The Impact of Under-Pricing of Default Risk on Investment: Evidence from Real Estate Investment Trusts (REITs)

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Abstract

Under-pricing the default risk of borrowers is inevitable in a market with many lenders because of a race to the bottom of lending rates. This study examines the impact of under-priced default risk on investment in the real estate investment trust (REIT) sector where firms' investment is highly sensitive to changes in credit market conditions. The findings reveal that REITs exploiting under-priced default risk have a higher level of investment than their peers because the former could obtain access to loans having low rates of interest. Moreover, exploiting the under-priced default risk is specific to not only REITs but also the whole real estate investment sector. In contrast, under-priced default risk appears to have an insignificant impact on investment decisions of industrial firms. It is attributable to their total assets that do not have much real estate assets to make non-recourse loans.

Keywords: default risk, investment, real estate investment trust (REIT), under-pricing of default risk

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1. Introduction

A non-recourse loan is a type of loan that is secured by a pledge of collateral, which is usually real estate assets. If the borrower defaults on mortgage repayments, the lender could seize and sell the collateral. However, the lender would not obtain any more compensation if the collateral is less than the value of the defaulted amount. Accordingly, a put option on the underlying asset is provided to borrowers when lenders make a non-recourse asset-backed mortgage loan (Pavlov & Wachter, 2004). By using the put option to sell the underlying asset to the bank when its value decreases below the outstanding balance of the loan, the borrower could easily walk away from any future obligations of the loan. Since the put option brings advantages to borrowers and disadvantage to lenders, the latter usually charge a higher interest rate on non-recourse loans than on recourse loans (Ghent & Kudlyak, 2011).

Pavlov & Wachter (2004, 2006) demonstrate that, if the put option embedded in a non-recourse loan is accurately priced, the price of assets (e.g., real estate assets) is not influenced by the lending. However, if the put option is under-priced, the borrower incorporates this mistake into investment decisions and results in severe consequences, which are discussed more detailed in Section 2. Under-priced put option is a situation where a lender under-prices the default risk of a borrower and charges an interest rate being lower than it should be, i.e. too low relative to the deposit interest rate (hereafter *under-pricing of the default risk*).

Real estate market, which is characterised by high leverage, is highly susceptible to changes in credit market conditions (Harrison et al., 2011; Pavlov et al., 2015). Regarding REITs, Breuer et al., (2019) report that the leverage ratio of REITs is, on average, about twice as high as that of industrial firms from the period of 1998 – 2015 (50% vs 25%). An et al., (2012) and Hardin & Wu (2010) also document that bank loans are utilised more intensively and widely by REITs than by industrial firms. In addition, Ott et al. (2005) document that there are only 7% of REIT's investment are financed by retained earnings, and Ooi et al. (2010) show that interest charges are the single largest expense item of most REITs. Therefore, under-pricing of the default risk, which leads to a relatively low lending interest rate, could significantly affect the rate of investment in the REIT sector because commercial mortgage loans are typically non-recourse (Hulse et al., 2016) and non-recourse loans have become "the marketplace standard for long-term financing of income-producing commercial real estate" (Stein, 1997). However, the influence of under-priced default risk on investment has been an under-researched question. Thus, this research is the first one that examines this influence in the REIT sector.

Using a sample consisting of 1,680 firm-year observations for 199 equity REITs over a period from 1998 to 2015, the findings from this study reveal that under-pricing of default risk is positively related to investment. Under-pricing of default risk could decrease the lending interest rate. Thus, REITs that exploit under-pricing of default risk could obtain access to loans with a low rate of interest, thereby increasing their investment, all else equal. This finding is robust when the effects of the crisis period, endogeneity bias and alternative measures of investment as well as under-priced default risk are controlled.

Furthermore, the impact of under-priced default risk on investment of industrial firms and real estate operating companies (REOCs) is also examined in the same research period. The investigation shows that under-pricing of default risk has a significant effect on investment of REOCs, but insignificant for industrial firms. Accordingly, under-pricing of default risk could be a prevalent symptom in the sector of real estate investment, but not in industrial firms. This finding is attributable to real estate assets that account for a large proportion in REITs' and REOCs' total assets and could play the role of valuable collateral to apply for a non-recourse loan.

In summary, the contribution of this research over the previous literature is to provide empirical evidence of a new driver of a firm' investment decision, i.e. under-pricing of default risk. The rest of this paper is organized as follows. Section 2 gives a brief overview of the related literature. Section 3 outlines the method of measuring under-pricing of default risk while Section 4 describes data. In Section 5, empirical results are discussed. Section 6 and Section 7 present robustness checks and an additional test, respectively before conclusions are drawn in Section 8.

2. Literature review

Several studies argue that lenders might not be able to accurately value the put option embedded in non-recourse loans because the present value of real estate projects is difficult to be accurately estimated (see, e.g., Hendershott & Kane, 1995; Pavlov & Wachter, 2004). In addition, Pavlov et al. (2015) show that under-pricing of default risk happens when limited liability, deposit insurance, managers' myopia or a combination of these factors cause the credit market to be inefficient. Moreover, there are several objective facts that induce bank managers to under-price the put option. For example, Allen (2001) argues that managers are willing to make risky but high-return investment decisions if they get only a limited penalty as these investments go bad but a high bonus when they go well. In addition, Pavlov & Wachter (2004, 2006) indicate that managers with a short-term tenure focus not only on salary but also on additional bonuses on firm performance. Thus, bank managers have a strong motivation to increase lending volume by under-pricing the put option, so that they can increase their total income. Furthermore, Pavlov & Wachter (2006) prove that under-pricing of default risk is inevitable in a market with many lenders due to the race to the bottom of lending standards.

Previous literature shows that under-pricing of default risk has several effects on firms and economy, such as inflated asset prices, stronger market crashes, and lower stock returns. In a lending market analysis, Pavlov & Wachter (2004) document that the lending interest rate is negatively related to the market prices of assets and under-pricing of default risk could reduce the lending interest rate. Hence, the presence of under-priced default risk would inflate asset prices.

Extending the theoretical model of Pavlov & Wachter (2004), Pavlov & Wachter (2006) account for the presence of many lenders. They find that a race to the bottom of the lending rate can be triggered by an increase in a number of lenders who desire to increase lending volume to earn highly short-term profits by under-pricing borrowers' default risk. This race has a negative effect on expected profits for all lenders. Accordingly, if accurately pricing banks could not gain positive profits or much profit as their expectation due to the race to the bottom, these managers could choose to under-price instead of correctly price the put option. Consequently, under-pricing of default risk becomes market-wide and inevitable. To find empirical evidence that supports the under-pricing theory of Pavlov & Wachter (2006), Pavlov & Wachter (2009) use a sample consisting of 543 REITs from 25 countries to analyse. Their analysis reveals that when a negative demand shock occurs, market crashes are more severe in countries where exhibit the symptom of under-priced default risk than in countries where do not. This finding is attributable to asset prices that have to drop deep enough to take out the prior price rise resulting from under-priced default risk, as well as capture the new supply and demand. Bao & Ding (2016) examine the influence of non-recourse and recourse loans on housing price dynamics in major U.S. cities between 2000 and 2013. Consistent with the finding of Pavlov & Wachter (2009), they find that housing price in states exhibiting non-recourse mortgages experiences a deeper drop than it is in recourse states. Similarly, Koh et al. (2005) document that under-pricing of default risk is one of the potential causes of the Asian real estate collapse in the 1990s.

Besides the effects on the economy, under-pricing of default risk also has a significant impact on stock returns of borrowers. Pavlov et al. (2015) use a sample comprising 585 REITs from 20 countries to examine the impact of macroeconomic risk factors on international stock returns. The authors find a significantly negative relationship between under-priced default risk and firm returns. Hence, they conclude that REITs exploiting under-pricing of default risk have a lower return than their peers. They explain that when exploiting under-priced default risk, REITs might generate excess free cash flow which is used to pursue inefficient projects or build corporate empires, as is the prediction of Jensen (1986) and Jensen & Meckling (1976). These investment decisions reduce the firm value, so investors bid down the stock price to penalise managers. However, Pavlov et al. (2015) provide no empirical evidence supporting their explanation.

REITs have a constraint on cash flow retention because of the mandatory dividend payment; Riddiough & Wu (2009) thus expect that REITs should have a lower rate of investment than firms that are less cash constrained do. However, the authors find evidence that rates of investment from REITs are equal or exceed that from industrial firms. They attribute it to bank loans that mitigate cash flow constraint and accelerate REITs' investment. Therefore, it is interesting to directly examine whether exploiting under-priced default risk fuel investment of REITs. However, no previous study has investigated the effects. Thus, this research aims to analyse the impact of exploiting under-priced default risk on investment in the REIT sector.

3. Measuring under-priced default risk

3.1 Identifying the symptom of under-priced default risk

The put option embedded in a non-recourse loan could be priced correctly or not. In a market assumed to have many lenders and no costs of switching lenders, the price of assets is not influenced by the lending if the put option is priced correctly or even is over-priced. In the case where the put option is over-priced, the lender would charge an interest rate higher than it should be. As a result, the borrower would no longer seek a loan from this lender, but from other lenders providing reasonable interest rates. Accordingly, these two cases are not the focus on interest. Instead of, this study focuses on under-pricing of default risk that is inevitable in a market with many lenders and has significant effects on firms and the economy.

Pavlov & Wachter (2009) develop a theoretical framework based on three main assumptions: 1) equity market is efficient, 2) investors are fully diversified and 3) the supply of assets is fixed. Their analysis suggests that there are two potential causes for a reduction in the default spread: (a) a decrease in the expected future volatility of firm returns and (b) under-pricing of the default risk. From the perspective of outsiders, they could not differentiate between the two causes of default spread declines because lenders (borrowers) would not admit that they exhibit (exploit) the behaviour of under-pricing. In addition, outsiders could also not observe the value of the put option or the fundamental price of the underlying asset. Therefore, the authors have to determine the origin of the decrease in default spread by using an intermediate factor, i.e. equity price, which has different reactions to the two reasons of reduction in default spread and is assumed to be efficient.

Specifically, the decrease in the expected future volatility of firm returns, which is a rational reason to reduce the default spread, has little influence on equity price because the volatility is fully diversifiable. Hence, correctly pricing the default risk or the value of the put option embedded in a non-recourse loan results in no correlation between changes in the default spread and equity price. In contrast, the correlation between changes in default spread and equity price is negative if lenders under-price the default risk. Under-pricing of default risk narrows the default spread, and under-priced financing produces a substantial increase in equity price because low-cost capital could increase earnings and benefit investors (for a detailed discussion and proof, see Pavlov & Wachter (2009), page 92). Therefore, the correlation between equity returns of a firm and changes in the default spread is used as an observable symptom of under-priced default risk.

3.2 Measuring under-priced default risk

Based on their theoretical framework, Pavlov & Wachter (2009) and Pavlov et al. (2015) empirically measure under-pricing of default risk as follows to find empirical support for their predictions:

$$CORR_{i,t} = \rho(r_i, \Delta) \,, \tag{1}$$

where *CORR* is the value of correlation between r_i and Δ, ρ is the correlation function, r_i is the monthly equity returns on firm *i* and Δ is the monthly changes in the default spread. The lending spread consists of the default spread and remaining components, such as operating costs. Pavlov & Wachter (2009) and Pavlov et al. (2015) assumes that the remaining components are relatively small and remain unchanged throughout the business cycle. Hence, they use the lending spread as a proxy for the default spread.

Figure 1 shows the correlation between monthly equity returns and monthly changes in the default spread. The quadratic prediction line (the dash line) appears to be as straight as the linear prediction line (the short-dash-dotted line). Therefore, the non-linear relationship between monthly equity returns and monthly changes in the defaults spread could be eliminated.

<< Insert Figure 1 here. >>

Pavlov et al. (2015) use this correlation as the proxy for under-priced default risk. However, Pavlov & Wachter (2009) indicate that only the negative correlation between monthly equity returns and monthly changes in the default spread captures the symptom of under-priced default risk. In other words, under-priced default risk should be measured as the negative value of the correlation between equity returns and changes in default spread. Therefore, *UPDR* and *COR_PO* are generated to reflect the negative and positive values of *CORR*. In particular, *UPDR* is equal to *CORR* for values of *CORR* less than zero and zero otherwise, thereby identifying under-pricing of default risk. *COR_PO* equals *CORR* for values of *CORR* greater than zero and zero otherwise, thereby capturing the positive values of *CORR*.

The width of the time window for calculating this correlation is an issue that deserves discussion (Pavlov et al., 2015). Changes in borrowing costs result in changes in real investment decisions, and changes in the investment need time to be manifested in equity returns. Accordingly, the width of the time window should be substantial enough to detect the symptom of under-priced default risk. However, if the time window is too long, the effects of under-pricing will be dismissed. Hence, the window should also be short enough to mitigate the smoothing effect. To ensure that under-pricing of default risk is adequately captured, the time windows of 12, 24 and 36 months are used simultaneously to calculate the correlation. Specifically, *CORR12, CORR24* and *CORR36* are the correlation between monthly equity returns and monthly changes in the default spread from time $t-12$, $t-24$, and $t-36$ to $t-1$, respectively.

4. Data

The sample comprises all constituent equity REITs of FTSE NAREIT All REITs Index between 1998 and 2015 that are obtained from the website https://www.reit.com. To mitigate potential problems with survivorship bias, all historical constituent equity REITs are included in the sample. All data on the firm-level are obtained from Thomson Reuters Datastream/Eikon. Data on the difference between yields of 10-year Treasury note and 3-month Treasury bill are collected from the Federal Reserve Bank of St Louis's Economic Database. Since this study includes lagged and first-difference variables, the first-year observations for each firm are lost. In addition, firm-year observations where all considered explanatory variables are not available are excluded. Thus, the final REIT sample consists of 1,679 firm-year observations for 199 equity REITs over the period from 1999 to 2015. To ease the influence of extreme outliers, the sample is winsorized at the 1% and 99% levels for all continuous firm-specific variables.

Our main dependent variable is the rate of investment (*INVEST*) while independent variables include under-priced default risk (*UPDR*), positive correlation (*COR_PO*), firm-specific characteristic variables and market variables. Firm-specific characteristic variables leverage (*LEV*), cash flow (*CASHFLOW*), growth opportunities (*GROWTH*), firm size (*SIZE*), equity issue (*EQUITY_ISSUE*) and debt issue (*DEBT_ISSUE*). In line with Pavlov et al. (2015), the effects of changes in costs of debt financing are controlled by incorporating market variables, i.e., term structure (*T10Y3M*) and lending rate (*LENDING_RATE*). The definition of these variables is shown in Table 1.

<< Insert Table 1 here. >>

Tables 2 and 3 present summary statistics and pairwise correlation coefficients, respectively. According to Table 2, the rate of investment is on average 16% that is in accordance with other studies (see, e.g., Alcock & Steiner, 2017; Ott et al., 2005). Regarding the variables of under-priced default risk (*UPDR12*, *UPDR24*, *UPDR36*) their means (absolute value) and standard deviations decrease with the increase of the time-window width for calculating correlation. This result suggests that the effects of under-priced default risk could be smoothed if the time window is longer. Table 3 shows the pairwise correlation coefficients between the independent variables. Generally, the predictors show low levels of correlation, except variables capturing under-pricing of default risk with the value of 0.51 between *UPDR12* and *UPDR24* or 0.59 between *UPDR24* and *UPDR36*. However, this is not a concern since they are regressed in separate models.

<< Insert Table 2 here. >>

<< Insert Table 3 here. >>

5. Under-pricing of default risk and investment

Lenders who under-price the default risk would decrease lending rates to increase their lending volume. If firms exploit the under-pricing of default risk, they could access low-cost capital and generate excess free cash flow that could be used to pursue new investment projects. Hence, under-priced default risk is expected to have a positive impact on REITs' investment. The following panel data regression model is conducted to test this expectation:

$$INVEST_{i,t} = \alpha + \beta_1 UPDR_{i,t-1} + \beta_2 COR\_PO_{i,t-1} + \beta_3 FIRM_{i,t-1} + \beta_4 MARKET_{i,t-1} + \varepsilon_{i,t}\,, \qquad (2)$$

where *FIRM* is a vector comprising firm-specific characteristic variables, specifically *LEV*, *CASHFLOW*, *GROWTH*, *SIZE*, *EQUITY_ISSUE* and *DEBT_ISSUE*. The vector *MARKET* includes *T10Y3M* and *LENDING_RATE*. The parameters β_i comprise the estimated coefficients while $\varepsilon_{i,t}$ consists of the error terms of the model. All explanatory variables are lagged by one year to mitigate concerns regarding potential endogeneity or reverse causality problem.

Table 4 presents the results of this analysis. Under-pricing of defaulted risk using the time window of 12 months (*UPDR12*) is presented in Column 1, while *UPDR24* in Column 2 and *UPDR36* in Column 3. Hausman's specification test indicates that the fixed effects model is the most appropriate specification for the data (see Panel A of Table A1 in the Appendix, which is available from the authors upon request). Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity. The main variables of interest are *UPDR12*, *UPDR24* and *UPDR36* that capture the effects of under-priced default risk.

Our analysis shows that the estimated coefficients of *UPDR12* and *UPDR24* are negative suggesting that under-pricing of default risk could increase REITs' investment (note that the sign of *UPDR* is negative), as is the expectation. The point estimates range from –0.104 to –0.053, suggesting that a one standard deviation shock to under-pricing of default risk moves the rate of investment by about 2 percentage points (0.104·0.175, where 0.175 is standard deviation of *UPDR12*) to 1 percentage points (0.053·0.105, where 0.105 is standard deviation of *UPDR24*), holding all other variables in the model constant. However, this investment-increasing impact is significant in only *UPDR12*. This finding and the positive coefficient of *UPDR36* are attributable to the effects of under-pricing that is smoothed when the longer time windows are used to calculate the correlation between equity returns and changes in default spread.

Regarding firm-specific variables, the analyses show that the sensitivity of investment to cash flow is significantly positive which is in line with previous results (see, e.g., Aivazian et al., 2005; Carpenter & Guariglia, 2008). This finding suggests that an increase in cash flow would increase the investment of a firm. For example, the point estimate (1.816) of *CASHFLOW* in Column 1 indicates that the elasticity of investment with respect to cash flow, evaluated at sample means, is 0.579 (1.816·0.051/0.160, where 0.051 is the mean of *CASHFLOW* and 0.160 is the mean of *INVEST*). Hence, a 10% increase in the cash flow to asset ratio leads to an increase in investment of 5.79 percentage points, all else equal. Similarly, the impacts of equity issue and debt issue on investment are also positive that is consistent with the evidence in Alcock & Steiner (2017) and Riddiough & Wu (2009). This finding comes with no surprised because REITs rely on external funds to finance their investment. Breuer et al. (2019) document that REITs are exogenously financially constrained because they have to distribute at least 90% of their taxable income to shareholders.

In contrast, there is no evidence that the leverage ratio significantly impacts the rate of investment. This finding supports previous results in Alcock & Steiner (2017) who find that leverage has no apparent effect on investment decisions in the REIT sector. Accordingly, the authors conclude that REITs prioritise the choice of investment over the choice of leverage.

Regarding market variables, this investigation reveals that both term structure and lending interest rate have a significantly negative impact on REITs' investment. These findings suggest that an increase in lending interest rate would decrease REITs' investment because REITs heavily depend on liquidity provided by banks as they develop or acquire new properties (Hardin & Wu, 2010). In addition, REITs use more long-term debt than short-term debt (Alcock et al., 2014; Breuer et al., 2019), the increase in interest rate of long-term capital relative to short-term one, therefore, would decrease REITs' investment.

<< Insert Table 4 here. >>

6. Robustness checks

6.1 Controlling for effects of the crisis period

Following Senior Loan Officer Opinion Survey on Bank Lending Practices conducted by the Board of Governors of the Federal Reserve System[1], both supply and demand for bank loans highly fluctuate in financial crises. Hence, it is interesting to investigate to what extent the results are held during the financial crises. To control for the effects of the crises, a dummy variable (*D_CRISIS*) is included in Eq. 2. In addition, its interaction term with under-priced default risk (*UPDR* × *D_CRISIS*) is also considered to compare the influence of under-priced default risk between normal times and crisis times. From 1998 to 2015, the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER) determines that 2001, 2007, 2008 and 2009 are the years of recession[2]. Hence, *D_CRISIS* is defined to be equal to 1 for the years 2001, 2007, 2008 or 2009 and 0 otherwise.

Table 5 presents the results of this investigation. Firstly, the coefficients of *D_CRISIS* are negative in all columns. This result suggests that the crisis is negatively related to the rate of

[1] Available at https://www.federalreserve. gov/data/ sloos.htm
[2] Available at https://www.nber.org/cycles.html

investment. For example, the coefficient of *D_CRISIS* in Column 1 implies that investment in the crisis periods is, on average, 5.3 percentage points lower than investment in normal times. Regarding the interaction terms, the significant coefficient of *UPDR12* × *D_CRISIS* indicates that the effects of *UPDR12* on the rate of investment are different between normal times and crisis times. The direction and significance of the impact of the proxies for under-priced default risk as we as the remaining variables are unchanged as compared to them in Table 4. Accordingly, this outcome confirms the robustness of the main findings.

<< Insert Table 5 here. >>

6.2 Controlling for endogeneity

It is possible that the measure of under-priced default risk is endogenously determined. The characteristics of a firm which cause it to exploit under-priced default risk could also cause a change in the rate of investment. In other words, there might be some omitted variables affecting both under-priced default risk and investment, thereby leading to a correlation between *UPDR* and the error term, $\varepsilon_{i,t}$. In particular, a firm having many potential investment projects might be more likely to increase exploitation of under-priced default risk. Hence, an instrumental variable approach should be used to alleviate this endogeneity bias.

Since the existing literature provides no guidance on suitable instruments for under-priced default risk, this research develops new instruments and evaluates their reliability. As discussed in Section 2, the moral hazard could induce bank managers to under-price the default risk of borrowers. Therefore, the annual growth of bonus (*BONUS)* and that of wages and salaries (*WAGE*) of employees in the industry of "Federal Reserve banks, credit intermediation, and related activities" (data are obtained from the Economic Time Series Page[3]) are used as instruments. *BONUS* is defined as the natural logarithm of the ratio of compensation of

[3] Available at http://www.economagic. com/nipa.htm

employees at year *t* to compensation of employees at year *t – 1*. *WAGE* is calculated as the natural logarithm of the ratio of wages and salaries at year *t* to wages and salaries at year *t – 1*. The rationale for choosing these instruments is that the increase in annual bonus or wages in the previous year could induce bank managers to increase lending volume so that they could receive more bonus payments. One way to increase lending volume is to under-price the put option and reduce the lending interest rate. Therefore, these two instruments could have a direct impact on under-priced default risk, but they do not have a direct influence on REITs' investment.

After determining *BONUS* and *WAGE*, a two-stage least squares approach (2SLS) is used to estimate the effects of under-priced default risk on investment. In the first stage, under-priced default risk is regressed on all independent variables in Eq. 2 and the two instruments. In the second stage, *UPDR* is replaced with its predicted values from the first stage and re-run the Eq. 2. The results of these 2SLS are reported in Table 6. Columns 1, 3 and 5 present the results of the first stage while Columns 2, 4 and 6 present that of the second stage.

In the first stage, both *BONUS* and *WAGE* have significant effects on under-priced default risk. Annual compensation appears to increase the symptom of under-priced default risk, whereas wages have a negative impact on under-priced default risk. The validity of these two instruments is confirmed by Sanderson-Windmeijer (SW) multivariate F test of excluded instruments (Sanderson & Windmeijer, 2016) and Hansen J statistic (Baum et al., 2007) which are reported at the bottom of Table 6. The SW multivariate F test (p-value = 0) confirms that the null hypothesis (H_0: instruments can be excluded from the first-stage regressions) is rejected, which suggests that the instruments are not weak. Similarly, Hansen J statistic is far from the rejection of its null hypothesis (H_0: the instruments are valid instruments). Therefore, these two instruments are appropriate.

In the second stage, the findings reveal that the estimated coefficient of *UPDR12* retains the same sign and is significant, while *UPDR24* and *UPDR36* keep their insignificant impact on the rate of investment. In addition, the economic significance of *UPDR12*'s influence also significantly increases after controlling endogeneity bias. Specifically, the estimated coefficient, –0.252, suggests that, ceteris paribus, a one standard deviation shock to under-pricing of default risk moves the rate of investment by about 4 percentage points (0.252·0.175, where 0.175 is the standard deviation of *UPDR12*). Therefore, the outcomes of this investigation confirm that the impact of under-priced default risk, which is captured by *UPDR12*, on the rate of investment is robust and is not due to omitted variables or reverse causality problem.

<< Insert Table 6 here. >>

6.3 Alternative measures of investment

In all models used so far, investment is measured as the definition of Alcock & Steiner (2017) and Ott et al. (2005). The literature also offers other definitions of investment. For example, investment (*INVEST1*) is defined as the sum of capital expenditure, acquisitions and research and development less cash receipts from the sale of property, plant and equipment, then divided by total assets (Richardson, 2006), or investment (*INVEST2*) is measured as capital expenditures minus depreciation, then scaled by total assets (Lang et al., 1996).

For robustness check, *INVEST1* and *INVEST2* are used as the alternative measures of investment. The results are presented in Table 7. Once again, the investigation shows that only *UPDR12* has significantly negative coefficients in both models of *INVEST1* and *INVEST2*. This outcome assures that the main findings are robust even when alternative measures of investment are used. In summary, the outcomes of these robustness checks assure that under-pricing of default risk has a significantly positive impact on the rate of investment in the REIT sector. In addition, the time window of 12 months seems to be the most appropriate time window for estimating under-priced default risk.

<< Insert Table 7 here. >>

6.4 An alternative measure of under-priced default risk

Vassalou & Xing (2004) use the option pricing model of Merton (1974) to estimate default risk for individual firms (henceforth *Merton model*). Empirical studies show that this model could create a good default measure for individual firms (see, e.g., Gropp et al., 2006; Mitra & Duggar, 2009). Hence, this research uses Merton model to calculate an alternative measure of under-priced default risk.

Following Vassalou & Xing (2004), the default likelihood indicator (*DLI*) for individual firms is estimated as follows:

$$LDI = N\left(-\frac{ln(V_{A,t}/X_t + \left(\mu - \frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}}\right) \quad (3)$$

where N is the cumulative density function of the standard normal distribution, V_A is the firm's assets value, X is the book value of the debt, μ is an instantaneous drift, σ_A is the volatility of assets value and is the result of an iterative procedure, T is the maturity of debt (for the detailed calculation procedure, see Vassalou & Xing (2004), pages 835 – 837).

The default likelihood indicator reflects the default probability of a firm and ranges from 0 to 1. The probability of default is high if a firm has a high value of *LDI* and vice versa. Figure 2 depicts the aggregate default likelihood indicator for all REITs in the sample from 1998 to 2015. The aggregate *DLI* is calculated as the mean of the *DLI* of all REITs. The shaded areas represent recession periods as defined by National Bureau of Economic Research (NBER). The graph indicates that the probability of default highly fluctuates before and in crises and reaches a peak in the 2008 financial crisis.

<< Insert Figure 2 here. >>

To capture under-priced default risk, two assumptions are made. First, total debt of REITs is offered by lenders who use Merton model to assess borrowers' default risk. Second, default risk of borrowers is the only factor affecting lending decisions of lenders. According, lenders would restrict the access of loans of borrowers if the borrowers' default probability increases and vice versa. Hence, if total debt of the borrowers increases with the increase in their probability of default, this situation should be explained as the impact of under-priced default risk of lenders.

Based on this reasoning, the new measure of under-priced default risk (*NEW_UPDR*) is generated as an indicator variable that takes the value of 1 if a firm-year observation has simultaneously a positive change in *LDI* and a positive change in total debt, and zero otherwise. The change in *LDI* and the change in total debt are calculated as the difference in *LDI* between at year *t* and year *t-1* and the difference in total debt between year *t* and year *t-1*, respectively. Next, Equation 2 is re-run, but *UPDR* and *COR_PO* are replaced by *NEW_UPDR*.

Table 8 reports the results of this analysis. *INVEST*, *INVEST1* and *INVEST2* are the dependent variables of models in Panels A, B and C, respectively. Columns 1, 3 and 5 show the results of the model using the new measure of under-priced default risk while Columns 2, 4 and 6 examine the impact of the default probability on investment. All estimated coefficients of *NEW_UPDR* are significantly positive which suggests that under-pricing of default risk has a significant influence on the rate of investment in the REIT sector. For example, in Column 1, the rate of investment is, on average, 13.6 percentage points higher for years exhibiting the symptom of under-priced default risk than for years not exhibit under-priced default risk, all else equal. In addition, the analysis also provides evidence that REITs with a higher default probability have a lower rate of investment than their peers, i.e., *LDI* is negatively related to investment. When the default risk increases, it is more difficult for firms to access sources of external funds. Hence, these firms are more likely to have a shortage of capital to finance their investment. Overall, these findings support the main finding in Section 5 that under-pricing of default risk could increase the rate of investment.

<< Insert Table 8 here. >>

7. Additional test

This section examines whether the effects of under-priced default risk on investment are REIT-specific or it also exists in the whole real estate investment sector and other industries. For this purpose, the non-RE sample and the REOC sample are used. The non-RE sample consists of industrial firms while the REOC sample includes listed real estate operating companies which operate in a similar line of business as REITs but are taxable firms. The two samples are built from the Datastream universe. Regarding the non-RE sample, a company must fulfil the following criteria to be included in this sample: 1) listed on AMEX, NASDAQ or NYSE; 2) currency is listed in U.S. dollar; 3) categorized as equity; and 4) it is not in the financial sectors, specifically bank, financial services, life insurance, nonlife insurance, real estate investment and services and real estate investment trust, following the Industry Classification Benchmark. For the REOC sample, the fourth criterion of the non-RE sample is replaced by the ICB sector "Real Estate Investment and Services." Similar to the REIT sample, these two samples include both active and inactive companies to alleviate a survivorship bias. After lagging, differencing and excluding firm-year observations with missing values of any relevant variables, the non-RE sample covers 25,756 firm-year observations for 2,586 non-REs, while the REOC sample covers 407 firm-year observations for 59 REOCs. The summary statistics are presented in Table A.2 in the Appendix.

To examine the difference in the impact of *UPDR* on the rate of investment between REITs and non-REs as well as between REITs and REOCs, two joint samples (the REIT-non-RE sample and the REIT-REOC sample) and interaction terms between the indicator variable for REITs (*D_REIT*) with under-priced default risk are analysed. The REIT-non-RE sample includes REITs and non-REs and *D_REIT* takes a value of 1 for REITs and 0 for non-REs. The REIT-REOC sample consists of REITs and REOCS and *D_REIT* takes a value of 1 for REITs and 0 for REOCs.

The results of the analyses are reported in Table 9. Panel A presents the results of the REIT-non-RE sample while Panel B shows the results of the REIT-REOC sample. In Panel A, *UPDR12* has an insignificant influence on investment; however, the coefficient of the interaction term between *D_REIT* and *UPDR12* is significant at the level of 1%. This result suggests that the effects of under-priced default risk on investment are significantly different between REITs and industrial firms. In contrast, Panel B shows that the coefficient of *UPDR12* is significantly negative while the coefficient of the interaction term is insignificant. Hence, under-priced default risk has a significant effect on investment in the sector of real estate investment, and its effect is not different between REITs and REOCs. Taken together, these results reveal that under-priced default risk does not appear to affect investment decisions of industrial firms. This is attributable to non-REs that do not have many real properties which play the role of valuable collateral to make mortgage loans. In contrast, under-pricing of default risk has a significantly positive impact on investment in the sector of real estate investment. In addition, its effects are not different between REITs and REOCs because they operate in the same sector and have similar nature of assets (real estate assets account for a significant percentage of their total assets).

<< Insert Table 9 here. >>

8. Conclusion

REITs highly rely on liquidity provided by banks to finance their investment due to the mandatory requirement of dividend payment (Hardin & Wu, 2010). Ooi et al. (2010) also show that interest charges constitute about between 30% and 70% of the total expenses of REITs. Therefore, REITs' investment is more likely to be highly sensitive to changes in lending interest rates. Accordingly, under-priced default risk, which decreases lending interest rate and is inevitable in a market with many lenders (Pavlov & Wachter, 2004, 2006), could significantly affect REITs' investment. However, this impact has not been examined. Hence, this research contributes to the literature on drivers of a firm's investment by documenting the significant role of under-priced default risk on investment decisions.

The evidence from this study reveals that under-pricing of default risk has a significantly positive impact on the rate of investment in the REIT sector. Specifically, a one standard deviation increase in exploiting under-priced default risk is associated with a 4 percentage-point increase in investment. It is because under-pricing of default risk generates low-interest rate loans and bank loans play an important role in REITs' investment decisions. In addition, the time window of 12 months is indicated as the most appropriate time window for capturing the symptom of under-pricing of default risk. Regarding industrial firms, under-pricing of default risk appears to have an insignificant influence on their investment. This finding is attributable to their nature of assets that do not have much valuable collateral (real estate assets) to make non-recourse loans.

The analysis also has some limitations. Firstly, characteristics of managers that could control the impact of under-priced default risk, such as long-term tenure vs. short-term tenure, internal manager vs. external manager, have not been considered due to the limitation of data. Secondly, the influence of under-priced default risk has not been directly measured. Instead of, its impact is indirectly identified via the correlation between equity returns and the default spread or the positive relationship between changes in the default probability and changes in total debt. Therefore, further studies could be carried out to enhance the results of this research.

Reference

Aivazian, V. A., Ge, Y., & Qiu, J. (2005). The impact of leverage on firm investment: Canadian evidence. *Journal of Corporate Finance*, *11*(1–2), 277–291.

Alcock, J., & Steiner, E. (2017). The interrelationships between REIT capital structure and investment. *Abacus*, *53*(3), 371–394.

Alcock, J., Steiner, E., & Tan, K. J. K. (2014). Joint leverage and maturity choices in real estate firms: the role of the REIT status. *Journal of Real Estate Finance and Economics*, *48*(1), 57–78.

Allen, F. (2001). Do financial institutions matter? *Journal of Finance*, *56*(4), 1165–1175.

An, H., Hardin, W., & Wu, Z. (2012). Information asymmetry and corporate liquidity management: evidence from real estate investment trusts. *Journal of Real Estate Finance and Economics*, *45*(3), 678–704.

Bao, T., & Ding, L. (2016). Nonrecourse mortgage and housing price boom, bust, and rebound. *Real Estate Economics*, *44*(3), 584–605.

Baum, C. F., Schaffe, M. E., & Stillman, S. (2007). Enhanced routines for instrumental variables/generalized method of moments estimation and testing. *Stata Journal*, *7*(4), 465–506.

Breuer, W., Nguyen, L. D., & Steininger, B. I. (2019). *Decomposing industry leverage: the Real Estate Investment Trust (REIT) debt puzzle*.

Carpenter, R. E., & Guariglia, A. (2008). Cash flow, investment, and investment opportunities: new tests using UK panel data. *Journal of Banking and Finance*, *32*(9), 1894–1906.

Chou, W. H., Hardin, W. G., Hill, M. D., & Kelly, G. W. (2013). Dividends, values and agency costs in REITs. *Journal of Real Estate Finance and Economics*, *46*(1), 91–114.

Frank, M. Z., & Goyal, V. K. (2009). Capital structure decisions: which factors are reliably important? *Financial Management*, *38*(1), 1–37.

Ghent, A. C., & Kudlyak, M. (2011). Recourse and residential mortgage default: evidence from US states. *Review of Financial Studies*, *24*(9), 3139–3186.

Gropp, R., Vesala, J., Vulpes, G., Journal, S., & Mar, N. (2006). Equity and bond market signals as leading indicators of bank fragility. *Journal of Money, Credit and Banking*, *38*(2), 399–428.

Hardin, W. G., & Wu, Z. (2010). Banking relationships and REIT capital structure. *Real Estate Economics*, *38*(1), 257–284.

Hardin, W., & Hill, M. D. (2008). REIT dividend determinants: excess dividends and capital markets. *Real Estate Economics*, *36*(2), 349–369.

Harrison, D. M., Panasian, C. A., & Seiler, M. J. (2011). Further evidence on the capital structure of REITs. *Real Estate Economics*, *39*(1), 133–166.

Hendershott, P. H., & Kane, E. J. (1995). US office market values during the past decade: how distorted have appraisals been? *Real Estate Economics*, *23*(2), 101–116.

Hulse, B. D., Christophorou, P. L., & Guida, P. A. (2016). Sample nonrecourse loan carveout and springing recourse provisions with borrow comments. *Practical Lawyer*, *62*(1), 49–

58.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review*, *76*(2), 323–329.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305–360.

Koh, W. T. H., Mariano, R. S., Pavlov, A., Phang, S. Y., Tan, A. H. H., & Wachter, S. M. (2005). Bank lending and real estate in Asia: market optimism and asset bubbles. *Journal of Asian Economics*, *15*(6), 1103–1118.

Lang, L., Ofekb, E., & Stulz, R. M. (1996). Leverage , investment, and firm growth. *Journal of Financial Economics*, *40*(1), 3–29.

Merton, R. C. (1974). On the pricing of corporate debt: the risk structure of interest rates. *Journal of Finance*, *29*(2), 449–470.

Mitra, S., & Duggar, E. (2009). External linkages and contagion risk in Irish banks. *IMF Staff Papers*, *56*(4), 758–786.

Morri, G., & Beretta, C. (2008). The capital structure determinants of REITs. Is it a peculiar industry? *Journal of European Real Estate Research*, *1*(1), 6–57.

Ooi, J. T. L., Ong, S. E., & Li, L. (2010). An analysis of the financing decisions of REITs: the role of market timing and target leverage. *Journal of Real Estate Finance and Economics*, *40*(2), 130–160.

Ott, S. H., Riddiough, T. J., & Yi, H.-C. (2005). Finance, investment and investment performance: evidence from the REIT sector. *Real Estate Economics*, *33*(1), 203–235.

Pavlov, A., Steiner, E., & Wachter, S. (2015). Macroeconomic risk factors and the role of mispriced credit in the returns from international real estate securities. *Real Estate Economics*, *43*(1), 241–270.

Pavlov, A., & Wachter, S. (2004). Robbing the bank: non-recourse lending and asset prices. *Journal of Real Estate Finance and Economics*, *28*(2–3), 147–160.

Pavlov, A., & Wachter, S. (2006). The inevitability of marketwide underpricing of mortgage default risk. *Real Estate Economics*, *34*(4), 479–496.

Pavlov, A., & Wachter, S. (2009). Mortgage put options and real estate markets. *Journal of Real Estate Finance and Economics*, *38*(1), 89–103.

Richardson, S. (2006). Over-investment of free cash flow. *Review of Accounting Studies*, *11*(2–3), 159–189.

Riddiough, T. J., & Wu, Z. (2009). Financial constraints, liquidity management and investment. *Real Estate Economics*, *37*(3), 447–481.

Sanderson, E., & Windmeijer, F. (2016). A weak instrument F-test in linear IV models with multiple endogenous variables. *Journal of Econometrics*, *190*(2), 212–221.

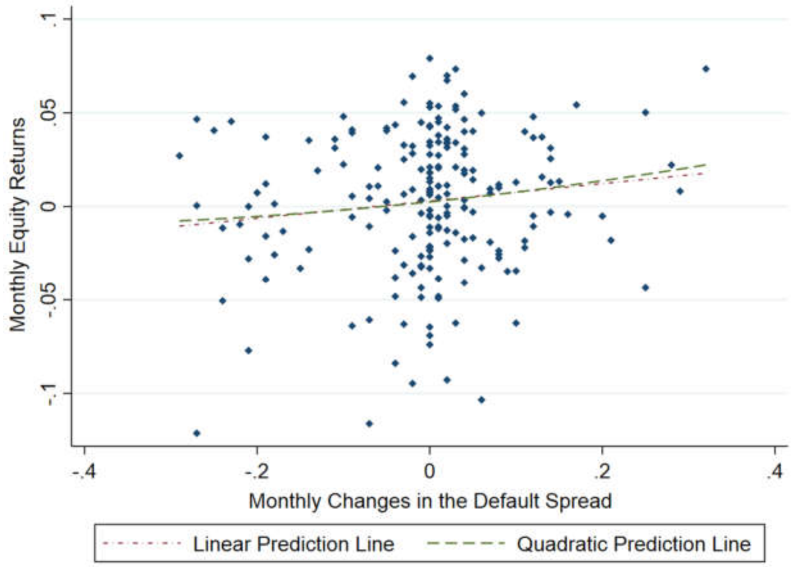
Stein, J. (1997). Nonrecourse carveouts: how far is far enough? *Real Estate Review*, *27*(1), 3–11.

Sun, L., Titman, S. D., & Twite, G. J. (2015). REIT and commercial real estate returns: a postmortem of the financial crisis. *Real Estate Economics*, *43*(1), 8–36.

Vassalou, M., & Xing, Y. (2004). Default risk in equity returns. *Journal of Finance*, *59*(2), 831–868.

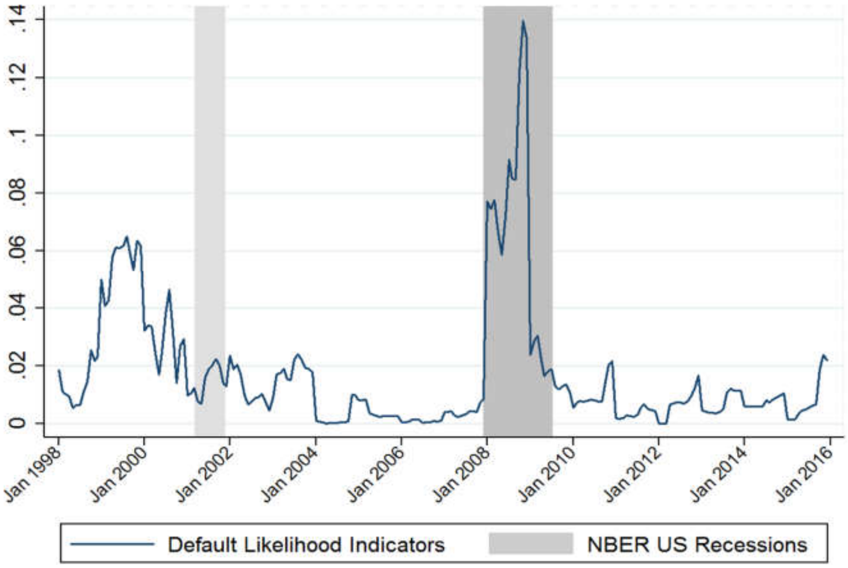
Figure and Tables

Figure 1: The correlation between monthly changes in default spread and monthly equity returns



The figure shows monthly changes in the default spread (Δ) on the horizontal axis and the mean of monthly equity returns ($\bar{r}$) on the vertical axis. The mean of monthly equity returns is the average of monthly equity returns of all firms in the given month. Each diamond represents the mean values of monthly equity returns and monthly changes in default spread in the given month. The short-dash dot line is the resulting line of the prediction for $\bar{r}$ from an OLS regression of $\bar{r}$ on Δ while the dash line is the resulting curve of the prediction for $\bar{r}$ from an OLS regression of $\bar{r}$ on Δ and Δ^2.

Figure 2: Aggregate default likelihood indicator



The figure shows the aggregate default likelihood indicator of firms in the sample from 1998 to 2015. The aggregate *DLI* is defined as the simple average of the *DLI* of all firms. The shaded areas denote recession periods, as defined by National Bureau of Economic Research (NBER).

Table 1: Definition of variables

Name	Measurement	Reference
Rate of investment (*INVEST*)	(Change in book capital + depreciation) / total assets, where book capital is the book value of equity, book value of short-term debt and book value of long-term debt	Alcock & Steiner (2017); Ott et al. (2005)
Correlation (*CORRn*)	Correlation between monthly equity returns and monthly changes in the default spread in the time windows of n months, where n = 12, 24 and 36 months	Pavlov & Wachter (2009); Pavlov et al. (2015)
Under-pricing of defaulted risk (*UPDRn*)	Equal *CORRn* for values of *CORRn* less than zero and zero otherwise, where n = 12, 24 and 36 months	
Positive correlation (*COR_POn*)	Equal *CORRn* for values of *CORRn* greater than zero and zero otherwise, where n = 12, 24 and 36 months	
Leverage (*LEV*)	Total debt / total assets	Hardin & Hill (2008); Breuer et al. (2019)
Cash flow (*CASHFLOW*)	Funds from operations / total assets	Chou et al. (2013); Sun et al. (2015)
Growth opportunities (*GROWTH*)	Ratio of the market value of equity to the book value of equity	Harrison et al. (2011)
Firm size (*SIZE*)	Natural logarithm of total assets (in million USD)	Morri & Beretta (2008); Sun et al. (2015)
Equity issue (EQUITY_ISSUE)	Net issuance (retirement) of stock / total assets	Alcock & Steiner (2017); Riddiough & Wu (2009)
Debt issue (DEBT_ISSUE)	Net issuance (retirement) of debt / total assets	Alcock & Steiner (2017); Riddiough & Wu (2009)
Term structure (*T10T3M*)	Difference between yields of 10-year treasury note and 3-month treasury bill	Frank & Goyal (2009); Ooi et al. (2010)
Lending rate (*LENDING_RATE*)	Prime lending rate charged by banks	Pavlov & Wachter (2009); Pavlov et al. (2015)

This table shows the definition of variables under consideration. All data are obtained from Thomson Reuters Datastream/Eikon, except for *T10T3M* that is obtained from Federal Reserve Bank of St Louis's Economic Database.

Table 2: Descriptive statistics

	N	Mean	Std. Dev.	Min.	Median	Max.
INVEST	1,680	0.160	0.266	-0.321	0.094	2.841
UPDR12	1,680	-0.116	0.175	-0.720	0.000	0.000
COR_PO12	1,680	0.146	0.185	0.000	0.034	0.672
UPDR24	1,517	-0.055	0.105	-0.542	0.000	0.000
COR_PO24	1,517	0.129	0.139	0.000	0.087	0.555
UPDR36	1,360	-0.035	0.075	-0.489	0.000	0.000
COR_PO36	1,360	0.129	0.132	0.000	0.097	0.555
LEV	1,680	0.507	0.147	0.000	0.507	0.903
CASHFLOW	1,680	0.051	0.023	-0.012	0.048	0.141
GROWTH	1,680	0.139	0.333	-0.227	0.057	5.610
SIZE	1,680	7.642	1.092	3.389	7.669	10.118
EQUITY_ISSUE	1,680	0.041	0.068	-0.066	0.013	0.683
DEBT_ISSUE	1,680	0.031	0.080	-0.206	0.025	0.462
T10Y3M	1,680	0.020	0.011	-0.001	0.023	0.031
LENDING_RATE	1,680	0.051	0.022	0.032	0.04	0.095

The table shows the descriptive statistics (number of observations, mean, standard deviation, minimum, median and maximum) of the REIT sample from 1999 to 2015. The definitions of variables are presented in Table 1.

Table 3: Correlation coefficients for independent variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) *UPDR12*	1													
(2) *COR_PO12*	0.54*	1												
(3) *UPDR24*	0.51*	0.36*	1											
(4) *COR_PO24*	0.41*	0.50*	0.49*	1										
(5) *UPDR36*	0.26*	0.26*	0.59*	0.40*	1									
(6) *COR_PO36*	0.30*	0.43*	0.40*	0.71*	0.46*	1								
(7) *LEV*	-0.02	-0.04	-0.03	-0.03	0.00	0.00	1							
(8) *CASHFLOW*	-0.01	-0.03	0.01	-0.04	0.02	-0.08*	-0.43*	1						
(9) *GROWTH*	-0.02	-0.06*	-0.01	-0.06*	0.03	-0.05	0.01	-0.11*	1					
(10) *SIZE*	0.02	-0.02	0.05	0.01	0.06*	0.04	0.09*	-0.15*	0.02	1				
(11) *EQUITY_ISSUE*	0.03	0.07*	0.04	0.02	0.01	0.02	-0.19*	-0.08*	0.29*	-0.12*	1			
(12) *DEBT_ISSUE*	-0.08*	-0.11*	-0.04	-0.09*	0.03	-0.07*	0.13*	0.01	0.40*	-0.02	-0.06*	1		
(13) *T10Y3M*	-0.02	0.04	-0.16*	-0.02	0.03	0.12*	0.01	-0.05	-0.13*	-0.02	0.00	-0.16*	1	
(14) *LENDING_RATE*	-0.22*	-0.14*	-0.05	-0.15*	-0.03	-0.23*	0.05	0.08*	0.08*	-0.10*	-0.12*	0.18*	-0.59*	1

This table displays the pairwise Pearson correlation coefficients between the independent variables. The definitions of variables are presented in Table 1.
The symbol * indicates a correlation coefficient's significance at the 5% level.

Table 4: Under-pricing of default risk and investment

	1	2	3
UPDR12	-0.104**		
	(-2.290)		
COR_PO12	0.059*		
	(1.694)		
UPDR24		-0.053	
		(-0.980)	
COR_PO24		0.038	
		(0.564)	
UPDR36			0.004
			(0.043)
COR_PO36			-0.007
			(-0.118)
LEV	-0.121	-0.075	0.018
	(-1.003)	(-0.585)	(0.126)
CASHFLOW	1.816***	1.783***	1.718***
	(4.040)	(3.875)	(3.234)
GROWTH	0.055	0.007	-0.009
	(1.379)	(0.230)	(-0.282)
SIZE	-0.134***	-0.127***	-0.132***
	(-5.608)	(-5.408)	(-5.105)
EQUITY_ISSUE	0.715***	0.697***	0.682***
	(5.160)	(4.849)	(5.051)
DEBT_ISSUE	0.384***	0.436***	0.450***
	(3.207)	(3.342)	(3.193)
T10Y3M	-4.582***	-5.519***	-5.991***
	(-6.505)	(-6.980)	(-7.177)
LENDING_RATE	-3.323***	-2.990***	-3.367***
	(-8.046)	(-7.565)	(-5.819)
CONSTANT	1.340***	1.297***	1.328***
	(5.871)	(5.704)	(5.320)
No. of Obs.	1,680	1,517	1,360
R-square	0.152	0.128	0.122

The table reports regression results, which include coefficients and *t*-statistics in brackets, for factors affecting REITs' investment. Column 1 uses *UPDR12* to capture the under-pricing of default risk. Columns 2 and 3 use *UPDR24* and *UPDR36* to capture the under-pricing of default risk, respectively. Hausman's specification test indicates that the fixed effects model is preferable for the data (see Panel A of Table A1 in the Appendix, which is available from the authors upon request). Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity. The definitions of variables are presented in Table 1.
* p<0.10, ** p<0.05, *** p<0.01

Table 5: Controlling *D_CRISIS*

	1	2	3
D_CRISIS	-0.053***	-0.024	-0.026
	(-4.464)	(-1.569)	(-1.498)
UPDR12	-0.084*		
	(-1.709)		
UPDR12 × *D_CRISIS*	-0.219***		
	(-3.080)		
COR_PO12	0.055		
	(1.584)		
UPDR24		0.001	
		(0.010)	
UPDR24 × *D_CRISIS*		-0.402***	
		(-2.858)	
COR_PO24		0.049	
		(0.730)	
UPDR36			0.031
			(0.343)
UPDR36 × *D_CRISIS*			-0.413
			(-1.188)
COR_PO36			0.007
			(0.124)
Firm-specific variables	Yes	Yes	Yes
Market variables	Yes	Yes	Yes
CONSTANT	1.380***	1.364***	1.252***
	(5.618)	(5.339)	(4.427)
No. of Obs.	1,680	1,517	1,360
R-square	0.162	0.133	0.123

The table reports regression results, which include coefficients and *t*-statistics in brackets, for factors affecting REITs' investment, but controlling for the effects of the crisis period. Column 1 uses *UPDR12* to capture the under-pricing of default risk. Columns 2 and 3 use *UPDR24* and *UPDR36* to capture the under-pricing of default risk, respectively. Hausman's specification test indicates that the fixed effects model is preferable for the data (see Panel B of Table A1 in the Appendix, which is available from the authors upon request). Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity. *D_CRISIS* takes the value of 1 if the year is 2001, 2007, 2008 or 2009 and zero otherwise. *Firm-specific variables* include *LEV*, *CASHFLOW*, *GROWTH*, *SIZE*, *EQUITY_ISSUE* and *DEBT_ISSUE*. *Market variables* include *T10Y3M* and *LENDING_RATE*. The definitions of other variables are presented in Table 1.

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 6: Controlling instrumental variables

	Panel A		Panel B		Panel C	
	First Stage (*UPDR12*)	Second Stage (*INVEST*)	First Stage (*UPDR24*)	Second Stage (*INVEST*)	First Stage (*UPDR36*)	Second Stage (*INVEST*)
	1	2	3	4	5	6
UPDR12		-0.252*				
		(-1.958)				
COR_PO12	0.376***	0.114*				
	(21.733)	(1.670)				
UPDR24				-0.408		
				(-1.613)		
COR_PO24			0.313***	0.165*		
			(17.839)	(1.711)		
UPDR36						-1.167
						(-1.568)
COR_PO36					0.215***	0.273
					(12.650)	(1.364)
BONUS	-2.876***		-1.435***		-0.433***	
	(-12.840)		(-12.167)		(-3.899)	
WAGE	3.942***		2.456***		0.505**	
	(9.855)		(11.052)		(2.599)	
Firm-specific variables	Yes	Yes	Yes	Yes	Yes	Yes
Market variables	Yes	Yes	Yes	Yes	Yes	Yes
CONSTANT	0.201**	0.210**	-0.453***	0.094	-0.335***	-2.365
	(2.010)	(2.541)	(-6.669)	(0.714)	(-4.789)	(-0.896)
No. of Obs.	1,581	1,581	1,517	1,517	1,360	1,360
SW multivariate F test	87.200		68.790		13.320	
p-value	0.000		0.000		0.000	
Hansen J statistic	0.453		2.396		0.240	
p-value	0.501		0.121		0.624	

The table reports regression results (coefficients and *t*-statistics in brackets) of 2SLS for factors affecting REITs' investment. Panel A uses *UPDR12* to capture the under-pricing of default risk. Panels B and C use *UPDR24* and *UPDR36* to capture the under-pricing of default risk, respectively. Instruments are *BONUS* and *WAGE*. *BONUS* is defined as the natural logarithm of the ratio of compensation of employees at year *t* to compensation of employees at year *t* – 1. *WAGE* is calculated as the natural logarithm of the ratio of wages and salaries at year *t* to wages and salaries at year *t* – 1. Firm-speci*fic variables* include *LEV*, *CASHFLOW*, *GROWTH*, *SIZE*, *EQUITY_ISSUE* and *DEBT_ISSUE*. *Market variables* include *T10Y3M* and *LENDING_RATE*. The definitions of other variables are presented in Table 1. Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity.
* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 7: Alternative measures of investment

	Panel A: *INVEST1*			Panel B: *INVEST2*		
	1	2	3	4	5	6
UPDR12	-0.052*			-0.048**		
	(-1.843)			(-2.173)		
COR_PO12	0.021			0.018		
	(1.035)			(1.024)		
UPDR24		-0.014			-0.015	
		(-0.505)			(-0.627)	
COR_PO24		-0.049*			-0.030	
		(-1.665)			(-1.333)	
UPDR36			0.021			0.008
			(0.452)			(0.196)
COR_PO36			-0.060**			-0.039
			(-1.991)			(-1.537)
Firm-specific variables	Yes	Yes	Yes	Yes	Yes	Yes
Market variables	Yes	Yes	Yes	Yes	Yes	Yes
CONSTANT	0.778***	0.692***	0.684***	0.742***	0.688***	0.671***
	(5.350)	(6.117)	(5.322)	(5.425)	(7.196)	(6.024)
No. of Obs.	1,696	1,533	1,376	1,649	1,489	1,335
R-square	0.093	0.089	0.089	0.143	0.137	0.132

The table reports regression results, which include coefficients and *t*-statistics in brackets, for factors affecting REITs' investment. In Panel A, *INVEST1* is the dependent variable and defined as the sum of capital expenditure, acquisitions and research and development less cash receipts from the sale of property, plant and equipment, then divided by total assets. In Panel B, *INVEST2* is defined as capital expenditures minus depreciation, then scaled by total assets. The definitions of variables are presented in Table 1. Hausman's specification test indicates that the random effects model is preferable for Panel A (*INVEST1*) while the fixed effects model is preferable for Panel B (*INVEST2*) (see Panels C1 and C2 of Table A1 in the Appendix, which is available from the authors upon request). *Firm-specific variables* include *LEV*, *CASHFLOW*, *GROWTH*, *SIZE*, *EQUITY_ISSUE* and *DEBT_ISSUE*. *Market variables* include *T10Y3M* and *LENDING_RATE*. Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity.

* p<0.10, ** p<0.05, *** p<0.01

Table 8: Alternative measures of under-priced default risk

	Panel A: *INVEST*		Panel B: *INVEST1*		Panel C: *INVEST2*	
	1	2	3	4	5	6
NEW_UPDR	0.136***		0.038***		0.047***	
	(7.800)		(4.051)		(6.209)	
DLI		-0.165***		-0.024		-0.059*
		(-2.609)		(-0.541)		(-1.741)
Firm-specific variables	Yes	Yes	Yes	Yes	Yes	Yes
Market variables	Yes	Yes	Yes	Yes	Yes	Yes
CONSTANT	1.976***	1.850***	0.723***	0.547***	0.706***	0.546***
	(4.279)	(3.136)	(4.868)	(3.980)	(5.143)	(5.009)
No. of Obs.	1,754	1,356	1,770	1,363	1,722	1,328
R-square	0.250	0.182	0.107	0.047	0.185	0.092

The table reports regression results, which include coefficients and *t*-statistics in brackets, for factors affecting REITs' investment. Dependent variables are *INVEST*, *INVEST1* and *INVEST2* in Panels A, B and C, respectively. Columns 1, 3 and 5 use *NEW_UPDR* to capture the under-pricing of default risk. Columns 2, 4 and 6 uses *DLI* to test the influence of the default probability on investment. Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity. *NEW_UPDR* is a indicator variable that takes the value of 1 if a firm-year observation has simultaneously a positive change in *LDI* and a positive change in total debt and zero otherwise. *DLI* is calculated from Eq. 3. *Firm-specific variables* include *LEV*, *CASHFLOW*, *GROWTH*, *SIZE*, *EQUITY_ISSUE* and *DEBT_ISSUE*. *Market variables* include *T10Y3M* and *LENDING_RATE*. The definitions of other variables are presented in Table 1.

* p<0.10, ** p<0.05, *** p<0.01

Table 9: Under-pricing of default risk and investment in a joint sample

	Panel A: REIT vs non-RE			Panel B: REIT vs REOC		
	1	2	3	4	5	6
UPDR12	0.038			-0.118**		
	(1.284)			(-2.526)		
D_REIT × UPDR12	-0.140***			0.062		
	(-3.130)			(0.392)		
COR_PO12	0.045*			0.094**		
	(1.662)			(2.060)		
UPDR24		0.050			-0.035	
		(1.099)			(-0.663)	
D_REIT × UPDR24		-0.033			0.122	
		(-0.598)			(0.777)	
COR_PO24		0.016			0.052	
		(0.433)			(0.804)	
UPDR36			0.248***			0.029
			(4.533)			(0.332)
D_REIT × UPDR36			-0.027			-0.002
			(-0.290)			(-0.013)
COR_PO36			-0.076**			-0.032
			(-2.059)			(-0.650)
Firm-specific variables	Yes	Yes	Yes	Yes	Yes	Yes
Market variables	Yes	Yes	Yes	Yes	Yes	Yes
CONSTANT	2.543***	2.583***	2.726***	2.231***	1.564***	1.561***
	(18.857)	(17.371)	(16.076)	(4.205)	(8.956)	(8.582)
No. of Obs.	27,436	25,092	22,829	2,087	1,879	1,685
R-square	0.060	0.057	0.059	0.111	0.101	0.094

The table reports regression results, which include coefficients and *t*-statistics in brackets, for factors affecting a firm's investment. Panel A uses a joint sample including REITs and non-REs. Hence, *D_REIT* takes the value of 1 for REITs and 0 for non-REs. Panel B uses a joint sample including REITs and REOCs. Hence, *D_REIT* takes the value of 1 for REITs and 0 for REOCs. Columns 1 and 4 use *UPDR12* to capture the under-pricing of default risk. Columns 2 and 5 use *UPDR24*, Columns 3 and 6 use *UPDR36* to capture the under-pricing of default risk. Hausman's specification test indicates that the fixed effects model is preferable for the data (see Panel E of Table A1 in the Appendix, which is available from the authors upon request). Standard errors are clustered by the firm level to be robust to autocorrelation and heteroscedasticity. The definitions of variables are presented in Table 1.

* p<0.10, ** p<0.05, *** p<0.01

Appendix

Table A1: Fixed effects models vs Random effects model: Sargan-Hansen test results

	UPDR12 Model	*UPDR24* Model	*UPDR36* Model
Panel A: Under-pricing of default risk and investment			
Sargan-Hansen statistic	67.809	50.355	51.927
p-value	0.000^{fe}	0.000^{fe}	0.000^{fe}
Panel B: Controlling for effects of the crisis period			
Sargan-Hansen statistic	81.508	65.154	48.205
p-value	0.000^{fe}	0.000^{fe}	0.000^{fe}
Panel C1: Alternative measure of investment (*INVEST1*)			
Sargan-Hansen statistic	38.060	32.921	47.524
p-value	0.000^{fe}	0.001^{fe}	0.000^{fe}
Panel C2: Alternative measure of investment (*INVEST2*)			
Sargan-Hansen statistic	49.540	38.319	60.528
p-value	0.000^{fe}	0.001^{fe}	0.000^{fe}
Panel D1: Additional test: REITs vs non-REs			
Sargan-Hansen statistic	396.818	304.822	279.622
p-value	0.000^{fe}	0.000^{fe}	0.000^{fe}
Panel D2: Additional test: REITs vs REOCs			
Sargan-Hansen statistic	37.896	79.988	72.577
p-value	0.000^{fe}	0.000^{fe}	0.000^{fe}

The table reports the results of the Sargan-Hansen test for the *UPDR12* model, *UPDR24* model and *UPDR36* Model. The *p*-value is the probability, under the null hypothesis (H_0): difference in coefficients not systematic, of obtaining a result equal to or more extreme than what was actually observed.
^{fe}: the test indicates that the fixed-effects model is preferable.

Table A2: Descriptive statistics of the non-RE and REOC samples

	N	Mean	Std. Dev.	Min.	Median	Max.
			Panel A: non-REs			
INVEST	25,756	0.212	0.698	-3.030	0.117	7.095
UPDR12	25,756	-0.110	0.166	-0.663	0.000	0.000
COR_PO12	25,756	0.138	0.181	0.000	0.032	0.704
UPDR24	23,571	-0.072	0.118	-0.524	0.000	0.000
COR_PO24	23,571	0.114	0.143	0.000	0.048	0.603
UPDR36	21,467	-0.056	0.099	-0.482	0.000	0.000
COR_PO36	21,467	0.114	0.136	0.000	0.061	0.576
LEV	25,756	0.226	0.193	0.000	0.200	0.848
CASHFLOW	25,756	0.057	0.218	-1.966	0.093	0.415
GROWTH	25,756	0.167	0.560	-0.584	0.062	5.632
SIZE	25,756	6.524	2.142	-0.320	6.600	11.111
EQUITY_ISSUE	25,756	0.011	0.098	-0.296	0.000	0.576
DEBT_ISSUE	25,756	0.031	0.167	-0.243	0.001	1.255
T10Y3M	25,756	0.021	0.010	-0.001	0.023	0.031
LENDING_RATE	25,756	0.048	0.02	0.032	0.036	0.095
			Panel B: REOCs			
INVEST	407	0.169	0.911	-2.757	0.065	15.371
UPDR12	407	-0.094	0.148	-0.587	0.000	0.000
COR_PO12	407	0.141	0.176	0.000	0.037	0.717
UPDR24	362	-0.059	0.102	-0.468	0.000	0.000
COR_PO24	362	0.113	0.130	0.000	0.062	0.535
UPDR36	325	-0.048	0.083	-0.378	0.000	0.000
COR_PO36	325	0.102	0.118	0.000	0.063	0.504
LEV	407	0.375	0.267	0.000	0.326	0.964
CASHFLOW	407	0.030	0.109	-0.739	0.019	0.644
GROWTH	407	0.197	0.861	-0.796	0.035	8.227
SIZE	407	5.326	1.808	0.131	5.204	8.963
EQUITY_ISSUE	407	0.023	0.129	-0.178	0.000	1.092
DEBT_ISSUE	407	0.017	0.130	-0.344	0.000	0.895
T10Y3M	407	0.020	0.011	-0.001	0.023	0.031
LENDING_RATE	407	0.05	0.021	0.032	0.04	0.095

The table shows the descriptive statistics (number of observations, mean, standard deviation, minimum, median and maximum) of the REIT sample from 1999 to 2015. The definitions of variables are presented in Table 1.