
The Illiquidity Premium in Tokenized Real-World Assets: Modifying Asset Pricing Models for Utility-Backed NFTs

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Abstract

Tokenization promises to convert lumpy, illiquid real-world assets into divisible, transferable claims, yet secondary markets for these instruments remain thin and trading is infrequent. Standard asset pricing models, including the capital asset pricing model and its liquidity-adjusted extensions, were not designed for assets whose holders derive consumption, access, or governance value directly from ownership. This paper develops a conceptual asset pricing framework for utility-backed non-fungible tokens (NFTs) and tokenized real-world assets by augmenting the liquidity-adjusted capital asset pricing model with a utility (convenience) yield. The framework decomposes the required pecuniary return into a risk-free rate, a systematic liquidity-risk premium, an amortized illiquidity level premium that scales with transaction costs and turnover, and a utility-yield offset that lowers the return investors require in cash. Two analytical implications follow. First, utility backing compresses observed pecuniary returns without eliminating the underlying illiquidity premium. Second, where utility flows covary positively with illiquidity, estimates that regress pecuniary returns on liquidity proxies understate the gross illiquidity premium. An illustrative calibration, with parameter ranges drawn from the empirical tokenization literature, quantifies the mechanism rather than estimating it. The framework yields testable predictions and implications for valuation and disclosure.

Keywords: illiquidity premium; tokenization; non-fungible tokens; real-world assets; liquidity-adjusted CAPM; convenience yield

1. Introduction

Blockchain-based tokenization allows ownership claims on physical and financial assets to be recorded, divided, and transferred on a distributed ledger (Yermack, 2017; Cong & He, 2019). Proponents argue that converting indivisible, costly-to-trade assets such as real estate, fine art, private credit, and infrastructure into divisible tokens lowers entry barriers, widens the investor base, and reduces the discount investors apply for being unable to sell quickly (Baum, 2021; Schär, 2021). The implicit claim is that tokenization shrinks the illiquidity premium that has long been documented for the underlying asset classes.

The empirical record to date is more cautious. Studies of the first large tokenized asset class, residential real estate issued through security token offerings, find that ownership is widely dispersed but secondary trading is sparse: tokens change hands roughly once per year, transaction costs remain material, and investors hold poorly diversified positions (Kreppmeier et al., 2023; Swinkels, 2023). Markets for non-fungible tokens (NFTs) display similar features. Trading is concentrated, intermittent, and dominated by a small set of active participants, and prices are strongly tied to the broader cryptocurrency cycle (Nadini et al., 2021; Dowling, 2022a, 2022b; Kräussl & Tugnetti, 2024). Tokenization changes the rails on which ownership is recorded and transferred, but it does not by itself create deep, continuous secondary markets.

A second feature distinguishes many tokenized assets from the securities that asset pricing theory was built to describe. A growing share of tokens are utility-backed: holding the token confers a stream of non-pecuniary or in-kind benefits beyond any claim on future cash flows. These benefits include access to a service or community, governance and voting rights, in-game or metaverse functionality, staking and royalty entitlements, and the consumption value of provenance and display (Cong et al., 2021; Kräussl & Tugnetti, 2024). For such assets the return that matters to the marginal holder is not exhausted by the pecuniary payoff, because part of the value is consumed rather than realized through sale.

These two features interact in a way that existing models do not capture. The capital asset pricing model and its multifactor descendants price the covariance of cash returns with systematic risk (Sharpe, 1964; Lintner, 1965; Fama & French, 1993). The liquidity literature extends this logic to the cost and risk of trading, treating illiquidity both as a level cost borne by holders and as a priced risk factor (Amihud & Mendelson, 1986; Amihud, 2002; Pástor &

Stambaugh, 2003; Acharya & Pedersen, 2005). None of these frameworks accommodates an asset whose holder simultaneously faces a large and uncertain cost of trading and derives consumption value from continued ownership. When both forces are present, the pecuniary return observed in the market is a biased measure of the compensation investors require for bearing illiquidity.

This paper addresses that gap. It develops a conceptual asset pricing framework for utility-backed tokenized assets by augmenting the liquidity-adjusted capital asset pricing model of Acharya and Pedersen (2005) with a utility (convenience) yield analogous to that used for commodities and money-like claims. The required pecuniary return is decomposed into four components: the risk-free rate, a systematic liquidity-risk premium, an amortized illiquidity level premium that scales with transaction costs and turnover in the manner of Amihud and Mendelson (1986), and a utility-yield offset that reduces the cash return investors demand. The contribution is theoretical and interpretive. The framework is not estimated; instead it is used to derive qualitative implications and is illustrated with a calibration whose parameter ranges are taken from the empirical tokenization literature.

Two implications follow. First, utility backing compresses the pecuniary return an asset must offer in equilibrium, so two tokens with identical illiquidity can command different cash returns purely because of their utility content. Second, when more useful tokens are also held longer and traded less, utility yield and illiquidity covary, and a regression of pecuniary returns on liquidity proxies understates the gross illiquidity premium. The remainder of the paper proceeds as follows. Section 2 reviews the relevant literature. Section 3 sets out the framework and the illustrative calibration. Section 4 presents the analytical results and the calibration. Section 5 discusses implications and limitations, and Section 6 concludes.

2. Literature Review

2.1. Illiquidity in asset pricing

The standard equilibrium model prices an asset by the covariance of its return with a systematic factor (Sharpe, 1964; Lintner, 1965), later generalized to multiple priced factors (Fama & French, 1993). This baseline abstracts from the cost of trading. Market microstructure research showed that trading is costly because of adverse selection and inventory frictions, and that informed trading moves prices in proportion to order flow (Kyle, 1985). Amihud and

Mendelson (1986) brought these costs into asset pricing: in equilibrium, gross returns are increasing and concave in the relative bid-ask spread because investors with longer horizons hold higher-cost assets, so the per-trade cost is amortized over the holding period. This clientele result implies that the return premium attributable to a fixed trading cost falls as the expected holding horizon lengthens.

Subsequent work treated illiquidity not only as a level cost but as a source of systematic risk. Amihud (2002) constructed a widely used price-impact measure and documented that expected returns rise with illiquidity, while Datar et al. (1998) showed that turnover, an inverse proxy for liquidity, is negatively related to the cross-section of returns. Pástor and Stambaugh (2003) found that sensitivity to aggregate liquidity shocks is priced, and Acharya and Pedersen (2005) unified these strands in a liquidity-adjusted capital asset pricing model in which the required return depends on the expected level of illiquidity and on three liquidity betas in addition to the standard market beta. Brunnermeier and Pedersen (2009) linked market liquidity to funding constraints, showing how liquidity can evaporate during stress. These contributions establish that both the level and the risk of illiquidity carry compensation, which provides the baseline this paper extends.

A related literature studies portfolio choice and pricing when assets cannot be traded continuously. Longstaff (2009) shows that the inability to rebalance distorts portfolio composition and asset prices, and Ang et al. (2014) demonstrate that uncertainty about the length of the non-trading interval, rather than its mere existence, is a primary determinant of the cost of illiquidity. These results are directly relevant to tokenized assets, whose secondary markets open and close unpredictably with the broader crypto cycle.

2.2. Pricing of digital assets and tokens

Cryptocurrencies and tokens have been examined as an asset class. Corbet et al. (2019) review their relationship to conventional assets, and Liu and Tsyvinski (2021) show that cryptocurrency returns are not well explained by standard equity or macro factors but exhibit their own risk structure, with Liu et al. (2022) identifying market, size, and momentum factors specific to the asset class. Makarov and Schoar (2020) document substantial trading frictions and arbitrage gaps across crypto venues, underlining that these markets are far from frictionless. Cong et al. (2021) model token valuation explicitly through transactional demand

rather than discounted cash flows, capturing the idea that a token can be valued for the use it enables on a platform; this is the closest antecedent to the utility yield used here.

Research on NFTs is more recent. Nadini et al. (2021) map the NFT market and show that trading is concentrated, that traders specialize, and that sale history predicts price. Dowling (2022a, 2022b) finds that NFT prices co-move with cryptocurrencies and exhibit low but positive predictability, and Kräussl and Tugnetti (2024) survey the pricing-determinants literature and propose a framework for NFT price formation that distinguishes intrinsic from speculative components. Borri et al. (2022) examine the risk and return characteristics of NFTs and document high volatility and exposure to crypto-market risk. This body of work establishes the empirical regularities, especially thin and intermittent trading, that motivate treating illiquidity as central to token pricing.

2.3. Tokenization of real-world assets

The application of tokens to real-world assets has grown around the promise of liquefying traditionally illiquid holdings. Baum (2021) sets out the case for real estate tokenization and the conditions under which secondary liquidity might develop, while Schär (2021) describes the decentralized finance infrastructure, including decentralized exchanges and on-chain asset management, on which tokenized claims trade. Aspris et al. (2021) show that decentralized exchanges list large numbers of illiquid tokens and that migration to a centralized venue is accompanied by a sharp increase in trading volume, evidence of market segmentation and thin on-chain liquidity.

Direct evidence on tokenized real-world assets is concentrated in real estate. Kreppmeier et al. (2023) hand-collect data on a large set of United States real estate tokens and the underlying blockchain transactions, finding that tokenization broadens access but that investors remain under-diversified and that crypto-market conditions, including transaction costs, shape secondary activity. Swinkels (2023) documents fragmented ownership and only modest secondary turnover among tokenized properties, with somewhat higher activity for tokens listed on decentralized exchanges. Steininger (2023) analyzes the return-risk profile of real estate tokens and argues they constitute a distinct asset class. Together these studies indicate that tokenization changes the mechanics of ownership transfer without, so far, delivering the deep liquidity often assumed. The framework below takes this empirical picture

as its starting point and asks how the joint presence of illiquidity and utility value should shape required returns.

3. Framework and Methodology

The approach is theoretical. The framework augments an established equilibrium model with a single additional term and derives qualitative implications, which are then illustrated through calibration. No parameters are estimated; the calibration serves to make the mechanism concrete using ranges reported in the empirical literature reviewed above. Table 1 summarizes the notation.

Table 1: *Notation used in the framework.*

Symbol	Definition
$E(r_i)$	Required (expected) gross pecuniary return on token i
r_f	Risk-free rate
c_i	Per-period relative illiquidity cost of token i (fraction of price)
c_M	Market-wide relative illiquidity cost
s_i	Effective round-trip transaction cost (spread, fees, slippage, gas)
τ_i	Expected turnover: round-trips per period (inverse of holding horizon)
ϕ_i	Utility (convenience) yield from holding token i , expressed as a return
λ	Market price of risk, $E(r_M - c_M - r_f)$
$\beta^1\text{--}\beta^4$	The four covariance (beta) terms of the liquidity-adjusted CAPM (see text)

3.1. The liquidity-adjusted baseline

The starting point is the liquidity-adjusted capital asset pricing model of Acharya and Pedersen (2005). Let c_i denote the per-period relative illiquidity cost of token i and r_i its gross return, so the net return is $r_i - c_i$. In equilibrium the required gross return satisfies

$$E(r_i) - r_f = E(c_i) + \lambda (\beta_i^1 + \beta_i^2 - \beta_i^3 - \beta_i^4), \quad (1)$$

where $\lambda = E(r_M - c_M - r_f)$ is the market price of risk and the four betas are normalized covariances with the net market portfolio: β_i^1 captures the covariance of the token return with the market return, β_i^2 the commonality of the token's illiquidity with market illiquidity, β_i^3 the sensitivity of the token return to market illiquidity, and β_i^4 the sensitivity of the token's illiquidity to the market return. The term $E(c_i)$ is the expected illiquidity level borne by the holder, and the bracketed term is the systematic liquidity-risk premium. For an asset that trades on thin on-chain venues during a crypto downturn, β_i^2 is high and β_i^3 and β_i^4 are strongly negative, so each channel raises the required return (Brunnermeier & Pedersen, 2009; Aspris et al., 2021).

3.2. An amortized illiquidity level premium

Following Amihud and Mendelson (1986), the per-period illiquidity cost can be expressed through the round-trip transaction cost and the rate at which the position is turned over. Let s_i be the effective round-trip cost of trading the token, comprising the bid-ask spread, marketplace fees, automated-market-maker slippage, and on-chain gas, and let τ_i be the expected number of round-trips per period, the inverse of the holding horizon. The expected per-period illiquidity cost is then approximated by

$$E(c_i) \approx s_i \tau_i. \quad (2)$$

This expression captures the amortization result directly: a fixed trading cost contributes more to the required return the more frequently the asset is traded, and less for long-horizon holders. Turnover is the same liquidity dimension used empirically by Datar et al. (1998), which makes $s_i \tau_i$ a tractable empirical counterpart. For tokenized real-world assets, s_i is large relative to listed securities and τ_i is low, consistent with the once-a-year turnover and material transaction costs documented by Kreppmeier et al. (2023) and Swinkels (2023).

3.3. Adding a utility yield

Utility-backed tokens deliver a flow of benefits to the holder that is consumed rather than realized through sale. Examples include access and membership rights, governance and voting power, in-platform functionality, royalty and staking entitlements, and the consumption value of verified provenance (Cong et al., 2021; Kräussl & Tugnetti, 2024). Let $\phi_i \geq 0$ denote this utility yield, expressed as a per-period return-equivalent. Because the holder receives ϕ_i directly, the pecuniary return required to hold the token in equilibrium is reduced by exactly that amount, in the same way that a convenience yield lowers the required financial return on a commodity. Augmenting equation (1) gives

$$E(r_i) = r_f + s_i \tau_i - \phi_i + \lambda (\beta_i^1 + \beta_i^2 - \beta_i^3 - \beta_i^4). \quad (3)$$

Equation (3) decomposes the required pecuniary return into the risk-free rate, the amortized illiquidity level premium $s_i \tau_i$, the utility-yield offset $-\phi_i$, and the systematic liquidity-risk premium. The gross illiquidity premium, defined as the total compensation for the level and risk of illiquidity, is $s_i \tau_i + \lambda(\beta_i^2 - \beta_i^3 - \beta_i^4)$. The utility yield does not appear in the gross illiquidity premium; it enters only as a wedge between that premium and the pecuniary return investors observe.

3.4. Calibration design

The calibration is illustrative and is not an estimate. Parameter ranges are chosen to span values suggested by the cited literature. The risk-free rate is set at 4%. The systematic liquidity-risk premium is set at 5% for a liquid listed security and 6% for a tokenized asset, reflecting the higher liquidity betas implied by on-chain market segmentation (Aspris et al., 2021; Makarov & Schoar, 2020). The effective round-trip cost s_i is set near zero for the liquid security and at 8% for tokenized assets, within the range implied by spreads, fees, slippage, and gas on thin venues; turnover τ_i is set to one round-trip per year, consistent with the holding behavior reported for real estate tokens (Kreppmeier et al., 2023; Swinkels, 2023). The utility yield ϕ_i is varied from 0% to 6% to trace its effect. Figure 1 plots equation (3) as a function of s_i for three values of ϕ_i , and Table 2 and Figure 2 report the full decomposition for three asset profiles.

4. Results

The results are analytical implications of equation (3) together with an illustrative calibration. They are stated as qualitative propositions; the numbers attached to them are demonstrations of the mechanism, not empirical magnitudes.

4.1. Utility backing compresses pecuniary returns

Equation (3) is strictly decreasing in the utility yield. Holding illiquidity and systematic risk fixed, a higher ϕ_i lowers the pecuniary return the token must offer in equilibrium, one for one. Two tokens with identical transaction costs, turnover, and liquidity betas can therefore trade at different cash returns solely because one carries more utility value. Figure 1 shows this as a downward parallel shift of the required-return schedule: at any level of transaction cost, raising the utility yield from 0% to 6% lowers the required pecuniary return by six percentage points. This is the sense in which utility backing can make a token appear to price illiquidity less aggressively than it does.

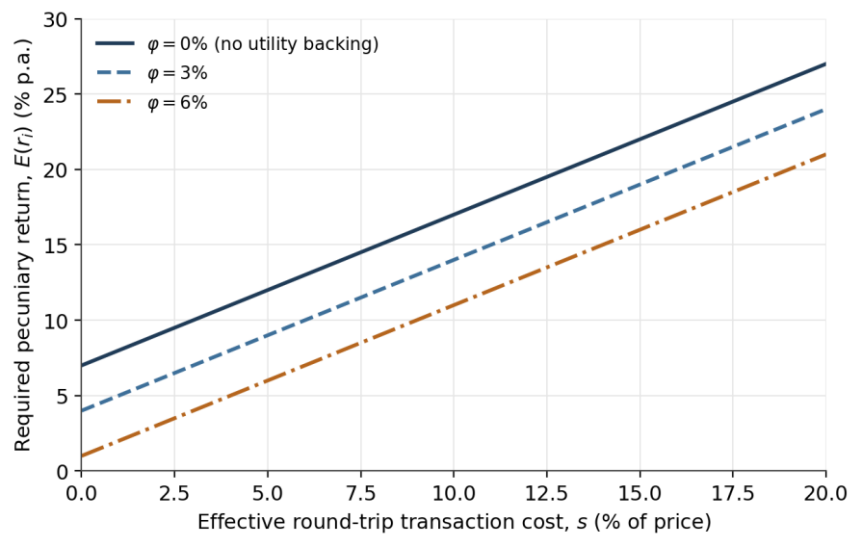


Figure 1. Required pecuniary return as a function of the effective round-trip transaction cost, for three levels of the utility yield (turnover fixed at one round-trip per year; systematic liquidity-risk premium fixed at 3%). Values are illustrative.

4.2. The wedge between gross and observed illiquidity premia

Rearranging equation (3) isolates the gross illiquidity premium:

$$s_i \tau_i + \lambda (\theta_i^2 - \theta_i^3 - \theta_i^4) = E(r_i) - r_f - \lambda \theta_i^1 + \phi_i. \quad (4)$$

The observed pecuniary illiquidity premium, the left-hand side computed from prices alone, falls short of the gross premium by ϕ_i . An empirical exercise that proxies the illiquidity premium with realized pecuniary returns therefore understates the true compensation for illiquidity whenever utility yield is positive and unobserved. The bias is not constant across assets. If more useful tokens are also held for use rather than trade, so that ϕ_i covaries positively with s_i and inversely with τ_i , then the omitted utility term is correlated with the liquidity proxies, and a cross-sectional regression of pecuniary returns on those proxies is biased toward zero or, in the limit, toward a counterintuitive negative coefficient. This provides a theoretical account of why some tokenized assets with severe trading frictions nonetheless exhibit modest pecuniary returns.

4.3. Illustrative decomposition

Table 2 and Figure 2 apply equation (3) to three stylized profiles: a liquid listed equity, an illiquid tokenized real-world asset with no utility flow, and a utility-backed NFT with the same illiquidity but a utility yield of five percentage points. The decomposition makes three points concrete. The illiquidity level premium dominates the difference between the liquid security and the tokenized assets, contributing the larger part of the gap. The two tokenized assets carry the same gross illiquidity premium of eight percentage points, yet the utility-backed NFT requires a pecuniary return five percentage points lower because part of its value is consumed rather than realized. An observer comparing only cash returns would conclude, incorrectly, that the utility-backed token is less exposed to illiquidity.

Table 2: *Illustrative decomposition of the required pecuniary return for three asset profiles.*

Values are illustrative and are not empirical estimates.

Component	Liquid equity	Illiquid RWA token	Utility-backed NFT	Symbol
Risk-free rate	4.0%	4.0%	4.0%	r_f
Systematic risk premium	5.0%	6.0%	6.0%	$\lambda(\cdot)$
Illiquidity level premium	0.3%	8.0%	8.0%	$s_i\tau_i$

Component	Liquid equity	Illiquid RWA token	Utility-backed NFT	Symbol
Utility-yield offset	0.0%	0.0%	-5.0%	$-\phi_i$
Net required pecuniary return	9.3%	18.0%	13.0%	$E(r_i)$
Gross illiquidity premium	0.3%	8.0%	8.0%	$s_i \tau_i$

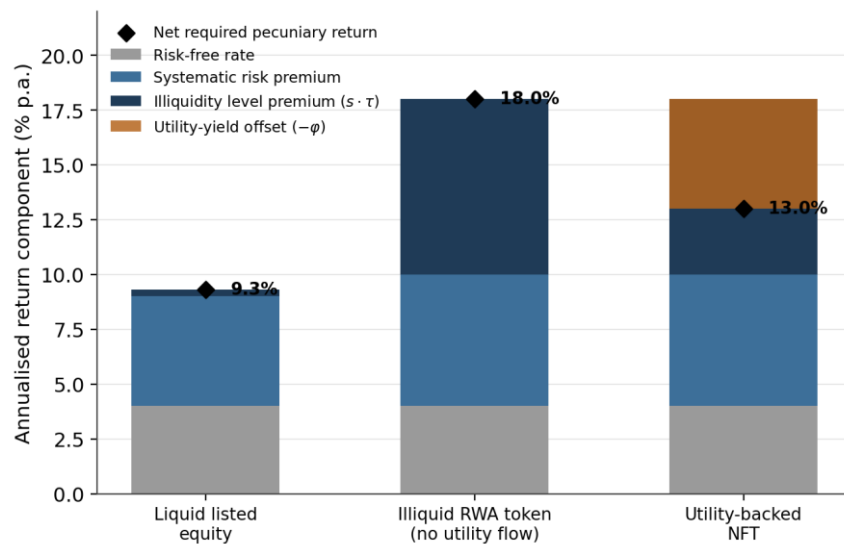


Figure 2. Decomposition of the required pecuniary return for three asset profiles. Components stack upward; the utility yield enters as a downward offset, and the diamond marks the net required pecuniary return. Values are illustrative.

5. Discussion

The framework reframes a claim that recurs in the tokenization literature. The argument that tokenization reduces the illiquidity premium (Baum, 2021) conflates two distinct effects. Tokenization can lower the round-trip cost s_i by automating settlement and removing intermediaries, and it can in principle raise turnover τ_i by enabling fractional secondary trading. Both would reduce the amortized illiquidity level premium. The evidence so far suggests that these gains are limited: on-chain venues remain thin and segmented, costs include slippage and gas, and turnover is low (Aspris et al., 2021; Kreppmeier et al., 2023; Swinkels, 2023). At the same time, the utility yield ϕ_i lowers the observed pecuniary return

through a different channel that has nothing to do with liquidity. Conflating the two leads to an overstatement of how far tokenization has liquefied the underlying asset.

The analysis also speaks to measurement. Because the utility yield is unobserved and plausibly correlated with illiquidity, naive estimates of the illiquidity premium from token prices are biased. Identifying the gross premium requires either an independent measure of utility value or a research design that holds utility content fixed while varying liquidity, for example by comparing the same token across venues with different depth, or by exploiting events that change tradability without changing the underlying benefit. The intermittent, regime-dependent nature of on-chain liquidity, in which markets are deep in normal times and shallow under stress, mirrors the uncertain non-trading intervals analyzed by Ang et al. (2014) and the funding-liquidity spirals of Brunnermeier and Pedersen (2009), and suggests that the liquidity betas in equation (1) are themselves state-dependent.

For valuation and disclosure, the decomposition implies that the price of a utility-backed token embeds a consumption component that conventional discounted-cash-flow analysis omits. Treating such a token purely as a financial claim understates its value to a holder who uses it and overstates the comparability of its cash return to that of a passive security. The framework connects to models in which token value derives from use rather than from cash flows (Cong et al., 2021) and to the observation that NFT and crypto prices contain both fundamental and speculative components (Dowling, 2022a, 2022b; Liu & Tsyvinski, 2021; Liu et al., 2022; Kräussl & Tugnetti, 2024).

Several limitations bound these conclusions. The framework is conceptual. It adds a single reduced-form term to an existing equilibrium model and does not derive the utility yield from primitives such as preferences over access or network participation; a fuller treatment would endogenize ϕ_i , as in platform-adoption models of token value (Cong et al., 2021; Cong & He, 2019). The calibration is illustrative: the parameter values demonstrate the mechanism and are anchored to ranges in the literature, but they are not estimated, and the figures should not be read as predictions of return levels for any asset. The treatment of illiquidity through the product $s_i \tau_i$ is a linear approximation to the concave relationship derived by Amihud and Mendelson (1986) and is most accurate for moderate costs. Finally, on-chain markets raise frictions, such as wash trading, custody and smart-contract risk, and regulatory uncertainty, that the framework does not model and that may interact with both the illiquidity and utility

terms (Nadini et al., 2021; Schär, 2021; Yermack, 2017; Corbet et al., 2019). The empirical evidence remains concentrated in real estate tokens and a small number of NFT markets (Kreppmeier et al., 2023; Steininger, 2023; Borri et al., 2022), so the external validity of the calibration is correspondingly narrow.

These limitations also define a research agenda. The central prediction, that pecuniary returns understate the gross illiquidity premium by the magnitude of the utility yield, is testable wherever utility content can be measured or held fixed. Cross-venue comparisons, listing and delisting events, and tokens that strip or bundle utility rights all offer potential identification. Estimating the state dependence of the liquidity betas across crypto-market regimes would sharpen the systematic-risk component.

6. Conclusion

Tokenization has been promoted as a technology for liquefying illiquid assets, but its first markets are thin and many of its instruments are valued for use as well as for cash flows. This paper has argued that pricing such assets requires a model that holds both features at once. Augmenting the liquidity-adjusted capital asset pricing model with a utility yield produces a decomposition of the required pecuniary return into a risk-free rate, an amortized illiquidity level premium that scales with transaction costs and turnover, a systematic liquidity-risk premium, and a utility-yield offset. The framework clarifies that utility backing compresses observed cash returns without reducing the underlying illiquidity premium, and that estimates based on pecuniary returns are biased downward for the gross premium when utility and illiquidity covary. These are conceptual results illustrated by calibration rather than estimated magnitudes, but they yield concrete, testable predictions and caution against reading low cash returns on utility-backed tokens as evidence that tokenization has eliminated the illiquidity premium. As secondary markets and data mature, the framework offers a structure within which the distinct contributions of liquidity and utility to token prices can be separately identified.

References

- Acharya, V. V., & Pedersen, L. H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics*, 77(2), 375–410. <https://doi.org/10.1016/j.jfineco.2004.06.007>
- Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets*, 5(1), 31–56. [https://doi.org/10.1016/S1386-4181\(01\)00024-6](https://doi.org/10.1016/S1386-4181(01)00024-6)
- Amihud, Y., & Mendelson, H. (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics*, 17(2), 223–249. [https://doi.org/10.1016/0304-405X\(86\)90065-6](https://doi.org/10.1016/0304-405X(86)90065-6)
- Ang, A., Papanikolaou, D., & Westerfield, M. M. (2014). Portfolio choice with illiquid assets. *Management Science*, 60(11), 2737–2761. <https://doi.org/10.1287/mnsc.2014.1986>
- Aspris, A., Foley, S., Svec, J., & Wang, L. (2021). Decentralized exchanges: The “wild west” of cryptocurrency trading. *International Review of Financial Analysis*, 77, 101845. <https://doi.org/10.1016/j.irfa.2021.101845>
- Baum, A. (2021). Tokenization—The future of real estate investment? *The Journal of Portfolio Management*, 47(10), 41–61. <https://doi.org/10.3905/jpm.2021.1.260>
- Borri, N., Liu, Y., & Tsyvinski, A. (2022). *The economics of non-fungible tokens* (SSRN Working Paper No. 4052045). Social Science Research Network. <https://doi.org/10.2139/ssrn.4052045>
- Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *The Review of Financial Studies*, 22(6), 2201–2238. <https://doi.org/10.1093/rfs/hhn098>
- Cong, L. W., & He, Z. (2019). Blockchain disruption and smart contracts. *The Review of Financial Studies*, 32(5), 1754–1797. <https://doi.org/10.1093/rfs/hhz007>
- Cong, L. W., Li, Y., & Wang, N. (2021). Tokenomics: Dynamic adoption and valuation. *The Review of Financial Studies*, 34(3), 1105–1155. <https://doi.org/10.1093/rfs/hhaa089>
- Corbet, S., Lucey, B., Urquhart, A., & Yarovaya, L. (2019). Cryptocurrencies as a financial asset: A systematic analysis. *International Review of Financial Analysis*, 62, 182–199. <https://doi.org/10.1016/j.irfa.2018.09.003>
- Datar, V. T., Naik, N. Y., & Radcliffe, R. (1998). Liquidity and stock returns: An alternative test. *Journal of Financial Markets*, 1(2), 203–219. [https://doi.org/10.1016/S1386-4181\(97\)00004-9](https://doi.org/10.1016/S1386-4181(97)00004-9)

- Dowling, M. (2022a). Fertile LAND: Pricing non-fungible tokens. *Finance Research Letters*, 44, 102096. <https://doi.org/10.1016/j.frl.2021.102096>
- Dowling, M. (2022b). Is non-fungible token pricing driven by cryptocurrencies? *Finance Research Letters*, 44, 102097. <https://doi.org/10.1016/j.frl.2021.102097>
- Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1), 3–56. [https://doi.org/10.1016/0304-405X\(93\)90023-5](https://doi.org/10.1016/0304-405X(93)90023-5)
- Kräussl, R., & Tugnetti, A. (2024). Non-fungible tokens (NFTs): A review of pricing determinants, applications and opportunities. *Journal of Economic Surveys*, 38(2), 555–574. <https://doi.org/10.1111/joes.12597>
- Kreppmeier, J., Laschinger, R., Steininger, B. I., & Dorfleitner, G. (2023). Real estate security token offerings and the secondary market: Driven by crypto hype or fundamentals? *Journal of Banking & Finance*, 154, 106940. <https://doi.org/10.1016/j.jbankfin.2023.106940>
- Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica*, 53(6), 1315–1335. <https://doi.org/10.2307/1913210>
- Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Statistics*, 47(1), 13–37. <https://doi.org/10.2307/1924119>
- Liu, Y., & Tsyvinski, A. (2021). Risks and returns of cryptocurrency. *The Review of Financial Studies*, 34(6), 2689–2727. <https://doi.org/10.1093/rfs/hhaa113>
- Liu, Y., Tsyvinski, A., & Wu, X. (2022). Common risk factors in cryptocurrency. *The Journal of Finance*, 77(2), 1133–1177. <https://doi.org/10.1111/jofi.13119>
- Longstaff, F. A. (2009). Portfolio claustrophobia: Asset pricing in markets with illiquid assets. *American Economic Review*, 99(4), 1119–1144. <https://doi.org/10.1257/aer.99.4.1119>
- Makarov, I., & Schoar, A. (2020). Trading and arbitrage in cryptocurrency markets. *Journal of Financial Economics*, 135(2), 293–319. <https://doi.org/10.1016/j.jfineco.2019.07.001>

- Nadini, M., Alessandretti, L., Di Giacinto, F., Martino, M., Aiello, L. M., & Baronchelli, A. (2021). Mapping the NFT revolution: Market trends, trade networks, and visual features. *Scientific Reports*, 11, 20902. <https://doi.org/10.1038/s41598-021-00053-8>
- Pástor, L., & Stambaugh, R. F. (2003). Liquidity risk and expected stock returns. *Journal of Political Economy*, 111(3), 642–685. <https://doi.org/10.1086/374184>
- Schär, F. (2021). Decentralized finance: On blockchain- and smart contract-based financial markets. *Federal Reserve Bank of St. Louis Review*, 103(2), 153–174. <https://doi.org/10.20955/r.103.153-74>
- Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance*, 19(3), 425–442. <https://doi.org/10.1111/j.1540-6261.1964.tb02865.x>
- Steininger, B. I. (2023). Return–risk analysis of real estate tokens: An asset class of its own. *The Journal of Portfolio Management*, 49(10), 83–102. <https://doi.org/10.3905/jpm.2023.1.540>
- Swinkels, L. (2023). Empirical evidence on the ownership and liquidity of real estate tokens. *Financial Innovation*, 9, 45. <https://doi.org/10.1186/s40854-022-00427-5>
- Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, 21(1), 7–31. <https://doi.org/10.1093/rof/rfw074>