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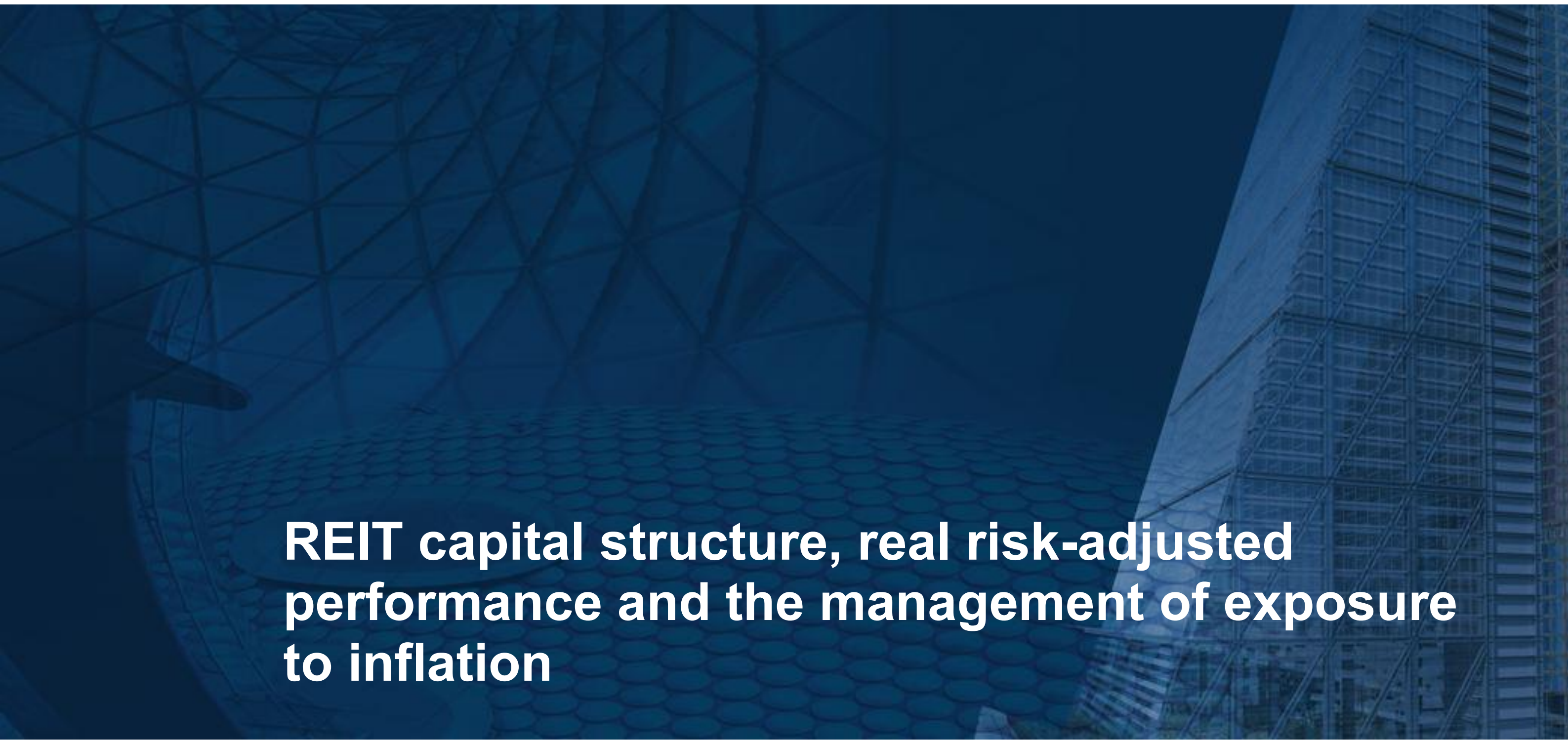


REIT capital structure, real risk-adjusted performance and the management of exposure to inflation

Content table

Jamie Alcock
Lecturer (Land Economy)

Eva Steiner
PhD Candidate (Land Economy)

Dr Jamie Alcock
Dr Jamie Alcock teaches Real Estate Finance at The University of Cambridge and is a Fellow of Economics at Downing College, Cambridge. He is also a part-time Associate Professor of Quantitative Finance at The University of Queensland where he received a PhD in Mathematics in 2005.

Eva Steiner
Eva Steiner is a doctoral researcher at the Department of Land Economy, The University of Cambridge. Her research interests include real estate finance, corporate finance and applied econometrics. She holds degrees from the University of Cambridge and the University of Heilbronn, Germany.

Contact

Jamie Alcock
jta27@cam.ac.uk

Eva Steiner
es434@cam.ac.uk

Fraser Hughes, EPRA Research Director:
f.hughes@epra.com

REIT CAPITAL STRUCTURE, REAL RISK-ADJUSTED PERFORMANCE AND THE MANAGEMENT OF EXPOSURE TO INFLATION

Jamie Alcock[1] and Eva Steiner[2], University of Cambridge, November 2012

1 Executive Summary

Research focus: We study the interrelationships between real risk-adjusted returns to REIT firm equity, inflation hedging characteristics of investments in firm equity, and corporate capital structure choices, in the presence of nominal and real assets and liabilities. We argue that, *ceteris paribus*, firms can choose an optimal capital structure that maximises real risk-adjusted performance by implicitly hedging the real value of firm equity against erosion through unexpected inflationary shocks.

Background: Investors are commonly thought to maximise expected utility over immediate consumption and terminal wealth to fund future consumption. However, the ability to consume out of wealth is determined by its real purchasing power. Moreover, investors are typically concerned about the efficiency of an investment relative to the risk. Therefore, firm managers may be interested in maximising real risk-adjusted returns to firm equity.

Method: We model the real risk-adjusted return to firm equity in the presence of real and nominal assets and liabilities using the real Sharpe ratio. We argue that managers can maximise this measure by holding nominal (fixed-rate) debt and nominal assets (proxied by the NAV of the firm) in a directly proportional relationship. We show that adhering to this simple capital structure rule supports real risk-adjusted performance because it is equivalent to hedging the real value of firm equity against unexpected inflationary shocks.

Results: We test the empirical implications of our model using a large sample of US equity REITs over the period 1989 to 2011. We find that managers appear to adhere to the positive linear relationship between nominal assets and liabilities we propose. As we expect, firms that adhere to the proposed relationship appear to outperform their peers in terms of their real risk-adjusted performance as measured by the real Sharpe ratio. Consistent with the implication of our model, firms that adhere to the proposed relationship between nominal assets and liabilities also appear to provide a stronger hedge against inflation than their peers. We find additional support for the notion of nominal liabilities as a buffer against inflationary shocks by providing evidence that firms hold more nominal liabilities in times of higher inflation uncertainty.

Conclusion and practical implications: We provide evidence that firms can successfully maximise real risk-adjusted performance by matching nominal assets and liabilities. The underlying mechanism relies on implicitly hedging the real value of firm equity against unexpected inflationary shocks. Our results imply that investors can extract information about inflation hedging capabilities from capital structure data, promoting more efficient investment decisions. Leverage-constrained investors benefit from the management of inflation risk at no extra cost to unconstrained investors. We view the findings of this study largely in the context of the REIT capital structure and inflation hedging literature. We provide insight into the question why tax-exempt REITs may hold more leverage than theory suggests. REIT leverage choices may be a function of efforts to manage real risk-adjusted performance. We further contribute to the debate about the inflation hedging characteristics of REITs as a securitised form of real estate. We highlight the importance of cross-sectional variation in these characteristics and relate them to firm-level differences in corporate capital structure choices.

Outline of this study: The next section provides the conceptual background for this study, followed by an outline and derivation of our model of real risk-adjusted performance. We then develop empirically testable implications of the model. We provide details on data and methodology underlying the empirical analysis and subsequently discuss the main empirical findings alongside their practical implications.

[1] University of Cambridge and University of Queensland, Email: jta27@cam.ac.uk
[2] Corresponding author: Department of Land Economy, The University of Cambridge, 19 Silver Street, Cambridge, CB3 9EP, UK Tel.: +44-1223-337152 Fax: +44-1223-337130, Email: es434@cam.ac.uk

2 Conceptual background

Real estate investments as a hedge against inflation: Empirical evidence is mixed

The suitability of direct real estate investments as a hedge against inflation is well established. Fama and Schwert (1977) and Hartzell, Hekman and Miles (1987) present evidence that direct (residential) real estate is a complete inflation hedge. Subsequent studies confirm direct real estate at least as a partial hedge. Gyourko and Linneman (1988) attribute their slightly weaker evidence for the inflation hedging properties of real estate investments to a potential omitted variable bias. Wurtzebach, Mueller and Machi (1991) establish the influence of over-supply in real estate markets on determining the inflation hedging properties of the asset class. Hoesli, Lizieri and MacGregor (2008) employ an error-correction framework and generally confirm the suitability of direct real estate as a hedge against expected inflation.

Research has not yet fully established whether exposure to listed REITs as a securitised form of direct real estate protects investor wealth against rising prices. Some studies find evidence against the suitability of listed REITs as an inflation hedge, consistent with results commonly established for industrial stocks. Darrat and Glascock (1989) explicitly consider the role of monetary policy as well as real economic and financial indicators. Glascock, Lu and So (2002) argue that monetary policy drives the spurious negative relationship between REIT returns and inflation. Simpson, Ramchander and Webb (2007) distinguish between positive and negative changes in expected and unexpected inflation and confirm the suitability of equity REITs as an inflation hedge.

Most studies to date implicitly assume that inflation hedging properties are equal across firms consider these to be exogenous, potentially determined by the general nature of the underlying real estate assets. The existence and drivers of potential variation in inflation hedging properties across REIT firms has not attracted substantial academic interest. In this study, we contribute to filling this gap by establishing an explicit relationship between REIT capital structure, real risk-adjusted performance and inflation hedging capabilities on the firm level.

REIT leverage choices: Traditional theories are unable to fully explain these decisions

The interest in REIT leverage choices is partly fuelled by the fact that the major traditional theories of corporate leverage are unable to fully explain the capital structure choices of these strictly regulated firms. Trade-off theory posits a value-maximising debt ratio where the marginal bankruptcy costs and tax benefits of debt are equal. However, REITs are exempt from corporate taxation if they distribute 90\% of taxable income as dividends, which nullifies the tax shields and some agency costs of debt. Howe and Shilling (1988) assert that in the absence of tax benefits, REITs cannot compete for debt and will favour equity. Shilling (1994) argues that REIT value is maximised for equity-only financing. Consistently, Ghosh, Nag and Sirmans (1997) find that REITs raise more capital through seasoned equity than debt.

Pecking order theory claims that capital structure changes reflect a need for external funds given the higher informational sensitivity and thus adverse selection costs of equity. Boudry, Kallberg and Liu (2010) argue that REITs especially are a fairly transparent investment vehicle as they focus on cash yields and stable cash flows from the operation of real estate, questioning the existence of asymmetric information. Pecking order also assumes discretion over earnings, debt and equity. However, REIT pay-out requirements restrict funding choices to debt and equity. Accordingly, Boudry, Kallberg and Liu (2010) find no evidence for pecking order in REIT financing choices.

The limited explanatory power of the major traditional capital structure theories to REITs opens up the possibility that those firms follow less conventional financing policies. For instance, Alcock, Steiner and Tan (2012) provide evidence that the tax exemption and reduced agency conflicts associated with the REIT status free up scope in the capital structure to pursue more offensive strategies such as signalling firm quality and optimising transaction costs. Alcock, Glascock and Steiner (2012) study REIT performance and find evidence consistent with the hypothesis that REITs employ leverage choices in order to manage market exposure and thus modify risk-adjusted performance. In this study, we consider the possibility that REITs choose leverage so as to optimise real risk-adjusted returns to firm equity by managing exposure to inflation.

Proposition: Firms can maximise the real Sharpe ratio via capital structure

In the traditional Intertemporal CAPM (Merton, 1969) framework, investors maximise expected utility over immediate consumption and terminal wealth to fund future consumption. However, the ability to consume out of wealth is determined by its real purchasing power, which depends on the prevailing price level, and is thus a real, rather than a nominal concept (Ritter, 2002). Therefore, firm managers may be incentivised to maximise the real, rather than nominal return to firm equity. Furthermore, investors are typically concerned about the efficiency of an investment relative to the risk involved (Sharpe, 1966, 1994; Jensen, 1967). As a result, firm managers may justifiably seek to maximise not only real, but real risk-adjusted performance.

A firm can arguably maximise real risk-adjusted performance through different means, for instance the pursuit of a suitable investment policy that selects assets on the basis of their real risk-adjusted performance characteristics. We consider an alternative strategy, and show how a firm can maximise real risk-adjusted performance through the choice of an appropriate financing policy, given its asset structure. We illustrate that this strategy relies on implicitly providing a hedge against the erosion in the real value of firm equity as a result of unexpected inflationary shocks.

Our proposition rests on the assumption that a significant investor group finds it beneficial to delegate to the firm the capital structure choices made for the purpose of jointly maximising real risk-adjusted performance and hedging inflation. Consider a situation where a significant proportion of investors who have an incentive to maximise real risk-adjusted performance and aim to maintain the real value of their investments do not have full discretion over their liability structure, e.g. pension funds. These leverage-constrained investors benefit from the firm's financing policy we describe. At the same time, our model does not prevent unconstrained investors from managing their capital structure, performance and inflation hedging objectives independently. Therefore, it is optimal for the firm in our model to expand its potential investor base and thus sources of capital by managing inflation via leverage.

Preview of the main results

The key findings and implications from this study can be summarised as follows:

We model the real risk-adjusted performance of an investment in a firm's equity in the presence of nominal as well as real assets and liabilities. We show that firms can choose a capital structure that maximises real risk-adjusted performance by matching nominal liabilities with nominal assets. We illustrate that in doing so, firms minimise the sensitivity of risk-adjusted returns to unexpected inflationary shocks.

Our results imply that managers can jointly target performance and inflation hedging objectives and achieve them through suitable capital structure choices. Our results also imply that investors can extract information about inflation hedging capabilities from capital structure data, promoting more efficient investment decisions.

We explore the empirical support for our theoretical predictions using a sample of US equity REITs. We find evidence that firms observe the predicted linear relationship between nominal assets and liabilities. Firms that adhere to the predicted capital structure rule outperform their peers in terms of the real Sharpe ratio. Increasing deviations from the optimal nominal liability holdings reduce the inflation hedging qualities of investments into firms’ equity. Lastly, firms' holdings of nominal debt appear to increase in times of higher inflation uncertainty.

Our findings further have implications that are specific to REITs. Firstly, our study contributes to the continuing debate about the drivers of REIT leverage choices in the absence of traditional motivations for holding debt. We provide evidence consistent with the hypothesis that REITs choose leverage so as to improve real risk-adjusted performance. Our results also contribute to the debate about inflation hedging characteristics of REITs as a securitised form of direct real estate. In this study, we provide evidence that REITs may be able to preserve the inflation hedging properties of direct real estate if they follow the relationship between nominal assets and liabilities we predict.

3 A simple model of the real risk-adjusted return to firm equity

Consider a manager whose objective it is to maximise the real risk-adjusted return on firm equity. The focus on real performance requires an analysis of the impact of inflation on the different types of assets and liabilities held by the firm. Assets and liabilities can be classified as either nominal or real (Bach and Stephenson, 1974; Kessel, 1956; Bach and Ando, 1957; Alchian and Kessel, 1959; Kessel and Alchian, 1960; Hong, 1977). The value of nominal assets and liabilities is fixed in currency terms, while that of real assets and liabilities fluctuates with the price level (Bach and Stephenson, 1974). In an efficient market (Fama, 1970), nominal contracts also account for expected inflation.

Following Bradford (1974), let E_0 denote the value of firm equity at time t=0, defined as the sum of real and nominal assets and liabilities:

$$E_0 = (A^R{}_0 - L^R{}_0) + (A^N{}_0 - L^N{}_0)$$

where $A^R{}_0$ and $L^R{}_0$ are the values of the firm's real assets and liabilities at time t=0. $A^N{}_0$ and $L^N{}_0$ are the corresponding values of the nominal assets and liabilities. We assume $E_0>0$. At t=1, unexpected inflation has caused the general price level to change at rate e^u, u ~ N (0, $\sigma^2{}_u$). The total value of firm equity at t=1, E_1, is then:

$$E_1 = (A^R{}_0\, e^{\kappa} - L^R{}_0)\, e^{r+u} + (A^N{}_0\, e^{\kappa} - L^N{}_0)\, e^{r+\alpha}$$

where r ~ N (μ_r, $\sigma^2{}_r$) is the premium for real corporate debt $L^R{}_0$ over the risk-free rate measured at time t=1. The variable κ ~ N (μ_κ, $\sigma^2{}_\kappa$) is the premium that differentiates the return on assets from that on liabilities. The variable α ~ N (μ_α, $\sigma^2{}_\alpha$) represents the premium for expected inflation that differentiates the return on nominal assets and liabilities from that on their real counterparts. As u is unexpected inflation, we assume that cov (r, u)=0.

The total, one-period, continuously compounded excess rate of return on firm equity, R, is then given by:

$$R = \ln [E_1/E_0]$$

Accounting for the effect of inflation, the real excess return on firm equity, R^R, is:

$$R\hat{\ }R = \ln [(E_1 e^{-u})/E_0]$$

The real risk-adjusted return on firm equity may be measured using the real Sharpe ratio (Sharpe, 1966; 1994), denoted SR^R. This measure is defined as the ratio of the expectation and the variance of R^R:

$$SR^R = E[R^R]/V[R^R]$$

We argue that firms can maximise SR^R by choosing an appropriate liability structure. More specifically, we focus on the choice of nominal liabilities. This focus is consistent with Bradford (1974). In the absence of nominal assets, the real value of firm equity is naturally protected from erosion due to unexpected inflation through any combination of real assets and liabilities that ensures the firm remains in going concern, that is $A^R{}_0 \geq L^R{}_0$. In the presence of nominal assets, the firms must hold a strictly positive amount of nominal liabilities in order to be able to protect firm equity from eroding in real value.

We propose that SR^R is maximised when the firm's holdings of nominal liabilities are an increasing monotonic function of the holdings of nominal assets. Our proposed choice of nominal liabilities maximises SR^R because it sets the inflation sensitivity of the real return on firm equity to zero, thereby reducing the variance of the real return. Adhering to this optimal relationship between nominal assets and nominal liabilities eliminates the risk to real equity returns from small changes in the price level caused by unexpected inflation. Formally, the sensitivity of real equity returns to unexpected inflation, S, is given by the partial derivative of R^R with respect to u:

$$S = dR^R/du = [e^{-u}(A^N{}_0\, e^{\alpha+\kappa} - L^N{}_0\, e^{r+\alpha})]/E_1$$

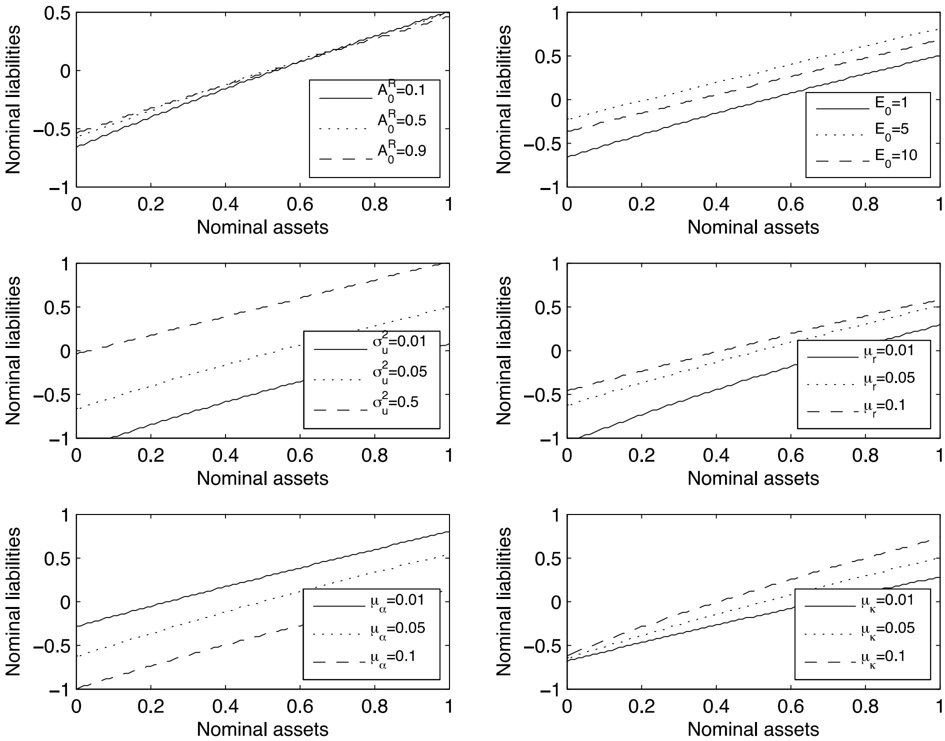
Setting S to zero and solving for the corresponding level of nominal debt yields:

$$S = 0 \rightarrow L^N_0 = A^N_0 e^{\kappa} \rightarrow L^N_0 \sim A^N_0$$

Simulations confirm that the proposed capital structure rule maximises the real Sharpe ratio

We explore our proposed relationship using a set of simulations for SR^R along a range of values for nominal assets and liabilities. We impose that $A^N_0 \geq 0$. Nominal liabilities are not restricted to be positive, allowing for short positions in debt. Real liabilities are the residual in this set-up, modelled as a linear function of the remaining asset, liability and equity positions. This structure allows us to focus on nominal liabilities and by implication, the ratio of nominal to real liabilities, conditional on a given asset structure and initial equity.

Figure 1: Simulation results for SR^R



For each combination of nominal assets and liabilities we obtain the expectation and variance of the real excess return on equity over the distribution of the random variables r, u, α and κ. We compile a matrix of real Sharpe ratios corresponding to the possible combinations of nominal assets and liabilities. For each value of nominal assets, we identify the maximum real Sharpe ratio and the value of nominal liabilities that generates this maximum real Sharpe ratio. We expect that a plot of each value of nominal assets against the corresponding Sharpe ratio-maximising value of nominal liabilities to demonstrate a monotonically increasing relationship between these two items. We simulate different scenarios to explore comparative statics. Technical details on the simulation can be made available upon request.

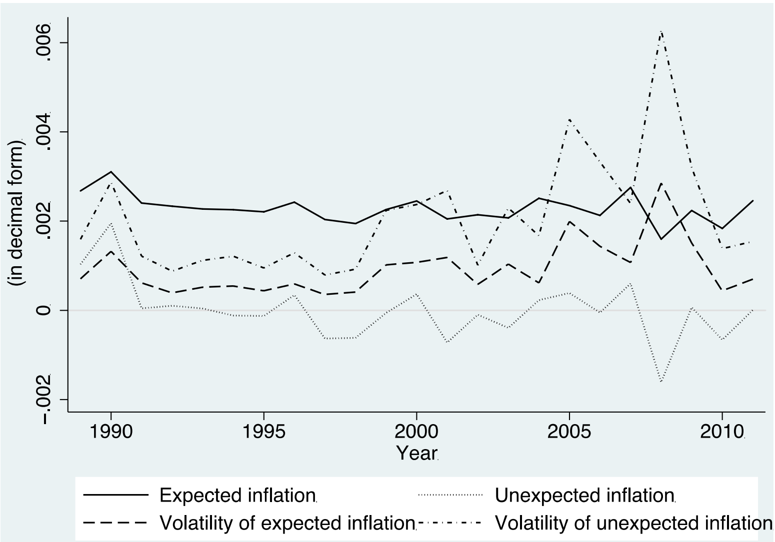
Figure 1 shows the results. Consistent with our model, the amount of nominal liabilities that maximises the real Sharpe ratio is a monotonically increasing function of the amount of nominal assets held in the firm. The comparative statics suggest that this basic linear relationship is robust to the modifications in the various simulation scenarios. The functional relationship between nominal assets and liabilities is specified by the intercept, that is the optimal baseline amount of nominal liabilities, and the slope, that is the marginal increase in optimal liabilities for a one-unit increase in nominal assets.

In general, the simulation results suggest that those factors determining the value of the nominal items on the balance sheet at t=1 affect the intercept, so the optimal baseline amount of nominal liabilities. Those factors also influencing the value of the real items on the balance sheet at time t=1 additionally affect the slope of the linear relationship between nominal assets and liabilities.

Consistent with this general interpretation of the results, the optimal baseline level of nominal liabilities in the absence of nominal assets is positively related to the degree of uncertainty surrounding unexpected inflation. As the variance of unexpected inflation increases, so does the baseline level of nominal liabilities that maximises the real Sharpe ratio when the firm does not hold any nominal assets. This relationship suggests that nominal liabilities can serve as a buffer against erosion in the real value of equity during times of high inflation uncertainty.

This study focuses on the role of unexpected inflation and particularly its volatility in determining the real risk-adjusted return to firm equity. Our model suggests a strategy for managers to jointly improve the inflation hedging qualities of their firm’s equity and real risk-adjusted returns to their firm’s equity. We test the implications of our model over the period 1989-2011. Figure 2 shows the evolution of different aspects of US CPI inflation over this period. Expected inflation was low and averaged just over 0.2% per month over the 22 years in study period, reflecting that this period was generally one where inflation was deemed under control. The average of unexpected inflation is zero by definition. However, the volatility of unexpected inflation over the study period also averaged around 0.2% per month. This was twice as high as the average volatility of expected inflation (0.1% per month) over the same period. Assuming a normal distribution of unexpected inflation, this implies that on average, every month there was a c. 30% chance that actual inflation was more than twice as high as expected. Therefore, while the time period we examine may be considered a low inflation regime, this simple exercise here suggests that the level of uncertainty surrounding unexpected inflation, the measure we focus on in this study, was significant. In addition, it appears that the volatility of unexpected inflation has increased over time, peaking at 0.6% per month in 2008. As a result, this volatility seems of increasing importance for equity performance.

Figure 2: Time series plot of inflation characteristics



The baseline level of optimal nominal liabilities also depends on the expectation of α. The compensation for expected inflation affects the value of nominal assets and liabilities at time t=1. However, the value of nominal assets is a function of r and α and the premium that differentiates the return on assets from that on liabilities, κ. For a given change in α, all else equal, optimal nominal liabilities whose return does not depend on κ must change in order to match the resulting change in the value of nominal assets at time t=1 that is determined by the total real rate of return on nominal assets. This result follows from the non-linearity of continuously compounded returns.

The baseline level of optimal nominal liabilities and the slope of the linear relationship between nominal assets and liabilities depend on the expectation of r. The rate of return on real corporate liabilities in excess of the risk-free rate is the basic building block of E_1 and affects the value of all items on the balance sheet at time t=1. As r changes, the value of nominal liabilities at time t=1 changes by the same rationale that underlies the effect of a change in α. However, r also affects the value of the real items on the balance sheet. Especially the change in the value of real assets that outweighs the change in the value of real liabilities by the compounding rationale helps mitigate the effect of nominal assets on the real risk-adjusted return to equity. Therefore, the slope of the relationship between nominal assets and liabilities decreases in the expectation of r.

The opposite is the case for the relationship between nominal assets and liabilities and its dependence on the expectation of κ. The premium that differentiates the return on assets from that on liabilities affects the value of nominal and real assets at time t=1. However, the effect on nominal assets exceeds that on real assets due to the non-linearity of continuously compounded returns. Therefore, for higher expected values of κ, the slope of the linear relationship between nominal assets and liabilities increases in the expectation of κ.

Lastly, the optimal baseline amount of nominal liabilities is also positively related to the starting value of equity. A higher value of equity at time t=0 implies a relatively lower holding of real liabilities, all else equal. As real liabilities decrease, the holdings of nominal liabilities need to be adjusted to offset this effect, giving rise to the variation in the optimal baseline amount of nominal liabilities.

Empirically testable implications of the model

We explore the support for the implications of our model from several perspectives. First, we expect managers who are concerned about maximising real risk-adjusted performance as measured by the real Sharpe ratio to adhere to the proportional relationship between nominal liabilities and nominal assets we describe. We therefore anticipate a positive linear relationship between these two items. We also expect firms that adhere to the proposed relationship between nominal assets and liabilities to outperform their peers in terms of real risk-adjusted returns to firm equity. We anticipate that deviations from the optimal holdings of nominal liabilities depress performance as measured by the real Sharpe ratio.

Further, we expect firms that adhere to the proposed relationship between nominal assets and liabilities to outperform partly because they hedge the real value of equity from the effects of unexpected inflation. We anticipate a relationship between a firm's adherence to the capital structure rule we describe and its inflation hedging characteristics. A stock is commonly considered an inflation hedge if an inflationary shock does not affect the real return on firm equity (Branch, 1974; Fama and MacBeth, 1974; Oudet, 1973) or, equivalently, if it results in an ideally proportionate change in the nominal rate of return on firm equity (Lintner, 1973; Bodie. 1976; Alchian and Kessel, 1959). We expect that the inflation sensitivity of nominal firm returns decreases in the deviation of nominal liability holdings from the optimum.

Lastly, our model suggests the suitability of nominal liabilities as a buffer against erosion in the real value of firm equity due to unexpected inflation. We therefore expect that firms have higher holdings of nominal liabilities in times of high uncertainty surrounding unexpected inflation.

Hypothesis 1: A firm's holdings of nominal liabilities are positively related to the amount of nominal assets held.

Hypothesis 2: A firm's real Sharpe ratio is inversely related to the deviation of the firm's nominal liability holdings from the optimum.

Hypothesis 3: The sensitivity of a firm's nominal return to unexpected inflation is inversely related to the deviation of nominal liability holdings from the optimum.

Hypothesis 4: The firm's holdings of nominal liabilities are positively related to the uncertainty surrounding unexpected inflation.

4 Empirical analysis

Data and descriptive statistics

We study all listed US equity REITs (SIC code 6798) on SNL. We begin with the inception of SNL in 1989 and end in 2011. We exclude mortgage REITs (GIC Sub-Industry 40402030) as they invest in mortgage debt instead of owning and operating real estate. Balance-sheet data is from SNL and Compustat. Return data is from CRSP. Inflation data is from the Bureau of Labour Statistics. Bond yields are from the Federal Reserve Bank of St. Louis. The Case Shiller House Price Index is from S&P. Market, size and value factors and the risk-free rate are from Kenneth French.

We discard observations where the ratio of long-term debt to total debt, the ratio of nominal assets to all assets or the ratio of nominal liabilities to all liabilities lies outside [0,1]. We measure all variables except earnings volatility and abnormal earnings at the fiscal year-end prior to the year in which nominal liabilities and maturity are measured (Johnson, 2003; Datta, Iskandar-Datta and Raman, 2005; Billett, King and Mauer, 2007). Earnings volatility and abnormal earnings are measured contemporaneously. All variables except dummies are winsorised at the 1st and 99th percentiles to remove any undue influence of outliers.

In order to assess the empirical evidence for the implications of our model, we need to measure the amount of nominal assets and liabilities held by a firm. US REITs follow a strictly regulated business model that simplifies their asset structure and the identification of a proxy measure for nominal assets. In addition, the focus on US equity REITs allows us to exploit detailed data on our chosen proxies for nominal assets and liabilities compiled by SNL.

US equity REITs primarily own and operate real estate assets and derive the majority of their income from letting these assets to occupiers (Lehman and Roth, 2010). Rental payments under existing leases can reflect inflation through indexation clauses that periodically adjust the rent to the prevailing price level. However, given the discrete nature of these reviews, rental payments lag changes in the price level (Bach and Ando, 1957; Hoesli, Lizieri and MacGregor, 2008), and leases are considered a nominal contract (Zarowin, 1988). The value of the REIT's real estate assets can be measured by discounting the future rental income; after deducting the value of any debt used to purchase these assets, this calculation results in the Net Asset Value (NAV) of the REIT (Baum, 2002). Given that this value is derived on the basis of the nominal rental contracts, we use the tie series of the REITs' NAV obtained from SNL as a proxy for nominal assets. We assume that the REIT finances asset purchases using a combination of debt and equity. Fixed-rate debt constitutes a nominal liability (Flannery and James, 1984). The value of nominal debt is fixed in currency terms and, in an efficient market, accounts for expected inflation (Fama, 1970). We use the REIT's holdings of fixed-rate debt obtained from SNL as a proxy for nominal liabilities.

Table 2 shows the descriptive statistics for the REITs in our sample. The mean nominal debt (assets) to equity ratio is 1.93 (2.46). The majority of REIT debt on average is nominal (fixed-rate) debt (81%), supporting the view that firms prefer fixed-rate debt for the purposes of financial security but potentially also because it may offer additional benefits, such as enhancing inflation hedging capabilities.

Table 2: Summary statistics of REIT and macroeconomic variables 1989-2011

Characteristic	Mean	SD	Min	25th	50th	75th	Max
Nominal debt to equity	1.93	8.97	-161.41	0.95	1.34	2.18	67.39
Log of nominal debt	13.13	1.31	7.90	12.58	13.29	13.88	16.38
Nominal debt to total debt	0.81	0.13	0.26	0.74	0.83	0.90	1.00
Nominal assets to equity	2.46	1.85	-3.15	1.45	2.14	2.72	12.61
Log of nominal assets	13.47	1.23	7.50	12.99	13.64	14.21	15.99
Log of firm size	20.20	1.48	15.07	19.57	20.38	21.06	22.99
Profitability	0.08	0.03	-0.05	0.07	0.08	0.10	0.15
Market-to-book	1.30	0.29	0.79	1.12	1.27	1.47	2.09
Fixed assets ratio	0.99	0.03	0.84	0.99	1.00	1.00	1.00
Abnormal earnings	-0.02	0.27	-3.07	-0.02	-0.00	0.01	2.82
Volatility	1.51	1.93	0.08	0.36	0.68	1.69	14.33
Debt maturity	0.49	0.19	0.00	0.36	0.49	0.61	1.00
Log of asset maturity	3.47	0.27	2.83	3.29	3.46	3.64	4.82
Log of rent per property	2.53	0.49	-1.07	2.45	2.62	2.71	3.22
Proportion of firm-years with							
Net operating loss dummy	0.08	0.27					
Debt rated dummy	0.49	0.50					
Term structure	1.85	1.35	-0.35	0.87	2.16	3.23	3.42
Inflation	0.02	0.01	0.00	0.01	0.02	0.02	0.03
Inflation uncertainty	1.25	0.50	0.42	0.93	1.21	1.70	2.19
Case Shiller index	103.90	22.98	57.80	89.88	96.94	124.10	141.89

Note: Details on variable measurements can be made available upon request.

The mean fixed assets ratio is 0.99, reflecting the asset requirement of the U.S. REIT legislation that stipulates REITs invest a large share of their capital in real estate for the purpose of leasing and operating these properties. The mean annual inflation rate over the study period is 2%. However, the average annual standard deviation of the monthly price levels (inflation uncertainty) is 125 basis points, suggesting that total inflation uncertainty may constitute a substantial risk for firms that aim to provide a hedge against inflation for their investors.

Table 3 shows the pairwise Pearson correlation coefficients between the firm-level variables. Correlation coefficients are generally low with the exception of the log of nominal debt, the log of nominal assets, the log of rental revenue and firm size, highlighting the importance of managing the influence of firm size in our regressions.

Table 3: Correlation coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(1)	1.000																							
(2)	0.088	1.000																						
(3)	0.033	0.295	1.000																					
(4)	0.529	0.181	0.052	1.000																				
(5)	0.048	0.880	0.189	0.215	1.000																			
(6)	-0.032	0.027	0.033	0.313	0.377	1.000																		
(7)	0.054	0.856	0.280	0.052	0.901	0.122	1.000																	
(8)	0.020	0.275	0.197	0.336	0.379	0.545	0.252	1.000																
(9)	0.032	0.216	0.128	0.026	0.388	0.417	0.612	0.243	1.000															
(10)	0.012	0.013	-0.012	0.133	0.091	0.227	0.149	0.276	0.132	1.000														
(11)	-0.012	-0.030	-0.009	-0.007	-0.008	0.056	0.054	0.224	0.093	0.030	1.000													
(12)	0.006	0.457	0.125	-0.043	0.388	-0.137	0.329	-0.138	-0.006	-0.074	-0.031	1.000												
(13)	0.053	-0.005	0.500	0.035	-0.013	0.035	-0.009	0.110	0.048	0.079	0.053	-0.043	1.000											
(14)	-0.040	-0.204	-0.023	-0.135	-0.189	-0.080	0.152	-0.169	0.190	0.247	0.080	-0.114	0.195	1.000										
(15)	0.074	0.907	0.216	0.202	0.881	0.143	0.815	0.381	0.239	0.080	0.044	0.352	-0.001	-0.247	1.000									
(16)	0.053	-0.000	0.018	0.192	-0.005	0.117	-0.058	0.199	0.038	0.023	0.106	-0.143	0.040	0.043	0.320	1.000								
(17)	-0.028	0.232	0.037	0.010	0.409	0.370	0.396	0.457	0.325	0.210	0.166	-0.013	0.177	0.317	0.303	0.233	1.000							
(18)	-0.013	0.114	0.044	0.019	0.081	0.009	0.089	-0.103	-0.055	-0.123	0.112	0.111	-0.026	-0.046	0.127	0.048	0.142	1.000						
(19)	-0.018	-0.136	-0.032	0.039	-0.201	-0.077	-0.163	0.053	-0.069	-0.112	0.032	-0.030	0.001	-0.181	-0.041	0.020	-0.166	-0.010	1.000					
(20)	-0.000	0.472	0.182	0.013	0.504	0.093	0.495	0.184	0.275	0.189	-0.007	0.225	0.079	0.085	0.491	0.018	0.213	0.082	0.120	1.000				
(21)	-0.069	-0.018	-0.007	-0.056	-0.002	-0.009	-0.052	-0.178	-0.122	0.063	-0.072	0.122	-0.147	-0.070	0.028	-0.053	-0.253	0.045	0.026	0.036	1.000			
(22)	-0.022	-0.031	0.010	0.001	-0.010	0.102	-0.019	0.179	0.027	0.100	-0.002	-0.091	0.117	0110	-0.038	0.072	0.254	-0.007	-0.051	-0.026	-0.274	1.000		
(23)	-0.025	0.001	-0.022	-0.009	-0.005	0.053	-0.046	0.083	-0.081	0.061	-0.056	-0.104	0.062	0.065	-0.014	0.066	0.232	0.015	-0.026	-0.043	-0.220	0.621	1.000	
(24)	0.080	0.121	0.107	0.019	0.046	-0.127	0.174	-0.060	0.258	-0.194	0.050	-0.036	0.062	-0.132	0.067	-0.039	0.100	0.009	0.079	-0.005	-0.418	-0.049	-0.022	1.000

Note: Variables: (1) Fixed-rate debt to equity ratio, (2) Log of nominal debt, (3) Proportion of fixed rate debt relative to all debt, (4) Nominal assets to equity ratio, (5) Log of Nominal assets, (6) Proportion of nominal assets relative to all assets, (7) Log of Firm size, (8) Profitability, (9) Market-to-book, (10) Fixed assets ratio, (11) Abnormal earnings, (12) Time series of earnings volatility, (13) Debt Maturity, (14) Log of Asset maturity, (15) Log of Rental Revenue, (16) Log of Rent per property, (17) Mean Estimate of long-term growth, (18) Earnings forecast dispersion, (19) Operating Loss Carryfwd Dummy, (20) Debt Rating Dummy, (21) Term Structure 10yr m 6mths(\%) bills, (22) Inflation, (23) Inflation uncertainty, (24) Case Shiller Index.

Methodology

Testing the expected positive linear relationship between nominal assets and liabilities

We formally test Hypothesis 1 by considering the natural logarithm of nominal debt LNFRDT as a function of the natural logarithm of nominal assets LNNA and a set of control variables. We measure nominal liabilities as the amount of fixed-rate debt reported on SNL. We measure nominal assets as the net asset value (NAV) of the firm, also obtained from SNL.

We estimate the following random effects panel:

$$LNFRDT_{it} = \beta_0 + \beta_1 \, LNNA_{it} + \beta_2 \, CTRL_{it} + u_{it}$$

where u_{it} is a normally distributed residual. We use heteroskedasticity-robust standard errors. The matrix CTRL contains a set of commonly employed capital structure (leverage) controls, see Table 4. We include year dummies to capture the effect of latent economic factors. We expect a positive sign on the coefficient β_1.

Table 4: Control variables in test of hypothesis 1

Proxies for leverage hypotheses	Theory	Reference
Maturity (share of total debt maturing in more than 3 years)	Maturity determines leverage to maximise firm value	Leland and Toft, 1996
Alternative tax shields (dummies for operating loss carry forward, 1 in presence of alternative tax shield)	Trade-off theory	DeAngelo and Masulis, 1980
Growth opportunities (market to book)	Mitigate agency costs of underinvestment	Myers, 1977
Firm size (log of market value of the firm)	Static pecking order (information asymmetry)	Myers and Majluf, 1984
Profitability (EBITDA to book value of assets)	Dynamic pecking order	Donaldson, 1961; Myers and Majluf, 1984
Firm quality (abnormal earnings)	Signalling	Ross, 1977
Fixed assets ratio	Information extraction	Harris and Raviv, 1990; Williamson, 1988
Volatility of earnings (stdev. of 1st diff. in EBITDA over 4 yrs.)	Credit risk	Bradley, Jarrell and Kim, 1984

Proxies for maturity hypotheses	Theory	Reference
Asset maturity (log of gross depreciable assets to depreciation expense)	Asset-matching principle	Myers, 1977
Debt rating (dummy, 1 in presence of debt rating)	Liquidity risk	Diamond, 1991; Sharpe, 1991; Titman, 1992
Term structure (10-yr. vs. 6-month government bond)	Tax benefits	Brick and Ravid, 1985

In order to mitigate any bias resulting from the potential endogenous determination of nominal assets, we re-estimate this equation using 2SLS. We obtain LNNA in a first stage using the Case Shiller House Price Index and the log of the rental revenue per property as instruments, on the basis that these influence the NAV of the firm, but not directly the way in which the underlying assets are financed.

Following the evidence for a relationship between leverage and maturity (Leland and Toft, 1996; Alcock, Finn and Tan, 2011) we augment this equation by debt maturity, measured as the ratio of long-term debt to total debt (Alcock, Finn and Tan, 2011). In order to account for any bias stemming from the potential simultaneous determination of leverage and maturity (Johnson, 2003; Barclay, Marx and Smith, 2003), we lastly consider maturity to be endogenous also, and use the log of asset maturity, the term structure and a debt rating dummy as instruments (Alcock, Finn and Tan, 2011; Alcock, Steiner and Tan, 2012).

Testing the impact of deviations from optimal nominal liabilities on the real Sharpe ratio

We explore the evidence for Hypothesis 2 by relating the annual real Sharpe ratio SR^R of the firm to the deviation of its nominal liability holdings from the optimum DEV. For each firm, we obtain the annual real Sharpe ratio by computing the average real excess return and dividing by its variance. We relate this measure of real risk-adjusted performance to a measure of the deviation of nominal liability holdings from their optimum. We measure this deviation by computing the annual squared differences between nominal assets and liabilities (both deflated by the producer price index) in millions.

We estimate the following fixed effects panel model:

$$SR^R_{it} = \beta_0 + \beta_1 DEV_{it} + \beta_2 CTRL_{it} + u_{it}$$

where u_{it} is a normally distributed residual. We cluster standard errors by firm. The matrix CTRL contains the control variables. Risk-adjusted performance can be viewed as a function of the firm's investment decisions and, as we propose here, its financing policy. Therefore, the control variables include the leverage controls from Table 4. In addition, we include dummies to indicate the firm's property sector. The property sector a firm primarily invests in arguably determines the type of leases, including their indexation clauses, and thus has an immediate impact on inflation hedging characteristics that we need to separate from the effect of capital structure. We control for latent economic influences using year dummies. We expect a negative sign on β_1.

In order to explore the relative sensitivity of changes in the real Sharpe ratio to changes in the deviation from the optimal holdings of nominal liabilities, we re-estimate this equation but replace the levels of the dependent variable SR^R and the predictor of interest DEV by their first differences.

Testing the relationship between optimal nominal liabilities and inflation hedging characteristics

We explore the evidence for Hypothesis 3 by relating the sensitivity of a firm's nominal return to unexpected inflation to the deviation from the optimal holdings of nominal liabilities. We measure the firm's sensitivity to unexpected inflation using annual regressions of the nominal monthly firm returns in excess of the risk-free rate NRET on monthly unexpected inflation UINFL, controlling for the excess return on the market, size and value factors as well as expected inflation and changes in the federal funds rate, summarised in the matrix CTRL1.

We measure unexpected inflation as the residual from filtering monthly logged CPI figures using an ARIMA(0,1,1) specification (Fama and Gibbons, 1984; Vassalou, 2000), and expected inflation as the predicted values from this filtering exercise. For each firm, we collect the series of annual regression coefficients of the unexpected inflation variable. We then regress each firm's unexpected inflation beta series over the study period UINFLB on the firm's annual deviation from the optimal holdings of nominal liabilities, defined as before DEV, and a set of control variables summarised in the matrix CTRL2. In summary, we estimate the following regressions:

$$NRET_{it} = \beta_0 + \beta_1\, UINFL_t + \beta_2\, CTRL1_t + u_{it}$$
$$UINFLB_{it} = \gamma_0 + \gamma_1\, DEV_{it} + \gamma_2\, CTRL2_{it} + e_{it}$$

where u_{it} and e_{it} are normally distributed residuals. The first regression is run iteratively per firm and year, allowing us to compile a panel of β_1 coefficients. The second regression is a fixed-effects panel. We remedy potential heteroskedasticity from the estimated dependent variable in this regression using robust standard errors (Lewis and Linzer, 2005), and additionally cluster standard errors by firm. We control for common determinants of the firm's leverage choices (see Table 4). We include property type and year dummies. We expect a negative sign on γ_1. In order to explore the relative sensitivity of changes in the firm's unexpected inflation sensitivity to changes the deviation from optimal nominal liabilities, we re-estimate this equation replacing the levels of UINFLB and DEV by their first differences.

Testing the notion of nominal liabilities as a buffer against unexpected inflation

We empirically test Hypothesis 4 by relating a firm's annual relative holdings of nominal debt, measured as the ratio of nominal debt to all debt FRDTSHARE, to annual unexpected inflation uncertainty UNC. We measure this uncertainty as the annual standard deviation of unexpected inflation figures over 12 months to year-end. We thus produce one uncertainty measure per year that we match to the year-end capital structure data. We estimate the following model:

$$NDSHARE_{it} = \beta_0 + \beta 1\, UNC_t + \beta_2\, CTRL_{it} + u_{it}$$

where u_{it} is a normally distributed residual. We use heteroskedasticity-robust standard errors. In CTRL, we control for common determinants of the firm's leverage choices (see Table 4). We consider the maturity control to be endogenously determined and estimate it in a first stage as in the test for hypothesis 1. We include property type and year dummies. We expect a positive sign on β_1. In order to explore the sensitivity of the firm's absolute holdings of nominal liabilities to unexpected inflation uncertainty, we re-estimate this model but replace the dependent variable by LNFRDT.

Results

Supported: Firms adhere to the positive linear relationship between nominal assets and liabilities

Table 5 presents the regression results for US REITs over the study period 1989 to 2011. Consistent with our expectation, we find empirical evidence for a positive linear relationship between the holdings of nominal debt and the holdings of nominal assets (Columns 1-4). This evidence is robust to various alternative specifications. Careful identification (Columns 2-4) additionally appears to reveal the directly proportional nature of the relationship between nominal assets and liabilities that is implied in our model. The regression coefficient on nominal assets is statistically indistinguishable from unity at a 5% level.

Table 5: Regression results for hypothesis 1, 1989-2011

	(1)	(2)	(3)	(4)
VARIABLES	LNFRDT	LNFRDT	LNFRDT	LNFRDT
Nominal assets	0.273***	1.148***	1.137***	0.790***
	(0.08)	(0.42)	(0.42)	(0.24)
Debt Maturity			0.093	0.463
			(0.18)	(0.51)
Firm size	0.471***	-0.082	-0.071	0.222
	(0.08)	(0.35)	(0.35)	(0.21)
Profitability	-0.668	-3.603	-3.592	-1.610
	(0.82)	(3.21)	(3.15)	(2.05)
Market to book	-0.732***	-0.313	-0.324	-0.599***
	(0.13)	(0.37)	(0.36)	(0.22)
Fixed assets ratio	-1.791*	1.629	1.610	1.323
	(0.95)	(1.21)	(1.22)	(1.10)
Abnormal earnings	0.005	-0.031	-0.035	-0.071
	(0.08)	(0.15)	(0.15)	(0.13)
Earnings volatility	-0.002	-0.005	-0.005	-0.004
	(0.00)	(0.00)	(0.00)	(0.00)
Loss carry fwd.	-0.022	0.225	0.220	0.134
	(0.12)	(0.23)	(0.23)	(0.20)
Constant	2.545*	p/o	p/o	p/o
	(1.41)			
Observations	476	441	441	441
Regression Fstat	n/a	149.2	137.2	161.4
Year dummies	Yes	Yes	Yes	Yes
Relevance P-value	n/a	0.027	0.030	0.000
Validity P-value	n/a	0.385	0.408	0.411

Note: The table shows the results from a set of panel regression models using annual balance sheet data from our final sample of REITs over the full period 1989-2011. Column (1) shows a random effects panel regression of the log of nominal debt (LNFRDT) on the log of nominal assets and a set of control variables. Standard errors are clustered by firm. Column (2) shows the 2SLS regression of LNFRDT on nominal assets and a set of control variables. Here, we estimate the log of nominal assets in a first stage as a function of the Case Shiller House Price Index and the log of rental revenue per property. The instruments pass the test for relevance and validity. To avoid multicollinearity among the year dummy variables, we partial them out together with the constant, which does not affect the estimates of the remaining coefficients by the Frisch-Waugh-Lovell (FWL) theorem in IV. Column (3) additionally controls for debt maturity. Column (4) controls for debt maturity as well but additionally considers this variable to be endogenous also, and determined in a first stage alongside the log of nominal assets as a function of the log of asset maturity, a debt rating dummy and the term spread (Alcock, Finn and Tan, 2011). Heteroskedasticity-robust standard errors in parentheses, significance indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Our finding suggests that the firms in our sample follow the simple capital structure rule we propose, resulting in a positive linear relationship between nominal assets and liabilities. Firms appear to match these two items on their balance sheets. This evidence is consistent with our model, suggesting that capital structure choices, inflation hedging and performance management appear to be related. This evidence implies that the management of real risk-adjusted returns to firm equity is of concern to managers, and that this is partly carried out via capital structure choices.

Our results also provide novel insight into the question of why REITs may carry more leverage than theory suggests. The tax-exempt status and strict distribution requirements of REITs limit the explanatory power of the main traditional capital structure theories for REIT leverage choices. However, empirical evidence suggests that REITs typically carry substantial amounts of debt. For instance, Alcock, Steiner and Tan (2012) report that REITs on average have 45% leverage, significantly more than their unregulated counterparts in the same line of business. Consequently, in the absence of many of the traditional motivations for holding debt, REITs may be able to follow less conventional financing policies. In this context, our results suggest that REIT leverage may be a function of efforts to manage real risk-adjusted performance.

Supported: Firms that adhere to our capital structure rule achieve higher real Sharpe ratios

Table 6 presents the regression results regarding hypothesis 2. Consistent with our expectation, we find empirical evidence for an inverse linear relationship between the deviation from firms' optimal nominal liability holdings and their annual real Sharpe ratios.

Firms that adhere closely to the positive linear relationship between nominal assets and liabilities we propose appear to achieve a higher real Sharpe ratio relative to their peers. Increasing deviations form the optimal holdings of nominal liabilities depress real risk-adjusted performance as measured by the real Sharpe ratio.

Our result is robust to controlling for a broad set of potential explanatory variables. The choice of explanatory variables reflects the notion that real risk-adjusted performance is the product of the firm's investment decisions and its financing choices. In this study, we focus particularly on the role of the financing choices in determining the firm's real risk-adjusted performance.

The evidence we present here provides additional support for the theoretical argument we propose. We argue that capital structure choices, performance and inflation hedging characteristics are related. We find evidence for a positive linear relationship between nominal assets and liabilities and interpret this as evidence in favour of our argument. The results we offer here further support the link between capital structure choices and real risk-adjusted performance. If firms follow the simple capital structure rule we propose, they seem to be able to successfully improve real risk-adjusted returns to firm equity.

Column 2 of Table 6 presents the effect of changes in the deviation from the optimal holdings of nominal liabilities on changes in the real Sharpe ratio. The coefficient corresponding to the changes in the deviation from the optimum is negative. This result suggests that the relationship between the real Share ratio and the holdings of nominal liabilities is not strictly linear in nature. More specifically, our finding implies that increasing deviations from the optimum have a decreasing relative negative impact on the real Sharpe ratio. In other words, the marginal effect of an additional small shift away from the optimal holdings of nominal liabilities is decreasing. However, on the basis of our analysis it appears that deviations resulting in excess, that is more than optimal, holdings of nominal liabilities have a similar negative effect on the real Sharpe ratio to deviations resulting in insufficient, that is, less than optimal, holdings of nominal liabilities.

Table 6: Regression results for hypothesis 2, 1989-2011

	(1)	(2)
VARIABLES	Real Sharpe ratio	D.Real Sharpe ratio
Deviation from optimum	-0.019***	
	(0.01)	
D.Deviation from optimum		-0.067***
		(0.01)
Debt Maturity	0.045	0.733
	(0.14)	(0.74)
Loss carry fwd.	0.018	-0.323
	(0.07)	(0.41)
Firm size	-0.029	0.274
	(0.06)	(0.30)
Profitability	-0.031	-5.990
	(0.85)	(6.62)
Market to book	0.209	-1.145
	(0.20)	(1.10)
Fixed assets ratio	0.342	-1.373
	(0.84)	(2.15)
Abnormal earnings	-0.019	0.003
	(0.03)	(0.10)
Constant	-0.386	-2.762
	(1.28)	(4.54)
Observations	465	451
R-squared	0.298	0.078
Property type dummies	Yes	Yes
Year dummies	Yes	Yes

Note: The table shows the results from a set of fixed-effects panel regression models estimating the firm's annual real Sharpe ratio (column 1) and the change in the annual real Sharpe ratio (column 2) as a function of the deviation from its optimal nominal liability holdings (column 1) and the change in this deviation (column 2). Standard errors (in parentheses) are clustered by firm. Significance indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Supported: Deviations from optimal nominal liabilities reduce inflation hedging qualities

Table 7 shows the regression results of the panel of annual firms' inflation betas on the deviation of their holdings of nominal debt from the optimum we imply in our model. On this basis, we can establish evidence that observing the predicted linear relationship between nominal assets and liabilities improves real risk-adjusted performance by modifying the influence of unexpected inflationary shocks on the returns to equity, thus helping to hedge real equity performance against unexpected inflation.

Consistent with our third hypothesis, we find that firms with higher smaller of nominal debt in their total debt deviations from the optimal holdings of nominal liabilities appear to exhibit a higher sensitivity of nominal returns to unexpected inflation, as measured by the series of their unexpected inflation beta over the study period. This result holds in the presence of common capital structure controls. The result also holds when controlling for the property sector a REIT predominantly invests in, on the basis of the assumption that the sector directly determines the structure of the lease and thus the terms under which rent adjusts to inflation. Our results are also robust to controlling for latent economic shocks captured in year dummies.

These findings are broadly consistent with the nominal contracting hypothesis that describes a relationship between the balance of a firm's nominal assets and liabilities and the sensitivity of its equity returns to unexpected inflation (Bach and Stephenson, 1974; Kessel, 1956; Bach and Ando, 1957; Alchian and Kessel, 1959; Kessel and Alchian, 1960; Hong, 1977).

Table 7: Regression results for hypothesis 3, 1989-2011

	(1)	(2)
VARIABLES	UINFLB	D.UINFLB
Deviation from optimum	-0.449*	
	(0.26)	
D.Deviation from optimum		-0.571**
		(0.26)
Debt Maturity	-19.819***	-11.341
	(6.11)	(8.36)
Loss carry fwd.	1.708	2.422
	(3.90)	(6.31)
Firm size	0.434	-4.115
	(1.81)	(3.06)
Profitability	36.398	135.141
	(25.48)	(90.53)
Market to book	-16.122***	-1.335
	(3.81)	(9.63)
Fixed assets ratio	7.487	-10.375
	(27.05)	(48.49)
Abnormal earnings	2.048	4.312
	(2.56)	(3.48)
Constant	13.458	77.318
	(46.51)	(76.01)
Observations	449	427
R-squared	0.073	0.270
Property type dummies	Yes	Yes
Year dummies	Yes	Yes

Note: The table shows the results from a set of fixed-effects panel regressions of firms' unexpected inflation beta as a function of the deviation from their optimal holdings of nominal liabilities (column 1) and an identical regression considering annual changes in the unexpected inflation beta as a function of changes in the deviation (column 2). The unexpected inflation beta is estimated from regressions per firm and year of the monthly nominal firm returns on unexpected inflation (the residual from an ARIMA(0,1,1) filter of logged monthly CPI figures following \citet{FamaGibbons:84,Vassalou:00}), the market, size and value factors as well as expected inflation (the prediction from the ARIMA model) and changes in the federal funds rate. To avoid multicollinearity among the year dummy variables, we partial them out together with the constant, which does not affect the estimates of the remaining coefficients by the Frisch-Waugh-Lovell (FWL) theorem in IV. Standard errors (in parentheses) are clustered by firm and robust to heteroskedasticity that might be introduced through the estimated dependent variable set-up, significance indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

On the basis of our findings, we contribute to the debate surrounding the suitability of investments in REIT equity as a hedge against inflation. Research typically supports the notion of direct real estate as an inflation hedge. As a securitised form of real estate, REITs may preserve this property. Alternatively, REITs may behave like common stocks and represent a perverse hedge against inflation. On balance, empirical evidence points in this direction. However, existing studies often rely on index-level analyses, implicitly assuming either that inflation-hedging characteristics of REITs are equal across firms or that cross-sectional differences in inflation hedging characteristics are irrelevant.

Our approach allows us to focus on firm-level variation in inflation hedging properties by linking these to firm-specific capital structure choices. Firms that observe the predicted relationship between nominal assets and liabilities appear to provide superior inflation hedging properties relative to their peers. This finding is also consistent with the discussion in Case and Wachter (2011).

The second column of Table 7 presents the effect of a change in the deviation from the optimal nominal liability holdings on the change in the firm's unexpected inflation beta. The sign on the coefficient is negative. This finding resonates our result for the relationship between changes in the deviation from the optimal nominal liability holdings and changes in the firm's real risk-adjusted performance. As the change in the deviation becomes larger, the marginal negative effect on the inflation hedging qualities of the stock decreases.

Supported: Nominal liability holdings buffer against unexpected inflation when volatility is high

Table 8 shows the results of the regression relating the relative holdings of nominal liabilities to uncertainty surrounding unexpected inflation.

If the prediction of our model is correct and REIT managers consider future inflation hedging properties in their capital structure choices, then we expect these financing decisions to be directly related to inflation uncertainty. Consistent with our hypothesis, we find that higher inflation uncertainty results in higher relative holdings of nominal debt as firms attempt to build a buffer against the possibility of higher inflation in the future.

The relative holdings of nominal liabilities, measured by the ratio of nominal liabilities to all liabilities, can increase because of an active increase in nominal liabilities or because of a decrease in real liabilities. Our results suggest that contemporaneous inflation uncertainty results in an increase in the relative holdings of nominal liabilities.

Column 2 shows the effect of lagged inflation uncertainty on the absolute holdings of nominal liabilities. In combination, these results suggest that firms primarily respond to higher inflation uncertainty by letting real liabilities expire, thus indirectly increasing the relative holdings of nominal liabilities. However, for firms to actively increase the holdings of nominal liabilities, the effect of lagged inflation uncertainty seems more important. It appears that managers require a sufficiently high threshold level of evidence for a macroeconomic regime characterised by higher inflation uncertainty to actively increase the holdings of nominal liabilities. This finding may reflect the higher cost of nominal liabilities relative to real liabilities.

Table 8: Regression results for hypothesis 4, 1989-2011

	(1)	(2)
VARIABLES	FRDTSHARE	LNFRDT
Unexpected inflation uncertainty	0.922***	
	(0.24)	
L.Unexpected inflation uncertainty		0.403**
		(0.16)
Debt Maturity	0.237	2.780*
	(0.19)	(1.60)
Loss carry fwd.	-0.000	-0.369**
	(0.03)	(0.18)
Firm size	0.028***	0.827***
	(0.01)	(0.03)
Profitability	0.692**	-0.773
	(0.31)	(2.23)
Market to book	-0.032	-1.182***
	(0.03)	(0.17)
Fixed assets ratio	0.031	-0.707
	(0.23)	(1.56)
Abnormal earnings	-0.004	-0.235
	(0.04)	(0.18)
Earnings volatility	0.001	-0.007
	(0.00)	(0.01)
Observations	476	476
Regression F-stat	14.02	87.53
Property type dummies	Yes	Yes
Year dummies	Yes	Yes
Relevance P-value	0.035	0.035
Validity P-value	0.933	0.010

Note: The table shows the results from a set of 2SLS regressions of holdings of nominal debt relative to all debt (FRDTSHARE) unexpected inflation uncertainty (column 1) and an identical regression considering total holdings of nominal liabilities (LNFRDT) as the dependent variable and the lagged unexpected inflation uncertainty as the predictor of interest (column 2). The unexpected inflation uncertainty is obtained as the variance of unexpected inflation (the residual from an ARIMA(0,1,1) filter of logged monthly CPI figures following (Fama and Gibbons, 1984; Vassalou, 2000). In both regressions, the maturity control variable is estimated in a first stage as a function of the instruments log of asset maturity, a debt rating dummy and the term spread (Alcock, Finn and Tan, 2011). Heteroskedasticity-robust standard errors in parentheses, significance indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

5 Conclusion

In this paper, we model the real risk-adjusted performance of an investment in a firm's equity in the presence of nominal as well as real assets and liabilities. We show that firms can choose a capital structure that maximises real risk-adjusted performance by matching nominal liabilities with nominal assets. We illustrate that in doing so, firms minimise the sensitivity of risk-adjusted returns to unexpected inflationary shocks. Our results imply that managers can jointly influence performance and inflation hedging qualities of investments in firm equity through suitable capital structure choices. Our results also imply that investors can extract information about inflation hedging capabilities from capital structure data, promoting more efficient investment decisions.

We explore the empirical support for our theoretical predictions using a sample of US equity REITs. We find evidence that firms observe the predicted linear relationship between nominal assets and liabilities. Firms that adhere to the predicted capital structure rule outperform their peers in terms of the real Sharpe ratio. Increasing deviations from the optimal nominal liability holdings reduce the inflation hedging qualities of investments into firms' equity. Lastly, firms' holdings of nominal debt appear to increase in times of higher inflation uncertainty.

Our findings further have implications that are specific to REITs. Firstly, our study contributes to the continuing debate about the drivers of REIT leverage choices in the absence of traditional motivations for holding debt. We provide evidence consistent with the hypothesis that REITs choose leverage so as to improve real risk-adjusted performance. Our results also contribute to the debate about inflation hedging characteristics of REITs as a securitised form of direct real estate. In this study, we provide evidence that REITs may be able to preserve the inflation hedging properties of direct real estate if they follow the relationship between nominal assets and liabilities we predict.

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Author Biographies

Bio Dr Jamie Alcock
Dr Jamie Alcock teaches Real Estate Finance at The University of Cambridge and is a Fellow of Economics at Downing College, Cambridge. He is also a part-time Associate Professor of Quantitative Finance at The University of Queensland where he received a PhD in Mathematics in 2005. His research interests include corporate and real estate finance, computational and empirical finance. Dr Alcock has been repeatedly recognised for excellence in research across a broad range of financial sub-disciplines, including the 'Best Derivatives Paper' prize at the prestigious Australasian Banking and Finance Conference, 2007 and the 'Best Paper on Real Estate Investment' at the 2010 European Real Estate Society annual conference and the 2011 A M Parker Prize form the Institute of Actuaries in Australia.

Bio Eva Steiner
Eva Steiner is a doctoral researcher at the Department of Land Economy, The University of Cambridge. Her research interests include real estate finance, corporate finance and applied econometrics. She holds degrees from the University of Cambridge and the University of Heilbronn, Germany. Prior to joining the Department of Land Economy, Eva worked as an analyst at LaSalle Investment Management in London. Eva's research has received international recognition, such as the prize for the 'Best Paper on Real Estate Investment' at the 2010 European Real Estate Society annual conference and the 2011 and, more recently, a 'Best Paper Award' at the AREUEA International Meeting 2012.