The Collateral Channel:
How Real Estate Shocks affect Corporate Investment*

Job Market Paper

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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 real estate shocks 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 by (1) controlling for observable determinants of ownership and (2) looking at the investment 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. We interpret these results in the light of a dynamic model of investment under financing constraints.

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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 financial 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 dramatic 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 United States, an assessment of the relevance of this collateral channel is called for. This paper attempts to empirically uncover the microeconomic foundation of this mechanism.

We show that over the 1993-2007 period, a $1 increase in collateral value leads the representative U.S. public corporation to raise its investment by 6 cents. Since real estate represents a significant fraction of the assets of public corporations,[1] this sensitivity is quantitatively important. A drop in real estate prices by 20%, as happened in the United States between 2006 and 2008, depresses aggregate investment by 3% *because of purely financial frictions*. To get at this estimate, we use variations in local real estate prices, either at the state or 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 across 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 that of 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), we address the first source of endogeneity by instrumenting local real estate prices using the interaction of long-term interest rate with local constraints on land supply. 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.

To interpret these results, we lay out a simple dynamic model of investment under financing

[1] In 1993, the market value of real estate assets accounted, for the median (resp. average) Compustat firm, for 6% (resp. 15%) of the total market value of assets.

constraints. Along the lines of Hart and Moore (1994), financing frictions originate from firms' imperfect commitment to contractual terms. As a result, the promised actualized payments to an outside investor can never exceed the current value of collateral. Firms face convex investment costs as in Lucas (1967), Hayashi (1982) and Abel and Eberly (1994). We show that investment depends on real estate prices if and only if a firm is financially constrained. Three types of firms emerge from the analysis. First, neoclassical firms are unconstrained and simply trade off the marginal cost and benefit of investment. Their investment does not depend on the value of their collateral. Second, some firms are constrained in the short run. Their current debt capacity, and therefore their investment decisions, are directly determined by current real estate prices. More interestingly, some firms will be constrained in the long run only: Their investment along the life cycle is limited by their intertemporal debt capacity, which depends on future real estate prices. As real estate prices are persistent, an increase in current prices relaxes this intertemporal budget constraint. Because of the convex investment costs, this, in turn, triggers an increase in investment in the current period. Therefore, while these firms do not use their entire current debt capacity, their investment will react to variations in real estate prices.

Our model implies that a positive empirical sensitivity constitutes a rejection of the null hypothesis that all firms are "Neoclassical."More importantly, we show that this test remains valid even when the market to book ratio is held constant. In the presence of financing constraints, the average Q is no longer a sufficient statistic for investment, even in simple environments with a linear production function and homogenous investment costs. This result is reminiscent of that of Hennessy et al. (2007). Therefore, our research can also be viewed as a contribution to the extensive debate on the existence of credit constraints among large public corporations. This debate, initiated by Fazzari et al. (1988) and fueled since by many contributions (e.g., Blanchard et al. ,1994, Lamont,1997, Kaplan and Zingales, 1997, Rauh, 2006, and Hennessy and Whited, 2007), has essentially focused on investment to cash flow sensitivities.[2] Yet cash is only one among many sources of liquidity firms can use to increase their financing capacity. By exploring the value of collateral as a source of additional liquidity, we shed a complementary light on this debate.

As in Kaplan and Zingales (1997), our model does not predict a monotonic relation between the sensitivity of investment to collateral value and the extent of credit constraints. We rely on the data to determine the direction of this relation. We find that the investment of firms that are more likely to be credit constrained (i.e., larger firms, firms issuing dividends, and firms with a rating on their bond) is twice as sensitive to the value of their collateral. We also show, using data on French business groups, that affiliation to a group partly insulates firms from shocks to their collateral value.

Finally, our model is also helpful in understanding the underlying motives behind the decision to buy a property. We show that firms that face stronger financial frictions have greater incentives to rent their real estate. Because they lack commitment, firms that are more credit constrained find it more difficult to extract future liquidity from collateral value. Hence, from a liquidity perspective, an additional dollar of cash is more valuable to these firms than an additional dollar of collateral.

[2]Other related literature has recently debated how cash management policies could be interpreted in terms of credit constraints (see, e.g., Almeida et al., 2004, and Riddick and Whited, forthcoming).

Our paper is related to the recent emerging literature on collateral and investment. In an important contribution, Gan (2007 (a)) 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. She also highlights that business group affiliation insulates firms from the impact of the bubble, a result similar to ours. 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 such as in the United States. 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. We use a large U.S. sample over a long period, covering mostly "normal" market conditions. Third, her identification assumption is that, except for liquidity reason, land-holding firms were not differentially affected by the bust of the bubble than 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 rate 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.[3] Yet another important contribution is that of Peek and Rosengreen (2000), 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.[4]

Finally, 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 pledgeable (or more "redeployable") assets are financed with loans of longer maturities and durations. Benmelech and Bergman (2008) document 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.[5]

The remainder of this paper is organized as follows. Section 2 develops a simple dynamic model of investment under financing constraints. Section 3 presents the construction of the data and summary statistics. Section 4 describes our main empirical results on investment. Section 5 presents evidence on capital structure decisions. Section 6 briefly presents results on the French sample. Section 7 presents our conclusions.

[3]Another contribution delving into collateral shocks triggered by the Japanese crisis can be found in Goyal and Yamada (2001).

[4]Gan (2007 (b)) also uses the Japanese crisis as a shock to bank health and identifies the importance of a bank's health in its clients' investment.

[5]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 A Model of Investment Under Collateral Constraints

We develop a simple dynamic model of investment in the presence of financing frictions. We derive three main predictions. First, investment is positively affected by the value of a firm's collateral if and only if the firm is financially constrained. In particular, the mere expectation of future binding constraints makes current investment sensitive to real estate prices. Second, we show that, even after controlling for the average Q (i.e., the market value of a firm), the sensitivity of investment to collateral value remains a valid test for the existence of credit constraints. Finally, we show that firms facing stronger financial frictions have greater incentives to lease their real estate.

2.1 Model Setup

The model has three dates: 0, 1, and 2. The discount factor is $r \geq 0$. At time 0, the risk-neutral firm is an ongoing concern with cash flow from current operations c_0 and capital k_0. At dates 0 and 1, the firm has the option to invest in a long-term project that yields gross profit $\pi(k_t, \theta)$ in period $t \in \{1, 2\}$ if the firm has capital k_t and productivity $\theta \in [\underline{\theta}, \bar{\theta}]$. The production function π has the standard properties, that is, it is twice differentiable, increasing with k and θ, weakly concave with k and θ, and such that $\pi_{k\theta} \geq 0$. After date 2, the project stops yielding profit so that it is liquidated (see later for the definition of the liquidation proceeds). That the project has a finite horizon is by no mean necessary to our analysis, but it helps simplify the exposition.

The firm has the opportunity to invest and increase its stock of capital at both dates 0 and 1. Installing capital, however, is costly: To increase the existing stock of capital k to $k + i$, the firm needs to invest $i + G(i, k)$, where $G(,)$ is twice differentiable, increasing in i, decreasing in k, convex, and such that $G_{ik} \leq 0$. The convexity of the adjustment costs is an essential ingredient of our analysis. It is standard in the investment literature since, at least, Lucas (1967). That the adjustment costs depend on the current stock of capital is not necessary but is also standard in the investment literature and helps us compare our model to neoclassical benchmarks such as Hayashi (1982) and Abel and Eberly (1994). Finally, to operate, the project also needs an additional input (e.g., real estate) in quantity R. We assume in this section that the firm is initially endowed with this asset; the discussion on the decision to acquire or rent it is deferred to Section 2.4.

Investment may require additional external funding if the initial cash flow c_0 and the interim cash flow $\pi(k_1, \theta)$ are insufficient to cover the investment costs. To obtain these funds, the firm contracts with a deep-pocket, risk-neutral outside investor. A financing contract specifies transfers $(b_t)_{t\in\{0,1,2\}} \in \mathbb{R}^3$ from the firm to the investor. We introduced financing frictions along the lines of Hart and Moore (1994). The contract is imperfectly enforced: At each date, the firm can renegotiate a fraction $\frac{1}{\psi} \in]0, 1[$ of its outstanding liabilities, where $\frac{1}{\psi}$ is a reduced form parameter that captures the lack of commitment by the firm and, hence, the degree of financial frictions it faces. The firm is assumed to have the entire bargaining power in the renegotiation process. Hence, outside financing is possible only if the firm can transfer control over its assets in case of renegotiation. Importantly, we assume that such an ex post transfer of control rights is possible but that the firm's owner is an essential input in the production function. Thus, the investor's outside option during renegotiation corresponds to the resale value of the assets.

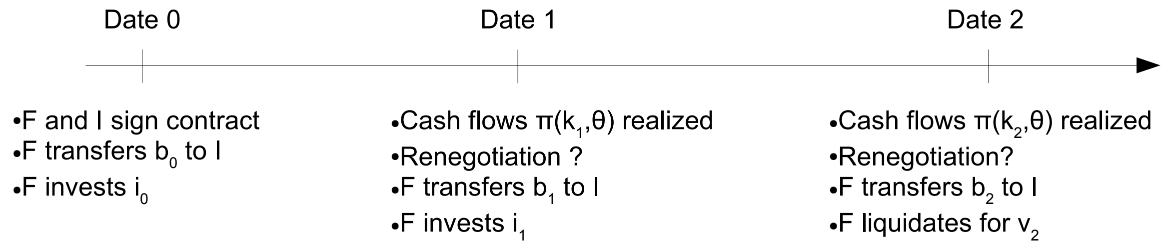

Figure 1: Sequence of Events

To focus the analysis on the non-intensive asset (i.e., real estate), the market value of used capital is set to 0. The unit market value of real estate is $(p_t)_{t\in\{0,1,2\}}$. It is deterministic and persistent: $\frac{\partial p_2}{\partial p_0} = \frac{\partial p_1}{\partial p_0} = 1$.[6] We note $(\nu_t)_{t\in\{0,1,2\}}$, the market value of the firm's collateral, where $\nu_t = p_t \times R$. To prevent renegotiation, the contract must prevent the present value of transfers to the outside investor to be larger than the current value of collateral. We assume that the firm offers the contract to the investor, which has an outside option $B_0 \geq 0$. The sequence of events is summarized in Figure 1. Note that the liquidation value of the firm is ν_2, since capital k has no outside value. We also assume that ex ante and interim liquidations are never efficient. This is the case if, for instance, $(1+r)\pi(k_0,\theta) \geq \nu_t$ for $t = 0, 1$.

The nature of the financial friction, here imperfect enforcement of contract, is not essential to our argument. What matters is that there is an upper bound on the amount the firm can borrow and that this upper bound increases with collateral value. This is a natural feature of most models of financing constraints, such as those of Townsend (1979) and Holmstrom and Tirole (1998).

2.2 Investment and Collateral

We focus on renegotiation-proof contracts. As we show in Appendix A.1, the optimal contract satisfies the following program:

$$\left|\begin{array}{ll} \max\limits_{(i_0,i_1,b_0,b_1)} c_0 - G(i_0,k_0) + \dfrac{\pi(k_1,\theta) - G(i_1,k_1)}{1+r} + \dfrac{\pi(k_2,\theta)+\nu_2}{(1+r)^2} & \\ (1+r)(B_0 - b_0) \leq \psi\nu_1 & (\lambda_1) \\ (1+r)^2\left(B_0 - b_0 - \dfrac{b_1}{1+r}\right) \leq \psi\nu_2 & (\lambda_2) \\ G(i_0,k_0) \leq c_0 - b_0 & (\lambda_3) \\ G(i_1,k_1) \leq \pi(k_1,\theta) - b_1 & (\lambda_4) \end{array}\right. \tag{1}$$

The optimal contract thus maximizes the project's net present value under four constraints. Constraints 1 and 2 impose that at dates 1 and 2 a fraction $\mu = \frac{1}{\psi}$ of the discounted value of total payments to the investor have to be lower than the value of collateral. If these conditions are not verified, the firm would successfully renegotiate down future transfers on the fraction of

[6]Introducing uncertainty does not modify our analysis as long as real estate prices are persistent.

the contract that can be renegotiated. The additional constraints simply state that dividends have to be positive, or, in other words, that investment costs must be covered by cash flows and transfers from the investor.

First Best

The neoclassical benchmark is reached when neither of these constraints are binding. First-best investment is given by the following first-order conditions:

$$\begin{cases} G_1\left(i_1^\star, k_1^\star\right) = \dfrac{\pi_k(k_2^\star, \theta)}{1+r} \\ G_1\left(i_0^\star, k_0\right) = \dfrac{\pi_k(k_1^\star, \theta) - G_2\left(i_1^\star, k_1^\star\right)}{1+r} + \dfrac{\pi(k_2, \theta)}{(1+r)^2} \end{cases} \tag{2}$$

These conditions simply ensure that at dates 1 and 2, the marginal cost of investment equates its marginal benefit. First best will be attained, for instance, if (1) the market for outside finance is sufficiently competitive (i.e., B_0 is low enough) (2) the firm has sufficient initial cash c_0, and (3) the firm has a sufficient commitment ability ψ. While first-best investment is unique, the first-best contract is not.

Second Best

A firm is financially constrained if its value is strictly lower than the first-best value. There are two types of constrained firms.

First, some firms are constrained as of the first period, that is, $\lambda_1 > 0$. Their investment in the first period is therefore simply given by the current financing constraint: $G(i_0, k_0) = c_0 + \frac{\psi\nu_1}{1+r} - B_0$. When second-period debt capacity is large enough (because, for instance, p_2 is large enough), their date 1 investment simply equates its marginal cost to its marginal benefit, that is, $G_1\left(i_1, k_1\right) = \frac{\pi_k(k_2,\theta)}{1+r}$. When such an investment cannot be financed, the date 1 investment is simply given by the date 1 budget constraint, that is, $G(i_1, k_1) = \pi(k_1, \theta) + \psi\frac{\nu_2-\nu_1}{1+r}$. Independently of date 1 investment, these firms invest more at date 0 when they have initially more cash c_0 or less initial liability B_0. More interestingly, an increase in collateral value at date 0 leads to an increase in their investment.

Second, some firms are constrained only in the second period, that is, their investment is determined through an *intertemporal* budget constraint and a condition equating marginal cost of investment across the two periods:

$$\begin{cases} G(i_0, k_0) + \dfrac{G(i_1, k_1)}{1+r} = c_0 + \dfrac{\pi(k_1, \theta)}{1+r} + \psi\nu_2 - B_0 \\ G_1\left(i_0, k_0\right) = \dfrac{\pi_k(k_1, \theta) - G_2\left(i_1, k_1\right) + G_1(i_1, k_1)}{1+r} \end{cases} \tag{3}$$

This is, for instance, the case of firms that expect low date 2 but high date 1 collateral value. From an observational point of view, these firms look, at date 0, "as if" they were unconstrained: They do not use their entire debt capacity although their investment is lower than the first-best investment $i_0^\star$. Yet their date 0 investment depends positively on collateral value. This is the object of our first proposition.

Proposition 2.1 *The sensitivity of investment to collateral value is strictly positive for constrained firms. Unconstrained firms' investment is unrelated to the value of their collateral.*

Proof See Appendix A.2. ∎

It is not surprising that firms constrained at date 0 react to variations in collateral value, as their investment is directly determined by the binding constraint. Less evidently, firms that only face the intertemporal budget constraint will also increase their investment following an increase in collateral value. This is because (1) real estate prices are persistent and (2) there are convex adjustment costs. An increase in collateral value at date 0 also increases collateral value at date 1 and hence relaxes the intertemporal budget constraint. Because there are convex adjustment costs, the firms prefer smoothing out this additional debt capacity across the two periods and hence increase their investment as of date 0. In other words, firms that only expect binding credit constraints *in the future* react to variations in their collateral value. This is important for the interpretation of our empirical results, as this suggests that a broad set of firms might react to variations in real estate prices as soon as they hold real estate assets on their balance sheet.

In our model, the sensitivity of investment to collateral value is not monotonic with the extent of credit constraint. A firm is said to be more credit constrained the further its value is from the first-best value. A simple way to obtain monotonic variations in credit constraint is to increase the commitment ability parameter ψ. Note $V(c_0, k_0, B_0, \nu_0, \theta, \psi)$, the date 0 value of the firm. We know that $\frac{\partial V}{\partial \psi} = \lambda_1 \nu_1 + \lambda_2 \nu_2$ so that V_ψ is strictly increasing as soon as the firm is constrained. Therefore, as ψ decreases, the firm becomes more credit constrained. Yet the evolution of the sensitivity of investment to collateral value is not necessarily higher as ψ increases. On the one hand, a lower ψ leads to a lower investment i_0 so that the marginal cost of investment is also lower: this implies that the firm will react with a larger increase of investment for a given increase in collateral value. On the other hand, as ψ decreases, the firm can extract a lower debt capacity from its collateral, so that the firm will become less sensitive to variations in collateral value. Which of these effects dominate depends on the convexity of the cost function and on the level of date 0 investment. This result is reminiscent of that in Kaplan and Zingales (1997), who proved that even in a simple static model of investment with costly financing, investment to *cash flow* sensitivities are not monotonic with financing costs.[7]

[7] Note, however, that in some simple cases, there is such a monotonic relation between credit constraints and the sensitivity of investment to collateral value. A firm is also more credit constrained when its investor has a higher outside option B_0, as $V_{B_0} = -\lambda_3$ is strictly negative as soon as the firm is constrained. Consider a firm that is constrained at date 0. An increase in B_0 decreases investment at date 0 and hence the marginal cost of investment at date 0. An increase in collateral value will thus unambiguously lead to a higher increase in investment for higher values of B_0. Formally, $\frac{\partial^2 i_0}{\partial \nu_0 \partial B_0} = -\frac{G_1 1(i_0,k_0)}{G_1(i_0,k_0)} \frac{\partial i_0}{\partial \nu_0} \frac{\partial i_0}{\partial B_0} > 0$. Unfortunately, for firms that are only constrained at date 1, this result no longer holds. While the sensitivity of overall investment $i_0 + i_1$ to collateral value remains higher for higher B_0, the sensitivity of the initial investment, i_0, depends on how higher levels of the investor's outside option B_0 affects the distribution of investment across the two periods and cannot be signed unambiguously.

2.3 Investment Equations

A structural estimation of the parameters of interest of the model (ψ, the concavity of the production function, the convexity of the cost function, etc.) is beyond the scope of this paper. In the reduced-form approach we adopt in the empirical part of this paper, we are more modestly interested in finding an unbiased estimate of the sensitivity of investment to collateral value for the representative firm in our sample. This is already interesting, since(1) a positive estimate constitutes a rejection of the null hypothesis that all firms are unconstrained and (2) it provides a simple way to quantify the average effect of shocks on asset values on aggregate investment, as in Bernanke and Gertler (1989). Of course, this estimate itself depends on the structural parameters of the model but, as we saw in the previous section, the relation between these parameters and the sensitivity of investment to collateral value is not straightforward.

A simple way to think of our reduced-form approach is to consider a linear approximation of the policy function i_0, solution to program 1, around a firm with the median characteristics:

$$i_0 = h(c_0, k_0, B_0, \nu_0, \theta) \approx \gamma + \frac{\partial h}{\partial c_0}(\bar{x})c_0 + \frac{\partial h}{\partial k_0}(\bar{x})k_0 + \frac{\partial h}{\partial B_0}(\bar{x})B_0 + \frac{\partial h}{\partial \nu_0}(\bar{x})\nu_0 + \frac{\partial h}{\partial \theta}(\bar{x})\theta \quad (4)$$

where $\bar{x} = \left(\bar{c_0}, \bar{k_0}, \bar{B_0}, \bar{\nu_0}, \bar{\theta}\right)$ represents the state variables at their median level and γ is a constant.[8]

A potential pitfall in the previous regression is that θ, the firm's future productivity, is not observable. Any correlation between this productivity and the initial value of collateral, ν_0, will thus lead to a biased estimate. Such a correlation can arise either from a correlation (1) between real estate prices and productivity shocks or (2) between productivity shocks and the decision to own real estate. In our empirical work, we will deal with (1) by instrumenting real estate prices. Next, in Section 2.4, we first argue that in the absence of the correlation in (1), firms facing stronger financial frictions have more incentive to lease their properties. Furthermore, we show that a larger correlation between real estate prices and investment opportunities does not necessarily provide firms with greater incentive to buy their real estate assets.

Another, traditional solution in the investment literature is to complete the set of observable state variables by controlling for the initial value of the firm V. This amounts to swapping the state variables x for a new set of state variables $y = (c_0, k_0, B_0, \nu_0, V^0)$ and leads us to the estimation of the following linear approximation:

$$i_0 = j(c_0, k_0, B_0, \nu_0, V^0) \approx \rho + \frac{\partial j}{\partial c_0}(\bar{y})c_0 + \frac{\partial j}{\partial k_0}(\bar{y})k_0 + \frac{\partial j}{\partial B_0}(\bar{y})B_0 + \frac{\partial j}{\partial \nu_0}(\bar{y})\nu_0 + \frac{\partial j}{\partial V^0}(\bar{y})V^0, \quad (5)$$

where $\bar{y}$ represents the median vector of state variables and ρ is the new constant.

In our simple model where only one state variable, θ, is unobservable, the estimation of Equation 5 is clearly unbiased. Controlling for V^0, however, is not innocuous, as V is not only a function of θ but also a function of the remaining state variables. Our next proposition discusses the interpretation of this alternative regression.

[8] γ is given by $i_0(\bar{x}) - \sum_{y \in c_0, k_0, B_0, \nu_0, \theta} \frac{\partial h}{\partial y}\bar{y}$.

Proposition 2.2 *Controlling for the value of the firm provides a lower bound on the true sensitivity of investment to collateral value:* $\frac{\partial h}{\partial \nu_0} \geq \frac{\partial j}{\partial \nu_0}$.

The conditional sensitivity of investment to collateral value is (1) strictly negative for unconstrained firms, (2) strictly positive for firms constrained at date 0, and (3) of ambiguous sign for firms constrained at date 1.

Proof See Appendix A.3. ∎

The intuition behind the first part of Proposition 2.2 is the following. Consider two firms, firm 1 and firm 2, with the same market value. Assume firm 1 has a higher collateral value than firm 2. This implies that firm 1 has a lower productivity than firm 2. Because date 0 investment is increasing with productivity, the apparent difference in investment between these two firms will be lower than if they had the same productivity.

An unconstrained firm's investment does not react to collateral value. When collateral value rises, however, even the unconstrained firm's value increases, as its final liquidation value is higher. If firm value V^0 is to stay constant, productivity and hence investment must decrease. Therefore, for Neoclassical firms, there is a negative correlation between investment and collateral value once V^0 is controlled for.

Consider now the case of a date 0 constrained firm. Because investment at date 0 is given by the binding budget constraint, it is independent of productivity θ.[9] However, its value is increasing with productivity θ. Thus, to leave unchanged the value V^0, productivity will decrease but that will not affect date 0 investment. Therefore, for the date 0 constrained firm, the conditional sensitivity is equal to the unconditional sensitivity, which is strictly positive.

Finally, consider the case of a date 1 constrained firm with a \$1 increase in collateral value. For its value to remain constant, its productivity needs to strictly decrease. The extent of this decrease depends on the marginal benefit of productivity, π_θ. Furthermore, we know that for this firm date 0 investment is strictly increasing with productivity, as an increase in productivity raises the date 1 marginal product of capital. Hence the downward adjustment in productivity necessary to keep the value constant after an increase in collateral value leads to a strict decrease in date 0 investment. The extent of this decrease in date 0 investment depends on how productivity impacts date 0 investment, which depends on the convexity of the investment cost function and on how productivity affects the marginal benefit of capital. Whether the overall adjustment leads to a strict decrease in date 0 investment is ambiguous and depends on the model's parameters.

Proposition 2.2 is important for the interpretation of our empirical results. When we control for the market to book ratio, that is, for initial firm value V^0, the estimation is a priori unbiased. The estimation of the sensitivity, however, corresponds to a lower bound of the true, unconditional elasticity. Moreover, a positive, significant, conditional sensitivity can be interpreted as

[9] One might worry that this particular result is driven by the assumption that date 0 cash flow c_0 is independent of productivity θ. This is not the case. If $c_0 = \pi(k_0, \theta)$ instead, then it is still the case that the conditional sensitivity for the date 0 constrained firm is strictly positive. This is because in order to have a constant value V^0, it takes less than a $\$\frac{1}{k_0}$ decrease in productivity to compensate a \$1 increase in collateral value, while a $\$\frac{1}{k_0}$ decrease in productivity has the same impact on investment as a \$1 increase in collateral value.

a rejection of the hypothesis that all firms are unconstrained in our sample. This is because the sensitivity of unconstrained firms is always strictly negative whereas it is strictly positive for date 0 constrained firms.

2.4 Ownership Decision

Controlling for the firm's value in the investment Equation 4 might not be always the ultimate answer to endogeneity issues. While our simple model entails a unique source of unobserved heterogeneity, productivity, a more complex model with multiple unobservable variables would make this strategy less efficient. In this section, we try to understand the predictions of our model on the nature of the endogeneity that might plague the estimation of Equation 4. Remember that there are two potential sources of correlation between productivity shocks and collateral value: (1) Real estate prices can be correlated with productivity shocks and (2) ownership decision might be driven by productivity. We deal with the first source of correlation empirically, by instrumenting local real estate prices. We now ask whether there are theoretical reasons to worry about the second source of correlation.

Assume the firm can decide, just before date 0, either to buy the real estate at a price ν_0 or to rent it at a fee (f_0, f_1, f_2). We assume that there is perfect competition among renters, so that $F = \sum_{t=0}^{2} f_t = \nu_0 - \frac{\nu_2}{1+r}$. The decision to buy also entails an upfront decision to take on additional debt or to spend some existing cash to finance the acquisition of the asset. We first remark that firms without sufficient initial financial capacity cannot acquire the asset: If $c_0 < B_0$, that is, if the firm's initial cash position is low or if the investor has a strong outside option, the firm will not be able to find the liquidity to pay the upfront price ν_0. Buying the asset would require an initial transfer from the investor at least equal to $\nu_0 - c_0 > \nu_0 - B_0$, which would raise the firm's liability to the investor above B_0 and would trigger immediate renegotiation of the contract.

Consider now a firm with $c_0 > B_0$. This firm is indifferent between using cash or debt to acquire the asset, since $V^0_{B_0} + 1 = V^0_{c_0}$. To simplify the analysis, but without loss of generality, assume that $c_0 > \nu_0$ and that the firm uses only cash to finance the acquisition. To make the analysis starker, we assume that (1) without collateral ν_0 the first-best investments cannot be financed and (2) with collateral ν_0 first-best investments can be sustained if and only if $\psi \geq \psi^\star > (1+r)^2$.[10] We now deliver our final proposition, which relates the ownership decision to the value of the commitment parameter ψ.

Proposition 2.3 *There exists a threshold $\bar{\psi} \in [1+r, (1+r)^2]$ such that the firm strictly prefers buying the real estate asset if and only if $\psi > \bar{\psi}$.*

Proof See Appendix A.4. ∎

The key element in the analysis of Proposition 2.3 is that the net present value of buying is similar to that of renting, *except* for future liquidity motives. Because we have assumed that without collateral, firms are credit constrained, this liquidity rationale is relevant in the decision to buy versus lease the asset. Firms that decide to purchase the asset trade off a lower cash

[10] The alternative cases deliver similar intuitions and are therefore left for Appendix A.4.

position in exchange for a stronger collateral value. Consider first the case where $\psi < 1 + r$. A dollar of date 0 cash brings $(1+r)$ and $(1+r)^2$ dollars of liquidity at dates 1 and 2, respectively. A dollar of date 0 additional collateral yields only $\psi < 1 + r < (1 + r)^2$ dollars of additional liquidity at dates 1 and 2. Thus, such a firm should always be better off not buying the asset at date 0. Similarly, consider a firm with $\psi > (1 + r)^2$. Now, the benefit of an additional dollar of collateral in terms of future liquidity is always larger than that of an additional dollar of debt, as the firm can extract an important amount of liquidity from its real estate. Finally, we can prove that if a firm prefers not buying the asset, then a similar firm with a lower commitment ability ψ cannot strictly prefer buying the asset: This is because both firms have the same value without collateral and, when they do own real estate, the firm with the higher commitment ability should always have a larger value.

Although Proposition 2.3 is important for understanding the selection process at work in our data, it unfortunately does not provide us with an unambiguous interpretation of the potential selection bias. This proposition asserts that firms with a lower commitment ability, and therefore more credit constrained firms (as $V_\psi \geq 0$), are more likely to own than rent their properties. We already noticed, however, in Section 2.2 that the sensitivity of investment to collateral value is not necessarily monotonic with the commitment ability ψ. On the one hand, firms with larger ψ invest more and hence their investment react less to a given appreciation of collateral value ; on the other hand, firms with larger ψ are able to extract more liquidity from an increase in real estate prices. We interpret this result as a sign that, in our simple framework, there is no reason to expect a priori a selection bias of a given sign.

The discussion in this section assumes that we are working in our standard framework with no correlation between real estate prices and investment opportunities. At first glance, one might worry that firms with a high correlation between real estate prices and investment opportunities might have more incentive to buy their real estate assets, since these become better hedges for future financing constraint risks. This would be the case if $V_{\theta\psi}$ would unambiguously be positive, that is, if higher productivity would make the marginal value of collateral greater or, in other words, if firms would be more constrained with an increase in productivity. This is, however, not always the case. Here again, two opposing effects are at play: On the one hand, a higher productivity raises the marginal value of capital and hence first-best investment; on the other hand, a higher productivity increases interim cash flows and hence might decrease the intertemporal budget constraint, in particular when the initial capital k_0 is large enough. This implies that $V_{\nu\theta}$ cannot be signed in general. Hence, it is not generally true that real estate is necessarily a good hedge for firms whose productivity shocks are correlated with real estate prices. This implies that there is no way to predict a systematic selection bias in the decision to own versus lease real estate assets, even when real estate prices are correlated with investment opportunities.

3 Data

This section describes the data analyzed in this paper. We use accounting data on U.S. listed firms merged with real estate prices at the state and Metropolitan Statistical Area (MSA) level.

3.1 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 3 consecutive years in the sample. This leaves us with a sample of 5,121 firms and 51,467 firm-year observations.

3.1.1 Real Estate Assets

We collect data on the value of the real estate assets of each firm. After measuring the initial market value of real estate assets of each firm, we identify variations in their value 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 equipment 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)[11] measures the proportion of the original value of a building claimed as depreciation. Based on a depreciable life of 40 years,[12] 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.[13] 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 construct a measure of the market value of real estate assets and 28,014 corresponding firm-year observations.

Second, to accurately measure 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. The data, however, report 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

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

[12] 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.

[13] In 1994, 10 of the 15 schedules required for Electronic Data Gathering, Analysis and Retrieval (EDGAR) system filings were eliminated. In particular, the accumulated depreciation on buildings is no longer reported.

represent an important fraction of corporation real estate assets. We discuss the relevance of this choice in Section 3.3.

3.1.2 Other Accounting Data

Aside from data on real estate, we use other accounting variables and construct ratios as is typically done in the corporate finance literature. We compute investment rate as the ratio of capital expenditures (Compustat item #128) to the past year's property, plant, equipment (PPE, item #8).[14] 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 the end-of-year close price of common shares (item #24). To this, we add the book value of debt and quasi-equity, computed as the 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 the book value of assets (item #6). We also use the ratio of cash flows (item #18 plus item #14) to the 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 issue 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.

In most of the regression analysis, we use the initial characteristics of firms to control for the potential heterogeneity among our 2,750 firms. These controls are based on return on assets (operating income before depreciation, item #13, minus depreciation, item #14) divided by total assets (item #6)), total assets (item #6), age measured as the number of years since IPO, leverage, two-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.[15] Table 1 provides summary statistics on most of the accounting variables used in this 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). This is because (1) these variables are normalized by lagged PPE, which is notably smaller than the total asset, and (2) these variables are left censored so that they are naturally right skewed, so that our windsorizing methodology still leaves an important mass on the right tail of these distributions.

[14] This normalization by PPE is standard in the investment literature (see, e.g., Kaplan and Zingales, 1997, and Almeida et al., 2007). It typically provides 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 delivers notably lower ratios. Our results are robust to this alternative normalization choice.

[15] Windsorizing at the 1st percentile or trimming the variables at the 5th or 1st percentile does not significantly change our results.

3.1.3 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 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.

3.2 Real Estate Data

3.2.1 Real Estate Prices

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

Residential real estate prices come from the Office of Federal Housing Enterprise Oversight.[16,17] The OFHEO provides a Home Price Index (HPI), which is a broad measure of the movement of single-family home prices in the United States.[18] Because of the breadth of the sample, it provides more 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.[19] This index is only available for a

[16] `http://www.ofheo.gov/index.asp.`

[17] The OFHEO 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)."

[18] 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.

[19] We use the offices index in our analysis but the main results are left unchanged if we use the industrial index instead.

subset of 64 MSAs in the United States 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 two residential indices is .86.

3.2.2 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 various local constraints on land supply.

Geographical restrictions on land supply are provided by data from Rose (1989).[20] Rose's index of land supply ranges from 1 in Atlanta and Phoenix (areas without water) to .521 in San Francisco and .561 in Chicago.[21]

As recently argued by Glaeser et al. (2005) and Green et al. (2005), regulation also plays a key role in restricting the construction of new homes and therefore in limiting the expansion of land supply. Regulation can affect the return to new homes and the willingness of investors to build them, through, for instance, rent control (as in New York City, Boston, and Los Angeles). Regulation issued at the state or city level can directly impede the construction of new homes. At the state level, regulation usually takes the form of environmental regulation (to protect the coast, to preserve wetlands) or planning. At the city level, the key restriction is zoning (land devoted to commercial real estate, to single family homes, to multiple family homes, etc.), as well as the ability for a household or a real estate developer to rezone a given residential subdivision and obtain a building permit. We use measures of rent control (at the city level) and state-level regulation from Malpezzi (1996). These measures are available for the 56 largest MSAs in the United States and have been shown to be strongly correlated with measures of land supply elasticities by Green et al. (2005). Accounting forstate regulation, the ordering of MSAs changes somewhat, but the correlation between these indices remains very high.

As a measure of long-term interest rates, we use the contract rate on 30-years, fixed-rate conventional home mortgage commitments from the Federal Reserve website, between 1993 and 2007.

3.3 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.

[20]Rose computes, for the 40 most populated U.S. MSAs, measures of the availability of land for urban use. He takes the sum of weighted annular areas, except water, around the city center. The weights decrease exponentially to 0 at a rate determined by population density. These measures are then normalized by the hypothetical value they would take in the absence of water.

[21]In the regression analysis that follows, we use 1 minus the Rose measure instead of the Rose measure so that, like the other regulation measures we use, it increases with land restrictions.

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. To check the validity of this approximation, we hand-collected the 10K forms filed with the Security and Exchange Commission (SEC) 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 (`http://www.sec.gov/edgar.shtml`). Among these 375 firms, 179 firms report real estate ownership both in Compustat and in their 10K file. A total of 80% of these 179 firms (i.e., 139 firms) report in their 10K file a major property in the state where their headquarters are 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 headquarters' 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 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. Thus, the extent of measurement errors from using balance sheet data to assess firms' real estate holdings seems limited. In Additional Table 9, we re-run our main specification on this small subsample of firms for which we hand-collected the 10K information and compare the results to those using the Compustat information. We find no significant difference.

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 is high, from .42 (at the MSA level) to .57 (at the state level), but not perfect. We run our main regressions using the various indices and find, if anything, that the point estimates are always slightly larger when using commercial real estate prices, which seems to indicate that using residential prices only adds exogenous noise to the regression. The low coverage of the commercial data, however, leads us to prefer specification using the residential state-level price index.

4 Real Estate Prices and Investment

In this section we analyze the impact of real estate shocks on corporate investment. Our goal is twofold. First, we test the predictions of our model of investment under financing constraints. We reject the null hypothesis that firms do not face financing constraints. Second, we evaluate empirically the magnitude of those financing constraints; in particular, we are able to assess the extent of the financial multiplier (i.e., by how much an increase in assets' value increases investment) at the firm level.

4.1 Empirical Strategy

We run different specifications of Equation 4. Specifically, for firm i, at date t, with headquarters located in state s, investment is given by

$$INV_{it}^{s} = \alpha_i + \delta_t + \beta.RE\ Value_i \times \frac{P_t^s}{P_{93}^s} + \gamma \frac{P_t^s}{P_{93}^s} + controls_{it} + \epsilon_{it}, \tag{6}$$

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. Following the guidance of our model, and as is typically done in the reduced-form investment literature, we control for the ratio of cash flows to PPE, the 1-year lagged market to book value of assets, and the lagged leverage. Our model predicts that the reduced form coefficient $\hat{\beta}$ should be larger in the absence of a control for the market value of the firm but should still be positive, provided there is a sufficient fraction of constrained firms in the sample. We also include a firm fixed effect α_i, as well as year fixed effects δ_t, designed to capture aggregate specific investment shocks, that is, 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 et al., 2004).

As noted in Section 3.1.1, the market value of the entire real estate portfolio of a firm can only be estimated before 1993, which is the last year for which accumulated depreciations on buildings are available. Here $RE\ Value_i$ is thus defined as the initial market value of a firm's real estate assets and $RE\ Value_i \times \frac{P_t^s}{P_{93}^s}$ measures 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

As noted in our theoretical Section 2, there are two potential sources of endogeneity in the estimation of Equation 6: (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 overestimate 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 3.2.2, and following Himmelberg et al. (2005), we do so by interacting measures of local constraints on land supply 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 MSAs where land supply is more constrained, a drop in interest rate should have a larger impact on real estate prices (our first-stage regression). We thus estimate, for MSA m, at date t, the following equation predicting real estate prices P_t^m:

$$\frac{P_t^m}{P_0^m} = \alpha^m + \delta_t + \gamma.SupplyConstraint^m \times IR_t + u_t^m, \tag{7}$$

where $SupplyConstraint^m$ measures constraints on land supply at the MSA level and is one of the three measures introduced in Section 3.2.2, IR_t is the real aggregate 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 6 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 overestimate 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 five quintiles of age, assets, return on assets, and leverage, as well as two-digit industry dummies and state dummies. We show in Table 10 that these characteristics indeed have some predictive power on the decision to buy real estate assets and, to a lesser extent, on the amount of real estate purchased. Table 10 is a simple ordinary least squares (OLS) regression of $RE\ OWNER$, a dummy variable equal to 1 when the firm owns real estate, and $RE\ value$ on the initial characteristics mentioned above. Older, larger, and more profitable firms, that is, mature firms, are more likely to be owners in our data set.[22]

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

$$INV_{it}^s = \alpha_i + \delta_t + \beta.RE\ Value_i \times \frac{P_t^s}{P_{93}^s} + \gamma\frac{P_t^s}{P_{93}^s} + \kappa\sum_k X_k^i \times P_t^s + controls_{it} + \epsilon_{it} \tag{8}$$

Some determinants of the land-holding decisions, however, might not be observable, which makes our approach in Equation 8 insufficient. Unfortunately, it is very difficult to find firm-level instruments that predict real estate ownership. Yet we can still attempt to empirically grasp how different land-holding firms are compared to non-land-holding firms. To do so, we look in Section 4.4 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 are fixed across time, 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 4.4 explains the implementation of this test in greater detail. We insist, however, that while suggestive, this approach is by no means definitive, as the unobserved heterogeneity could well vary with times.

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

4.2 Main Results

Table 2 reports estimates of various specifications of Equations (6) and (8). Column (1) starts with the simplest estimation of Equation 6 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 .07, so that each additional $1 of collateral increases investment by 7 cents. The coefficient is significant at the 1% confidence level. The effect is economically large. A one standard deviation (s.d.) increase in $RE\ Value$ explains 25% of the 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 .06, somewhat smaller but not statistically different from .07.

Column (3) adds the additional determinants in the investment equation, that is, cash, market to book, and leverage. As predicted by our model, the reduced form sensitivity remains positive but is now smaller, equal to .043.[23] In other words, a one s.d. increase in collateral value explains a 16% 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 have a significant, positive impact on investment. Leverage, on the other hand, has, as predicted, a negative impact on investment. We also notice that the additional explanatory power brought about by these controls remains limited, however, increasing the R^2 of the regression from .39 up to .45.

Column (4) replicates the estimation performed in column (3) using the 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 greatly weakens our identifying assumption that investment opportunities are uncorrelated with variations in local prices. The estimation, however, becomes more dependent on the assumption that all the real estate assets that a firm owns are located in the headquarter's city. The results in column (4) show that the coefficient remains stable, at .043.

Column (5) implements the instrumental variable (IV) strategy where real estate prices are instrumented using the interaction of interest rates and constraint on land supply (see Section 4.1). Let us first briefly comment on the first stage regressions, which are direct estimations of Equation 7. These estimations are presented in Table 3. Each of the three columns in Table 3 considers a different measure of constraints on land supply. In column 1, we use geographical characteristics (lake or sea) preventing city expansion in one direction. This specification has slightly fewer observations, since the physical constraints variables compiled by Rose (1989) are only available for 20 cities in the United States. In column 2, we take a dummy equal to 1 in the presence of rent control for at least part of the homes. In column 3, we use city-level regulation (zoning restrictions, building permits, and infrastructure).

A high value of $SupplyConstraint^m$ corresponds to an MSA with very constrained land supply. We expect the effect of declining interest rates on prices to be stronger in an MSA

[23] 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 the other state variables.

the higher $SupplyConstraint^m$. As expected, the γ coefficient from Equation 7 is negative and significant at the 1% confidence level. For instance, using the results in column (3), a decline in interest rates of 100 basis points increases the index by 12 percentage points more in "constrained" cities (75th percentile of the supply constraint 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 7 and use them as an explanatory variable in Equation 8.[24] Column (4) reports the result of the estimation when the instrument used in the first stage is city-level regulation.[25] The coefficient estimated from this IV regression is very close to the one obtained from the OLS regression, equal to .042, although, due to data limitations, the number of observations severely drops when compared to column (4).

Column (6) uses commercial real estate prices instead of residential prices. The low number of MSAs with available commercial real estate prices strongly reduces the number of observations (6,759 observations compared to 27,672 in the first specification using state-level residential prices). The sensitivity, however, remains strongly positive and significant at the 1% level and is slightly higher than that computed using residential prices: A \$1 increase in collateral leads to an average increase of 5 cents in investment.

Finally, column (7) tests whether the relation between collateral value and investment 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 real estate) with the commercial 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. Note, however, that this 0/1 model has a lower explanatory power on investment than when we use the full information on collateral value: An increase of one s.d. in real estate prices now only explains a .1 s.d. increase in investment for land-holding firms.

A potential issue with pooled regressions such as the ones presented in Table 2 is that they might conceal a fair amount of heterogeneity in 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 8 on two different sample periods: before 1999 – see columns (1), (3), and (5) in the additional Table 11 – and after 2000 – see columns (2), (4), and (6) in the additional Table 11. 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 any particular years in our sample.

4.3 Using Ex Ante Measures of Credit Constraints

Our model does not predict unambiguously that the sensitivity of investment to collateral value is increasing with the extent of credit constraints. The estimated sensitivity, however, should

[24] Standard errors are adjusted to account for this two-step procedure.

[25] Second-stage results using the other instruments yield very close results and are available from the authors upon request.

be greater if estimated on a group of firms that are more likely to be constrained in the current period. We test this prediction using three different ex ante measures of credit constraints based on (1) dividend payments, (2) firm size, and (3) credit rating. These measures are defined in Section 3.1.3. We estimate Equation 8 separately for constrained and unconstrained firms.

As reported in Table 4, 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 three bottom deciles of the size distribution is .062, compared to .029 for the firms in the three top deciles. The difference between these two coefficients is significant at the 1% level for all three measures of credit constraints.

4.4 Are Real Estate Purchasers Different from Nonpurchasers?

In this section, we show that the sensitivity of investment to the value of real estate collateral is not caused by constant-in-time unobserved heterogeneity that would simultaneously cause real estate ownership and investment decisions. This is an important point, since such an unobserved heterogeneity would lead to a biased estimation of Equation 8. Our test consists in estimating the sensitivity of investment to real estate prices for firms that *will* purchase a property both before and after this acquisition. We find that *before* the acquisition, firms that are about to acquire real estate assets are statistically indistinguishable from firms that never own real estate. Yet these firms behave like other real estate holding firms *once* they acquire their properties.

The implementation of this idea does not rely on the market value of real estate assets but only on whether firms own some property. This allows us to work with a larger sample, as we do not rely any more on the availability of buildings depreciations. In particular, we are able to find a significant number of real estate purchasers.

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 3 consecutive years of appearance in the data. The sample period is from 1984 to 2007, 1984 being the first year in Compustat with information on real estate assets. We define a firm as a purchaser if it has initially no positive real estate assets on its balance sheet and ends up with positive real estate assets after some date.[26] We exclude from our sample firms that move several times from 0 to positive real estate assets. We end up with a sample of 999 purchasers and 8,743 purchaser-year observations, with purchase dates ranging from 1986 to 2005. The number of purchaser-year observations *before* the purchase is 4,733. The group of nonpurchasers 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 nonpurchasers.

We first estimate Equation 6 separately for nonpurchasers and for purchasers *before* the purchase of land. The results are presented in Table 5, columns (1) and (2). If anything, purchasers have, prior to acquiring real estates, a lower sensitivity of investment to real estate prices than

[26] 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.

nonpurchasers. Neither, however, of these sensitivities are significant and the difference between the two is not statistically different from 0. Hence, the data rejects the existence of a fixed-in-time unobserved heterogeneity that would simultaneously cause ownership of real estate and investment. We emphasize again, however, 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 real estate cycle.

The sample of purchasers also allows to confirm the finding in Section 4.2 by investigating the *within* dimension of the data. In order to do so, we compare the sensitivity of investment to real estate prices of firms acquiring real estate before and after they purchase the real estate asset. This is an alternative to estimating the β coefficient in Equation 6. This can be done by estimating the following equation on the sample of purchasers only:

$$INV_{it}^s = \alpha_i + \delta_t + \beta POST_{it} \times \frac{P_t^s}{P_{84}^s} + \gamma \frac{P_t^s}{P_{93}^s} + \mu POST_{it} + controls_{it} + \epsilon_{it} \quad (9)$$

where $POST_{it}$ is a dummy variable equal to 1 if the purchase occurred at least 2 years before year t. In this equation, γ represents the overall sensitivity for purchasers, μ how much more they invest after purchasing some properties, and β measures the average increase in the sensitivity of investment to real estate prices for the firm after the purchase. To eliminate the concern that the investment in real estate is causing our result, Equation 9 is estimated excluding the year of the purchase, as well as the year before and the year after.

The results are presented in column (3) of Table 5. The sensitivity of investment to real estate prices increases by a significant .47. This effect is twice as large as the comparable coefficient in column (7) of Table 2.[27]. It suggests an even stronger impact of collateral value on corporate investment.

5 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. We find that firms finance their additional investment through debt issues.

5.1 Debt Issuance

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 this to be the case. This implies that outside financing has to increase to explain the observed increase in investment. As suggested by our model, we expect that the increase in collateral value leads to more or larger issues of new debt, secured on the appreciated value of land holdings.

[27]As the estimation of Equation 9 corresponds to a specification with a *RE OWNER* dummy variable, the natural benchmark is that of column (7) in Table 2

Table 6 reports the 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, market to book, and leverage controls from Equation (8) and replace investment on the right-hand side with debt issues and debt repayments:

$$DebtIssues_{it}^{s} = \alpha_i + \delta_t^s + \beta.RE\ Value_i \times \frac{P_t^s}{P_0^s} + \varepsilon_{it}^s \tag{10}$$

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 10 should be compared with the coefficient β derived in column 2 of Table 2, that is, .06.

The results are presented in Table 6. Columns (1) and (2) look at the inflows and outflows of debt. We find that land-holding firms are more likely to both issue and repay debt when the value of their real estate increases. A $1 increase in collateral value increases debt issues by 19 cents and debt repayments by 13 cents. The difference, that is, the net debt issues, corresponds to an increase in the inflows of debt of 6 cents, approximately similar to the increase in investment. The fact that *both* repayment *and* issues increase when collateral value increases 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.

On the short-term liability side, lines of credits might be easier to obtain when secured on valuable collateral (Sufi,*forthcoming*). We observe only a small, positive, and slightly significant net increase in short term debts, however, with a coefficient of 1.3 cents per dollar. Borrowers are more likely to use longer-term liabilities to finance their additional investment.

6 Collateral Value and Investment: Evidence from France

In this final section, we present additional evidence on the link between collateral value and investment using data from a different country, France, and a different population of firms. This first change represents a strong robustness check of our U.S.-based evidence. Furthermore, the structure of the French data set allows us (1) to address one of the measurement errors present in the U.S. data set, namely, the unknown "true" location of real estate assets, and (2) to tackle the question of the functioning of internal capital markets. We report strong evidence that internal capital markets are able to partially shield firms from financing shocks.

6.1 Data

Real estate prices come from the Ministre de l'Equipement, that is, the French Ministry of Infrastructure, and provides an index of residential real estate prices at the *région*, or region, level.[28] The data cover the period 1986-2005. The firm-level data sets used for this section are based on accounting information available for all French firms, public or private, whose annual sales exceed 100,000 Euros in the service sector and 200,000 Euros in other sectors. These accounting data are extracted from the tax files used by the Ministry of Finance for corporate tax collection purposes. French firms above these thresholds are required by tax authorities to fill in a detailed balance sheet and profit statement. Individual firms can be tracked over time by the use of a unique identifier, which allows for the construction of a panel data set. For more details on this data set, see Bertrand et al. (2007). As in Compustat, this data set has information on the historic cost of buildings and land as well as on the depreciations accumulated on the buildings. We can use a method similar to that presented in Section 3.1.1 to compute the market value of real estate assets. An important difference, however, is that the common practice in French accounting is to depreciate buildings over 25 years, and not 40 as in the United States.

To avoid outliers induced by very small firms, we focus on firms with more than 50 employees and non-missing real estate data in 1990. As in the United States, we exclude firms in the finance, insurance, real estate, construction, and mining industries and require that a firm be present for at least 3 consecutive years in the sample.

A first interesting feature of the French data is that it provides information similar to that contained in the LRD sample in the United States, that is, the number, size, and location of the plants of each firm present in the sample. This allows us to address an important measurement issue we face with the U.S. data, that is, the determination of real estate assets' true location. We simply restrict the sample to firms with plants located in a unique region.

A second interesting feature of the French data relates to business groups. We know that business groups are pervasive in the French capitalist environment (see, for instance, Faccio et al., 2005). From 1990 to 2000, the data set we use contains information on whether a firm belongs to such a business group, providing us with a unique opportunity to study how internal capital markets affect the reaction of firms to financing shocks. To do so, we restrict our sample to the period where information on group membership is available. We end up with a sample of 10,176 firms, which represents 94,923 firm-year observations. Summary statistics for the main variables used in the analysis are described in Table 7. There are some important differences with the U.S. sample. First, investment is defined as yearly growth in PPE. This implies a much lower mean for investment than what one finds when using capital expenditure data such as in Compustat.[29] Moreover, the market to book ratio is not available, since the sample contains mostly private firms, for which market capitalization data are not available. Another important difference with the U.S. sample is that net debt issues are computed as the total debt in year t minus the total debt in year $t-1$, normalized by lagged PPE, and we cannot disentangle debt issues from debt repayment as in the U.S. sample.

[28] A region is a geographical unit comparable to a state in the United States. There are 26 *regions* in France.

[29] As noted earlier, this ratio was already fairly high due to the normalization by lagged PPE.

6.2 Results

We estimate different specifications of Equations (6) and (8). Columns (1), (2), and (3) of Table 8 simply replicate columns (1), (2) and (3) of Table 2 on the French sample. The main differences with the U.S. sample are (1) a different time period (1990-2000 vs. 1993-2007) and (2) a different population of firms (both private and listed firms vs. listed firms only). The sensitivity of investment to collateral for the French sample is positive, significant at the 1% level, and somewhat higher than for Compustat firms. This is not surprising, as credit constraints are likely to be more prevalent in the French sample, which contains smaller firms on average. Accounting for observable determinants of investment and observed heterogeneity in land-holding decisions, we find that a $1 increase in real estate value leads to an 11-cent increase in investment. This effect is economically large: One s.d. deviation in real estate value leads to a 19% s.d. increase in investment.

Column (4) of Table 8 replicates the regression in column (3) of Table 6: It shows that a $1 increase in collateral value leads to 10 cents of debt issues. As for the U.S. sample, this corresponds closely to the additional investment triggered by the $1 increase in collateral value. Thus, in France as in the United States, firms are able to use their appreciated real estate assets to increase their debt capacity. These results can be interpreted as strong robustness checks of our findings on the U.S. sample.

Using information on business groups, we show that internal capital markets allow firms to be partially shielded from financing shocks. There is extensive literature on the efficiency of internal capital markets (see, e.g., Scharfstein and Stein, 2000, and Rajan et al., 2000, for negative views on internal capital markets). The persistence of business groups despite evidence of a diversification discount (e.g., Lang and Stulz, 1994) remains a puzzle. Empirically, Lamont (1997) provides clean evidence that belonging to a business group allows a firm to tap internal capital markets for fundings. Stretching the findings in Lamont (1997), we should expect that firms that belong to a business group do not rely solely on their own collateral to finance additional investment. In the context of our empirical strategy, it means that the investment of firms that belong to a business group should be less sensitive to shocks to their own real estate assets than stand-alone firms.

We confirm this prediction in columns (5) and (6) of Table 8. We replicate the specification of column (3) separately for firms belonging to business groups and stand-alone firms. While the elasticity remains at 10 cents for firms in business groups, it rises to 15 cents for stand-alone firms. The difference between the two coefficients is significant at the 1% level.

7 Conclusion and Leads for Further Research

In line with the prediction of a simple model of collateral value and investment, we find in this paper that for the average listed U.S. corporation, investment is positively affected by the value of its real estate. When the value of a firm's properties appreciates by $1, its investment increases by 6 cents. This investment is financed through additional debt issues. In line with our predictions, the impact of real estate shocks on investment is stronger when estimated on a group which is more likely to be credit constrained, where financing constraints are measured using firm size, dividend payouts, and bond ratings. It is also stronger for firms that belong to industrial groups than for stand-alone firms. This suggests that internal capital markets mitigate financing constraints.

The present paper opens up many leads for further research. We develop two of them here. We provide some evidence that business groups allow firms to insulate from financing shocks. This is similar in spirit to the evidence in Lamont (1997). We still know little, however, about the interaction between the structural organization of a group and the efficiency of its internal capital market. Using such collateral value shocks and trying to follow their propagation within a business group would allow one to study the organizational determinants of well-functioning capital markets. It could help to empirically disentangle the various theories of internal capital markets.

Another avenue for future research could consist in investigating the link between collateral value and the shape of financial contracts. Should a firm with more valuable collateral use fewer or more covenants? Should it use loan contracts with longer maturity? These are fascinating questions that deserve thorough investigation.

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A Proofs

A.1 Derivation of the Optimal Contract

We can write the optimal contract as

$$\left|\begin{array}{l}\max\limits_{((b_t),(x_t),(i_t))} c_0 - G(i_0,k_0) - b_0 - x_0 + \dfrac{\pi(k_1,\theta) - G\left(i_1,k_1\right) - b_1 - x_1}{1+r} + \dfrac{\pi(k_2,\theta) + \nu_2 - b_2 - x_2}{(1+r)^2} \\ b_0 + \dfrac{b_1}{1+r} + \dfrac{b_2}{(1+r)^2} \geq B_0 \\ b_1 + \dfrac{b_2}{(1+r)} \leq \psi\nu_1 \\ b_2 \leq \psi\nu_2 \\ x_0 \geq 0 \\ x_1 + x_0(1+r) \geq 0 \\ x_2(1+r)^2 + x_1 + x_0(1+r) \geq 0 \\ G(i_0,k_0) \leq c_0 - b_0 \\ G(i_1,k_1) \leq \pi(k_1,\theta) - b_1 \end{array}\right. \tag{11}$$

It maximizes the expected net payment to the firm under the investor's participation constraint (constraint 1), two no-renegotiation constraints (constraints 2 and 3), three positive saving balance constraints (constraints 4 through 6), and two positive dividend constraints (constraints 7 and 8). The private savings are redundant with the transfers to the bank. Abusing notations, let us call $b_t = b_t + x_t$. Then, program 11 becomes

$$\left|\begin{array}{l}\max\limits_{((b_t),(i_t))} c_0 - G(i_0,k_0) - b_0 + \dfrac{\pi(k_1,\theta) - G\left(i_1,k_1\right) - b_1}{1+r} + \dfrac{\pi(k_2,\theta) + \nu_2 - b_2}{(1+r)^2} \\ b_0 + \dfrac{b_1}{1+r} + \dfrac{b_2}{(1+r)^2} \geq B_0 \\ b_1 + \dfrac{b_2}{(1+r)} \leq \psi\nu_1 \\ b_2 \leq \psi\nu_2 \\ G(i_0,k_0) \leq c_0 - b_0 \\ G(i_1,k_1) \leq \pi(k_1,\theta) - b_1 \end{array}\right. \tag{12}$$

The participation constraint is necessarily binding, so that program 12 can be transformed into

$$\left|\begin{array}{l}\max\limits_{((b_t),(i_t))} c_0 - G(i_0,k_0) + \dfrac{\pi(k_1,\theta) - G\left(i_1,k_1\right)}{1+r} + \dfrac{\pi(k_2,\theta) + \nu_2}{(1+r)^2} - B_0 \\ (1+r)\left(B_0 - b_0\right) \leq \psi\nu_1 \\ (1+r)^2\left(B_0 - b_0 - \dfrac{b_1}{1+r}\right) \leq \psi\nu_2 \\ G(i_0,k_0) \leq c_0 - b_0 \\ G(i_1,k_1) \leq \pi(k_1,\theta) - b_1 \end{array}\right. \tag{13}$$

Finally, adding the constant B_0 to the previous program yields program 1.

A.2 Proof of Proposition 2.1

Consider first a firm such that none of the constraints in program 1 are binding. Its investments satisfy the first-order condition when the four Lagrange multipliers in program 1 are zero and therefore verify system 2. Clearly, these investments $i_0^\star$ and $i_1^\star$ are independent of both ν_1 and ν_2 and hence of ν_0.

Consider now a firm such that $\lambda_1 > 0$, that is, the date 0 budget constraint is binding. Then $G(i_0, k_0) = c_0 - B_0 + \frac{\psi \nu_1}{1+r}$. Differentiating with respect to ν_0 and reminding the reader that $\frac{\partial \nu_1}{\partial \nu_0} = 1$, we have $\frac{\partial i_0}{\partial \nu_0} = \frac{\psi}{1+r} \frac{1}{G_1(i_0,k_0)} > 0$.

Finally, consider a firm such that $\lambda_1 = 0$ but $\lambda_2 > 0$. Its investments are given by the intertemporal budget constraint and the condition equating marginal costs of investment across periods as in system 3. Differentiating this system with respect to ν_0 yields the following system:

$$\begin{cases} G_1(i_1,k_1)\left(\dfrac{\partial i_0}{\partial \nu_0} + \dfrac{\partial i_1}{\partial \nu_0}\right) = \dfrac{\psi}{(1+r)^2} \\ \dfrac{\partial i_0}{\partial \nu_0} \underbrace{\left(G_{11}\left(i_0,k_0\right) - \dfrac{\pi_{kk}(k_1,\theta) - G_{22}\left(i_1,k_1\right) + G_{12}(i_1,k_1)}{1+r}\right)}_{>0} = \dfrac{\partial i_1}{\partial \nu_0} \underbrace{\dfrac{G_{11}(i_1,k_1) - G_{21}\left(i_1,k_1\right)}{1+r}}_{>0} \end{cases} \tag{14}$$

so that

$$\frac{\partial i_0}{\partial \nu_0} = \frac{\psi}{(1+r)^2} \frac{1}{G_1\left(i_0,k_0\right)} \frac{1}{1 + \frac{((1+r)G_{11}(i_0,k_0) - \pi_{kk}(k_1,\theta) + G_{22}(i_1,k_1) - G_{12}(i_1,k_1))}{G_{11}(i_1,k_1) - G_{21}(i_1,k_1)}} > 0$$

A.3 Proof of Proposition 2.2

Call $\theta\left(c_0,k_0,B_0,\nu_0,V,\psi\right)$ the function such that for all V and ν_0

$$V^0\left(c_0,k_0,B_0,\nu_0,\theta\left(c_0,k_0,B_0,\nu_0,V,\psi\right)\right) = V$$

Call x the initial vector of state variables, $x = (c_0,k_0,B_0,\nu_0,\theta,\psi)$, and y the modified vector of state variables, $y = (c_0,k_0,B_0,\nu_0,V,\psi)$. The policy function i_0 associated with program 1 is defined as a function of the initial state variable:

$$i_0 = h\left(x\right) = h\left(c_0,k_0,B_0,\nu_0,\theta(y),\psi\right) = j(y)$$

Therefore, $\frac{\partial j}{\partial \nu_0} = \frac{\partial h}{\partial \nu_0} + \frac{\partial \theta}{\partial \nu_0}\frac{\partial h}{\partial \theta}$. In other words, when two firms have the same value V^0 but different collateral values, productivity must adjust by $\frac{\partial \theta}{\partial \nu_0}$. As investments depend on productivity, this adjustment has an impact on investment decisions. Therefore, the conditional sensitivity is the "true" sensitivity, $\frac{\partial h}{\partial \nu_0}$ plus the impact on investment implied by the adjustment, $\frac{\partial \theta}{\partial \nu_0}\frac{\partial h}{\partial \theta}$.

Consider the case of an unconstrained firm. Its value depends on ν only through the final resale value, so that, using the envelope theorem, $\frac{\partial \theta}{\partial \nu} = -\frac{V_{\nu_0}}{V_\theta} = -\frac{1}{(1+r)\pi_\theta\left(k_1^\star,\theta\right) + \pi_\theta\left(k_2^\star,\theta\right)}$.

So the conditional sensitivity is therefore given by

$$\frac{\partial j}{\partial \nu_0} = \underbrace{\frac{\partial h}{\partial \nu_0}}_{=0} - \frac{1}{(1+r)\,\pi_\theta\left(k_1^\star,\theta\right) + \pi_\theta\left(k_2^\star,\theta\right)} \frac{\partial i_0^\star}{\partial \theta}$$

The derivative of $i_0^\star$ with respect to θ is given by differentiating system 2:

$$\begin{aligned} &\frac{\partial i_0^\star}{\partial \theta} \times \left\{(1+r)\,G_{11}\left(i_0^\star,k_0\right) + \frac{\pi_{kk}\left(k_2^\star,\theta\right)}{1+r}\left(\pi_{kk}\left(k_1^\star,\theta\right) - \left(G_{22} - 2G_{12} + G_{11}\right)\left(i_1^\star,k_1^\star\right) + \left(G_{11}G_{22} - \left(G_{12}\right)^2\right)\left(i_1^\star,k_1^\star\right)\right)\right\} \\ = &\left(G_{11}\left(i_1^\star,k_1^\star\right) - \frac{\pi_{kk}\left(k_2^\star,\theta\right)}{1+r}\right)\left(\pi_{k\theta}\left(i_1^\star,k_1^\star\right) + \frac{\pi_{k\theta}\left(i_2^\star,k_2^\star\right)}{1+r}\frac{\left(G_{11} - G_{21}\right)\left(i_1^\star,k_1^\star\right)}{(1+r)G_{11}\left(i_1^\star,k_1^\star\right) - \frac{\pi_{kk}\left(i_2^\star,k_2^\star\right)}{1+r}}\right) \end{aligned}$$

Using our assumptions on G (i.e., that $G_{11} > 0$, $G_{22} > 0$, $G_{12} < 0$, and $G_{11}G_{22} - \left(G_{12}\right)^2 \geq 0$), as well as the concavity of π in k and $\pi_{k\theta} \geq 0$, we can conclude that $\frac{\partial i_0^\star}{\partial \theta} > 0$. This in turns implies that $\frac{\partial j}{\partial \nu_0} < 0$. This is the first part of Proposition 2.2.

Consider now the date 0 constrained firm. Its investment is given by the binding budget constraint, $G(i_0,k_0) = c_0 - B_0 + \frac{\psi \nu}{1+r}$, and is independent of θ. Hence

$$\frac{\partial j}{\partial \nu_0} = \underbrace{\frac{\partial h}{\partial \nu_0}}_{>0} - \frac{\partial \theta}{\partial \nu} \times \underbrace{\frac{\partial i_0}{\partial \theta}}_{=0} > 0$$

This is the second part of Proposition 2.2.

Finally, consider a date 1 constrained firm. Its investment is given by system 3. In particular, we can obtain the derivative of initial investment i_0 with respect to θ:

$$\frac{\partial i_0}{\partial \theta} = (1+r)^2 \frac{\partial i_0}{\partial \nu_0} \left(\frac{\pi_\theta (k_1, \theta)}{1+r} + \frac{G_1 (i_1, k_1)}{G_{11} (i_1, k_1) - G_{12} (i_1, k_1)} \frac{\pi_{k\theta} (k_1, \theta)}{1+r} \right) > 0$$

This allows one to compute the conditional sensitivity:

$$\begin{aligned} \frac{\partial j}{\partial \nu_0} &= \frac{\partial h}{\partial \nu_0} - \frac{\partial \theta}{\partial \nu_0} \times \frac{\partial h}{\partial \theta} \\ &= \frac{\partial i_0}{\partial \nu_0} \frac{\left((\psi - 1) \lambda_3 \frac{\pi_\theta(k_1,\theta)}{1+r} + \frac{\pi_\theta(k_2)}{1+r} - (1+\psi\lambda_3) \frac{G_1(i_1,k_1)}{G_{11}(i_1,k_1) - G_{12}(i_1,k_1)} \frac{\pi_{k\theta}(k_1 \theta)}{1+r} \right)}{(1+\lambda_3) \frac{\pi_\theta(k_1,\theta)}{1+r} + \frac{\pi_\theta(k_2,\theta)}{1+r}} \end{aligned}$$

As remarked in Proposition 2.2, the sign of this last expression is ambiguous. On the one hand, the larger the impact of productivity on profit, and hence on value, the smaller the adjustment in θ needs to be, and hence the closer the conditional sensitivity to the unconditional sensitivity. On the other hand, the larger the impact of productivity on the marginal product of capital, the larger the effect of productivity on investment and, hence, the smaller the conditional sensitivity relative to the unconditional sensitivity.

A.4 Proof of Proposition 2.3

Consider, as is the case in Proposition 2.3, the case where with no collateral the firm cannot finance first best. Assume that firm best can be financed only with collateral and commitment ability $\psi \geq \psi^\star > (1+r)^2$. Call $z = (k_0, B_0, \theta, \psi)$ the vector of fixed state variables. The firm prefers buying the real estate asset as long as

$$V(z, c_0 - \nu_0, \nu_0) > V(z, c_0, 0) - \left(\nu_0 - \frac{\nu_2}{1+r} \right)$$

Consider the function defined over $[0, \nu_0]$: $\rho(x) = V(z, c_0 - x, x) + x \frac{\nu_2}{\nu_0(1+r)} - x$. We know that

$$\rho'(x) = (\lambda_1 + \lambda_2)\psi - \lambda_3 = (\psi - (1+r))\lambda_1 + \left(\psi - \left(1 + r^2\right)\right)\lambda_2$$

If $\psi < \psi^\star$, then it must that the firm is constrained for all $x \in [0, \nu_0]$. In particular, consider first the case where $\psi < 1 + r$. Therefore, $\rho'(x)$ must be strictly negative for all x, so that ρ is strictly decreasing over $[0, \nu_0]$ and the firm strictly prefers renting the asset.

Assume now that $\psi \in]\,(1+r)^2, \psi^\star[$. Then $\rho'(x)$ is strictly negative for all x so that ρ is strictly increasing over $[0, \nu_0]$ and the firm strictly prefers buying the asset.

Consider the case where $\psi > \psi^\star$. By assumption, first best is reached with collateral but not without, so that the firm ends up buying the asset.

To conclude the proof, suppose $\psi^\star > \psi^1 > \psi^2$ such that the firm strictly prefers renting the asset when $\psi = \psi^2$ but (weakly) prefers renting the asset when $\psi = \psi^1$. This is not possible. Without the asset, both firms make the same profit $V(z, c_0, 0)$, as the value of the firm is independent of ψ if the firm does not have any collateral. Moreover, we know that the value of the firm is increasing with ψ, so our assumption amounts to

$$\begin{aligned} V^2(z, c_0 - \nu_0, \nu_0) &< V^2(z, c_0, 0) - \left(\nu_0 - \frac{\nu_2}{1+r} \right) \\ &< V^1(z, c_0, 0) - \left(\nu_0 - \frac{\nu_2}{1+r} \right) \\ &< V^2(z, c_0 - \nu_0, \nu_0), \end{aligned}$$

which is not possible if $\psi^1 > \psi_2$. Hence, the existence of the threshold $\bar{\psi}$.

The alternative cases can be derived using similar arguments. First, if the firm with no collateral can reach first best, then the firm weakly prefers renting the asset. Second, if the firm with no collateral is constrained but first best is reached with collateral for $\psi \geq \psi^\star$ with $\psi^\star < \bar{\psi}$, then the previous argument applies.

Table 1: Summary Statistics

		Mean	Median	Std. Dev.	25^{th} Percentile	75^{th} Percentile	Observations
Firm-Level Data							
	Investment	.34	.21	.37	.11	.40	27,672
	Cash	.06	.26	1.56	-.11	.59	27,877
	Market to book	2.18	1.54	1.76	1.1	2.5	25,592
	Leverage	.44	.20	9.36	.03	.37	27,931
	Debt Issues	.75	.01	2.3	0	.38	26,772
	Debt Repayment	.54	.08	1.58	.01	.33	27,291
	Net Debt Issues	.19	0	1.36	-.08	.06	26,192
	Changes in Current Debt	.02	0	.55	0	0	28,014
	RE Value	.85	.28	1.35	0	1.12	28,014
Initial Firm-Level Data (1993)							
	RE OWNER	.58	1	.49	0	1	2,750
	ROA	.01	.07	.23	-.03	.12	2,742
	Age	12.26	8	10.6	3	19	2,750
	Leverage	.29	.19	1.12	.03	.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	851
	Office Prices Index	.79	.8	.18	.68	.92	862
	Land Constraint (Regulation)	2.04	2	.36	1.8	2.25	840
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 (panels 1 and 2), MSA level (panel 3), and state level (panel 3). Investment is defined as capital expenditure (item #128) normalized by the lagged book value of property, plant, and equipment (PPE: item #8). Cash is defined as income before extraordinary items plus depreciation and amortization (item #14 + item # 18) normalized by lagged PPE (item # 8). Market to 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 are 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 are defined as debt issuance minus debt repayment. Changes in current debt are defined as item #301 normalized by lagged PPE (item #8). The RE value is the ratio of the market value of real estate assets normalized by lagged PPE (see Section 3 for details on the construction of this variable). The return on assets (ROA) is defined as the 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 and RE OWNER is a dummy variable equal to 1 if the firm reports any real estate holding in 1993. The residential prices growth rate (MSA level – resp. state level) is the growth rate of the MSA (resp. state) OFHEO real estate price index. The residential price index (MSA level – resp. state level) is the OFHEO real estate price index, normalized to 1 in 2006. The office prices index is an index of MSA-level office prices normalized to 1 in 2006. The office prices growth rate is the growth rate of the office prices index.

Table 2: Real Estate Prices and Investment Behavior

	Capital Expenditure						
	(1) (OLS)	(2) (OLS)	(3) (OLS)	(4) (OLS)	(5) (IV)	(6) (OLS)	(7) (OLS)
RE Value (State)	.07***	.061***	.043***				
	(.004)	(.0041)	(.0039)				
RE Value (MSA)				.04***	.042***		
				(.0056)	(.007)		
RE Value (MSA Office Prices)						.052***	
						(.0096)	
RE OWNER × MSA Office Prices							.22***
							(.08)
State Residential Prices	-.10*	-.75**	-.34				
	(.05)	(.30)	(.32)				
MSA Residential Prices				-.51	.54		
				(.34)	(.62)		
MSA Office Prices						-.56	3.06
						(1.7)	(3.2)
Cash			.03***	.036***	.037***	.037***	.038***
			(.0033)	(.0042)	(.005)	(.005)	(.005)
Market to book			.063***	.069***	.073***	.075***	.076***
			(.0029)	(.0041)	(.0051)	(.0046)	(.0046)
Leverage			-.21***	-.2***	-.21***	-.18***	-.19***
			(.018)	(.023)	(.03)	(.029)	(.029)
Initial Controls × State Residential Prices	No	Yes	Yes	No	No	No	No
Initial Controls × MSA Residential Prices	No	No	No	Yes	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	27,520	22,351	11,179	6,842	6,759	6,927
Adj. R^2	.37	.39	.45	.49	.51	.5	.5

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). Columns (1) through (3) define the value of real estate assets using state-level residential prices. Columns (4) and (5) use MSA-level residential prices, while columns (6) and (7) use MSA-level office prices. Except for column (1), all regressions control for firm-level initial characteristics (five quintiles of age, asset, leverage, and ROA, as well as initial two-digit industry SIC code and state of location) interacted with real estate prices. All regressions, except for columns (1) and (2), control for cash, previous year market to book, and previous year leverage. Column (5) presents IV estimates where real estate prices are instrumented using the interaction of real mortgage rates with constraints on land supply (see Table 3 for first-stage regressions). All specifications use year and firm fixed effect and cluster observations at the state-year level. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 3: First-Stage Regression: Impacts of Geography, Land Regulation, and Rent Control on Housing Prices

	Price Index		
	(1)	(2)	(3)
Constraint on Land Supply×Mortgage Rate	-.073***	-.033***	-.049***
	(.019)	(.0071)	(.0067)
Year Dummies	Yes	Yes	Yes
MSA Fixed Effect	Yes	Yes	Yes
Observations	560	784	784
Adj R^2	.93	.93	.93
F statistic	14	21	53

Notes: This table investigates how geography, rent control, and land regulation affect real estate prices. The dependent variable is the real estate price index, defined at the MSA level. Column 1 uses the presence of a lake or the sea (variable geography) interacted with real (i.e., inflation adjusted) mortgage rates. Column 2 uses rent control while column 3 uses building regulation at the MSA level. **All three variables are increasing in land scarcity**. All regressions control for year as well as MSA fixed effects and robust standard errors are reported. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 4: Real Estate Prices and Investment Behavior: Constrained Versus Unconstrained Firms

	Capital Expenditure					
	Payout Policy		Firm Size		Bond Ratings	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
RE Value (State)	.058***	.036***	.062***	.029***	.05***	.027***
	(.0072)	(.0067)	(.0092)	(.0073)	(.0057)	(.0059)
State Residential Prices	-1.1**	.6	.66	-1.4	-.82***	1.2
	(.47)	(.42)	(3.5)	(1.2)	(.32)	(1.7)
Cash	.025***	.049***	.017***	.078***	.029***	.067***
	(.0039)	(.0072)	(.0044)	(.009)	(.0041)	(.016)
Market to book	.061***	.053***	.051***	.049***	.069***	.045***
	(.0038)	(.0051)	(.0041)	(.0053)	(.004)	(.0064)
Leverage	-.21***	-.17***	-.18***	-.16***	-.25***	-.21***
	(.023)	(.05)	(.024)	(.028)	(.022)	(.04)
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."	.008***		.001***		.04**	
Observations	10,303	7,954	6,634	6,423	13,503	4,010
Adj. R^2	.46	.62	.35	.7	.48	.67

Notes: This table differentiates the results of Table 2 according to the ex ante measure of credit constraints. The dependent variable is capital expenditure (item # 128 normalized by lagged item #8). The RE value (state) is the market value of real estate assets computed using state-level residential prices normalized by lagged PPE. All regressions control for firm-level initial characteristics (five quintiles of age, asset, leverage, and ROA as well as initial two-digit industry code, and state of location) interacted with real estate prices, as well as for cash, previous year market to book, and previous year leverage. Constraint category assignments use ex ante criteria based on firm dividend payout (columns (1) and (2)), size (columns (3) and (4)), and bond ratings (columns (5) and (6)). The test "Constrained=Unconstrained" is a t test of the equality of the RE Value coefficients between the constrained and unconstrained firms. All specifications use year and firm fixed effect and cluster observations at the state-year level. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 5: Real Estate Prices and Investment: The Case of Purchasers

	Capital Expenditure		
	Non Purchaser	Purchaser	Purchaser
State Residential Prices	.06	-.13	-.03
	(.24)	(.30)	(.06)
Post×State Residential Prices			.47***
			(.12)
Post			-.25
			(.19)
Cash	.0077**	.025***	.033***
	(.0036)	(.0059)	(.005)
Market to book	.043***	.027***	.03***
	(.0046)	(.0067)	(.0051)
Leverage	-.3***	-.2***	-.18***
	(.025)	(.053)	(.037)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Test "Purchaser=Nonpurchaser"	.791		
Observations	9992	3125	5272
Adj R^2	.46	.43	.43

Notes: This table looks at the investment behavior of real estate purchasers compared to non-land-holding corporations. Capital expenditure is the dependent variable in all columns. Column (1) looks at the sensitivity of investment to state residential prices for firms that never own real estate assets in our sample. Column (2) looks at the same sensitivity for firms that *will* acquire real estate but *before* they acquire it. Column (3) estimates the same sensitivity for firms acquiring real estate but both before and after the acquisition: Post is a dummy variable defined for purchasers that equals 1 after the firm has purchased the RE asset. All specifications control for cash, previous year market to book, previous year leverage, use year, and firm fixed effect and cluster observations at the state-year level. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 6: Real Estate Prices and Debt Issues

	Debt Issues	Debt Repayment	Net Debt Issues	Changes in Current Debt
	(1)	(2)	(3)	(4)
RE Value (State)	.19***	.13***	.073***	.013*
	(.032)	(.021)	(.02)	(.0072)
State Residential Prices	-2.1*	-2.6***	.63	.52**
	(1.3)	(.94)	(.83)	(.21)
Initial Controls × State Residential Prices	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	26,632	27,148	26,056	27855
Adj. R^2	.36	.42	.2	.16

Notes: This table reports the relation between collateral value and capital structure. The dependent variables are debt issues (column (1)), debt repayment (column (2)), net debt issues (column (3)), and changes in current debt (column (4)). The RE value (state) is the market value of real estate assets computed using state-level residential prices normalized by lagged PPE. All regressions control for firm-level initial characteristics (five quintiles of age, asset, leverage, and ROA as well as initial two-digit industry code 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. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 7: Summary Statistics on the French Sample

		Mean	Median	Std. Dev.	25^{th} Percentile	75^{th} Percentile	Observations
Firm-Level Data							
	Investment	.04	.03	.17	0	.09	51,969
	Cash	.20	.06	.30	.01	.22	51,969
	Leverage	.36	.30	.44	.09	.56	51,962
	Debt Issues	.06	.02	.71	-.13	.23	51,969
	RE Value	.44	.14	.67	0	.60	51,969
	Group	.40	0	.49	0	1	51,969
Initial Firm-Level Data (1993)							
	RE OWNER	.62	1	.48	0	1	8,408
	ROA	.20	.16	.40	.05	.32	8,290
	Leverage	.37	.32	.47	.10	.58	8,298
	Log(Asset)	9.6	9.6	1.5	8.7	10.4	8,290
Region-Level Data							
	Region Prices Growth Rate	.04	.04	.07	.007	.08	441
	Region Prices Index	1.07	1.08	.31	.92	1.23	463

Notes: This table provides summary statistics at the firm level (panels 1 and 2) and the region level (panel 3) for the French data set. Investment is defined as yearly variation in PPE normalized by the lagged book value of PPE. Cash is defined as income before extraordinary items plus depreciation and amortization normalized by lagged PPE. Leverage is defined as the sum of short-term and long-term debt normalized by the book value of assets. Debt issues are defined as yearly variation in total debt normalized by lagged PPE. The RE Value is the ratio of the market value of real estate assets normalized by lagged PPE (see Section 3 for details on the construction of this variable). The ROA is defined as operating income before depreciation minus depreciation and amortization normalized by total assets. The RE OWNER is a dummy variable equal to 1 if the firm reports any real estate holding in 1993. The region prices growth rate is the growth rate of the regional residential real estate price index; the region price index is the regional residential real estate price index, normalized to 1 in 1990.

Table 8: Real Estate Prices and Investment Behavior: Evidence from France

	Capital Expenditure			Debt Issues	Capital Expenditure	
					Group	Stand Alone
RE Value	.12***	.12***	.11***	.1***	.1***	.15***
	(.011)	(.011)	(.011)	(.03)	(.013)	(.012)
Region Residential Prices	-.021	-.13	-.09	-3	-.48	-.17
	(.032)	(.34)	(.29)	(3.3)	(.41)	(.38).
Cash			.11***		.096***	.11***
			(.0056)		(.0091)	(.0072)
Leverage			-.013***		-.0088*	-.014***
			(.0026)		(.0046)	(.0029)
Initial Controls × Region Residential Prices	No	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Test "Group=Stand Alone"					.001***	
Observations	51,969	47,547	47,540	47,547	19,224	28,316
Adj. R^2	.29	.29	.3	.19	.34	.34

Notes: This table reports evidence on the relation between collateral value and investment based on French data. The dependent variable is capital expenditure normalized by lagged PPE (columns (1) through (3), (5), and (6) and debt issues, defined as yearly variation in total debt normalized by lagged PPE – column (4)). Column (1) has no additional control. Column (2) adds initial controls (five quintiles of ROA, leverage, assets, and industry and region dummies) interacted with region residential prices. Columns (3) to (6) add control for cash and previous year leverage. Columns (5) and (6) estimate the investment equation separately for firms belonging to business groups and stand-alone firms. All specifications use year and firm fixed effect and cluster observations at the state-year level. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance.

B Additional Tables

Table 9: Robustness: Using the 10K Files as a Source of Information for Real Estate Ownership

	Capital Expenditure			
	Compustat	10K	Compustat	10K
	Information	Information	Information	Information
RE OWNER × Region Price Index	.11	.13**		
	(.069)	(.067)		
RE Value			.061***	.067***
			(.013)	(.015)
Region Price Index	-.16	-.086	-.28*	-.18*
	(.1)	(.086)	(.15)	(.11)
Cash	.037***	.037***	.051***	.052***
	(.0089)	(.0089)	(.0071)	(.0071)
Market to book	.092***	.092***	.082***	.083***
	(.0083)	(.0083)	(.0075)	(.0075)
Leverage	-.29***	-.29***	-.28***	-.28***
	(.04)	(.04)	(.04)	(.04)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	2854	2854	1702	1702
Adj. R^2	.47	.47	.5	.5

Notes: This table estimates the investment equation using Compustat information on real estate ownership (columns (1) and (3)) and the information reported on the 10K (columns (2) and (4)) for a subset of companies for which we hand-collected the data. All regressions control for cash, market to book, and leverage and include year as well as region fixed effects and cluster observations at the state-year level. Here * , **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance, respectively.

Table 10: Determinants of Real Estate Ownership

2^{nd} Quintile of Asset	.15***	.081
	(.022)	(.067)
3^{rd} Quintile of Asset	.28***	.1
	(.022)	(.07)
4^{th} Quintile of Asset	.45***	.27***
	(.024)	(.074)
5^{th} Quintile of Asset	.47***	.083
	(.027)	(.083)
2^{nd} Quintile of Leverage	.12***	.19***
	(.021)	(.065)
3^{rd} Quintile of Leverage	.19***	.2***
	(.022)	(.067)
4^{th} Quintile of Leverage	.18***	.23***
	(.022)	(.07)
5^{th} Quintile of Leverage	.23***	.27***
	(.022)	(.069)
2^{nd} Quintile of ROA	.12***	.34***
	(.023)	(.07)
3^{rd} Quintile of ROA	.14***	.26***
	(.024)	(.075)
4^{th} Quintile of ROA	.15***	.21***
	(.024)	(.075)
5^{th} Quintile of ROA	.16***	.28***
	(.023)	(.072)
2^{nd} Quintile of Age	.03	-.0074
	(.021)	(.066)
3^{rd} Quintile of ROA	.094***	.12*
	(.02)	(.063)
4^{th} Quintile of ROA	.21***	.49***
	(.021)	(.065)
5^{th} Quintile of ROA	.24***	.87***
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. The dependent variables are RE OWNER (column (1)), a dummy indicating whether the firm reports any real estate asset on its balance sheet, and RE Value (column (3)), the market value of real estate assets. Control variables include five quintiles of asset, age, leverage, and ROA, as well as industry and state fixed effects. Here *, **, and *** mean statistically different from zero at the 10, 5, and 1% levels of significance.

Table 11: Real Estate Prices and Investment Behavior: Robustness – Different Subperiods

			Capital Expenditure			
	State-Level Prices		MSA-Level Prices		Office Prices	
	Before 1999	After 2000	Before 1999	After 2000	Before 1999	After 2000
RE Value	.061***	.057***	.063***	.044***	.07***	.06***
	(.0085)	(.0078)	(.012)	(.01)	(.022)	(.013)
RE Prices	-1.7*	-.99*	.063***	.044***	.07***	.06***
	(.96)	(.59)	(.012)	(.01)	(.022)	(.013)
Cash	.031***	.026***	.039***	.035***	.04***	.032***
	(.0045)	(.0051)	(.0055)	(.0064)	(.0067)	(.0089)
Market to book	.072***	.053***	.074***	.067***	.08***	.072***
	(.0036)	(.0044)	(.0055)	(.0061)	(.0066)	(.0071)
Leverage	-.28***	-.19***	-.29***	-.15***	-.26***	-.12**
	(.029)	(.029)	(.033)	(.043)	(.04)	(.059)
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	12944	9407	6511	4668	4093	2666
Adj. R^2	.54	.48	.57	.53	.59	.54

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