Real Estate Risk, Corporate Investment and Financing Choice

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Abstract

This paper examines how asset risk impacts corporate investment and financing decisions. We derive a general model that incorporates risk, adjustment cost, and depreciation features of assets-in-place into investment decisions. The model suggests that the risk and adjustment cost of assets-in-place reduce both corporate investment and financing. We empirically test the model in a panel of US firms from 1985 to 2010 with data on real estate risk exposure. Evidence shows that real estate risk is negatively associated with firms' long-term investments and long-term external financing in equity and debt. However, the effect on leverage depends on risk measures and asset types. Overall, in contrast to previously documented effect of the real estate value, real estate risk exposure exhibits mostly the opposite effects on investment, financing, and capital structure.

Keywords: Real estate risk, corporate investment, external financing

JEL Code: G12, G30, G32

1. Introduction

The existing literature shows that the unique features of real estate assets compared to other capital goods are associated with several interesting patterns in corporate finance. First, a collateral effect of real estate assets suggests that an increase in real estate value exerts a positive impact on corporate financing hence investment through its collateral function (e.g., Berger and Udell 1990, Chaney, Sraer and Thesmar 2012). However, the collateral channel also makes firms vulnerable to real estate market fluctuations such as bubble and bust (Gan 2007). Second, high irreversibility and low depreciation rate of real estate assets (Glaeser and Gyourko 2005) deteriorate firms' capacity to sustain through productivity shocks (Tuzel 2010). Moreover, while real estate assets make an ideal diversification and inflation hedge instrument (Ambrose, Cao and D'Lima 2013), investors demand an additional return premium on firms concentrating in real estate ownership (Funke, Gebken, Gaston and Lutz 2010, Ling, Naranjo and Ryngaert (2012), which leads to underperformance in hedge funds that focus on real estate strategies (Ambrose, Cao and D'Lima 2013). Despite these complexities in financial performance associated with real estate risk, no study has examined the real effect of the risk embedded in corporate real estate holdings. This paper fills the void by examining how real estate risk affects corporate real investments and financing decisions.

We develop a general model in a real option framework to understand the adjustment cost and risk of production assets in affecting corporate investment and financing. Our model builds on the spirit of Berk, Green and Naik (1999), in which the firm value originates from the value of assets-in-place and the value of growth options, and the firm's investment decision is to exercise the real option to maximize firm value. The value of the option depends on demand shock level and risk, current and new investment production capacity, operational cost, and adjustment cost. We solve the maximization problem to find the optimal investment threshold.

The optimal solution predicts the following relations: first, the adjustment cost is negatively associated with investment. Second, the risk of assets raises the threshold for exercising option and leads to a low level of investment. Third, the correlated risk between different types of assets is also negatively associated with investment. Financing costs is positively associated with the threshold and hence negatively with investment. Consequently, assets with high collateral values lower debt cost and drive up firms' leverage. However, the risk of corporate assets-in-place raises financing costs, which reduces external financing in both debt and equity.

Using the US firm data from 1985 to 2010 and in the setting of real estate holding, we empirically verify the model's predictions, in particular those between risk of assets-in-place and investment and financing. We focus on the real estate assets holding, not only because it empirically captures the adjustment cost through its irreversibility feature, but also because the additional exposure to real estate market capture both the risk of assets and the correlated risk between different types of assets, i.e., real estate assets and other corporate assets.

We use two measures of real estate risk. The first one is a real estate industry specific risk which uses residuals from an estimation of real estate investment trusts (REITs) on capital market portfolio in time series. The second one measures the individual firms' exposure to real estate risk, i.e., an estimated beta on REITs returns from a two-factor model including both the capital market factor and the real estate factor. We find that both risk measures are negatively associated with corporate investment and external financing. However, the overall leverage effect is mixed due to the additional collateral effect in debt financing and related credit market condition.

In addition to the above new evidence, we also include the value of real estate holdings in the analysis and we find that the value of real estate is positively associated with debt financing and investment. These results are consistent with the model's new predictions as well as existing empirical evidence in the literature about the effect through collateral channel (Chaney, Sraer and Thesmar 2012).

Our paper makes important contributions to the literature: first, it is among the first few to model how features of assets-in-place affect corporate investment and financing. The model setting is general and the predicted relations between asset risk and investment as well as financing, in both time series pattern and cross sectional pattern, are applicable to all type of assets. Second, while prior empirical literature focuses on only the price level of the real estate assets, this paper highlights the effect of real estate risk. Gan (2007) documents that firms holding real estate assets are more vulnerable to real estate bubble bust than non-real estate holding firms in Japan, which is the closest to our paper's part that examines the effect of risk in term time series fluctuations. Our paper has two benefits in deriving and documenting this time series effect. One, it is a general setting rather than a specific significant event like bubble-and-burst and two, our model derives predictions directly from the real option value maximization problem within the firm in relation to asset features and demand shocks. Hence these predictions are robust to the financing channel and credit market condition, while the Japanese evidence during crisis relies heavily on the lending channel and bank industry conditions. Finally, our model provides theoretical support to the existing empirical evidence on how the value of real estate holding affects investment and debt financing.

Furthermore, this model provides the missing link -investment, for relation between production and assets pricing in studies that focuses on real estate asset holdings in corporations. Our model explains why asset irreversibility affects firm production. Tuzel (2010) suggests that, in a general equilibrium model in a production economy, high irreversibility cost and low depreciation rate of real estate held by the firm deteriorate firms' capacity to adjust for productivity shocks. Ling, Naranjo and Ryngaert (2012) attribute stock returns' exposure to a real estate factor in real-estate-intensive firms to this channel of production capacity. Our model illustrates this mechanism through investment. Moreover, our model's cross sectional prediction, that firms with high real estate risk have low investment, is an alternative explanation for the empirical evidence in the assets pricing literature that hedge fund strategies that target on real estate underperforms (Ambrose, Cao and D'Lima 2013). The inexact explanation provided in some previous studies claiming that extra risk estate exposure requires additional premium, actually should have implied the opposite.

The rest of the paper proceeds as follows. Section II presents the model, its extensions, and predictions. Section III describes the data and empirical test design. Section V presents the empirical results and robustness tests. Section VI concludes the paper.

2. The Model

In this section, we develop a model in a real option framework to show how capital heterogeneity in adjustment cost, operational cost, and risk of firms' assets-in-place affect corporate investment. The model's setting is similar to the one in Berk, Green, and Naik (1999) and Carlson, Fisher and Giammarino (2004) except that we take continuous approach for one representative firm and focus on corporate investment decision rather than explaining cross section stock returns. All random variables in the model are defined on a filtered probability space.

2.1 The basic model

A. The Firm and Investment Opportunities

The market clearance price for a firm is determined by its output and demands:

$$P_t = X_t Q_t^{-1/\alpha} \quad (1)$$

where P is price. Q is quantity. α is the elasticity of demand. The demand, $X_{t,}$ is an exogenous state variable as follows:

$$dX_t = \mu X_t dt + \sigma X_t dB_t \quad (2)$$

where μ and σ are respectively the growth and volatility of X_t, and B_t is a standard Brownian motion.

The firm produces goods from installed capital k_t and new investment I_t. The production function $Q(k_t)$ is strictly increasing. Capital accumulates as

$$K_{t+1} = I_t(X_t) + (1 - \delta)K_t \quad (3)$$

where δ is the rate of depreciation which depends on the composition of the assets such as real estate and other corporate capital.

Capital investment entails adjustment cost $\lambda(I_t)$. The firm incurs a fixed operating cost in each period $F_t = F(k_t) > 0$. Without outside financing, the cash flows of the firm are

$$C_t = X_t Q_t^{1-1/\alpha} - F_t - \lambda_t \quad (4)$$

B. Firm value Dynamics

We simplify the model by assuming a perfect interest alignment between the management and the shareholders. The management chooses investment and subsequent production to maximize firm value when facing exogenous demands Xt.

$$V_t \equiv \max_{Q,I} E\left\{\int_0^{\infty} e^{-rs} C_{t+s} ds | \digamma_t \right\}$$

$$\equiv \max_{Q,I} E\{\int_t^{\infty} e^{-r(s-t)}(Y_t - (F_t + \lambda_t))ds | \digamma_t\} \quad (5)$$

where r is the discount rate; C_{t+s} is the cash flow of the firm at time $t + s$; F_t is the fixed operating costs in each period; Y_t is total sales in each period equal to $X_t Q_t^{1-1/\alpha}$, which evolves according to the process of X_t.

Based on Bellman equation and Ito's Lemma (Fleming and Rishel, 1975; MaDonlad and Siegel, 1986; Dixit, 1990; Dixit and Pindyck, 1994), the process of V_t can be represented with the following differentiation equation[1]:

$$rVdt = EdV = \frac{1}{2}\sigma^2 Y^2 V_{yy} + \mu Y V_y \quad (6)$$

To solve V_t , it should take a form of [2]

$$V(Y) = AY^{\varphi} \quad (7)$$

where A is a scale and the value is determined by parameters in the value maximization problem; and φ is the firm value elasticity of sales and its value is determined by the parameters r (the discount rate), μ (growth of X_t, hence Y_t) and σ (volatility of X_t, hence Y_t). V_y and V_{yy} respectively denote the first and second derivatives of firm value with respect to sales Y_t. Combining equation (6) and (7), the scale, A, is canceled out on both sides and gives $\frac{1}{2}\sigma^2\varphi(\varphi - 1) + \mu\varphi - r = 0$. We can therefore solve for φ[3]:

$$\varphi = \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} + \frac{1}{2} - \frac{\mu}{\sigma^2} \quad (8)$$

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[1] The firm value must also satisfy the following boundary conditions $V(0) = 0$; $V(Y^*) = Y^* - F - \lambda$ (the critical investment condition) and also $\frac{dV(Y^*)}{dY^*} = 1$ (smooth and continuous are the critical point) (Dixit and Pindyck 1994). Furthermore, this representation assumes that the firm pays no dividend. If we were to consider cash dividend payment, there would be an additional component in firm value, and this component nevertheless would be incorporated in the optimal investment level.

[2] Dixit and Pindyck (1994) prove that this is the function form that meets the above boundary condition.

[3] The other root, $= -\sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} + \frac{1}{2} - \frac{\mu}{\sigma^2} < 0$, does not meet the boundary condition.

C. Optimal investment point and the critical value of demand

We can now solve the total sales at the critical investment point based on the elasticity parameter φ and the boundary conditions: [4]

$$Y^* = \frac{\varphi}{\varphi-1}(F + \lambda) \tag{9}$$

As the process of Y_t^* evolves in this form,

$$dY_t^* = \frac{\varphi}{\varphi-1}(dF_t + d\lambda_t) \tag{10}$$

the total growth option value therefore is

$$\int_t^{\infty} dY_t^* = \frac{x_t^* Q_t^{1-\frac{1}{\alpha}}}{\delta} = \frac{\varphi}{\varphi-1}(F + \lambda) \tag{11}$$

The optimal investment strategy is achieved when the variable X_t reaches the critical value x_t^*, where $X_t = X_{t+\Delta} = x_t^*$, therefore,

$$x_t^* = (1 + \frac{1}{\varphi-1})(F + \lambda)\frac{\delta}{Q_t^{1-1/\alpha}} \tag{12}$$

2.2 The extension of the model

A. Risk hedging

The basic model confines the role of firms' assets-in-place to production. Practically, the firm can use liquid tradable assets to hedge the demand shock X_t (Carlson et. al., 2004) . The hedging assets are also correlated with other assets in production. We extend the traditional analytical framework to incorporate this additional feature of firms' assets composition.

Suppose that the price process of the risk-free bond/asset evolves with dynamics

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[4] The boundary condition of $V(Y^*) = Y^* - F - \lambda$ gives $AY^{*\varphi} = Y^* - F - \lambda$ .Taking first-order differentiation, we have $A\varphi Y^{*\varphi-1} = 1$. Together with the condition itself, we solve $Y^* = \frac{\varphi}{\varphi-1}(F + \lambda)$ and $V(Y^*)=\frac{1}{\varphi-1}(F + \lambda)$. Therefore, we know $V(Y)=\varphi^{-\varphi}(\varphi-1)^{\varphi-1}(F + \lambda)^{1-\varphi}Y^{\varphi}$.

$$dR_t = rR_t dt, R_0 = 1, \tag{13}$$

where r is the risk free rate, and price for tradable risky assets (market portfolio, N_t) evolves in a geometric Brownian motion as follows.

$$dN_t = \mu_n N_t dt + \sigma_n N_t dG_t, N_0 = n > 0 \tag{14}$$

where μ_n and σ_n are respectively the drift and volatility of N_t, and G_t is a standard Brownian motion. The other production assets such as real estate are arguably less liquid. Let the value of the real estate evolve in the following Brownian motion:

$$dH_t = \mu_h H_t dt + \sigma_h H_t dW_t, H_0 = h > 0 \tag{15}$$

where μ_h and σ_h are positive, and the process W_t is a new standard Brownian motion, correlated with G_t. The correlation coefficient ρ is ranging from -1 to 1.

The total portfolio with possibly time-varying weights in risk-free asset (R_t) ω_{0t}, market portfolio (N_t) ω_{1t}, and real estate assets (H_t) ω_{2t} is perfectly correlated with X_t. The process of X_t in equation (2) therefore is equivalent to the following:

$$dX_t = (r - \delta)X_t dt + \sigma X_t d\hat{B}_t \tag{16}$$

Where the process $\hat{B}_t$ is a new standard Brownian motion [5] and $\sigma^2 = (\omega_{1t}\sigma_n)^2 + (\omega_{2t}\sigma_h)^2 + 2\omega_{1t}\omega_{2t}\rho\sigma_n\sigma_h$. That is, the hedging assets risk, other production assets risk, and their co-movement are jointly associated with the risk of X_t and determine the risk of firm value. Correspondingly, φ in this extended model becomes:

$$\varphi = \sqrt{\left(\frac{1}{2} - \frac{r-\delta}{(\omega_{1t}\sigma_n)^2+(\omega_{2t}\sigma_h)^2+2\omega_{1t}\omega_{2t}\rho\sigma_n\sigma_h}\right)^2 + \frac{2r}{(\omega_{1t}\sigma_n)^2+(\omega_{2t}\sigma_h)^2+2\omega_{1t}\omega_{2t}\rho\sigma_n\sigma_h}} + \frac{1}{2} - \frac{r-\delta}{(\omega_{1t}\sigma_n)^2+(\omega_{2t}\sigma_h)^2+2\omega_{1t}\omega_{2t}\rho\sigma_n\sigma_h} \tag{17}$$

[5] Specifically, $\hat{B}_t = B_t + \frac{\omega_{1t}\mu_n + \omega_{1t}\mu_h - r}{\sigma} t$

B. Financing

We can also incorporate external financing into the model. Suppose the firm issues debt or equity to finance the investment which incurs a cost τ_t , $\tau_t = \min(d_t, e_t)$, where d_t is the cost of debt, and e_t is the equity cost. The firm's cost of debt is determined by the availability of collateral (e.g., real estate H_t and other collateral assets) and overall credit market conditions. Therefore, the financing cost $d(H_t, CM_t)$ decreases with value collateral assets $d_H < 0$ and credit market booming $d_{CM} < 0$, and increases with the risk of collateral assets, $d_{HH} > 0$. The cost of equity is determined by value of the firm's assets-in-place, $A_t = H_t + N_t$. Therefore the equity cost, $e(A_t)$, decreases with the value of assets-in-place, $e_A < 0$ and increases with the risk of assets-in-place, $e_{AA} > 0$.

Hence, the firm's maximization problem changes as

$$V_t \equiv \max_{Q,I} E\left\{\int_t^{\infty} e^{-r(s-t)}(Y_t - (F_t + \lambda_t + \min(d_t, e_t))ds | \mathcal{F}_t\right\} \quad (18)$$

Following the same derivation above, we can show that the critical value of demand x_t^* is now:

$$x_t^* = \left(1 + \frac{1}{\varphi - 1}\right)(F + \lambda + \int d\min(d_t, e_t))\frac{\delta}{Q_t^{1-1/\alpha}} \quad (19)$$

In a simpler form:

$$x_t^* = \left(1 + \frac{1}{\varphi - 1}\right)(F + \lambda + \tau)\frac{\delta}{Q_t^{1-1/\alpha}} \quad (19')$$

where, $\tau_H < 0$, $\tau_{CM} < 0$, $\tau_{HH} > 0$, $\tau_{HN} > 0$

2.3 Predictions of the model

The model and its extensions generate interesting implications for the relations between adjustment cost, risk, and co-movement of the assets and firm investment and financing. Equation (12) shows that the critical value of demand x_t^* is a function of adjustment cost λ, output Q_t and the elasticity parameter φ, which itself, as equation (8) and equation (17) show, is a function of risk of assets σ, their correlation ρ, and depreciation rate δ. These equations predict the following for the critical values of demand X_t: when adjustment cost λ increases, the critical value of demand x_t^* increases. When risk of assets σ or their correlation ρ increase, the elasticity parameter φ decreases[6], which in turn also raises the critical value of demand x_t^*. The mechanisms are intuitive: as the uncertainty over the future value/cash flow of the firm increases, or the adjustment cost of capital is high, the firm demands high excess payoff to make investment. The mathematical representation is that elasticity parameters between sales Y_t^*, and production costs $F + \lambda$ needs to be large enough.

As the investment decision is less likely to be made when the critical value for option exercising increase, the above relations generate the following hypotheses for investment:

H1: Investment is low when adjustment cost is high.

H2: Investment is low when the risk of assets is high.

H3: Investment is low when the correlation between assets-in-place is high.

As for financing decisions, equation (19') shows that the critical value x_t^* is high when financing cost τ is high. The intuition is direct: if the opportunity cost of investment is high, firms require a high threshold to exercise the real option. Therefore, investment and financing are negatively associated with financing costs.

Nevertheless, the financing cost depends on the capital market dynamics and risk of firm value, hence the risk of its assets-in-place. Although the collateral channel

[6] Taking differentiation of φ with respect to σ in equation (8) givers a negative relation between φ with respect to σ. We can measure the risk of assets with σ, because the value of firm follows the same process of X_t. Hence the risk of firms is σ. We can also show the relation between assets risk and X_t risk explicitly by modeling a perfect hedge between assets-in-place and demand shock, which results a solution that, if compared to the result from our basic model, only changes in the drift term from μ to $r - \delta$ (Carlson, Fisher and Giammarino, 2004)

suggests that the value of assets-in-place, in particular, real estate assets, enables better access to debt financing ($\tau_H < 0$,,), the risk of real estate, disregarding whether it comes from the market fluctuations, such as a downturn in housing/equity markets or firms' heterogeneous exposure to the markets, increases the uncertainty of future cash flows, hence hurts firms' credit worthiness ($\tau_{HH} > 0$, $\tau_{HN} > 0$). Therefore, the risk of assets raises firms' financing costs in both equity and debt, and reduces firms' external financing capacity. Furthermore, the market performance, highly correlated with economic cycle, is often correlated with overall credit market conditions, hence when assets values increase, firm leverage is likely to increases because of further reduction in the debt cost ($d_{CM} < 0$).

H4: The value of collateral assets-in-place enhances debt financing and firm leverage.

H5: The risk of firm's assets-in-place reduces external financing in both equity and debt.

Since assets market shocks are often correlated with real economy shocks, the bank industry is likely to go through a credit crunch during the assets markets' downturn period. The debt financing may be decreased more than equity financing because of this feedback effect. Therefore, the overall leverage is likely to be negatively associated with the assets risk in time series pattern. In cross section, however, while the assets risk raises financing cost in both equity and debt, assets with collateral values may help reduce the cost in debt. Therefore, firm leverage is likely to be positively associated with the portion of collateral assets in the firm. Therefore, how the risk of assets-in-place is correlated with firm leverage depends on the measurement of the risk and composition of assets.

H6A: The market wide risk of firm's assets-in-place reduces firms' leverage.

H6B: The exposure to collateral assets' risk raises firm's leverage.

Moreover, the depreciation cost of assets-in-place is likely to be negatively associated with investment and financing also through the collateral channel, because fast depreciation results in less collateral assets. The existing literature largely focuses on empirical test of H4 only. In the rest of the paper, we will empirical verify all the hypotheses generated from the model.

3. The sample

The sample includes a panel of US listed firms from 1985 to 2010. We exclude financial, energy, and REITs. The accounting data are retrieved from COMPUSTAT and the stock return data from CRSP. Following Nelson et al. (1999) and Chaney et al. (2012), we use the observations on buildings, land and improvement, and construction in progress from COMPUSTAT to proxy the value of real estate in each firm[7]. "Building" is reported at the replacement cost of the buildings; "Land and improvement" reports both acquisition costs and related expenses on the land; "Construction in process" includes the uncompleted real estate development projects.

We choose to measure the risk of assets-in-place with the risk of real estate assets held by the firm for three reasons: first, the adjustment cost of any particular type of assets lacks variation within itself but differs across the real estate assets and other corporate assets, hence we can use the exposure or relative portion of real estate assets over total assets as a good proxy for the adjustment cost. Second, we want to measure both the time series and cross sectional variation in the risk of assets. The real estate assets are better than general corporate assets, because the real estate market fluctuation is not as correlated as the stock market with the real economy

[7] We record the value for the real estate holdings on the book value instead of the market value in Chaney et al. (2012), since the market value endogenizes the risk of the real estate assets.

fluctuation. Third, testing the model in real estate setting allows us to relate the prediction with the existing empirical evidence on the value of real estate assets in the literature.

3.1 Sample descriptions and variables

We deploy the overall returns on real estate investment trusts (REITs) as the benchmark to construct measures of the real estate assets. REITs return is the right benchmark for this purpose: On the one hand, REITs are excluded from the portfolio formation of the major asset pricing factors, hence using REITs return isolates the real estate risk from other pricing factors (Funke, Gebken, Gaston and Lutz 2010). On the other hand, REITs compared to other real estate assets contain more timely information about the public real estate market due to more frequent disclosure which reduces information asymmetry. Restrictions on investment options for real estate assets and regulations on dividend pay-outs (Boudry 2011) force REITs to rely primarily on external financing to fund investments and use external financing far more often than general firms do (Boudry, Kallberg and Liu 2011; Ott, Riddiough and Yi 2005).

To capture the time series variation in real estate market risk, we orthogonalize the excess returns of REIT returns to the excess market return:

$$R_{re,t} - R_f = \alpha_0 + \alpha_1(R_{mk,t} - R_f) + \varepsilon_t \tag{20}$$

where $\mathrm{R_{re}}$ is the return on the composite REITs index[8] minus, $\mathrm{R_{mk}}$ is the return on the CRSP value-weighted portfolio, and both are measured in excess of the risk-free rate R_f on U.S. 3-month treasury. The regression is conducted with monthly data, and then for each year, we sum up the residuals. We define the real estate specific risk

[8] Composite REITs index contains a broad set of publicly-traded real estate, including equity REITs (EREITs), hybrid REITs (HREITs), and mortgage REITs (MREITs). The index data is obtained from the National Association of Real Estate Investment Trusts (NAREIT) website (www.nareit.com).

(REF) with the yearly residual ε_t, which gives us measures of a time series real estate assets risk.

We plot in Figure 1 the market returns and the estimated real estate industry specific risk (REF) across the sample over 1985 to 2010. It is salient that the market and real estate specific returns have varied significantly over time. These two markets co-move better and the volatility of real estate market is relatively smaller prior to 1997 than afterwards. Both real estate risk and market risk exhibit wider fluctuations in early 2000s when the tech-bubble hit the peak and then burst with market bottoming out in 2000. After 2005, real estate market fluctuates more than the stock market as the subprime crisis emerges.

[Insert Figure 1 about here]

To capture the cross sectional variation of real estate risk among the firms due to the variation in corporate real estate holdings, we measure firms' heterogeneous exposure to real estate market risk using a multi-factor asset pricing framework (Jorion 1990; Ling, Naranjo and Ryngaert 2012). We estimate the following two factor model using monthly data.

$$R_{it} - R_f = \alpha_0 + \beta_i^{mk}(R_{mk,t} - R_f) + \beta_i^{re}(R_{re,t} - R_f) + \varepsilon_{it} \quad (21)$$

where R_{it} is the return on firm stocks, R_f is the returns on 3-month treasury, R_{re} is the returns on REITs, and R_{mk} is the returns on the CRSP value-weighted portfolio. The coefficient β_i^{mk} is the market beta. The coefficient β_i^{re} (the real estate beta) is the firm i's exposure to the real estate risk, after controlling the stock market exposure. We prefer the two-factor equation here over Fama-French equation, because the beta measured from the latter are likely suffer from a correlated-error problem as large firms are more likely to hold real estate than small firms. Nevertheless, we conduct robustness test with the latter.

For each firm and each year, we run equation (21) with monthly returns from the past 60 months. Observations with less than 24 months in the past 60 months are excluded. We define individual firms' exposure to real estate risk with the estimated beta. Regressions with rolling window produces a panel of individual firms' real estate market exposure.

To capture the correlation among the assets-in-place, real estate vs. others, we measure the co-movement of real estate market and equity market. Using the monthly observations of returns on the composite REITs index and CRSP value-weighted index, we calculate their correlation on a yearly basis.

We measure corporate investment with CAPEX over total PPE. Firm characteristics control variables follow the conventions in the literature: we use the nature logarithm of firm's market capitalization (Size) as firm size, the logarithm of firms' market value divided by its book value (logMB) as market-to-book ratio. We use cash flows including both cash and short-term investment measured as log(Cash). We measure financing, equity and debt, both in term of access and amount. Table 1 describes these key variables and the controls used in the analysis.

[Insert Table 1 about here]

To verify that firm's exposure to real estate risk is not mimicking the market exposure, we form 10*10 portfolios based on firm size and real estate βs estimated with data in the prior five years in any year during 1985 to 2010. We estimate the portfolio's real estate beta and market beta. Table 2 reports portfolio returns, post-ranking real estate βs, and market βs, respectively in panel A, B, and C. Panel A shows that the spread of returns across the 10 real estate β deciles is smaller than the spread across the 10 size deciles, and the spreads of average returns across the real estate β deciles decrease with firm's size. Panel B and C shows that post-ranking real estate βs closely reproduce the ordering of the pre-ranking real estate βs, but the post-ranking market βs seem to reproduce the inverse ordering of the pre-ranking real estate βs. This pattern confirms that real estate factor is not a mimicking factor for the market factor.

[Insert Table 2 about here]

3.2 Empirical test design

To test model's implications on investment, we run a standard investment equation with observations for all firms, for each firm i and each data t:

$$INV_{it} = \alpha_i + \beta REex_{it} + \gamma controls_{it-1} + \varepsilon_{it} \qquad (22)$$

where INV is the ratio of CAPEX to PPE, REex is the real estate industry specific risk measure with either REF or the firms' exposure to real estate risk. We also include the value of real estate holding to allow comparison with prior evidence. α_i is firm fixed effect.

It is problematic to directly measure adjustment costs. Nevertheless, as real estate assets have higher adjustment cost λ compared to other corporate assets, it is reasonable to assume that the portion of real estate assets over total assets is highly correlated with firms' assets' adjustment cost. We hence use the ratio of real estate value over total assets value to proxy for the cross sectional variation in the asset adjustment cost.

Control variables include market-to-book ratio, cash, leverage and others that are identified in the previous studies. Estimated β from this regression, in such specification, measures the sensitivity of corporate investment in responding to each unit of increase in the overall real estate market risk and individual firms' exposure to real estate fluctuation.

It is a legitimate concern that investment opportunity is endogeneous to real estate market conditions. We address the concern by using the natural experiment provided by the subprime crisis, which allows for difference-in-difference identification with individual firms' risk exposure, β_i^{re}. This identification is similar to Gan (2007)'s approach in examining the value of real estate holdings.

In contrast to the existing literature that implicitly assumes a constant risk in real estate risk relative to other asset classes and focuses on collateral constraints in debt financing, our model allows for the change of risk profile of firms' underlying assets and considers both equity and debt financing. We analyze the following financing equations:

$$EXF_{it} = \alpha_i + \beta REex_{it} + \gamma controls_{it-1} + \varepsilon_{it} \qquad (23)$$

where EXF is external financing such as debt and equity issuance, respectively. For the analysis is on debt financing, EXF_{it} are log(new debt issuance amount) and log(change in debt balance) observed for each firm in each year, respectively. REex is real estate industry specific risk and firms' exposure to real estate risk, α_i is firm fixed effect. The value of real estate holding is included for comparison with precious studies. Control variables include market-to-book ratio, cash, leverage and others that are identified in the previous studies.

As for equity issuance, EXF_{it} takes both the access and amount. To measure access, EXF_{it} takes the value 1 if the firm i issues equity in year t, otherwise 0. For the amount, EXF_{it} takes log(equity issuance amount) for firm i and year t.

To analyze the effect of real estate risk on the overall leverage, we run the following regression:

$$LEV_{it} = \alpha_i + \delta_t + \beta REex_{it} + \gamma controls_{it-1} + \varepsilon_{it} \qquad (24)$$

where LEV_{it} is the book leverage for each firm in each year. We choose the book leverage over the market leverage, because the latter, influenced by the overall market, would be endogeneous to real estate market conditions. $REex$ is real estate industry specific risk, firms' exposure to real estate risk, and the value of real estate holding. α_i is firm fixed effect, and δ_t is time fixed effect. Control variables include market-to-book ratio, cash, leverage and others that are identified in the previous studies.

4. Empirical Results

This section of the paper reports the empirical evidence. We first report the evidence on investment, then financing and capital structure. The empirical evidence overall supports the model's predictions on how risk of assets affects investment and financing and is also consistent with the empirical evidence document in previous studies regarding the value of real estate holdings.

4.1 Real estate risk and corporate investment

Table 3 report the empirical relations between real estate risk and corporate investment, log(CAPEX/PPE). The mean value of CAPEX/PPE is 0.362. Column (1) reports the results with the simplest estimation with only control variables, and they explain about 8.8 % of corporate investment. Column (2) shows that the weight of real estate assets in total assets, as a cross sectional proxy for adjustment cost, is significantly and negatively associated with investment. The coefficient for the weight of real estate is -0.778, so that each additional 1% of real estate collateral in relative to total assets decreases investment ratio by 0.778%. The effect is economically large: one standard deviation increase in the weight of real estate assets explains 6.2% of the investment ratio's standard deviation.

Column (3) and (4) show that real estate industry specific risk (REF) and the firm specific exposure to real estate market are both significantly and negatively associated with investment. The coefficient of the real estate industry specific risk (REF) is -1.323, which is significant at 1% confidence level. The effect is also economically significant: each additional standard deviation in real estate industry specific risk explains 1.8% standard deviation decrease in the investment ratio. As for the firm specific exposure to real estate market, the coefficient is -0.023. Each additional standard deviation in firm specific exposure to real estate market explains 1.9% standard deviation decrease in the investment ratio. Adding these risk measures into the regression also improve adjusted R2 of the regression.

To test the consistent with existing literature on real estate value, Column (5) to Column (6) include firm's real estate value (RE value scaled by PPE) as well as the real estate risk measures. It shows that the coefficients on the risk measures stay negative and the coefficient on the real estate value is positive (Chaney, Sraer and Thesmar, 2012). The coefficients for real estate value ratio are 0.009 for both Column (5) and (6), which are significant at 1% confidence level. Consistent with prior studies, the effect is economically significant: each additional standard deviation in the real estate value ratio explains 2.8% standard deviation increase in the investment ratio. Column (7) and Column (8) include the correlation between REITs returns and stock market returns in the specification. We find that correlated risk between the two types of assets is significantly associated with investment. A high correlated risk tends to decrease the investment. The effect is also economically significant: for Column (7), each additional standard deviation in the correlated risk explains 2.3% of the investment ratio's standard deviation.

Overall, the results in table 3 provide support to the hypotheses that corporate investment is negatively associated with adjustment cost and risk of assets-in-place (H1, H2, H3).

[Insert Table 3 about]

To control for the endogeneity in investment opportunity, we run the regression in the subsample from 2007 to 2009, when the twin crises in real estate market and real economy occurred. This setting gives two advantages: First the investment opportunity is relatively and homogeneously low for all firms in the twin crises; and second, the correlated risk between real estate and other corporate assets are high during the crisis period. We find that the coefficients on the real estate risk measures remain significantly negative and the magnitude of all the measures are greater compared with those in the whole sample result. However, the measure for the firm real estate value loses its explanation power in the subsample, which suggests that the findings on the real estate value in relation to investment during crisis (Gan 2007) is indeed a specific case of our model's prediction on risk, rather than the effect of real estate value.

We also run the standard difference-in-difference test in the full sample, with an indicator for crisis period and its interaction with real estate risk and real estate value, the results are consistent with the sub-sample approach here. In addition, we include the interaction term between REF and RE exposure in the specification in the robust test, the result of which indicates that firms with larger exposures to real estate are more sensitive in shrinking their investment when real estate industry risk is high. As the real estate industry risk increases during the bubble bust, this also lends support to Gan(2007)'s finding on real estate holding firms, since firms with larger exposures to real estate tend to have more real estate holdings.

Overall, the results in Table 4 confirms that the relation between investment and real estate risk is robust to investment opportunity and provides the evidence that corporate investment is negatively associated with the correlation among corporate assets (H1,H2, and H3).

[Insert Table 4 about]

4.2 Real Estate Risk and Corporate Financing Choice

A. Debt Financing

Table 5 presents the results on how real estate risk affects long term debt issuance. The dependent variable in the first three columns is a log(new debt issuance amount) observed for each firm in each year, and in the last three columns is log(change in debt balance). Consistent with prior literature on collateral effect (H4), we find that the value of real estate assets is positively and significantly associated with new debt issuance and the change in debt balance. Consistent with our model prediction (H5), the risk of real estate in both measures are negatively and significantly associated with debt issuance and change in debt balance.

[Insert Table 5 about here]

B. Equity Financing

As firms' assets risk also affect equity financing cost, we report in table 6 the results on how equity financing is affected. The dependent variable is a dummy variable that takes the value one when the firm issue new equity in the year, otherwise zero. We find that both real estate risk measures are significantly and negatively associated with the likelihood of firm issuing new equity. The coefficient on firm real estate value however is negative and significant, which aligns with crowding of debt through collateral effects.

[Insert Table 6 about here]

We further test how the amount of equity issuance is affected by the real estate risk. In Table 7, we regress log(new equity issuance amount) on real estate risk and firm characteristics. We find that both real estate risk measures are significantly and negatively associated with the amount raised through equity. Overall, the results in table 6 and 7 support our model prediction that the risk of real estate assets raises financing costs, which reduces equity financing (H5).

[Insert Table 7 about here]

C. Capital Structure

Finally, we test the implication on capital structure. Table 8 shows that the real estate industry specific risk is negatively associated with the leverage (H6A). However, in cross sectional, firm specific exposure to real estate market is positively associated with firm leverage (H6B), but the magnitude is small. In Columns (3) to (4), we include the value of real estate assets into the specification, the coefficients on real estate risk measures remains significant and the signs are consistent with those in the first two columns.

[Insert Table 8 about here]

The robustness tests discussed in the methodology and empirical results section give similar results to those reported here. They are available upon request.

5. Conclusions

We develop a model in a real option framework that incorporates the risk of assets-in-place in investment decision. The optimal solution suggests that both the adjustment cost and the risk of assets raise the threshold for exercising option and lead to a low level of investment. Furthermore, financing cost increases with assets risk, which is turn further raises the threshold for exercising the real option, and hence lowers investment. Although the external financing in both equity and debt are reduced, the overall effect on leverage depends on the measure of risk and composition of assets. We empirically test the model using US firm data but in the setting of real estate holdings. The empirical evidence supports all the predictions from the model.

This paper contributes to the literature on the real effect of real estate assets. While real estate composes a significant part of firm's portfolio, very little is known about the effects of real estate risk on these firms. Our paper fills the gap with both theoretical modeling and empirical tests.

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Table 1 Descriptive Statistics

This table describes the key variables used in this analysis: the real estate market risk, firms' exposure to real estate market risk, investment (CAPEX/PPE), market-to-book ratio, cash, and leverage.

Panel A: Real estate risk measures		
	REF	RE exposure
Mean	-0.00179	0.261
Medium	-0.00283	0.215
Standard Deviation	0.0136	0.792
Observations	61,063	61,063

Panel B: Firm characteristics					
	Investment	Cash	Asset	Market-to-book	Leverage
Mean	0.362	2.193	5.468	1.590	0.316
Medium	0.191	2.190	5.381	1.109	0.302
Standard Deviation	2.594	2.420	2.185	2.011	0.252
Observations	61,063	61,063	61,063	61,063	61,063

Figure 1: Stock market returns and the real estate specific returns from 1985 to 2010

The figure plots the stock market returns and the estimated real estate specific returns over 1985 to 2010. Real estate specific returns are estimated using in the following model.

$$R_{re,t} - R_f = \alpha_0 + \alpha_1(R_{mk,t} - R_f) + \varepsilon_t$$

where R_{re} is the excess REIT return, calculated as the returns on the composite REITs index, R_f is the U.S risk-free rate, and R_{mk} is the return on the CRSP value-weighted portfolio. The real estate risk is defined as the monthly residual ε_t from the time-series regression.

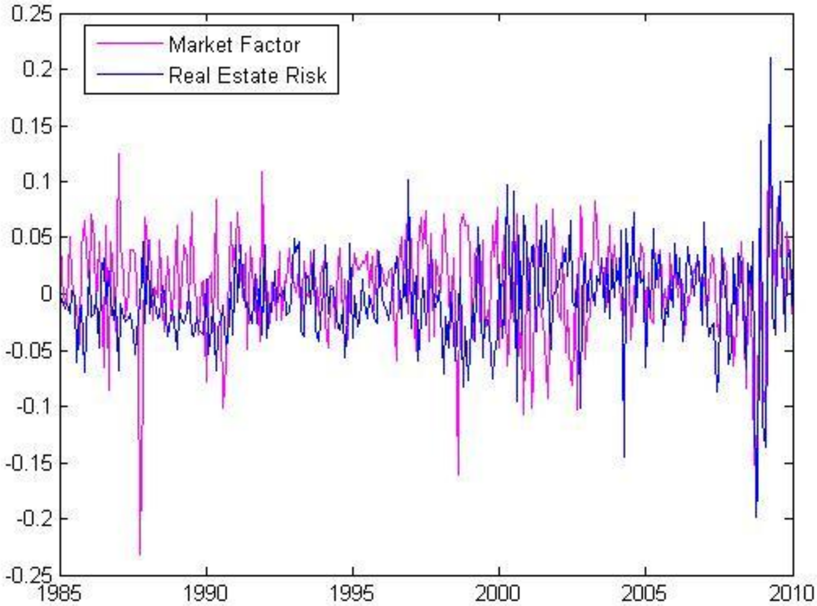

Table 2 Returns, and βs for 10*10 portfolios formed on Size and Real Estate β from 1985 to 2010

This table presents the average returns, post-ranking betas for portfolios formed on firm size and firm level real estate risk exposure (beta). Firm level real estate risk exposure and market beta estimated using the following model.

$$R_{it} - R_f = \alpha_0 + \beta_i^{mk}(R_{mk,t} - R_f) + \beta_i^{re}(R_{re,t} - R_f) + \varepsilon_{it}$$

where R_{re} is the excess REIT return, calculated as the returns on the composite REITs index, R_f is the U.S risk-free rate, and R_{mk} is the return on the CRSP value-weighted portfolio. The coefficient β_i^{mk} is the market beta. The coefficient β_i^{re} (the real estate beta) is the firm i's exposure to the real estate risk factor, after controlling for the stock market movement. All betas is calculated with observations in the 60 months prior to the month. Observations with less than 24 months return data in their prior 60 months are excluded.

	All	Low-β	β-2	β-3	β-4	β-5	β-6	β-7	β-8	β-9	High-β
Panel A: Average Monthly Returns											
All	1.18%	1.30%	1.10%	1.08%	1.01%	1.01%	1.12%	1.16%	1.20%	1.29%	1.52%
Small-ME	1.87%	2.29%	1.88%	1.74%	1.79%	1.74%	1.64%	1.62%	1.64%	1.89%	2.47%
ME-2	1.42%	1.82%	1.26%	1.31%	0.90%	1.09%	1.28%	1.48%	1.52%	1.70%	1.83%
ME-3	1.20%	1.38%	1.24%	1.20%	1.21%	0.85%	1.14%	0.97%	1.10%	1.18%	1.72%
ME-4	1.15%	1.22%	1.18%	1.10%	0.76%	0.79%	1.11%	1.08%	1.23%	1.50%	1.52%
ME-5	1.03%	1.13%	0.76%	0.74%	0.80%	0.97%	1.15%	1.11%	1.25%	1.17%	1.18%
ME-6	1.02%	0.93%	0.88%	0.95%	0.93%	0.93%	0.97%	1.16%	1.01%	1.07%	1.37%
ME-7	1.06%	1.15%	0.94%	0.97%	0.83%	0.95%	1.03%	1.17%	1.14%	1.18%	1.29%
ME-8	1.06%	0.88%	1.02%	0.98%	1.01%	0.95%	1.08%	1.07%	1.09%	1.18%	1.28%
ME-9	1.02%	1.23%	0.79%	0.95%	0.92%	0.97%	0.85%	0.98%	1.17%	1.07%	1.31%
Large-ME	0.96%	0.93%	1.01%	0.89%	0.90%	0.85%	0.94%	1.01%	0.88%	1.00%	1.19%

	All	Low-β	β-2	β-3	β-4	β-5	β-6	β-7	β-8	β-9	High-β
Panel B: Post Ranking real estate βs											
All	0.27	0.02	0.16	0.24	0.24	0.27	0.27	0.28	0.30	0.36	0.51
Small-ME	0.18	0.09	0.11	0.19	0.10	0.21	0.16	0.16	0.23	0.23	0.33
ME-2	0.18	0.05	0.17	0.20	0.17	0.16	0.15	0.17	0.21	0.18	0.32
ME-3	0.24	0.01	0.16	0.25	0.30	0.26	0.27	0.29	0.12	0.26	0.45
ME-4	0.31	0.03	0.25	0.27	0.30	0.34	0.36	0.34	0.38	0.39	0.47
ME-5	0.33	0.13	0.26	0.30	0.34	0.29	0.30	0.29	0.37	0.46	0.54
ME-6	0.36	0.06	0.23	0.35	0.35	0.41	0.41	0.31	0.34	0.50	0.59
ME-7	0.35	0.08	0.18	0.31	0.29	0.34	0.35	0.39	0.42	0.44	0.65
ME-8	0.33	0.02	0.17	0.32	0.33	0.33	0.31	0.37	0.34	0.46	0.64
ME-9	0.25	-0.05	0.12	0.18	0.19	0.27	0.22	0.27	0.27	0.37	0.66
Large-ME	0.14	-0.19	-0.07	0.07	0.06	0.13	0.19	0.19	0.27	0.26	0.45
Panel C: Post Ranking market βs											
All	0.80	1.36	0.99	0.76	0.70	0.65	0.66	0.67	0.66	0.74	0.80
Small-ME	0.71	1.14	0.80	0.74	0.71	0.54	0.60	0.55	0.53	0.68	0.79
ME-2	0.76	1.22	0.90	0.79	0.68	0.67	0.58	0.68	0.56	0.74	0.79
ME-3	0.76	1.28	0.93	0.64	0.65	0.60	0.59	0.62	0.69	0.75	0.82
ME-4	0.77	1.36	0.99	0.69	0.58	0.59	0.65	0.58	0.66	0.72	0.87
ME-5	0.78	1.39	0.87	0.69	0.59	0.61	0.69	0.71	0.64	0.77	0.82
ME-6	0.79	1.42	0.99	0.71	0.59	0.59	0.62	0.66	0.68	0.76	0.86
ME-7	0.81	1.40	1.00	0.72	0.73	0.70	0.70	0.69	0.66	0.75	0.77
ME-8	0.83	1.39	1.09	0.76	0.76	0.65	0.70	0.68	0.74	0.73	0.75
ME-9	0.88	1.49	1.10	0.90	0.81	0.73	0.73	0.74	0.77	0.78	0.74
Large-ME	0.91	1.51	1.20	0.98	0.90	0.79	0.76	0.76	0.71	0.75	0.76

Table 3 Real Estate Risk and Corporate Investment

This table presents the relation between real estate risk and corporate investment level. The dependent variable is corporate investment scaled lagged PPE (in logarithm) in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the real estate industry risk, corporate real estate value, corporate real estate composition, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Y= log (CAPEX/PPE)							
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
REF			-1.323***		-1.389***		-1.169***	
			(-3.31)		(-3.47)		(-2.95)	
RE exposure				-0.0229***		-0.0230***		-0.0249***
				(-2.93)		(-2.94)		(-3.19)
RE value					0.00879***	0.00865***		
					(6.86)	(7.32)		
RE weight		-0.778***						
		(-9.16)						
Correlation							-0.0933***	-0.106***
							(-5.23)	(-5.81)
Period	-0.0849***	-0.104***	-0.0992***	-0.0878***	-0.0992***	-0.0872***	-0.0674***	-0.0540***
	(-5.88)	(-7.19)	(-7.00)	(-6.08)	(-7.00)	(-6.04)	(-4.62)	(-3.54)
Market-to-book	0.0985***	0.0977***	0.0978***	0.0982***	0.0978***	0.0983***	0.0972***	0.0974***
	(13.34)	(13.33)	(13.30)	(13.36)	(13.30)	(13.36)	(13.21)	(13.26)
Cash	0.0404***	0.0366***	0.0391***	0.0402***	0.0391***	0.0403***	0.0386***	0.0394***
	(8.92)	(8.09)	(8.61)	(8.89)	(8.60)	(8.90)	(8.49)	(8.72)
Asset	-0.143***	-0.144***	-0.144***	-0.144***	-0.143***	-0.144***	-0.143***	-0.144***
	(-11.39)	(-11.55)	(-11.48)	(-11.49)	(-11.47)	(-11.48)	(-11.45)	(-11.49)
Sale	0.131***	0.134***	0.131***	0.132***	0.131***	0.131***	0.131***	0.132***
	(11.47)	(11.85)	(11.55)	(11.54)	(11.54)	(11.53)	(11.54)	(11.54)
Leverage	-0.643***	-0.633***	-0.637***	-0.636***	-0.638***	-0.637***	-0.638***	-0.635***
	(-21.36)	(-21.22)	(-21.13)	(-21.16)	(-21.18)	(-21.21)	(-21.16)	(-21.15)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	61063	61063	61063	61063	61063	61063	61063	61063
Adjusted R^2	0.088	0.093	0.089	0.089	0.090	0.090	0.090	0.090

Table 4 Real Estate Risk and Corporate Investment during the subprime crisis

This table presents the relation between real estate risk and corporate investment level during the financial crisis period. The dependent variable is corporate investment scaled lagged PPE (in logarithm) in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the real estate industry risk, corporate real estate value, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Y= log (CAPEX/PPE): Subsample 2007-2009				
	Column 1	Column 2	Column 3	Column 4	Column 5
REF		-14.16***		-14.16***	
		(-13.87)		(-13.86)	
RE exposure			-0.0672**		-0.0672**
			(-2.54)		(-2.54)
RE value				-0.0407	-0.0701
				(-0.11)	(-0.19)
Market-to-book	0.118***	0.102***	0.117***	0.102***	0.117***
	(8.43)	(7.52)	(8.39)	(7.51)	(8.38)
Cash	0.0440***	0.0505***	0.0439***	0.0504***	0.0437***
	(4.33)	(4.95)	(4.33)	(4.84)	(4.23)
Asset	-0.0915***	-0.0937***	-0.0935***	-0.0934***	-0.0931***
	(-2.88)	(-2.94)	(-2.95)	(-2.84)	(-2.84)
Sale	0.0849***	0.0819***	0.0864***	0.0817***	0.0862***
	(2.93)	(2.82)	(2.99)	(2.77)	(2.93)
Leverage	-0.621***	-0.611***	-0.609***	-0.611***	-0.609***
	(-8.93)	(-8.84)	(-8.73)	(-8.85)	(-8.74)
Constant	Yes	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes	Yes
No. of Obs.	9080	9080	9080	9080	9080
Adjusted R^2	0.0734	0.0873	0.0745	0.0872	0.0744

Table 5 Real Estate Risk and Long Term Debt Issuance

This table presents the relation between real estate risk and long term debt issuance. The dependent variable is firm's Log(long-term debt issued in amount) or Log(Changes in Long Term Debt balance) in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the real estate industry risk, corporate real estate value, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Log(long-term debt issued in amount)				**Log(Changes in Long Term Debt balance)**			
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
REF	-22.69***		-24.87***		-9.094***		-11.02***	
	(-8.42)		(-8.91)		(-2.82)		(-3.47)	
RE exposure		-0.0727***		-0.0638***		-0.115***		-0.109***
		(-3.46)		(-3.06)		(-5.27)		(-5.00)
RE value			0.0590***	0.0487***			0.0482***	0.0428***
			(9.95)	(9.10)			(7.73)	(7.25)
Period	0.406***	0.529***	0.418***	0.552***	0.0116	0.0432	0.0134	0.0551
	(8.27)	(10.28)	(8.56)	(10.78)	(0.21)	(0.77)	(0.24)	(0.98)
Market-to-book	-0.0676***	-0.0538***	-0.0653***	-0.0505***	-0.0571***	-0.0553***	-0.0559***	-0.0530***
	(-4.65)	(-3.75)	(-4.57)	(-3.56)	(-3.76)	(-3.76)	(-3.73)	(-3.67)
Leverage	3.777***	3.729***	3.757***	3.706***	4.624***	4.625***	4.606***	4.601***
	(37.95)	(36.81)	(38.85)	(37.51)	(44.53)	(44.58)	(45.56)	(45.55)
Profit	2.444***	2.334***	2.452***	2.331***	2.282***	2.247***	2.293***	2.248***
	(20.20)	(19.40)	(20.44)	(19.51)	(16.84)	(16.79)	(16.96)	(16.88)
Tangible Asset	1.154***	1.070***	1.062***	0.990***	1.267***	1.221***	1.189***	1.145***
	(12.46)	(11.42)	(11.63)	(10.63)	(14.29)	(13.81)	(13.50)	(12.97)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	33902	33902	33902	33902	20926	20926	20926	20926
Adjusted R^2	0.440	0.428	0.447	0.433	0.487	0.486	0.492	0.490

Table 6 Real Estate Factor and likelihood of Equity Issuance

This table presents the relation between real estate risk and equity issuance. The dependent variable is the equity issuance dummy in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the real estate industry risk, corporate real estate value, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Equity Dummy=1, if equity issuance is observed, otherwise 0			
	Column 1	Column 2	Column 3	Column 4
REF	-1.058**		-1.036**	
	(-2.71)		(-2.47)	
RE exposure		-0.0965***		-0.113***
		(-5.00)		(-5.82)
RE value			-0.152**	-0.255***
			(-2.36)	(-5.31)
Period	5.038***	5.715***	5.047***	6.744***
	(8.54)	(17.71)	(6.42)	(10.26)
MK2BK	0.00169	0.0223**	-0.00492	0.0187*
	(-0.12)	(2.23)	(-0.17)	(1.95)
Leverage	0.108	-0.241***	0.107	-0.158**
	(0.85)	(-3.24)	(0.75)	(-2.11)
Profit	-1.047***	-1.236***	-1.092***	-1.243***
	(-5.27)	(-11.99)	(-5.64)	(-12.09)
Tangible assets	-0.740***	-0.930***	-0.620***	-0.708***
	(-7.39)	(-10.65)	(-8.13)	(-7.94)
Cash	0.202***	0.280***	0.232***	0.311***
	(7.83)	(33.83)	(7.49)	(35.92)
Constant	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes
No. of Obs.	62424	62424	62424	62424
Pseudo R^2	0.365	0.190	0.359	0.207

Table 7 Real Estate Factor and amount of equity financing

This table presents the relation between real estate risk and the amount of equity issuance. The dependent variable is the log(equity issuance amount) in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the real estate industry risk, corporate real estate value, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Log(Equity Issuance Amount)				
	Column 1	Column 2	Column 3	Column 4	Column 5
REF		-4.313**		-4.254**	
		(-2.35)		(-2.32)	
RE exposure			-0.173***		-0.172***
			(-5.99)		(-5.97)
RE value				0.0580***	0.0579***
				(5.34)	(5.29)
Cash	0.395***	-1.180***	-1.210***	-1.187***	-1.217***
	(23.86)	(-26.09)	(-27.16)	(-26.31)	(-27.37)
Market-to-book	0.410***	0.363***	0.359***	0.364***	0.359***
	(9.53)	(10.15)	(10.18)	(10.15)	(10.18)
Profit	-0.327***	0.934***	0.961***	0.910***	0.937***
	(-2.74)	(9.17)	(9.62)	(8.95)	(9.40)
Sale	0.466***	1.209***	1.236***	1.224***	1.251***
	(22.25)	(9.79)	(10.01)	(9.83)	(10.05)
Leverage	-0.0854	1.134***	1.169***	1.082***	1.118***
Constant	Yes	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes	Yes
No. of Obs.	24481	24481	24481	24481	24481
Adjusted R^2	0.306	0.307	0.308	0.309	0.309

Table 8 Real Estate Factor and Capital Structure

This table presents the relation between real estate risk and capital structure. The dependent variable is the book leverage for each firm in the observation year. The independent variables are the real estate industry risk, firm level real estate risk exposure, the firm level real estate value, market-to-book ratio, cash, leverage and sale. *, ** and *** represents the 10%, 5% and 1% significance level respectively. T-statistics are included in parentheses.

	Book Leverage			
	Column 1	Column 2	Column 3	Column 4
REF	-0.396*		-0.402**	
	(-1.95)		(-1.98)	
RE exposure		0.0244***		0.0243***
		(11.89)		(11.83)
RE value			0.0610***	0.0588***
			(8.43)	(8.04)
Market-to-book	-0.0183***	-0.0179***	-0.0185***	-0.0180***
	(-12.99)	(-13.10)	(-13.06)	(-13.16)
Cash	-0.0446***	-0.0440***	-0.0447***	-0.0440***
	(-33.86)	(-33.45)	(-33.88)	(-33.46)
Assets	0.0643***	0.0651***	0.0647***	0.0655***
	(20.30)	(20.53)	(20.29)	(20.51)
Sale	0.00616**	0.00541*	0.00581**	0.00501*
	(2.20)	(1.93)	(2.05)	(1.77)
Profit	-0.197***	-0.198***	-0.196***	-0.197***
	(-16.96)	(-17.13)	(-16.89)	(-17.05)
Constant	Yes	Yes	Yes	Yes
Fixed Effect-firm	Yes	Yes	Yes	Yes
Fixed Effect-year	Yes	Yes	Yes	Yes
No. of Obs.	62022	62022	61840	61840
Adjusted R^2	0.272	0.278	0.272	0.278