The Relation between Reporting Quality and Financing and Investment: Evidence from Changes in Financing Capacity

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Abstract

We use changes in the value of a firm's real estate assets as an exogenous change in a firm's financing capacity to examine (i) the relation between reporting quality and financing and investment conditional on this change, and (ii) firms' reporting quality responses to the change in financing capacity. We find that financing and investment by firms with higher reporting quality is less affected by changes in real estate values than are financing and investment by firms with lower reporting quality. Further, firms increase reporting quality in response to decreases in financing capacity. Our findings contribute to the literature on reporting quality and investment, and on the determinants of reporting quality choices.

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1. Introduction

How financing capacity affects investment is the subject of a large literature in corporate finance (see Hubbard [1998] and Stein [2003] for reviews). More recently, researchers have begun to study whether and how reporting quality mitigates under-investment associated with financing constraints (e.g., Biddle, Hilary and Verdi [2009]). Despite a growing number of papers in this area, little research directly examines whether reporting quality alleviates constraints on financing capacity. Therefore, one objective of this paper is to build on recent studies on the role of collateral assets in mitigating financing constraints and increasing financing capacity. Prior studies show that firms with greater collateral value are able to raise more external finance and to invest more (Gan [2007], Benmelech and Bergman [2009], Chaney, Sraer and Thesmar [2012]). We extend this literature by predicting that if a firm has higher reporting quality, financing and investment will be less sensitive to changes in collateral value.

Our second objective is to study firms' reporting quality responses to changes in financing capacity. Prior research that examines the impact of reporting quality on investment has implicitly assumed that reporting quality is exogenously determined and that a given level of reporting quality has implications for future investment. However, it is conceivable that a dynamic relation exists such that an increase in the likelihood of under-investment (e.g., an decrease in financing capacity) leads to an increase in reporting quality, which ultimately facilitates financing and leads to a reduction in (or avoidance of) under-investment. We also test this hypothesis.

We use changes in a firm's collateral values caused by changes in real estate prices as an exogenous change to the financing capacity of a firm. As we discuss below, changes in real estate prices are likely to be exogenous to firm-level investment choices, allowing us to attribute

our findings to changes in financing capacity. Our identification comes from comparing firms that have different levels of real estate assets. When real estate prices change, firms with greater levels of real estate experience greater changes in collateral value, which in turn leads to greater changes in their financing capacity. Our methodology is akin to a difference-in-difference specification that compares changes in financing, investment, and reporting quality activities between treatment firms and a benchmark group of firms less affected by changes in real estate values.

Our analysis of the effect of reporting quality on changes in collateral builds on the approach of Chaney et al. [2012] who estimate the sensitivity of investment to exogenous changes in collateral prices. They find that, over the 1993-2007 period, an increase in real estate values that causes an increase of collateral results in significant increases in external financing and investment.[1] They interpret this result as collateralizable assets mitigating financing constraints that are associated with under-investment. We extend this analysis by examining the role of reporting quality on the relation between changes in financing and investment, and changes in collateral values. We argue that firms with higher reporting quality will suffer fewer financing constraints because firms with higher reporting quality will have less information asymmetry with external capital providers and thus will be less reliant on collateral. We therefore predict that the investment and financing choices of these firms will be less affected by changes in collateral values.

Consistent with this prediction, we find that firms with higher reporting quality have a lower sensitivity of investment to collateral changes. For example, while the average firm's sensitivity of investment to real estate prices in our sample equals 2.20 (i.e., approximately two

[1] A related study, Gan [2007], finds that a negative change in Japanese real estate values caused significant reductions in financing and investment.

cents for each dollar of collateral price changes), the sensitivity for a firm with a one standard deviation higher value of reporting quality is only 1.58 (a reduction of 28%). We proxy for reporting quality by timely loss recognition, the information asymmetry component of the bid-ask spread, the length of MD&A section of 10K, the number of 8Ks filed, and the number of management forecasts. We find similar results with each of these measures individually and with an index that combines the measures.

To shed light on the mechanism behind the investment result, we examine the role of reporting quality on the effect of changes in collateral value on financing. The reason that changes in collateral value matter for investing is that changes in collateral values affect the amount of capital a firm can raise. If the level of collateral falls, lenders may ration credit or increase interest rates (Stiglitz and Weiss [1981], Benmelech and Bergman [2009]). Empirically, this manifests as a positive association between changes in collateral values and financing (Chaney et al. [2012]). We expect reporting quality to mitigate this relation as firms with better reporting quality will have less information asymmetry with external capital providers and thus will be less reliant on collateral to secure financing. Our results are partially consistent with our hypothesis. Consistent with our prediction, firms with low reporting quality issue more debt and use this capital to finance investment when the value of collateral goes up. In contrast, firms with high reporting quality also issue debt but, instead of using these funds to invest, they return the capital to shareholders when the value of collateral goes up. In other words, firms with low reporting quality use changes in collateral values to alleviate their financing constraints whereas firms with high reporting quality take advantage of collateralized financing to rebalance their capital structures.

We then examine whether firms respond to the changes in collateral values by changing their reporting quality.[2] Our findings are consistent with our hypothesis that firms increase reporting quality subsequent to decreases in the values of their real estate assets. Specifically, a one standard deviation reduction in real estate values is associated with a 6% increase in MD&A length, a 5% increase in the frequency of 8K filings, and an 18% increase in the frequency of management forecasts. These findings are robust to controlling for firm performance, and to controlling for firm and year fixed effects. Overall, these findings show that firms change their reporting quality practices in response to changes in financing capacity.

We perform a series of sensitivity analyses. First, we show that the magnitude of our findings is greater for firms more likely to suffer from under-investment (as opposed to over-investment). Because under-investing firms (as we define below) are also more likely to be financially constrained firms, this strengthens the interpretation that reporting quality mitigates financing constraints. Second, we examine the source of identification by conducting randomization tests. We show that the identification in our paper depends on the magnitude of real estate owned by a firm. Third, we show that our results are robust to different ways of addressing measurement error issues in our specification as well as selecting sub-samples with different types of real estate changes such as good/bad news, excluding the financial crisis, etc.

Our study contributes to three streams of literature. First, it contributes to research that examines the relation between reporting quality and investment. Most of this literature shows that reporting quality serves a monitoring role that mitigates moral hazard problems associated with over-investment (e.g., Francis and Martin [2010], Hope and Thomas [2008], McNichols and

[2] Throughout the paper, we use the term "reporting quality" broadly to encompass earnings attributes such as timely loss recognition, disclosure practices such as management forecasts and 8K filings, and ex-post measures such as the adverse selection component of the bid-ask spread.

Stubben [2008]). However, there is less research on whether reporting quality serves an information role that alleviates financing constraints. Biddle et al. [2009] provide initial evidence of this link by showing that, among firms more likely to under-invest, reporting quality is positively associated with investment. We extend their paper by using an exogenous change in financing capacity in order to study a mechanism linking reporting quality and under-investment. Our results are consistent with reporting quality substituting for collateral in mitigating the information asymmetry (and accordingly the financing constraints) associated with under-investment.

Second, our study also adds to the literature that examines the determinants of disclosure policies (e.g., Healy, Hutton and Palepu [1999], Leuz and Verrecchia [2000]). Most of these studies examine disclosures around corporate events, such as dividend changes or share repurchases (e.g., Grullon, Michaely and Swaminathan [2002], Kumar, Sorescu, Boehme and Danielsen [2008]), or they examine disclosure choices when firms access capital markets (e.g., Lang and Lundholm [2000]). In contrast, we identify changes in financing capacity as an exogenous event that changes firms' investment, financing, and reporting quality decisions.

Our paper is related to two working papers. Leuz and Schrand [2009] use the fall of Enron as a change to the firms' cost of capital and then study whether changes in disclosure are associated with changes in firms' cost of capital. Frederickson and Hilary [2010] use the 1986 drop in oil prices as a change in financing constraints and examine how firms with different levels of disclosure respond to the change. In contrast to these papers, we use collateral changes as proxies for changes in financing capacity that motivate changes in reporting quality. Because firms have different amounts of real estate and because real estate price changes are distributed over time, we have different treatment and benchmark samples to test our hypotheses. Further,

the real estate price changes coupled with different starting collateral values allow us to attribute the effects we find to variation in collateral values. Thus, we also contribute to the literature that studies the impact of collateral on a firm's investment and financing decisions (Gan [2007], Benmelech and Bergman [2009], and Chaney et al. [2012]).

The remainder of the paper proceeds as follows. Section 2 develops our hypotheses. Section 3 describes our research design. Section 4 presents the results; and Section 5 concludes.

2. Hypotheses Development

In this section, we describe our hypotheses. Our main predictions are (i) that a change in collateral value has a greater effect on financing and investment for firms with lower reporting quality, and (ii) that firms increase their reporting quality in response to a decrease in collateral value.

Our hypotheses assume that information frictions affect financing and investment. In contrast, in the neoclassical framework, a firm's growth opportunities are the sole driver of investment policy (e.g., Yoshikawa [1980], Hayashi [1982], Abel [1983]). Managers obtain financing for all positive net present value (NPV) projects, and investment policy is optimal. In other words, information frictions do not affect financing and investment because there are no differences in information. Outsiders can observe the value of growth options as easily as managers can, and thus outsiders finance all positive NPV projects. However, when there is information asymmetry between managers and outside suppliers of capital, it affects managers' investment and financing choices.

Models of adverse selection such as Myers and Majluf [1984] suggest that if managers are better informed than investors are about a firm's prospects, they will time capital issues to sell overpriced securities. Alternatively, models of moral hazard show that managers may

undertake investments that are not in shareholders' best interests (Berle and Means [1932], Jensen and Meckling [1976]). Suppliers of capital rationally anticipate these information frictions and ration capital ex-ante (Myers and Majluf [1984]) and/or increase financing costs (Lambert, Leuz and Verrecchia [2007]). This reduced financing leads to a reduction in investment, as documented by Chaney et al. [2012]. Specifically, given that managers are better informed (relative to investors) about a firm's prospects, capital is rationed, and when firms have less financing capacity (due, for example, to collateral changes), they are not as able to raise capital and consequently invest less.

We use changes in real estate prices that change the value of firm real estate assets as exogenous changes in the value of collateral. A decrease in collateral value implies a decrease in a firm's financing capacity. Collateralizable assets increase financing capacity by providing a source of borrowing with low information asymmetry between the lender and the borrower (Stiglitz and Weiss [1981]). Prior research shows that when collateral values fall, so does investment and financing, consistent with a reduction in the firms' financing capacity and hence an increase in their financing costs (Gan [2007], Chaney et al. [2012]).

We build on this literature by predicting that if a firm has lower reporting quality, its ability to finance and to invest will be more affected by changes in collateral. This prediction is based on two assumptions: (1) information asymmetry drives financing frictions, and (2) reporting quality mitigates information asymmetry (Verrecchia [2001]). To see the relation between information asymmetry and financing frictions, consider how financing changes as a function of information asymmetry. In the limit when there is no information asymmetry, the neoclassical model holds, and the firm can finance all its investment opportunities. In this case,

collateral values and changes in collateral values have no effect on financing, and therefore no effect on investment.

Once information asymmetry arises, however, changes in collateral value matter because they change financing capacity. Consider a reduction in collateral value. The decrease in collateral value exacerbates the information asymmetry problem between the firm and financing providers. Specifically, the change increases the weighted average information costs associated with the firm's capital (that is, low-asymmetry internal finance declines as a proportion of total capital). For example, less collateral means less security for a loan. In response, lenders increase monitoring, increase rates and ration credit (Stiglitz and Weiss, [1981], Benmelech and Bergman [2009]). Thus, firms will have lower access to debt financing and may have to look for alternative sources of financing such as equity. But also in this case, information asymmetry decreases the ability to raise equity and increases financing costs (Myers and Majluf [1984]).

Our second assumption is that reporting quality mitigates information asymmetry so that firms with higher reporting quality have lower financing frictions. Theoretical models of disclosure provide support for this assumption (Verrecchia [2001], Lambert, Leuz, and Verrecchia [2007]). In addition, empirical papers have linked reporting quality to lower costs of debt financing (Bharat, Sunder and Sunder [2008], Wittenberg-Moerman [2008]), as well as to lower costs of equity financing (Lang and Lundholm [2000], Lee and Masulis [2009]). Further, recent research has also documented a negative association between reporting quality and investment distortions (e.g., Biddle and Hilary [2006], Biddle, Hilary, and Verdi [2009]).

In summary, we hypothesize that the effect of a change in collateral values on financing and investment will be higher for firms with lower reporting quality. This occurs because reporting quality reduces information asymmetry. Thus, when information asymmetry is low

(i.e., when reporting quality is high), financing frictions are low and investment approximates the neoclassical model in which variations in collateral values will have a limited effect (if any) on financing and investment policies. On the other hand, as information asymmetry increases (i.e., when reporting quality is lower), financing frictions increase, and investment and financing become more sensitive to fluctuations in collateral values.

This leads to our first hypothesis:

H_1: A change in collateral value has a lower impact on financing and investment for firms with higher reporting quality (than for firms with lower reporting quality).

Next, we study how a firm changes its reporting quality in response to the change in collateral value. The change in collateral value causes a shift in financing capacity. This change can cause a firm to change its reporting practices if managers perceive a higher benefit to disclosure, because disclosure mitigates the potentially larger reduction in financing costs associated with higher information asymmetry (Verrecchia [2001]). The intuition is that firms adjust their reporting choices based on cost-benefit tradeoffs, and that a change in collateral values will affect future reporting choices. In other words, when a change takes place that affects collateral value, the change shifts the disclosure cost-benefit tradeoff, and firms may re-optimize their reporting quality. We state this hypothesis below:

H_2: An increase (decrease) in collateral value is associated with a decrease (increase) in reporting quality.

3. Research Design

In this section, we describe our research design and the data used in the paper. We test the above hypotheses using the following reduced-form specifications:

H_1: $\text{Investment}_t = f(\text{change in collateral}_t, \text{reporting quality}_{t-1}, \text{controls})$

H_1: $\text{Financing}_t = f(\text{change in collateral}_t, \text{reporting quality}_{t-1}, \text{controls})$

H_2: Reporting quality$_t$ = f(change in collateral$_t$, controls)

In the above equations, reporting quality serves both as an explanatory variable and as a dependent variable. The idea is a dynamic setting in which firms choose reporting quality, then choose financing and investment, and then repeat the process by again choosing reporting quality, financing and investment, and so on. Firms choose reporting quality at time *t-1* in part based on their expectation of future financing and investment needs, and in part based on other costs and benefits (e.g., proprietary costs). While this makes reporting quality endogenous with respect to *expected* financing and investment, reporting quality at *t-1* is arguably exogenous with respect to an unanticipated *change* in financing capacity. We test Hypothesis 1 by investigating whether the effect of the change on investment and financing is a function of the level of reporting quality before the change in collateral value. Hypothesis 2 then endogenizes reporting quality by studying how the change in financing capacity affects the firm's reporting choices subsequent to the change.

3.1 Data

We start with the sample of active Compustat firms in 1993 with non-missing total assets. We start the sample period in 1993 because this was the last year of an SEC requirement that firms report the accumulated depreciation of buildings; we use the historic depreciation of buildings to estimate the current value of real estate (described below). We retain firms whose headquarters are located in the United States, leaving us with a sample of 8,459 unique firms. We exclude from the sample those firms operating in the finance, insurance, real estate, construction, and mining industries, as well as firms involved in major takeovers. We retain firms that appear for at least three consecutive years in the sample, resulting in a sample of 25,797 firm-year observations for the sample period of 1993 to 2009. In this sample, there are

2,795 unique firms out of which 1,610 own real estate in 1993, and 1,185 own no real estate in 1993.

The key construct for our study is the effect of the change in real estate prices on the value of a firm's real estate assets. To compute this variable, we first measure the market value of a firm's real estate assets. We define real estate assets as buildings, land and improvement, and construction in progress (Compustat variables FATB, FATC and FATP). In essence, this is the property and plant subset of property, plant, and equipment. These assets are not marked-to-market, but are valued at historical cost. To estimate their market value, we follow Chaney et al. [2012] and estimate the average time since their acquisition. To do this, we measure the ratio of the accumulated depreciation of buildings to the historic cost of buildings, which gives us the proportion of the original value of a building that has been depreciated. Assuming that, on average, the depreciable life is 40 years, the average age of buildings for a given firm is 40 multiplied by the proportion depreciated. An illustration of this approach is provided in Appendix A for International Business Machines (IBM). In this example, we estimate the average age of the buildings to be approximately 19 years (i.e., the real estate IBM owned in 1993, it acquired in 1974, on average).

Next, we use real estate price indices to estimate the market value of real estate assets in 1993 and then track the change in the market value of these assets for each subsequent year as a function of changes in real estate prices. Following Chaney et al. [2012], we use state-level real estate prices. (As we discuss below, the use of state prices is not crucial as we obtain similar results when we instead use average prices for the U.S.) We obtain residential price indices from the Office of Federal Housing Enterprise Oversight (O.F.H.E.O). We use residential real estate prices as a proxy for commercial real estate prices because office real estate data are not

available for the entire country, and even then, this data is not available until 1985 (Chaney et al. [2012]). Data on state-level residential prices starts in 1975. For the years before 1975, we use the consumer price index (CPI) to adjust real estate prices.

We estimate the value of real estate assets held in 1993 as the book value at the time of the acquisition multiplied by the cumulative price increase from the acquisition date to 1993. We then estimate the value of these assets for the subsequent years as the market value at 1993 multiplied by the cumulative price increase from 1993 to a given year. Appendix A illustrates this computation for IBM.

It is worth noting that following Chaney et al.'s [2012] methodology, we do not incorporate the value of any real estate acquisitions or dispositions following 1993. An advantage of this approach is that it helps mitigate any endogeneity between real estate value and investments, since any future variation in the value of real estate assets is driven only by variation in real estate prices (and not by the firm's future investments). However, the downside of this approach is that it introduces noise into our measure because the value of real estate in a given year is not precisely estimated. The trade-off between endogeneity and measurement error is also evident in the IBM illustration in Appendix A. For example, IBM disposed of its PC business in 2005, but this asset sale is ignored by our approach. Thus, in Section 4.5.2 we perform a number of sensitivity tests to assess the effect of potential measurement error in our tests.

3.2 Empirical Specification

3.2.1 Investments, Collateral Value, and Reporting Quality

To examine the effect of reporting quality and collateral values on investment, we build on specifications used in prior literature. Traditionally, previous research has predicted that

investment is a function of growth opportunities (Tobin's q), cash flows, and other explanatory variables (e.g., Fazzari et al. [1988], Hubbard [1998], Lamont [1997], Richardson [2006], Almeida and Campello [2007]). More recently, Chaney et al. [2012] extend this literature by estimating a model that includes exogenous fluctuations in collateral prices to study the relation between collateral values and investment. Chaney et al. estimate the following model:

$$INV_{it} = \alpha_i + \beta_1 RE\_VALUE_{it} + \gamma_1 STATE\_INDEX_{st} + \sum_{j=1}^{J} \chi_j X_{jit-1} + \varepsilon_{it}. \quad (1)$$

where α_i is a firm fixed effect, *INV* is capital expenditures scaled by lagged assets, and *X* is a vector of control variables (measured as of *t-1*) that includes year fixed effects. The innovation in Chaney et al. [2012] is to introduce a measure of exogenous fluctuations in the value of real estate assets by including *RE_VALUE* in Eq. (1). *RE_VALUE* is computed as follows:

$$RE\_VALUE_{t,t} = (RE\_VALUE_{t,93} * STATE\_INDEX_{s,93-t}) \quad (2)$$

Thus, *RE_VALUE* is the market value of real estate in 1993 (calculated as described in Section 3.1 above), multiplied by an index of state-level real estate prices from 1993 to year *t*. Since firms had different amounts of real estate assets in 1993, *RE_VALUE* consists of cross-sectional variation in the initial value of real estate assets as well as time-series variation in the values of those assets due to variation in real estate prices. Our identification uses this variation to isolate the effect of changes in collateral values on investment, financing, and reporting quality. We normalize *RE_VALUE* by total assets in year *t-1*, which is also the deflator for investment and financing.

In Eq. (1), $STATE\_INDEX_{st}$ is a control for the change in real estate prices in state *s* from 1993 to year *t*. This variable, in conjunction with year fixed-effects, controls for macroeconomic changes (e.g., recessions, expansions, changes in interest rates) that affect the economy as a

whole. The firm fixed-effects gives the coefficients a changes interpretation, i.e., Chaney et al. [2012] find a positive coefficient β_1, and interpret it as evidence that a change in real estate value is associated with a change in investment.

Note that the firm fixed effect in Eq. (1) removes the firm mean. It can also be estimated (with an appropriate adjustment to degrees of freedom) as:

$$\widetilde{INV}_{it} = \beta_1 \widetilde{RE\_VALUE}_{it} + \gamma_1 \widetilde{STATE\_INDEX}_{st} + \sum_{j=1}^{J} \chi_j \widetilde{X}_{jit-1} + \varepsilon_{it} \quad (3)$$

where the "~" above the variable name indicates that the firm mean has been subtracted from the variable, e.g.,

$$\widetilde{INV}_{it} = INV_{it} - \frac{1}{T}\sum_{t=1}^{T} INV_{it} \quad (4)$$

Our prediction in Hypothesis 1 is that changes in investment will be less sensitive to real estate prices when the *level* of reporting quality is higher (we examine changes in reporting quality in Hypothesis 2). In order to test this prediction, we include an interaction between reporting quality and the effect of interest. Thus, we modify Eq. (3) by introducing an interaction between $\widetilde{RE\_Value}_{it}$ and reporting quality. We also include a main effect for reporting quality.[3] Specifically we estimate the following:

$$\widetilde{INV}_{it} = \beta_1 \widetilde{RE\_VALUE}_{it} + \beta_2 \widetilde{RE\_VALUE}_{it} \times FRQ_{it-1} + \gamma_1 \widetilde{STATE\_INDEX}_{st} + \gamma_2 FRQ_{it-1} + \sum_{j=1}^{J} \chi_j \widetilde{X}_{jit-1} + \varepsilon_{it} \quad (5)$$

where *FRQ,* measured at year *t-1,* is one of our six proxies for reporting quality (the information asymmetry component of the bid-ask spread (*IAC_spread*), timely loss recognition (*TLR_BASU*), the length of MD&A (*MDA_LENGTH*), the number of 8Ks filed by the company (*COUNT_8K*),

[3] Implicit in our model (and in Chaney et al. [2012]) is the assumption that the firms in the sample are under-investing. We investigate this assumption in Section 4.5.1, where we further decompose our tests into firms that are more likely to over- or under-invest.

the number of management forecasts (*MGMT_FCST*), and a composite measure of reporting quality (*FRQ_INDEX1*). We describe these measures below.

In Eq. (5), we remove the means from the same variables as in Eq. (1), but not from *FRQ*. This specification allows us to interpret β_1 as the average sensitivity of the change in investment to changes in collateral prices. Chaney et al. [2012] show that the sensitivity of changes in investment to changes in collateral prices (i.e., β_1) is positive, a finding that suggests that firms invest more (less) when real estate assets experience an increase (decrease) in value. Thus, if reporting quality attenuates this effect, then we predict that the estimated coefficient β_2 will be negative.

Our approach in Eq. (5) assumes that reporting quality prior to the change is a pre-determined variable that will affect the increase in information asymmetry due to the change in real estate prices. As discussed in the beginning of this section, reporting quality at *t-1* is arguably exogenous with respect to a subsequent (unanticipated) *change* in financing capacity (although it may be endogenous with respect to *expected* financing and investment). When we later test Hypothesis 2, we examine whether firms, subsequent to observing their financing capacity following a real estate change, then adjust their reporting quality.

Following prior literature (e.g., Richardson [2006], Almeida and Campello [2007], Biddle et al. [2009]), in Eq. (5) we control for contemporaneous cash flow (cash flow from operations divided by lagged assets)[4], lagged Tobin's Q (measured as the market value of assets divided by the book value of assets), the logarithm of lagged market value of equity, lagged age

[4] We define cash flow as cash flow from operations, which differs from Chaney et al. [2012], who define cash flow as income before extraordinary items plus depreciation and amortization. While this latter definition is widely used in the finance literature, it has potential shortcomings because it includes accruals, which are "investments" in working capital (Bushman et al. [2010]).

(measured as the logarithm of the number of years a firm has a record in Compustat), and lagged leverage (measured as the sum of short-term and long-term debt divided by the book value of assets). In addition to these control variables, all of our specifications include year fixed-effects.

Following Chaney et al. [2012], we cluster standard errors using a two-dimensional cluster at the state and year levels, which addresses both cross-sectional and firm-specific dependence. By clustering in this way, our standard errors are conservative, given that the explanatory variables of interest are defined at the firm level (see Bertrand, Duflo, and Mullainathan [2004]).

Before we proceed, we discuss a potential source of endogeneity. Changes in real estate prices could proxy for something other than changes in collateral value and financing capacity (e.g., changes in growth opportunities). If the firm's choice to own real estate is correlated with its expected growth opportunities, the estimated sensitivity of investment to real estate prices can be biased upwards. For example, for a homebuilder operating in a given state, an increase in real estate prices indicates greater growth opportunities as well as greater collateral. To mitigate this concern, we exclude industries that are more likely to be affected by this issue (e.g., real estate and construction). Further, we control for proxies intended to capture growth opportunities such as state-level real estate prices, year fixed-effects, Tobin's q, and cash flows.

In addition, while the direction of the bias is in favor of a positive sensitivity of investment to real estate (i.e., β_1 in Eq. 5), in terms of the interaction with reporting quality (i.e., β_2 in Eq. 5), there could be a bias against us finding our results. Specifically, Bushman et al. [2011] find that high reporting quality firms have a *higher* sensitivity of investment to changes in growth opportunities because reporting quality lowers adverse selection costs and allows these firms to raise more capital and further tap into the growth opportunities. In contrast, we predict

that high reporting quality firms will have a *lower* sensitivity of investment (and financing) to changes in collateral values because reporting quality lowers the firm's need for collateral.

3.2.2 Financing, collateral value, and reporting quality

To test Hypothesis 1 with respect to financing, we modify Eq. (5) by replacing investment as the dependent variable with measures of external finance raised by the company. Specifically we estimate the following:

$$\tilde{EXT\_FIN}_{it} = \beta_1 \tilde{RE\_VALUE}_{it} + \beta_2 \tilde{RE\_VALUE}_{it} \times FRQ_{it-1} + \gamma_1 \tilde{STATE\_INDEX}_{st} + \gamma_2 FRQ_{it-1} + \sum_{j=1}^{J} \chi_j \tilde{X}_{jit-1} + \varepsilon_{it}, \quad (6)$$

where $\tilde{EXT\_FIN}$ is one of the three measures of net finance raised by a firm – $\tilde{DEBT\_NET}$, $\tilde{EQUITY\_NET}$, and $\tilde{FIN\_NET}$. As before, *FRQ*, is one of our six proxies for reporting quality, as in Eq. (5), and the "~" above the variable name indicates that the firm mean has been subtracted from the variable. We focus on debt, equity, and total financing, as prior research has shown that reporting quality can affect both debt and equity financing.

Chaney et al. [2012] show that financing is sensitive to changes in collateral prices. Our hypothesis is that financing will be less sensitive to a change in real estate prices when reporting quality is higher. Thus we predict that the estimated coefficient β_1 will be positive and the coefficient β_2 will be negative.

Following Bradshaw, Richardson, and Sloan [2006], we measure net debt financing as the net cash received from (paid for) the issuance (reduction) of debt (Compustat variable DLTIS minus DLTR plus DLCCH, where we set DLCCH to zero if missing). *DEBT_NET* is the ratio of net debt financing in a given year scaled by the lagged value of assets (Lemmon and Roberts [2010], Leary and Roberts [2005]). We measure net equity financing as the net cash received from the sale (repurchase) of equity, less common dividends (Compustat variable SSTK minus

PRSTKC minus DVC).[5] *EQUITY_NET* is the ratio of net equity financing in a given year (Compustat variable SSTK) scaled by the lagged value of assets. *FIN_NET* is the sum of debt and equity financing in a given year scaled by the lagged value of assets. Finally, we control for contemporaneous cash flow (cash flow from operations divided by lagged assets), lagged Tobin's Q (measured as the market value of assets divided by the book value of assets) and the logarithm of lagged market value of equity, lagged age (measured as the logarithm of the number of years a firm has a record in Compustat).

3.2.3 Reporting responses to changes in collateral value

In the previous section, we used reporting quality prior to the change as a conditioning variable that mitigates the effect of real estate price changes on investment. That specification assumes that reporting quality in the prior period is a pre-determined variable (with respect to an unanticipated change in financing capacity). However, as discussed in Section 2, a complementary prediction is that firms adjust their reporting choices based on cost-benefit tradeoffs, and that a change in collateral values affects future reporting choices (Hypothesis 2).

We test this hypothesis by estimating a regression of reporting quality on changes in collateral. The model is similar to the one in Eq. (1) but uses reporting quality as the dependent variable (as opposed to investment):

$$FRQ_{it} = \alpha_i + \beta_1 RE\_VALUE_{it} + \gamma_1 STATE\_INDEX_{st} + \sum_{j=1}^{J} \chi_j X_{jit-1} + \varepsilon_{it}, \qquad (7)$$

where FRQ_t is one of our proxies for reporting quality (*MDA_LENGTH*, *COUNT_8K*, *MGMT_FCST*, *IAC_SPREAD* and a composite measure, *FRQ_INDEX2*, described below) and

[5] We do not subtract preferred dividends from net equity issuances, as we consider these to be largely nondiscretionary and analogous to interest payments.

α_i is a firm fixed effect.[6] Note that we estimate Eq. (7) directly with firm-fixed effects whereas we estimate the investment and financing models above by first de-meaning the variables and estimating Eq. (5) and (6) above. This is because our first hypothesis pertains to the *level* of reporting quality whereas Hypothesis 2 relates to the change in reporting quality.

Our second hypothesis is that firms will increase (decrease) reporting quality in response to a decrease (increase) in real estate prices. Thus we predict that the coefficient β_1 will be negative. Again, the presence of the firm fixed effect allows the coefficients to be interpreted as changes. Thus, if we find a negative coefficient β_1, we will interpret it as a decrease in the value of real estate assets being associated with an increase in reporting quality.

In Eq. (7), consistent with the prior literature (e.g., Healy et al. [1999], Lang and Lundholm [2000], Leuz and Verrecchia [2000]), we control for *ROA* (measured as operating income before depreciation and amortization divided by total assets) and the logarithm of the market value of equity (*MVE*). We also control for *Q*, the logarithm of *LEVERAGE*, and the logarithm of *AGE*. Finally, in addition to these control variables, we include year indicator variables.

3.2.4 Measures of Reporting Quality

In our tests, we use five proxies for reporting quality and two composite indexes.

IAC_spread measures the extent to which unexpected order flow affects prices and is increasing in information asymmetry. This variable measures the effect of information asymmetry on the stock price (i.e., the price impact or adverse selection that results from

[6] Note that for this test we do not use timely loss recognition (*TLR_BASU*). We compute this proxy at the industry level, and do not expect firm changes in disclosure policy to affect it.

information asymmetry among investors). It is intended as an ex-post proxy for (the inverse of) reporting quality based on several prior studies that document a negative relation between reporting quality and the bid-ask spread (e.g., Verrecchia [2001]). A caveat with this measure, however, is that high levels of information asymmetry might lead firms to increase disclosure in response to it, which is not the relation we want to capture. Thus, the use of this measure assumes an average negative relation between reporting quality and information asymmetry.

We estimate *IAC_spread* following Madhavan, Richardson, and Roomans [1997] (as described in Armstrong et al. [2011]). The resulting estimate expresses the information asymmetry component of the bid-ask spread as a percentage of price ("*IAC_spread*"). Because running the algorithm is very time-consuming, we measure *IAC_spread* for each firm once a year at its fiscal year-end, using all intra-day data for that month. Again, to give the variable the interpretation of increasing reporting quality, we multiply it by negative one. Further, given the noise inherent in the process of estimating *IAC_Spread*, we include this measure as a ranked variable (converted into deciles) in all our tests. We then re-scale it to range from zero to one.

We also use timely loss recognition (*TLR_BASU*) computed at the industry-level (e.g., Wittenberg-Moerman [2008], Ball, Bushman and Vasvari [2008]). To the extent that debtholders (common suppliers of collateralized capital) are more sensitive to borrower's losses and firms with more conservative financial reporting are less likely to report losses ex-post, conservative accounting can facilitate access to credit markets. Consistent with this argument, Wittenberg-Moerman [2008] shows that firms with higher timely-loss recognition (her proxy for conservative reporting) have lower debt financing costs.

Following Wittenberg-Moerman [2008] we employ an industry-level estimation of timely-loss recognition using the Basu [1997] methodology at the 3-digit SIC level. An

advantage of this measure is that, because it is measured at the industry level, there is a less of a concern about endogeneity.[7] We measure *TLR_BASU* as follows. For each 3-digit SIC industry-year in Compustat, we estimate the following piecewise-linear regression of annual price-deflated earnings (NI_{it}) on annual stock returns (R_{it}, ending three months after the end of the fiscal year) and stock returns interacted with a dummy variable for negative returns (DR_{it}):

$$NI_{it} = b0 + b1\ DR_{it} + b2\ R_{it} + b3\ R_{it} * DR_{it} + u_{it} \quad (8)$$

TLR_BASU is measured as the sum of b2 and b3. This industry-level measure of timely loss recognition is then assigned to each firm in a given industry.

We also use the length of the MD&A, the issuances of 8Ks and the issuance of management forecasts as proxies for reporting quality. The sample for these proxies begins in 1995 because it is the first year with available SEC filings on EDGAR's website to collect MD&A and 8K information and because First Call coverage improves significantly post-1994 (e.g., Rogers and Stocken [2005], Ng, Tuna, and Verdi [2013]).

We use the length of the Management's Discussion and Analysis (MD&A) section of the 10-K reports filed by firms as a proxy for reporting quality. We retrieve firms' 10-K filings from SEC EDGAR and then employ text-mining programs to extract the MD&A section. The *MDA_LENGTH* is the number of words in the MD&A section of the 10-K statement. Recent studies provide evidence that the forward-looking statements in a firm's MD&A are positively correlated with its future earnings and have explanatory power over other variables that can predict future performance (e.g., Li [2010], Feldman et al. [2010]). This suggests that the MD&A

[7] Patatoukas and Thomas [2011] argue that the Basu measure is biased. Ball, Kothari and Nikolaev [2013] show that controlling for size, book-to-market, leverage, and volatility in the Basu regression addresses potential estimation biases. In untabulated analyses we follow the suggestions in Ball et al. [2013], and find that our inferences are unaffected.

is a reasonable proxy for reporting quality. Using similar logic, Leuz and Schrand [2009] employ MD&A length as their primary measure of disclosure.

We also employ the number of 8K forms (*COUNT_8K*) filed by the firm. This variable is also used by Leuz and Schrand [2009] when investigating disclosure responses to the Enron event. The SEC requires that firms use the 8K form to disclose material information and to update any information provided in previous SEC filings. While the SEC lays out specific reportable events, the guidelines are generic enough that firms have discretion in filing an 8K for other information.

Our final proxy is the issuance of earnings forecasts by the management (*MGMT_FCST*). Several papers have used management forecasts as a proxy for voluntary disclosure activity. Overall, this literature shows that management forecasts provide information to the market and that they are associated with market returns and analyst forecast revisions. Prior research that examines earnings forecasts suggests that managers who wish to enhance transparency issue more frequent, specific, and accurate forecasts (Skinner [1994], Kasznik and Lev [1995], Kim and Verrecchia [1991]). In addition, investors and analysts react to these forecasts, which suggests that they have information content (e.g., Ajinkya and Gift [1984], Waymire [1984], Jennings [1987], Williams [1996]). We acknowledge that all of these disclosure measures are noisy because managers may disclose for reasons other than to improve the information environment; for example, they may disclose in response to abstain-or-disclose rules (Li, Wasley, and Zimmerman [2011]).

We note that, while we use several proxies for reporting quality, none of these proxies are perfect and they vary in terms of relative strength and measurement error. Thus, we also create two composite indexes in which we aggregate the individual proxies for reporting quality with

the intent of reducing measurement error in the individual proxies. For the tests of Hypothesis 1, we create *FRQ_INDEX1* as the average of standardized values of *IAC_SPREAD*, *TLR_BASU*, *MDA_LENGTH*, *COUNT_8K* and *MGMT_FCST* (we require at least two of the individual proxies to be available to compute the index). Since these variables are used as explanatory variables in Eq. (5) and (6), all variables are measured as of year *t-1*. For the tests of Hypothesis 2, we create *FRQ_INDEX2* as the average of standardized values of *IAC_SPREAD*, *MDA_LENGTH*, *COUNT_8K* and *MGMT_FCST* (i.e., *TLR_BASU* is not included since it is not used in the tests for H2). Again, we require at least two of the individual proxies to be available to compute the index. In this case, since these variables are used as dependent variables in Eq. (7), all variables are measured as of year *t*.

4. Results

4.1 Descriptive Statistics

Table 1 presents descriptive statistics for the variables used in our analysis. Following Chaney et al. [2012], we winsorize all variables at the 5th and 95th percentiles. In robustness tests discussed below, we examine the sensitivity of our results to winsorization at 1%.We begin with our measures of investment, financing, collateral, and real estate prices. The mean value for *INV* suggests that the firms in our sample invest, in a given year, approximately 6.54% of their lagged assets. The mean values for *DEBT_NET* are 1.41% of lagged assets; for *EQUITY_NET*, 2.57% of lagged assets; and for *FIN_NET*, 4.98% of lagged assets. The mean annual change in real estate prices ($STATE\_INDEX_{t-1,t}$) equals 4% (the gross value in the table is 1.04), whereas the mean cumulative change in our sample ($STATE\_INDEX_{93,t}$) equals 41%. The mean *RE_VALUE* equals 0.27, which means that the current value of real estate (property and plant) is equal to 27% of the book value of lagged assets.

We now turn to our proxies for reporting quality. Although we use standardized values of these variables in our tests, we report raw values in Table 1 in order to enable a comparison with prior research (e.g., Armstrong et al. [2011], Ball et al. [2008]). The mean for *IAC_SPREAD* is -0.23% (recall that *IAC_SPREAD* is multiplied by -1) whereas that of *TLR_BASU* is 0.12. The mean number of words in the MD&A (*MDA_LENGTH*) is 5,430, comparable to prior studies (e.g., Li [2008], Feldman et al. [2010]). The mean firm in our sample files 6.9 8Ks and 1.3 management forecasts in a given year. Table 1 Panel B presents the correlations between all measures used in this study. *FRQ_INDEX1* and *FRQ_INDEX2* are positively correlated with all financial reporting quality measures used in this paper.

4.2 Role of Reporting Quality in Investment Response to Changes in Collateral

Table 2 presents the results of our tests of Hypothesis 1. The first column replicates the regression specification in Chaney et al. [2012]. A key result in Chaney et al. is a positive and significant coefficient on *RE_VALUE*. This suggests that when firm real estate values increase due to changes in real estate prices, investments increase. Specifically, the estimated coefficient of 2.15 suggests that for each dollar increase in the value of real estate, investment increases by 2.15 cents. We observe similar positive significant coefficients across all columns in Table 2.[8]

The next six columns provide evidence consistent with Hypothesis 1. The coefficient of interest is the interaction between the value of real estate (*RE_VALUE*) and the proxies for reporting quality. To facilitate interpretation, all reporting quality proxies are standardized to have a mean of zero and a standard deviation of one. This way the coefficient on the interaction between reporting quality and *RE_VALUE* may be interpreted as the change in sensitivity when

[8] The estimated coefficient of 2.15 is smaller than the one reported in Chaney et al. [2012]. The difference occurs because we deflate investment and financing by lagged assets whereas Chaney et al. deflate by lagged PPE in their main tests. Chaney et al. report in their footnote 9 that, when they use lagged assets as a deflator, they also find a smaller coefficient.

the reporting quality increases by one standard deviation. The coefficients on the interaction between *RE_VALUE* and the *FRQ* proxies are negative and significant (an exception is the interaction between *RE_VALUE* and *IAC_SPREAD*, which has a *t*-statistic of 1.61). For example, the coefficient when using *TLR_BASU* is -0.60. Thus, while the sensitivity of investments to real estate prices is 2.27 for the average firm in our sample (based on *TLR_BASU*) (this number equals the coefficient on *RE_VALUE* in Table 2, Column 3), the sensitivity for a firm with a one standard deviation higher value for *TLR_BASU* is only 1.67 (= 2.27-0.60), a decrease of 26%. The specification in the last column uses our composite measure of reporting quality, *FRQ_INDEX1*, as an alternate measure of reporting quality; the results are consistent.

Overall the results in Table 2 are consistent with our first hypothesis that the change in collateral value has a lower impact on investment for firms with higher reporting quality than on firms with lower reporting quality. In other words, investment is more sensitive to collateral values when reporting quality is low.

4.3 Role of Reporting Quality on the Effect of Changes in Collateral on Financing

Table 3 examines the effect of financial reporting quality on the sensitivity of a firm's financing activities to changes in collateral values. We present results based on our composite reporting quality index, *FRQ_INDEX1*. The coefficients of interest are the main effect on *RE_VALUE* as well as the interaction between *RE_VALUE* and *FRQ_INDEX1*, and we predict that these coefficients will be positive and negative, respectively.

In Column 1, we examine net debt financing (*DEBT_NET*). The main effect on *RE_VALUE* is positive and significant, but the coefficient on the interaction term for *FRQ_INDEX1* is insignificant. This suggests that when collateral prices go up, firms with both low and high reporting quality issue more debt. In contrast, when we examine net equity

financing (*EQUITY_NET* - column 2), the main effect on *RE_VALUE* is insignificant, but the coefficient on the interaction term is negative and significant. In this case, when collateral prices go up, firms with low reporting quality do not increase their equity financing whereas firms with high reporting quality reduce their equity financing.

Column 3 presents results for the sum of net debt and net equity financing (*FIN_NET*). The main effect is positive and marginally significant (coefficient of 2.17 and *t*-statistic of 1.46), and the interaction term is negative and significant (coefficient of -2.48 and *t*-statistic of 2.79). These results suggest that net financing for firms with low reporting quality is positively associated (though weak in statistical terms) with increases in collateral values, but for firms with high reporting quality, net financing is not affected by changes in collateral prices [e.g., for a firm with an one standard deviation higher reporting quality the effect equals -0.31 (=2.17-2.48)].[9]

Taken together, these results provide a more nuanced interpretation than our hypothesis of the effect of changes in collateral value on financing conditional on reporting quality. Specifically, when the value of collateral goes up, firms with low reporting quality issue more debt and use this capital to finance investment. This is consistent with our predictions and evidence in Table 2. In contrast, for firms with high reporting quality, when collateral goes up they also issue debt but, instead of using these funds to invest, they return the capital to shareholders. In other words, firms with low reporting quality use changes in collateral values to

[9] In untabulated analyses, we also use the individual reporting quality proxies in the financing tests, and find results similar to those presented in Table 3. Specifically, the main effect for *RE_VALUE* is positive (insignificant) in the debt (equity) models whereas the interaction term between *RE_VALUE* and the proxies for reporting quality is insignificant (negative) for these respective models. Further, in the net total financing models, the main effect for *RE_VALUE* is weakly positive whereas the interaction term is negative.

alleviate their financing constraints whereas firms with high reporting quality take advantage of collateralized financing to rebalance their capital structure.

4.4 Reporting Quality Response to Changes in Collateral Value

Our next set of tests examines our second hypothesis, that firms will adjust their reporting quality in response to changes in collateral. Table 4 presents the estimates of Eq. (7). Column (1) uses the length of the MD&A as the measure of reporting quality (*MDA_LENGTH*). The negative and significant coefficient on the *RE_VALUE* suggests that a decrease (increase) in real estate prices leads to an increase (decrease) in the length of the MD&A. In terms of economic significance, a one standard deviation increase in *RE_VALUE* is associated with a decrease in the length of the MD&A by 310 words. Given that the mean value of *MDA_LENGTH* is 5,430, this represents a reduction of 6%.[10] Columns 2 through 5 present the results for the remaining proxies for reporting quality. We find similar results with one-year-ahead *COUNT_8K*, *IAC_SPREAD*, *MGMT_FCST*, as well as with the composite measure *FRQ_INDEX2*. In sum, the evidence in Table 4 is consistent with our second hypothesis, that firms increase (decrease) reporting quality when real estate values decrease (increase).

4.5 Additional Tests

4.5.1 Over- vs. Under-investment

We conclude from our analysis thus far that reporting quality mitigates financing constraints. Implicit in this conclusion is an assumption that our sample firms, on average, have constrained financing capacity and that an increase in collateral value mitigates under-investment. However, it is possible that some of our sample firms do not face financing

[10] The negative coefficients for *ROA* and *Q* appear, *a priori*, to be inconsistent with the previous literature. We note, however, that our specification uses a changes specification instead of levels. Leuz and Schrand [2009] also find a negative coefficient on *ROA* and *Q* when looking at the change in disclosure (but a positive coefficient on levels).

constraints. In this case, when collateral values increase, any extra investment might be excessive instead of efficient investment.

In order to examine the sensitivity of our results to potential over-investment, we follow Biddle et al. [2009] and categorize firms into two sub-samples based on their propensity to under- or over-invest. Specifically, we first rank firms into deciles based on their cash balance and their leverage (we multiply leverage by minus one before ranking so that, as for cash, it is increasing with the likelihood of over-investment) and re-scale them to range between zero and one. We create a composite score measure as the average of the ranked values of the two partitioning variables and compare firms in the extreme terciles of the distribution. We classify firm- years in the highest tercile as those that are likely to over-invest; those in the bottom tercile are firms that are likely to under-invest.

We then examine the effect of changes in collateral values on investments, financing and reporting quality in both these subsamples. Firms in the bottom tercile have low cash and/or high leverage and are likely to be financially constrained. These are the firms to which our above hypotheses are most likely to apply. For the firms in the highest tercile (classified as more likely to over-invest), however, the predictions are less clear. On one hand, evidence in Biddle et al. [2009] and others suggests that reporting quality mitigates over-investment. This result suggests that firms more likely to over-invest with high reporting quality also could be less likely to over-invest after an increase in collateral. On the other hand, firms more likely to over-invest have rich internal resources, so that it is unclear whether a change in collateral value would affect their investing, financing, and reporting choices.

Table 5 compares the results for the over- and under-investment samples for investment, financing, and reporting quality, respectively.[11] Columns 1 and 2 compare investment for the two samples. For the over-investment sample (Column 1), the main effect on *RE_VALUE* for investment is insignificant, but the interaction is significantly negative. In contrast, for the under-investment sample (Column 2), the main effect on *RE_VALUE* for investment is positive, and the interaction is significantly negative. The difference between the coefficients on *RE_VALUE* suggests that firms prone to under-investment are more sensitive to changes in collateral value than firms prone to over-investment (*t*-statistic for the difference of 3.17). In addition, this result holds for firms with higher reporting quality as proxied by the joint effect of *RE_VALUE* and its interaction with reporting quality (*t*-statistic for the difference of 3.19). The differences in financing shown in Columns 3 and 4 are similar. Over-investing firms do not react to the collateral change, while under-investing firms show a significant change in financing. As for reporting quality (Hypothesis 2), we find evidence that changes in collateral are associated with changes in reporting quality for the over-investment sample (Column 5), but the under-investment sample (Column 6) reacts slightly more strongly (*t*-statistic for the difference of 1.60). Thus, our findings in Table 5 are consistent with the effects we document arising from firms suffering from potential under-investment.[12]

4.5.2 Identification Tests

Our tests implicitly assume that a firm's real estate assets (or at least a large portion of them) are located in the same state as the firm's headquarters. As a way of assessing the

[11] We use the full sample to divide firms based on their likelihood of over-investing. Thus, when we intersect this ranking with our reporting quality measures, it results in different numbers of observations across the four columns.

[12] As a second approach, Gan [2007] uses quantile regressions (at the 90th percentile of the investment distribution) to study whether collateral affects major investments, on the assumption that major investments are less likely to capture moral hazard (over-investment) problems. In untabulated analysis, we follow a similar methodology and find that our results on investment continue to hold, providing additional evidence on under-investment.

importance of this assumption, we re-run our tests using a U.S. price index instead of the state price indices. Column 2 of Table 6 shows these results (first for investment, then for total financing, and finally for reporting quality as the dependent variable), which are very similar to the results shown in Column 1, which show the main results from Tables 2 through 4. Given that state real price changes have a substantial systematic (U.S.) component, this result suggests that the idiosyncratic statewide component from state prices is not providing identification.

To further explore this result, we conduct randomization tests. We start by randomizing the state that a given firm is assigned. Specifically, instead of using the real estate price for the state in which the firm's headquarter is assigned, we assign a firm to a random state other than the state of the headquarters. Column 3 of Table 6 presents these findings. We find that randomizing the state yields identical inference, again suggesting that the state location is not crucial for our identification. As discussed in the prior paragraph, a primary explanation for this is that the cumulative state indexes are highly correlated over time (average state pairwise correlation of 0.84), and therefore randomizing leads to little difference.

We then perform two additional randomization tests to determine whether the identification is coming from cross-sectional or time-series variation in the value of real estate assets. Specifically, to explore the time-series variation, we randomize $RE\_\widetilde{VALUE}_{it}$ over time holding the firm constant; this is akin to assigning a given firm a placebo yearly change in the value of its real estate assets over its time-series. Second, to explore the cross-sectional variation, we randomize $RE\_\widetilde{VALUE}_{it}$ across firms holding the year constant; in this case the test is akin to assigning a given firm the change in the value of the real estate assets of a placebo firm in the cross-section.

The last two columns of Table 6 present these results. In both cases the main effect for *RE_VALUE* and the interaction between *RE_VALUE* and *FRQ* are no longer significant. This suggests that the identification in our paper crucially depends on the initial value of real estate assets; this initial value induces cross-sectional and time-series variation in the value of real estate assets among our firms. Finally, as noted above, about 42% of our sample has no real estate in 1993. To ensure that our randomization tests are not simply capturing the choice of ownership, we drop non-owners, and repeat the randomization tests. The results for this subsample (untabulated) are very similar to the results in Table 6. This suggests that the identification in our paper depends, not only on the choice of ownership in 1993, but also on the *magnitude* of real estate owned by a firm.

4.5.3 Measurement Error in Real Estate Values

We use the methodology in Chaney et al. [2012] to identify exogenous variation in the value of a firm's real estate assets. The main advantage of this approach is that it mitigates endogeneity concerns (e.g., that variations in real estate assets proxy for future growth opportunities), but it requires assumptions that lead to potential measurement errors in the data. In this section, we discuss these assumptions and provide sensitivity tests.

An important measurement concern is that we value a firm's real estate assets in 1993, and then assume that value evolves over time based on changes in real estate prices. This procedure ignores the firm's real estate purchases and sales after 1993. To investigate whether this source of measurement error affects our results, we consider two extreme cases. First, we identify firms that initially had real estate in 1993, but later sold all of their real estate ("disposers"). In our sample, there are approximately 1,688 firm-year observations that occur after a complete sale of real estate. Second, we identify firms that initially had no real estate in

1993, but later acquired real estate ("acquirers"). In our sample, there are approximately 3,382 firm-year observations that occur after an initial real estate purchase. We then re-estimate the main regressions in the paper (Eq. 5 to 7) for these two sub-samples.[13]

These results are presented in Columns 2 to 4 of Table 7 Panel A (Column 1 presents the results for the main sample to facilitate comparison). In Column 2 we first present the results for the firms that own real estate in 1993 (1,610 firms as discussed in Section 3.1 above) but without the firm years after the "disposal." The resulting sample is 11,959 firm-years. This provides a way to assess the measurement error driven by inclusion of firms (and firm-years) without real estate and also serves as a benchmark to compare the results for the "disposers" sample. The results in Column 2 yield inferences similar to the results with the full sample, although the coefficients of interest tend to be larger in absolute magnitude. For instance, the coefficient on *RE_VALUE* increases from 2.20 to 2.98 for investment, increases from 2.17 to 7.09 for financing, and decreases from -0.15 to -0.21 for disclosure. As for the interaction with reporting quality, the magnitude of the coefficients also increases.

In Column 3, we find that disposers, after the disposal, have a lower sensitivity to real estate prices and an interaction with reporting quality that is smaller in magnitude. For example, the coefficient on *RE_VALUE*, when compared to the firms with real estate (Column 2), decreases by 48% (from 2.98 to 1.56) in the investment model. This suggests that real estate disposers, after they sell real estate, have a diminished sensitivity to real estate prices. In Column 4, we find that real estate purchasers, after they acquire real estate, have a positive sensitivity to

[13] For firms in the 'acquirer' group, we estimate the value of their real estate during the acquisition year as the acquisition cost. We then use the state index prices to compute the market value of this real estate over the remainder of the sample period. For example, suppose a firm acquires $50 million in real estate in 2000. We track the subsequent market value of this real estate using the state index prices (i.e., $50 million times the cumulative state index in a given year, and deflated by assets as described in Sections 3.1 and 3.2 above), and then correlate it with investment decisions during the period of 2001 to 2009.

real estate prices and a negative, but insignificant, interaction with reporting quality. Overall these results suggest that (1) real estate disposers, after they sell real estate, create measurement error that diminishes the sensitivity to real estate prices, and that (2) real estate purchasers, after they acquire real estate, have a significant sensitivity to real estate prices.[14]

We perform two additional tests to deal with measurement error in the value of real estate. Specifically, we assess the sensitivity of our findings using ranked values and an alternative winsorization procedure. Following Chaney et al. [2012], in our main specification we measure *RE_VALUE* as a continuous variable, but winsorize all variables at the 5% and 95%. As additional analyses we convert *RE_VALUE* to deciles as well as use it continuously but winsorize variables at the 1% and 99%. The results for all these tests are presented in Columns 5 and 6 of Table 7 Panel A. In general our findings are similar to those reported in Tables 2 through 4 shown in Column 1. The only exception is that the investment regression yields weaker results when using ranked *RE_VALUE* or when winsorizing the data at the 1% and 99%, suggesting that measurement error is indeed an issue in this model (the results with financing and reporting quality are robust to these tests).

Finally, we examine alternative measures of our dependent variables and our reporting quality index. First, our measures of investment and financing exclude operating leases (which are excluded from financial statements under U.S. accounting rules). It is possible, however, that when faced with a reduction in collateralizable assets, firms might switch away from on-balance-sheet to off-balance-sheet investment and financing. Following Beatty et al. [2010], we estimate

[14] As additional analysis, we calculate the cumulative amount of acquisitions plus capital expenditures net of asset disposals since 1993 for a given firm in a given year. We then re-estimate our regressions after deleting firms in the largest quintile (top 20%) of this measure i.e., firms more likely to have large changes in the composition of their real estate assets. We find that our inferences remain with this sub-sample.

the asset/liability associated with operating leases[15], and add the change in asset/liability associated with operating leases to our measure of investment and financing. Second, we measure our dependent variables (investment, financing and reporting quality) in year *t+1* (instead of year *t*) because it is possible that firms might take some time to react to the changes in real estate assets. Last, in the construction of *FRQ_INDEX1* in our tests above, we require that only two of the individual proxies be available in order to maximize sample size. To test the sensitivity of this assumption, we re-estimate our models for the sub-sample of firms with data for all the individual *FRQ* proxies.

The results for all these tests are presented in Columns 7 to 9 of Table 7 Panel A. Again, in general our findings are similar to those reported in Tables 2 through 4 shown in Column 1. An exception is that our results with investment also become slightly weaker when investment is measured in year t+1 suggesting that investment actions manifest in the same year of the changes in collateral values. The results with financing, however, become stronger when the dependent variable is moved to year *t+1*. One possible interpretation of this result is that financing activities are more lumpy (i.e., have higher adjustment costs) and take more time for firms to adjust their financing activities subsequent to changes in financing capacity.[16]

4.5.4 Type of news

Another concern is that our results may be capturing a "bad news" effect. In particular, years in which real estate values decline may be eventful (e.g., greater possibility of

[15] Following Beatty et al. [2010], we estimate the total operating lease asset/liability by dividing the next-year operating leasing payment (Compustat item *MRC1*) by 0.10. This assumes an interest rate of 10% and that the payment has an infinite horizon. Beatty et al. show that this approach results in similar inferences as alternative, more complex methodologies.

[16] We also use the change in a firm's market value as a dependent variable and estimate a model similar to Eq. (5). The idea is that changes in collateral value would affect the market value of the firms, especially financially constrained firms because such changes alleviate financing constraints. Consistent with our hypothesis we find that this is indeed the case (i.e., the coefficient on *RE_VALUE* is positive and significant). More importantly, we find that this sensitivity is smaller for firms with higher reporting quality.

restructuring) and, hence, associated with higher levels of reporting quality and transparency in general. To address this issue, we partition our sample into firm-years in which the yearly change in the real estate index was above 4%, which is the median change in our sample. We then re-estimate our regressions separately for years with above (below) the median change in the state price index – our proxy for good (bad) news.[17] In addition, we re-estimate our models after excluding the period of the financial crisis (years 2008 and 2009). This mitigates a concern that our results could be capturing other factors beyond variations in real estate prices (e.g., supply of lending). Finally, we examine the effect of large changes in real estate values. Firms are less likely to change their investment, financing and reporting activities in response to small variations in financing capacity. To test this argument, we keep only firms in the top and bottom tercile of yearly changes in state real estate price index (i.e., drop firm years in the middle tercile). The results of these tests are presented in Table 7 Panel B (first for investment, then for total financing, and finally for reporting quality as the dependent variable). With the exception of an insignificant coefficient on the interaction for positive news firm, the results are very similar to those reported in Tables 2 through 4 suggesting our findings are not specific to a particular type of news.

5. Conclusions

Whether and how reporting quality affects financing and investment is an area that has seen a great deal of recent academic study. We contribute to this literature by identifying an exogenous change in the financing capacity of a firm to study a mechanism linking reporting quality to investment and financing. Specifically, we use the effect of state-level variation in real estate prices on the value of a firm's real estate holdings as a proxy for changes in collateral

[17] We also estimate our disclosure models after controlling for additional performance measures such as contemporaneous ROA, sales growth, and stock returns. The results are virtually identical to the findings in Table 4.

values and hence to the firm's financing capacity. We then examine the relation between reporting quality and financing and investment conditional on this change in financing capacity. We also examine the firm's changes in reporting choices in response to changes in its collateral values.

Our analyses build on the approach in Chaney et al. [2012] who estimate the sensitivity of capital investment to exogenous changes in collateral prices and find that, over the 1993-2007 period, a positive change in U.S. real estate values that causes an increase of collateral value results in additional investments. However, after conditioning on financing reporting quality, we find that firms with higher reporting quality have a lower sensitivity of investment to changes in collateral. For example, the firm's sensitivity of investment to real estate prices in our sample is 28% lower for firms with higher reporting quality. The results with financing show that firms with higher reporting quality also have a lower sensitivity of financing to collateral changes.

We then look at whether and how firms respond to the change in their collateral values by changing their reporting practices. We find evidence consistent with our hypothesis that firms increase reporting quality subsequent to decreases in the values of their real estate assets. Specifically, the length of the MD&A, the filing of 8Ks and the issuance of management forecasts increase, and the information asymmetry component of the spread decreases in the year subsequent to the decrease in collateral values. Overall this suggests that firms increase reporting quality in response to a decrease in financing capacity.

Our study contributes to the literature that examines the relation between reporting quality and investment by better identifying the relation between these variables. We provide evidence consistent with reporting quality mitigating the adverse section problems that give rise to under-investment. In addition, we show that firms change their reporting practices in response

to a change in collateral values. This result contributes to the literature on the association between disclosure and external financing by providing a specific mechanism (financing capacity) that drives reporting choices.

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Appendix A: Sample Calculations for International Business Machines (IBM) (millions of dollars)

Step 1: Obtain Age and Purchase Year of Real Estate

Fiscal Year 1993 data:

Property, Plant, and Equipment for Buildings at Cost = $13,314
Accumulated Depreciation for Buildings = $6,553
Proportion of Buildings Used = $6,553 / $13,314 = 0.492
Age = 40 * Proportion Used = 19.68
Purchase_year = 1993 – age = 1974

Step 2: Estimate Book Value of Real Estate

Book Value of Real Estate = Buildings at Cost + Construction in Progress at Cost + Land and Improvements at Cost = $14,736

Step 3: Estimate Market Value of Real Estate as of 1993

Market Value of Real Estate as of 1993
= RE_total * (HPI_1993/HPI_1975) * (CPI_1975/HPI_purchase_yr)
= RE_total * (HPI_1993/HPI_1975) * (CPI_1975/HPI_1974)
= $58,291

Step 4: Estimate Impact of Real Estate Changes on Market Value of Real Estate from 1993 to 2009

Year	RE_VALUE_1993	State Index	Mkt_RE_VALUE
1993	58,291	1.00	58,291
1994	58,291	0.98	57,082
1995	58,291	0.97	56,687
1996	58,291	0.99	57,793
1997	58,291	1.00	58,434
1998	58,291	1.05	61,451
1999	58,291	1.11	64,953
2000	58,291	1.22	70,855
2001	58,291	1.33	77,659
2002	58,291	1.47	85,883
2003	58,291	1.63	94,735
2004	58,291	1.84	107,061
2005	58,291	2.08	121,107
2006	58,291	2.23	130,004
2007	58,291	2.26	131,884
2008	58,291	2.22	129,462
2009	58,291	2.15	125,218

Table 1 - Summary Statistics

This table presents the summary statistics and correlation matrices for the variables used in this study. *INV* is capital expenditures scaled by the lagged book value of assets expressed in percentage points. *DEBT_NET* is net debt issuances in a given year scaled by the lagged book value of assets. *EQUITY_NET* is net equity financing (issuances minus repurchases minus common dividends) in a given year scaled by the lagged book value of assets. *FIN_NET* is the ratio of the sum of net debt issuances plus net equity issuances in a given year to the lagged book value of assets. $STATE\_INDEX_{93,t}$ measures the growth in real estate prices in that state from 1993 until that year. $STATE\_INDEX_{t-1,t}$ measures the growth in real estate prices in that state from the previous year. *RE_VALUE* is the market value of the firm's real estate assets as of year t scaled by the lagged book value of assets. *IAC_SPREAD* is the adverse selection component of the bid-ask spread estimated following Madhavan et al. [1997] (in percentage points). *TLR_BASU* is the timely loss recognition estimated following Wittenberg-Moerman [2008] using industry-level estimation of TLR using the Basu methodology. *MDA_LENGTH* is the number of words (in '000s) in the MD&A section of the 10-K statement. *COUNT_8K* is the number of 8K forms filed by the firm in a year. *MGMT_FCST* is the number of management earnings forecasts in a year. *FRQ_INDEX1* is the average of standardized values of *IAC_SPREAD*, *TLR_BASU*, *MDA_LENGTH*, *COUNT_8K* and *MGMT_FCST*. *FRQ_INDEX2* is the average of standardized values of *IAC_ SPREAD*, *MDA_LENGTH*, *COUNT_8K* and *MGMT_FCST*. *CASH_FLOW* is the cash flow from operations scaled by the lagged book value of assets. *Q* is the market value of assets divided by their book value. *MVE* is the market value of equity in a given year. *AGE* is the number of years a firm has a record in Compustat. *LEVERAGE* is the sum of short-term and long-term debt divided by the book value of assets. *ROA* is operating income before depreciation and amortization divided by lagged total assets.

Panel A – Descriptive Statistics

Variable	Mean	Median	Std	P25	P75	N
INV_t (%)	6.54	4.69	5.96	2.38	8.65	25,797
$DEBT\_NET_t$	1.41	0.00	8.48	-2.34	2.35	25,797
$EQUITY\_NET_t$	2.57	0.03	10.90	-0.20	1.00	25,797
FIN_NET_t	4.98	0.00	17.25	-3.31	5.58	25,797
$STATE\_INDEX_{93,t}$	1.41	1.24	0.46	1.05	1.65	25,797
$STATE\_INDEX_{t-1,t}$	1.04	1.04	0.06	1.02	1.07	25,797
RE_VALUE_t	0.27	0.12	0.38	0.00	0.39	25,797
IAC_SPREAD_{t-1} (%)	-0.23	-0.11	0.32	-0.28	-0.04	21,304
TLR_BASU_{t-1}	0.12	0.10	0.17	0.02	0.19	18,156
MDA_LENGTH_{t-1}	5.43	4.56	4.03	2.51	7.88	13,579
$COUNT\_8K_{t-1}$	6.92	5.00	6.56	2.00	10.00	12,570
$MGMT\_FCST_{t-1}$	1.33	0.00	2.70	0.00	1.00	15,528
FRQ_INDEX1_{t-1}	-0.03	-0.11	0.60	-0.47	0.33	21,749
FRQ_INDEX2_t	-0.04	-0.16	0.65	-0.54	0.35	18,316
$CASH\ FLOW_t$	0.13	0.26	1.23	0.03	0.55	25,797
Q_{t-1}	1.93	1.47	1.27	1.08	2.28	25,797
MVE_{t-1}	1119	130	2795	28	722	25,797
AGE_{t-1}	20.06	16.00	14.08	9.00	29.00	25,797
$LEVERAGE_{t-1}$	0.23	0.20	0.20	0.05	0.36	25,797
ROA_{t-1}	0.04	0.08	0.15	0.01	0.13	18,316

Table 1: (Cont'd.)

Panel B – Correlation Matrix

	INV	*FIN*	*DEBT*	*EQUITY*	*INDEX*	*RE_VALUE*	*SPREAD*	*TLR*	*MDA*	*8K*	*FCST*
FIN_NET_t	0.25	1.00									
$DEBT\_NET_t$	0.27	0.58	1.00								
$EQUITY\_NET_t$	0.13	0.76	0.01	1.00							
$STATE\_INDEX_{93,t}$	-0.21	-0.13	-0.06	-0.15	1.00						
RE_VALUE_t	0.02	-0.12	-0.03	-0.13	0.05	1.00					
IAC_SPREAD_{t-1}	0.13	-0.06	0.06	-0.11	-0.01	0.03	1.00				
TLR_BASU_{t-1}	-0.04	-0.02	-0.01	-0.02	0.07	0.00	0.01	1.00			
MDA_LENGTH_{t-1}	-0.09	-0.06	-0.03	-0.06	0.41	-0.02	0.15	0.04	1.00		
$COUNT\_8K_{t-1}$	-0.09	-0.11	-0.04	-0.13	0.53	0.03	0.13	0.01	0.40	1.00	
$MGMT\_FCST_{t-1}$	-0.03	-0.12	-0.02	-0.15	0.32	-0.03	0.33	0.04	0.24	0.27	1.00
FRQ_INDEX1_{t-1}	0.00	-0.09	0.00	-0.12	0.33	0.01	0.64	0.51	0.65	0.66	0.67

Table 2 - Role of Reporting Quality on the Effect of Collateral Shocks on Investment

This table examines the role of information quality in the effect of collateral shocks on investment. The dependent variable is *INV*, the ratio of capital expenditures to the past year's assets expressed in percentage points. *FRQ* represents the reporting quality measures that we employ in the specification and is mentioned in the header of the column. All other variables are defined in Table 1. We also include year indicator variables (not tabulated). All variables, except the *FRQ* proxies, are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. To facilitate interpretation, the *FRQ* proxies are standardized to have a mean of zero and a standard deviation of one. Standard errors are clustered at the state and year level. *t*-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two-sided) at 10%, 5%, and 1%, respectively.

	Expected		FRQ_{t-1} Proxy					
VARIABLES	Sign		*IAC_SPREAD*	*TLR_BASU*	*MDA_LENGTH*	*COUNT_8K*	*MGMT_FCST*	*FRQ_INDEX1*
RE_VALUE_t	+	2.15***	2.75***	2.27***	2.29***	2.19***	2.35***	2.20***
		(5.37)	(7.13)	(4.42)	(6.38)	(8.19)	(5.70)	(5.54)
$STATE\_INDEX_{93,t}$	?	-0.09	-0.25	-0.04	-0.51*	-0.08	-0.26	-0.11
		(-0.26)	(-0.76)	(-0.08)	(-1.87)	(-0.31)	(-0.97)	(-0.33)
$CASH\ FLOW_t$	+	0.05	0.08	0.06	0.07*	0.09***	0.08*	0.09**
		(1.31)	(1.12)	(1.32)	(1.85)	(3.46)	(1.66)	(2.14)
Q_{t-1}	+	1.19***	1.14***	1.14***	0.94***	0.96***	0.96***	1.11***
		(12.12)	(12.21)	(11.94)	(9.53)	(9.80)	(11.58)	(12.39)
LN_MVE_{-1}	+	0.37***	0.40***	0.30**	0.40***	0.35***	0.29**	0.33***
		(3.90)	(3.24)	(2.54)	(3.81)	(4.94)	(2.47)	(3.06)
LN_AGE_{t-1}	-	-0.99***	-1.04***	-0.89***	-0.48	0.24	-0.57	-0.75***
		(-3.78)	(-3.68)	(-2.98)	(-1.01)	(0.55)	(-1.37)	(-3.03)
$LEVERAGE_{t-1}$	-	-4.34***	-5.50***	-4.27***	-4.14***	-3.59***	-5.11***	-4.68***
		(-10.61)	(-13.83)	(-9.64)	(-10.09)	(-11.00)	(-11.46)	(-10.40)
FRQ_{t-1}	?		0.03	-0.02	-0.02	-0.07*	-0.05**	-0.01
			(0.41)	(-1.54)	(-0.73)	(-1.75)	(-2.11)	(-0.13)
$\boldsymbol{FRQ_{t-1*}\ RE\_VALUE_t}$	**H_1: -**		**-0.35**	**-0.60*** **	**-0.38***	**-0.36*** **	**-0.26*** **	**-0.62*** **
			(-1.61)	**(-3.02)**	**(-1.93)**	**(-2.68)**	**(-3.32)**	**(-3.12)**
RE_VALUE+FRQ*RE_VALUE		-	2.40	1.67	1.90	1.83	2.09	1.58
t-stat		-	4.91	3.41	4.54	7.27	4.87	3.99
Observations		25,797	21,304	18,156	13,579	12,570	15,528	21,749
R-squared		0.225	0.249	0.221	0.232	0.223	0.243	0.240

Table 3 - Role of Reporting Quality on the Effect of Collateral Shocks on Financing

This table examines the role of information quality in the effect of collateral shocks on financing. The dependent variables are *DEBT_NET*, *EQUITY_NET*, and *FIN_NET*. *DEBT_NET* is net debt issuances in a given year scaled by the lagged book value of assets. *EQUITY_NET* is net equity financing (issuances minus repurchases minus common dividends) in a given year scaled by the lagged book value of assets. *FIN_NET* is the ratio of the sum of net debt issuances plus net equity issuances in a given year to the lagged book value of assets. All other variables are defined in Table 1. We also include year indicator variables (not tabulated). All variables, except the *FRQ* proxies, are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. To facilitate interpretation, the *FRQ* proxies are standardized to have a mean of zero and a standard deviation of one. Standard errors are clustered at the state and year level. *t*-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two-sided) at 10%, 5% and 1%, respectively.

	Expected	Dependent Variable		
VARIABLES	Sign	$DEBT\_NET_t$	$EQUITY\_NET_t$	FIN_NET_t
RE_VALUE_t	+	1.85**	-0.34	2.17
		(2.46)	(-0.44)	(1.46)
$STATE\_INDEX_{93,t}$	?	1.41***	-1.41***	0.19
		(3.24)	(-3.40)	(0.26)
$CASH\ FLOW_{t-1}$	-	-0.84***	-0.93***	-2.29***
		(-4.83)	(-4.63)	(-8.22)
Q_{t-1}	+	0.44***	2.96***	4.56***
		(5.42)	(5.78)	(7.90)
LN_MVE_{t-1}	?	0.65***	-1.56***	-1.47**
		(3.58)	(-4.67)	(-2.51)
LN_AGE_{t-1}	?	-0.08	-3.68***	-3.84***
		(-0.22)	(-3.78)	(-3.43)
$LEVERAGE_{t-1}$	?	-14.20***	5.23***	-10.57***
		(-12.08)	(5.79)	(-8.96)
FRQ_INDEX1_{t-1}	?	0.00	-0.01	-0.04
		(0.09)	(-0.16)	(-0.41)
$\boldsymbol{FRQ\_INDEX_{t-1} * RE\_VALUE_t}$	-	**-0.24**	**-1.77*** **	**-2.48*** **
		(-0.82)	**(-3.94)**	**(-2.79)**
RE_VALUE+FRQ*RE_VALUE		1.609	-2.110	-0.314
t-stat		2.371	-2.468	-0.253
Observations		21,749	21,749	21,749
R-squared		0.093	0.137	0.132

Table 4 –Effect of Collateral Shocks on Disclosure

This table examines the effect of collateral shocks on disclosure. The dependent variables are *MDA_LENGTH, COUNT_8K*, *IAC_SPREAD*, *MGMT_FCST* and *FRQ_INDEX2*. All variables are defined in Table 1. We also include year indicator variables (not tabulated). All variables are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. Standard errors are clustered at the state and year level. *t*-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two at 10%, 5% and 1%, respectively.

		Dependent Variable				
VARIABLES	Sign	MDA_LENGTH_t	$COUNT\_8K_t$	IAC_SPREAD_t	$MGMT\_FCST_t$	FRQ_INDEX2_t
***RE_VALUE*$_t$**	**H_2: -**	**-0.83****	**-0.99***	**-0.26****	**-0.63*****	**-0.15*****
		(-2.05)	**(-1.96)**	**(-2.00)**	**(-2.98)**	**(-3.52)**
$STATE\_INDEX_{93,t}$	?	0.29	-0.19	-0.36***	0.09	0.01
		(1.22)	(-0.70)	(-2.59)	(0.48)	(0.24)
ROA_{t-1}	+	-1.56***	-2.37***	0.91***	0.30	0.05
		(-5.71)	(-5.62)	(4.92)	(1.26)	(1.05)
Q_{t-1}	+	-0.13**	-0.18***	0.09***	-0.15***	0.00
		(-2.49)	(-3.25)	(3.64)	(-3.44)	(0.09)
LN_MVE_{t-1}	+	0.01	0.21*	0.66***	0.66***	0.07***
		(0.09)	(1.76)	(15.00)	(12.35)	(6.39)
LN_AGE_{t-1}	+	0.09	-0.47	0.12	-0.62**	-0.04
		(0.34)	(-0.99)	(1.01)	(-2.13)	(-1.34)
$LEVERAGE_{t-1}$	-	1.09***	0.32	-0.07	0.32*	0.13***
		(2.69)	(0.84)	(-0.29)	(1.88)	(3.35)
Observations		15,334	14,411	21,670	17,623	18,316
R-squared		0.294	0.601	0.106	0.220	0.457

Table 5 – Partition by Over- and Under-Investment

This table examines the role of information quality on the effect of collateral shocks on *INV* (Columns 1 and 2) and on *FIN_NET* (Columns 3 and 4), and the effect of collateral shocks on disclosure - *FRQ_INDEX2* (Columns 5 and 6), conditional on firms' likelihood of over- or under-investing. *OVER* (*UNDER*) are firms in the upper (lower) tercile of a variable that proxies for the likelihood of over- (under-) investment. The variable is the average of a ranked (deciles) measure of cash and leverage (multiplied by minus one). All other variables are defined in Table 1. We also include year indicator variables (not tabulated). Control variables are not tabulated for brevity. All variables, except *FRQ_INDEX1*, are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. To facilitate interpretation, *FRQ_INDEX1* is standardized to have a mean of zero and a standard deviation of one. Standard errors are clustered at the state and year level. *t*-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two-sided) at 10%, 5% and 1%, respectively.

	Dependent variable								
	INV (H1)			*FIN_NET* (H1)			*FRQ_INDEX2* (H2)		
VARIABLES	OVER	UNDER	Over-Under	OVER	UNDER	Over-Under	OVER	UNDER	Over-Under
RE_VALUE$_t$	**-0.09**	**3.34*** **	**-3.43*** **	**-1.19**	**4.24** **	**-5.43**	**-0.16***	**-0.27*** **	**0.11**
	(-0.09)	**(6.70)**	**(-3.17)**	**(-0.46)**	**(2.08)**	**(-1.65)**	**(-1.78)**	**(-4.60)**	**(1.60)**
FRQ_INDEX1$_{t-1}$*RE_VALUE$_t$	**-0.94** **	**-0.51** **		**-3.54**	**-1.98** **				
	(-2.00)	**(-2.30)**		**(-1.48)**	**(-2.08)**				
RE_VALUE+FRQ*RE_VALUE	**-1.03**	**2.83**	**-3.86*** **	**-4.73**	**2.26**	**-6.99***			
t-stat	**(-0.91)**	**(6.61)**	**(-3.19)**	**(-1.39)**	**(1.24)**	**(-1.81)**			
Observations	6,748	7,792		6,748	7,792		5,438	6,812	
R-squared	0.200	0.253		0.177	0.141		0.409	0.443	

Table 6: Identification tests

This table examines the source of identification. Column 1, titled "Main Result", presents the respective results shown in Tables 2 through 4. Column (2) presents results employing an aggregate U.S. real estate index instead of the state index. Columns (3) through (5) present results where we randomize the location of the real estate, randomly sort the initial real estate value by year, and randomly sort the initial real estate value by firm, respectively. All other variables are defined in Table 1. We also include year indicator variables (not tabulated). Control variables are not tabulated for brevity. All variables, except *FRQ_INDEX1*, are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. To facilitate interpretation, *FRQ_INDEX1* is standardized to have a mean of zero and a standard deviation of one. Standard errors are clustered at the state and year level. t-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two-sided) at 10%, 5% and 1%, respectively.

VARIABLES	(1) Main Result	(2) U.S. Index	(3) Random State	(4) Random Year	(5) Random Firm
Dependent variable: Investment					
RE_VALUE_t	**2.20*** **	2.45***	**2.07*** **	**0.12**	**-0.07**
	(5.54)	(4.57)	**(5.54)**	**(0.63)**	**(-1.10)**
$FRQ\_INDEX1_{t-1}*RE\_VALUE_t$	**-0.62*** **	**-0.66*** **	**-0.50*** **	**-0.07**	**0.04**
	(-3.12)	**(-3.18)**	**(-3.01)**	**(-0.41)**	**(0.30)**
Obs	21,749	20,242	21,749	21,749	21,749
Dependent variable: Financing					
RE_VALUE_t	**2.17**	2.25	**1.91**	**-0.51**	**-0.60**
	(1.46)	(1.34)	**(1.30)**	**(-0.99)**	**(-0.63)**
$FRQ\_INDEX1_{t-1}*RE\_VALUE_t$	**-2.48*** **	**-2.37** **	**-2.59*** **	**0.06**	**-0.91**
	(-2.79)	**(-2.46)**	**(-3.22)**	**(0.11)**	**(-1.47)**
Obs	21,749	20,242	21,749	21,749	21,749
Dependent variable: Disclosure					
RE_VALUE_t	**-0.15*** **	**-0.16*** **	**-0.00**	**0.02**	**0.02**
	(-3.52)	**(-2.84)**	**(-0.08)**	**(0.81)**	**(0.81)**
Obs	18,318	16,837	18,318	18,318	18,318

Table 7: Robustness Checks

This table examines series of sensitivity analyses on the role of information quality in the effect of collateral shocks on *INV* and *FIN_NET*, and the effect of collateral shocks on disclosure - *FRQ_INDEX2*. Column 1, titled "Main Result" presents the respective results shown in Tables 2 through 4. The subsequent columns show the sensitivity test described in the header of the column. All other variables are defined in Table 1. We also include year indicator variables (not tabulated). Control variables are not tabulated for brevity. All variables, except *FRQ_INDEX1* in Panels A and B, are de-meaned at the firm level so that the model is equivalent to a model with firm fixed-effects. To facilitate interpretation, *FRQ_INDEX1* is standardized to have a mean of zero and a standard deviation of one. Standard errors are clustered at the state and year level. *t*-statistics are presented beneath the coefficients within parenthesis. *, **, *** denote significance (two-sided) at 10%, 5% and 1%, respectively.

Panel A – Measurement Error

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Model	Main Result	Own RE Full period	Disposer post-1993	Acquirer post-1993	Ranked RE_Value	1% Winsor.	With Op. Lease	Dependent Var_{t+1}	Full FRQIndex
Dependent variable: Investment									
RE_VALUE_t	2.20***	2.98***	1.56*	10.81***	6.13***	1.01***	3.51***	4.67***	2.34***
	(5.54)	(7.03)	(1.88)	(4.64)	(6.52)	(2.84)	(6.91)	(3.28)	(5.57)
$\mathbf{FRQ\_INDEX1_{t-1} * RE\_VALUE_t}$	**-0.62*** **	**-0.79*** **	**-0.50**	**-2.09**	**-0.57**	**-0.36**	**-0.49***	**-2.19**	**-0.67*** **
	(-3.12)	**(-5.50)**	**(-0.83)**	**(-1.01)**	**(-1.26)**	**(-1.18)**	**(-1.87)**	**(-1.13)**	**(-2.85)**
Obs	21,749	11,959	1,688	3,382	21,749	21,749	21,749	19,628	6,016
Dependent variable: Financing									
RE_VALUE_t	2.17	7.09***	1.89	29.52***	7.12**	-0.18	3.48**	3.47**	2.55
	(1.46)	(5.13)	(0.53)	(3.01)	(2.34)	(-0.17)	(2.47)	(2.46)	(1.24)
$\mathbf{FRQ\_INDEX1_{t-1} * RE\_VALUE_t}$	**-2.48*** **	**-2.96*** **	**-0.50**	**-6.84**	**-3.86** **	**-2.39*** **	**-2.36** **	**-2.50*** **	**-2.13**
	(-2.79)	**(-2.77)**	**(-0.44)**	**(-0.78)**	**(-2.14)**	**(-3.33)**	**(-2.48)**	**(-2.81)**	**(-1.59)**
Obs	21,749	11,959	1,688	3,382	21,749	21,749	21,749	21,749	6,016
Dependent variable: Disclosure									
$\mathbf{RE\_VALUE_t}$	**-0.15*** **	**-0.21***	**-0.12***	**-0.38***	**-0.31*** **	**-0.09*** **	**N/A**	**-0.15*** **	**-0.10** **
	(-3.52)	**(-3.77)**	**(-1.88)**	**(-1.70)**	**(-3.55)**	**(-5.12)**		**(-3.46)**	**(-1.99)**
Obs	18,316	10,200	1,531	3,129	18,316	18,316		19,799	10,497

Table 7: (Cont'd.)

Panel B – Types of News

	Types of News			
	(1)	(2)	(3)	(4)
Model	Positive News	Negative News	No Financial Crisis	Large News
Dependent variable: Investment				
RE_VALUE_t	2.51***	1.73***	2.28***	1.85***
	(4.42)	(3.51)	(5.11)	(5.66)
$\boldsymbol{FRQ\_INDEX1_{t-1} * RE\_VALUE_t}$	**-0.41**	**-0.67*** **	**-0.66*** **	**-0.49** **
	(-1.38)	**(-2.86)**	**(-3.16)**	**(-2.33)**
Obs	12,426	9,323	20,242	14,670
Dependent variable: Financing				
RE_VALUE_t	3.23*	1.17	2.38	1.01
	(1.77)	(0.76)	(1.52)	(0.60)
$\boldsymbol{FRQ\_INDEX1_{t-1} * RE\_VALUE_t}$	**-1.26** **	**-2.89** **	**-2.17** **	**-2.35** **
	(-1.99)	**(-2.53)**	**(-2.32)**	**(-2.07)**
Obs	12,426	9,323	20,242	14,670
Dependent variable: Disclosure				
$\boldsymbol{RE\_VALUE_t}$	**-0.12** **	**-0.10** **	**-0.14*** **	**-0.11** **
	(-1.99)	**(-2.57)**	**(-2.92)**	**(-2.50)**
Obs	11,245	7,073	16,837	12,351