PRELIMINARY DRAFT

What Can We Learn about Investment and Capital Structure with a Better Measure of *q*?

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Abstract

This paper takes an integrated approach to examining the link between stock prices, investment, and capital structure decisions using data on a unique type of firm: Real Estate Investment Trusts (REITs). By using REITs, we are able to obtain high quality estimates of the net asset value of the firm, that can be used to create relatively accurate measures of Tobin's q. In addition, REITs have institutional features that allow us to abstract from other factors that have complicated previous studies. We have three main findings. First, while REIT investment is weakly related to the traditional measure of q, it is quite responsive to an alternative measure of q based on NAV. A REIT whose NAV-based q ratio rises from 1.0 to 1.1 will increase its assets by ten percent in the next year. Second, the debt-to-value ratio responds to deviations in price-to-NAV ratio as well, but more sluggishly. A 0.1 increase in price-to-NAV ratio leads to a relatively modest 0.52 percentage point decrease in the following year's debt-to-market-value ratio. Overall, REITs appear to finance marginal projects with a mix of debt and equity that is similar to their average debt-equity mix. Third, we find evidence that these relationships are nonlinear. Firms invest aggressively when q exceeds one, but do not dis-invest when q is below one. The investment results support traditional theories of firm investment with adjustment costs and imply that past difficulties in validating q theory are likely due to problems in adequately measuring q. The nonlinear relationship between investment and q is consistent with relatively high costs of disinvestment, but also agency models in which managers are reluctant to shrink the size of the firm. Finally, the evidence is weakly consistent with REIT managers attempting a limited amount of financial market timing based on quasi-public information on NAV.

I. Introduction

Managers have many margins on which they can maximize the value of the firm. A manager can choose the amount of investment in real assets. Traditional *q*-theory models describe the optimal level of investment subject to adjustment costs. Yet investment decisions do not occur in a vacuum; a manager must finance investments with some combination of debt and equity. Modigliani and Miller (1956) show that the choice of financing should not effect investment decisions, absent issues such as asymmetric information, bankruptcy costs, taxes, and market timing or inefficiency. Subsequent research suggests that such imperfections link firm value and financing choices. While many theories of firm behavior consider the financing and investment decisions together (for example, Myers and Majluf, 1984), empirical papers have tended to focus on either capital structure or investment separately.

In this paper, we consider both investment and capital structure in an integrated framework using a unique type of firm: Real Estate Investment Trusts (REITs). Analysts typically evaluate REITs by appraising their properties, which provide an estimate of Tobin's *q* that is arguably more accurate than the measures based on the book value of assets that researchers have used for industrial firms. In addition, REITs have institutional features that allow us to abstract from several of the margins that complicate the interpretation of other studies.[1] Thus REITs provide a natural place to examine how investment responds to deviations in the firm's stock market valuation from the cost of new investments. Two possible mechanisms may drive the responsiveness of investment to *q*. First, the stock price may reflect

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[1] REITs are exempt from corporate income taxes, but in return must limit their activities to owning and managing portfolios of real estate assets and must pay out the bulk of their taxable income as dividends. The dividend requirement means that REITs lose about one-half of their cash flow, giving them less discretion to fund new investment with retained cash. REITs must go to the capital markets to finance new investment of any significant scale, so all REITs can be considered "equity dependent firms."

variation in the quality of investment opportunities across firms or across time. Second, the level of the stock price may be related to the cost of equity capital and firms may respond to a lower cost of equity capital by issuing equity, and vice versa.

In addition to comparing our appraisal-based measure of q with traditional measures of q, we examine whether capital structure adjusts in response to q. To the extent that a firm's investment responds to q, it must finance this investment with either debt or equity. Our integrated approach to investment and capital structure allows us to estimate separate responses of debt and equity. Even if investment does not respond to q, however, firms can adjust their capital structure in response to q. For example, if q is high, firms may perceive equity to be relatively cheap and issue equity in order to reduce their reliance on debt. Therefore, instead of incurring the adjustment costs associated with physical investment, firms would incur the adjustment costs associated with changing their capital structure. By simultaneously looking at the investment and capital structure margins, we believe that our approach provides a more complete picture of how firms respond to how investors value their shares.

We have three principal findings. First, contrary to previous results on investment and q for manufacturing firms, our results suggest that REIT investment responds strongly to firm's value of q. Using our appraisal-based measure of q, we estimate that a REIT that starts the year with a q of 1.1 will be 10.3 percent larger after one year than if it starts the year with a q of 1.0. By comparison, our estimated elasticity is roughly ten times larger than the elasticities found in typical empirical studies of investment.[2] The responsiveness of investment to q is consistent with neoclassical investment theory but contradicts the view that stock market valuations are not

[2] See, *e.g.*, Bond and Cummins (2000) and the cites given in section III on previous estimates.

central in explaining investment, possibly because managers view stock prices as having a non-fundamental component (see, *e.g.*, Morck, Shleifer, and Vishny (1990) and Blanchard, Rhee, and Summers (1993)).

Second, we find that the levels of firms' equity and debt respond positively to q. Continuing the above example, the 10.3 percent increase in assets will be financed with 53 percent equity and 47 percent debt, proportions that closely correspond to the average proportions of equity and debt of REITs. We find some evidence that a higher q is associated with a tilt toward equity financing; if q is 0.1 higher at the start of a year, we estimate that the debt-to-value ratio drops by a modest 0.52 percentage points. This sluggish response of capital structure to equity market valuations is consistent with the findings in Baker and Wurgler (2002). However, the results are more consistent with firms having a target capital structure rather than opportunistically timing the form of financing based on equity valuations. The similarity of the debt and equity responses is inconsistent with firms systematically restructuring their capital structure (without a change in investment) in response to equity valuations.

Third, we find that the relationships between q and investment and the changes in equity and debt are nonlinear. Based on nonparametric kernel estimation and splitting the sample for observations with q above or below one, the nonlinearity can be roughly characterized as firms respond to q when q is above one but do not respond when q is below one. Asymmetric adjustment costs, especially with respect to irreversible investment, might provide a natural explanation for this pattern; however, the nature of the bulk of REIT investment – buying existing buildings – suggests that these arguments are weak for most REITs. An alternative story that is consistent with the nonlinear relationships is that, as suggested by agency conflict models such as Harris and Raviv (1990), managers are reticent to liquidate the firm, even if doing so would maximize shareholder value.

The paper is organized as follows. Section II provides background information on REITs. Section III reviews previous tests of the *q*-theory of investment and discusses why capital structure might respond to equity values. The data are summarized in Section IV. Section V discusses our empirical methodology and the measurement of *q*. Section VI presents our empirical results. Section VII concludes with an agenda for future research.

II. Background on REITs

With certain key tax-related exceptions, REITs are similar to other corporations. Like other corporations, REITs often initiate operations by raising capital from external markets and investing the capital in operating assets. To qualify as a REIT, among other things, a firm must meet certain asset and income tests that set minimum levels of real estate activity to prevent REITs from using their tax-advantaged status to move into other business areas. REITs must earn at least 75 percent of their income from real estate related investments and 95 percent of their income from these sources as well as dividends, interest and gains from securities sales. In addition, at least 75 percent of their assets must be invested in real estate, mortgages, REIT shares, government securities, or cash. While older REITs were often passive investors, several changes in tax rules in the late 1980s allowed REITs to actively manage their assets during the 1990s. Although some REITs invest in real estate mortgages, we restrict our focus to equity REITs, which primarily invest in rental properties.

The relatively straightforward nature of REITs' assets (compared to industrial firms) leads many analysts to value REITs by appraising their properties. We use one set of these appraisals in our empirical work. As discussed below, an advantage of studying REIT investment is that the industry is highly competitive and, arguably, can be characterized as having constant returns to scale. These features reduce the scope for measurement error in the traditional proxies for q that are used in studies of investment.

In addition to the asset and income tests, tax law requires REITs to pay out a minimum percentage of their taxable income as dividends each year. For most of our sample period, this percentage was 95 percent; however, tax changes in 2000 reduced the minimum percentage to 90 percent. This distribution requirement is based on taxable income rather than financial reporting income. Despite this requirement, REITs have some discretionary cash flow because operating cash flow typically exceeds taxable income, especially since depreciation allowances reduce taxable income but not cash flow. In general, however, the distribution requirement limits REITs' ability to finance investment with internally generated funds, so they uniformly rely more heavily on secondary equity issues than do regular corporations. Thus, while many studies of investment focus on the differences in the behavior of firms with and without internally generated funds, REITs offer less cross-sectional variation in dependence on external funds.

The benefit of qualifying as a REIT is avoiding the double taxation of equity-financed investment. Unlike regular corporations, REITs receive an annual tax deduction for dividends paid out to shareholders. REITs often distribute all of their taxable income to shareholders each year, which eliminates the corporate tax altogether.

The lack of double taxation changes the tax incentives for both investment and capital structure decisions. As discussed by Poterba and Summers (1983) and Cummins, Hassett and Hubbard (1994), tax policy affects the construction of q as a measure of the incentive for a firm to invest. Since REITs are exempt from the corporate tax, the corporate tax does not affect their q. In terms of capital structure, the absence of the corporate tax eliminates the usual tax advantage of debt financing for corporate investment. In addition, the distribution requirement virtually eliminates the tax advantages of repurchasing shares, instead of paying dividends, to distribute cash. If a REIT has paid all of its taxable income as a taxable dividend, it can choose between paying tax-free return of capital dividends or repurchasing shares; either way, investors face capital gains tax rates on the income associated with the distribution.[3] In general, the relatively simple tax environment for REITs reduces the importance of tax factors in capital structure decisions, allowing us to concentrate on non-tax incentives.

III. Stock Prices, Investment, and Capital Structure

This section reviews the theory and empirical evidence on how stock prices affect investment and capital structure. Our comparative advantage is using better data so we do not provide an exhaustive review of the previous econometric methodology.

III.A. Investment

Many studies of investment start with the insight of Tobin's (1969) q model of investment that a firm will want to invest if the market value of a project exceeds its replacement

[3] For the share repurchase, shareholders who sell their shares face capital gains taxes on any realized capital gains. For a return of capital distribution, shareholders reduce their tax basis by the amount of the distribution so they face larger capital gains taxes upon the eventual disposition of the shares.

value. The ratio of the market value to the replacement value is called q. If the output market is perfectly competitive and the production technology has constant returns to scale, Hayashi (1982) shows that Tobin's original hypothesis implies that the firm will invest if the market value of the firm exceeds the replacement value of the firm. The difference between these two statements is that the former applies to marginal q but the latter refers to average q. These conditions eliminate economic profits on inframarginal investments so that the firm's marginal project has the same value as its average project.

For empirical work on investment, the theory must be adjusted so that the capital stock does not immediately move to its optimal level where the firm faces no marginal incentive to invest. That is, the simplest view of q theory is that it provides a condition for the equilibrium capital stock but does not describe the dynamics of the investment process. To implement q theory empirically, adjustment costs have been added to the theory.[4] With adjustment costs, the benefits of investment as measured by q are traded off against the non-linear costs of investing.

For empirical work, q theory has the implication that q is a sufficient statistic for the value of investing. That is, q fully captures the firm's incentive to invest so the theory predicts a univariate relationship between investment and q. The functional form of this relationship depends on the form of adjustment costs. However, the regression equation does not need other variables. Despite the simple relationship predicted by theory, as discussed in more detail

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[4] Among the contributions on the role of adjustment costs in models of investment, see Lucas and Prescott (1971) and Mussa (1977). The functional form of the adjustment costs affects the predicted relationship between investment and q. A common functional form choice is quadratic adjustment costs because it implies a linear specification between investment and q and the parameter estimates can be interpreted as measures of the cost of adjustment. Unfortunately, as discussed by Erickson and Whited (2000), the linear specification of investment and q is consistent with a broader class of adjustment cost functions than just quadratic adjustment costs. Thus, using the parameters as estimates of adjustment costs requires a specific functional form choice.

below, the poor econometric performance of this univariate relationship has led researchers to augment *q* regressions with other variables, most commonly with cash flow.

In general, early attempts to test *q* theory in both aggregate and firm-level data found little support for the theory (see, *e.g.*, Summers, 1981). The theory failed on several counts. First, the estimated responsiveness of investment to *q* was low and often not statistically different from zero; based on common functional form assumptions about adjustment costs, the point estimates suggested unrealistically high adjustment costs. Second, the simple regressions did not explain much of the variation in investment data. Third, adding other variables to the regression improved the explanatory power of the regression, which refutes the argument that *q* is a sufficient statistic for investment incentives.

The dismal early results did not deter further empirical work because, in part, the simple elegance of *q* theory seems inherently logical. Broadly speaking, researchers blamed the empirical failure of *q* theory on measurement error. This measurement error takes many different forms (see Erickson and Whited, 2000, for a summary). First, accounting data only allows for a proxy of the true replacement cost of the firm. Accounting data provide historical cost data on previous investment, typically not adjusted for inflation. These historical data reflect accounting depreciation which is a noisy proxy for true economic depreciation. Another problem with using accounting measures (see Summers, 1981, and Poterba and Summers, 1983) is they provide pre-tax information but firms should respond to after-tax incentives; thus, some researchers focus on tax-adjusted *q* instead of the traditional measure of *q*. Second, while the stock market valuation of common equity is relatively straightforward, the market value of the firm includes the market value of debt and preferred equity which are more difficult to measure.

Third, the theory is stated in terms of the manager's perception of the value of the firm and its ideas but the empirical implementation uses the stock market valuation of the firm. Blanchard, Rhee, and Summers (1993) point out that the manager's valuation could differ from the market's valuation, especially if the stock market has fads or inefficiencies. Thus, the standard empirical exercises are based on the joint hypothesis of market efficiency and q theory.

Fourth, the theory calls for marginal q but the initial measures captured, at best, average q. If marginal q diverges from average q for any of the reasons described by Hayashi, such as imperfect competition, then the proxies fail to capture the incentive to invest. This form of measurement error led researcher to estimate the marginal value of additional capital.

Previous research has used many strategies to deal with measurement error. Assuming that the measurement error is serially uncorrelated, lagged values of q can be used as instruments for current values of q (see Blundell, Bond, Devereux, and Schiantarelli, 1992); unfortunately, many reasons for measurement error in q persist over time which complicates such attempts. Cummins, Hassett, and Hubbard (1994) argue that tax reforms create surprise innovations in tax-adjusted q. Another approach to moving toward marginal q instead of average q is to predict marginal profits based on variables known by the managers (see, Abel and Blanchard, 1986, and Gilchrist and Himmelberg, 1995). This strategy may help explain why investment is sensitive to cash flow even after controlling for q, if cash flow contains information about marginal profits that is not captured by the standard measures of q. Gilchrist and Himmelberg find that incorporating cash flow into the measure of 'fundamental' q outperforms standard measures of q, but cash flow still affects investment for firms that may face financial constraints. Finally, analysts' forecasts of earnings could provide information about future profitability. Cummins, Hassett, and Oliner (1998) and Bond and Cummins (2000) incorporate these forecasts into measures of q and estimate a responsiveness of investment to q that is roughly a factor of ten larger than estimates using traditional measures (*e.g.*, Bond and Cummins find that the coefficient on q increases from 0.0014 to 0.13).

These approaches have addressed the measurement error by attempting to improve the quality of the data, possibly including instrumental variable techniques to reduce the bias from measurement error. Erickson and Whited (2000) attack the measurement error problem by creating measurement-error consistent generalized method of moments estimators, using the higher moments of the distributions to impose restrictions on the data. With these estimators, they find that q suffers from substantial measurement error but the consistent estimators imply that q theory has good explanatory power; however, while these econometric techniques generate larger estimated q coefficients, the increases are relatively modest in economic terms (*e.g.*, the estimated coefficient increases from 0.014 to 0.044). Furthermore, they argue that the importance of cash flow found in some previous research is an artifact of the measurement error.

Our approach to the measurement error is strikingly simple. First, we concentrate on real estate firms – a competitive industry for which the constant returns to scale assumption seems more reasonable. Second, the nature of the industry allows us to obtain data on appraisals of the replacement cost of each firm's assets. Instead of relying on accounting data that uses historical measures of cost, we have fair market value estimates of the replacement cost.

A second line of empirical research on investment is whether q theory holds for some firms but not others. Financing constraints may explain the weak relationship between q and investment (see Fazzari, Hubbard, and Petersen, 1988, hereafter FHP). FHP argue that if financing constraints affect investment, then *q* will be less important and cash flow variables will be more important for explaining the investment of financially-constrained firms than they are for explaining the behavior of unconstrained firms. This insight spawned a large literature (summarized by Hubbard, 1998) on how to identify constrained firms and whether such regressions shed light on the role of financing constraints for corporate investment.[5] The main focus of these studies has been to use measures of *q* to control for investment opportunities and test for differences in the sensitivity of investment to cash flow or access to financing. While we include measures of cash flow, we concentrate on the sensitivity of investment to *q* because, in part, institutional features of the REIT industry complicate the financing constraints hypothesis.

In contrast to the financing constraint hypothesis that such constraints weaken the relationship between investment and *q*, Baker, Stein and Wurgler (2001, BSW hereafter) argue that the investment of firms that are likely to depend on external equity should be responsive to the firm's stock price because the stock price represents the cost of raising funds. In contrast, by the BSW argument, investment by firms with substantial internal funds may be less responsive to *q* because internal funds insulate the managers' decisions from fluctuations in the stock price, especially when the fluctuations are driven by non-fundamental factors.

In general, these financial market explanations of investment are more salient if *q* theory fails to explain investment because they provide alternative explanatory variables. Furthermore, as we discuss below (and consistent with the premise of BSW), financial structure decisions

[5] Kaplan and Zingales (1997) question the validity of the FHP approach and challenge the FHP results; see also the rejoinder by FHP (2000).

(*e.g.*, equity issuance, borrowing, and distribution policy) may also respond to stock price valuation so investment and financing activities are jointly determined.[6]

III.B. Capital Structure

Under Modigliani and Miller (1958), with efficient capital markets, the stock price does not play a role in capital structure decisions. If not for concerns about agency, bankruptcy, asymmetric information, or tax issues, a firm's capital structure would be irrelevant to its value. Introducing these issues creates the trade-off view of capital structure, which says that firms trade off the costs and benefits of different securities.[7] For financing marginal investment, if a firm's existing capital structure is close to its optimal mix of debt and equity, the marginal sources of finance would equal the average sources of finance. Alternatively, if the existing capital structure deviates from the optimal capital structure, the marginal mix of debt and equity should move the firm towards its optimal capital structure.

The pecking order view of capital structure (see, *e.g.*, Myers and Majluf (1984)) provides an alternative theory of capital structure. Under this view, asymmetric information problems dominate the process of raising funds.[8] The cheapest source of finance is internal funds. Among external sources of funds, debt is cheaper than equity since issuing equity is considered to send a

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[6] The financing constraints literature is aware of the simultaneity of investment opportunities and financial conditions. This potential simultaneity motivates research based on exogenous shifts in financial conditions (see, *e.g.*, Lamont, 1997).
[7] Harris and Raviv (1991) summarize various non-tax and non-bankruptcy costs and benefits of capital structure choices. Hovakimian, Opler, and Titman (2001) provide evidence in support of the target debt ratio implied by the trade-off view; they also discuss other empirical tests of capital structure.
[8] The relative tax treatment of internally-generated equity, debt and new share issues can also generate a pecking order for financing marginal projects that favors internal finance. See, *e.g.*, King (1977) on the theory of how taxes affect capital structure and MacKie-Mason (1990) for empirical evidence.

negative signal about managers' opinions regarding the firm's future prospects.[9] Under this view, unless the inefficiencies or mispricing of stocks are severe, one would not expect the pecking order to be reversed.

Adding stock market inefficiencies could affect firm's ideal capital structure, as well. If shares are temporarily overpriced, then managers will have an incentive to tilt the marginal source of finance towards equity. A more extreme reaction to overpriced equity would be to change the capital structure directly by issuing shares and retiring debt. In contrast, if shares are underpriced, the firm should avoid equity financing or it could borrow and repurchase shares. If these stock price inefficiencies are temporary, one would expect that the firm would return to its optimal capital structure when the stock price returns to "normal." The speed with which the firm would return to its optimal capital structure would depend on the transaction costs associated with changing its capital structure.

More recently, Baker and Wurgler (2002) have presented evidence that stock prices have long-term effects on capital structure. Not only does a firm's market-to-book ratio (taken as a measure of timing opportunities perceived by managers) affect short-term financing decisions, it predicts long-term differences in leverage and these differences persist for over a decade. Baker and Wurgler posit that their results imply "that capital structure is largely the cumulative

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[9] Several pieces of evidence support the pecking order view; however, this evidence does not necessarily refute other views. For example, firms that issue seasoned equity subsequently "underperform" the market, both based on the initial announcement (Asquith and Mullins 1986) and over a 5-year horizon (Loughran and Ritter 1995). Bayless and Chapinsky (1996) show that firms issue equity when the overall market is more favorable to such issuances. At the firm level, Korajczyk, Lucas, and MacDonald (1992) show that negative returns after equity issuance are also smaller immediately after earnings releases, which may be times when information asymmetries are smaller. For share repurchases, the market reacts negatively to announcements (see, *e.g.*, Asquith and Mullins (1986) and Ikenberry, Lakonishok, and Vermaelen (1995)), which has usually been interpreted in favor of the signaling hypothesis that managers have inside information about the future prospects of the firm.

outcome of past attempts to time the market." These market timing effects are potentially consistent with a dynamic version of the pecking order model. Two possibilities support the persistence of these effects. First, firms might not have an optimal capital structure so they have no reason to reverse the effects of market timing. Second, the transaction costs associated with moving to the optimal capital structure may outweigh the benefits of re-optimizing.

Graham and Harvey (2001) survey 392 CFOs about capital structure decisions and find direct evidence of market timing. They show that more than two-thirds of survey respondents answered that they issue in equity in part after considering "...the amount by which their stock is undervalued or overvalued by the market." Almost as many CFOs also respond that "If our stock has recently risen, the price at which we can sell is high." That firms issue more equity during certain times in the cycle is clear, however, the literature disagrees over the interpretation of this apparent "market timing."

By examining REITs, we have a more plausible measure of the fundamental value of the firm than in previous studies so we may have a better measure of timing opportunities for managers. Our appraisal-based measure of q is not purely public information, as discussed below, though it probably becomes public over the course of the year. Also, since the appraisals are known by some investors, it is less likely that managers use capital structure decisions to signal the information contained in our measure of q. The institutional features of REITs also affect our study of how stock prices affect financing decisions. The tax rules that require them to distribute most of their taxable income limits their access to internal funds. Thus our sample focuses on firms with a history of issuing equity and seeking both public and private debt. In addition, taxes are not a major factor in capital structure decisions for REITs since they do not pay corporate taxes.

Focusing on REITs has some disadvantages, as well. First, the results might not generalize to other industries or institutional settings. Second, we sample does not allow for much cross-sectional variation in dependence on external equity. Third, we do not have sufficient time series data to examine the long-run implications of market timing behavior.

IV. Data

Our sample period begins in 1992, which corresponds with the beginning of a 5-year period of strong growth in the REIT industry, and ends in 2001. The number of equity REITs grew from 89 in 1992 to 151 in 2001 and their equity market capitalization grew from $11 billion in 1992 to $147 billion in 2001, with a consequent gain in liquidity and trading volume.[10]

The key variable for our analysis is an alternative measure of Tobin's *q* that is based on private appraisals--estimates of the market value of each REIT's assets. We rely on Net Asset Value (NAV) estimates from Green Street Advisors, Inc to construct this alternative measure of *q*, referred to as NAV-*q*, below . In estimating NAV, Green Street assesses the value of the major properties of a REIT and subtracts the liabilities of the REIT. Green Street's goal is to compare the market value of the REIT's common stock with the market value of the underlying assets (after adjusting for other ownership claims). They use these estimates to advise clients (often large institutional investors) on selecting REITs as investments. While Green Street

[10] Industry statistics are from the National Association of Real Estate Investment Trusts' website at www.nareit.org.

provides NAV estimates for 40 percent of equity REITs in 2001, the firms they cover represent 75 percent of REIT value.

Several factors motivate using the Green Street NAV estimates. Industry observers and participants almost uniformly agree that Green Street produces the most careful and accurate estimates in the REIT industry. It is the only analyst firm to have a consistent set of estimates prior to 1996. Green Street focuses exclusively on real estate firms and each of its analysts follows only a few firms. These analysts specialize by type of property and compute NAV by determining the fair market value of each property owned by a REIT, often visiting larger properties. Finally, Green Street performs no investment banking functions for REITs, so it is immune from the potential conflicts of interest that may impact the research of banks that underwrite securities.

Over this sample period, the mean (median) share-price-to-NAV ratio is 1.05 (1.02). While the central tendency of this ratio is close to one, there is substantial variation both over time and within time periods. Figure 1 plots the 25th percentile, median, and 75th percentile price/NAV ratio by month for 1992-2001. The time series plot reveals a strong industry-wide component to the price/NAV ratio with the median value exceeding 1.20 for all of 1997 but being below 0.9 for most of 2000. Clayton and MacKinnon (2000) argue that this industry-wide component represents a form of investor sentiment for REITs. The spread between the 25th and 75th percentile of the monthly distribution has narrowed over time.

In addition to the NAV estimates from Green Street, we obtain accounting data from SNL Securities, Inc. and data on share prices from the University of Chicago's Center for Research in Security Prices (CRSP). We use the accounting data to measure investment activity, the book value of debt and preferred equity, and cash flow. The SNL data also provide industry-specific information that are not available from broad-based accounting databases, such as Compustat, including the number of operating partnership units in the ownership structure and the net investment in real estate.[11] All variables are measured on an annual basis.

Our sample includes 91 REITs and real estate companies covered by Green Street between 1992-2001. Overall, after matching with SNL data and restricting the sample to US equity REITs, we obtain information on 70 REITs and 343 firm-years with non-missing data.

V. Empirical Specification and Measurement of *q*

V.A. Investment Specification

Standard investment theory implies the following regression equation:

$$\frac{I_{it}}{K_{it-1}} = \alpha + \beta q_{it-1} + \varepsilon_{it} \tag{1}$$

where I/K is the rate of investment during the period (the ratio of investment during year *t* to the end of year *t* - 1 capital stock), *q* is a measure of firm-specific Tobin's *q* at the beginning of the period, α is a constant, β is the sensitivity of investment to *q*, and ε is the error term. The empirical model often includes year-effects, firm-effects, or both.

[11] One complication that we face is that many REITs operate as UPREITs, or umbrella partnership REITs (see Sinai and Gyourko, 2002, for details regarding the UPREIT structure). UPREITs have a separate class of stakeholders who own partnership units that are freely convertible one-for-one into REIT common shares. These partnership units arise when investors contribute appreciated properties to the umbrella partnership in exchange for partnership units, deferring any unrealized capital gains taxes on the properties. The partnership units are essentially equivalent to REIT shares, so we include equity in the form of the partnership units when computing the market value of equity. These partnership units are reported as a minority interest on the balance sheet and typically dominate that category of financing.

Previous investment research measures q as:

$$q_{it} = \frac{E_{it} + D_{it} + PE_{it}}{BVA_{it}} \tag{2}$$

where *E* is the market value of common equity, *D* is the book value of debt which is a proxy for the market value of debt (some authors have attempted to adjust the book value of debt so that it better reflects the market value), PE is the book value of preferred equity (again taken as a proxy for the market value), and *BVA* is the book value of the firm's assets. The book value of assets represents the replacement cost of the firm's assets.

As discussed above, using historical accounting data as a proxy for the replacement value induces measurement error in q. We compare the traditional measure of q to an alternative NAV-based q, which we compute by using estimates of the net asset value for the REIT in the denominator for q.[12] To obtain the gross value of assets so that the numerator and denominator of our measure of q are consistent, we add the book value of debt (as a proxy for the market value of debt) and the book value of preferred equity to the aggregate value of the REIT's NAV to get an estimate of the replacement cost of the REIT's assets.

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[12] We do not adjust our measure of q for taxes. The results are unlikely to be sensitive to our treatment of taxes for several reasons. First, over out sample period, the relevant parameters of the tax system were relatively stable. Second, REITs are not subject to the corporate tax, which reduces the tax burden on investment; the lack of a corporate-level tax implies that any tax adjustment must use the appropriate shareholder tax rate. The standard tax adjustments for q reflect how the tax system affects the cost of acquiring new assets. For REITs, based on the results in Gentry, Kemsley and Mayer (2002), one could argue for adjusting the market value of equity relative to the net asset value due to the capitalization of future shareholder taxes into share prices. Specifically, Gentry, Kemsley and Mayer find that, conditional on a REIT's NAV, the market value of its equity increases with the amount of tax basis that remains in its assets (*i.e.*, the firm's tax basis is relevant for the value of the firm's shares). This tax capitalization effect could affect our measured q but would not be relevant for the REIT's marginal incentive to invest. In our current specifications, we do not adjust for this market capitalization effect.

This NAV-based q assumes that REITs can buy more properties or sell its existing buildings at the current price of its buildings. The ability to sell buildings at the appraised value seems natural (provided the appraisals are fair). For positive investment, the REITs could purchase buildings from existing building owners or from real estate developers. Neither our measure of NAV q nor traditional accounting-based measures of q capture the incentives of real estate developers to build new buildings. In general, REITs are not construction companies and many of their acquisitions are from previously developed projects. Nonetheless, some REITs have joint ventures arrangements with developers or directly construct new buildings themselves. While REITs often buy existing assets, Jovanovic and Rousseau (2002) show that between 10 and 43.5 percent of annual general corporate investment between 1970 and 2000 is spent on used equipment or involves the merger of two companies. Thus the possibility of investing in existing assets is a general phenomenon.

Following previous studies of investment, we augment equation (1) with cash flow variables. As discussed in Section III, a common interpretation of the estimated coefficients on the cash flow variable is that it reflects the importance of financing constraints. However, Gilchrist and Himmelberg (1995) note that this interpretation is not valid if q is measured poorly and cash flow provides incremental information about future profitability. This argument suggests that if measurement error drives the estimated coefficients on cash flow, then better measures of q should reduce the importance of the cash flow variables. We focus on this hypothesis in comparing specifications that use traditional and NAV-based measures of q.

The dividend distribution requirement for REITs complicates the measurement of cash flow, but also provides an additional opportunity to explore why cash flow is often associated with investment. Typically, cash flow is measured as operating cash flows for the firm before dividends since dividends are a discretionary use of funds. REITs do not have complete discretion over dividends because tax rules require a minimum dividend. In our empirical specifications, we use two alternative cash flow measures. For comparison with previous research, we use the standard operating cash flow measure before dividends. We also decompose cash flow into two parts, an estimate of the minimum required dividend (95 percent of financial net income before 2000 and 90 percent for 2000 and afterwards) and the remaining cash flow reflecting discretionary funds.[13] We do not observe the actual required dividend as firms do not consistently report their taxable net income, which would be necessary to compute the actual required dividend, although we expect that GAAP net income is a good proxy for most firms. Discretionary cash flow after the required dividend proxies for internal resources that may mitigate financing constraints. To the extent that the required dividend helps predict investment, it may be evidence in favor of the hypothesis that cash flow captures an unobserved component in profitability since REITs cannot use these funds to pay for the investment. We scale all cash flow variables by the total assets at the end of the preceding year.

We define REIT investment as the percentage change in total assets during the year. We also develop an alternative measure of investment based on changes in real estate assets, which is closer to the property, plant and equipment definition of investment that is most common in the literature.[14] Our investment results are not sensitive to how we define investment. We

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[13] We subtract an estimate of the required dividend rather than the actual dividend because REITs often distribute a larger dividend than is required by the tax rule. We are examining the choice and timing of these discretionary dividends versus share repurchases in a related paper.

[14] The difference between these two measures is that the change in total assets includes changes in the cash (or liquid asset) position of the REIT, while the change in net investment in real estate focuses specifically on investment in properties.

choose to use the broader measure of investment in most of the analysis because we will be able to decompose the financing of that investment, as below.

V.B. Capital Structure Specification

Of course, it is possible to examine how REITs finance their marginal investment by taking differences in the usual accounting identity:

$$\Delta \text{Assets} = \Delta \text{Debt} + \Delta \text{Equity} \tag{3}$$

where all variables are measured as their book values. Debt includes all forms of debt. Equity includes preferred equity and minority interests, such as operating partnership units that REITs sometimes use to purchase buildings. These operating partnership units are convertible into common shares, but the owners of such units defer capital gains taxes from the sale of their buildings until they convert them into shares. (See footnote 11, earlier for more details on operating partnership units.)

We estimate change in debt and change in equity as a function of the same determinants of investment that are discussed above. Given the accounting identity, the coefficients on the determinants of changes in debt and equity will add to the coefficients on these independent variables in the investment equation. We estimate the debt and equity equations using seemingly unrelated regressions (SUR) since the error terms are likely to be correlated across the equations.

VI. Results

Table I provides summary statistics for the variables used in all regressions. In the investment and changes in capital structure equations, we only include observations for which we have cash flow data in SNL. In order to minimize the effects of firms going through major changes, such as mergers, we typically restrict the sample to REITs with annual net investment rates (as opposed to gross investment rates that would include replacement investment) of less than 100 percent of the previous capital stock, reducing the sample size by 18 observations. The median (mean) net investment rate is 11 (18) percent in the restricted sample and 13 (26) percent in the whole sample, which is consistent with the rapid growth in the industry.

For the traditional accounting-based measure of q, the median value in our sample is 1.30; however, the median appraisal-based q is only 1.04. The difference between these median values suggests that measures of q based on historical cost overstate the true value of q (i.e., accounting depreciation rates exceed economic depreciation rates or properties may appreciate in value). For regression analysis, however, the critical issue is not the level of the mismeasurement of q but how the measurement error varies across observations. The distribution of the appraisal-based measure of q is much less variable than the distribution of the accounting-based measure of q. The standard deviation of the NAV q is 0.13 compared to a standard deviation of 0.44 for the traditional measure, which suggests that the NAV-based measure is less noisy.

The cash flow measures show that the median REIT generates approximately 7.6 percent of assets in cash flow every year. However, the median REIT must payout a dividend of approximately 3.4 percent. Not surprisingly, REITs typically have dividend yields for their common shares of around seven percent, considerably greater than most corporations. However, REITs also have significant discretionary cash flow available due to depreciation allowances and other non-cash expenses that reduce taxable income.

VI.A. Basic Investment and Capital Structure Regressions

Table II presents the results of estimating the basic investment and change in debt and equity equations using the alternative measures of *q* and cash flow. Panel A presents the results with traditional *q*. In the investment equation in column (1), the coefficient on change in assets traditional *q* of .085 is statistically significant, but implies a relatively slow speed of adjustment of investment. That is, a firm with a *q* of 1.1 versus 1.0 will increase its assets by .85 percent more in the next year, less than 8 percent of median annual investment. Nonetheless, the fact that traditional *q* is statistically significant without any adjustments implies that REITs – arguably an industry that is more likely to be characterized by constant returns to scale than most industries – does mitigate some of the problems of estimating investment equations. As with other papers, we find a large and statistically significant coefficient on cash flow.

In column (4) we re-estimate the investment equation, decomposing cash flow into an estimate of the required dividend and the discretionary portion of cash flow. Interestingly, the coefficient on the required dividend is higher than the coefficient on remaining cash flow and an F-test rejects equality with a p-value of .09. The large coefficient on the required dividend, which is equal to 90 or 95 percent of net income, but cannot be retained by the firm, suggests that an important part of the correlation between cash flow and investment is driven by the association of cash flow with future prospects of the firm. Decomposing cash flow results in a somewhat lower coefficient on *q*, which is only significantly different from zero at the 92 percent confidence level.

The second and third, and fifth and sixth columns of Panel A report the companion SUR estimates of the changes in debt and equity equations. In both systems, the estimated coefficients imply that the additional investment associated with increases in *q* are financed more or less equally from equity than debt. Differences between the coefficients on *q* in the debt and equity equations are not close to statistical significance at conventional levels. When cash flow is separated into its components, the increase in investment associated with discretionary cash flow comes more from debt than equity, while the reverse is true for the coefficients on the required dividend.

Panel B of Table II present comparable specifications that use NAV-based *q* instead of traditional *q*. Across the board, the estimated sensitivity of investment to *q* is much larger in magnitude and statistically different than zero at conventional significance levels. For investment, the estimated coefficient on NAV *q* ranges from 1.03 to 1.05. Furthermore, the explanatory power of the regression (the R^2) more than doubles when using the NAV-based *q* when compared with Panel A. These estimated effects imply that REIT investment is highly sensitive to *q* as a proxy for investment opportunities when *q* is measured more accurately. For example, using the estimate of 1.03, a REIT that started the year with a *q* of 1.1 would be 10.3 percent larger than if it had started the year with a *q* of 1.0.

The previous literature, including papers that argue that their results support *q* theory, reports considerably smaller estimated sensitivities to *q* than what we find for REITs using the appraisal-based measure of *q*. For example, Erickson and Whited (2000) report ordinary least squares estimates of around 0.014 but Generalized Method of Moments (GMM) estimates of between 0.033 and 0.045. Bond and Cummins (2000) report estimates using traditional measures of around 0.014 but their estimates using analysts forecasts of earnings to construct *q* range from 0.104 to 0.139. Cummins, Hassett, and Hubbard (1994) report a vast array of estimated coefficients for q based on different years, under the hypothesis that years around tax reforms provide better measured values of q; for the major tax reform years of 1962, 1972, 1981, and 1986 using GMM estimators, they report estimated q coefficients of 0.585, 0.136, 0.262, and 0.245, respectively (taken from Table 4 of their paper).

Comparing estimated coefficients across papers is complicated because empirical methodology and sample design differ across studies. Most studies of investment include a variety of industries while focusing on manufacturing firms, but we focus exclusively on real estate firms so that the sensitivities may not be directly comparable. The real estate industry may face lower adjustment costs than other industries so that REITs may respond quickly, possibly by buying existing properties. However, if industry differences were the sole explanation for our result, one would expect that the traditional measures of q would also yield large estimated investment sensitivities but we only find the large sensitivities when we use the appraisal-based measure of q. While such appraisal-based measures are unavailable for other industries, our results can be taken as support for the claim that measurement error in q is a major hurdle for empirical work on investment.

Examining other variables in the investment equation, we also see that the estimated coefficient on cash flow falls by half with the inclusion of the NAV q. This result indicates that measurement error in q is an important factor in explaining the significance of cash flow in investment equations, which is consistent with the findings of Gilchrist and Himmelberg (1995), amongst others. Nonetheless, the estimated coefficient on cash flow is still positive and statistically significant. While the statistical significance of the coefficient on cash flow may suggest that our NAV-based measure of q suffers from some measurement error, it is also consistent with Abel and Eberly's (2002) model in which cash flow is positively correlated with investment, even when q is measured accurately. Two features of REITs suggest they may be good candidates for Abel and Eberly's model. First, Abel and Eberly do not assume convex adjustment costs, which is reasonable for REITs since they can plausibly just as easily sell buildings as buy them. Second, Abel and Eberly argue that the correlation between cash flow and investment should be larger for small, fast growing firms, such as the REITs in our sample.[15]

The coefficients on NAV q in the debt and equity equations are quite similar, suggesting that REITs finance their additional investment using roughly equal proportions of debt and equity. Given that REIT's ratio of debt-to-total-assets is approximately 54 percent, these findings appear consistent with a target debt-equity ratio given that marginal financing of new investment is similar to average financing. A higher stock price relative to the appraised value of the REIT's properties does not appear to lead REITs to shift more heavily toward equity financing.

Table III examines two robustness checks of these results. Panel A re-runs the regressions that use NAV q and the segmented cash flow with year fixed effects. As is clear from Figure 1, the ratio of Price-to-NAV varies substantially around unity for the industry, so much of the variation in NAV q is driven by time series movements. Yet q theory would predict that REITs should invest more in properties if the market value of those properties for REITs is higher than the cost of those properties in the private market, even if that effect is true for all or most REITs at a particular point in time. When we include year effects, the coefficient on q falls

[15] When we decompose cash flow into the discretionary component and the minimum dividend in column (4) the coefficient on the required dividend falls much more (relative to the Panel A estimates with traditional q) than the coefficient on the discretionary portion of cash flow, which is not surprising if the size of the coefficient on the required dividend is likely due to measurement error in q.

appreciably, but it remains large relative to the previous literature and is highly statistically significant. While the estimated coefficients in the change in debt and equity equations a high q favors equity financing, we cannot reject the hypothesis that the q coefficients are the same across the specifications.

Next, we examine the impact of censoring our sample by including the 18 firm-years with annual investment exceeding 100 percent. Instead of excluding these observations, we use robust regressions to downweight outliers based on the goodness of fit rather than based on an arbitrary cutoff. In Panel B, the three equations are run independently and the weights implied by the robust regression technique can differ across specification, so the coefficients in the debt and equity equations no longer must add up to those in the investment specification. Nonetheless, the sum of the coefficients in the columns (2) and (3) are quite similar to those in column (1). The coefficients with robust regressions are generally similar to those using OLS and SUR on the restricted sample. The coefficient on NAV q in the investment equation is a little smaller than the OLS estimates, but is still quite large in comparison to other papers. Also, the proportion of new financing for q-related investment coming from debt appears to rise, but we cannot reject the equality of the debt and equity coefficients.

Finally, we also consider the possibility that our measure of investment might be too broad relative to the previous literature. While REITs are required to restrict their investment to real estate and real estate-related activities, they can have a portion of their holdings in financial assets such as government securities. REITs may systematically vary the portion of their investment in real estate versus other assets in response to changes in q. When we decompose investment into real estate and other assets using our base specification – Table 3, column (4) –

we find that the estimated coefficient on NAV q in the equation using the change in net investment in real estate is 1.03 with a t-statistic of 10.60, while the estimated coefficient on NAV q in the other assets equation is 0.024 with a t-statistic of 1.07.[16]

VI.B. Non-Linearities in the Relationship with NAV q

These simple q regressions assume a linear relationship between investment and capital structure and q. The actual relationship could be non-linear. For example, adjustment costs may differ for selling buildings instead of acquiring buildings or managers might be more reluctant to shrink the size of the firm than to expand it. As a preliminary method for examining non-linearities in the relationships between investment and capital structure and q, we estimate a non-parametric kernel regression of investment on q. The kernel regression does not control for cash flow and thus might not give the same picture as one might get from a regression. Figures 2-4 plot the results from the kernel regression for change in assets, change in equity, and change in debt, respectively.

The results for investment in Figure 2 are quite striking and suggest that investment is quite responsive to changes in NAV q when NAV q exceeds one, but that firms do not dis-invest, even when q is well below 1. On average, REITs with $q<1$ appear to have annual net investment of roughly five percent. Yet NAV q less than one implies that the market value of the firm's assets is greater than the market value of the firm itself. While it might be difficult for managers to sell recently-acquired assets and comply with REIT rules that prohibit "flipping" properties within four years of acquiring them, it would seem feasible for managers to selectively sell

[16] To save space, these results are available from the authors upon request.

buildings when transactions costs of such sales would be well less than five percent of the sale price.

We confirm this non-linearity by splitting the sample and re-estimating our base regressions in Table IV alternatively for NAV *q*<1 and NAV *q*$1. In the first columns of Panels A and B (corresponding to OLS and robust regressions), we find that investment is quite responsive to NAV *q* when *q*$1. The estimated coefficients on NAV *q* are large and statistically significant and are similar across estimation methods. The coefficients on cash flow are also much smaller than in the base regression and are no longer statistically different from zero at conventional significance levels. One possible reason why internal cash flow does not predict investor for these firms is that they often raise capital via external capital markets. Overall, REITs with NAV *q*$1 appear to behave in a neoclassical fashion as in Tobin's original model – investment responds to *q* but not to cash flow.

Investment of REITs with NAV *q*<1 behaves quite differently than the investment of REITs with NAV *q*$1. As reported in the first columns of Panels C and D, the estimated coefficient on NAV *q* is much smaller (0.44 in the OLS and -0.020 in the robust regression) and no longer statistically different from zero at the 95 percent confidence level. While the estimated coefficient in the OLS specification is still fairly large, it is negative and close to zero when estimated with a robust regression, suggesting that the positive estimated coefficient in the OLS specification is driven by outliers. The kernel regression supports the interpretation that the investment sensitivity to NAV *q* for REITs with a NAV *q* <1 is quite low. In addition, the coefficient on both cash flow measures for these REITs is quite high, especially for the required dividend. Managers of these firms may believe that cash flow is a better measure of the firm's future prospects than NAV *q* in these circumstances, as they are reluctant to shrink the size of the firm; alternatively, the internal discretionary cash flow could affect investment because these REITs are less likely to access external capital markets.

The evidence with regard to capital structure tells a similar story. In the kernel regressions (Figures 3 and 4), REITs with a NAV *q*$1 expand their use of both debt and equity to finance new investment. The kernel regression suggests that both debt and equity increase approximately linearly with NAV *q* when NAV *q* exceeds one. The regression results reported in Panels A and B of Table IV imply that there is little evidence of a change in the relative use of debt and equity by REITs with NAV *q*$1. For REITs with NAV *q*<1, the kernel regressions suggest a relatively flat relationship between sources of financing and *q*. While the kernel regression suggests that REITs NAV *q* below .9 have a negative relationship between *q* and the change in equity, the estimated coefficients from the linear regression in Panels C and D of Table IV indicate a positive relationship, which is statistically significant at the 95 percent confidence level. In contrast, the estimated coefficient on NAV *q* in the debt coefficient is close to zero. This positive relationship between the change in equity and *q* would imply that a lower *q* leads to a reduction in equity, possibly through a share repurchase, which is consistent with managers engaging in financial market timing.

VI.C. Overall Capital Structure and NAV *q*

While the capital structure results, above, seem to suggest that REITs have a target debt-to-assets ratio, we examine this hypothesis more directly by comparing overall debt-to-assets ratio with a firm's NAV q at the end of the the previous year. Relative to regular corporations, REITs are more likely to access external capital markets because tax rules require a minimum dividend. Thus, REITs often make discrete choices of how to raise funds because they have less access to internal capital, which makes them a natural place to study the effects of stock prices on capital structure decisions. In particular, we look for evidence of market timing (i.e., REITs use more equity when equity appears cheap such as when NAV q<1), pecking order (REITs use up their debt capacity before turning to equity that is expensive due to information asymmetries), or a target debt-to-assets ratio. We regress the debt-to-asset ratio on its lagged value and the (lagged) NAV q.

The results, presented in Table V, indicate modest evidence that REITs adjust their capital structure based on the value of NAV q. For REITs with net investment less than 100 percent,[17] our estimates imply that a REIT with a NAV q of 1.1 versus 1.0 will reduce its overall debt-to-assets ratio by 0.52 percentage points (column 1, Panel A). Using the sample without this investment restriction yields an estimated effect of 1.0 percentage points (see column (3)). As reported in columns (2) and (4), including year fixed effects yields similar results. Given that the typical REIT with NAV q of 1.1 will increase investment by nine percent and must obtain new financing, it is unlikely that convex adjustment costs such as prepayment penalties on existing debt can explain the slow adjustment of overall capital structure. These results are consistent with a modest change in capital structure in response to q; however, the adjustments in capital structure are small relative to the effects on investment. Given that private owners of real estate often obtain loan-to-value ratios of 70 percent or more, REITs do not appear to tap into the debt markets as one might expect with a pure pecking order theory.

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[17] This sample includes observations that we excluded from the previous analysis due to missing information on cash flow. We are in the process of obtaining more complete cash flow data.

VII. Conclusion

REITs provide a good opportunity to examine how firms react to differences between their stock market value and the value of their underlying assets because property appraisals provide better measures of asset value than do measures of value based on historical cost. We examine the responsiveness of both investment and capital structure to these differences in value.

For investment, we compare the sensitivity of investment to traditional measures of Tobin's q to measures of q using appraisals. The accounting-based measures of q yield small and imprecise estimates of investment sensitivity, consistent with results from naive estimation strategies using broader spectrum of firms. In contrast, investment is quite sensitive to the appraisal-based measure of q with parameter estimates considerably larger than the values found by studies that use econometric methods to improve the measurement of q. For example, assets will increase by 10.3 percent during the year in response to a 0.1 increase in the beginning of the year q. Given our focus on the real estate industry, our results are not directly comparable to previous studies. Nevertheless, the difference in results across the two measures of q indicates that problems in measuring q can have major implications for estimated parameters.

Having a better measure of q allows us to examine whether the response of investment to q is linear. We find compelling evidence that the nonlinear relationship with a breakpoint that is around (or slightly below) q equal to one. Investment does not to respond to q when q is below one but responds strongly when q is above one. Since REITs can shrink relatively easily by selling properties into the private markets, but choose not to do so even when q is well below one, we conjecture that this nonlinearity results from agency problems that suggest that managers are reluctant to shrink the size of the firm.

For capital structure, we estimate models of leverage ratios as well as how equity and debt financing changes in response to q. The results on the leverage ratio suggest that reliance on debt financing decreases when the firm's share price is high relative to the underlying value of its assets. However, these potential market timing effects are much smaller than the investment effects. An increase in q by 0.1 decreases the debt-to-value ratio by 0.52 percentage points. In general, REITs appear to finance marginal investment with a mix of debt and equity that is similar to their average debt-equity mix, but below the debt-to-value ratios often used by private owners of real estate.

Our results shed light on how firms respond to their stock market value, implying that firms respond both along the investment and financing margins and that these responses are relatively large. A separate question is whether these responses are optimal. Empirical tests of the q theory of investment assume that the value of equity relative to the replacement cost of assets reflects real investment opportunities of the firm. In contrast, if stock prices are subject to "fads," then the difference between the stock market value and the value of underlying assets might present an investment opportunity for investors and for the firm but the value-maximizing response would not involve real investment. Instead, when the share price is relatively high, the firm could issue shares and reduce its debt; when the share price is relatively low, the firm could borrow and repurchase shares. Our results on the sensitivity to investment rule out this simple financial market response as managers sole response to share prices relative to asset value.

In addition to sorting out whether the responses maximize value, several other issues remain unresolved. First, on the financing side, we have not looked as closely as we could at the debt margin, especially given that REITs vary in what types of debt they use. Second, in terms of investment, REITs vary in whether they acquire existing properties or engage in joint ventures that develop new properties; this variation may provide more information on how adjustment costs vary across types of investment. Third, in order to better understand how financing choices respond to stock prices relative to NAV, we plan to examine discrete events, such as equity offerings and share repurchase announcements.

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Table I: Summary Statistics

Annual data on capital structure and investment

	N	Mean	Median	Standard Deviation
Traditional q_{t-1}	343	1.33	1.27	.34
NAV q_{t-1}	343	1.04	1.02	.11
Change in Assets: $(\text{Assets}_t - \text{Assets}_{t-1})/\text{Assets}_{t-1}$:				
Whole Sample	343	.26	.13	.39
Change in Total Assets less than 100% in One Year	325	.18	.11	.22
Change in Debt: $(\text{Liabilities}_t - \text{Liabilities}_{t-1})/\text{Assets}_{t-1}$	343	.14	.078	.21
Change in Equity: $(\text{Equity}_t - \text{Equity}_{t-1})/\text{Assets}_{t-1}$	343	.11	.036	.23
Cash flow from operating activities: Cash $\text{Flow}_t/\text{Assets}_{t-1}$	343	.083	.076	.030
Cash flow from operating activities less Required Dividend: (Cash Flow minus Required $\text{Dividend})/\text{Assets}_{t-1}$	343	.046	.043	.026
Required Dividend	343	.037	.034	.023
Debt to Value Ratio: $\text{Liabilities}_t/\text{Assets}_t$:				
Whole Sample	414	.54	.53	.17
Change in Total Assets less than 100% in One Year	437	.54	.53	.17
Debt to Value Ratio: $\text{Liabilities}_{t-1}/\text{Assets}_{t-1}$	343	.53	.52	.16

Table II: Investment and Capital Structure Equations Comparing Traditional *q*

Panel A: Base Specification with Traditional *q*

	OLS	Seemingly Unrelated Regressions		OLS	Seemingly Unrelated Regressions	
Dependent Variable	Δ Total Assets	Δ Total Debt	Δ Total Equity	Δ Total Assets	Δ Total Debt	Δ Total Equity
	(1)	(2)	(3)	(4)	(5)	(6)
Traditional *q*	.085 (.041)	.037 (.026)	.048 (.025)	.074 (.042)	.038 (.026)	.036 (.024)
Cash Flow	2.98 (.51)	1.56 (.32)	1.42 (.32)			
Cash Flow less Required Dividend				2.47 (0.59)	1.63 (0.37)	.84 (.35)
Required Dividend				3.53 (0.60)	1.48 (0.38)	2.05 (0.36)
Constant	-.16 (.05)	-.06 (.03)	-.10 (.03)	-.15 (.05)	-.064 (.033)	-.083 (.031)
R^2	.16	.11	.12	.17	.13	.12
N	325	325		325	325	

Note: Includes observations for all firm-years with change in total assets of less than 100% in one year.

Panel B:Base Specification with NAV *q*

	OLS	Seemingly Unrelated Regressions		OLS	Seemingly Unrelated Regressions	
Dependent Variable	Δ Total Assets	Δ Total Debt	Δ Total Equity	Δ Total Assets	Δ Total Debt	Δ Total Equity
	(1)	(2)	(3)	(4)	(5)	(6)
NAV *q*	1.03 (.10)	.49 (.06)	.55 (.06)	1.05 (.10)	.53 (.07)	.53 (.06)
Cash Flow	1.42 (.43)	.81 (.29)	.61 (.27)			
Cash Flow less Required Dividend				1.60 (0.50)	1.20 (0.32)	.40 (.31)
Required Dividend				1.21 (0.53)	.33 (.35)	.88 (.33)
Constant	-1.00 (.09)	-.45 (.06)	-.54 (.06)	-1.02 (.09)	-.50 (.06)	-.52 (.06)
R^2	.38	.24	.29	.38	.26	.30
N	325	325		325	325	

Note: Includes observations for all firm-years with change in total assets of less than 100% in one year.

Table III: Alternative Specifications for Investment and Capital Structure Equations
Panel A: Base Specification With Year Effects

Dependent Variable	OLS	Seemingly Unrelated Regressions	
	Δ Total Assets	Δ Total Debt	Δ Total Equity
	(1)	(2)	(3)
NAV *q*	.47 (.15)	.18 (.10)	.28 (.09)
Cash Flow less Required Dividend	1.28 (.49)	1.00 (.61)	.28 (.31)
Required Dividend	1.60 (.53)	.61 (.34)	.99 (.34)
Constant	-.23 (.18)	-.10 (.11)	-.13 (.11)
R^2	.46	.38	.34
N	325	325	

Note: Includes observations for all firm-years with change in total assets of less than 100% in one year.

Panel B: Base Specification With Robust Regressions

Dependent Variable	Δ Total Assets	Δ Total Debt	Δ Total Equity
	(1)	(2)	(3)
NAV *q*	.84 (.08)	.51 (.06)	.37 (.04)
Cash Flow less Required Dividend	1.28 (.32)	1.46 (.28)	.06 (.16)
Required Dividend	1.49 (.41)	.69 (.32)	.73 (.20)
Constant	-.83 (.08)	-.52 (.06)	-.37 (.04)
N	343	343	342

Note: Robust regressions are run using a bi-weighted estimator with Huber weights to downweight observations that are outliers.

Table IV: Split Sample Based on Whether NAV *q* is Greater Than or Less Than One

Panel A: Base regressions with NAV *q*$1

	OLS	SUR	
Dependent Variable	Δ Assets (1)	Δ Liabilities (2)	Δ Equity (3)
NAV *q*	.90 (.19)	.48 (.11)	.41 (.12)
Cash Flow less Required Dividend	1.15 (.82)	.68 (.52)	.47 (.53)
Required Dividend	.47 (.78)	-.22 (.50)	.69 (.51)
Constant	-.78 (.20)	-.39 (.13)	-.38 (.13)
R^2	.16	.10	.11
N	177	177	

Note: Includes observations for all firm-years with change in total assets of less than 100% in one year.

Panel B: Robust regressions with NAV *q*$1

Dependent Variable	Δ Assets (1)	Δ Liabilities (2)	Δ Equity (3)
NAV *q*	.86 (.19)	.50 (.12)	.38 (.12)
Cash Flow less Required Dividend	1.01 (.72)	1.69 (.51)	.58 (.44)
Required Dividend	.60 (.77)	.56 (.55)	.68 (.47)
Constant	-.74 (.21)	-.48 .15	-.36 (.13)
N	194	194	194

Note: Robust regressions are run using a bi-weighted estimator with Huber weights to downweight observations that are outliers.

Panel C: Base regressions with NAV *q*<1

Dependent Variable	OLS	Seemingly Unrelated Regressions	
Dependent Variable	Δ Assets (1)	Δ Liabilities (2)	Δ Equity (3)
NAV *q*	.44 (.24)	.10 (.17)	.34 (.12)
Cash Flow less Required Dividend	1.87 (.50)	1.64 (.36)	.23 (.24)
Required Dividend	2.67 (.64)	1.29 (.46)	1.37 (.31)
Constant	-.51 (.23)	-.15 (.16)	-.36 (.11)
R^2	.15	.13	.17
N	148	148	

Note: Includes observations for all firm-years with change in total assets of less than 100% in one year

Panel D: Robust regressions with NAV *q*<1

Dependent Variable	Δ Assets (1)	Δ Liabilities (2)	Δ Equity (3)
NAV *q*	-.020 (.133)	-.092 (.113)	.17 (.06)
Cash Flow less Required Dividend	1.30 (.28)	1.40 (.23)	.03 (.09)
Required Dividend	2.14 (.35)	1.27 (.30)	1.11 (.15)
Constant	.10 (.13)	.025 (.11)	-.20 (.05)
N	148	148	148

Note: Robust regressions are run using a bi-weighted estimator with Huber weights to downweight observations that are outliers.

Table V: Effect of *q* on Overall Capital Structure

	$[\text{Book Value of Debt / (Book Value of Assets)}]_t$			
	(1)	(2)	(3)	(4)
NAV *q*	-.052 (0.026)	-.054 (0.033)	-.10 (0.03)	-.11 (0.04)
$[\text{Book Value of Debt / (Book Value of Assets)}]_{t-1}$	.86 (0.02)	.86 (0.02)	.81 (0.02)	.81 (0.02)
Constant	.14 (.03)	.092 (044)	.22 (.04)	.15 (.05)
Year dummies	No	Yes	No	Yes
Investment restricted sample?	Yes	Yes	No	No
R^2	.86	.87	.81	.83
N	414	414	437	437

Note: The investment restricted sample excludes observations in which net investment exceeds 100 percent. The estimates are from an OLS regression.

Figure 1:
Price-to-NAV Ratio for REITs from 1992-2001

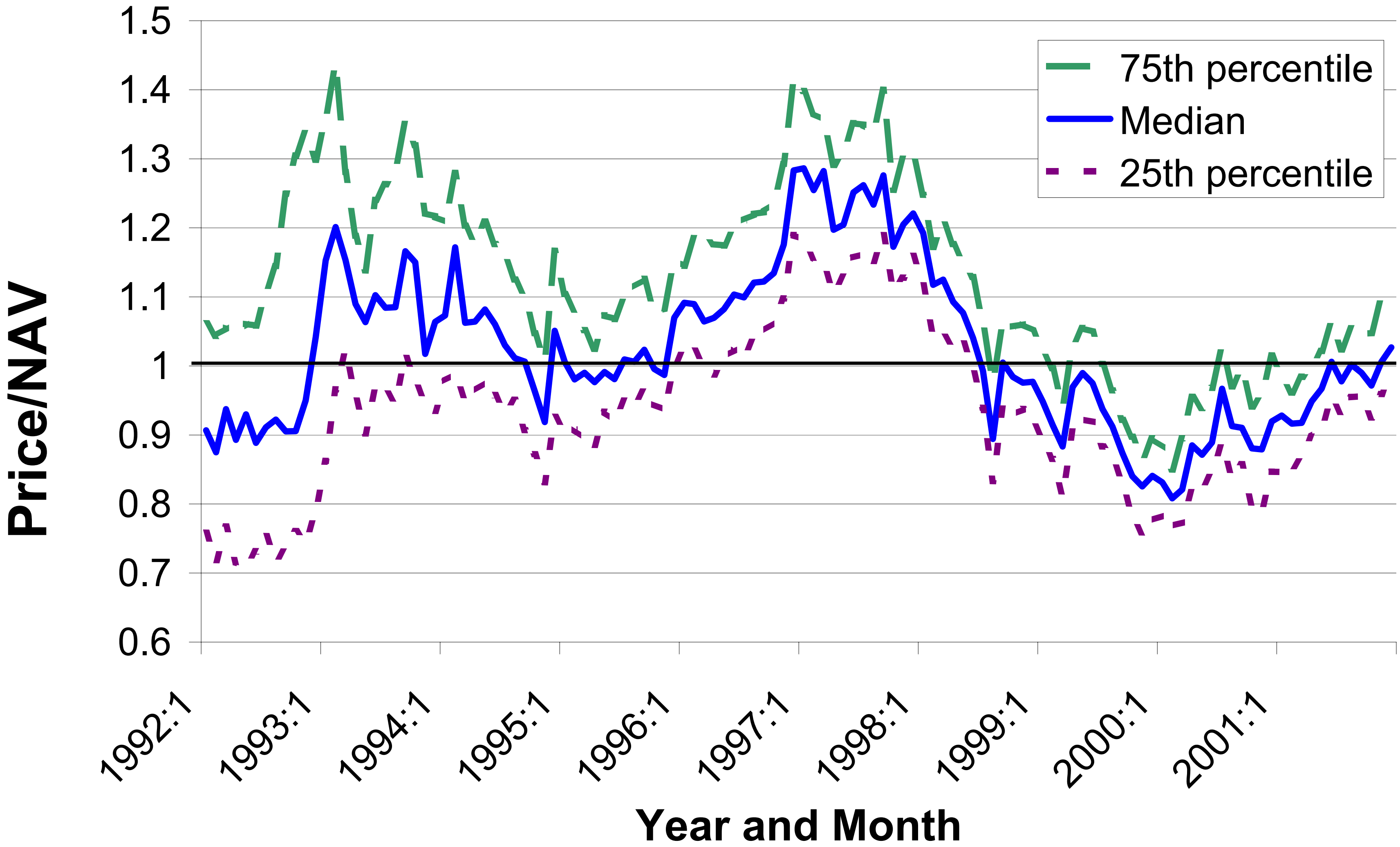

Figure 2:
Kernel Regresion of Investment on NAV *q*
1992-2001

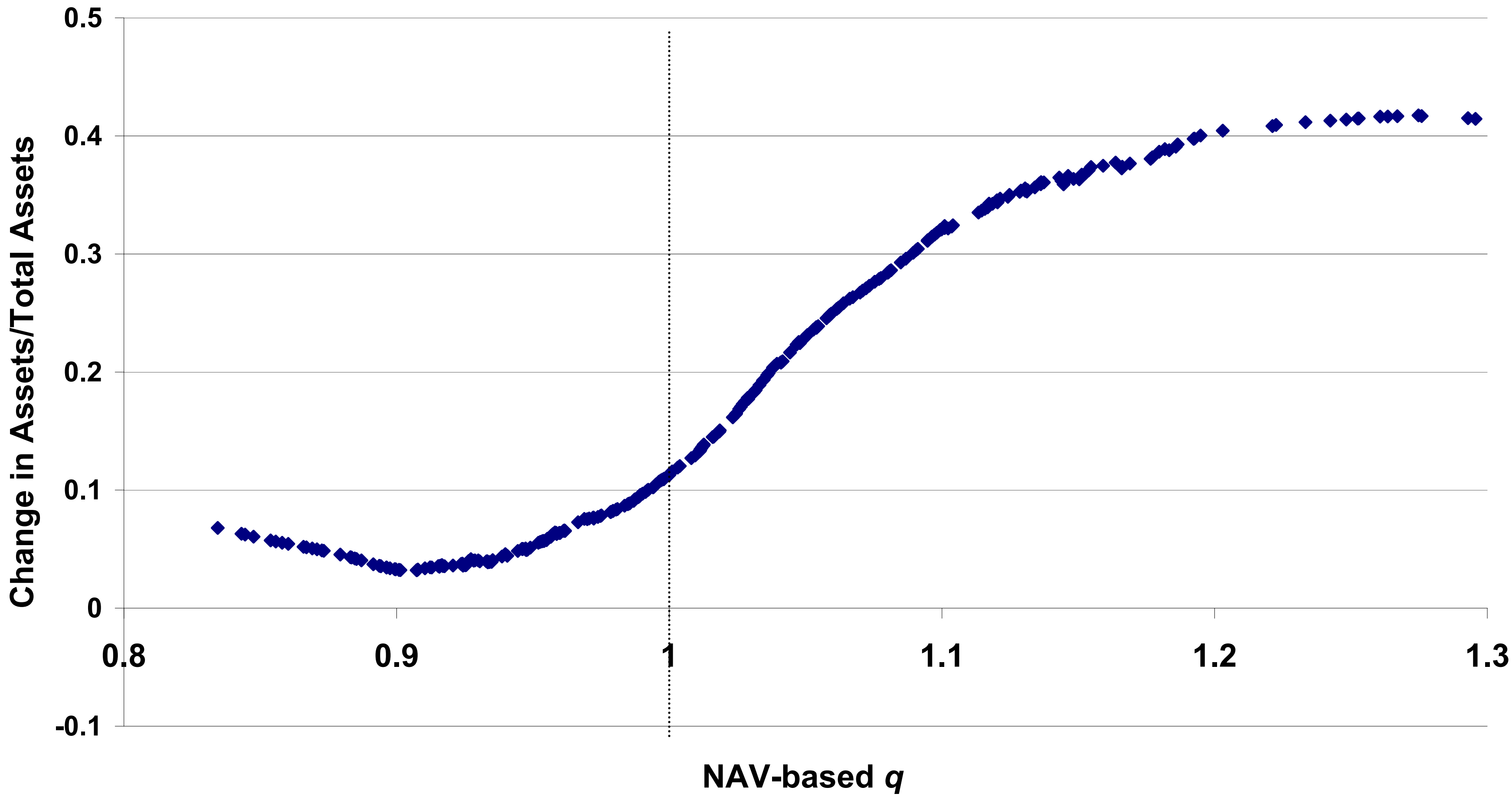

Figure 3:
Kernel Regression of Change in Equity on NAV *q*
1992-2001

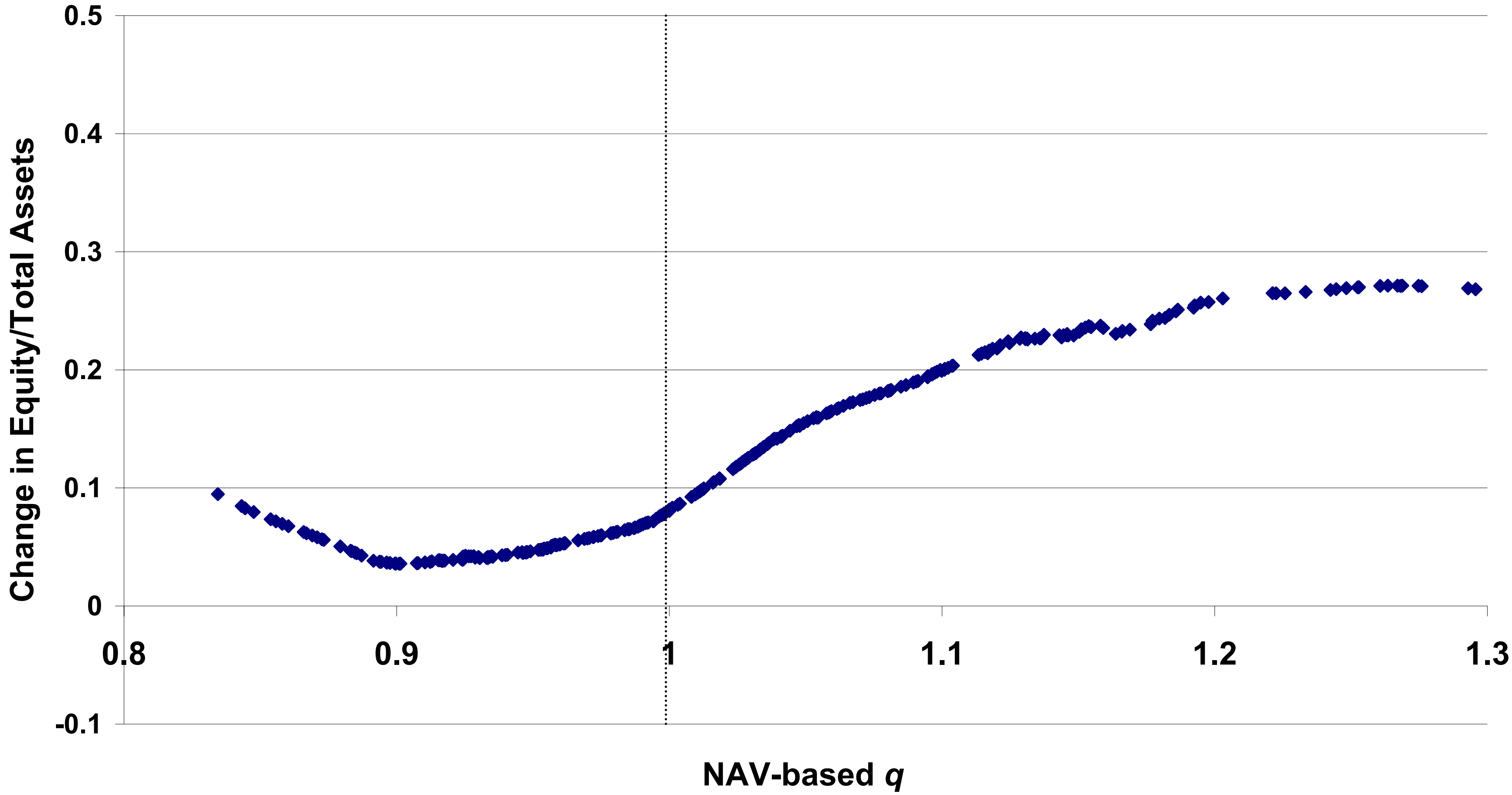

Figure 4:
Kernel Regression of Change in Debt on NAV *q*
1992-2001