

The Value of Liquidity

Lawrence Benveniste,* Dennis R. Capozza,** and Paul J. Seguin***

In this study, we examine the relationship between the liquidity of equity and its market value. We find that creating liquid equity claims on relatively illiquid property assets increases value by 12–22%. However, the fixed costs associated with creating these claims offset these liquidity gains for pools of assets below \$100 million. We also estimate that the liquidity of individual properties adds 16% to their value relative to a notional nontradable property asset. Managers can enhance the liquidity of equity and, therefore, the benefits of securitization by increasing size, focus, and institutional ownership.

In his seminal article, Coase (1937) addresses the fundamental question of why the corporation exists and prospers as an organizational form. Given that there are significant costs to forming a public corporation, including the cost of a management team and reporting costs, what benefits to public trading outweigh these costs? Coase and many authors that followed concentrate on identifying advantages along the dimensions of reducing contracting, monitoring, and agency costs.

However, another branch of the financial economics literature has examined an alternative benefit of the publicly traded corporation: namely, the enhancement of the liquidity of the claims on the assets. Under this paradigm, a firm is viewed as a collection of illiquid assets arising from capital budgeting decisions. Bundling these assets into a corporation and issuing comparatively liquid publicly traded claims to these assets can create value if liquidity is priced.

Since Amihud and Mendelson (1986), one goal of the finance literature has been to determine whether liquidity is priced by attempting to document a link between the value of equity and its underlying liquidity. Following Amihud and Mendelson, the first studies along these lines examined the relations between liquidity and expected or required rates of return. Implicit in this strategy is the

*Carlson School of Management, University of Minnesota, Minneapolis, MN 55455 or lbenveniste@csom.umn.edu.

**University of Michigan Business School, Ann Arbor, MI 48109-1234 or capozza@umich.edu.

***Carlson School of Management, University of Minnesota, Minneapolis, MN 55455 or pseguin@csom.umn.edu.

joint hypothesis that (i) an increase in liquidity results in a decrease in required rates of return, and (ii) holding cash flows constant, a decrease (increase) in required rates of return increases (decreases) the present value of future cash flows and, hence, the value of a traded security. However, required rates of return are unobservable, forcing researchers to employ realized rates of returns as unbiased proxies for expected rates. Unfortunately, the variance of the unexpected component of returns overwhelms the variance of the expected component,¹ so the statistical power of these tests is low.

One technique that mitigates the problem of low statistical power is to circumvent the use of expected returns and instead examine the value of the firm directly. For example, Lang and Stulz (1994) argue for examining the ratio of equity market values to replacement values (or Tobin's q):

By focusing on Tobin's q , rather than on performance over time, we avoid some of the problems of the earlier literature . . . since q is the present value of future cash flows divided by replacement costs, no risk adjustment or normalization is required to compare q across firms.

In this study, we exploit a unique attribute of REITs to improve upon this metric. Past studies have used the replacement value of assets as the denominator of this ratio calculated by adjusting depreciated historical accounting numbers. Instead, we follow Capozza and Seguin (1998, 1999, 2000) and take advantage of the fact that the underlying assets—real properties—trade in a distinct market (albeit illiquid) and use these real estate market values instead of accounting-based replacement values. Capozza and Seguin (2000) argue that q -ratios constructed in this manner

are the most sophisticated available. Further, given the homogeneity of the assets and the methodology employed, we posit that [these] estimates . . . are econometrically less noisy than those used in other studies to estimate Tobin's q , which are usually based on the depreciated accounting cost of assets.

Using these techniques, we find that, at the margin, a liquid equity claim on an additional dollar of underlying real estate assets is 12–22% more valuable

¹ Assume that $R = E\{R\} + u$, where R is the observed return, $E\{R\}$ is the expected or required return and u is the unexpected component. One method of assessing the relative variance of the two right-hand side components is to examine empirical studies that attempt to "explain" observed returns. Since R^2 is the ratio of the explained variance ($\text{Var}(E\{R\})$) to total variance ($\text{Var}(E\{R\}) + \text{Var}(u)$) and since the R^2 s in these studies are typically far below 10%, the unexplained variance is at least ten times the variance of the explained.

than the real estate market value. That is, we find that securitizing claims to real estate assets increases their value by 12–22% at the margin. This is not to say that REITs always trade at values that are above the underlying net asset values. Indeed, on average in our sample, market values are close to NAVs. The reason for the apparent contradiction is that the marginal liquidity gains come with attendant costs; the formation and operation of a publicly traded corporation generates its own set of expenses. Therefore, we find that the value gains due to enhanced liquidity offset the fixed costs associated with the corporate organizational form only for trusts that exceed roughly \$100 million in assets. Since this is about the average size of a REIT in the sample, the average q , as opposed to the marginal q , is about one.

We next examine the cross-sectional determinants of liquidity, which we measure as annual dollar trading volume. We find that a number of factors over which the trust's management exercises some control affect liquidity and, therefore, trust value. Specifically, we find that financial leverage as well as the size and focus of the asset pool affect liquidity. We also confirm the existence of the relationship between institutional ownership and liquidity, which has been previously documented for firms in general and REITs in particular.

Finally, we investigate the relationship between cross-sectional differences in liquidity and relative valuation. We find that, holding real estate market values constant, differences in liquidity are correlated with differences in equity market value. We also show that this relationship holds even after accommodating a number of factors that have been previously identified as affecting REIT value. Perhaps most importantly, we control for both the structural and style components of managerial expenses. Further, after we partition liquidity into a component that reflects managerial decisions (systematic) and a residual component (unsystematic) we find that value is affected equally by both components. This final finding is consistent with the hypothesis that investors care about and value the liquidity of their investment, regardless of the source of the liquidity.

Our study is by no means the first to examine liquidity in the context of REITs.² However, we believe that this study represents the first systematic investigation into the links between realized liquidity and firm value. Further, this study

² For example, Below, McDonald and Slawson (1999), Below, Kiely and McIntosh (1995) and Downs, Guner and Nuray (1999) examine the relations between institutional ownership and various measures of liquidity. Below, Kiely and McIntosh (1996), Bhasin, Cole and Kiely (1997) and Clayton and MacKinnon (2000) examine secular changes in measures of REIT liquidity surrounding the REIT "boom" of 1993, while Clayton and MacKinnon (1999) extend the analysis and consider changes in effective spreads around the bear market of 1998.

suggests alternative determinants of liquidity that have been thus far overlooked in the existing literature including features of the underlying asset portfolio. Our finding that liquidity is impacted by the size and focus of the asset portfolio represents evidence that the strategic choice of asset portfolio composition affects shareholder value through the avenue of liquidity.

Finally, our results concerning those managerial decisions that affect liquidity provide ready prescriptions for the creation of shareholder wealth. In this context, we view “good managers” as those that create shareholder value. Our results demonstrate that one avenue for creating value is by increasing the liquidity of equity. By investigating the determinants of liquidity, this research provides a road map for managers wishing to increase shareholder value.

In the following section, we outline a simple model that underpins our empirical strategy and links together our three sets of empirical investigations. We next provide a description of the data and variables used in this study. This is followed by evidence on the relations among firm value, liquidity, and the fixed costs associated with operating a publicly traded corporation. We next examine the determinants of cross-sectional variations in liquidity including previously identified determinants (industry cycle and ownership structure) as well as some novel determinants, including inside ownership and the extent of asset portfolio diversification. In the penultimate section, we investigate the links between cross-sectional variations in liquidity, and its components and shareholder value. In the final section, we provide a summary and discuss the implications of these findings for maximizing shareholder wealth.

The Model

The model underpinning our empirical specifications is the fundamental dividend discount relationship. If V_t is the value of an equity claim to the cash flows generated from a portfolio of real estate assets as of time t , Δ_t is the dividend paid to equity claimants at time t , and R is the required rate of return, we have

$$V_t = \int_t^{\infty} \Delta_t e^{-Rt} dt. \quad (1)$$

Cash flow available to be distributed to equity holders, C_t , is simply the cash flow from properties, Y_t , minus any interest expense, I_t , and expenses associated with the organizational form (general and administrative expenses), G_t :

$$C_t = Y_t - I_t - G_t. \quad (2)$$

If the portfolio pays out 100% of cash flows available to equity claimants, we have (from (1))

$$\begin{aligned}
 V_t &= \int_t^{\infty} (Y_t - I_t - G_t)e^{-Rt} dt \\
 &= V(C_t, R).
 \end{aligned}
 \tag{3}$$

From Equation (3), it is clear that for liquidity to affect value, the channel must be through at least one of the components of cash flow or the required rate or return, R . We investigate whether the choices of real investments and capital structure affect liquidity, but we assume that the causation is not bidirectional, so liquidity does not “cause” or affect these two decisions. That is, property level cash flows, Y , and interest costs, I , are assumed to be unaffected by the organizational form. The first of these assumptions, that property-level cash flows are unrelated to organizational form, is equivalent to arguing that the market for properties is competitive, or, at a minimum, that REITs do not have a systematic advantage compared to private investors in acquiring properties in the real estate market at lower prices, and, hence, higher cash flow yields. The second assumption is that, after controlling for a number of factors that would affect debt yields including the size and diversification of the underlying asset portfolio, the liquidity of the equity has no incremental impact on debt yields.

Therefore, we can narrow our focus to two variables: expenses associated with the organizational form (general and administrative expenses), G_t , and the required rate of return, R . Specifically, we assume that organizational expenses are determined by a vector of variables, X , that capture the size, composition, and financing of the asset portfolio, and an indicator variable, D , that equals one if the organization is publicly traded and zero otherwise.

$$G = G(D, X). \tag{4}$$

Intuitively, coefficients associated with D will capture the present value of the difference in fixed costs between holding a privately held versus a publicly held corporation.

We further assume that R , the required rate of return, is affected by Σ , a vector of variables that capture risk, and L , a measure of liquidity. Finally, we allow liquidity, L , to vary with both the vector of variables that describe the investment and financing decisions of the firm, X , and the choice of organizational form, D . We can write

$$L = L(D, X) \quad (5)$$

$$R = R(L, \Sigma) \quad (6)$$

$$R = R[L(D, X), \Sigma]. \quad (6a)$$

That is, organizational form affects the required return indirectly through liquidity. We can rewrite (3) as

$$V = V[G(D, X), R(L, \Sigma)]. \quad (3a)$$

Equation (3a) highlights the difference between property held in a trust versus the underlying property assets. In a trust there are costs embedded in G that reduce the value of the assets, but at the same time there are liquidity advantages that reduce the required return. The net asset value of the underlying properties can be written as

$$\begin{aligned} V &= V[G(0, X), R(L(0, X), \Sigma)] \\ &= V(G, R \mid D = 0), \end{aligned} \quad (3b)$$

where $L(0, X)$ is the liquidity of properties not held in a real estate investment trust. Net asset values do not include the cost of operating a trust, G , and do not benefit from the liquidity of exchange trading. We ordinarily expect $L(0, X) < L(1, X)$ and the required return on the properties to exceed the required return for a trust holding the same properties.

$V = V[G(1, X), R(L(1, X), \Sigma)]$, on the other hand, is the market capitalization or “Wall Street” value of the equity.

As mentioned above, our primary empirical method involves an analysis of average and marginal q . We will express average q as

$$\bar{q} = \frac{V(G, R \mid D = 1)}{V(G, R \mid D = 0)} \quad (7a)$$

and marginal q as

$$q' = \frac{dV(G, R \mid D = 1)}{dV(G, R \mid D = 0)}. \quad (7b)$$

The empirical tests presented below estimate equations of the form

$$V(G, R \mid D = 1) = \alpha + q'V(G, R \mid D = 0). \quad (7c)$$

That is, we will examine formulations where the Wall Street value of assets or equity is regressed on the NAV or Main Street counterparts. As a result, we will be estimating marginal q -ratios in our tests. The first set of tests estimates (7c) for a representative firm, where our objective is to estimate the typical impact of public listing on the value of a portfolio of real assets. We expect q' to be significantly different from one when estimated unconditional on liquidity.

In our second set of tests, we investigate the determinants of liquidity for publicly traded REITs. Our objective here is to determine a feasible specification for (5) for publicly traded firms, or

$$L = L(D, X \mid D = 1). \quad (5a)$$

Finally, we explore the links between cross-sectional variations in liquidity and variations in relative value or q . To do so, we estimate q' conditional on organizational form and on the liquidity of the equity of the trust

$$V[G, R(L) \mid D = 1] = \alpha + q'V[G, R(L^p) \mid D = 0], \quad (7d)$$

where $L^p = L(0, X)$ is the liquidity of property not held in a trust. When estimated conditional on liquidity and on G&A expenses, if q is not significantly different from one, then the evidence supports these two channels as the primary avenues through which organization as a trust affects value.

To clarify, note that tests of Equation (7c) will be conditioned only upon whether the trust is public or private, while tests of Equation (7d) will be conditioned upon cross-sectional differences in liquidity across publicly traded trusts as well.

An anonymous referee highlighted the parallel between REITs and equity closed-end funds. In the closed-end fund literature, it has been argued that management fees are adjusted to capture any gains due to superior abilities. So, a fund that out (under) performs would raise (lower) their fees, and all funds would trade at roughly equivalent values. That is, the fund manager would extract a significant proportion of the economic rents due to their superior ability. To examine whether this relationship holds in our sample, we explicitly include the REIT equivalent of fees—G&A expenses. Furthermore, we parse these fees into two components, one of which will reflect those expenses which are discretionary. As a result, our model and empirical strategy explicitly accommodates the possibility of variations in expenses that may reflect variations in management quality.

Data and Variables

The database, introduced and described in detail in Capozza and Lee (1995, 1996) and subsequently used in Bradley, Capozza and Seguin (1998) and Capozza and Seguin (1998, 1999, 2000, 2001), contains a subset of the REITs listed in the NAREIT (National Association of Real Estate Investment Trusts) source books from 1985 to 1992 (see Table 1). This database contains balance sheet and income statement information on 75 exchange-traded equity REITs other than mortgage, hotel, restaurant, and health-care REITs. Data for each of the 298 usable annual observations were manually extracted from 10-K reports, annual reports and proxy statements.

The Capozza-Lee database also provides estimates of the net asset values of the real estate properties held. They first assigned location- and type-specific capitalization rates to each property and then calculated a REIT's capitalization rate as the weighted average of the component property capitalization rates. A REIT's property assets were then estimated by dividing property cash flows by the weighted capitalization rate. Finally, net asset values were calculated by subtracting liabilities from estimated property assets plus other assets. Additional adjustments, where appropriate, were made for joint ventures, differences between coupon rates, and market yields on debt and property turnover.³

Since property-specific capitalization rates and hence property values are estimated using actual transactions data from the real property (*i.e.*, "Main Street") market, we can examine the relationship between equity market (Wall Street) values and replacement (Main Street) values with a precision that is finer than in typical q -ratio studies. Capozza and Seguin (2000) argue that

Since active markets for underlying assets do not exist for the majority of industries, previous studies could only coarsely estimate replacement costs by accumulating historical capital investment and adjusting for inflation and estimated economic depreciation (Lindenberg and Ross 1981). In contrast, our replacement cost estimates are based on recent market transactions prices of assets similar to those underlying each REIT.

³ Despite all due care, our NAVs, like all NAVs, are estimates that are measured with error. As a result of this errors-in-variables problem, estimated coefficients are biased towards zero. Therefore, our estimates of marginal q and the value of liquidity are also biased towards zero and the power of our tests is reduced. We have obviously not fully adjusted for every conceivable influence on capitalization rates, so our procedure may generate systematic biases on our estimates of q -ratios. As one example, if older properties have higher-than-average capitalization rates and more liquid REITs were more likely to hold these older buildings, then estimates of q would be biased upward. However, we know of no such dimensions with these systematic properties.

Table 1 ■ The sample REITs.

*BRE Properties Inc.	*One Liberty Properties Inc.
Berkshire Realty Co. Inc.	PS Business Parks Inc.
*Bradley Real Estate Trust	Partners Preferred Yield Inc.
Burnham Pacific Properties Inc.	Partners Preferred Yield II
*California Real Estate Investment Trust	Partners Preferred Yield III
Cedar Income Fund Ltd.	*Pennsylvania Real Estate Investment Trust
Cedar Income Fund 2 Ltd.	*Property Trust of America
Chicago Dock and Canal Trust	*Prudential Realty Trust
*Clevetrust Realty Investors	Public Storage Properties VI Inc.
*Continental Mortgage & Equity Trust	Public Storage Properties VII Inc.
Copley Property Inc.	Public Storage Properties VIII Inc.
Cousins Properties Inc.	Public Storage Properties IX Inc.
Dial Reit Inc.	Public Storage Properties X Inc.
Duke Realty Investments Inc.	Public Storage Properties XI Inc.
*EQK Realty Investors 1	Public Storage Properties XII Inc.
*Eastgroup Properties	Public Storage Properties XIV Inc.
*Federal Realty Investment Trust	Public Storage Properties XV Inc.
*First Union Real Estate Equity & Mortgage Investments	Public Storage Properties XVI Inc.
Grubb & Ellis Realty Inc. Trust	Public Storage Properties XVII Inc.
*HRE Properties	Public Storage Properties XVIII Inc.
*ICM Property Investors Inc.	Public Storage Properties XIX Inc.
*IRT Property Co.	Public Storage Properties XX Inc.
Income Opportunity Realty Trust	*Real Estate Investment Trust California Realty South Investors Inc.
Koger Equity Inc.	*Santa Anita Realty Enterprises
Landsing Pacific Fund	Sizeler Property Investors Inc.
Linpro Specified Properties	*Trammell Crow Real Estate Investment
*MGI Properties Inc.	*Transcontinental Realty Investors
*MSA Realty Corp.	*USP Real Estate Investment Trust
*Meridian Point Realty Trust 83	*United Dominion Realty Trust Inc.
*Meridian Point Realty Trust 84	Vanguard Real Estate Fund I
Meridian Point Realty Trust IV	Vanguard Real Estate Fund II
Meridian Point Realty Trust VI	Vinland Property Trust
Meridian Point Realty Trust VII	*Washington Real Estate Investment Trust
Meridian Point Realty Trust VIII	*Weingarten Realty Investors
*Merry Land & Investment Inc.	*Western Investment Real Estate Trust
Monmouth Real Estate Investment Corp.	Wetterau Properties Inc.
*New Plan Realty Trust	
*Nooney Realty Trust Inc.	

This is the sample of REITs drawn from the database described in Capozza and Lee (1995). This database is constructed from the 1992 NAREIT (National Association of Real Estate Investment Trusts) source book, which lists all publicly traded REITs (209 REITs) as of December 31, 1991. The database excludes all mortgage, hotel, restaurant and hospital REITs, REITs that do not trade on NYSE, AMEX or Nasdaq or REITs for which property information is not available. These exclusions lead to a sample of 75 REITs, which are listed here. Given this list, the researchers then attempted to construct one observation per REIT for each of the years between 1985 and 1992. Of the 75 equity REITs, 32 appear in all eight years and are annotated with a star (*), with the remaining appearing for at least one year.

Summary statistics for these Main Street-determined replacement values and for Wall Street-determined market capitalization values are presented in the first two rows of Table 2. Both Wall Street and Main Street equity values average just over \$100 million and vary from virtually zero to \$1 billion (\$650 million for Main Street replacement values).

The q -ratios we employ are constructed by dividing the equity-market (Wall Street) value of equity by the property-market replacement (Main Street) value of properties plus the book value of other assets minus the book value of debt. Other assets and debt have low durations, so deviations between book- and market-values for other assets and debt are small. The ratio of the Wall Street value to the Main Street value, the average q -ratio, is centered around 1,⁴ and shows wide variation with value lying between 0.1 and 3.

Along with our q metric, our study revolves around the measurement of liquidity. However, empirically measuring liquidity is not trivial due to the complexity and multidimensionality of liquidity. The dominant approach has been to measure the inputs or determinants of liquidity, especially quoted bid-ask spreads. However, recent evidence in both the finance literature and the real estate literature has cast doubt on the efficacy of this measure. For example, in the finance literature, Petersen and Fialkowski (1994) find that “quoted spread is a poor proxy for the actual transactions costs faced by investors.” In the real estate literature, Bhasin *et al.* (1997) and Clayton and MacKinnon (1999a) also argue that the use of quoted spreads is fraught with shortcomings. Specifically, the quoted spread is valid only for small orders that require immediate execution. Larger (institutional) orders will typically trade at quotes that are wider than quoted spreads, while orders that do not require immediate execution may trade at narrower (crossed) quotes.

To mitigate these problems, we avoid measures based on inputs of the trading process and instead examine liquidity using a measure that reflects the outputs of the market exchange process; namely, dollar trading volume. Clayton and MacKinnon (1999b) show that this measure is highly negatively correlated with the actual transactions costs borne by investors, with a correlation over their (1997–1998) sample period of -0.52 .

⁴ Note that the ratio of the means exceeds the mean of the ratios. If x is Wall Street value and y is Main Street value, $E\{x/y\} = E\{x\}E\{1/y\} + \text{cov}(x, 1/y)$. Since x and y are highly positively correlated ($\rho = 0.9$), the covariance between x and $1/y$ is negative, so $E\{x/y\}$, the mean of the ratio, is less than $E\{x\}E\{1/y\}$, which, aside from Jensen’s inequality, is the ratio of the expected values. Since the function $f(x) = x^{-1}$ is everywhere convex, $E\{y^{-1}\} > [E\{y\}]^{-1}$. So, $E\{x\}E\{y^{-1}\} > E\{x\}[E\{y\}]^{-1}$ for $E\{y\} > 0$. However, the negative covariance effect overwhelms the Jensen’s inequality effect.

Table 2 ■ Summary statistics.

Variable	Mean	Standard Deviation	Minimum	Maximum
Wall Street market value of equity (\$ million)	116.3	143.9	4.1	1,070.8
Main Street value of equity (\$ million)	110.3	107.5	5.9	642.1
<i>q</i> -ratio	1.00	0.37	.10	2.86
Dollar volume (\$ million)	131.3	152.8	1.3	925.1
Turnover (dollar volume/Main Street equity)	1.14	0.74	.13	5.57
Leverage ratio (%)	35.8	23.7	0.3	90.0
Property type Herfindahl (%)	66.8	24.1	26.0	1.00
Property region Herfindahl (%)	58.2	28.0	0.15	1.00
Percent held by institutions (%)	16.8	14.5	0.0	61.0
Percent held by insiders (%)	7.3	10.0	0.0	42.0

This table reports means, standard deviations and extreme values of the variables calculated across our sample of 298 observations for 75 firms. Wall Street value of equity is the market capitalization (size) of equity. Main Street value of equity is the real estate market value of assets as defined by Capozza and Lee (1995) minus the book value of liabilities. The *q*-ratio is the ratio of market equity (stock price times number of shares) to the market value of properties plus the book value of other assets minus book liabilities. Turnover is the annual dollar volume divided by the market capitalization. The leverage ratio is defined as total liabilities/(total liabilities + market value of the equity). Herfindahl concentration measures are the sum of squared fractions of asset portfolios by property type and geographic regions, respectively.

The fourth and fifth rows of Table 2 present summary statistics for volume and turnover, or volume deflated by Main Street Equity.⁵ Dollar volume varies from \$1 million to just under \$1 billion, with a mean of around \$130 million. The variation is also dramatic when expressed as a multiple of equity: the range is .13 through 5.6.

The leverage ratio is defined as total liabilities divided by the sum of total liabilities and the market value of the equity. The typical REIT in our sample

⁵ Although our results and conclusions are unchanged, we divide volume by the real estate market value of assets rather than the more traditional method of deflating by equity market values. We do so since our theory predicts that volume *per se* increases the Wall Street value of assets. Thus, deflating our explanatory variable (volume) by the variable we are seeking to explain (Wall Street value) would induce biases and/or spurious correlation.

is roughly one-third financed by debt, although this variable essentially spans its feasible range.

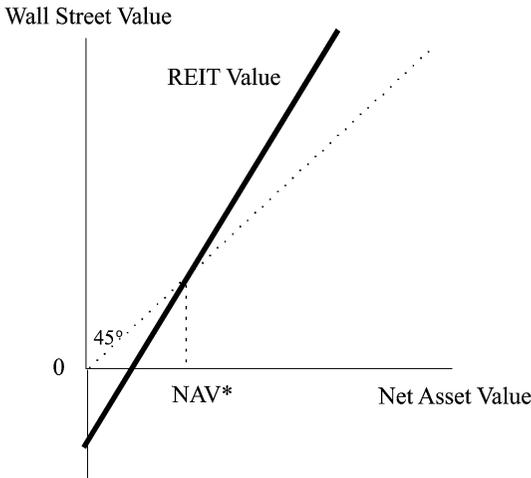
Since our research objective is to determine the extent to which liquidity affects shareholder value, it is necessary to control for those factors that have been previously identified as determinants of value for REITs. Capozza and Seguin (1999) find that more focused trusts have higher equity values, *ceteris paribus*. Therefore, we include two measures of the focus of the asset base: Herfindahl indices based on property type and regional location. The first, Property Type Herfindahl, is computed as $\sum_{i=1}^4 S_i^2$ where S_i is the proportion of a firm's assets invested in each of four real estate types: office, warehouse, retail, or apartment. We similarly compute Regional Herfindahls that reflect the proportion of a firm's assets invested in each of eight real estate regions. Both metrics vary across almost their entire range. Creating focused portfolios is one way that "good managers" increase shareholder value.

We also include two measures of shareholder identity—the percent of shares held by insiders and by institutions—to control for relations between holdings and value (Below *et al.* 1999). The data are drawn from Spectrum, an SDC (Securities Data Corporation) product that reports the quarterly holdings of investors and insiders based on these holders' mandated filings with the SEC (mostly 13-D and 13-F filings). Since our data are annual, we employ the first filing immediately following the trust's fiscal year end. Institutional holdings vary from 0 to 61% with a mean of 17%, while holdings by insiders vary from 0 to 42% with a mean of 7%.

The Average Effects of Liquidity

We begin our empirical analyses by estimating the effects of exchange trading on trust value. Our model presented above predicts that liquidity affects value through two avenues: the discount rate and G&A expenses. These predictions translate into an empirical model where the Wall Street value varies with Main Street value. However, the slope of the relationship will vary from one for at least two reasons. First, the (marginal) G&A expenses that vary with the size of the asset pool may vary at a rate that is different than the marginal operating costs of a non-publicly traded fund. Second, the enhanced liquidity of the publicly traded trust should reduce the required rate of return, and hence increase the Wall Street value relative to the Main Street value. The difference in slope will reflect the net impact of these two effects. Further, since the exchange-traded corporate form involves fixed costs that differ from those incurred by other organizational forms, we allow the intercept to differ from zero. Assuming linearity (which we examine empirically), this empirical model (based on Equations (7a) and

Figure 1 ■ Wall Street versus Main Street values. This figure illustrates the relationship between market capitalization or Wall Street value and net asset value. The slope of the solid line is the marginal q -ratio, q' , and is shown with a slope above one. The intercept of the solid line represents the present value of the difference in fixed costs associated with a publicly traded trust and is shown with an intercept below zero. Small REITs located on the solid line below the intersection of the 45° line have Wall Street values below their net asset values. Thus their average q is less than one, that is, securitizing the real properties destroys value. Above this point of intersection, Wall Street value exceeds net asset value. For these trusts, average q is greater than one and securitizing adds value.



(7b) can be graphically summarized in Figure 1. The slope of the solid line in the figure is the marginal q -ratio.

This figure presupposes that the liquidity effect outweighs any difference in marginal operating costs, so the slope exceeds one. Further, the fixed costs associated with a publicly traded corporation exceed those of an alternative structure, so the intercept is negative. Under this scenario, there exists some critical value (NAV^* , here) where the liquidity benefits of public trading exactly offset the additional costs. For asset portfolios above this critical value, public trading is the preferred structure, while public trading may actually destroy value for smaller portfolios.

Estimates of this model are presented in Table 3. This model is based on Equation (7c), which we describe as our unconditional model. Specifically, we compare the value of a publicly traded trust $V(G, R | D = 1)$ to the value of the underlying assets, our proxy for $V(G, R | D = 0)$, without conditioning on cross-sectional variations in the liquidity of publicly traded trusts. In the first

Table 3 ■ Estimating the average gains to exchange trading.

	Dependent Variable = Wall Street Market Value of Equity				
	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	-7,919 (-4.6)	-7,536 (-4.5)	-4,967 (-2.4)	-2,392 (-1.1)	-4,059 (-1.2)
Main Street value of equity [<i>t</i> -statistic for $H_0: \beta = 1$]	1.12 [5.7]	1.14 [4.8]	1.22 [4.7]	1.17 [3.7]	1.22 [3.0]
G&A expenses		-1.60 (-0.8)			
Structural G&A			-9.85 (-2.3)	-20.50 (-3.8)	-22.89 (-3.5)
Style G&A			0.65 (0.3)	1.76 (0.8)	2.38 (0.8)
Property type focus * assets				0.10 (2.8)	0.09 (1.8)
Regional focus * assets				0.05 (1.2)	0.01 (0.3)
% held by institutions * Main Street equity					-0.13 (-0.7)
% held by insiders * Main Street assets					0.60 (4.4)
Adjusted R^2	0.77	0.77	0.77	0.78	0.78

The dependent variable is the Wall Street value of equity, or “market cap,” of the trust. Estimation is by weighted least squares, with the Main Street value of equity used as weights. Structural and Style G&A terms are the fitted and residual components, respectively, from a quadratic regression of G&A expenses on assets and liabilities. Main Street equity and asset values are calculated using NAVs following Capozza and Lee (1995). Property-type focus is a Herfindahl coefficient generated by summing the squared proportions of a firm’s assets invested in each of four real estate types. Regional focus is calculated similarly using a Herfindahl index computed across eight geographic regions. *T*-statistics for the hypothesis that a coefficient equals zero are in parentheses, while *t*-statistics for a null that the coefficient equals one are in brackets.

column, we present our most parsimonious model, where we regress the Wall Street value of equity against an intercept and the Main Street or net asset value of equity.

It may seem curious that we present empirical estimates of models linking levels of Wall Street equity to levels of Main Street equity given that the preponderance of the previous literature as well as our own Equations (7a) and (7b) employ the ratio of the two. However, all regressions are estimated via weighted least squares (WLS) with (the inverse of) Main Street equity used as weights. Consequently, our regressions are, as we demonstrate in the statistical Appendix, regressions of the ratio against the inverse of Main Street equity and the identity vector. We choose our specification for two reasons. First, it is more robust and more efficient in the presence of heteroskedasticity, and second, the intercept, which remains in units of dollars, has a more straightforward interpretation.

The estimated slope coefficient of 1.12 is significantly above 1 and suggests that the effect of public exchange listing is to enhance equity value by 12% at the margin. However, this liquidity gain is not without cost; the intercept is roughly -\$8 million. We interpret this intercept as the present value of the incremental fixed costs associated with running a publicly traded company.

From these estimates, we can make a pair of “back-of-the-envelope” calculations of interest. First, by comparing the intercept to the slope, we can calculate a NAV*, or breakeven point, of around \$66 million. That is, the benefits of exchange trading outweigh the costs only for Main Street equity values in excess of \$66 million. Note from Table 2 that the mean leverage ratio is around 36%, so this critical value translates into a breakeven point of around \$100 million in assets. Second, we interpret the intercept as the present value of the difference between the fixed costs of running a publicly traded trust and the fixed costs associated with running a private trust or portfolio. If this value is the present value of a growth perpetuity, using an arbitrary discount rate of 7%, we can solve for the first year’s expected fixed costs as:

$$PV = \frac{\textit{fixedG\&A}}{R},$$

or

$$-7.9 \text{ million} = \frac{\textit{fixedG\&A}}{0.07},$$

or around \$560,000 per year. This represents about 45% of the average G&A expense of a REIT in the sample.

We next examine the robustness of our finding by augmenting this specification with other factors known to affect shareholder value. In the second column, we add reported G&A expenses. The coefficient associated with these expenses is insignificant and other parameter estimates do not change meaningfully. Following Capozza and Seguin (1998), we parse G&A expenses into two components: a structural component that is associated with the size of the trust and a style component that reflects management discretion. If management alters its compensation to capture the benefits of its superior abilities (or, more generally, adjusts G&A expenses to reflect their relative value as a managerial team), then this discretionary component would be captured in the style component.

As in Capozza and Seguin, the coefficient associated with the structural component is significantly negative, suggesting that a \$1 increase in structural G&A reduces equity value by \$10. The style or discretionary component is insignificant. However, of primary importance is the coefficient associated with Main Street equity value, which, at 1.22, remains significantly above 1.

We next add the two measures of asset portfolio focus: regional and property-type concentration in Model 4. Note that the two focus measures are multiplied by Main Street asset values (NAVs). As a result, the weighted least squares specification results in a regression of our q measure on these focus variables multiplied by the leverage factor of $(1 + \text{Debt/Equity})$. This correction is required since we believe these focus variables and inside ownership affect the value of the asset base. See the statistical Appendix for more details.

Consistent with Capozza and Seguin (1999), we find that the estimated coefficient associated with property-type focus is significant, indicating that more focused portfolios command higher premiums. The F -statistic for the joint significance of the two measures is 14.1, which exceeds the 1% critical value ($F_{(0.01, 2, \infty)} = 2.41$). Of primary importance, however, is the coefficient associated with Main Street equity, which indicates a 17% premium.

In Model 5, we add two variables that describe the shareholder base: the percents held by insiders and institutions. For reasons explained above, the percent held by insiders is multiplied by the Main Street asset value. Since institutional ownership affects equity directly, however, we multiply it by Main Street equity, so the leverage effect does not appear in the WLS regressions. Although the percent of equity held by institutions is not significant, the percent held by insiders is highly significant and the two are jointly significant ($F = 19.1$). Regardless of their inclusion, however, the coefficient associated with Main Street equity is significantly greater than 1, and indicates that publicly traded

real estate asset portfolios can trade at a 22% premium relative to their privately held counterparts.⁶

Our primary result is robust to a number of alternative specifications. These include the use of assets rather than equity as either multiplicative variables and/or weights, the use of quartile indicators for institutional and insider holdings, and allowing the intercept to vary annually. In every case, we find that securitizing real estate assets by forming publicly traded corporations increases their value by between 12% and 22%.

The Determinants of Liquidity

In the previous section, we report that securitizing real estate assets enhances value. That is, we find that public trading adds value, on average, compared to private holding. However, it is doubtful that the liquidity gains provided by exchange trading would be constant across all firms. Therefore, an obvious extension of this finding is to determine whether liquidity gains vary in the cross-section with the amount of liquidity provided by exchange trading. To do so, we first examine the cross-sectional dispersion in liquidity.

In Table 4, we begin by examining the relation between annual dollar trading volume and Main Street valuation. In the first model, we regress volume on Main Street equity. Since theory dictates that a firm with zero equity should have no trading volume, we constrain the intercept to equal zero. The estimated coefficient of 1.17, like all estimates associated with Main Street equity reported in this section, is highly significantly different from zero ($t > 33$). Further, this estimate is similar to the (unweighted) mean of turnover reported in Table 2.

In the next two columns, we explore alternative models to focus on an appropriate functional form. Model 2 allows the relation between the two to be nonlinear. If, for example, turnover itself varied with size, then volume would be a quadratic in equity with both terms positive. The estimates from Model 2, however, provide no evidence of a nonlinear relation.

In Model 3, we instead regress volume on Main Street market assets and book liabilities. As we show in the statistical Appendix, if volume depends on equity

⁶ It is difficult to interpret the intercepts or transformations therein in these later models. For example, the intercept in Model 5 estimates the fixed costs associated with a trust that has no assets, no G&A and no holdings by insiders or institutions, yet is fully diversified (the Herfindahls both equal zero). Adding back means of variables other than assets and G&A does not help, since the intercept in that case would estimate the fixed costs of a trust with no assets, yet average levels of diversification and share holdings.

Table 4 ■ The determinants of liquidity.

	Dependent Variable = Annual Dollar Volume of Trading					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept				-6,902 (-2.4)	-843 (-0.2)	-3,683 (-0.8)
Main Street value of equity [<i>t</i> -statistic for $H_0: \beta = 1$]	1.17 [4.7]	1.10 [1.5]	1.10 [1.5]	1.01 [0.1]	0.88 [-1.2]	0.87 [-1.2]
Main street value of equity ² (coefficient * 10 ⁶)		.31 (1.3)				
Total assets			1.06 [1.3]			
Total liabilities [<i>t</i> -statistic for $H_0: \beta = -1$]			-0.86 [1.4]			
Property type focus * Assets				0.21 (3.0)		0.16 (1.8)
Regional focus * assets				0.01 (0.1)		-0.08 (-1.0)
% held by institutions					0.74 (3.9)	0.60 (2.8)
% held by insiders					0.24 (0.9)	0.13 (0.5)
Adjusted R^2	0.46	0.46	0.47	0.47	0.47	0.48

The dependent variable is the annual dollar trading volume for the trust. Estimation is by weighted least squares, with the Main Street value of equity used as weights. Property-type focus is a Herfindahl coefficient generated by summing the squared proportions of a firm's assets invested in each of four real estate types. Regional focus is calculated similarly using a Herfindahl index computed across eight geographic regions. *T*-statistics for the hypothesis that a coefficient equals zero are in parentheses, while *t*-statistics for a null that the coefficient equals one are in brackets.

only, then we should expect the estimated coefficients associated with assets and liabilities to be of similar magnitudes yet of opposite signs. The estimates associated with assets and liabilities are visually consistent with this hypothesis. However, the F -test that the two are of equal size yet of opposite magnitude rejects the null, which, in this case, is a model linking volume to equity alone. These estimates suggest that adding an additional dollar of assets financed by equity increases trading volume by \$1.06, while the same asset increase financed by debt does increase trading volume, but by only \$0.20.

In the next set of models, we augment our primary specification by adding two sets of variables which we posit may be associated with trading volume. Note that since the value of the dependent variable conditional on setting all the independent variables simultaneously equal to zero is not obvious, we include intercepts in these models. We first add the two products of assets with the measures of portfolio focus. Capozza and Seguin (1999) argue that greater focus increases the “transparency” of the firm, easing analysis and valuation, and they conclude that focus matters through liquidity. Model 4 provides some support for this: The coefficient associated with property-type focus is highly significant, and the F -test associated with the joint significance of the two dimensions of focus is significant ($F = 5.26 > F_{(2,\infty,0.01)} = 2.41$). Consistent with Capozza and Seguin (1999), the results here indicate that asset portfolios that are more focused, especially along the dimension of property-type, command greater liquidity. For example, a portfolio with average focus would have a turnover of $1.03 (= 0.88 + (0.668) * 0.21 + (0.582) * 0.01)$, while a portfolio that was one standard deviation above the mean along both dimensions would have a predicted turnover of $1.08 (= 0.88 + (0.668 + 0.241) * 0.21 + (0.582 + 0.280) * 0.01)$.

In Model 5, we add two variables describing the shareholder base: the percent held by insiders and the percent held by institutions. Numerous studies (see Jennings, Schnatterly and Seguin 1999 and the references therein) show that institutional investors have a shorter investment horizon than noninstitutional ones. Further, we posit that insiders, who hold both equity stakes and managerial positions, are presumably “in for the long haul.” Therefore, we predict that turnover would vary positively with institutional ownership and negatively with inside ownership. The results, presented in Model 5, partially confirm our predictions: Institutional ownership is highly significantly related to volume, yet insider holdings are positively and insignificantly related to trading volume. This suggests that institutions do trade at a higher frequency, but that insiders have investment horizons that are statistically indistinguishable from other noninstitutional holders. “Back of the envelope” calculations based on these estimates suggest that noninsider individual investors have an average holding period of around 14 months ($= 1/0.88 * 12$ months), insiders have

a holding period of around 11 months ($1/(0.88 + 0.24) * 12$) and institutions have a holding period of only 7 months.

Finally, Model 6 contains both pairs of liquidity-related variables. Again, both property-type focus and institutional ownership are statistically significant. To measure economic significance, we calculate changes in turnover for variations in the two significant determinants: the first of one standard deviation and the second of a half-range of the variable. Increasing both institutional ownership and property-type focus by one standard deviation increases turnover by 11% ($= 0.60(0.145) + 0.09(0.241)$), while increasing each by their respective half-ranges increases turnover by 26% ($= 0.60(0.38) + 0.09(0.305)$). The impact of such increases of liquidity on subsequent firm value is the subject of the next section.

Value and Liquidity

In the previous two sections, we have shown that securitizing real estate assets enhances the portfolio value on average and that the liquidity gains provided by exchange trading are not constant across all firms. In this section, we integrate these two findings and investigate whether value gains attributable to enhanced liquidity vary in the cross-section with the amount of liquidity provided by exchange trading. That is, we explore whether the relative value of the Wall Street value of equity varies with liquidity.

As in the preceding sections, our engine of analysis is a model linking the levels of Wall Street values with Main Street values—again using WLS. Indeed, our specifications parallel the specifications presented in Table 3. However, here we examine Equation (7d), our conditional model, where we contrast the value of a publicly traded REIT, $V(G, R(L) \mid D = 1)$ against the Main Street value of the underlying asset $V(G, R(L^p) \mid D = 0)$. Our tests differ from those in Table 3 since we now condition on cross-sectional differences in liquidity across the publicly traded trusts. To do so, we first add dollar trading volume as an additional explanatory variable. As detailed in the statistical Appendix, the resulting specification is, *de facto*, a regression of our marginal q measure on turnover.

Model 1 represents the most parsimonious specification, yet the associated estimates provide the essential conclusions. The interpretation of these coefficients is aided if one assumes the existence of a (albeit bizarre) corporate organization where a collection of real estate assets are pooled into a trust, but equity claims on this trust are forever untradable. That is, neither the underlying properties nor the equity claims have any liquidity, so dollar trading volume equals zero. The estimated coefficient associated with Main Street or real estate market value, which represents the relationship between Wall Street and Main Street value

holding volume equal to zero, is 84% and is significantly less than unity. The magnitude of this coefficient indicates that the value of the claims to such a non-tradable trust are valued at a 16% discount to their Main Street value.⁷ This 16% figure can be interpreted as the difference in value between nontradable assets and assets traded in the real estate or Main Street market. Restated, we argue that although the Main Street market is less liquid than the Wall Street equity market, Main Street nonetheless provides some liquidity. The value of this liquidity compared to a world where real estate assets are not tradable is around 16%.

The estimated slope coefficient associated with trading volume can be used to approximate the value of the additional liquidity provided by exchange trading. If trading volume equals the Main Street value of assets (so turnover equals unity), then marginal q is around 107% (= $0.84 + 0.23$). Using the estimates from Table 4, where volume is typically around 117% of Main Street value, we can estimate the typical marginal value gain as 110% (= $0.84 + 0.23(1.17)$). These point estimates suggest that exchange trading adds an additional 7–10% of value at the margin. The link between trading volume and equity value is also economically significant: A one standard deviation change in turnover (74% from Table 3) alters equity valuation by a full 18%.

Finally, note that the estimated intercept remains significantly below zero and is of a magnitude similar to the intercepts in the simpler specifications presented in Table 3. We interpret this intercept as an estimate of the present value of the fixed costs associated with running our theoretic trust with zero trading volume. Note that any marginal costs associated with increased volume (as opposed to costs that vary with assets under management) would be captured in the slope coefficient.

Subsequent specifications in Table 5 may be viewed as robustness tests. Namely, we verify that the primary conclusions outlined in the previous paragraphs hold when we add numerous other factors known to affect equity value. As in Table 3, we find that the structural component of G&A expenses affects value, with coefficient estimates ranging from $-\$10$ to $-\$23$. We further find no evidence that asset portfolio focus, especially along the property type dimension, affects value after controlling for liquidity. Capozza and Seguin (1999)

⁷ Obviously, these point estimates are generated setting volume equal to zero, which is outside the domain of the independent variable. As such, care must be exercised when forecasting or predicting. However, we do point out that the level of zero is less than $\frac{1}{100}$ th of a standard deviation less than our minimum observation for volume, and around $\frac{1}{5}$ th of a standard deviation less than our minimum value for turnover. Thus, the value of zero is, in a statistical sense, barely outside the domain for our independent variable.

Table 5 ■ Liquidity and shareholder value.

	Dependent Variable = Wall Street Value of Equity			
	Model 1	Model 3	Model 4	Model 5
Intercept	-6,496 (-4.4)	-2,461 (-1.3)	-678 (-0.3)	-2,960 (-0.9)
Main Street value of equity [<i>t</i> -statistic for $H_0: \beta = 1$]	0.84 [-3.8]	0.96 [-0.8]	0.95 [-1.0]	0.97 [-0.5]
Annual dollar trading volume	0.23 (8.0)	0.24 (8.4)	0.23 (7.9)	0.23 (6.8)
Structural G&A		-13.62 (-3.2)	-21.21 (-4.0)	-23.03 (-3.5)
Style G&A		1.27 (0.6)	2.05 (1.0)	3.72 (1.4)
Property type focus * assets			0.05 (1.6)	0.04 (0.8)
Regional focus * assets			0.05 (1.2)	0.03 (0.7)
% held by institutions * Main Street equity				-0.10 (-0.9)
% held by insiders * Main Street assets				0.62 (4.8)
Adjusted R^2	0.81	0.81	0.82	0.82

The dependent variable is the Wall Street value of equity, or “market cap,” of the trust. Estimation is by weighted least squares, with the Main Street value of equity used as weights. Structural and Style G&A terms are the fitted and residual components respectively from a quadratic regression of G&A expenses on assets and liabilities. Main street equity and asset values are calculated using NAVs following Capozza and Lee (1995). Property-type focus is a Herfindahl coefficient generated by summing the squared proportions of a firm’s assets invested in each of four real estate types. Regional focus is calculated similarly using a Herfindahl index computed across eight geographic regions. *T*-statistics for the hypothesis that a coefficient equals zero are in parentheses, while *t*-statistics for a null that the coefficient equals one are in brackets.

interpret this as evidence that focus affects value, but only indirectly through liquidity. Finally, the percent of equity held by insiders remains highly significant. Of primary importance, however, is the coefficient associated with trading volume, which remains economically and statistically significant and remains remarkably stable across all specifications.

These results remain robust across a number of alternative specifications including those robustness tests described in Section 4 that, for reasons of brevity, we do not report here.⁸ In addition, we used the models presented in Table 4 to parse trading volume into expected and unexpected components. Regardless of the combination of the specification employed to dichotomize volume and the specification of the valuation model, the coefficients associated with the two components are both significant and, more importantly, statistically indistinguishable from one another. We interpret this as evidence that potential equity holders value liquidity, as measured by trading volume, regardless of its source.

Summary and Conclusions

In this study, we examined the relationship between the equity market value of claims to real estate assets and the liquidity of these claims. Our experimental design provides a number of unique advantages in exploring these issues. Primarily, the assets underlying these equity claims are traded in the real estate asset market. Consequently, we can calculate replacement values, and hence liquidity premia, with a precision not previously available. A second advantage stems from the regularity that the liquidity of the underlying assets is constant across trusts, yet the liquidity of the equity claims varies greatly. We can, therefore, finely estimate the relation between cross-sectional dispersions in liquidity and equity value, *ceteris paribus*.

We find that the real estate asset market is not completely illiquid and that the existence of this asset (Main Street) market increases value at the margin by

⁸ Two such robustness tests requested by our anonymous reviewers were tests of linearity and tests of consistency across years. Although we have mixed evidence of the existence of nonlinearity in the relation between equity value and net asset value, the coefficient associated with liquidity is unchanged. This result is not surprising given the results in the previous table that liquidity is (partially) uncorrelated with nonlinear terms of net asset value. We have also estimated most specifications annually. It should not be surprising that, given our limited sample size, we lack the statistical power to detect verifiable time variations in our results. To allay any potential problems due to spurious correlation (if “price” were measured with error), we reestimated our Table 5 specifications using an instrumental variable (IV) approach, using the annual *opening* prices as our instrument. The coefficient associated with trading volume falls to 0.16, which is in the range of the estimated benefits of liquidity from other specifications, and the slope remains highly significant.

about 16% over the hypothetical value in a market with zero liquidity. However, securitizing an additional dollar of these claims and offering exchange traded equity increases value by a further 10–20% at the margin.

We next explore the determinants of cross-sectional dispersion in liquidity, which we measure using annual dollar trading volume. We find that liquidity varies with institutional ownership and a number of parameters that are under the control of management including:

- the size of the asset pool under management,
- the capital structure of the trust, and
- the focus of the underlying asset portfolio.

Generally, larger, focused asset portfolios financed with little debt command the greatest liquidity. Further, greater institutional ownership increases liquidity while insider ownership has little effect.

Finally, we link cross-sectional dispersion in liquidity with variations in relative firm value. We find a strong link between liquidity and relative value: Increasing turnover by one standard deviation will increase shareholder wealth by around 18%.

Our conclusions are of interest to both academic and practitioner audiences. Our study contributes to the academic literature since we believe we offer the cleanest and most precise measures of the value of liquidity. Due to the unique experimental design inherent in REITs, especially the precision of underlying asset values, we are able to not only verify a link between liquidity and required returns, but we also are able to accurately quantify these gains.

Our results should be of interest to at least two sets of practitioners. First, our empirical estimates provide exchanges and other providers of liquidity or securitization services with an estimate of the value of such services. Specifically, we find that exchange trading increases shareholder wealth by around 10–15% at the margin compared to the relatively illiquid real estate market. However, our estimates of wealth creation jump to around 23% when comparing exchange traded claims to nontrading ones. Since the asset base of a typical corporation is mostly comprised of nontradable assets, especially intangibles, this 23% figure is probably more pertinent for evaluating the marginal gains of exchange trading.

Finally, our results are of interest to REIT management teams since they provide specific prescriptions for enhancing shareholder value. We demonstrate

that management can increase liquidity, and therefore shareholder value, by focusing the asset base, reducing the amount of debt in the capital structure and encouraging institutional ownership. Our results also indicate that liquidity gains are linear in asset size while G&A costs are not. This suggests that merging REITs into larger entities also creates wealth. We argue that the consolidation of the REIT industry throughout the 1990s is consistent with this prediction.

Obviously, we are not arguing that enhancing liquidity is the only, or even the primary, avenue through which management can enhance equity value. “Good management” along a number of alternative dimensions, including superior asset selection, negotiation talents, dividend policy, investor relations strategies, and G&A cost control, are important to valuation. However, after controlling for some of these factors, we find that liquidity remains a significant determinant of equity value.

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Statistical Appendix

The objectives of this Appendix are (i) to provide some supplemental explanation of the impact of our use of weighted-least-squares (WLS) on the specifications we employ, and (ii) to address some potential concerns around our use of “price” as determinants of both the dependent and independent variable.

Weighted Least Squares

For example, our primary engine of analysis in Table 3 is the specification

$$WSE = \alpha \iota + q' MSE + \varepsilon, \quad (A1)$$

where WSE and MSE are Wall Street and Main Street values of equity, respectively, and ι is a vector of ones. If, as our Glejser tests confirm, residual volatility varies with MSE , then more efficient estimation can occur with the use of weighted least squares (WLS). By dividing each component of each observation by its corresponding MSE value, (A1) becomes

$$\bar{q} \equiv \frac{WSE}{MSE} = \alpha \frac{\iota}{MSE} + q' \iota + \frac{\varepsilon}{MSE}. \quad (A2)$$

Thus our regressions are effectively average q -ratio regressions estimated more efficiently. When we add a Herfindahl concentration index, H , multiplied by the Main Street value of assets (MSA), the ordinary least squares (OLS) specification becomes

$$WSE = \alpha\iota + q'MSE + \lambda(H \cdot MSA) + \varepsilon, \quad (A3)$$

with a corresponding WLS specification of

$$\bar{q} \equiv \frac{WSE}{MSE} = \alpha \frac{\iota}{MSE} + q'\iota + \lambda H \frac{MSA}{MSE} + \frac{\varepsilon}{MSE} \quad (A4)$$

or,

$$\bar{q} \equiv \frac{WSE}{MSE} = \alpha \frac{\iota}{MSE} + q'\iota + \lambda H \left(1 + \frac{Debt}{MSE}\right) + \frac{\varepsilon}{MSE}. \quad (A5)$$

Implicit in (A5) is the belief that focus, as measured by H , affects asset value directly, and therefore equity value indirectly. Hence, the impact of focus on assets must be levered or geared up.

In Table 4, we examine the relationship between *Volume* and *MSE* or:

$$Volume = \alpha\iota + \beta MSE + \varepsilon \quad (A6)$$

By construction, $MSE = MSA - Debt$, so substituting into (A6) yields

$$Volume = \alpha + \beta(MSA - Debt) + \varepsilon \quad (A7)$$

or,

$$Volume = \alpha + \beta_A MSA + \beta_D Debt + \varepsilon, \quad (A8)$$

which collapses to (A6) if $\beta_A = -\beta_D$.

Finally, in Table 5, we examine specifications linking *WSE* with *MSE* and *Volume*, which has an OLS representation of

$$WSE = \alpha\iota + q'MSE + \delta Volume + \varepsilon \quad (A9)$$

with a corresponding WLS specification of

$$\bar{q} \equiv \frac{WSE}{MSE} = \alpha \frac{\iota}{MSE} + q'\iota + \delta \frac{Volume}{MSE} + \frac{\varepsilon}{MSE}. \quad (A10)$$

δ can now be interpreted as the relation between average q and Turnover.

Price and Spurious Correlation

One commentator questioned the use of specifications that regressed *WSE*, which is a multiple of price against dollar volume, which is also a multiple of price. Obviously, if price is measured without error, then spurious correlation is not a problem, since if instead of $Y = X\mathbf{B} + e$, we run $(YZ) = (XZ)\mathbf{B} + e$, then

$$\begin{aligned} E\{\mathbf{B}\} &= E\{[(XZ)'(XZ)]^{-1}(XZ)'(YZ)\} \\ &= E\{[(XZ)'(XZ)]^{-1}(XZ)'(Z(X\mathbf{B}) + e)\} \\ &= E\{[(XZ)'(XZ)]^{-1}(XZ)'(XZ)\mathbf{B}\} + E\{[(XZ)'(XZ)]^{-1}(XZ)'(Ze)\}, \end{aligned}$$

which equals \mathbf{B} if Z is orthogonal to e . Since it is common to assume that regressors are orthogonal to the true, underlying residuals, we require no more assumptions than any other investigator.

A problem may arise if “price” is measured with error. Although prices used in the *MSE* calculation are subject to large observation errors (see Capozza and Seguin 1996), the prices used here are from equity markets, where the magnitude of pricing errors are small. Nonetheless, due to features such as bid-ask “bounce,” spurious correlations may be present. However, our dependent variable is calculated as the product of shares outstanding and the end-of-year share price, p_{224} (assuming 252 equity trading days in a year), while the dollar trading volume is calculated as

$$\sum_{t=1}^{252} p_t q_t,$$

where p_t and q_t are daily prices and quantities respectively. If prices are measured with error, so that $p_t^0 = p_t + u_t$, then the magnitude of the inherent biases will be proportional to

$$\text{Cov}\left(\sum_{t=1}^{252} u_t q_t, u_{252} \cdot \text{SharesOutstanding}\right) / \text{Var}\left(\sum_{t=1}^{252} p_t q_t\right)$$

However, if u_t is serially uncorrelated, then it is easy to show that the bias will be roughly $.004\sigma_u$ since only the last pricing error would be common to both sides of the equation. If, due to bid-ask bounce, these observation errors are negatively autocorrelated (traditionally, it is assumed that bid-ask bounce generates autocorrelations equal to $-\frac{1}{4}s^2$, where s is the proportional bid-ask spread), then the $.004\sigma_u$ estimate is an upper-bound.