for establishing a more stable global production network.

2 Institutional Background

China's real estate market has witnessed a tremendous boom in the past two decades. In the early 2000s, the Chinese government implemented policies to stimulate the housing market, which led to rapid development in the construction and property sectors. From 2003 to 2013, in first-tier cities (Beijing, Shanghai, Guangzhou, and Shenzhen) housing prices had an average annual real growth rate of 13.1 percent. For 31 second-tier cities (e.g. autonomous municipalities, provincial capitals, or vital industrial/commercial centers), housing prices had an average annual real growth rate of 10.5 percent. And for the third-tier cities, the average annual real growth rate of housing prices is 7.9 percent (Fang, Gu, Xiong, and Zhou, 2016). At the national level, the housing price index in 2017 was about 4.5 times its 2003 level (Liu and Xiong (2018)).

The housing boom leads to concerns that the real estate sector could induce systemic risks for the economy. In response to the overheating of the housing markets, the State Council of China issued an announcement on April 17, 2010, urging local governments to take action to effectively regulate housing prices. In accordance with this guidance, the city government of Beijing introduced a policy on April 30, 2010, restricting the purchase of property for households within the city, and became the first city to adopt the "Housing Purchase Restriction policy". This measure was soon followed by more local

governments, with a total of 46 cities implementing this Housing Purchase Restriction policy by the end of 2011. As Figure 1 shows, cities that announced the policy are widely spread throughout the country and in almost every province.

The Housing Purchase Restriction policy typically includes several components. As the first one to announce the policy, For example, the Beijing government sets the requirement on both the number of apartments one household can own and the down payment of mortgage for the apartment. To be more specific, households that are Beijing residents can buy no more than two apartments and those who pay personal income tax in Beijing for more than five years can buy no more than one apartment. As for the mortgage, households are required to make a down payment of 30% of the total price for the first house and 50% of the total price for the second house. While there are other supplementary measures such as resale restrictions and price restrictions later in other cities, these two restrictions are the most dominant ones.

The Housing Purchase Restriction policy is effective in controlling for the housing price growth. Figure 2 plots the annual estimated logarithm differences in house prices between treated cities and control cities defined in my main analysis. The difference was relatively stable before 2010, which supports the parallel trend for the treated and control groups before the policy was announced. Starting in 2010 a rapid and constant drop in the log price difference for the treated group implies that the Housing Purchase Restriction is taking effect. From 2013 to 2016, most of these cities (excluding Beijing, Shanghai, Guangzhou, Shenzhen and Sanya) rescinded the purchase restriction policy. Similarly, the figure shows there is a sharp reverse of price difference around 2014.

While the policy successfully slowed down the housing price growth for households in the targeted cities, it affected corporations in an indirect way. The policy is initially targeting the welfare of households to make sure that more families are able to own a house for living. However, real estate assets are widely held by Chinese firms and used as collateral in the financial market [6]. In 2009, the average property investment for Chinese

[6] Chen, Liu, Xiong, and Zhou (2017) use the land transaction data to show that commercial land and residential land contribute to over 30% of the gross investments for Chinese publicly listed manufacturing

public firms was 30.06 million in RMB (4.4 million in USD).[7] In this way, the Housing Purchase Restriction policy serves as a clean identification strategy for firms with real estate assets.[8]

The advantage of using shocks to investment property in China's setting is that there exist divergences between industrial land prices and residential land prices, as well as between industrial real estate prices and residential real estate prices. The local government usually sells industrial land at low prices to attract firms' investment, and it sells residential and commercial land at high prices to extract fiscal revenue (He, Nelson, Su, Zhang, and Zhang (2023)).[9] The Housing Purchase Restriction policy did not affect industrial real estate such as plants. However, it did affect the value of investment property for Chinese firms as the investment property is mostly residential or commercial real estate not for production use.

3 Data

This study employs data from several different sources: (i) Shipment-level transaction data between U.S. customers and global suppliers from the S&P Global Panjiva database; (ii) Chinese public firms' financial and headquarter information from the China Stock Market & Accounting Research Database (CSMAR); (iii) Chinese public firms' investment property data from Wind; (iii) Chinese firms' exporting price and volume data from the Chinese Customs Database.

and service firms

[7] In 2006, China Securities Regulatory Commission (CSRC) required publicly listed firms to disclose the value of investment properties in the annual reports. Investment property is defined as property (land or a building - or part of a building - or both) held by firms to earn rentals or for capital appreciation or both. Most of the firms report their investment property in book value.

[8] The investment property can be either residential real estate or commercial real estate. While firms don't separately report the values by the real estate type, the price correlation of residential real estate and commercial real estate is as high as 0.91 from 2005-2021 based on data from the National Bureau of Statistics of China.(http://www.stats.gov.cn/sj/ndsj/2022/indexch.htm)

[9] He, Nelson, Su, Zhang, and Zhang (2023) shows that the average residential land price is more than ten times the average industrial land price between 2007-2019.

3.1 Global suppliers-U.S. customers shipment data

My main data source for shipment is the S&P Global Panjiva database. Panjiva data provides transaction-level details of goods trades across borders based on the bill of lading (BoL) collected by U.S. Customs and Border Protection (CBP) over the 2007-2020 period. U.S. firms are required to report shipment details in cargo declarations including the sender, the country of origination, the consignee, the product codes, and the shipment container specifications. The database contains transaction data for 236,245 U.S. firms importing from 242 countries.

3.2 Chinese public firm data

To construct my main dataset, I aggregate the Panjiva transaction level data to supplier-U.S. customer-year level. I use a fuzzy name-matching algorithm to link Panjiva suppliers to Chinese public firms. I obtain the Chinese firms financial information from the China Stock Market & Accounting Research database (CSMAR). Following the literature (Chaney et al. (2012)), I exclude from the sample firms operating in the finance, insurance, real estate, construction, agriculture, utility, transportation, and mining industries. The CSMAR database also includes information about the location of headquarters for the firms.

I also obtain firms' investment properties data from WIND database. Starting from 2006, China Securities Regulatory Commission (CSRC) requires public listed firms to disclose the value of investment properties in the annual reports. Investment property is defined as property (land or a building - or part of a building - or both) held by firms to earn rentals or for capital appreciation or both.

3.3 China Customs Data

The dollar values of transactions in the Panjiva dataset are largely missing. I supplement the Panjiva data with China Customs data to fill out the prices of exported goods from

Chinese firms. The China Customs database covers import and export transactions of Chinese firms, including product information, country of destination, trade volume, trade value, and identity of Chinese exporter or importer. I aggregate the data to the Chinese public firm level to obtain the weighted prices of exported goods.

3.4 Summary Statistics

Table 1 reports summary statistics for the main variables on trade volume, debt level, and real estate holdings. Our sample consists of 14,104 distinct Chinese public supplier - U.S. customer pairs during the period 2007-2020.[10] The average number of shipments between a Chinese supplier and U.S. customer is 1.3 in a given year. The average number of containers is 1.87 as there could be multiple containers in one shipment. The probability of trade in a given year for a supplier-customer pair is 0.17. Our full sample contains 1,121 Chinese public firms located in 171 cities.The average value of real estate as investment property is 37.88 million RMB. The short-term and long-term debt are 997 million and 466 million respectively.

4 Empirical Framework

Identifying the causal effect of real estate prices on firms' exporting decisions is challenging for a number of reasons. First, there exists a potential issue of reverse causality between real estate prices and firms' exporting volumes. This arises from the possibility that a surge in demand from global markets for large land-holding firms might induce a rise in demand for local labor and other related local activities, thereby driving up real estate prices. Second, the decision of firms to own real estate assets could be endogenous to investment opportunities. Firms that hold more real estate assets might be fundamentally

[10]Table A1 describe the sample selection process from Panjiva. The sample only includes U.S. - China trade relationships. Next, I exclude the non-listed Chinese firms as the investment property item is not available for these firms. Thus I have 18,770 distinct Chinese public supplier - U.S customer pairs. Last, I exclude Chinese public firms in specific industries including real estate and construction, financial service, agriculture, utility, transportation, and mining.

different from firms that hold few real estate assets. Third, it is difficult to simultaneously estimate the supply from upstream firms and demand from downstream firms without data that links supplier and customer over time.

I use city-level housing purchase restrictions as a quasi-natural experiment on housing prices following Chen et al. (2017). The housing purchase restriction policy resulted in a negative demand shock to the real estate sector in the affected cities. As the restriction policy only limited the housing demand of households and had no direct impact on manufacturing firms, it can serve as an exogenous real estate shock to study the potential impact of the shock on firm's decisions. I utilize a stacked difference-in-differences regression design in my main analysis following the idea in Cengiz et al. (2019), Deshpande and Li (2019), and Bisetti et al. (2023). The housing purchase restriction policy are announced from 2010Q2 to 2011Q4 across various cities. For each city in my sample, I denote by t the year of the policy announcement for the city and construct two cohorts based on the announcement year 2010 and year 2011. The sample period is from 2007 to 2014 which allows a window of $[t-3, t+3]$ years around the event. The treated sample consists of supplier-customer relationships in which the supplier headquarters in the city adopted the policy in year t. The control sample consists of supplier-customer relationships in which the supplier headquarters in the city that has never adopted any housing purchase restriction policy in my sample period (Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021).

My main stacked panel is at the supplier-customer-cohort-year level in which the suppliers are all Chinese public firms and the customers are U.S. public and private firms. In this stacked panel, I estimate my main regression model:

$$Y_{ijct} = \beta \text{Treated Supplier}_{ic} \times \text{Post}_{ct} + \mu_{ijc} + \gamma_{jct} + \varepsilon_{ijct} \tag{1}$$

where the main dependent variable Y_{ijct} is a measure of trade between supplier i and customer j in year t which belong to cohort c. I measure Y_{ijct} in the main specifications in three ways: i) an indicator of having trade records between supplier i and customer j

in year t; ii) the natural logarithm of one plus the number of shipments between supplier i and customer j in year t; iii) the natural logarithm of one plus the number of containers traded between supplier i and customer j in year t. $TreatedSupplier_{ic}$ is an indicator that equals to one if the supplier headquarters in a city that adopts the policy in cohort c; $Post_{ct}$ is an indicator that equals to one if the year is following the event year t in cohort c; μ_{ijc} is the supplier-customer-cohort fixed effect, which allows us to identify trade variation between the same supplier and the same customer over time; and γ_{jct} is the customer-cohort-time fixed effect, which allows us to identify cross-sectional variation between treated and control suppliers for the same customer. In all specifications, I cluster standard errors at the supplier-cohort level. The coefficient of interest in (1) is β, which can be interpreted as i) the change in relative probability of trade between treated and control Chinese firms to U.S. customers before and after the policy change; ii) the percentage change in the number of shipments or containers imported by U.S. customers from treated Chinese suppliers after the policy change, relative to those imported from Chinese suppliers located in cities that have never experience the real estate prices shock, based on different outcome variables in the specifications.

5 Validation: Collateral Value and Financial Constraints

The key assumption of this paper is that real estate assets are widely used as collateral for bank loans among Chinese firms. This assumption is supported by anecdotal evidence: A recent report from Fitch Ratings states that in 2015 loans secured by property now make up 40% of total loans for Fitch-rated banks in China.[11] Additionally, under the Chinese five-tier loan risk classification system, banks are required to increase their provisioning in response to a decrease in collateral value, and this will decrease their lending capacity.[12] If the value of collateral drops, it can negatively impact firms' ability to obtain new loans.

[11] https://www.fitchratings.com/research/banks/rise-in-property-collateral-makes-real-estate-china-banks-biggest-weakness-07-05-2015

[12] https://www.piie.com/blogs/china-economic-watch/how-vulnerable-are-chinese-banks-real-estate-downturn

In Table A10, I also show that this assumption is supported in the data unconditionally: The value of real estate affects the amount of secured loans a firm can get. Utilizing the secured loan data from WIND between 2016 and 2021, I test whether the real estate assets directly affect firms' secured loans. Table A10 shows that firms tend to have a higher collateral loan ratio over total liability when the real estate value is higher, after controlling for year-fixed effects and other time-varying firm characteristics.

To formally test whether the Housing Purchase Restriction policy negatively affected firms' collateral value, I next predict that firms with high real estate assets are more likely to get less external financing. To test the hypothesis, I use the firm-level fundamental data from CSMAR to look at the short-term loans, cash holding, and dividends payout before and after the events by comparing firms that are located in cities that announced Housing Purchase Restrictions with firms that are located in other cities. I estimate the regression model:

$$Y_{ict} = \beta_1 \text{Treated}_{ic} \times \text{Post}_{ct} + \mu_{ic} + \gamma_{ct} \tag{2}$$

where the dependent variable Y_{ict} is the measure of financial condition for firm i in year t which belongs to cohort c. Y_{ict} is i) the natural logarithm of short-term loans; ii) the natural logarithm of cash holding; iii) the ratio of cash holding over total assets; or iv) the natural logarithm of dividend payout. I define *Treated* as the Chinese public firms that are located in cities with Housing Purchase Restriction policy. μ_{ic} is the firm-cohort fixed effect, which allows me to identify the financial constraints of the same firm in the cohort over time. γ_{ct} is the cohort-year fixed effect, which allows me to identify cross-sectional variation between treated and control firms in the same year from the same cohort. The coefficient of interest in the specification 2 is β_1, which identifies the effects on the treated firm's financial constraints. In this specification, I expect the sign of β_1 to be negative if the Housing Purchase Restriction policy indeed negatively affects the collateral value of firms.

Table 3 shows the results of the tests. Columns (1), (2), and (4) use the natural log-

arithm of short-term loans, cash holdings, and dividends as outcome variables, respectively. Column (3) uses the ratio of cash holding over total assets as outcome variables. The sample is restricted to high real estate assets firms, which are firms that hold real estate assets values above the median. The result in column (1) shows that when holding high real estate assets, Chinese firms located in a treated city experience an average 15.5% drop in short-term loans compared to the firms in a control city after the policy adoption. In columns (2) and (3), I find that firms hold less cash after the policy adoption, which suggests that firms are using more internal capital when external financing is more difficult. Column (4) shows that firms located in treated cities pay 21.2% less dividends compared to firms in control cities after the policy shock (DeAngelo and DeAngelo, 1990). The results serve as evidence for firms using real estate as collateral for short-term financing and the effectiveness of the housing purchase restriction policy.

I conduct two sets of robustness tests in Table A3 and Table A9. First, The real estate shock could affect firms' external financing either from a bank lending channel or firm borrowing channel (Peek and Rosengren, 2000). From a bank lending channel, banks with real estate assets may cut credit supply after the negative real estate policy. If this is the case, firms will become more financially constrained no matter how much they are exposed to real estate assets. I examine the question by constructing a sample of low/no real estate asset firms in a placebo test. In this test, I compare a Chinese public firm with little or no real estate assets located in a city that adopted the Housing Purchase Restriction policy to a similar firm located in a control city. If firms are affected by a bank lending channel, I should observe a similar effect for the low/no real estate holding firms as the high real estate holding firms when banks cut the credit supply.

Table A3 shows the result of the tests. The model specification is the same as Table 3 and the outcome variables are the same including short-term loans, cash holdings, and dividends. I don't find similar results for the low/no real estate holding firms as in Table 3, which suggests that the real estate shock affects firms' external financing not through a bank lending channel, but from firms' exposure to the real estate market. Firms get

financially constrained after the negative shock to the collateral value of the real estate assets on their balance sheet.

Second, one might argue that exporting firms in my setting can always use trade credit as collateral for bank loans even if the value of real estate assets is negatively affected. In fact, in China, as well as many other developing countries, banks are reluctant to accept trade credits as collateral when lending to firms (Calomiris, Larrain, Liberti, and Sturgess (2017)). In 2022, the average ratio of accounts receivable financing over total liability is 6.3% for publicly listed Chinese firms. Utilizing the trade credit financing data from CSMAR between 2019 and 2022, I investigate the relationship between real estate and trade credit in external financing for exporting firms. Table A9 shows that exporting firms are more likely to have higher trade credit financing if the firm holds little or no real estate assets. However, if the firm holds more real estate assets, there is no such relationship between exporting and trade credit financing. These results suggest that real estate assets and trade credit financing are substitutes for external financing.

6 Global Supplier-Customer Relationships

6.1 Trade Volumes with U.S. Customers

In this section, I investigate how firms react to the negative external financing shock with their exporting decisions. I utilize the granular data of firm-to-firm trade between the U.S. and China from Panjiva to investigate the trade volume change in the global supply chain. Using supplier-customer level trade data and a (Khwaja and Mian, 2008)-style test, I compare the trade volume changes of a U.S. customer with one treated Chinese supplier and one control Chinese supplier to observe the effects of financial constraints on the trade.

Table 4 shows the results. The negative real estate shock in the location of the suppliers negatively affects the trade between public-listed Chinese suppliers and both publicly-listed and privately-held U.S. customers. Column (1) of Panel A shows that the probabil-

ity of trades between Chinese suppliers and U.S. customers decreases by around 11.1% when the supplier is located in cities with negative housing price shocks and holds large amounts of real estate assets. Next, I examine the intensive margin. In columns (2) and (3), I find that negative shocks in the real estate price of the cities that suppliers are located in are associated with 17.1% and 19.2% drops in the number of shipments and containers traded with U.S. customers respectively, relative to trade with suppliers located in unaffected cities. In this table, I control for pair (supplier-customer)-cohort fixed effects, to account for relationship-specific characteristics, and control for customer-year-cohort fixed effects, to account for time-varying customer characteristics. This suggests that trade with the same customers drops if the suppliers are affected by the policy, compared to the suppliers that are located in a city that never adopts this policy.

A natural concern is the potential for concurrent national or regional policies in China, which may disproportionately impact big cities that are more inclined towards implementing housing purchase restrictions. If the effect is directly from the housing purchase restriction policy, I would expect large reductions in trade for a supplier with high real estate value and little impact in trade for a supplier with low real estate value even both are located in the affected city. Thus, I run a placebo test for trades of suppliers with less or no real estate assets. Panel B contains the results of placebo tests which show that there is no incremental effects on the placebo suppliers in trade volume with U.S. customers when their cities adopt the policy. These results suggest that my findings in Panel A are most likely related to the real estate value change rather than other channels.

6.1.1 Robustness

Reverse of Housing Purchase Restriction From 2013 to 2016, most of the cities that have adopted the policy announced the cancellation of the restrictions except Beijing, Shanghai, Guangzhou, Shenzhen, and Sanya. By utilizing the reverse of the Housing Purchase Restriction policy, I study whether the trade with U.S. customers will reverse when the treated Chinese suppliers are less financially constrained.

Table 9 shows the results. The outcome variables are the same as Table 4 but now the treatment groups are the firms that are located in cities that reverse the housing purchase restriction and the control groups are the firms that are located in cities that haven't canceled the policy. Column (1) shows that the probability of trades between Chinese suppliers and U.S. customers increases by around 3.1% when the supplier is located in cities with positive housing price shocks. Next, I examine the intensive margin. In columns (2) and (3), I find that positive shocks in the real estate price of the cities that suppliers are located in are associated with 9% and 10.1% drops in the number of shipments and containers traded with U.S. customers respectively, relative to trade with suppliers located in unaffected cities. The result of policy reverse is consistent with the story of real estate as collateral affecting firms' exporting in the global supply chain. However, it also shows that the global supply chain relationship is hard to recover.

Drop Tier 1 Cities China has four Tier 1 cities: Beijing, Shanghai, Guangzhou, and Shenzhen. The housing prices in these cities are much higher than in other cities. In the meantime, about 21.6% of the firms in the sample are located in the four Tier 1 cities. One may worry that the results are mostly driven by the drop in housing prices in these large cities and the reduction in trade from firms in the cities. Thus, I test whether Chinese suppliers suffer from the trade reduction for firms that are not located in Tier 1 cities. Table A4 shows that the results are similar to the results using the whole sample.

Poisson Regression To mitigate the concern that using the log of 1 plus the outcome could produce the wrong signs, I apply the Poisson model with fixed effects for count variables including the number of shipments and containers.(Cohn, Liu, and Wardlaw (2022)) In Table A5, I show that the results still hold in negative signs which indicates that treated suppliers reduce their trade volumes with their U.S. customers.

Covariate Balance Table Table 2 compares the Chinese public firms that are located in cities that adopted the Housing Purchase Restriction policy and the cities that did not. In

this sample, I only keep the high real estate holding firms which are firms holding real estate assets above the median unconditionally. The table shows that before the policy implementation, the two groups of firms are similar in terms of size, leverage (including short-term loans), revenue, and inventory. Firms in treated cities on average hold more cash which means they are less likely to be in financial constraints. This tends to against finding any results for the treated firms to be financially constrained after the negative collateral shock. The two groups of firms are also similar in profitability including net profit, ROA, and ROE. The balance table supports the argument that firms in treated and control cities are not fundamentally different.

6.2 Reallocation

Given the results in Table 4, a natural question is whether the U.S. customers with multiple suppliers reallocate imports to other suppliers that are located in other cities or countries. All else equal, a firm with suppliers in treated cities and other locations may prefer to switch away from suppliers with the real estate shock.

I examine this question following Berg et al. (2021) and apply the method to test the spillover effects within the supply chain network. The main idea of Berg et al. (2021) is that the effect on the outcome variables depends not only on a firm's own treatment status but also on the fraction of treated firms in the same industry or region. In my setting, I ask U.S. customers to switch to other suppliers if one or some of their suppliers are affected by the Chinese real estate shock. This panel consists of i) relationships between U.S. firms and Chinese suppliers as I used in the previous test; and ii) relationships between U.S. firms that have at least one Chinese supplier before the shock and their international suppliers. For each customer-cohort, I define $\%TreatedSupplier$ as the fraction of treated suppliers over the total number of suppliers trading with the same customer. I also construct an indicator variable $TreatCust, ControlSupp$, that equals one when the suppliers outside China share the same U.S. customer with the treated Chinese suppliers. I estimate the regression model:

$$Y_{ijct} = \beta_1 \text{Treated Supplier}_{ic} \times \text{Post}_{ct} + \beta_2 \%\text{Treated Supplier}_{jc} \times \text{Treated Supplier}_{ic} \times \text{Post}_{ct}$$
$$+ \beta_3 \%\text{Treated Supplier}_{jc} \times \text{TreatCust, ControlSupp}_{ic} \times \text{Post}_{ct} + \mu_{ijc} + \gamma_{ct} + \varepsilon_{ijct} \quad (3)$$

where $\%TreatSupp_{jc}$ denotes the fraction of suppliers affected by the real estate shock for customer j in cohort c, measured in the year before the shock; $TreatCust, ControlSupp_{ic}$ is an indicator for international suppliers (outside China) of U.S. customers with at least one Chinese supplier affected by the real estate shock; and the remaining variables are identical to those in specification 1. The coefficient of interest in the specification 3 is β_3, which identifies the reallocation effects on other suppliers that share the same U.S. customer with at least one treated supplier, after controlling for potential spillover effects on other treated suppliers (pinned down by the coefficient β_2). In this specification, I compare the control international suppliers that share the same U.S. customers with treated Chinese firms with control international suppliers that share the same customers with control Chinese firms. I would expect the sign of β_3 to be positive if the customer reallocates their import from affected Chinese suppliers to another supplier in the production network.

Results are reported in Table 5. Column (1) reports results on the $ShipmentDummy$ variable, while columns (2)-(3) report results on the natural logarithm of one plus numbers of shipments and one plus numbers of containers respectively. The estimation of β_1 is consistent with my main results. Trades between U.S. customers and treated suppliers reduce as much as 5-11%. The effect is stronger if customers have a large proportion of treated suppliers. Consistent with my prediction, U.S. customers do increase their trades with control suppliers in their production network and the magnitude is non-neglectable.

6.3 Channel: Financial Constraints and Customer Base

6.3.1 Product Prices

Firms under financial constraints have an incentive to increase product prices to gain short-run cash flow at the cost of a lower future customer base (see, e.g., Chevalier and Scharfstein, 1996; Dasgupta and Titman, 1998; Gilchrist, Schoenle, Sim, and Zakrajšek, 2017; and Dou and Ji, 2021). Here I examine the question by utilizing the China Custom Data which includes product prices and quantity of exported goods. The panel is at the firm-product-cohort-year level. I estimate the regression model:

$$Y_{ipct} = \beta_1 \text{Treated}_{ic} \times \text{Post}_{ct} + \mu_{ipc} + \gamma_{pct} \tag{4}$$

where the dependent variable Y_{ipct} measures product p of firm i in year t which belongs to cohort c. Y_{ipct} can be the natural logarithm of price, quantity, and revenue. I define *Treated* as the Chinese public firms that are headquartered in cities with Housing Purchase Restriction policy as in the previous specifications. μ_{ipc} is the firm-product-cohort fixed effect, which allows me to identify prices and quantity of the same product from the same firm in the cohort over time. γ_{pct} is the product-cohort-year fixed effect, which allows me to identify cross-sectional variation between treated and control firms who are producing the same products in the same year from the same cohort. The coefficient of interest in the specification 4 is β_1, which identifies the effects on the treated firm's product pricing decision. In this specification, I would expect the sign of β_1 to be positive if the firms under financial constraints would sacrifice their future customer base by raising the product prices.

Table 6 contains the results of these tests. Column (1) examines the prices for all Chinese public firms that are exporting the same products. The result shows that suppliers located in a treated city on average increase the exporting product prices by 8.3% compared to the suppliers in a control city after the policy adoption. In column (2), I show that treated firms decreased their export quantity by 27.2% after the shock for the same

product. After the adoption of the housing purchase restriction policy, the collateral value of real estate holding firms decreases, which induces the financially constrained firms to increase product prices when exporting goods. However, the trade volume decreases which implies that the trading partners of Chinese exporters react to the price increase.

I have a set of heterogeneity tests on the subsamples to test what are the determinants of the pricing decisions. Table 7 shows three sets of tests. Columns (1) and (2) compare the subsample of firms with high and low/no real estate assets. The results show that only firms with high real estate assets react to the Housing Purchase Restriction shock by increasing product prices. This is consistent with Table 3 and A3 which show that only high real estate holding firms are more financially constrained after the negative collateral shock. Columns (3) and (4) decompose the sample of high real estate holding firms into two groups: firms operating in highly concentrated industries and those operating in low-concentrated industries. I calculate the Herfindahl-Hirschman Index (HHI) within industries for Chinese suppliers and define a highly concentrated industry as an industry with a Herfindahl-Hirschman Index above the median. The results show that firms in a more concentrated industry are more likely to increase product prices as they have more bargaining power. Similarly, columns (5) and (6) decompose the sample of high real estate holding firms into state-owned enterprises and private-owned enterprises based on the ownership structure of the firms. I define a firm as state-owned if a public firm's controlling stakeholder is either the government or State-owned Assets Supervision and Administration Commission (SASAC). Private-owned enterprises are in general more financially constrained than state-owned enterprises as SOEs have better relationships with the banks (Poncet et al. (2010)). Consistent with the argument, I find that privately owned enterprises are more likely to increase their exporting product prices when they face a negative collateral shock.

6.3.2 Selling Expense

Product market frictions require firms to spend resources on customer acquisition (Gourio and Rudanko, 2014). One way to build a customer base is through advertising and marketing. Firms under financial constraints can not only adjust product prices but also adjust their investment in advertisement and marketing. In this section, I use the firm-level selling expense variables to test whether financially constrained firms invest less in the customer base. The model specification is the same as 2.

Table 8 shows the results of the tests. Columns (1) use the natural logarithm of selling expenses and column (2) use the ratio of selling expenses over the total operating revenue as dependent variables. The sample is again restricted to high real estate asset firms, which are firms that hold real estate asset values above the median. The result in column (1) shows that when holding high real estate assets, Chinese firms located in a treated city spend 15.5% less in selling-related activities compared to the firms in a control city after the policy adoption. In column (2), I find that the ratio of selling expenses over total revenue doesn't change much, which is consistent with the trade volume reduction in section 6.1. There is a limitation for the test as the selling expense variable does not specify whether it is for a domestic customer base or an international customer base. In general, international trade has more friction in the product market than the domestic market. Thus it would require more investment in marketing such as exhibitions and advertising. So I would assume that the test of total selling expenses will only underestimate the results.

7 Alternative Channels

7.1 Labor Cost Channel

Real estate shock did only affect the collateral value of the firms but also the housing prices for local residents. For renters, a negative shock to the housing market will lower

the cost of living and thus they might require less compensation from work. For house owners, the housing prices drop could have a negative wealth effect and result in more compensation from work. Labor cost is an important factor of production and will affect firms' exporting decisions. In this section, I will explore the change in labor costs after the adoption of the Housing Purchase Restrict policy and see whether it would result in a reduction in trade volumes.

First, I study how the Housing Purchase Restriction policy affects the average wage in a city. I obtain the city-level average wage from the Bureau of Statistics and compare the wages in cities that adopted the policy with wages in other cities before and after the policy implementation. I estimate the regression model:

$$Y_{qct} = \beta_1 \text{Treated}_{qc} \times \text{Post}_{ct} + \mu_{qc} + \gamma_{ct} \tag{5}$$

where the dependent variable Y_{qct} is the average employee wages for city q in year t which belongs to cohort c. I define *Treated* as the cities that are located in cities with the Housing Purchase Restriction policy. μ_{qc} is the city-cohort fixed effect, which allows me to identify the wage changes of the same city in the cohort over time. γ_{ct} is the cohort-year fixed effect, which allows me to identify cross-sectional variation between treated and control cities in the same year from the same cohort. The coefficient of interest in the specification 5 is β_1, which identifies the effects on the treated cities' average wages. Table A8 shows the result. On average, the average wages are 5.7% lower after the policy for treated cities compared to other cities. The result implies that on average the negative housing price shock lowers the labor costs.

Next, I look at employee compensation expenses at the firm level. I calculate the total employee compensation cost as the sum of cash paid to and on behalf of employees and employee compensation payable at the end of the year minus employee compensation payable at the beginning of the year. I use the same model specification as Table 3 and run the stacked difference in differences regression on compensation in natural logarithm and total employee compensation over the total revenue.

Table 10 shows the results. Column (1) shows that negative shocks in the real estate market of the cities that firms are located in are associated with an 11.3% drop in total employee compensation expenses, relative to firms located in unaffected cities. This is consistent with the previous finding that firms with high real estate value have more financial constraints and will try to cut expenses in production. In column (2), I find that the employee compensation cut is smaller relative to the revenue change, which means that wages and employment are relatively sticky. However, the reduction in average wages is not likely to be the reason for the trade volume drop in the global supply chain as the labor cost for firms is decreasing.

7.2 Trade Credit Channel

Trade credit is a common practice where a supplier allows a customer to purchase goods or services on credit and pay for them at a later date. Firms could manage financial constraints by adjusting their trade credit issued to customers (e.g., Fisman and Love, 2003, and Amberg, Jacobson, Von Schedvin, and Townsend, 2021). For example, firms can manage the trade credit claims held on customers by reducing the number of days a customer has to pay their invoice after receiving the goods or services or by proactive monitoring of the outstanding contracts to avoid overdue settlement of customer debts. Hence, a firm may reduce its accounts receivable in the balance sheet and keep its liquidity. However, customers' liquidity could be negatively affected as they are providing liquidity to the suppliers and this might also lead to the reduction in trade along the supply chain. I test this channel using the change of accounts receivables of the Chinese public firms which I define as the accounts receivable at the end of the year minus the accounts receivable at the beginning of the year. Again, I use the same model specification as Table 3 and estimate the stacked difference in differences regression on the change of accounts receivable in natural logarithm and accounts receivable change over the total revenue.

Table 11 shows the results. The negative real estate shocks do not significantly affect the accounts receivable for Chinese public firms with high real estate value. Column (1)

shows that negative shocks in the real estate market of the cities that firms are located in are associated with an insignificant drop in accounts receivable, relative to firms located in unaffected cities. In column (2), I find that there is no significant drop in the ratios of accounts receivable change over the total revenue for Chinese public firms located in the cities that adopted the Housing Purchase Restriction policy, relative to the firms located in other cities. The test is not perfect as I do not distinguish the trade credits issued to domestic customers and international customers due to the data limitation. But in general, the results suggest that trade credit doesn't change much after the negative real estate shock.

8 Conclusion

How does collateral value affect firms' position in the global supply chain? In this paper, I provide causal evidence that collateral value affects firms' relationship with global customers. I focus on the trade between U.S. customers and Chinese suppliers using detailed firm-to-firm shipment data and apply a stacked diff-in-diff design involving city-level housing purchase restrictions in China. I find that firms facing a negative shock to collateral value become more financially constrained. These Chinese firms raise their exporting product prices to boost short-term profits and sacrifice their long-term customer base. The U.S. customers reduce the imports from these Chinese firms and reallocate their imports to other suppliers in the production network. This study shed light on the causal relationship between real estate collateral value and exporting behavior of firms.

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Table 1

Summary Statistics

This table presents summary statistics for the main variables in the paper. The number of shipments is an annual count of shipments to the U.S. at the U.S. customer-Chinese supplier-year level over the period of 2007-2020 from the U.S. Customs bill of lading record. Similarly, the container is the total number of containers a Chinese supplier sends to the U.S. in one year on the bill of lading. $\mathbb{1}(Trade > 0)$is an indicator that equals one if the Chinese supplier has any trade with the U.S. customer in a year. Real Estate value is the property investment of Chinese firms in the annual reports at the Chinese supplier - year level. Short-term debt, long-term debt, and operating revenue are from the China Stock Market & Accounting Research Database (CSMAR). Real Estate value, short-term debt, long-term debt, and operating revenue are all in million RMB. The leverage ratio is defined as the total liability over the total assets of Chinese suppliers.

	Mean	SD	p10	p50	p90	Observations
Number of Shipment	1.30	5.28	0.00	0.00	2.00	197,456
Container	1.81	7.93	0.00	0.00	2.00	197,456
1(Trade>0)	0.17	0.37	0.00	0.00	1.00	197,456
Real Estate Value	37.88	153.77	0.00	0.00	64.47	15,487
Short Term Debt	997.00	2146.89	0.00	258.55	2547.22	8,616
Long Term Debt	466.07	1348.84	0.00	30.50	1052.14	7,539
Leverage Ratio	0.42	0.20	0.16	0.42	0.69	9,037
Operating Revenue	5830.49	13185.25	403.49	1681.22	12139.98	9,029

Table 2

Covariate Balance Table

In this table, I show the averages of covariates for the treated and control groups. I compare firms that are located in cities that adopted the Housing Purchase Restriction policy with firms located in other cities. Size is the total assets and leverage is the total liability from the balance sheet. Short-term loan is the amount of loans with a maturity of less than one year (including one year) but not yet repaid. Revenue is the total operating revenue. Cash is the cash holding and cash equivalents of the firm. Inventory is the difference between inventories and inventory depreciation reserves. ROA is defined as net profit over total assets and ROE is defined as net profit over total shareholders' equity. Size, leverage, short-term loan, revenue, cash, inventory and net profit are in million RMB. The sample contains all Chinese public firms with real estate value above the median during 2006-2009.

	Mean_t	Observations	Mean_c	Observations
Size	4242.796	1,634	4084.497	585
Leverage	2469.439	1,634	2282.049	585
Short-term Loan	555.239	1,634	531.367	585
Revenue	4113.712	1,633	3600.048	584
Cash	716.368	1,634	579.049	585
Inventory	746.974	1,634	699.483	585
Net Profit	171.248	1,634	168.027	585
ROA	0.035	1,634	0.031	584
ROE	0.066	1,634	0.067	584

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 3

Collateral Value and Financial Constraints

This table examines whether the Housing Purchase Restriction policy affects firms' external financing level. The dependent values are the natural logarithm of firm's short-term debt, cash, dividend, and the ratio of cash over assets. *Treated* is an indicator that takes the value of one if the Chinese firm is located in a city that announced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. I report standard errors clustered at the firm-cohort level. The sample contains all Chinese public firms with high real estate values that have importing records on the Chinese custom during the period 2008-2014.

	Log(Short Term Debt)	Log(Cash)	Cash/Assets	Log(Dividend)
	(1)	(2)	(3)	(4)
Treated × Post	-0.155*	-0.184***	-0.015**	-0.212***
	(0.08)	(0.06)	(0.01)	(0.08)
Firm-Cohort FE	Yes	Yes	Yes	Yes
Cohort-Year FE	Yes	Yes	Yes	Yes
R-Squared	0.789	0.830	0.739	0.751
Observations	5,396	6,589	6,589	5,682

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 4

Real Estate Prices and U.S.- China Trade

This table examines whether real estate prices in China affect U.S.- China trade. The dependent variable in column (1) is Shipment Dummy, which is an indicator that takes the value of one if there is trade between the supplier-customer pair in the year. The dependent variables in column (2) and (3) are the natural logarithm of one plus the number of shipment and containers, respectively between the supplier-customer pair in the year. *Treated Suppliers* is an indicator that takes the value of one if the Chinese supplier is located in a city that experienced the Housing Purchase Restriction Policy. In Panel A, the sample includes Chinese public firms that hold real estate value more than median and in Panel B, the sample includes Chinese public firms that hold real estate value less than median or zero. I report standard errors clustered at the supplier-cohort level. The sample contains all trading pairs between Chinese public firms and U.S. firms that have importing records on the U.S custom during the period 2007-2014.

Panel A: High Real Estate Holding Firms			
	Shipment Dummy	Log(1+Shipment)	Log(1+Container)
	(1)	(2)	(3)
Suppliers Treated × Post	-0.111***	-0.171***	-0.192***
	(0.03)	(0.06)	(0.06)
Pair-Cohort FE	Yes	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.639	0.724	0.714
Observations	8,428	8,428	8,428
Panel B: Low/No Real Estate Holding Firms			
	Shipment Dummy	Log(1+Shipment)	Log(1+Container)
	(1)	(2)	(3)
Suppliers Treated × Post	0.008	0.026	0.032
	(0.02)	(0.04)	(0.04)
Pair-Cohort FE	Yes	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.637	0.678	0.675
Observations	28,973	28,973	28,973

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 5

Reallocation of Imports for U.S. Customers

This table examines whether U.S. customers reallocate their imports from treated Chinese suppliers to other suppliers. The dependent variables are the same as Table 4. *%Treat* is the fraction of suppliers affected by the real estate shock to a customer in a cohort. *Treat Cust, Control Supp* is an indicator that takes the value of one if the untreated supplier shares the same customer with a treated supplier. I report standard errors clustered at the supplier-cohort level. The sample contains all trading pairs between U.S. firms and Chinese public firms or suppliers that share the same customers with the Chinese public firms during the period 2007-2014.

	Shipment Dummy	Log(1+Shipment)	Log(1+Container)
	(1)	(2)	(3)
Treated Supplier×Post	-0.057***	-0.101***	-0.110***
	(0.02)	(0.03)	(0.03)
%Treat×Treat Supp×Post	-0.382***	-0.411***	-0.420***
	(0.05)	(0.12)	(0.13)
%Treat×Treat Cust, Control Supp×Post	1.698***	2.280**	2.510**
	(0.55)	(1.07)	(1.26)
Pair-Cohort FE	Yes	Yes	Yes
Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.357	0.519	0.509
Observations	64,696	64,696	64,696

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 6

Suppliers' Exporting Product Prices

This table studies how Housing Purchase Restriction policy affects Chinese firms' product prices of exporting goods. The dependent variables in column (1) - (3) are the natural logarithm of product prices, quantity and revenue, respectively, of exporting goods for a Chinese firm. *Treated* is an indicator that takes the value of one if the Chinese supplier is located in a city that experienced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. I report standard errors clustered at the supplier-cohort level. The sample contains all Chinese public firms that have importing records on the Chinese custom during the period 2008-2014.

	Log(Price)	Log(Quantity)	Log(Revenue)
	(1)	(2)	(3)
Treated × Post	0.083*	-0.272**	-0.168
	(0.05)	(0.12)	(0.12)
Firm-Product-Cohort FE	Yes	Yes	Yes
Product-Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.719	0.738	0.809
Observations	22,806	23,002	23,002

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 7

Cross-sectional Test on Product Prices

In this table, I test the heterogeneous effect of the Housing Purchase Restriction policy on exporting product prices. The dependent variable is the natural logarithm of product prices of exporting goods of Chinese firms. *Treated* is an indicator that takes the value of one if the Chinese supplier is located in a city that experienced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. In columns (1) - (2) I split the sample by the value of real estate holdings of Chinese firms. In columns (3) - (4) I decompose the sample of high real estate holding firms into firms operating in high concentrated and low concentrated industries. In columns (5) - (6) I decompose the sample of high real estate holding firms into state-owned enterprises and private-owned enterprises. I report standard errors clustered at the supplier-cohort level. The sample contains all Chinese public firms that have importing records on the Chinese custom during the period 2008-2014.

	Log(Price)					
	High RE	Low RE	High HHI	Low HHI	SOE	POE
Treated × Post	0.218***	-0.138	0.477*	0.106	0.215	0.657***
	(0.06)	(0.10)	(0.23)	(0.20)	(0.29)	(0.16)
Firm-Product-Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Product-Cohort-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.714	0.694	0.483	0.734	0.714	0.677
Observations	10,576	9,823	1,958	6,873	5,472	3,975

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 8

Selling Expenses

This table examines whether the Housing Purchase Restriction policy affects firms' selling expenses. The dependent values are the natural logarithm of firm's selling expenses and the ratio of selling expenses over total revenue. *Treated* is an indicator that takes the value of one if the Chinese firm is located in a city that announced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. I report standard errors clustered at the firm-cohort level. The sample contains all Chinese public firms with high real estate values that have importing records on the Chinese custom during the period 2008-2014.

	Log(Selling Expenses)	Selling Expenses/Revenue
Treated × Post	-0.089*	-0.001
	(0.05)	(0.00)
Firm-Cohort FE	Yes	Yes
Cohort-Year FE	Yes	Yes
R-Squared	0.920	0.839
Observations	6,455	6,518

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 9

Reverse of the Housing Purchase Restriction Policy

This table examines whether the reverse of Housing Purchase Restriction Policy affects firms' exporting behavior. The dependent variables are the same as Table 4. I limit the sample to firms that have experienced the housing purchase restriction in the previous year. *Suppliers Treated (Reverse)* is an indicator that takes the value of one if the Chinese supplier is located in a city that canceled the housing purchase restriction policy *Post* is an indicator that takes the value of one if the year is after the policy cancellation in the city. I report standard errors clustered at the supplier-cohort level. The sample contains trading pairs between U.S. firms and Chinese public firms that located in the cities that announce housing purchase restriction policy during the period 2010-2019.

	Shipment Dummy	Log(1+Shipment)	Log(1+Container)
	(1)	(2)	(3)
Suppliers Treated (Reverse) × Post	0.031*	0.090**	0.101**
	(0.02)	(0.04)	(0.04)
Pair-Cohort FE	Yes	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.643	0.729	0.722
Observations	37,662	37,662	37,662

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 10

Labor Channle

This table examines whether the Housing Purchase Restriction policy affects firms' labor costs. The dependent values are the natural logarithm of firm's compensation expenses and the ratio of selling expenses over total revenue. *Treated* is an indicator that takes the value of one if the Chinese firm is located in a city that announced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. I report standard errors clustered at the firm-cohort level. The sample contains all Chinese public firms with high real estate values that have importing records on the Chinese custom during the period 2008-2014.

	High RE Value Firms	
	Log(Comp.)	Comp./Revenue
Treated × Post	-0.113***	0.007*
	(0.04)	(0.00)
Firm-Cohort FE	Yes	Yes
Cohort-Year FE	Yes	Yes
R-Squared	0.925	0.691
Observations	6,129	6,131

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table 11

Trade Credit Channel

This table examines whether the Housing Purchase Restriction policy affects firms' trade credit. The dependent values are the natural logarithm of firm's accounts receivable and the ratio of accounts receivable over total revenue. *Treated* is an indicator that takes the value of one if the Chinese firm is located in a city that announced the housing purchase restriction policy. *Post* is an indicator that takes the value of one if the year is after the policy adoption in the city. I report standard errors clustered at the firm-cohort level. The sample contains all Chinese public firms with high real estate values that have importing records on the Chinese custom during the period 2008-2014.

	High RE Value Firms	
	Log(Acc. Receivable)	Acc. Receivable/Rev.
Treated × Post	-0.126	-0.006
	(0.10)	(0.01)
Firm-Cohort FE	Yes	Yes
Cohort-Year FE	Yes	Yes
R-Squared	0.677	0.330
Observations	3,858	6,121

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Figure 1

Cities with Housing Purchase Restriction and Control Cities

The figure plots the cities that adopted Housing Purchase Restriction policy and the control cities in which a public firm is headquartered but no such policy is adopted.

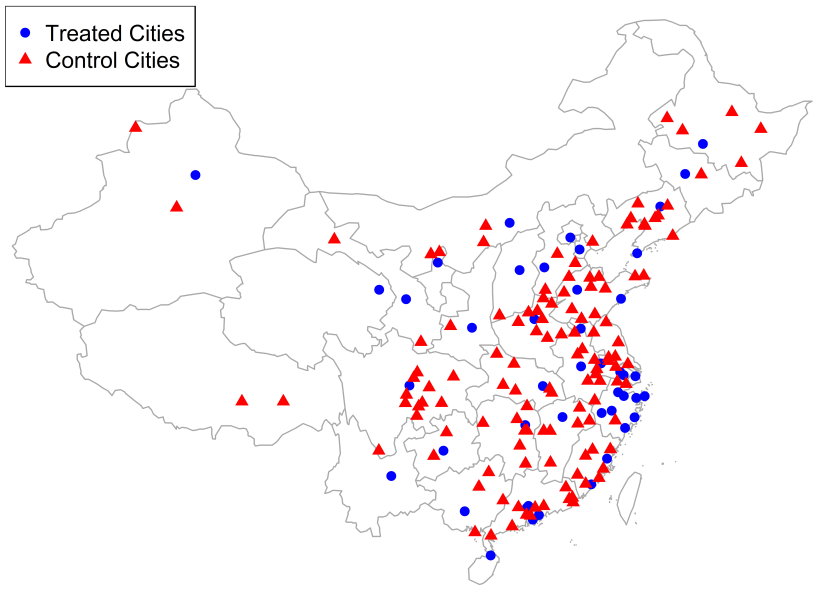


Figure 2

The Effects of Housing Purchase Restriction on Housing Prices

The figure plots the time series trends of housing prices for both treated and control cities from 2003 to 2020. A city's house prices are scaled by its city-level mean to make the prices comparable between cities. The solid line captures the monthly differences in log house prices between treated cities and control cities defined in the paper. The solid vertical line indicates the beginning year of Housing Purchase Restriction adoption. The dashed vertical line indicates the beginning year of the policy cancellation.

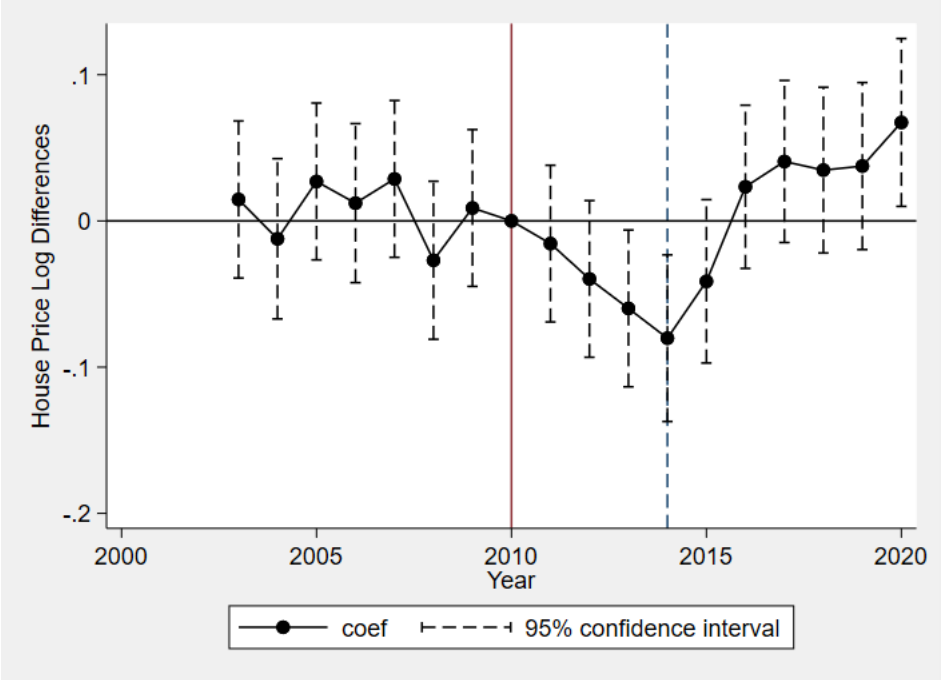
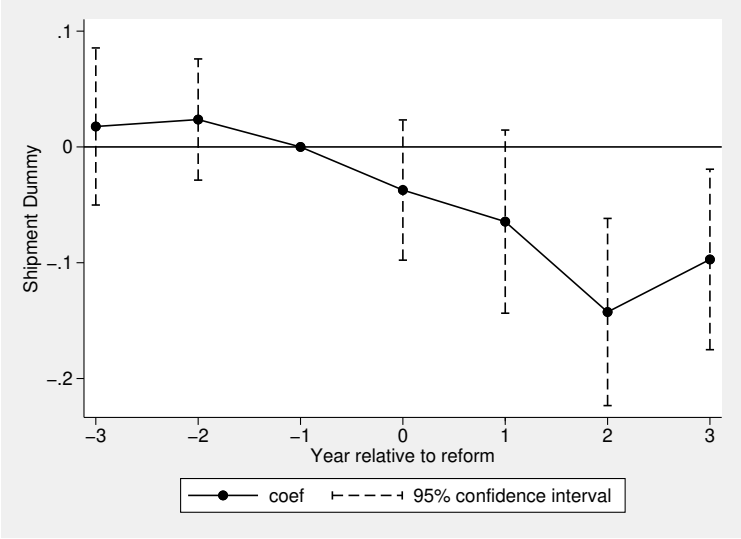


Figure 3

Dynamic Effects of Chinese Real Estate Shock on US-China Trade

The figure plots the dynamic effects of Chinese real estate price shock on U.S.- China Trade. I use the year in which Chinese firms experience a city-level Housing Purchase Restriction policy as baseline. The dependent variable is the shipment dummy variable which takes the value of 1 if the supplier and customer have trade in the year. I plot the estimated coefficients and the associated 95% confidence intervals.



Appendix: For Online Publication

Table A1

Panjiva Sample Selection

	#Suppliers	#Customers	#Supplier-Customer Pairs
Panjiva sample	330,507	236,245	1,416,572
(-) Non U.S. - China Trade	279,796	149,033	954,563
(-) Non Listed Chinses Firms	49,395	74,223	443,239
U.S. - Chinese Public Firm Relationship	1,316	12,989	18,770

Table A2

Top Ten Industries for Real Estate Holding Firms

This table presents the top ten industries for three groups of firms: no real estate holding firms, low real estate holding firms, and high real estate holding firms.

Most Frequent Industries	No Real Estate Holding Firms	Low Real Estate Holding Firms	High Real Estate Holding Firms
1	Computer & Communications	Computer & Communications	Computer & Communications
2	Chemical	Special Equipment	Automotive
3	Special Equipment	Electrical Machinery	Electrical Machinery
4	Electrical Machinery	Chemical	Chemical
5	Automotive	General Equipment	Wholesale
6	Non-metallic Mineral Products	Automotive	General Equipment
7	General Equipment	Pharmaceutical	Special Equipment
8	Rubber and Plastic Products	Rubber and Plastic Products	Pharmaceutical
9	Pharmaceutical	Metal Products	Transportation Equipment
10	Metal Products	Metal Smelting and Rolling Industry	Software and IT

Table A3

Collateral Value and Financial Constraints: Placebo

This table runs the same regressions as in Table 3, but with the sample of firms that hold no/low real estate assets based on the median of the variable. The real estate asset value is the firm's investment property obtained from WIND.

	Short Term Debt	Log(Cash)	Cash/Assets	Log(Dividend)
	(1)	(2)	(3)	(4)
Treated × Post	-0.049	0.005	-0.007	-0.011
	(0.08)	(0.05)	(0.01)	(0.08)
Firm-Cohort FE	Yes	Yes	Yes	Yes
Cohort-Year FE	Yes	Yes	Yes	Yes
R-Squared	0.799	0.791	0.718	0.772
Observations	6,628	8,546	8,546	6,982

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A4

Real Estate Prices and U.S.- China Trade: Drop Four Largest Cities

This table is similar to Table 4 using a subsample of cities without four largest cities in China (Beijing, Shanghai, Shenzhen, Guangzhou).

	Shipment Dummy	Log(1+Shipment)	Log(1+Container)
	(1)	(2)	(3)
Suppliers Treated × Post	-0.100**	-0.179**	-0.201***
	(0.04)	(0.07)	(0.08)
Pair-Cohort FE	Yes	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes	Yes
R-Squared	0.638	0.710	0.701
Observations	4,732	4,732	4,732

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A5

Poisson Regression

This table is similar to Table 4 using Poisson Regression for shipment and container variables.

	Shipment	Container
	(1)	(2)
Suppliers Treated × Post	-1.752***	-1.498***
	(0.57)	(0.47)
Pair-Cohort FE	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes
R-Squared		
Observations	1,687	1,687

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A6

Cross-Section Test of Trade on Supplier Numbers

In this table, I split the sample from Table 4 Panel A into U.S. customers that have multiple suppliers and unique suppliers and run the same test.

	Shipment Dummy		Log(1+Shipment)		Log(1+Container)	
	Multi-Sup.	Uni-Sup.	Multi-Sup.	Uni-Sup.	Multi-Sup.	Uni-Sup.
Suppliers Treated × Post	-0.127***	0.029	-0.211***	0.067	-0.226***	0.049
	(0.04)	(0.10)	(0.06)	(0.11)	(0.07)	(0.12)
Pair-Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Customer-Cohort-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-Squared	0.635	0.619	0.734	0.712	0.723	0.685
Observations	9,355	351	9,355	351	9,355	351

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A7

Cost of Debt for Suppliers

This table examines whether real estate value affects firms' cost of debt and long-term loans. The dependent variable in columns (1) and (2) are cost of debt, which is defined by the finance expense of the firm divided by its total liability during the year. The dependent variable in columns (3) and (4) are the natural logarithm of firms' long-term loans which are loans that the company borrows from banks or other financial institutions, with a maturity of over one year. I report standard errors clustered at the supplier-cohort level. The sample contains all Chinese public firms during the period 2007-2014.

	Cost of Debt		Log(Long Term Debt)	
	High RE Firms	Low/No RE Firms	High RE Firms	Low/No RE Firms
Treated × Post	-0.081	0.046	0.109	0.179
	(0.08)	(0.57)	(0.11)	(0.12)
Firm-Cohort FE	Yes	Yes	Yes	Yes
Cohort-Year FE	Yes	Yes	Yes	Yes
R-Squared	0.439	0.472	0.781	0.792
Observations	5,560	6,837	3,526	3,896

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A8

City wages

This table examines how average wages at the city level change after the city adopted HPR policy. The dependent variable is the natural logarithm of the city-level average wage. *Treated* is an indicator that takes the value of one if the city adopted the HPR policy. I report standard errors clustered at the city level. The sample contains 287 Chinese cities where wage data is available on the province/city bureau of statistics during the period 2000-2020.

	Log(Average Wage)		
	(1)	(2)	(3)
Treated × Post	-0.056***	-0.057***	-0.057***
	(0.01)	(0.01)	(0.01)
City FE	Yes	Yes	No
Year FE	Yes	No	No
City-Cohort FE	No	No	Yes
Cohort-Year FE	No	Yes	Yes
R-Squared	0.971	0.971	0.974
Observations	5,375	5,375	5,375

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A9

Trade Credit Financing

This table examines the relationship between real estate assets and account receivable for exporting firms. The dependent variable is account receivable financing over total liability. Column (1) use the subsample of high real estate holding firms and column (2) use the subsample of low/no real estate holding firms. *Export Dummy* is an indicator that takes the value of one if the firm is exporting from the custom data. I report standard errors clustered at the supplier level. The sample contains Chinese public firms with account receivable financing data during the period 2019-2020.

	Account Receivable Financing/Debt	
	High RE Value Firms	Low/No RE Value Firms
Export Dummy	0.011	0.016**
	(0.01)	(0.01)
Size	-0.020***	-0.042***
	(0.01)	(0.01)
Leverage	-0.191***	-0.263***
	(0.03)	(0.04)
Revenue	0.022***	0.031***
	(0.01)	(0.01)
year	Yes	Yes
R-Squared	0.109	0.140
Observations	1,134	2,496

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.

Table A10

Real Estate Holdings and Secured Loans

This table examines whether real estate assets affect firms' secured loan levels. The dependent variable in column (1) is the collateralized loan size over total liability and the dependent variable in column (2) is the natural logarithm of the collateralized loan. The dependent variables in columns (3) and (4) are the natural logarithm of short-term and long-term collateralized loans, respectively. I report standard errors clustered at the supplier level. The sample contains all Chinese public firms during the period 2016-2021.

	Collateral Ratio	Log(Secured Loan)	Log(Short Sec. Loan)	Log(Long Sec. Loan)
	(1)	(2)	(3)	(4)
Log(Real Estate Value)	0.006**	0.236***	0.149***	0.267***
	(0.00)	(0.02)	(0.02)	(0.03)
Size	0.004	0.228**	0.192*	0.253*
	(0.01)	(0.10)	(0.10)	(0.14)
Leverage	-0.020	1.760***	1.846***	1.112***
	(0.04)	(0.30)	(0.30)	(0.39)
Log(Revenue)	-0.021*	0.008	-0.027	0.009
	(0.01)	(0.09)	(0.09)	(0.12)
Year FE	Yes	Yes	Yes	Yes
R-Squared	0.008	0.126	0.090	0.122
Observations	6,803	4,669	3,838	2,639

Note: Standard errors in parentheses. ***, **, and * respectively denote statistical significance at the 1%, 5%, and 10% levels.