NBER WORKING PAPER SERIES

THE COLLATERAL CHANNEL: HOW REAL ESTATE SHOCKS AFFECT CORPORATE INVESTMENT

Thomas Chaney
David Sraer
David Thesmar

Working Paper 16060
http://www.nber.org/papers/w16060

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2010

We are grateful to Institut Europlace de Finance for financial support. For their helpful comments, we would like to thank Nicolas Coeurdacier, Stefano DellaVigna, Denis Gromb, Luigi Guiso, Thierry Magnac, Ulrike Malmendier, Atif Mian, Adam Szeidl and Jean Tirole. We are especially indebted to Chris Mayer, for providing us with the Global Real Analytics data. We are also grateful to seminar participants at INSEE in Paris, USC, UC San Diego Rady School of Management, NYU Stern, MIT Sloan, the University of Amsterdam, London Business School, Oxford's Sa d School of Business, the University of Chicago, the European University Institute in Florence, Bocconi University, Toulouse University, the Kellog School of Management, Princeton University, the Haas School of Business at Berkeley, and the University of Naples. We are solely responsible for all remaining errors. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The Collateral Channel: How Real Estate Shocks Affect Corporate Investment
Thomas Chaney, David Sraer, and David Thesmar
NBER Working Paper No. 16060
June 2010
JEL No. E44,G3

ABSTRACT

What is the impact of real estate prices on corporate investment? In the presence of financing frictions, firms use pledgeable assets as collateral to finance new projects. Through this collateral channel, shocks to the value of real estate can have a large impact on aggregate investment. Over the 1993-2007 period, the representative U.S. corporation invests 6 cents out of each additional dollar of collateral. To compute this sensitivity, we use local variations in real estate prices as shocks to the collateral value of firms that own real estate. We address the endogeneity of local real estate prices using the interaction of interest rates and local constraints on land supply as an instrument. We address the endogeneity of the decision to own land (1) by controlling for observable determinants of ownership and (2) by looking at the investment behavior of firms before and after they acquire land. The sensitivity of investment to collateral value is stronger the more likely a firm is to be credit constrained.

Thomas Chaney
Department of Economics
University of Chicago
1126 East 59th Street
Chicago, IL 60637
and NBER
tchaney@uchicago.edu

David Sraer
Princeton University
Department of Economics
Bendheim Center for Finance and International Econ
26 Prospect Avenue, Princeton, NJ 08540
dsraer@princeton.edu

David Thesmar
HEC Paris
1 rue de la libération
78351 Jouy-en-Josas cedex
France
thesmar@hec.fr

1 Introduction

In the presence of contract incompleteness, Barro (1976), Stiglitz and Weiss (1981) and Hart and Moore (1994) point out that collateral pledging enhances a firm's debt capacity. Providing outside investors with the option to liquidate pledged assets *ex post* acts as a strong disciplining device on borrowers. This, in turn, eases financing *ex ante*. Asset liquidation values thus play a key role in the determination of a firm's debt capacity. This simple observation has important macroeconomic consequences: as noted by Bernanke and Gertler (1989), business downturns will deteriorate assets values, thus reducing debt capacity and depressing investment, which will amplify the downturn. This "collateral channel" is often the main suspect for the severity of the Great Depression (Bernanke (1983)) or for the extraordinary expansion of the Japanese economy at the end of the 80s (Cutts (1990)). In the current context of abruptly declining real estate prices in the U.S., an assessment of the relevance of this "collateral channel" is called for. This paper attempts to empirically uncover the *microeconomic* foundation for this mechanism.

We show that over the 1993-2007 period, a one dollar increase in collateral value leads the representative U.S. public corporation to raise its investment by 6 cents. This sensitivity can be quantitatively important in the aggregate. This is because real estate represents a sizable fraction of the tangible assets that firms hold on their balance sheet. As we show in this paper, in 1993, among public firms in the US, 58% reported at least some real estate ownership. Among these land-holding firms, the market value of real estate accounted for 19% of the firm's total market value. To get at this 6 cents sensitivity, we use variations in local real estate prices, either at the state or the city level, as shocks to the collateral value of land holding firms. We measure how a firm's investment responds to each additional dollar of real estate that the firm *actually* owns, and not how investment responds to real estate shocks overall. This empirical strategy uses two sources of identification. The first comes from the comparison, within a local area, of the sensitivity of investment to real estate prices accross firms with and without real estate. The second comes from the comparison of investment by land holding firms across areas with different variations in real estate prices. The methodology is similar to Case et al. (2001) in their study of home wealth effects on household consumption.

Two sources of endogeneity might affect our estimation: (1) real estate prices may be correlated with the investment opportunities of land holding firms and (2) the decision to own or lease real estate may be correlated with the firm's investment opportunities. As in Himmelberg et al. (2005) or Mian and Sufi (2009), we address the first source of endogeneity by instrumenting local real estate prices using the interaction of long-term interest rate with local housing supply elasticity. We do not have a proper set of instruments to deal with the second source of endogeneity. We make two attempts at gauging the severity of the bias it may cause. We first control for the observable determinants in the ownership decision, which leaves the estimation unchanged. Second, we estimate the sensitivity of investment to real estate prices for firms that acquire real estate *before* and *after* they do so. Before acquiring real estate, future purchasers are statistically indistinguishable from firms that never own real estate. The sensitivity of their investment to real estate prices becomes large, positive and significant only after they acquire real estate.

Our paper is related to existing work on collateral and investment. Jie Gan (2006) in an important contribution, showed, using a difference-in-difference like approach, that land holding

Japanese firms were more affected by the bust of the real estate bubble in the beginning of the 90s than firms with no real estate. We view our contribution as complementary. First, one might worry that, because the Japanese economy is bank-oriented, the role of collateral might be much larger than in a more market-based economy like the U.S. Second, her paper exploits extreme market conditions, and in particular a period where banks in Japan were distressed. This might affect the degree of financing frictions that firms face, and hence lead to an upward-bias of the effect. While we provide specific evidence on the recent real estate bubble, we also use a large U.S. sample over a long period, covering mostly "normal" market conditions. Third, the identification assumption in Gan (2006) is that land holding firms were not differentially affected by the bust of the bubble when compared to non-land holding firms. This is a strong assumption considering that land-holding firms are larger firms that might have been more exposed, for instance, to exchange rates swings contemporaneous to the bubble. Our identifying assumption requires only that land holding and non land holding firms have the same reaction to variations in *local* real estate prices, a much weaker assumption.[1] Another important contribution is Peek and Rosengreen (1997), who look at the supply side of credit. Based also on the Japanese real estate bubble, they show that banks owning depreciated real estate assets cut their credit supply, leading to a decrease in their clients' investment.[2]

Secondly, our paper is also closely related to recent works that try to highlight the role of collateral in financial contracts. Benmelech, et al. (2005) document that more liquid (or more "redeployable") pledgeable assets are financed with loans of longer maturities and durations. Benmelech and Bergman (2008) documents how U.S. airline companies are able to take advantage of lower collateral value to renegotiate *ex post* their lease obligation downward. Finally, Benmelech and Bergman (forthcoming) construct industry-specific measures of redeployability and show that more redeployable collateral leads to lower credit spreads, higher credit ratings, and higher loan-to-value ratios. While we do not go into such details in the examination of financial contracts, our paper contributes to this literature by empirically emphasizing the importance of collateral for financing and investment decisions.[3]

The remainder of the paper is organized as follows. Section 2 presents the construction of the data and summary statistics. Section 3 describes our main empirical results on investment and capital structure decisions. Section 4 concludes.

2 Data

We use accounting data on US listed firms, merged with real estate prices at the state and Metropolitan Statistical Area (MSA) level.

[1]Another contribution looking at collateral shocks triggered by the Japanese crisis can be found in Goyal and Yamada (2001).

[2]Gan (2007) also uses the Japanese crisis as a shock to banks health and identifies the importance of bank health on their clients' investment.

[3]For other contributions emphasizing the role of collateral in boosting pledgeable income, see, among others, Eisfeldt and Rampini (forthcoming) and Rampini and Viswanathan (2008)

2.1 Accounting Data

We start from the sample of active COMPUSTAT firms in 1993 with non-missing total assets (COMPUSTAT item #6). This provides us with a sample of 9,211 firms and a total of 83,719 firm-year observations over the period 1993 - 2007. We keep firms whose headquarters are located in the United States and exclude from the sample firms operating in the finance, insurance, real estate, construction and mining industries, as well as firms involved in a major takeover operation. We keep firms that appear at least three consecutive years in the sample. This leaves us with a sample of 5,121 firms and 51,467 firm year observations. We defer the reader to Appendix A for details on the construction of accounting ratios used in the regression analysis.

2.1.1 Real Estate Assets

We collect data on the value of real estate assets of each firm. After measuring the initial market value of real estate assets of each firm, we will identify variations in their value coming from variations in real estate prices across space and over time.

First, we measure the market value of real estate assets. Following Nelson et al. (1999), three major categories of property, plant and equipments are included in the definition of real estate assets: Buildings, Land and Improvement and Construction in Progress. Unfortunately, these assets are not marked-to-market, but valued at historical cost. To recover their market value, we calculate the average age of those assets, and use historical prices to compute their current market value. The procedure is as follows. The ratio of the accumulated depreciation of buildings (COMPUSTAT item #253) to the historic cost of buildings (COMPUSTAT item #263)[4] measures the proportion of the original value of a building claimed as depreciation. Based on a depreciable life of 40 years,[5] we compute the average age of buildings for each firm. Using state-level residential real estate inflation after 1975, and CPI inflation before 1975, we compute the market value of real estate assets for each year in the sample period (1993-2007).

The accumulated depreciation on buildings is no longer available in COMPUSTAT after 1993.[6] This is why we restrict our sample to firms active in 1993. There are 2,750 firms in 1993 in our sample for which we are able to construct a measure of the market value of real estate assets and 28,014 corresponding firm-year observations. Table 1 reveals two striking facts. In 1993, 58% of all US public firms reported some real estate ownership. Moreover, for the median firm in the entire sample, the market value of real estate represents 30% of the book value of Property, Plants and Equipment (and 5% of the firm's total market value). For the median *land holding* firm in COMPUSTAT, the market value of real estate represents 98% of the book value of Property, Plant and Equipment and 19% of the firm's total market value. Real estate is thus a sizable fraction of the tangible assets that corporations hold on their balance sheet.

[4]Unlike buildings, land and improvements, are not depreciated.

[5]As in Nelson et al. (1999), this assumption can be tested by estimating annual depreciation amounts (as the change in total depreciation). Building cost, when divided by annual depreciation, provides an estimate of depreciable life. Although inconsistent, the average life estimated by this approach ranges from 38 to 45 years. This confirms our assumption of a 40-year-life.

[6]In 1994, ten of the fifteen schedules required for Electronic Data Gathering, Analysis and Retrieval system (EDGAR) filings were eliminated. In particular, the accumulated depreciation on Buildings is no longer reported.

Second, to measure accurately how the value of real estate assets evolves, we need to know the location of these assets. COMPUSTAT does not provide us with the geographic location of each specific piece of real estate owned by a firm. However, the data reports headquarter location (variables STATE and COUNTY). We use the headquarter location as a proxy for the location of real estate. There are two assumptions underlying this choice. First, headquarters and production facilities tend to be clustered in the same state and MSA. Second, headquarters represent an important fraction of corporation real estate assets. We discuss the relevance of this choice in section 2.3.

2.1.2 Ex-Ante Measure of Credit Constraint

The standard empirical approach in the investment literature uses ex ante measures of financial constraint to sort between "Constrained" and "Unconstrained" firms. Estimations are performed separately for each set of firms. We follow Almeida et al. (2004) in this approach and define three measures of credit constraint using the following schemes:

- Payout ratio: In every year over the 1993 - 2007 period, we rank firms based on their payout ratio and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the annual payout distribution. We compute the payout ratio as the ratio of total distributions (dividends plus stock repurchases) to operating income.

- Firm Size: In every year over the 1993 - 2007 period, we rank firms based on their total assets and assign to the financially constrained (unconstrained) group those firms in the bottom (top) three deciles of the annual asset size distribution.

- Bond Rating: In every year over the 1993 - 2007 period, we retrieve from COMPUSTAT data on bond ratings assigned by Standard & Poor's and categorize those firms with debt outstanding but without a bond rating as financially constrained. Financially unconstrained firms are those whose bonds are rated.

2.2 Real Estate Data

2.2.1 Real Estate Prices

We use data on residential and commercial real estate prices, both at the state and at the MSA level.

Residential real estate prices come from the Office of Federal Housing Enterprise Oversight.[7][8] The O.F.H.E.O. provides a Home Price Index (HPI), which is a broad measure of the movement of single-family home prices in the US.[9] Because of the breadth of the sample, it provides more

[7] http://www.ofheo.gov/index.asp

[8] The O.F.H.E.O. is an independent entity within the Department of Housing and Urban Development, whose primary mission is "ensuring the capital adequacy and financial safety and soundness of two government-sponsored enterprises (GSEs) - the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac)".

[9] The HPI is computed using a hedonic regression and each release of the HPI offers a different value of the index for a given state year. The results presented in the paper are not, however, significantly different if, for instance, we use the 2006 release instead of the 2007 release.

information than is available in other house price indices. In particular, the HPI is available at the state level since 1975. It is also available for most Metropolitan Statistical Areas, with a starting date between 1977 and 1987 depending on the MSA considered. We match the state level HPI with our accounting data using the state identifier from COMPUSTAT. To match the MSA level HPI, we aggregate FIPS codes from COMPUSTAT into MSA identifiers using a correspondence table available from the OFHEO website.

Commercial real estate prices come from Global Real Analytics. This dataset provides a price index for Offices and Industrial Commercial Real Estate.[10] This index is only available for a subset of 64 MSAs in the U.S. with a starting date between 1985 and 2003.

Table 1 provides details on these indices (that have been normalized to 1 in 2006). The correlation between the residential and commercial indices at the state level is .57, and .42 at the MSA level. The correlation between the MSA-level and state-level residential indices is .86.

2.2.2 Measuring Land Supply

Controlling for the potential endogeneity of local real estate prices in an investment regression is an important step in our analysis. Following Himmelberg et al. (2005), we instrument local real estate prices using the interaction of long-term interest rates and local housing supply elasticity. Local housing supply elasticities are provided by Saiz (2009) and are available for 95 MSAs. These elasticities capture the amount of developable land in each metro area and are estimated by processing satellite-generated data on elevation and presence of water bodies. As a measure of long-term interest rates, we use the "contract rate on 30 year, fixed rate conventional home mortgage commitments" from the Federal Reserve website, between 1993 and 2007.

2.3 Measurement Issues

The empirical methodology we use in this paper relies on several approximations that introduce measurement errors in the regression analysis. In this Section, we present evidence in support of these approximations.

The first approximation we make relates to the location of firms' real estate assets. We assume that firms own most of their real estate assets in the state (or MSA) where their headquarters are located. We do so because there is no systematic source of information on corporations "true" location(s). To check the validity of this approximation, we hand collected the 10K forms filed with the Security and Exchange Commission for a randomly selected sample of 375 corporations with non-missing real estate data in COMPUSTAT. These documents were retrieved from the SEC's EDGAR website. Among these 375 firms, 179 firms report real estate ownership both in COMPUSTAT and in their 10K file. 80% of these 179 firms (i.e. 139 firms) report in their 10K file a major property in the state where their headquarter is located. This gives credence to our assumption that most firms reporting real estate assets in COMPUSTAT have a sizable fraction of these assets located in their headquarter's state.

Looking directly into the 10K files also allows us to address a second concern, which relates to the quality of the real estate information in COMPUSTAT. Among the 132 firms with no

[10] We use the Offices index in our analysis but the main results are left unchanged if we use the Industrial index instead.

ownership reported on COMPUSTAT, 24 (i.e. 18%) declare at least some property in their 10K file. Symmetrically, among the 243 firms that report real estate assets on their balance sheet, 64 (i.e. 23%) declare no property on their 10K files.

Finally, using the OFHEO residential real estate prices as a proxy for commercial real estate prices could be a source of noise in our regression. As noted earlier, the correlation between the two indices ranges from .42 (at the MSA level) to .57 (at the State Level). Moreover, the commercial index is available only at the MSA level, and for a subset of cities. Therefore, there is a trade-off: this index corresponds more accurately to the true nature of firms real estate assets but it relies on the stronger assumption that these assets are mostly located in the city where headquarters are located. We present evidence using both types of prices (residential and commercial) and show that our results do not depend on the price index used.

3 Real Estate Prices and Firm Behavior

In this Section we analyze the impact of real estate shocks on corporate investment. Our goal is to provide an estimate of the financial multiplier (i.e. by how much an increase in assets' value increases investment) at the firm-level.

3.1 Empirical Strategy

We run different specifications of a standard investment equation for firm i, at date t, with headquarters located in state or MSA s. We start with the following specification:

$$INV_{it}^{s} = \alpha_i + \delta_t + \beta.RE\ Value_i \times \frac{P_t^s}{P_{93}^s} + \gamma \frac{P_t^s}{P_{93}^s} + controls_{it} + \epsilon_{it}, \quad (1)$$

where INV is the ratio of investment to lagged PPE, $RE\ Value_i$ is the ratio of the market value of real estate assets in 1993 to lagged PPE and $\frac{P_t^s}{P_{93}^s}$ measures the growth in real estate prices in state s from 1993 to year t. As is typically done in the reduced-form investment literature, we control for the ratio of cash flows to PPE, the one year lagged market to book value of assets and the lagged leverage. We also include a firm fixed effect α_i, as well as year fixed effects δ_t, designed to capture aggregate specific investment shocks, i.e. fluctuations in the global economy. Finally, the variable $\frac{P_t^s}{P_{93}^s}$ controls for the overall impact of the real estate cycle on investment, irrespective of whether a firm owns real estate or not. Shocks ε_{it} are clustered at the state $\times$ year level. This correlation structure is conservative given that the explanatory variable of interest $RE\ Value_i \times \frac{P_t^s}{P_{93}^s}$ is defined at the firm level (see Bertrand, Duflo and Mullainathan [2004]).

As noted in Section 2.1.1, the market value of the real estate holdings of a firm can only be estimated before 1993, which is the last year for which accumulated depreciations on Buildings are available. $RE\ Value_i$ is thus defined as the initial market value of a firm's real estate assets, and $RE\ Value_i \times \frac{P_t^s}{P_{93}^s}$ capture fluctuations in the market values of these particular assets. In particular, $RE\ Value_i$ is not time-varying, and its level is not identified separately from the firm fixed effect α_i.

Let us also highlight that the coefficient β measures how a firm's investment responds to each additional $1 of real estate *the firm actually owns*, and not how investment responds to real estate shocks overall. This specification allows us to abstract from state-specific shocks that would affect both firms with and without real estate assets.

Endogeneity Issues

There are two potential sources of endogeneity in the estimation of equation 1: (1) real estate prices could be correlated with investment opportunities and (2) the ownership decision could be related with investment opportunities.

There are two immediate reasons why real estate prices could be correlated with investment opportunities. The first one is a simple reverse causality argument: large firms might have a non negligible impact through labor demand on the local activity, so that an increase in investment for such large, land holding firms, could trigger a real estate price appreciation. This would lead us to over-estimate β. Second, it could be that our measure of real estate prices proxies for local demand shocks, and that land holding firms are more sensitive to local demand.

To address this source of endogeneity, we instrument MSA level real estate prices. As already mentioned in Section 2.2.2, and following Himmelber et al. (2005) and Mian and Sufi (2009), we do so by interacting local housing elasticities with aggregate shifts in the interest rate. When interest rates decrease, the demand for real estate increases. If the local supply of land is very elastic, the increased demand will translate mostly into more construction (more quantity) rather than higher land prices. If the supply of land is very inelastic on the other hand, the increased demand will translate mostly into higher prices rather than more construction. We expect that in MSA's where land supply is more constrained, a drop in interest rate should have a larger impact on real estate prices. As our first stage regression, we thus estimate, for MSA m, at date t, the following equation predicting real estate prices P_t^m:

$$\frac{P_t^m}{P_{93}^m} = \alpha^m + \delta_t + \gamma.Elasticity^m \times IR_t + u_t^m, \tag{2}$$

where $Elasticity^m$ measures constraints on land supply at the MSA leve, IR_t is the nationwide real interest rate at which banks refinance their home loans. α^m is an MSA fixed effect, and δ_t captures macroeconomic fluctuations in real estate prices, from which we want to abstract.

The second source of endogeneity in the estimation of equation 1 comes from the ownership decision: if firms that are more likely to own real estate are also more sensitive to local demand shocks, we would over-estimate β. As a first step in addressing this issue, we control for initial characteristics of firm i, X_i, interacted with real estate prices $\frac{P_t^s}{P_{93}^s}$. The X_i are controls that we believe might play an important role in the ownership decision and include 5 quintiles of Age, Assets, Return on Assets and Leverage as well as 2-digit industry dummies and State dummies. We show in Table 2 that these characteristics are good predictors of the decision to buy real estate assets and, to a lesser extent, on the amount of real estate purchased. Table 2 is a simple cross-sectional OLS regression of $RE\ OWNER$, a dummy equal to 1 when the firm owns real estate, and $RE\ value$, the market value of the firm's real estate assets, on the initial characteristics mentioned above. Older, larger and more profitable firms, i.e. mature firms, are more likely to be owners in our dataset. [11]

[11] Note that, from an intuitive perspective, these firms seem to be more likely to be insulated from local demand

Controlling for the observed determinants of real estate ownership, we end up estimating the following reduced form investment equation:

$$INV_{it}^{s} = \alpha_i + \delta_t + \beta.RE\ Value_i \times \frac{P_t^s}{P_{93}^s} + \gamma \frac{P_t^s}{P_{93}^s} + \kappa \sum_k X_k^i \times P_t^s + controls_{it} + \epsilon_{it} \qquad (3)$$

However, some determinants of the land holding decisions might not be observable, which makes our approach in equation (3) insufficient. Unfortunately, it is difficult to find firm-level instruments that predict real estate ownership. Yet, we can still attempt to empirically measure how different land holding firms are compared to non-land holding firms. To do so, we look in Section 3.5 at the sensitivity of investment to real estate prices for firms that are about to purchase a property, but *before* the purchase. If the unobserved characteristics that co-determine investment and ownership is time invariant, then it should be the case that firms that are about to purchase real estate assets are already more sensitive to the real estate cycle. Section 3.5 detail the implementation of this test in greater details. We insist however that while suggestive, this approach is by no mean definitive, as the unobserved heterogeneity could well vary with time.

3.2 Main Results

Table 3 reports estimates of various specifications of equation (1) and (3). Column (1) starts with the simplest estimation of equation (1) without any additional controls. Land holding firms increase their investment more than non land holding firms when real estate prices increase. The baseline coefficient is .08, so that each additional $1 of real estate collateral increases investment by 8 cents. The coefficient is significant at the 1% confidence level. The effect is economically large: a one s.d. increase in $RE\ Value$ explains 28% of investment's s.d.

In Column (2), we add the initial controls interacted with real estate prices that account for the observed heterogeneity in ownership decisions and its potential impact on the sensitivity of investment to real estate prices. The coefficient is now .07, still significant at the 1% confidence level, somewhat smaller but not statistically different from .08 found in column (1).

Column (3) adds state variables traditionally used in investment equations, i.e. Cash and Market to Book. The reduced form sensitivity remains positive but is now smaller, equal to .055.[12][13] In other words, a one s.d. increase in collateral value explains a 20% s.d. increase in investment once the effect of the Market to Book and the other controls are accounted for. Note that, as is traditional in the investment literature, both Cash and Market to Book

shocks. This suggests that the hypothesis according to which land holding firms are *inherently* more likely to be affected by local demand shocks is not the most likely *a priori*.

[12]In particular, in unreported regressions, we see that most of the drop in the sensitivity comes from adding the control for the Market-to-Book ratio and not from adding Cash.

[13]As we explain in our working paper (Chaney et al. (2009)), the drop in β once the Market-to-Book ratio is controlled for can easily be interpreted in the light of a simple model of investment with collateral constraints. Intuitively, to leave the Market-to-Book ratio unchanged after a positive shock to the value of the firm's real estate assets, there need to be a negative shock to unobserved productivity. This negative shock to productivity generates a negative shock to investment. As a consequence, the response of investment to the initial shock in real estate prices will be smaller than it would have been had the Market-to-Book ratio not been controlled for.

have a significant, positive impact on investment. However, we also notice that the additional explanatory power brought about by these controls remains limited, increasing the R^2 of the regression from .35 up to .4.

Column (4) tests whether the relation between collateral value and investment found in column (3) depends on the shape of the empirical distribution of collateral values. To do so, we interact the $RE\ OWNER$ dummy (equal to 1 when a firm initially owns some real estate assets) with the real estate price index. The estimated coefficient is positive and strongly significant, indicating that our results are not driven by firms with large real estate holdings. Somewhat mechanically, the binary model has a lower predictive power on investment: A one s.d. increase in real estate prices explains a 9% s.d. increase in investment for land holding firms.

Column (5) replicates the estimation performed in Column (3) using MSA-level residential price index instead of the State-level index. Using MSA level prices has both advantages and drawbacks. It offers a more precise source of variation in real estate prices. It also makes our identifying assumption that investment opportunities are uncorrelated with variations in local prices much milder. However, there are potentially larger measurement errors, as we now rely on the assumption that all the real estate assets that a firm owns are located in the headquarters' city. The results in Column (4) show that the coefficient remains stable, at .055.

Column (6) uses commercial real estate prices instead of residential prices. The lower number of MSAs with available commercial real estate prices reduces slightly the number of observations (18,062 observations compared to 22,771 in the specification using MSA residential prices). However, the sensitivity is equal to 0.063 and significant at the 1% level, and is slightly higher than that computed using residential prices: a $1 increase in the value of commercial real estate assets leads to an average increase of 6.3 cents in investment.

Column (7) implements the IV strategy where real estate prices are instrumented using the interaction of interest rates and local constraint on land supply (see Section 3.1). Let us first briefly comment the first stage regressions, which are direct estimations of equation 2. These estimations are presented in Table 4. The first two columns predict MSA residential prices, while the two last columns predict MSA office prices. In column (1) and (3), we directly use the measure of local housing supply elasticity provided in Saiz (2009). In column (2) and (4), we group MSAs by quartile of local housing supply elasticity.

Low values of local housing supply elasticity corresponds to MSAs with very constrained land supply. We expect the effect of declining interest rates on prices to be stronger in MSAs with less elastic supply. As expected, the γ coefficient in equation 2 is positive and significant at the 1% confidence level. For instance, using the results in Column (4), a 100 basis points interest rate decline increases the office price index by 6 percentage points more in "constrained" cities (75th percentile of the elasticity distribution) than in "unconstrained" cities (25th percentile). These effects are economically large, and significant. All F-tests for nullity of the instrument are above 10 which leads us to conclude that these instruments are not weak. Moving to the second stage equation, we simply use predicted prices $\widehat{P_t^m}$ from the estimation of equation 2 and use them as an explanatory variable in equation 3. Column (7) in Table 3 reports the result of the estimation when the instrument used in the first stage is the local housing supply elasticity (i.e. Column (3) of Table 4). The coefficient estimated from this IV regression is very close to the one obtained from the OLS regression, equal to .065 and remains significant at the 1% level.

A potential issue with pooled regressions as the ones presented in Table 3 is that they might conceal a fair amount of heterogeneity in the elasticity across time. The sensitivity of investment may be different in a growing environment than in a recession for instance. We cannot report yearly estimates, but we reproduce the estimation of equation 3 on two different sample periods: before 1999 (Columns (1), (3) and (5) in Table 5) and after 2000 (Columns (2), (4) and (6) in Table 5). The coefficients before 1999 are only marginally higher than those after 2000. The significance of the coefficient of interest does not seem to come from some particular years in our sample.

3.3 Heterogeneous Responses: Ex Ante Credit Constraints

As pointed out in a different context by Kaplan and Zingales (1997), it is unclear *a priori* that the sensitivity of investment to collateral value should be increasing with the extent of credit constraints.[14] This remains ultimately an empirical question which we answer using three different ex ante measures of credit constraints based on: (1) dividend payments (2) firm size and (3) credit rating. Those measures are defined in Section 2.1.2. We estimate equation 3 separately for "constrained" and "unconstrained" firms.

As reported on Table 6, there is a strong cross-sectional heterogeneity in the response of investment to balance sheet shocks. The sensitivity of investment to collateral value is on average twice as large in the group of "constrained" firms relative to the group of "unconstrained" firms. For instance, the coefficient β for firms in the 3 bottom deciles of the size distribution is .09 compared to .045 for the firms in the 3 top deciles. The difference between these two coefficients is significant at the 5% level for all three measures of credit constraints.

3.4 Collateral and Debt

In this Section, we try to explore the channel through which firms are able to convert capital gains on real estate assets into further investment. In unreported regressions, we investigate whether firms, when confronted with an increase in the value of their real estate assets, are more likely to sell them and cash out the capital gains. We do not find it to be the case. This implies that outside financing has to increase to explain the observed increase in investment. Standard theories of investment with collateral constraints (as, e.g. in Hart and Moore (1994)) would predict that collateral value leads to more or larger issues of new debt, secured on the appreciated value of land holdings.

Table 7 reports results of the effect of an increase in land value on debt issues, using COMPUSTAT data. To simplify interpretations and minimize endogeneity issues, we remove the Cash and Market/Book controls from equation (3), and replace investment on the right hand side with debt issues and debt repayments:

$$DebtIssues_{it}^{s} = \alpha_i + \delta_t^s + \beta.RE\ Value_i \times \frac{P_t^s}{P_0^s} + \varepsilon_{it}^{s} \quad (4)$$

[14] For instance, firms with strong agency problems may simply have a lower ability to convert collateral into cash, because of these very agency issues.

To obtain estimates comparable to investment results, our debt issues variables are normalized by lagged tangible fixed assets (PPE). Thus, the results obtained when estimating equation 4 should be compared with the coefficient β derived in Column (2) of Table 3, i.e. .06.

The results are presented in Table 7. Columns (1) and (2) look at the inflows and outflows of debt. We find that land holding firms make larger debt issuances and repayments when the value of their real estate increases. A $1 increase in collateral value increases debt issues by 13 cents and debt repayments by 7 cents. The difference, i.e. the net debt issues, corresponds to an increase in the inflows of debt of 4 cents, in a range similar to the observed increase in investment. The fact that *both* repayment *and* issues increase when collateral value increase suggests that firms take advantage of the appreciated value of their collateral to renegotiate former debt contracts, reimbursing former loans and issuing new, cheaper ones. If this were the case, the marginal interest rates of companies with increasing collateral value should decrease. Unfortunately, COMPUSTAT only reports a noisy measure of average interest rates, preventing us from testing this natural interpretation of the results. Doing so would require the use of an alternative source of data. A potential worry with results in Column (1) to (3) is that flows data (i.e. issuances and repayments) are of a lower quality than stock data (i.e. the level of long-term debt). Column (4) confirms the robustness of these results by looking at yearly variations in the stock of long-term debt. The reported coefficient is similar to that in Column (3).

On the short-term liability side, lines of credits might be easier to obtain when secured on valuable collateral (e.g. Sufi, 2009). However, we observe only a small, positive and slightly significant net increase in short term debts, with a coefficient of .5 cents per dollar. Borrowers are more likely to use longer-term liabilities to finance their additional investment.

3.5 Are Real Estate Purchasers different from Non-Purchasers?

The decision by firms to own real estate assets on their balance sheet is not random. This can introduce a bias in the various regressions we have presented so far. For instance, if firms with more cyclical strategies were to own their real estate properties – for a reason we do not model here – the estimated β would be upward-biased.

In this section, we show that our results are robust to assuming a time-invariant unobserved heterogeneity across firms that would affect both the real estate ownership and the sensitivity of investment to real estate prices. Our test consists in estimating the sensitivity of investment to real estate prices for firms that purchase a property both before and after this acquisition. We find that, *before* the acquisition, future owners are statistically indistinguishable from firms that never own real estate. Yet, these firms behave like other real-estate holding firms *after* they acquire their properties.

To implement this idea we do not rely on the market value of the real estate assets, but only on whether firms own real estate or not. This allows us to work with a larger sample, as we do not require information on buildings depreciations.

We start with a sample of all COMPUSTAT firms that are not in the Finance, Insurance, Real Estate, Construction or Mining Industries, that are not involved in major takeovers, and that have at least three consecutive years of appearance in the data. The sample period is 1984 to 2007, 1984 being the year when information on real estate assets appears in COMPUSTAT. We define a firm as a purchaser if it has initially no positive real estate assets on its balance sheet and positive real estate assets after some date.[15] We exclude from our sample firms that move several time between 0 and positive real estate assets, i.e. multiple acquirers. We also require that the firm has at least three years of available data before and after the purchase of the real estate asset. We end up with a sample of 876 purchasers and 11,083 purchaser-year observations, with purchasing date ranging from 1986 to 2005. The number of purchaser-year observations *before* the purchase is 4,733. The group of non-purchaser is defined as those firms that always report no real estate assets throughout their history in COMPUSTAT. This leaves us with a sample of 2,742 firms and 15,842 firm year observations for non-purchaser.

We first estimate equation (1) separately for non purchasers and for purchasers *before* the purchase of land. The results are presented in Table 8, Column (1) and (2). If anything, purchasers have, prior to acquiring real estate, a lower sensitivity of investment to real estate prices than non-purchasers. More importantly, the difference between the two is not statistically different from 0. Future owners are statistically indistiguishable from non-owners before they acquire land. The data rejects the existence of a time-invariant unobserved heterogeneity that would simultaneously affect real estate ownership and investment sensitivity to the local real estate cycle. However, we emphasize again that this does not imply that the decision to own land is exogenous: firms could decide to buy real estate anticipating that their investment opportunities will be more correlated with the local real estate cycle, creating a bias in the estimation.

The sample of purchasers also allows to confirm the finding in Section 3.2 by investigating the *within* dimension of the data. In order to do so, we also estimate equation (1) for purchasers *after* they acqure real estate assets. The results are presented in Column (3) of Table 8. The sensitivity of investment to real estate prices is .47 for purchasers once they become land holders, and it is significant at the 1% level. Relative to Column (2), we see that purchasing real estate is associated with a .54 increase in the sensitivity of investment to real estate prices. This difference is significant at the 3% level. This difference between owners and non owners is larger but not statistically different from the comparable coefficient in Column (4) of Table 3.[16]

Column (4), (5) and (6) of Table 8 run the same regressions as in Column (1), (2) and (3) using variations in long-term debt as a dependent variable. The sensitivity of debt issues to local real estate prices for land-holding firms is not significantly different from that of future owners *before* they purchase their real estate assets (Column (4) and (5)). Debt issues become significantly more sensitive to local real estate prices *after* firms acquire land (Column (6)). Overall, the analysis in this section confirms that our main results on investment and debt issuance do not seem to be caused by a time-invariant unobserved heterogeneity that would simultaneously affect real estate ownership and investment or debt sensitivity to the local real estate.

[15] Before 1995, many firms have missing real estate data in COMPUSTAT. To maximize the number of purchasers, we define as a purchaser a firm that has initially missing real estate observations, then 0 real estate assets and then positive real estate assets for the remaining years.

[16] As the estimation of equation 1 corresponds to a specification with a $RE\ OWNER$ dummy variable, the natural benchmark is that of Column (4) in Table 3

3.6 A Closer Look at the Real Estate Bubble

In this Section, we investigate the impact of the recent surge of real estate prices between 2002 and 2006 on corporate investment. This allows us to (1) further test the robustness of our results (2) reduce the extent of measurement errors and (3) provide a simple illustration of the methodology used in this paper. This Section follows closely the methodology outlined in Mian and Sufi (2009) and is similar in spirit to that in Gan (2006).[17]

We divide the sample between MSAs with high and low local housing supply elasticity (fourth vs. first quartile), and between firms owning vs. renting real estate. In order to reduce the extent of measurement errors (see Section 2.3), we hand collect information on headquarter ownership for firms that report at least some ownership in COMPUSTAT in 2001.[18] We thus take seriously the claim made in Section 2.3 that headquarters represent a significant fraction of the non-specific real estate assets held by corporation and restrict the identification on headquarters ownership. We then simply compare the evolution of investment of headquarters' owners vs. renters in cities with high vs. low elasticities.

Figure 1 shows the evolution of office prices from 2001 to 2006 depending on the MSA local housing supply elasticity. It confirms that, while the bubble had a more dramatic impact on residential prices, it did also affect commercial prices. Low elasticity MSAs experienced a much larger increase in office prices (30% increase in 2 years) than high elasticity MSAs. Figure 2 implements our methodology looking at growth in assets. In low elasticity MSAs, firms owning their headquarters experienced a 70% growth in assets (blue line, left panel), while the aggregate assets of firms renting their headquarters saw only a 15% increase (red line, left panel). By contrast, in high elasticities MSAs, there is no significant difference in the evolution of assets of firms owning their headquarters (blue line, right panel) relative to firms renting them (red line, right panel). It clearly shows a significant net effect of local real estate prices on corporate investment. Figure 3 leads to similar conclusions on long-term debt: firms owning their headquarters in low elasticity MSAs took advantage of the real estate price bubble to increase their stock of debt relative to firms in similar MSAs but renting headquarters and relative to MSAs where the bubble did not have a large impact on office prices.

Table 9 confirms these graphical evidence using firm-level regressions. We adopt a standard long-run difference-in-difference strategy and estimate the following equation:

$$\frac{\Delta(Assets)_{i,m}^{01-06}}{Assets_{im}^{01}} = \alpha_m + \beta\frac{\Delta(Office\ Price)_m^{01-06}}{Office\ Price_m^{01}} \times Headquarters_i + \gamma\frac{\Delta(Office\ Price)_m^{01-06}}{Office\ Price_m^{01}} + \epsilon_{im} \quad (5)$$

where $\frac{\Delta(Assets)_{i,m}^{01-06}}{Assets_{im}^{01}}$ is firm i asset growth from 2001 to 2006, $\frac{\Delta(Office\ Price)_m^{01-06}}{Office\ Prices_m^{01}}$ is MSA m office price growth from 2001 to 2006 and $Headquarters_i$ is a dummy equal to 1 if firm i owns its headquarters in 2001.

Column (5) in Table 9 directly estimates equation 5 while Column (1) uses variation in long-term debt normalized by initial assets as a dependent variable. Column (2) and (6) augment the

[17] Again, it is worth emphasizing that Gan restricts her analysis to the time-series dimension, i.e. she does not exploit the cross-sectional variations in real estate prices.

[18] Such data collection is possible for 2001 (and not in 1993) as 10K files for this year are available online through the SEC website.

previous regressions by controlling for initial firm size. This is natural as there is a fair amount of heterogeneity between firms owning their headquarters and firms renting them. Column (3) and (7) replace office price growth by local housing supply elasticity: this corresponds to the reduced form of an instrumental variable regression where growth in price from 2001 to 2006 is instrumented by local housing supply elasticity. Finally, column (4) and (8) use quartiles of local housing supply elasticity instead of the elasticity itself. Overall, results in Table 9 are coherent with Figures 2 and 3. Firms owning their headquarters experienced a significantly larger growth in assets and long-term debt relative to renters, especially so in MSAs where office prices increased a lot, i.e. in MSAs with lower housing supply elasticity. This effect is monotonic in the local housing supply elasticity. It is also economically important: taking the estimate of column (6), an increase in real estate prices of 25% (which corresponds to the difference between high and low elasticity MSAs, see figure 1) leads to an increase in firms' assets by 0.79x0.25=20% over the 2001-2006 period.

4 Conclusion

When the value of a firm's real estate appreciates by $1, its investment increases by approximately 6 cents. This investment is financed through additional debt issues. The impact of real estate shocks on investment is stronger when estimated on a group of firms which are more likely to be credit constrained. As we showed in this paper, real estate represents a significant fraction of the assets held on the balance sheet of corporations. As a consequence, one could expect the impact of real estate shocks on aggregate investment to be non-trivial. However, this is not necessarily the case in a world where responses to balance sheet shocks are heterogenous. In particular, small firms respond more than large firms, which attenuates the agregate impact of credit constraints. Understanding how one can go from the micro estimates we offer in this paper to the macro impact of real estate shocks on investment, and therefore on GDP, remains unclear. We hope to tackle this question in future research.

References

Almeida, Heitor, Murillo Campello and Michael S. Weisbach, 2004. "The Cash Flow Sensitivity of Cash," *Journal of Finance*, American Finance Association, 59(4):1777-1804.

Barro, Robert J, 1976. "The Loan Market, Collateral, and Rates of Interest," *Journal of Money, Credit and Banking*, Ohio State University Press, 8(4):439-56.

Benmelech, Efraim, Mark J. Garmaise and Tobias J. Moskowitz, 2005. "Do Liquidation Values Affect Financial Contracts? Evidence from Commercial Loan Contracts and Zoning Regulation," *The Quarterly Journal of Economics*, 120(3):1121-1154.

Benmelech, Efraim and Nittai Bergman, forthcoming. "Collateral Pricing", *Journal of Financial Economics.*

Benmelech, Efraim and Nittai Bergman, 2008. "Liquidation Values and the Credibility of Financial Contract Renegotiation: Evidence from U.S. Airlines," *Quarterly Journal of Economics*, 123(4): 1635-1677.

Bernanke, Benjamin and Mark Gertler, 1989. "Agency Costs, Net Worth and Business Fluctuations" *American Economic Review*, 79(1):14-34.

Bernanke, Ben S, (1983). "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression," *American Economic Review*, 73(3):257-76.

Bertrand, Marianne, Esther Duflo and Sendhil Mullainathan, 2004. "How Much Should We Trust Difference in Difference Estimators ?", *Quarterly Journal of Economics*, 119:249-275

Case, Karl, Quigley, John and Robert Shiller , 2001. "Comparing Wealth Effects: The Stockmarket Versus the Housing Market," NBER Working Paper N.8606.

Cutts, Robert, L., (1990). "Power from the Ground Up: Japan's Land Bubble", *Harvard Business Review*, 68:164-72.

Eisfeldt, Andrea, and Adriano Rampini, forthcoming. "Leasing, Ability to Repossess, and Debt Capacity," *Review of Financial Studies.*

Gan, Jie, 2006. "Collateral, Debt Capacity, and Corporate Investment: Evidence from a Natural Experiment", *Journal of Financial Economics*, 85:709-734.

Gan, Jie, 2007. "The Real Effects of Asset Market Bubbles: Loan- and Firm-Level Evidence of a Lending Channel", *Review of Financial Studies*, 20:1941-1973.

Goyal, Vidhan and Takeshi Yamada, 2001. "Asset Price Shocks, Financial Constraints and Investment: Evidence From Japan,"*Journal of Business*, 77(1):175-200

Hart, Oliver and John Moore, 1994. "A Theory of Debt Based on the Inalienability of Human Capital," *The Quarterly Journal of Economics*, 109(4):841-79.

Himmelberg, Charles, Christopher Mayer and Todd Sinai, 2005. "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions," Journal of Economic Perspectives, 19(4):67-92.

Kaplan, Steven N. and Luigi Zingales, 1997. "Do Investment-Cash Flow Sensitivities provide Useful Measures of Financing Constraints?", *The Quarterly Journal of Economics*, 112: 169-215.

Mian, Atif and Amir Sufi, 2009. "House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis", Working Paper.

Nelson, Theron R., Thomas Potter and Harold H. Wilde, 1999. "Real Estate Asset on Corporate Balance Sheets," *Journal of Corporate Real Estate*, 2(1):29-40.

Peek, Joe and Eric S. Rosengren, 2000. "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States," *American Economic Review*, 90(1):30-45, March.

Rampini, Adriano, and S. Viswanathan, "Collateral, Financial Intermediation, and the Distribution of Debt Capacity," Working paper, Duke University.

Rauh, Joshua D., 2006. “Investment and Financing Constraints: Evidence from the Funding of Corporate Pension Plans,” *Journal of Finance*, 61(1):33-71.

Saiz, Albert, 2009. “On Local Housing Supply Elasticity”, *Quarterly Journal of Economics, forthcoming.*

Sufi, Amir, 2009. “Bank Lines of Credit in Corporate Finance: An Empirical Analysis”, *The Review of Financial Studies, 22(3):1057-1088.*

Stiglitz, Joseph E. and Andrew Weiss, 1981. “Credit Rationing in Markets with Imperfect Information,” *American Economic Review*, 71(3):393-410.

Townsend, Robert M. , 1979. “Optimal Contracts and Competitive Markets with Costly State Verification”, *Journal of Economic Theory* 20:265-293.

A Construction of Accounting Ratios

Aside from data on real estate, we calculate other accounting variables following the standards of the corporate finance literature. We compute investment rate as the ratio of capital expenditures (COMPUSTAT item #128) to past year's Property Plant & Equipment (item #8).[19] We compute the Market-to-Book ratio as follows: we take the total market value of equity as the number of common stocks (item #25) times end-of-year close price of common shares (item #24). To this, we add the book value of debt and quasi equity, computed as book value of assets (item #6) minus common equity (item #60) minus deferred taxes (item #74). We then normalize the resulting firm's "market" value using book value of assets (item #6). We also use the ratio of cash flows (item #18 plus item #14) to past year's PPE (item #8). Leverage is computed as the ratio of short-term and long term liabilities (item #34+item #9) normalized by total assets (item #6).

We use COMPUSTAT to measure debt issuance. We measure long term debt issues as long term debt issuance (item #111) normalized by lagged PPE (item #8). We also compute long term debt repayment (item #114) divided by lagged PPE. Finally, only the net change in current debt (item #301) is available in COMPUSTAT, and we also normalize it by lagged PPE. Net change in long term debt is defined as long term issuance minus long term repayments normalized by PPE. Because data on issuances and repayments are sometimes missing, we also compute net change in long term debt as the yearly difference in long term debt normalized by lagged PPE.

In most of the regression analysis, we use initial characteristics of firms to control for the potential heterogeneity among our 2,750 firms. These controls, measured in 1993, are based on Return on Assets (operating income before depreciation (item #13) minus depreciation (item #14) divided by total assets (item #6)), Assets (item #6), Age measured as number of years since IPO, Leverage, 2-digit SIC codes and state of location.

Finally, to ensure that our results are statistically robust, all variables defined as ratios are windsorized at the 5th percentile.[20] Table 1 provides summary statistics on most accounting variables used in the paper. We simply remark that the debt-related variables (Debt Repayment, Debt Issues, Net Debt Issues and Changes in Current Debt) have a high means (.75 for debt issues, for instance) but fairly low medians (e.g., .01 for debt issues).

[19] This normalization by PPE is standard in the investment literature (see, e.g., Kaplan and Zingales (1997) or Almeida et al. (2007)). It provides typically a median investment ratio of .21. An alternative specification is to normalize all variables by lagged asset value (item #6), as in Rauh (2006) for instance, which deliver notably lower ratios. Our results are robust to this alternative normalization choice.

[20] Windsorizing at the first percentile or trimming the variables at the 5th/1st percentile does not qualitatively change our results.

B Figures and Tables

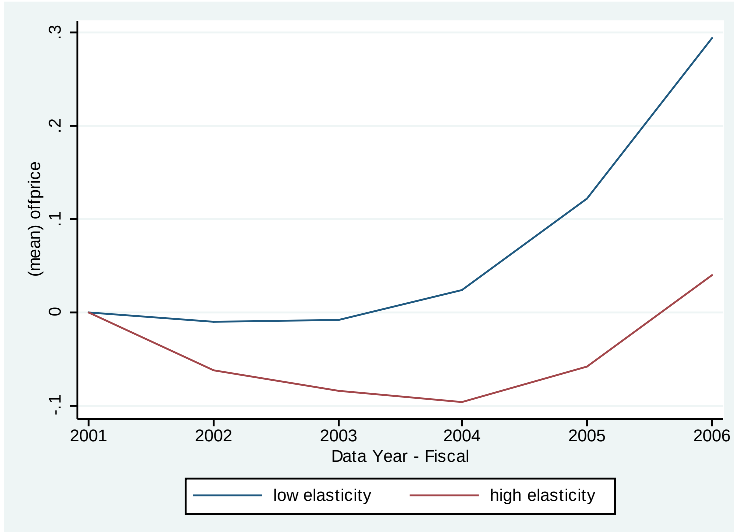

Figure 1: Relative Evolution of Office Prices (High vs. Low Elasticity MSA) (2001-2006)

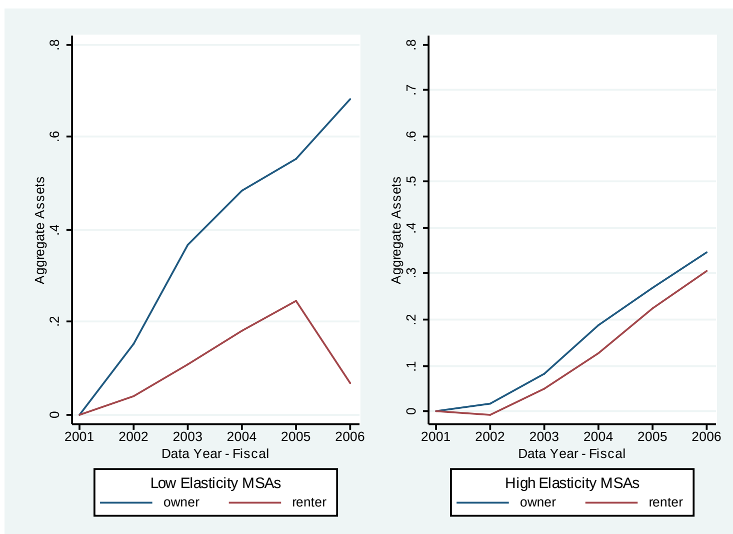

Figure 2: Evolution of Aggregate Assets (2001-2006)

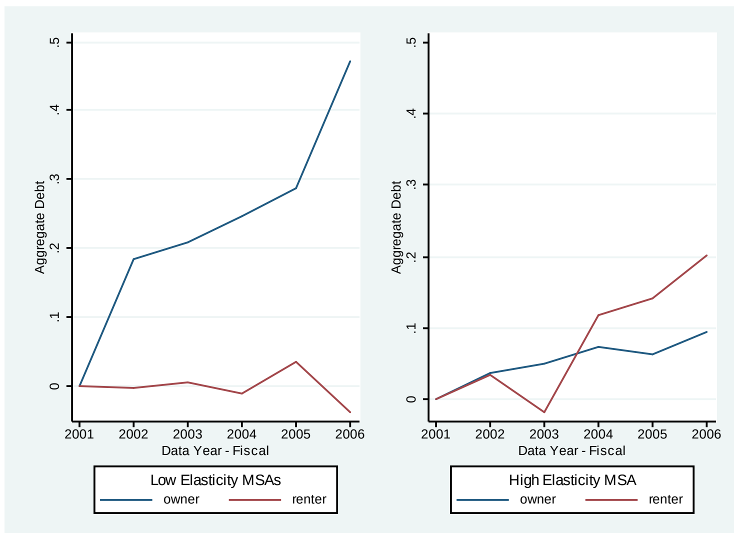

Figure 3: Evolution of Aggregate Debt (2001-2006)

Table 1: Summary statistics

		Mean	Median	Std. Dev.	25^{th} percentile	75^{th} percentile	Observations
Firm Level Data							
	Investment	.35	.21	.37	.11	.41	27,672
	Cash	-.11	.26	2.3	-.11	.59	27,877
	Market/Book	2.23	1.54	1.93	1.1	2.5	25,592
	Leverage	.44	.20	9.36	.03	.37	27,931
	Debt Issues	.54	.01	1.23	0	.38	26,772
	Debt Repayment	.39	.08	.76	.01	.33	27,291
	Net Debt Issues	.09	0	.56	-.08	.06	26,192
	Changes in Current Debt	.01	0	.14	0	0	28,014
	RE Value	.85	.28	1.36	0	1.12	28,014
Initial Firm Level Data (1993)							
	RE OWNER	.58	1	.49	0	1	2,750
	ROA	-.01	.07	.26	-.03	.12	2,742
	Age	12.26	8	10.6	3	19	2,750
	Leverage	.29	.19	1.13	.04	.36	2,746
	Log(Asset)	4.1	3.97	2.2	2.6	5.5	2,750
MSA Level Data							
	Residential Prices Growth Rate	.05	.04	.05	.03	.06	5,679
	Residential Prices Index	.71	.70	.2	.57	.88	5,695
	Office Prices Growth Rate	.04	.03	.08	-.01	.07	880
	Office Prices Index	.79	.8	.18	.67	.91	890
	Local Housing Supply Elasticity	1.57	1.34	.86	.96	2.02	1,455
State Level Data							
	Residential Prices Growth Rate	.06	.05	.04	.03	.07	765
	Residential Prices Index	.70	.66	.20	.54	.86	765

Notes: This table provides summary statistics at the firm level (panel 1 and 2), at the MSA level (panel 3) and at the state level (panel 3). Investment is defined as capital expenditure (item #128) normalized by the lagged book value of properties, pland and equipment (PPE: item #8). Cash is defined as Income before extraordinary items + depreciation and amortization (item #14 + item # 18) normalized by lagged PPE (item # 8). Market/Book is defined as the market value of assets (item #6 +(item #60 × item #24) -item #60 -item #74) normalized by their book value (item #6). Leverage is defined as the sum of short-term and long-term debt (item #34+ item #9) normalized by the book value of assets (item #6). Debt Issues is defined as item #111 normalized by lagged PPE (item #8). Debt Repayment is defined as item #114 normalized by PPE (item #8). Net Debt Issues is defined as Debt Issuance minus Debt Repayment. Changes in current debt is defined as item #301 normalized by lagged PPE (item #8). RE Value is the ratio of the market value of real estate assets normalized by lagged PPE (see Section 2 for details on the construction of this variable). ROA is defined as operating income before depreciation minus depreciation and amortization normalized by total assets ((item #13-item #14)/item #6). Age is the number of years since IPO. RE OWNER is a dummy variable equal to 1 if the firm reports any real estate holding in 1993. Residential Prices Growth Rate (MSA Level – resp. State Level) is the growth rate of the MSA (resp. State) OFHEO real estate price index ; Residential Price Index (MSA Level – resp. State Level) is the OFHEO real estate price index, normalized to 1 in 2006. Office Prices Index is an index of MSA level office prices normalized to 1 in 2006. Office Prices Growth Rate is the growth rate of the Office Prices Index. Local Housing Supply Elasticity come from Saez (2009).

Table 2: Determinants of Real Estate Ownership

	RE OWNER (1)	RE Value (State) (2)
2^{nd} Quintile of Asset	.16***	.071
	(.021)	(.066)
3^{rd} Quintile of Asset	.31***	.13**
	(.022)	(.069)
4^{th} Quintile of Asset	.48***	.27***
	(.024)	(.074)
5^{th} Quintile of Asset	.48***	.035
	(.028)	(.086)
2^{nd} Quintile of Leverage	.14***	.2***
	(.02)	(.062)
3^{rd} Quintile of Leverage	.18***	.19***
	(.021)	(.066)
4^{th} Quintile of Leverage	.17***	.17**
	(.022)	(.068)
5^{th} Quintile of Leverage	.23***	.28***
	(.022)	(.069)
2^{nd} Quintile of ROA	.099***	.33***
	(.022)	(.069)
3^{rd} Quintile of ROA	.12***	.25***
	(.023)	(.072)
4^{th} Quintile of ROA	.12***	.17**
	(.023)	(.071)
5^{th} Quintile of ROA	.13***	.23***
	(.022)	(.069)
2^{nd} Quintile of Age	.028	-.0091
	(.021)	(.066)
3^{rd} Quintile of Age	.094***	.11*
	(.02)	(.063)
4^{th} Quintile of Age	.21***	.47***
	(.021)	(.066)
5^{th} Quintile of Age	.23***	.89***
	(.023)	(.072)
Industry Fixed Effect	Yes	Yes
State Fixed Effect	Yes	Yes
Observations	2,738	2,738
Adj. R^2	.58	.27

Notes: This table shows the determinant of Real Estate Ownership in 1993. The dependent variable is RE OWNER (Column (1)), a dummy indicating whether the firm reports any real estate asset on its balance sheet in 1993 and RE Value (Column (2)), the market value of real estate assets in 1993. Control variables include 5 quintiles of Asset, Age, Leverage, ROA, as well as Industry and State Fixed Effects. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 3: Real Estate Prices and Investment Behavior

	Capital Expenditure						
	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (OLS)	(6) (OLS)	(7) (IV)
RE Value (State)	.077***	.067***	.055***				
	(.005)	(.0052)	(.0048)				
RE OWNER × State Residential Prices				.17***			
				(.07)			
RE Value (MSA)					.055***		
					(.0052)		
RE Value (MSA Office Prices)						.063***	.065***
						(.0066)	(.0072)
State Residential Prices	-.1*	-.9**	-.51	-.43			
	(.061)	(.37)	(.34)	(.33)			
MSA Residential Prices					-.68**		
					(.33)		
MSA Office Prices						.67	.094
						(.67)	(.59)
Cash			.016***	.016***	.016***	.015***	.015***
			(.0028)	(.0028)	(.0028)	(.0029)	(.0029)
Market/Book			.062***	.063***	.062***	.065***	.064***
			(.0034)	(.0033)	(.0035)	(.0039)	(.004)
Initial Controls × State Residential Prices	No	Yes	Yes	Yes	No	No	No
Initial Controls × MSA Residential Prices	No	No	No	No	Yes	No	No
Initial Controls × MSA Office Prices	No	No	No	No	No	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	27,672	27,438	24,480	24,480	22,771	18,062	17,844
Adj. R^2	.35	.37	.4	.4	.4	.41	.41

Notes: This table reports the empirical link between the value of real estate assets and investment. The dependent variable is capital expenditure (item # 128 normalized by lagged item #8). Column (1), (2), (3) and (4) use the state-level residential price index. Column (4) uses MSA-level residential prices, while Column (5),(6) and (7) use MSA-level office prices. Except for column (1), all regressions control for firm-level initial characteristics (5 quintiles of Age, Asset, Leverage and ROA as well as initial 2-digit industry and state of location) interacted with Real Estate Prices. All regressions, except Column (1) and (2) control for Cash, previous year Market/Book. Column (5) presents IV estimates where MSA office prices are instrumented using the interaction of real mortgage rate interacted with the local elasticity of land supply taken from Saez (2009) (See Table 4 for the first stage regressions). All specifications use year and firm fixed effect and cluster observations at the state-year level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 4: First-Stage Regression: the Impact of Local Housing Supply Elasticity on Housing Prices

	MSA Residential Prices		MSA Office Prices	
	(1)	(2)	(3)	(4)
Local Housing Supply Elasticity×Mortgage Rate	.028***		.036***	
	(.0044)		(.0072)	
First Quartile of Elasticity×Mortgage Rate		-.064***		-.066***
		(.0071)		(.013)
Second Quartile of Elasticity×Mortgage Rate		-.046***		-.033**
		(.0077)		(.016)
Third Quartile of Elasticity×Mortgage Rate		-.014**		-.0097
		(.0067)		(.023)
Year Dummies	Yes	Yes	Yes	Yes
MSA Fixed Effect	Yes	Yes	Yes	Yes
Observations	1,358	1,358	804	804
Adj R^2	.94	.94	.84	.84

Notes: This table investigates how local housing supply elasticity, as defined by Saez (2009), affects real estate prices. The dependent variable is the real estate price index, defined at the MSA level – Column (1) and (2) – and the MSA office price index – Column (3) and (4). Column (1) and (3) use directly the local housing supply elasticity, while Column (2) and (4) use quartiles of the elasticity. All regressions control for year as well as MSA fixed effects and cluster observations at the MSA level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 5: Real Estate Prices and Investment Behavior: Robustness – Different Sub-periods

	Capital Expenditure					
	State-level Prices		MSA-level Prices		Office Prices	
	Before 1999	After 2000	Before 1999	After 2000	Before 1999	After 2000
RE Value	.084***	.066***				
	(.011)	(.0094)				
RE Value (MSA)			.086***	.065***		
			(.012)	(.0099)		
RE Value (MSA Office Prices)					.083***	.085***
					(.013)	(.013)
State Residential Prices	-2.9***	-1.2*				
	(.94)	(.66)				
MSA Residential Prices			-3.4***	-1.2**		
			(1.1)	(.63)		
MSA Office Prices					-.76	.26
		(.96)	(.83)			
Cash	.017***	.015***	.016***	.015***	.016***	.013**
	(.0042)	(.0049)	(.0041)	(.005)	(.0044)	(.0056)
Market/Book	.069***	.049***	.069***	.05***	.072***	.051***
	(.0043)	(.005)	(.0043)	(.0051)	(.0048)	(.0061)
Initial Controls × RE Prices	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,049	9,431	14,130	8,641	11,597	6,465
Adj. R^2	.48	.45	.48	.45	.48	.46

Notes: This table tests the robustness of the link between the value of real estate assets and investment by reporting regression results for two sub-periods: 1993-1999 (Column (1), Column (3), Column (5)) and 2000-2007 (Column (2), Column (4), Column (6)). The dependent variable is capital expenditure (item # 128 normalized by lagged item #8). Column (1) and (2) defines the value of real estate assets using state-level residential prices. Column (3) and (4) use MSA-level residential prices, while Column (5) and (6) use MSA-level office prices. All specifications use year and firm fixed effect and cluster observations at the state-year level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 6: Real Estate Prices and Investment Behavior: "Constrained" vs. "Unconstrained" Firms

	Capital Expenditure					
	Payout Policy		Firm Size		Bond Ratings	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
RE Value (MSA Office Prices)	.086***	.047***	.09***	.045***	.078***	.032***
	(.012)	(.011)	(.016)	(.0092)	(.011)	(.0084)
MSA Office Prices	-.47	.17	-6.9	-.59	.55	-2.3
	(2.5)	(1.15)	(9.6)	(1.1)	(.83)	(2)
Cash	.01***	.04***	.0051	.063***	.014***	.043***
	(.0037)	(.008)	(.0042)	(.012)	(.0045)	(.017)
Market/Book	.061***	.057***	.05***	.052***	.069***	.061***
	(.0049)	(.007)	(.0049)	(.007)	(.0054)	(.011)
Initial Controls × State Residential Prices	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Test "Const.=Unconst."	.02**		.05**		.01***	
Observations	9,003	6,153	5,931	4,561	10,573	3,283
Adj. R^2	.43	.6	.33	.71	.44	.67

Notes: This table differentiates the results of table 3 according to ex-ante measure of credit constraints. The dependent variable is capital expenditure (item # 128 normalized by lagged item #8). RE Value (MSA Office Prices) is the market value of real estate assets computed using MSA-level office prices normalized by lagged PPE. All regressions control for firm-level initial characteristics (5 quintiles of Age, Asset, Leverage and ROA as well as initial 2-digit industry and state of location) interacted with Real Estate Prices, as well as for Cash, previous year Market/Book and previous year Leverage. Constraint category assignments use ex ante criteria based on firm dividend payout (Column (1) and (2)), size (Column (3) and (4)) and bond ratings (Column (5) and (6)). Test "Const.=Unconst." is a t-test of equality of the RE Value coefficients between the constrained and the unconstrained firms. All specifications use year and firm fixed effect and cluster observations at the state-year level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 7: Real Estate Prices and Debt Issues

	Debt Issues	Debt Repayment	Net Debt Issues	Changes in Long-Term Debt	Changes in Current Debt
	(1)	(2)	(3)	(4)	(5)
RE Value (MSA Office Prices)	.13***	.071***	.037***	.044***	.0045*
	(.022)	(.012)	(.01)	(.008)	(.0025)
MSA Office Prices	-.38	-.99	1**	.62	.55**
	(1.9)	(1.8)	(.47)	(.79)	(.26)
Initial Controls × State Residential Prices	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	19,674	20,010	19,251	20,464	20,531
Adj. R^2	.39	.44	.22	.11	.14

Notes: This table reports the relationship between collateral value and capital structure. The dependent variable is Debt Issues (Column (1)), Debt Repayment (Column (2)), Net Debt Issues (Column (3)), Changes in Long-Term Debt (Column(4)) and Changes in Current Debt (Column (5)). RE Value (MSA Office Prices) is the market value of real estate assets computed using MSA-level office prices normalized by lagged PPE. All regressions control for firm-level initial characteristics (5 quintiles of Age, Asset, Leverage and ROA as well as initial 2-digit industry and state of location) interacted with Real Estate Prices. All specifications use year and firm fixed effect and cluster observations at the state-year level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 8: Real Estate Prices and Investment: The Case of Purchasers

	Capital Expenditure			Changes in Long-Term Debt		
	Non Purchaser	Purchaser Before the Purchase	Purchaser After the Purchase	Non Purchaser	Purchaser Before the Purchase	Purchaser After the Purchase
	(1)	(2)	(3)	(4)	(5)	(6)
MSA Office Prices	.068	-.07	.47***	.07	-.27	.29*
	(.067)	(.18)	(.15)	(.053)	(.19)	(.15)
Cash	.017***	.03***	.04***	-.006***	-.0071	.0059
	(.0027)	(.0082)	(.01)	(.0021)	(.0064)	(.01)
Market/Book	.035***	.036***	.029***	-.0072***	-.0067	-.013
	(.0036)	(.0085)	(.0094)	(.0026)	(.0067)	(.0092)
Test "Purch.=Non Purch."	.076			.14		
Test "Purch. before=Purch. after"		.03**			.02**	
Observations	17,480	2,289	2,611	17,648	2,307	2,616
Adj. R^2	.35	.4	.39	.15	.18	.17

Notes: This table looks at the investment behavior of real estate purchasers compared to non-land holding Corporations. Capital Expenditure, normalized by lagged PPE, is the dependent variable in Column (1) to (3); Changes in Long-Term Debt, normalized by lagged PPE, is the dependent variable in Column (4) to (6). Column (1) and (3) looks at the sensitivity of investment and debt issues to MSA Office Prices for firms that never own real estate assets in our sample. Column (2) and (4) looks at the same sensitivities for firms that *will* acquire real estate but *before* they acquire it. Column (3) and (6) estimates the same sensitivities for real estate purchasers but *after* they have purchased their real estate assets. Test "Purch.=Non Purch." presents the p-value from a t-test of equality of the MSA Office Prices coefficients between the non-purchasers and the purchasers *before* the purchase. Test "Purch. before=Purch. after " presents the p-value from a t-test of equality of the MSA Office Prices coefficients between the purchasers before and after the purchase. All specifications control for Cash and previous year Market to Book, use year and firm fixed effect and cluster observations at the state-year level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.

Table 9: Headquarter Ownership and the Impact of the Real Estate Bubble

	Changes in Long Term Debt				Changes in Total Assets			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Headquarter Owner × Δ(office prices)$_{2001-2006}$	.18***	.21***			.44*	.79***		
	(.069)	(.071)			(.23)	(.2)		
Δ(office prices)$_{2001-2006}$	.028	.0059			.098	-.23*		
	(.054)	(.051)			(.15)	(.12)		
Headquarter Owner × Elasticity			-.057*				-.21**	
			(.029)				(.086)	
Elasticity			.028				.088	
			(.021)				(.059)	
Headquarter Owner × First Quartile of Elasticity				.12**				.3**
				(.053)				(.14)
Headquarter Owner × Second Quartile of Elasticity				.095				.29
				(.068)				(.19)
Headquarter Owner × Third Quartile of Elasticity				.06				.11
				(.075)				(.26)
First Quartile of Elasticity				-.027				-.091
				(.042)				(.11)
Second Quartile of Elasticity				-.009				.09
				(.046)				(.12)
Third Quartile of Elasticity				.047				.0091
				(.054)				(.17)
Log(Asset$_2$001)		-.015***	-.017***	-.017***		-.22***	-.22***	-.22***
		(.0048)	(.0048)	(.0048)		(.017)	(.016)	(.016)
Observations	2,130	2,130	2,255	2,255	2,149	2,149	2,274	2,274

Notes: This table explores the impact of the real estate bubble from 2001 to 2006, depending on headquarter ownership. Column (1) to (4) use change in long term debt normalized by initial assets as a dependent variable. Column (5) to (8) use changes in assets normalized by initial assets as a dependent variable. Elasticity refers to local housing supply elasticity provided in Saez (2009). Observations are clustered at the MSA Level. *, **, and *** means statistically different from zero at 10, 5 and 1% level of significance.