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Collateral and the Choice Between Bank Debt and Public Debt

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This paper tests how collateral value affects a firm's choice between bank debt and public debt by considering the exogenous variation in the market value of a firm's real-estate assets caused by fluctuations in local real-estate prices. Using local land supply elasticities as an instrument for local real-estate prices, I estimate that a one-standard-deviation increase in collateral value causes bank debt as a fraction of total debt to increase by six percentage points.

Keywords: debt structure; collateral; bank debt; bonds; public debt; real estate
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1. Introduction

Recent research has shown that recognizing the heterogeneity of debt is important to understand corporate financial policy (e.g., Rauh and Sufi 2010, Colla et al. 2013). Some firms borrow primarily from banks and nonbank intermediaries, others rely heavily on public debt market, and still others simultaneously use different types of debt. In theory, banks' ability to obtain more accurate information about the borrower through monitoring allow them to more effectively resolve agency problems or make more efficient liquidation decisions (Berlin and Loeys 1988, Diamond 1991, Chemmanur and Fulghieri 1994, Park 2000). However, bank debt is not always preferred by firms because monitoring can be costly, which makes bank debt more expensive (Chemmanur and Fulghieri 1994), or banks' information monopoly allows them to extract rents from the borrowers (Rajan 1992). In equilibrium, firms self-select into different debt contracts based on, among other things, the severity of moral hazard and adverse selection problems, the probability of financial distress, and the liquidation value of the firm.

In particular, an important determinant of a firm's debt financing decision is its tangible collateral. As discussed in more detail in the next section, however, theories of debt structure do not have unequivocal predictions about the relation between a borrower's collateral value and its optimal debt structure. In Hoshi et al. (1993), the probability of a firm issuing public debt increases with the proportion of its assets that is tangible, because debt becomes relatively safe and monitoring becomes less important as collateral value increases relative to the amount of debt. Cantillo and Wright (2000) also argue that firms with more tangible collateral are more likely to tap the credit market directly, but for the reason that the expected bankruptcy costs induced by bondholders are lower for firms with more tangible collateral. Berlin and Loeys (1988), however, argue that the benefits of efficient liquidations made by banks increase with the liquidation value of the borrower and thus bank debt becomes more attractive as the liquidation value of the borrower increases.[1] Finally, based on a model where a firm borrows both from banks and public lenders and bank debt is collateralized by the liquidation value of the borrower, Park (2000) also predicts that a firm moves from public debt to bank debt as its collateral value increases.

Echoing the mixed theoretical predictions are the inconsistent empirical findings on the relation between collateral value and debt structure. Whereas most empirical studies, such as Johnson (1997), Cantillo and Wright (2000), Denis and Mihov (2003), and Rauh and Sufi (2010), find that firms with a higher ratio of tangible collateral to total assets tend to borrow from public lenders, Houston and James (1996) find a statistically insignificant relation between tangible assets ratio and debt structure. In this paper,

[1] In Berlin and Loeys (1988) and many other models, lenders have claims over the liquidation value of a borrower's assets if the borrower defaults. This essentially assumes that debt is collateralized by the liquidation value of the borrower. This is consistent with the fact that under U.S. law, even unsecured lending is implicitly collateralized in that creditors are allowed to seize debtors' assets in case of default (if the assets are not used as collateral for other debt). Therefore, explicit collateralization is consequential mainly within multilateral financial arrangements (Lacker 2001).

I revisit the issue of collateral and debt structure. Compared with previous empirical studies, this paper has at least two distinctions. First, with the exception of Cantillo and Wright (2000), previous studies focus on the cross-sectional variation in firm debt structure for a small sample of firms.[2] The sample in this paper consists of a panel of more than 2,000 firms over a 10-year period, which not only allows me to analyze the behavior of debt structure for a much larger data set than previous studies, but also to control for time-invariant unobserved firm characteristics using firm-fixed-effects estimation.

Second, all previous studies focus on a firm's total tangible assets and present cross-sectional correlation between tangible assets and debt structure, which makes it difficult to make causal inference and thus assess whether their findings support existing theoretical predictions. In this paper, to test the presence of a causal relationship, I focus on one specific component of a firm's collateralizable assets—real-estate assets. As discussed below, focusing on real-estate assets allows me to identify plausibly exogenous shocks to a firm's collateral value and then estimate the causal effect of collateral value on a firm's choice between bank debt and public debt. Real-estate assets are a significant portion of a firm's tangible assets that can be used as collateral for debt financing. For my sample of U.S. public firms, the real-estate assets of an average firm account for 12% of its total assets and 34% of its tangible assets. Campello and Giambona (2013) find that real-estate assets support high debt capacity and have the most explanatory power over leverage ratios compared to other tangible assets because of their great redeployability.

I find that an increase in a firm's collateral value causes the firm to shift its debt structure toward bank debt. During the 2002 to 2011 sample period, a one-standard-deviation increase in real-estate value leads to a six percentage point increase in bank debt as a fraction of total debt. The positive relation between bank debt and real-estate value holds for both financially constrained and unconstrained firms. In addition, I find that the proportion of bank debt in a firm's debt structure is also positively associated with non-real-estate tangible assets, suggesting that the positive relation between bank debt and tangible assets is not limited to real-estate assets. My finding thus supports the prediction by Berlin and Loeys (1988) and Park (2000) that a firm shifts its debt structure toward bank debt when its liquidation value increases.

My empirical strategy exploits variation in the value of a firm's real-estate assets caused by fluctuations in local real-estate prices. The macroeconomic fluctuations in real-estate prices represent a plausibly exogenous shock to the market value of assets that firms can pledge as collateral. The identification comes from the cross-sectional variation in real-estate assets held by firms as well as the differential variation in local real-estate prices across different geographic locations. To address the endogeneity concern that the local real-estate prices are driven by local economic shocks that affect a firm's financing costs, I use the land supply elasticities introduced by Saiz (2010) as an instrument for real-estate prices. (Mian and Sufi 2011 and Chaney et al. 2012 also use this instrument.) Still, even local real-estate cycles not induced by local shocks could have a feedback effect on local economies and perhaps local credit supply.[3] However, such credit supply shocks are most likely to affect all local firms regardless of their real-estate ownership, whereas the collateral channel I am interested in is identified through firms with different real-estate ownership being differentially affected by fluctuations in local real-estate prices. The identification strategy is discussed in more detail in §4.1.

It is important to point out that the bank debt in this paper is measured as the sum of term loans and revolving credit reported by S&P Capital IQ, which in most cases does not include mortgage debt. Therefore, the finding that bank debt increases with real-estate prices is not a mechanical result of firms with more real-estate assets purchasing even more real-estate properties with mortgage debt when real-estate prices increase. Capital IQ sometimes misclassifies mortgage debt as term loans, but this error is unlikely to have a major impact on the results because the majority of the firms in the sample do not have mortgage debt. Rauh and Sufi (2010) show that in their random sample of 305 firms mortgage debt and equipment notes account only for about 4% of a firm's debt, whereas bank debt accounts for about 26%.

In addition to the work mentioned above, this paper is also related to the contemporaneous work by Cvijanovic (2014). The focus of Cvijanovic (2014) is how collateral value affects a firm's leverage ratio. However, the author also looks at the differential effect of collateral on different types of debt. There are a few important differences between our findings and conclusions. First, Cvijanovic (2014) finds that both bank debt and public debt increase after a positive shock to collateral value, whereas I find that public debt does not rise with collateral value. Second, she finds that financially unconstrained firms reduce their bank debt financing after collateral value rises, whereas I find that both constrained firms and

[2] The number of observations used in the analysis of Houston and James (1996), Johnson (1997), and Rauh and Sufi (2010) are 358, 847, and 2,453, respectively.

[3] I use the term "credit supply channel" to describe this effect, and "collateral channel" to describe the effect that real-estate prices have on a firm's financing ability through its collateral value.

unconstrained firms use more bank debt when collateral value rises. Third, she concludes that her findings support the group of theories that hypothesize that firms move from bank debt to nonbank debt as their reputation improves, whereas I argue that my findings are consistent with theories that predict that firms move from public debt to bank debt as their collateral value increases.

There are several possible explanations for the conflicting findings. First, the samples used in the two papers are different. The debt structure analysis of Cvijanovic (2014) is based on approximately 3,900 observations during the period from 2002 to 2006. My sample consists of more than 14,000 observations from 2002 to 2011. Thus, her debt structure sample may not be representative of the population of all firms. For example, panel C of Table 1 of Cvijanovic (2014) reports a total debt to assets ratio of 43.4%, which is over 50% larger than the book leverage ratio for her entire sample reported in panel A. Second, Cvijanovic (2014) uses somewhat different classification of debt type than my paper. In her sample, bank debt and public debt on average account for 27.4% and 50.2% of a firm's total debt, whereas in my sample bank debt and public debt account for 42.8% and 51.6% of a firm's total debt.[4] Third, even though these two papers use very similar identification strategies, there are some important differences in our model specifications. In particular, I control for initial real-estate value over lagged book assets in my regressions, which allows my main independent variable to capture only variations in real-estate prices and the impact of changes in collateral value on debt structure.[5]

2. Theoretical Motivation

In this section, I discuss the theories of firm debt structure choices, and in particular their implications on the relation between collateral value and debt structure choices.

2.1. Models Based on Information Asymmetry

Theories of financial intermediaries characterize financial intermediaries as delegated monitors that can more effectively resolve the information asymmetry problems between borrowers and lenders (Leland and Pyle 1977; Diamond 1984, 1991; Hoshi et al. 1993). A direct implication of these models is that firms with greater information asymmetry problems can benefit more from the monitoring of bank debt. Houston and James (1996) and Denis and Mihov (2003) maintain that tangible assets contain less information asymmetry because they are easier to value than intangible assets or growth opportunities. Therefore, they argue, firms with more tangible assets would prefer public debt. The same prediction is explicitly made in Hoshi et al. (1993), in which tangible assets are essentially assumed to contain no information asymmetry. In their model, a firm with both tangible, collateralizable assets and intangible assets can invest in two types of projects. Project 2 has higher expected payoffs than project 1 but the manager can only get private benefits from project 1. The firm can either borrow from public lenders who do not monitor or banks who monitor at a cost and who can force the firm to take the good project. If the project fails, the lender gets the liquidation value of the firm's collateral. As more of a firm's assets become collateralizable, debt issues (of any type) become relatively safe and the borrower receives more of the cash flow benefits of the project. Therefore, bank monitoring becomes less crucial in inducing efficient project selection and the firm is more likely to issue public debt.

2.2. Models Based on Efficient Liquidation

In the above models, banks monitor to resolve the moral hazard or adverse selection problems introduced by the information asymmetry between borrowers and lenders. In other models, banks monitor to obtain more accurate information about the borrower and make efficient liquidation decisions (Berlin and Loeys 1988, Chemmanur and Fulghieri 1994, Cantillo and Wright 2000). In these type of models, collateral value affects the borrower's optimal financing decisions by impacting the benefits of efficient liquidations. In the simple theoretical framework of Cantillo and Wright (2000), firms borrow from bondholders if intermediation costs induced by banks exceed the expected bankruptcy loss induced by bondholders. They argue that firms with more tangible collateral suffer less from relatively inefficient bankruptcy induced by bondholders because tangible assets have thicker secondary markets and therefore their disposal takes less time. As a result, firms with more tangible collateral are more likely to tap the credit market directly. In Berlin and Loeys (1988), compared to bondholders, banks can make relatively efficient liquidation decisions through costly monitoring, and the benefits of efficient liquidation increase with liquidation value. As a result, firms that have invested mostly in firm-specific or intangible capital do not benefit as much from bank monitoring as firms that own a large amount of tangible collateral. Consequently, their model predicts that firms move from public debt to bank debt as collateral value increases.

[4] For comparison, Colla et al. (2013), who also use Capital IQ debt classification, report 43.2% and 48.0% for bank debt ratio and public debt ratio.

[5] See §§3.3 and 4.1 for discussions of this issue.

2.3. Models Based on Seniority Structure

In the theories discussed above, a firm can only borrow from either private lenders or public lenders. Other theories allow firms to borrow from multiple sources and derive the optimal seniority and priority structure (Diamond 1993, Berglf and von Thadden 1994, Rajan and Winton 1995, Bolton and Scharfstein 1996). Most relevant to the analysis in this paper is the model by Park (2000), who examines why it can be optimal for firms to borrow from multiple lenders and why the lender who monitors should hold senior debt. The optimal debt contract is characterized by the following: (1) The firm borrows both senior bank debt and junior public debt. (2) The senior lender monitors at a cost and the junior lender does not monitor. (3) The firm borrows the liquidation value of the project, L, from the senior lender, and the rest from junior lender. (4) When the senior lender discovers that the project is a bad type, he forces liquidation of the project and gets L and leaves nothing for the junior lender.

In equilibrium, the composition of senior bank debt and junior public debt depends on, among other things, the amount of financing needed relative to cash flow of the project and the liquidation value of the project. In particular, Proposition 13 of Park (2000) predicts that more senior bank debt will be used as the liquidation value (collateral value) L increases. The reason is that as the liquidation value increases and as the firm borrows more bank debt against its liquidation value, banks have stronger incentive to liquidate a bad project than let it continue. Thus, the borrower has stronger incentive to invest in the good project, which lowers the cost of bank debt as well as the cost of public debt.

Taken together, the theories discussed above suggest different, and often opposing forces that could move firms toward bank debt or public debt as their collateral value changes. It is, therefore, ultimately an empirical question, which forces dominate in reality. It should be noted, however, because among the models that endogenize the seniority structure of debt claims, Park (2000) is the only paper that explicitly derives the comparative static of how optimal debt structure should vary with collateral value, the empirical test in this paper cannot discriminate among the models with endogenous seniority structure.

3. Data

My sample consists of all firms in the Compustat-CRSP universe from 1993 to 2011 that meet the following criteria: (1) book value of assets is greater than zero; (2) book leverage, defined as total debt over total assets, has a value greater than zero and less than one;[6] (3) market-to-book ratio, defined as market value of assets over book value of assets, is greater than zero; (4) the headquarters of the firm is located in the United States; (5) the firm is operating in a nonfinancial, nonutility industry. The sample starts in 1993 because it is the last year that a firm is required to report accumulated depreciation of buildings, which will be used later to estimate the market value of a firm's real-estate assets. This sample is then matched to the debt structure data and real-estate price data described below.

3.1. Debt Structure Data

The debt structure data used in this paper come from S&P Capital IQ. Capital IQ classifies debt into seven exclusive types: commercial paper, revolving credit, term loans, senior bonds and notes, subordinated bonds and notes, capital leases, and other debt. Using Capital IQ data, Colla et al. (2013) provide one of the first large sample studies on the patterns and determinants of debt structure. As in Colla et al. (2013), the Capital IQ sample used in this paper starts in 2002, when the coverage of Capital IQ becomes comprehensive. Merging Capital IQ data with the Compustat-CRSP data and real-estate price data leaves me with 15,550 firm-year observations for 2,220 firms. I follow Colla et al. (2013) to remove firm-years for which the difference in total debt reported in Compustat and Capital IQ exceeds 10% of total debt.

Table 1 reports the average fraction of debt classified as bonds (sum of senior and subordinated bonds) and bank debt (sum of revolving credit and term loans). On average bonds account for 51.6% and bank debt accounts for 42.8% of debt. Together these two types of debt make up over 94% of a firm's total debt. The debt structure analysis in this paper is focused on these two components of debt. The summary statistics of debt structure are very close to those reported in Colla et al. (2013, Table 2).

In addition to examining the mix of debt, I also examine how collateral value impacts the issuance of new debt. The issuance of bank loans are obtained from Thomson Reuters LPC's DealScan, which provides comprehensive coverage of global syndicated loan market. I match firms in my sample and DealScan using the link table provided by Chava and Roberts (2008). The issuance of bonds is obtained from Thomson Reuters SDC Platinum.

3.2. Real-Estate Prices

Because Compustat does not provide the exact location of each piece of real estate owned by a firm, I use the headquarters location as a proxy for the location

[6] Firms with no debt are excluded because the focus of this paper is on the debt structure of firms.

Table 1 **Summary Statistics**

	Mean	Median	Std. dev.	Min	Max	No. of observations
Debt structure						
Blev	24.83	21.87	18.28	0.00	99.95	15,550
Mlev	17.89	14.05	15.28	0.00	92.67	15,550
Bonds	51.64	59.12	40.68	0.00	100.00	15,550
Senior bonds and notes	41.42	32.84	40.88	0.00	100.00	15,550
Subordinated bonds and notes	10.22	0.00	25.96	0.00	100.00	15,550
Bank debt	42.79	31.41	40.72	0.00	100.00	15,550
Term loans	20.39	0.00	33.02	0.00	100.00	15,550
Revolving credit	22.40	0.73	33.20	0.00	100.00	15,550
Real-estate value						
*REvalue*01_*m*	0.13	0.07	0.21	0.00	2.46	14,344
*REvalue*01_*s*	0.16	0.09	0.25	0.00	2.79	14,923
*REvalue*93_*m*	0.24	0.10	0.39	0.00	3.35	6,201
*REvalue*93_*s*	0.40	0.19	0.57	0.00	2.61	5,894
Control variables						
Ln(*assets*)	6.30	6.39	1.98	1.09	10.36	15,550
MB	1.78	1.46	1.15	0.58	12.14	15,550
CF	0.08	0.11	0.18	−0.69	0.40	15,543
Col	0.41	0.37	0.30	0.00	0.99	15,549
NotRated	0.63	1.00	0.48	0.00	1.00	15,550
InvGrade	0.18	0.00	0.38	0.00	1.00	15,550

Notes. *Blev* is book leverage, defined as book value of total debt (DLTT + DLC) over book value of total assets (AT) and measured in percentage points. *Mlev* is market leverage, defined as book value of total debt (DLTT + DLC) over market value of total assets (AT + PRCC_F × CSHO–CEQ–TXDB) and measured in percentage points. *Bonds* and *Bank debt* are bonds and bank debt as a fraction of total debt, respectively, measured in percentage points. *REvalue* is the estimated market value of real-estate assets divided by lagged book assets, defined by Equation (2), and the suffix *m* indicates that the *REprice* in Equation (2) is the MSA residential real-estate price and the suffix *s* indicates state commercial real-estate price. Ln(*assets*) is the logarithm of total assets. *MB* is market-to-book ratio defined as market value of assets over book value of assets. *CF* is cash flow defined as operating income before depreciation (OIBDP) over total assets. *Col* is non-real-estate collateralizable assets defined as the sum of inventories (INVT), machinery and equipment (FATE), natural resources (FATN), and other PP&E (FATO) over total assets. *NotRated* is a dummy variable equal to 1 if a firm does not have an S&P long-term rating and 0 otherwise. *InvGrade* is a dummy variable equal to 1 if a firm's S&P long-term rating is BBB− or above and 0 otherwise.

of real-estate assets. I use real-estate prices at both the headquarters metropolitan statistical area (MSA) level and state level to measure the shock to a firm's real-estate value. The underlying assumption is that the majority of a firm's real-estate assets are located either in the same MSA or the same state as its headquarters. As pointed out by Chaney et al. (2012), if not all of a firm's real-estate assets are located in its headquarters MSA or state, the empirical methodology tends to overestimate the fraction of a firm's real-estate assets that comoves with local real-estate prices and therefore to underestimate the impact of collateral on a firm's financing decisions. The magnitude of the measurement error will depend on the likelihood that a firm's real-estate assets are located outside of the headquarters MSA or state and the time-series correlation of real-estate prices across different MSAs or states during the sample period.

The residential house prices at the MSA and state level are from the Federal Housing Finance Agency (FHFA). The zip codes of the headquarters location from Compustat are matched to the MSA code from the FHFA by using a correspondence table from the U.S. Census Bureau.[7] The FHFA's residential house price index represents the most comprehensive housing price index covering most MSAs, with a starting date between 1976 and the mid-1980s. It is also available at the state level since 1975.

I also construct a commercial real-estate price index at the state level using data from the National Council of Real Estate Investment Fiduciaries (NCREIF). The NCREIF database goes back to 1977 and as of 2013 consists of approximately 30,000 historical properties, and approximately 10,000 current properties. It reports the market value of commercial real-estate properties by location (region, division, state, CBSA) and property type (industrial, office, retail, apartments, etc.). It allows users to create their own index based on location and property type. Because the number of commercial real-estate properties in the NCREIF database can be very small for small MSAs in a given year, the real-estate price index constructed

[7] 2010 ZCTA to Metropolitan and Micropolitan Statistical Areas Relationship File. Last accessed March 26, 2015, http://www2.census.gov/geo/docs/maps-data/data/rel/zcta_cbsa_rel_10.txt.

at the MSA level can be very volatile. This is why I opt to construct a commercial real-estate price index only at the state level.

3.3. Real-Estate Assets

The key variable in this paper is the market value of a firm's real-estate assets. Because of potential measurement errors in a firm's real-estate ownership and in shocks to real-estate prices that shift the market value of real-estate assets, in the empirical tests I compute the market value of real-estate assets in four different ways. As discussed below, these four measures correspond to combinations of measuring real-estate ownership in 1993 and 2001 and measuring real-estate price shocks at the state and MSA level.

The market value of real-estate assets is a function of real-estate ownership and real-estate prices. A firm's real-estate ownership is very likely to be endogenous to its financing decisions. To minimize the endogeneity concern, I rely on the variation in the market value of real-estate assets that comes from fluctuations in real-estate prices rather than a firm's real-estate ownership. Therefore, I make sure the cross-sectional variation across firms in their exposure to real-estate prices comes from ex ante real-estate ownership—the real-estate ownership before the estimation period from 2002 to 2011.

In measuring a firm's ex ante real-estate ownership, I start with real-estate assets at the beginning of the sample period—2001. Real-estate assets are computed by the sum of buildings (Compustat data item FATB), land and improvement (FATP), and construction in progress (FATC). During the sample period, the variation in real-estate value only comes from fluctuation in real-estate prices. By doing this, I ignore the acquisitions and sales of real-estate assets after 2001 and thus minimize potential endogeneity problems.[8]

Because real-estate assets are reported at historical cost, the market value of real-estate assets can be very different from the Compustat numbers depending on the time when the assets were purchased and the real-estate price variation from the purchase year to the reporting year. Therefore, my second measure of real-estate ownership is to follow Chaney et al. (2012) to estimate the market value of a firm's real-estate assets. Specifically, the ratio of accumulated depreciation of buildings (DPACB) to the historic cost of buildings measures the proportion of the original value of a building that has been depreciated. Assuming an average depreciable life of 40 years, the average age of buildings for a given firm is 40 multiplied by the proportion depreciated. Unfortunately, 1993 is the last year that a firm is required to report accumulated depreciation of buildings. Therefore, I can only estimate the market value of real-estate assets for firms that have existed since 1993. Specifically, the market value of real-estate assets in 1993 is inferred by inflating their historical costs with real-estate inflation from estimated purchase year to 1993,

$$
\begin{aligned}
REassets_{i,j,1993} = {} & (Fatb+Fatp+Fatc)_{i,j,1993} \\
& \times REprice_{j,1993}/REprice_{j,1993-Age_{i,j}},
\end{aligned} \tag{1}
$$

where i indexes firm, j indexes MSA, $Age_{i,j} = 40 \times (Dpacb_{i,j,1993}/Fatb_{i,j,1993})$, 1993–$Age$ is the estimated purchase year of real-estate assets in 1993, and $REprice$ is the inflation-adjusted MSA-level residential real-estate price index.[9] If the purchase year is after 1975 but before the first year when the MSA's real-estate price is available, the state-level residential real-estate inflation from the purchase year to the first available year is used. If the purchase year is before 1975, the CPI (consumer price index) inflation from the purchase year to 1975 is used to compute the inflation in real-estate assets during that period.

Taken together, the main independent variable of interest—a firm's real-estate value scaled by its lagged total book value of assets—is given by

$$
\begin{aligned}
REvalue01_{i,j,t} &= REassets_{i,j,2001}/Assets_{i,j,t-1} \\
&\quad \times REprice_{j,t}/REprice_{j,2001}, \\
REvalue93_{i,j,t} &= REassets_{i,j,1993}/Assets_{i,j,t-1} \\
&\quad \times REprice_{j,t}/REprice_{j,1993},
\end{aligned} \tag{2}
$$

where $REassets_{i,j,2001}$ is the book value of real-estate assets in 2001 and $REassets_{i,j,1993}$ is the market value of real-estate assets given by Equation (1). Real-estate price in the first measure is standardized by the 2001 value and in the second measure by the 1993 value. $REprice$ is either the MSA-level residential price index or the state-level commercial price index discussed in §3.2. Together $REvalue$ is defined in four different ways. The summary statistics are reported in Table 1.

[8] The drawback is that it introduces measurement errors to the amount of real-estate assets that are exposed to fluctuations in real-estate prices. An alternative that reduces the measurement errors is to measure a firm's real-estate assets at the beginning of the year and examine how the shocks to real-estate prices affect its financial decision by the end of the year. The trade-off is that if firms make real-estate purchases and sales decisions in anticipation of future price changes, even real-estate ownership measured at the beginning of the year could be endogenous to a firm's decision at the end of the year. Nevertheless, the main results of the paper are robust to measuring real-estate ownership at the beginning of the year. These results are not reported in the paper but are available from the author upon request.

[9] If a firm's book value of real-estate assets is missing in 1993 but is zero in 1994, I assign a book value of zero in 1993. Here only the MSA-level residential real-estate price is used to infer the market value of real-estate assets in 1993 because the state-level commercial real-estate price is missing for many states in late 1970s and early 1980s.

Because the real-estate value defined above not only varies with real-estate prices but also lagged total assets, in all the regressions I also control for initial real-estate assets scaled by lagged total assets to capture potential nonlinear relation between financing decisions and firm size,

$$\begin{aligned} REassets01_{i,j,t} &= REassets_{i,j,2001}/Assets_{i,j,t-1}, \\ REassets93_{i,j,t} &= REassets_{i,j,1993}/Assets_{i,j,t-1}. \end{aligned} \tag{3}$$

$REassets01_{i,j,t}$ and $REassets93_{i,j,t}$ are winsorized at 1% in Equation (3) and in constructing *REvalue* in Equation (2).

3.4. Housing Supply Elasticity

To address the endogeneity of local real-estate prices, I follow Mian and Sufi (2011) and Chaney et al. (2012) to instrument MSA-level real-estate prices by the housing supply elasticities estimated by Saiz (2010). Using satellite-generated data on terrain elevation and the presence of water bodies, for each MSA Saiz (2010) measures the fraction of undevelopable area within a 50-km radius from the metropolitan central city. Saiz (2010) emphasizes that this measure of undevelopable area represents an ex ante physical constraint on housing supply, as opposed to ex post ease of development. Saiz (2010) then shows that the same change in housing demand causes the house prices in MSAs with more undevelopable area to increase more—housing supply elasticity is lower in MSAs with more undevelopable land. Saiz (2010) provides the estimates of housing supply elasticities for 95 MSAs with population over 500,000 in the 2000 Census. For example, Miami has the lowest supply elasticity of 0.6, whereas Wichita, Kansas has the highest supply elasticity of 5.45. The elasticities for other MSAs are available in Table VI (pp. 1283–1284) of Saiz (2010).

Because each of several MSAs in Saiz (2010) corresponds to more than one MSA in the FHFA house price data, merging the two data sets results in a 13,827 quarter-MSA observations for 106 MSAs from 1976 to 2012, which is used in the preliminary stage regression to construct the instrumental variables.

4. Identification Strategy

This section presents the estimation model. In particular, I discuss how potential endogenous problems are dealt with to ensure the exogeneity of real-estate shocks. The "generated instrument" estimation procedure is also discussed in detail.

4.1. Regression Model

The empirical strategy relies on firms with different real-estate assets being differentially affected by fluctuations in local real-estate prices. The estimation model takes the form

$$\begin{aligned} Y_{i,j,t} = \alpha_i + \beta REvalue_{i,j,t} + \gamma\, REassets_{i,j,t} \\ + Controls_{i,j,t} + \mu_{j,t} + \epsilon_{i,j,t}, \end{aligned} \tag{4}$$

where i indexes firm, j indexes MSA or state, t indexes year, $Y_{i,j,t}$ represents the dependent variable of interest. $REvalue_{i,j,t}$, the main independent variable of interest, is firm i's market value of real-estate assets, defined in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). *REassets* is included in the regression to capture the variation in *REvalue* that comes from lagged assets so that the coefficient of *REvalue* captures only the impact of real-estate price shocks.[10] $Controls_{i,j,t}$ is firm characteristics that could impact optimal financing policy, α_i is firm fixed effects, and $\mu_{j,t}$ is MSA-year or state-year fixed effects. The coefficient of interest is β, which captures the causal effect of collateral value on a firm's financial policy.

The concern about endogeneity naturally arises because the real-estate ownership and real-estate prices used to compute *REvalue* could be correlated with a firm's financing decisions through a noncollateral channel. In what follows, I distinguish several sources of endogeneity, roughly in the order of the likelihood that the endogeneity issue arises and the ease with which it can be addressed, and discuss how I try to deal with each source of endogeneity.

The first source of endogeneity is that a firm's real-estate ownership and debt structure could be jointly determined by firm characteristics. For example, it may be optimal for a firm with severe agency problems to use bank debt and to own real-estate properties instead of leasing them. As discussed in §3, this potential endogeneity is partially addressed by fixing real-estate ownership at the beginning of the sample period. And then firm fixed effects are included in the estimation of Equation (4) to absorb all possible variation in time-invariant unobserved firm characteristics.

The second source of endogeneity is that real-estate prices could be correlated with local shocks *common to all firms*. The theories discussed in §2 only consider a firm's credit demand and treat credit supply as exogenous. But observed firm debt structure reflects the equilibrium point of credit demand and credit supply. For example, local real-estate prices could drive the local economy and local bank credit supply (see

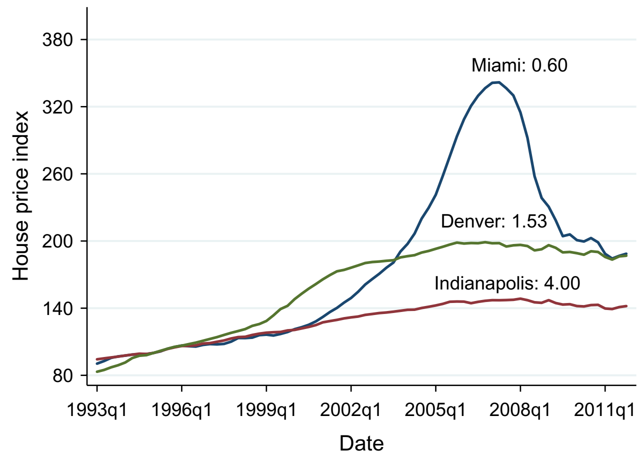
[10] *REvalue* is essentially an interaction term of *REassets* and real-estate prices. This is why it is important to control for both *REassets* and real-estate prices in the regression, although real-estate price is not separately identified from MSA-year or state-year fixed effects and thus only implicitly controlled for.

Becker and Ivashina 2014 for a discussion of the procyclical nature of bank credit supply). If we see that firms use more bank debt when local real-estate prices rise, we do not know if this is through a collateral channel or a credit supply channel. This concern is dealt with by controlling for MSA-year or state-year fixed effects, which captures the impact of the local economic conditions on corporate financing decisions, irrespective of whether a firm owns real estate or not. And β will capture the collateral channel effect through the differential response to real-estate prices for firms that own different amount of real-estate assets. Furthermore, in §6.1, I conduct a falsification test to show that real-estate prices do not affect firms through leased real-estate assets.

The third source of endogeneity is that local real-estate prices could be correlated with local shocks that affect real-estate-holding (RH) firms' financing costs differently than nonreal-estate-holding (NRH) firms. For example, Chaney et al. (2012) point out that local real-estate prices could be proxies for local demand shocks and RH and NRH firms could have different sensitivities to local demand. And endogeneity arises if local demand is correlated with investment opportunities, which impacts a firm's debt structure choices in the theories discussed in §2. To address such endogenous local shocks, I follow Mian and Sufi (2011) and Chaney et al. (2012) to instrument MSA residential real-estate prices with the local housing supply elasticities.[11] The housing supply elasticities are estimated by Saiz (2010) using geographic data on developable land in the metropolitan areas, and therefore very unlikely to be correlated with local demand shocks.

The last source of endogeneity is that RH firms and NRH firms could have different sensitivities to real-estate prices (not driven by local demand) through other channels than the collateral channel. In untabulated results, I show that the findings are robust to controlling for firm characteristics that could be correlated with both a firm's real-estate ownership decisions and its sensitivities to real-estate prices by including in the regression initial firm characteristics such as size, market-to-book ratio, investment, and industry, interacted with real-estate prices. However, it is still possible that some unobserved initial firm characteristics could make firms more likely to own real estate and more sensitive to fluctuations in real-estate prices through a noncollateral channel. Although it is difficult to think of any example of such unobservables, I admit that I do not have a proper instrument to handle this endogeneity issue. And the

Figure 1 (Color online) House Price Index: 1993–2011



Notes. The house price index is the quarterly residential house price index at the MSA level from the FHFA. The number after each city name is the city's housing supply elasticity estimated by Saiz (2010).

absence of such unobservables is essentially the identifying assumption that I have to make.

4.2. Instrumental Variable Estimation

The instrumental variable (IV) estimation in this paper adopts a "generated instrument" approach, where the instrumental variable is estimated in a preliminary stage and then a standard IV estimation is conducted using the generated IV (Wooldridge 2010, pp. 124–125). In what follows, I discuss the estimation procedure in detail and explain why this approach is preferred over some alternative approaches.

4.2.1. Preliminary Stage Regression. The regression I employ to construct the IV is

$$REprice_{m,t} = \alpha_m + \rho\, Elasticity_m \times Mortgage\_Rate_t + \gamma\, Mortgage\_Rate_t + \mu_t + v_{m,t}, \quad (5)$$

where $REprice_{m,t}$ is the quarterly inflation-adjusted residential house price index of MSA m in quarter t, $Mortgage\_Rate_t$ is the quarterly inflation-adjusted 30-year fixed-rate mortgage average available on the Federal Reserve Bank of St. Louis's website (https://research.stlouisfed.org/fred2/series/MORTGAGE30US/), α_m is MSA fixed effects, and μ_t is quarter fixed effects.[12] The rationale behind this regression is that when interest rates are low, the demand for real estate is high. In MSAs with elastic land supply, the increased demand will translate mostly into more supply of real estate, whereas in MSAs with inelastic land supply, the increased demand will translate

[11] State-level commercial real-estate prices are not instrumented and ordinary least squares (OLS) estimation results will be presented for *REvalue* computed using state-level real-estate prices.

[12] Because $Mortgage\_Rate_t$ does not vary with MSA, it is actually not identified separately from time fixed effects μ_t. But it is included in the regression to facilitate the interpretation of the estimation.

Table 2 **Preliminary Stage Regression: The Impact of Local Housing Supply Elasticity on House Prices**

Elasticity × *Mortgage_Rate*	1.63***
	(0.06)
Mortgage_Rate	−3.78***
	(0.24)
Quarter fixed effects	Yes
MSA fixed effects	Yes
R^2	0.923
N	13,827

Notes. The dependent variable is the quarterly real-estate price index at the MSA level for 106 MSAs from 1976 to 2012. *Elasticity* is the housing supply elasticity defined by Saiz (2010). *Mortgage_Rate* is the 30-year fixed-rate mortgage average available on the Federal Reserve Bank of St. Louis's website, measured in percentage points. Standard errors are in parentheses. The R^2s are the within R^2s from MSA-fixed-effects estimation.
$^{***}p<0.01$.

mostly into higher real-estate prices.[13] Therefore, ρ is expected to be positive. Figure 1 plots the residential house price index for Miami, Denver, and Indianapolis from 1993 to 2011. Miami with a very low elasticity of 0.6 experiences a drastic boom and bust cycle in the real-estate market, whereas Indianapolis with a high elasticity of 4.0 experiences only moderate real-estate price fluctuations. Table 2 reports the results of the preliminary stage regression. The coefficient on the interaction term is positive and highly statistically significant.

4.2.2. Constructing IVs. For each measure of real-estate value defined in Equation (2), the corresponding IV is constructed by replacing the actual MSA-level real-estate price with predicted real-estate price from the preliminary stage estimation,

$$\begin{aligned} IV\_REvalue01_{i,j,t} &= REassets_{i,j,2001}/Assets_{i,j,t-1} \\ &\quad \times \widehat{REprice}_{j,t}/\widehat{REprice}_{j,2001}, \\ IV\_REvalue93_{i,j,t} &= REassets_{i,j,1993}/Assets_{i,j,t-1} \\ &\quad \times \widehat{REprice}_{j,t}/\widehat{REprice}_{j,1993}. \end{aligned} \tag{6}$$

Wooldridge (2010, pp. 124–125) points out that the fact that an IV is estimated in a preliminary stage does not affect consistency or standard errors of the IV estimation under the conditions that the variables in the preliminary stage regression are orthogonal to the error term in the second-stage regression. Because the mortgage rates used in the preliminary stage estimation (5) will be controlled for by the MSA-year fixed effects in the IV estimation and housing supply elasticities are unlikely to be correlated with the error term in the second-stage regression, the generated instrument is plausibly exogenous and the standard IV estimation should yield consistent estimates.

The reason that I opt to use the generated instruments in Equation (6) as opposed to using elasticity itself (or the interaction of real-estate assets and elasticity) as an IV for *REvalue* is because of the nonlinear relationship between elasticity and house price formulated in Equation (5). It is not straightforward to implement a conventional IV estimation to take care of the nonlinearity, whereas the generated instruments approach has the appeal of being simple and intuitive.

In Chaney et al. (2012), instead of being used as instruments, the variables in Equation (6) are used as explanatory variables in their second-stage estimation. This approach may not be appropriate in the presence of the interaction effect—$REassets \times (REprice - \widehat{REprice})$ will be part of the error term in the second stage and therefore the error term could be correlated with the instrumented real-estate values through *REassets*. It should be noted, however, the OLS estimation and IV estimation in their paper produce very similar results, suggesting that the potential problem described here may not be a big concern in this context. In addition, in untabulated results I find similar results if I follow their estimation procedure as opposed to using the generated IV approach.

5. Real-Estate Prices and Firm Financial Policy

In this section, I estimate the impact of real-estate value on firm borrowing, debt structure, and borrowing costs.

5.1. Real-Estate Prices and Debt Structure

I start by confirming the findings in Gan (2007) and Chaney et al. (2012) that firms borrow more when the value of their real-estate assets appreciates, and then I turn my attention to how real-estate prices impact a firm's choice between bank debt and public debt, which is the focus of this paper.

Table 3 reports the estimated effects of real-estate price shocks on a firm's use of debt. Because *REvalue* is defined as real-estate assets scaled by lagged total assets, to facilitate interpretation, I also use total debt scaled by lagged total assets as the dependent variable (expressed in percentage points). Then the coefficient of *REvalue* can be interpreted as the amount of new debt issued for an additional \$1 increase in real-estate value. As discussed in §3.3, I present

[13] An alternative model is to interact local land supply elasticity with national real-estate price index instead of mortgage rates. The rationale is that real-estate prices of MSAs with low elasticities tend to fluctuate more than the aggregate real-estate prices, whereas real-estate prices of MSAs with high elasticities tend to fluctuate less. The results are very similar with this alternative model.

Table 3 **Real-Estate Prices and Debt Financing**

	2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	21.19***	10.99***	15.92***	9.79***
	(6.74)	(2.12)	(5.22)	(1.55)
REassets	21.11**	31.50***	0.26	11.32***
	(9.10)	(4.12)	(10.20)	(4.34)
Ln(*assets*)	9.49***	9.85***	9.21***	8.91***
	(0.43)	(0.41)	(0.68)	(0.66)
MB	−0.47**	−0.51***	−1.15***	−1.18***
	(0.19)	(0.17)	(0.32)	(0.31)
CF	−18.45***	−18.46***	−18.74***	−18.42***
	(1.53)	(1.42)	(2.41)	(2.30)
Col	−2.63**	−2.17**	−3.66**	−4.18***
	(1.19)	(1.10)	(1.61)	(1.57)
NotRated	−9.17***	−9.17***	−11.48***	−11.76***
	(0.82)	(0.76)	(1.29)	(1.23)
InvGrade	−5.39***	−6.82***	−7.42***	−8.42***
	(0.94)	(0.85)	(1.23)	(1.15)
R^2	0.141	0.113	0.230	0.164
N	13,339	14,901	5,806	5,913

Notes. The dependent variable is total debt scaled by lagged book assets, measured in percentage points. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

$^{**}p<0.05$; $^{***}p<0.01$.

results based on measuring real-estate ownership in both 2001 and 1993, and measuring real-estate price shocks at both the MSA level and state level. When MSA-level real-estate prices are used, the IV estimation discussed in §4 is adopted. When state-level real-estate prices are used, the standard panel estimation (without using IVs) is adopted. Overall, four sets of results are reported in Table 3. All following tables also report four sets of results for the same test.

Table 3 shows that for a $1 increase in real-estate value, on average a firm increases its debt by 10¢ to 21¢. The results confirm the findings that firms borrow more after a positive shock to collateral value in Gan (2007) and Chaney et al. (2012). The results do not imply, however, an increase in leverage ratio following a positive shock to real-estate value. In fact, I find that a firm's leverage ratio and especially its market leverage ratio decreases with real-estate value (results not tabulated). This suggests that a firm's market value of assets also increases with its real-estate value, and the new debt issued over the increase in market value is likely to be smaller than the market leverage of an average firm (17.9%).

Next, I look at what type of debt responds more to collateral shocks. I break down debt into bank debt and public debt, and as in Table 3, estimate the dollar value change in each type of debt for a $1 increase in real-estate value. Table 4 shows that the increase in debt is almost entirely driven by the increase in bank debt. Public debt, on the other hand, hardly responds to real-estate value. As a result, we should expect shocks to real-estate value to have a significant impact on a firm's debt structure. This is tested in Table 5.

In Table 5, I look at how a firm's bank debt as a fraction of total debt varies with its real-estate value. As expected, an increase in *REvalue* significantly raises the proportion of bank debt in a firm's debt structure. The first column shows that increasing *REvalue* by one standard deviation (0.21) raises bank debt as a percentage of total debt by $28.50 \times 0.21 = 6.0$ percentage points. In the fourth column, when real-estate ownership is measured in 1993 and when the state-level commercial real-estate price is used, a one-standard-deviation (0.57) increase in *REvalue* causes bank debt over total debt to increase by $13.65 \times 0.57 = 7.8$ percentage points. Because bank debt and public debt on average make up for over 90% of a firm's total debt, an increase in bank debt ratio almost always implies a drop in public debt ratio by the same magnitude. Therefore, I do not report the results with public debt as a dependent variable in a separate table.

So far the results reported are based on Equation (4), which implicitly assumes that a firm always operates under its optimal debt structure. Adjustment costs, however, could cause firms to converge to their optimal debt structure partially and gradually. Therefore, I further control for the lagged dependent variable to capture the persistence of a firm's debt structure. This specification resembles but is not identical with the partial adjustment models used in the capital structure literature (e.g., Flannery and Rangan 2006, Huang and Ritter 2009).

The last four columns of Table 5 report results controlling for lagged bank debt ratio to allow for persistence in a firm's debt structure. This could be important given that Becker and Ivashina (2014) document path dependence in a firm's bank debt financing—a firm issuing a bank loan in a given year is more likely to issue bank loans than bonds in the near future. Table 5 shows that a firm's debt structure in the previous year indeed has a significant impact on its current debt structure. After controlling for the lagged debt structure, *REvalue* still has a statistically significant impact on debt structure except when the 1993 sample and MSA-level real-estate prices are used to construct *REvalue*.

Overall, the results show that bank debt as a share of total debt rises with the value of real-estate assets. Thus, they are consistent with theories such

Table 4 Real-Estate Prices and Debt Financing: Bank Debt vs. Public Debt

	Bank debt				Public debt			
	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	19.20***	10.49***	12.98***	7.07***	1.25	0.41	3.02	3.41***
	(4.77)	(1.52)	(3.75)	(1.13)	(5.52)	(1.72)	(4.33)	(1.30)
REassets	−7.33	2.40	−6.15	5.35*	24.53***	24.59***	4.02	2.43
	(6.43)	(2.96)	(7.32)	(3.17)	(7.45)	(3.35)	(8.45)	(3.63)
Ln(*assets*)	4.96***	5.43***	5.49***	5.93***	3.98***	3.79***	3.26***	2.59***
	(0.31)	(0.29)	(0.49)	(0.48)	(0.35)	(0.33)	(0.56)	(0.55)
MB	−0.17	−0.22*	−0.51**	−0.64***	−0.41***	−0.40***	−0.77***	−0.69***
	(0.13)	(0.12)	(0.23)	(0.23)	(0.15)	(0.14)	(0.26)	(0.26)
CF	−5.61***	−6.83***	−6.49***	−7.67***	−12.12***	−11.38***	−11.30***	−10.28***
	(1.08)	(1.02)	(1.73)	(1.68)	(1.25)	(1.15)	(1.99)	(1.92)
Col	0.83	1.11	−0.23	−0.14	−2.63***	−2.54***	−3.45***	−3.92***
	(0.84)	(0.79)	(1.15)	(1.14)	(0.98)	(0.90)	(1.33)	(1.31)
NotRated	1.00*	0.50	0.44	−0.66	−10.00***	−9.33***	−12.32***	−11.28***
	(0.58)	(0.55)	(0.92)	(0.90)	(0.67)	(0.62)	(1.07)	(1.03)
InvGrade	−2.98***	−4.22***	−2.95***	−4.59***	−2.86***	−3.00***	−4.94***	−4.42***
	(0.66)	(0.61)	(0.88)	(0.84)	(0.77)	(0.70)	(1.02)	(0.97)
R^2	0.097	0.064	0.175	0.115	0.124	0.082	0.195	0.113
N	13,339	14,901	5,806	5,913	13,339	14,901	5,806	5,913

Notes. The dependent variable is bank debt or public debt scaled by lagged book assets, measured in percentage points. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

Table 5 Real-Estate Prices and Debt Structure

	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	28.50**	12.50***	27.94***	13.65***	29.42**	10.68***	10.03	7.39**
	(12.09)	(3.84)	(9.85)	(2.94)	(14.84)	(4.00)	(12.41)	(3.06)
REassets	−35.25**	−10.37	−26.39	1.88	−36.01*	−6.35	0.48	14.42
	(16.30)	(7.47)	(19.23)	(8.23)	(20.61)	(8.02)	(25.30)	(8.82)
BankLag					0.38***	0.39***	0.37***	0.38***
					(0.01)	(0.01)	(0.02)	(0.01)
Ln(*assets*)	1.94**	2.33***	5.46***	6.63***	2.10**	2.71***	5.07***	6.71***
	(0.78)	(0.74)	(1.28)	(1.25)	(0.82)	(0.77)	(1.36)	(1.34)
MB	−0.29	−0.36	0.30	−0.21	−0.03	−0.08	0.17	−0.16
	(0.34)	(0.31)	(0.58)	(0.57)	(0.35)	(0.32)	(0.61)	(0.59)
CF	6.95**	4.72*	−2.50	−3.43	1.53	−0.21	−6.76	−9.34**
	(2.74)	(2.57)	(4.48)	(4.30)	(2.84)	(2.66)	(4.63)	(4.45)
Col	7.98***	7.80***	11.05***	12.36***	5.47**	5.18***	6.96**	9.87***
	(2.14)	(2.00)	(3.03)	(2.96)	(2.15)	(2.00)	(3.03)	(2.95)
NotRated	14.82***	13.97***	12.03***	11.32***	7.17***	7.24***	3.03	3.26
	(1.47)	(1.39)	(2.42)	(2.32)	(1.50)	(1.39)	(2.43)	(2.30)
InvGrade	−3.72**	−4.58***	−1.71	−3.10	−3.80**	−4.25***	−2.66	−4.09*
	(1.68)	(1.55)	(2.32)	(2.19)	(1.63)	(1.49)	(2.21)	(2.10)
R^2	0.094	0.052	0.150	0.084	0.234	0.204	0.277	0.229
N	13,339	14,901	5,825	5,932	11,105	12,390	4,913	4,999

Notes. The dependent variable is the ratio of bank debt over total debt, measured in percentage points. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). *BankLag* is the lagged bank debt ratio. The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

as Berlin and Loeys (1988) and Park (2000) that predict a positive relation between collateral value and bank debt and not consistent with theories such as Hoshi et al. (1993) and Cantillo and Wright (2000) that predict otherwise. It is also worth noting that in addition to real-estate collateral, which is the focus of the paper, Table 5 also shows that non-real-estate fixed assets (*Col*) are also positively related to bank debt. Thus, the findings in this paper are in contrast to those in existing empirical debt structure studies such as Johnson (1997), Cantillo and Wright (2000), Denis and Mihov (2003), and Rauh and Sufi (2010) that find that collateral value is positively related to public debt. Even though the sample differences could potentially contribute to the opposite findings, the main cause is that I control for firm fixed effects and thus focus on within-firm variation, whereas these other studies focus on the cross-sectional correlation, which is likely to be driven by some time-invariant unobserved firm characteristics. Because the fixed assets ratio could be correlated with these unobservables, it is important to control for firm fixed effects to identify a causal relationship.

5.2. Real-Estate Prices and Debt Structure—Extensive Margin

Section 5.1 provides clear evidence that firms shift their debt structure toward bank debt when their real-estate value appreciates. This could be driven by firms with existing bank debt using more bank debt and firms with no bank debt starting to borrow from the banks. In this subsection, I test whether real-estate value impacts debt structure on the extensive margin: whether a firm starts to use a new type of debt after real-estate price shocks. For this test, I look at whether firms that do not have any bank debt (public debt) in the previous year start to use bank debt (public debt) in the current year after real-estate price shocks.

The first four columns of Table 6 report the results of bank debt initiation where a firm-year is included in the regression only if the firm has zero bank debt in the previous year. The dependent variable is an indicator variable equal to 1 if bank debt is positive

Table 6 Real-Estate Prices and Debt Structure: Extensive Margin

	Bank debt initiation				Public debt initiation			
	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	1.75**	0.64***	1.43*	0.41**	−0.10	0.15	−0.02	0.03
	(0.75)	(0.18)	(0.73)	(0.17)	(0.68)	(0.19)	(0.81)	(0.15)
REassets	0.33	0.54*	0.09	1.01**	0.19	−0.18	0.70	0.01
	(0.36)	(0.29)	(0.38)	(0.39)	(0.35)	(0.24)	(0.75)	(0.39)
Ln(*assets*)	0.12***	0.12***	0.18***	0.15**	0.08**	0.11***	0.07	0.05
	(0.03)	(0.03)	(0.06)	(0.06)	(0.03)	(0.03)	(0.07)	(0.06)
MB	−0.02	−0.02	−0.04	−0.05**	−0.01	−0.02*	−0.01	−0.03
	(0.01)	(0.01)	(0.03)	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)
CF	−0.16	−0.24**	−0.38*	−0.46**	−0.28***	−0.34***	−0.38***	−0.36***
	(0.11)	(0.10)	(0.20)	(0.19)	(0.09)	(0.08)	(0.15)	(0.14)
Col	0.24**	0.27***	0.21	0.23	−0.00	0.02	−0.10	−0.12
	(0.10)	(0.10)	(0.16)	(0.16)	(0.09)	(0.07)	(0.17)	(0.15)
NotRated	−0.13**	−0.14**	−0.28***	−0.20*	−0.35***	−0.35***	−1.01***	−0.59***
	(0.06)	(0.06)	(0.11)	(0.11)	(0.08)	(0.07)	(0.25)	(0.15)
InvGrade	−0.10*	−0.10*	−0.17**	−0.11	0.21	0.19	−0.90**	−0.27
	(0.06)	(0.05)	(0.08)	(0.08)	(0.17)	(0.14)	(0.38)	(0.30)
R^2	0.307	0.185	0.474	0.299	0.282	0.184	0.505	0.342
N	2,821	3,070	1,216	1,223	2,490	2,761	962	961

Notes. The dependent variable in the first four columns is a dummy variable equal to 1 if firms have bank debt outstanding and 0 otherwise. The dependent variable in the last four columns is a dummy variable equal to 1 if firms have public debt outstanding and 0 otherwise. In the first four columns, a firm-year is included in the regression if the firm does not have any bank debt in the previous year. In the last four columns, a firm-year is included in the regression if the firm does not have any public debt in the previous year. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as “M-IV,” *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as “S-OLS,” *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years “2001” and “1993” correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

and 0 otherwise.[14] The results suggest that a positive shock to real-estate value indeed makes a firm more likely to start to borrow from the banks. The last four columns look at public debt initiation, in which the results show no impact of real-estate value on public debt initiation. On the flip side, I find some evidence that firms are more likely to terminate public debt but not bank debt after a positive shock to real-estate value (results not tabulated).

5.3. Real-Estate Prices and Debt Structure—Financial Constraints

In this subsection, I investigate whether the sensitivity of debt structure to real-estate prices varies with a firm's financial constraints. Chaney et al. (2012) show that the sensitivity of investment to collateral value is about twice as large for constrained firms relative to unconstrained firms. This makes intuitive sense because constrained firms are more likely to take advantage of collateral value appreciation and to borrow to invest. Alternatively, firms could adjust their debt structure to reduce borrowing costs without significantly increasing investment. And financially unconstrained firms may have lower costs of adjusting debt structure. Therefore, it is not clear a priori whether constrained firms or unconstrained firms have larger debt structure sensitivity to collateral value.

Following the practice in the literature, a firm is considered as unconstrained if it has an investment-grade credit rating or pays dividends. I interact the unconstraint dummy *Uncon* with *REvalue* to test whether the sensitivities of the two groups of firms are significantly different from each other. The interaction of the unconstraint dummy and the instrument of *REvalue* in Equation (6) is used as the instrument for *REvalue* × *Uncon*. Table 7 shows that both financially constrained and unconstrained firms use more bank debt when the value of their real-estate assets rises, and the sensitivity of debt structure to real-estate value is not significantly different between the two groups. This finding complements the Chaney et al. (2012) findings by showing that unconstrained firms also actively adjust their debt structure even though their investments do not rise as much as constrained firms.

5.4. Real-Estate Prices and Borrowing Costs

Previous sections show that firms replace public debt with bank debt after the value of their real-estate assets increases. One possible reason for firms to do this is that they can refinance their debt with better terms by pledging more collateral to the banks. If this is true, we should observe that, ceteris paribus, firms' borrowing costs decrease when the value of real-estate assets increases. I test this prediction in this subsection.

To measure borrowing costs, I use the average interest rate a firm pays on its debt, computed as the ratio of interest expenses (XINT) in a year divided by the year-end total debt. This average interest rate is used to measure the costs of debt by Pittman and Fortin (2004) and Vig (2013), among others. Many studies also use a firm's syndicated loan spread from Dealscan or bond yield to measure its borrowing costs. The average interest rate measure is more relevant in this paper because if a firm refinances its public debt with cheaper bank debt when its collateral value appreciates, we will see that its average interest rate drops but its bank loan rate or bond yield may stay the same. I also do not adjust the average interest rate by a benchmark risk-free rate such as treasury

Table 7 **Real-Estate Prices and Debt Structure: Financial Constraints**

	2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	27.11**	10.52**	26.03***	12.25***
	(12.40)	(4.11)	(10.07)	(3.24)
REvalue × *Uncon*	3.59	4.51	3.27	2.58
	(4.98)	(3.42)	(3.90)	(2.37)
Uncon	2.22	0.62	1.79	2.58
	(1.40)	(1.28)	(1.93)	(1.89)
REassets	−34.29**	−8.60	−25.14	3.73
	(16.37)	(7.55)	(19.24)	(8.31)
Ln(*assets*)	1.86**	2.31***	5.28***	6.46***
	(0.78)	(0.74)	(1.28)	(1.25)
MB	−0.30	−0.38	0.27	−0.24
	(0.34)	(0.31)	(0.58)	(0.57)
CF	6.85**	4.63*	−2.72	−3.62
	(2.73)	(2.57)	(4.48)	(4.30)
Col	8.05***	7.88***	11.20***	12.72***
	(2.14)	(2.00)	(3.03)	(2.96)
NotRated	14.82***	13.97***	12.17***	11.44***
	(1.47)	(1.39)	(2.42)	(2.32)
InvGrade	−4.98***	−5.13***	−2.69	−4.35*
	(1.78)	(1.63)	(2.42)	(2.29)
R^2	0.095	0.052	0.151	0.085
N	13,339	14,901	5,825	5,932

Notes. The dependent variable is the ratio of bank debt over total debt, measured in percentage points. *Uncon* is an indicator variable equal to 1 if a firm pays dividends or has an investment grade credit rating. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.
*$p<0.1$; **$p<0.05$; ***$p<0.01$.

[14] Here the simple linear probability model is adopted. Similar results are obtained using a nonlinear model such as probit (together with IV and panel estimation).

Table 8 **Real-Estate Prices and Interest Rate**

	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	−4.24***	−1.35***	−3.44***	−1.53***	−8.94***	−1.77***	−3.41**	−1.46***
	(1.42)	(0.44)	(1.13)	(0.33)	(1.91)	(0.50)	(1.53)	(0.37)
REassets	1.54	−2.13**	1.94	−1.11	7.34***	−2.43**	3.08	−0.64
	(1.89)	(0.86)	(2.18)	(0.93)	(2.59)	(1.00)	(3.05)	(1.05)
InterestLag					0.12***	0.10***	0.14***	0.13***
					(0.01)	(0.01)	(0.02)	(0.02)
Blev	−0.04***	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***	−0.05***	−0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(*assets*)	−1.48***	−1.53***	−1.59***	−1.60***	−1.42***	−1.52***	−1.49***	−1.47***
	(0.09)	(0.09)	(0.15)	(0.15)	(0.11)	(0.10)	(0.17)	(0.17)
MB	−0.03	−0.03	−0.15**	−0.10	0.05	0.05	0.01	0.07
	(0.04)	(0.04)	(0.07)	(0.07)	(0.05)	(0.05)	(0.08)	(0.08)
CF	2.04***	2.30***	−0.38	−0.13	1.90***	2.21***	0.16	0.69
	(0.37)	(0.35)	(0.57)	(0.54)	(0.43)	(0.40)	(0.66)	(0.61)
Col	1.10***	1.30***	1.20***	1.27***	1.19***	1.31***	1.33***	1.37***
	(0.25)	(0.23)	(0.35)	(0.34)	(0.27)	(0.25)	(0.37)	(0.36)
NotRated	−0.75***	−0.84***	−0.34	−0.83***	−0.95***	−0.98***	−0.43	−0.90***
	(0.17)	(0.16)	(0.28)	(0.27)	(0.19)	(0.17)	(0.31)	(0.29)
InvGrade	−0.59***	−0.72***	−0.54**	−0.71***	−0.59***	−0.77***	−0.51*	−0.66***
	(0.19)	(0.17)	(0.26)	(0.24)	(0.20)	(0.18)	(0.26)	(0.25)
R^2	0.130	0.100	0.196	0.147	0.150	0.127	0.229	0.182
N	12,146	13,603	5,430	5,538	10,027	11,243	4,543	4,637

Notes. The dependent variable is the average interest rate, defined as interest expenses divided by book debt outstanding in the same year and measured in percentage points. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). *InterestLag* is the lagged interest rate. The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

*$p<0.1$; **$p<0.05$; ***$p<0.01$.

bill rate because I control for year fixed effects and the results are identical with or without the adjustment.

Because this average interest rate is a noisy measure of a firm's borrowing costs, many extreme values arise. I follow Pittman and Fortin (2004) to exclude firms with an interest rate above the 95 percentile from the sample. But the results change little if I instead winsorize interest rates at the 95 percentile. The trimmed sample has a maximal interest rate of 16.5%. The mean and median interest rates are 6.5% and 6.2%, respectively.

Table 8 shows that an increase in the value of real-estate assets significantly reduces the interest rate a firm pays on its debt. The effect is also economically large. The first four columns show that depending on how *REvalue* is defined, a one-standard-deviation increase in collateral value causes a reduction in the interest rate by 34 to 89 basis points. In the last four columns, I further control for a firm's interest rate in the previous year. The results suggest that although borrowing costs exhibit positive serial correlation, controlling for this path dependence does not reduce the effect of real-estate value.

6. Robustness

In this section, I conduct several robustness checks for the main results in §5. First, I employ a falsification test to show that the results in §5 are unlikely due to reverse causality or a credit supply channel. Second, I adopt an incremental approach to look at whether real-estate value impacts new issuance of debt.

6.1. Falsification Test with Leased Capital

To address the concern that the findings in the previous section do not reflect the working of the collateral channel but instead some spurious relations, I conduct what is known in the literature as a falsification test. Specifically, leased assets such as leased real-estate properties or leased machinery cannot be used as collateral in debt financing. Therefore, real-estate prices are not expected to have any impact on a firm's debt structure through leased assets. I test this by looking at whether a firm's debt structure responds to the "market value" of leased assets. To this end, I define a new variable *Lvalue* by replacing real-estate assets in 1993 or 2001 in Equation (2) with leased assets in 1993 or 2001. Following Rampini and Viswanathan (2013), I compute a firm's leased assets

Table 9 Real-Estate Prices and Leased Assets

	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
Lvalue	0.09	−0.36	4.10	1.35	−7.85	−0.39	4.80	2.01
	(4.61)	(1.61)	(4.81)	(1.56)	(5.82)	(1.71)	(9.96)	(1.65)
Lassets	0.46	2.30	−24.44	−5.02	9.30	2.62	−5.83	1.23
	(6.13)	(3.05)	(15.08)	(6.76)	(8.16)	(3.45)	(20.30)	(7.56)
BankLag					0.39***	0.39***	0.37***	0.38***
					(0.01)	(0.01)	(0.01)	(0.01)
Ln(*assets*)	1.99**	2.13***	4.61***	4.09***	1.93**	2.48***	4.26***	4.63***
	(0.85)	(0.80)	(1.18)	(1.09)	(0.89)	(0.83)	(1.22)	(1.13)
MB	−0.29	−0.43	−0.07	−0.34	−0.02	−0.19	0.14	−0.22
	(0.36)	(0.33)	(0.54)	(0.50)	(0.36)	(0.34)	(0.55)	(0.51)
CF	6.38**	4.68*	−0.62	−1.14	2.08	0.72	−7.55*	−8.45**
	(2.85)	(2.66)	(4.18)	(3.95)	(2.96)	(2.77)	(4.33)	(4.08)
Col	7.93***	7.35***	10.59***	9.87***	5.44**	4.87**	5.84**	7.09***
	(2.24)	(2.08)	(2.81)	(2.67)	(2.25)	(2.10)	(2.80)	(2.66)
NotRated	14.91***	14.21***	14.43***	15.62***	6.95***	7.35***	6.46***	7.98***
	(1.54)	(1.45)	(2.07)	(1.95)	(1.57)	(1.46)	(2.10)	(1.96)
InvGrade	−3.58**	−4.76***	−4.80**	−5.68***	−3.73**	−4.21***	−4.21**	−5.39***
	(1.74)	(1.60)	(2.01)	(1.79)	(1.68)	(1.54)	(1.92)	(1.71)
R^2	0.095	0.054	0.136	0.072	0.236	0.200	0.267	0.210
N	12,512	13,892	7,248	7,937	10,410	11,552	6,113	6,684

Notes. The dependent variable is bank debt as a fraction of total debt, measured in percentage points. *Lvalue* is the hypothetical "market value" of leased assets, defined in Equation (7). In columns labeled as "M-IV," *Lvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *Lvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *Lassets* is leased assets in 2001 or 1993 scaled by lagged book assets. *BankLag* is the lagged bank-debt ratio. The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.
$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.

by capitalizing the rental expenses (XRENT) by a factor of 10.[15] Then *Lvalue* is defined as

$$Lvalue01_{i,j,t} = XRENT_{i,j,2001} \times 10/Assets_{i,j,t-1} \times REprice_{j,t}/REprice_{j,2001},$$

$$Lvalue93_{i,j,t} = XRENT_{i,j,1993} \times 10/Assets_{i,j,t-1} \times REprice_{j,t}/REprice_{j,1993}. \quad (7)$$

The instrumental variables for leased assets value computed using MSA-level prices are simply constructed by replacing real-estate assets in Equation (6) by leased assets ($XRENT \times 10$). If real-estate prices have influence on a firm's debt structure through other channels than the collateral channel, we would observe that *Lvalue* also has a significant impact on how much bank debt and public debt that firms use. But this is not the case. Table 9 reports the results of the same debt structure regressions as in Table 5 except that *REvalue* has been replaced by *Lvalue*. The coefficients of *Lvalue* are economically small and statistically insignificant in all eight regressions.

6.2. Real-Estate Prices and Debt Issuance

So far I have focused on how real-estate value impacts a firm's mix of debt. Compared to an incremental approach that examines new debt issuance, the advantage of looking at the mix of debt is that the debt mix reflects both debt issuance and retirement decisions and thus provides a more complete picture of how firms adjust their debt structure after shocks to real-estate value. For example, the fact that a firm issues a lot of bank debt but no public debt in a year does not necessarily suggest that bank debt becomes more important in the firm's debt structure. This firm could be using the new bank debt to retire existing bank debt, and thus does not change its debt mix. Unfortunately, whereas the debt issuance data can be easily obtained from sources such as DealScan and SDC Platinum, debt retirement data are not easily accessible, preventing us from getting a compete picture of debt structure change using the incremental approach. Despite this drawback, in this subsection, I examine the impact of real-estate price shocks on the

[15] For accounting purposes, there are two types of leases: operating leases and capital leases. Operating leases are generally considered to be the "true leases," and capital leases are considered as assets (leased assets) and liability (lease payments). The rental expense only includes payment for operating leases. Therefore, capitalizing rental expenses provides a proxy for a firm's operating leases. Graham et al. (1998) report that operating leases, capital leases, and debt are 42%, 6%, and 52% of fixed claims for Compustat firms from 1981 to 1992.

Table 10 Real-Estate Prices and Debt Issuance

	Bank debt issuance				Public debt issuance			
	2001		1993		2001		1993	
	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)	(M-IV)	(S-OLS)
REvalue	32.28***	12.78***	19.11**	8.13***	3.55	1.54*	3.13	1.59**
	(8.88)	(2.81)	(7.43)	(2.22)	(2.78)	(0.89)	(2.45)	(0.74)
REassets	−11.25	11.99**	−9.75	14.91**	−0.11	2.21	−2.58	0.85
	(11.97)	(5.47)	(14.52)	(6.22)	(3.75)	(1.73)	(4.78)	(2.06)
Ln(*assets*)	5.80***	6.24***	5.30***	6.82***	0.79***	0.77***	0.77**	0.86***
	(0.57)	(0.54)	(0.96)	(0.94)	(0.18)	(0.17)	(0.32)	(0.31)
MB	0.09	0.08	0.08	−0.03	−0.04	−0.05	−0.19	−0.17
	(0.25)	(0.23)	(0.44)	(0.43)	(0.08)	(0.07)	(0.15)	(0.14)
CF	−5.56***	−6.71***	−1.70	−3.29	−1.58**	−1.68***	−1.67	−1.60
	(2.01)	(1.88)	(3.38)	(3.25)	(0.63)	(0.60)	(1.11)	(1.08)
Col	0.61	−0.06	−1.53	−0.99	−0.57	−0.90*	−0.55	−0.56
	(1.57)	(1.46)	(2.29)	(2.24)	(0.49)	(0.46)	(0.75)	(0.74)
NotRated	−2.20**	−1.95*	−0.76	−0.31	−3.44***	−3.26***	−4.35***	−3.88***
	(1.08)	(1.01)	(1.83)	(1.76)	(0.34)	(0.32)	(0.60)	(0.58)
InvGrade	−2.69**	−3.00***	−3.01*	−3.26**	0.23	0.09	0.01	−0.19
	(1.24)	(1.13)	(1.75)	(1.65)	(0.39)	(0.36)	(0.58)	(0.55)
R^2	0.098	0.061	0.170	0.102	0.086	0.039	0.132	0.070
N	13,339	14,901	5,819	5,926	13,339	14,901	5,823	5,930

Notes. The dependent variable is the amount of bank loans or public debt issued, scaled by lagged book assets. *REvalue* is the value of real-estate assets, defined in Equation (2). In columns labeled as "M-IV," *REvalue* is computed using the MSA-level residential real-estate price and the results are estimated using an IV estimation. In columns labeled as "S-OLS," *REvalue* is computed using the state-level commercial real-estate price and the results are estimated using an OLS estimation. The years "2001" and "1993" correspond to the years when real-estate assets are measured in Equation (2). *REassets* is real-estate assets in 2001 or 1993 scaled by lagged book assets, defined in Equation (3). The definitions of other variables are in Table 1. All regressions include firm fixed effects and MSA-year or state-year fixed effects. The R^2s are the within R^2s from firm-fixed-effects estimation.

*$p<0.1$; **$p<0.05$; ***$p<0.01$.

issuance of bank loans and public bonds because Capital IQ sometimes misclassifies bank debt and public debt and therefore it is useful to see whether the results extend to the new issuance data obtained from different sources.

On average, each year about one third of my sample firms issue new bank loans and 10% issue public debt. The estimated impact of real-estate value on new debt issuance is reported in Table 10, where the dependent variable is the amount of bank loans or public debt issued over lagged book assets. Table 10 shows that when real-estate value increases, firms issue significantly more bank loans. On the other hand, the increase in public debt issuance is much smaller and only statistically significant when *REvalue* is computed with state-level real-estate prices. The results here are thus consistent with those in Tables 4 and 5 that focus on the level of debt.

7. Conclusion

Theories suggest that one of the most important determinants of a firm's optimal source of debt financing is its collateral value, but identifying the effect of collateral value on debt structure has been difficult given the endogenous nature of a firm's collateral ownership. By relying on fluctuations in real-estate prices as exogenous shocks to a firm's collateral value, the paper seeks to identify a causal relation between collateral value and debt structure. It finds that a positive shock to the value of a firm's real-estate assets causes the firm to shift their debt structure toward bank debt. It also shows that non-real-estate tangible assets are also positively correlated with bank debt. These findings are in contrast to some previous studies that find a positive relation between public debt and tangible assets.

The findings of this paper also suggest the housing market boom before the financial crisis fueled the credit boom not only in the residential mortgage market but also in the commercial loan market through the collateral channel. During the financial crisis, the collapse of the housing market could impair banks' profitability as a result of defaults of both personal borrowers and corporate borrowers. Whether firms that experienced the most appreciation in their real-estate assets before the financial crisis were indeed more likely to default during the financial crisis is not tested directly in this paper and is left to future research.

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