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Real estate security token offerings and the secondary market: Driven by crypto hype or fundamentals?

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ABSTRACT

Tokens, the digital form of assets, are an innovation that has the potential to disrupt how to transfer and own financial instruments. We hand-collected data on 173 real estate tokens in the USA between 2019 and 2021 and trace back 238,433 blockchain transactions. We find that tokens provide broad real estate ownership to many small investors through digital fractional ownership and low entry barriers, while investors do not yet hold well-diversified real estate token portfolios. We analyze the determinants of the success of security token offerings (STOs), secondary market trading, and daily aggregated capital flows. In addition to some property-specific determinants, we find that crypto-market-specific determinants, such as transaction costs and the related sentiment, are relevant both to the STO and capital flows.

1. Introduction

Innovation and technology have influenced and enhanced financial services and products for a long time. One of the most important technical innovations in this context is the *Distributed Ledger Technology* (DLT), a decentralized transparent and tamper-proof verification system.[1] Thus, the blockchain transfers the traditionally centralized ledger system using a single book to the digital world. This technology enables the creation and exchange of digital assets in the form of tokens. Tokenization refers to digitally adding and representing assets in the blockchain (Benedetti and Rodriguez-Garnica, 2023; Schär, 2021). Tokens can be endowed with value, rights, and obligations, similar to traditional forms of ownership, such as stocks or funds. *Smart contracts*, which self-execute once pre-specified conditions are met (Buterin, 2013), enable the issuance and the transfer of tokens time- and cost-efficient. Consequently, financial intermediaries such as banks, exchanges, clearing houses, and notaries are rendered obsolete.

Utility and security tokens can be used to tokenize various rights and assets. Utility tokens grant consumption rights linked to platform services and are issued through an initial coin offering (ICO). Security tokens represent shares of ownership in corporate equity, commodities, currencies, or real estate, and they are issued through a security token offering (STO). After ICOs suffered from a lack of investor protection and frequent fraudulent activities (Momtaz et al., 2019), security tokens emerged as innovative and more trustworthy investment products (Lambert et al., 2022). Security tokens are classified as conventional securities and thus subject to the corresponding regulatory requirements. They can be traded on secondary markets after the offering, enabling divestment and liquidity. The concept of fractional ownership by digital tokens facilitates the fragmentation of assets into multiple tokens, attracting new investors globally to gain access to previously lumpy and illiquid asset classes with high entry barriers. Tokenization is particularly suitable for assets such as land and properties due to their high costs, indivisibility, involvement of multiple intermediaries, and high regulatory requirements (Baum, 2021). Tokens entail lower transaction times since clearing and settlement

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[1] In this article, we employ the terms DLT and blockchain synonymously, even though the blockchain represents only one subtype of DLT. For a detailed discussion, see Liu et al. (2020b).

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occur instantly, and costs for third parties (e.g., a broker or notary) is much lower (Ante and Fiedler, 2020; Lambert et al., 2022; Yermack, 2017). This development opens up new diversification opportunities for investors while significantly reducing costs and illiquidity premia, paving the way toward entirely digitized financial markets.

The financial industry has already developed various solutions for (in-)direct investments in real estate due to the attractive characteristics of real estate in terms of constant cash flows or low correlation to stocks and bonds. Specifically, open and closed-end funds or REITs enable retail investors to gain access to this asset class. The increasing adoption of blockchain has led to the emergence of real estate tokens as a new investment vehicle and digital surrogate for direct property ownership (Baum, 2021). A real estate token, like closed-end funds, mostly comprises one property and not a portfolio of properties, such as open-end funds and REITs. In the case of REITs or funds, investors do not own the properties and, unlike tokens, cannot influence the decision to invest in a particular property. A token gives the investor fractional ownership of the property, making it the technically closest form to fractional direct investment to date. In contrast to closed-end funds, token investors can avoid high minimum investment amounts and administrative costs.

The literature on real estate tokens is to date mainly of a theoretical nature regarding the general procedure (Gupta et al., 2020; Liu et al., 2020a; Markheim and Berentsen, 2021), financial application (Baum, 2021; Markheim and Berentsen, 2021), legal (Konashevych, 2020), and technical aspects (Gupta et al., 2020). Markheim and Berentsen (2021) present descriptive data based on a small sample of real estate tokens, where they point, despite the many theoretical advantages of tokens, towards challenges, such as regulatory uncertainties and relatively long transaction times. Swinkels (2023) examines the liquidity and ownership of real estate tokens using the same data source as our study, albeit with an earlier end date, and considers 58 tokens. His findings suggest that a tokenized property has, in the mean, 254 owners, with ownership changes occurring annually on average. In addition, he concludes that investors are interested in the exposure to the residential house price index, as token prices are linked to housing prices. Our study starts one step earlier and differentiates between the determinants of STOs on the transaction level and daily capital flows on the macro level.

We hand-collected data on 173 real estate tokens with their property and financial characteristics in the USA between 2019 and 2021. Moreover, we examine the related 238,433 blockchain transactions to analyze investor behavior. We have enriched this database with crypto market-specific characteristics and macroeconomic indicators. In this regard, our main findings are threefold.

First, we are among the first to trace back the underlying blockchain transactions in an empirical analysis to derive insights into investor behavior. Our analysis shows that investors hold an average of ten different tokens and an investment amount of 4030 USD, which does not represent a well-diversified real estate token portfolio. Tokenization provides broad access to real estate ownership for many small investors as property ownership is not concentrated on a few large investors. Most investors acquire tokens during STOs, while secondary market trading plays a minor role. Second, we investigate the determinants of STO success, defined as the number of days until all tokens are sold and the mean funding amount per day. For the latter and primary success variable of interest in this study, we find that some property-specific fundamentals and the crypto market-related transaction costs explain most of the success of the STO. Third, we switch from the individual STO to the macro-level view of aggregated daily capital flows per property to account for the specific crypto market over time. We observe that real estate token investors similarly consider the crypto market sentiment and transaction costs when purchasing tokens. In contrast, only transaction costs directly reducing the return on investment are relevant when selling. Additionally, macroeconomic factors have a minor role in capital flows.

Our study contributes to several streams of literature. First, we add to the literature on blockchain technology and the economics of digital assets. The first wave of academic literature in this substream focused on ICOs as an innovative form of crowdfunding, bearing the advantage that the blockchain tokens enable secondary market trading (Lee et al., 2022). Empirical studies on ICOs examine success determinants (Fisch, 2019; Howell et al., 2020), investor characteristics and motives (Fisch et al., 2021; Fahlenbrach and Frattaroli, 2021), white papers (Florysiak and Schandlbauer, 2022; Thewissen et al., 2022), and post-ICO performance (Benedetti and Kostovetsky, 2021; Fisch and Momtaz, 2020; Lyandres et al., 2022). Momtaz (2023) emphasizes that the reasons security tokens are driving digitization in finance are interoperability, fractional ownership, instantaneous settlement, and market liquidity. Gan et al. (2021) find that STOs, in contrast to ICOs, entail lower agency costs, lower token turnover, lower cash diversion, and raise higher amounts of funds and firm profits. The existing empirical literature on STOs primarily examines success determinants during the funding process, focusing on the issuer and offering characteristics (Lambert et al., 2022; Ante and Fiedler, 2020).

Second, we contribute to the literature on real estate investments. The real estate sector is a major sector for study in its own right in the literature on crowdfunding (Jiang et al., 2020; Schweizer and Zhou, 2017; Shahrokhi and Parhizgari, 2020). Fisch et al. (2022) compare ICOs and, among others, REITs to analyze whether gender, ethnicity, and geography influence the decision for an ICO. While the authors point out that real estate is a highly relevant use case for blockchain-based financing, they do not directly examine real estate STOs. In a sample of 1125 ICOs for external firm financing, Howell et al. (2020) find a positive relationship between ICO success, measured by employment, and the operating sector of tokenizing real assets. They attribute this result to the underlying concept of security tokens but do not deepen the analysis further on this aspect. STOs of real estate projects need to be studied separately to simultaneously consider the underlying asset class and the specific crypto market environment.

Third, we complement the literature on portfolio construction and diversification. Diversification is a fundamental concept in portfolio theory (Markowitz, 1952). Goetzmann and Kumar (2008) document that 60,000 individual US investors hold under-diversified equity portfolios, leading to high idiosyncratic risk and, consequently, a welfare loss. The small investment amount resulting from fractional ownership of digital tokens theoretically makes diversification easier. Therefore, we aim to verify whether real estate tokens live up to their promise of portfolio diversification.

The remainder of this paper is organized as follows. In Section 2, we present the real estate tokenization process and derive our hypotheses. We describe our data and method in Section 3. The main analyses and discussion of our empirical results are presented in Section 4, followed by further analyses and robustness checks in Section 5. In Section 6, we conclude our study.

2. Conceptual framework and derivation of hypotheses

2.1. Real estate tokenization

Our dataset comprises real estate tokens issued by the platform RealToken (RealT), an active issuer and platform for real estate tokens in the USA. Based on the *Howey test*, digital assets are investment contracts and, therefore, considered securities. Consequently,

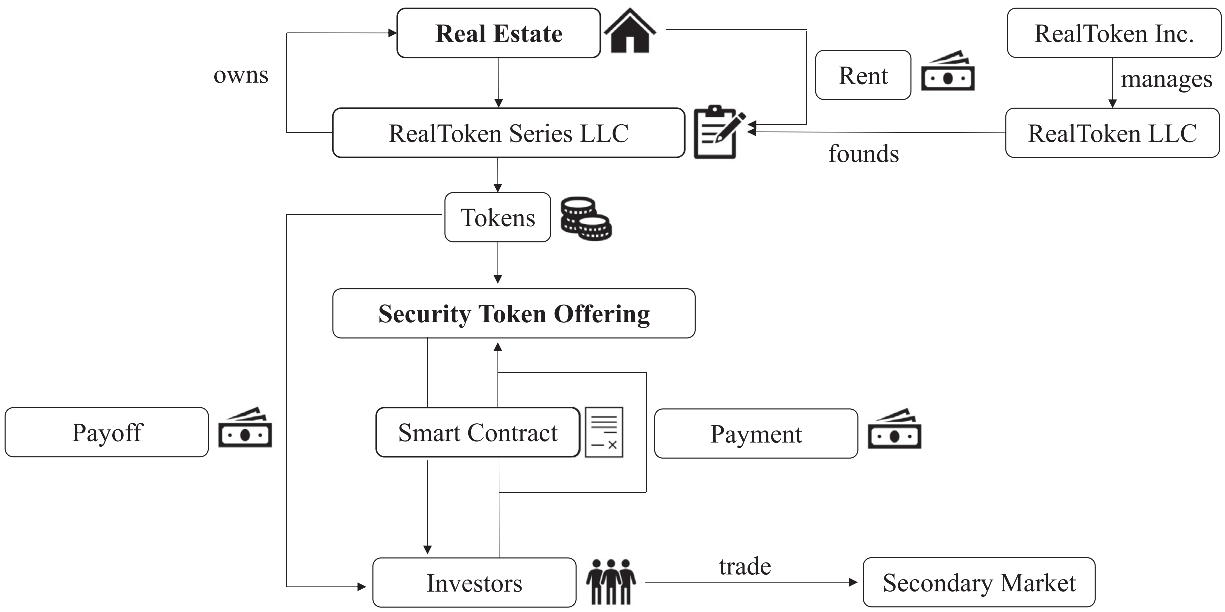


Fig. 1. Process Map.
This figure illustrates the process of real estate tokenization and STOs in the case of the platform RealT.

real estate tokens must be registered with the Securities and Exchange Commission and are subject to laws and regulations protecting investors. RealT offers the tokens in unregistered securities offerings, or private placements, under Regulation D 506(c) (US-accredited investors) and Regulation S (non-US investors) of the Securities Act. We illustrate the process of real estate tokenization and STOs in the case of RealT in Fig. 1 and describe the process below.[2]

RealToken LLC creates a RealToken Series LLC for each property since properties cannot be directly digitalized. This LLC acts as a special purpose vehicle (SPV) and holds the property deed.[3] These SPVs stand solely and legally on their own and are, in the next step, tokenized using the technical standard of the Ethereum ERC-20 token. The properties are primarily rented residential buildings. Property management is outsourced to local professionals. Investors can purchase the tokens during the STO. After successful payment and signing the offering memorandum digitally, they automatically receive the tokens in their wallets employing a smart contract. On the Ethereum blockchain, computing power is required to perform operations successfully, and users have to additionally pay a so-called *gas fee*. The tokens give the investor a deed in the respective tokenized RealToken Series LLC. After operating costs, insurance, and real estate taxes, the net rent is submitted weekly to the RealToken rent contract linked to the property and automatically issued to the token holders' wallets. The value of a token is specified by the assessed property value after a maintenance and repair reserve divided by the total number of tokens issued. RealT charges a fee of 10%, for which investors, in exchange, receive governance tokens from RealT itself. Afterward, the security tokens can be either returned to RealT or traded on decentralized exchanges (DEX) as a means of decentralized finance.[4] The properties are re-valued annually, resulting in the depreciation or appreciation of the tokens. After the rapid increase in transaction costs in combination with longer execution times on the Ethereum blockchain at the beginning of 2021, RealT decided to alternatively enable transactions on the Gnosis blockchain.[5] In particular, for the relatively low weekly rent payments, using Gnosis and avoiding high transaction costs on the Ethereum blockchain is favorable. After elucidating the mechanics of real estate tokenization, the following hypotheses are derived from the academic literature.

2.2. Derivation of hypotheses

We first tackle the impact of different property-specific factors on the perceived quality, risk, and expected cash flow, which can be related to the success of an offering. From a theoretical perspective, property type and location are the major property-specific characteristics that influence value. These factors are empirically confirmed by various studies (see, e.g., Cronqvist et al., 2001; Pai and Geltner, 2007; Ro and Ziobrowski, 2012; Hartzell et al., 2014). Real estate is naturally immobile, which means that the location determines its value to a large extent. Therefore, a purchaser acquires both the building and the site at the same time (Kiel and Zabel, 2008). The options for determining the location's quality are manifold: political or historical zones, indirect factors, such as the school quality of the district, or the distance to important places, such as the central business district. These indicator variables mostly imply indirect influences on house values since investors consider specific locations or location characteristics more or less favorable. In particular, the low minimum investment amount for tokens enables investors to diversify their portfolios more broadly, especially regarding location. This makes the location an important factor for the attractiveness of the STO for an investor and could, consequently, influence the success of a real estate STO.

The size of the property measured by its value determines the rent and return, similar to the way the size factor determines the return on the stock market (Fama and French, 1993).

[2] For a description of the ICO or STO process, see Momtaz (2020) and Lambert et al. (2022).

[3] A form to digitize ownership is non-fungible tokens (NFTs) or with the help of Decentralized Autonomous Organizations (DAOs). However, these are only theoretical concepts not often applied to the real estate market and, consequently, lie beyond the scope of this paper.

[4] For a detailed discussion, see Aspris et al. (2021).

[5] Gnosis (formerly xDai) blockchain is a second-layer protocol to create, trade, and hold digital assets on Ethereum.

Geltner et al. (2014) report that size is a suitable factor for explaining the return variation of real estate on a large scale. Pai and Geltner (2007) use the market value as a size factor and find the opposite impact compared to the stock market – larger properties have a higher expected return premium. Esrig et al. (2011) state that large properties outperform other properties on an absolute and risk-adjusted basis for different property types. Sirmans et al. (2005) conduct a review of around 125 studies using hedonic modeling to estimate house prices and report that lot size had a positive effect in the vast majority of observations. Therefore, we expect that the size has a positive relationship with the success of the STO.

If the quality of the property is not specified, its age can be used as a proxy for it. A lower quality induces higher uncertainty for maintenance and repair costs and, thus, higher risk for the buyer (Bourassa et al., 2009). Since investors try to avoid this kind of risk, older properties may be less attractive to investors. This argumentation is supported by Sirmans et al. (2005), who find in their review that the influence of age on house prices was almost entirely negative.

The major risk regarding the expected cash flow is a rent default. This risk can be reduced by splitting the rent between several different tenants. Therefore, single-tenant buildings limit the diversification possibilities of potential investors in contrast to multi-tenant properties. The limited diversification options make single-tenant properties, in contrast to multi-tenant properties, less attractive, which may result in a less successful funding process. Opposed to that Ling and Archer (2021) find that single-family properties have a lower risk than multi-family homes because single-family homes are typically located in desirable suburban areas with steady demand. Based on the importance of both effects – lower default risk for multi-tenant buildings vs. location – an exact expectation cannot be formulated, and the issue has to be settled empirically.

In the USA, low-income households can receive rental housing assistance via Section 8 of the United States Housing Act of 1937 (42 U.S.C. §1437 et seq.). This program helps them in finding a decent and affordable place to live. The state pays the rent directly to the landlord, which significantly reduces the risk of payment issues or default. The Section 8 program guarantees token purchasers a stable and predictable rent payment. Consequently, investing in such properties bears a lower risk of rent default. Investors may find properties with a greater percentage of rental assistance from the Section 8 program to be more attractive. As such, our Hypothesis 1 reads:

Hypothesis 1: *The quality of a location, the size of a property, and a higher portion of rental assistance through Section 8 are positively related to the success of an STO, while age is negatively related.*

In addition to the property and financial characteristics, we also consider campaign features commonly known from the literature on crowdfunding (CF) (Belleflamme et al., 2014). In the context of CF, it is decisive for the funding success of a campaign to be able to signal the quality of a project to potential investors (Ahlers et al., 2015). Conventional CF campaigns often have a short or missing track record or lack a market-ready product. Therefore, investors need to base their decision on other information, such as the description in text and pictures on the platforms. This information allows companies to reduce information asymmetries and signal project quality (Diamond, 1984). Apart from the text, pictures assist in visualization and enable an evaluation of the property's location and actual condition. Previous CF studies identified a detailed project description to overcome information asymmetries and increase campaign success (De Crescenzo et al., 2020; Gao et al., 2023). This effect has also been investigated in the literature on real estate for its impact on home prices and home-buyer attention in a similar vein (Luchtenberg et al., 2019; Nowak and Smith, 2016; Seiler et al., 2012). The more detailed and larger the number of pictures, the more realistic and accurate the presentation of the potential investment is for an investor. High-quality projects are incentivized to deploy detailed project descriptions, whereas low-quality projects tend to be vaguer in their disclosures. Therefore, we assume that a detailed project description is a positive quality signal for an investor, which prompts an investment and can increase the success of an offering.

Hypothesis 2: *A detailed project description is positively related to the success of an STO.*

The investment decision process, akin to other markets, is potentially driven by the market-specific environment and investor or market sentiment. Investors follow investment recommendations and central strategies, and retail investors mostly exhibit herding behavior, often caused by market sentiment. Herding behavior has been studied in the traditional stock market (Chang et al., 2000; Chiang and Zheng, 2010; Litimi et al., 2016) and in the cryptocurrency market (Ajaz and Kumar, 2018; Bouri et al., 2019). Investors, particularly non-rational investors like many crypto investors, are potentially subject to herding behavior. Investor sentiment can be particularly pronounced in the market for tokens (Drobetz et al., 2019), as this seems to be in such highly subjective asset classes (Baker and Wurgler, 2006). From an investor perspective, we assume, similarly to Ante and Fiedler (2020), that in the market for STOs, a house money effect exists, meaning that investors take higher risks after prior gains (Thaler and Johnson, 1990), especially during periods of positive market sentiment. Since issuers anticipate this irrational investor behavior, they will await the right time on the market to place the offers. For example, Drobetz et al. (2019) show that companies seeking funding via ICOs avoid phases of general negative market sentiment for their exchange listing, which results in short-term negative returns of the tokens. Token platform operators can time the publication of a project to periods of positive market sentiment. Thus we expect a positive link between market sentiment and the success and daily capital inflows as token purchases and a negative link with daily capital outflows as token sales.

With regard to the specific market environment for blockchain-based tokens, a cost effect that runs counter to the market sentiment must also be taken into account. Apart from the administrative fees directly imposed by the token issuer, specific transaction costs called *gas fees* are additional costs associated with a token investment that need to be considered and paid by the investor. Since gas is needed to perform operations and space is limited on a block, the resulting transaction costs may vary due to fluctuations in supply and demand on the network.[6] Gas fees rise when demand increases, and vice versa; hence, they signify crypto popularity. Additionally, users can pay an extra fee to increase the likelihood of their transaction being included in the next block when demand is high. Gas fees can be observed and predicted easily for investors on corresponding websites opening up the possibility to time the investment and avoid high transaction costs. Momtaz et al. (2022) provide the first empirical evidence of tokens on the Ethereum blockchain, including stablecoins, startup tokens, and lottery tokens. The authors find that investors reduce their trading activity when transaction costs are high. In conclusion, we expect that crypto market transaction costs are negatively related to the success of an STO and capital inflows and outflows

[6] By definition, 'gas fee' and 'transaction fee' are not synonyms, as the actual total cost per transaction is the multiplication of gas used and a base gas fee. For more detailed information on the mechanism and calculation of gas fees, see Ethereum.org (2022).

because investors seek to circumvent high transaction costs. The decision of an investor to make a real estate token investment can therefore be based on two opposing effects as indicators of crypto popularity, which is why an empirical investigation is required.

Hypothesis 3a: *Crypto market sentiment is positively related to capital inflows, while it is negatively related to capital outflows.*

Hypothesis 3b: *Crypto-market related transaction costs are negatively related to the success of an STO as well as capital inflows and outflows.*

3. Data and method

3.1. Data sources

We collect the US real estate token data directly from the RealToken platform, resulting in 173 financed projects as of December 31, 2021. The data comprises information at the property level and its financial characteristics. The blockchain transaction data comes from two blockchain explorer and analytic platforms, namely *Blockscout* and *Etherscan*, which was also used by Lyandres et al. (2022). We rely on these two sources for the transaction data as RealT has enabled transactions on the Gnosis blockchain since the beginning of 2021.

3.2. Method: Blockchain transaction analysis

The blockchain is a digital ledger in which one entry corresponds to one transaction. We derive all blockchain transactions related to the real estate tokens in our sample until the end of our observation period in December 2021. The structure of a blockchain transaction comprises the respective token, a unique transaction hash (transaction ID), a time stamp, the number of tokens, and the sending (from) and receiving addresses (to). We trace back investors through their unique and pseudonymous *wallet* address, which is comparable to the account number in the traditional banking sector. Even if an investor can have several wallets and, thus, more than one unique wallet address, we assume that most investors have only one wallet.[7] The switch of the blockchain from Ethereum to Gnosis is no issue regarding the unique wallet address, as Gnosis is built upon Ethereum and, therefore, the wallet addresses remain the same. Due to the focus of our study, we do not consider other investments by investors in their wallets besides real estate tokens. We can clearly distinguish transactions from the STO from secondary market transactions by identifying the emitting wallet address of the platform operator from which tokens are transferred to investors for each property. Consequently, the remaining transactions from non-emitting wallets are secondary market buy-or-sell transactions.

Based on the transaction data, we derive several variables that shed light on both investors and their investment strategies concerning tokenized properties. To this end, we analyze two distinct perspectives: the wallet-investor and the token-property perspective. In the wallet-investor perspective, the variable *Properties per Investor* accounts for the number of properties an investor has invested in. This variable addresses the extent to which investors diversify their real estate token portfolio. Further, we convert the number of tokens observed in the transactions into a more easily interpretable and meaningful dollar amount, using the price of the tokens from the STO and calculate the *Holdings per Investor as of Dec 2021* in dollars. To measure the time dimension of the investments and thus the willingness to speculate on the side of the investors, we analyze the *Holding Period all Investors as of Dec 2021* in days. From the token-property perspective, we consider the concentration of ownership with the Herfindahl-Hirschman index (Herfindahl, 1950; Hirschman, 1964). We calculate the Herfindahl-Hirschman index as

$$HHI = \sum_{i=1}^{N} s_i^2 \tag{1}$$

in which s is the percentage of ownership of an investor i, and N constitutes the total number of investors on the property level. The index ranges between $1/N$ and 1. The latter implies that complete ownership is concentrated on a single investor. To account for variations in the HHI caused by a different number of investors in the properties and to facilitate direct comparison between properties, we consider the normalized Herfindahl-Hirschman index as

$$HHI^* = \frac{HHI - 1/N}{1 - 1/N}. \tag{2}$$

This measure varies between 0, which corresponds to equal ownership of all investors, and 1, which corresponds to a single investor with full ownership. The variable *Investors per Property* measures the number of unique wallets invested in a specific property.

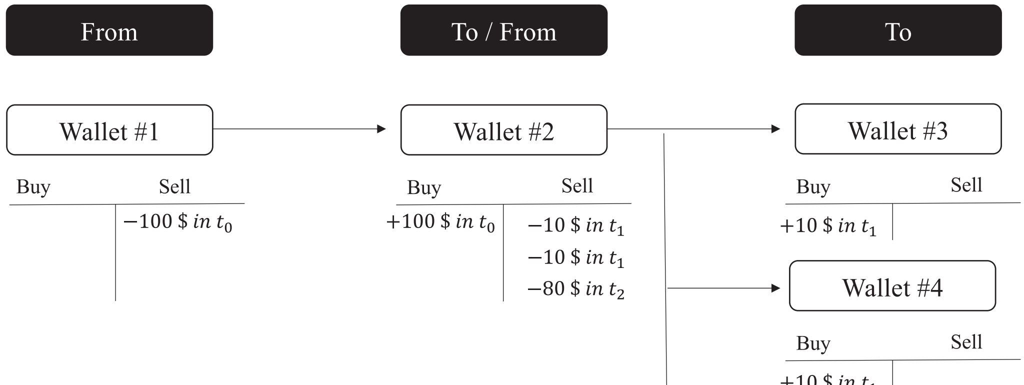
In addition, we examine investors' trading activities on both the buy and sell sides. With the variable *STO Buy*, we measure the absolute dollar amount of purchases during the STO. Figure 2 illustrates the calculation scheme of the *Secondary Market Buy* and the *Secondary Market Sell* side. We implemented a daily balance calculation to summarize the transactions per day to determine the daily dollar holdings per wallet. This approach entails evaluating the changes in wallet balances over time, where an increase in the balance indicates a buy transaction, and a decrease in the balance represents a sell transaction. We use this method because the dollar volume per wallet gives more insight than the volume per individual transaction. Therefore, *Secondary Market Buy* depicts how large the purchasing investment amounts are in the secondary market. The variable *Secondary Market Buy/Existing Exposure* indicates the percentage of purchases on the secondary market compared to the existing investment. On the sell side, we analyze with the variable *Secondary Market Sell* the dollar amount investors sell on the secondary market. The variable *Secondary Market Sell/Existing Exposure* puts this in relation to the existing investment. Lastly, the variable *Holding Period Sellers* measures how many days investors who sell their tokens have previously held them. The latter two variables provide insights into whether investors are interested in regular cash flows from the rent payments or the changes in the token's value itself.

3.3. Method: Multivariate analysis STO success determinants

In the first multivariate analysis, we test for determinants of the success of real estate STOs. We operationalize the funding time and speed as our measures of success. The funding time measures the number of days until 95% of the tokens have been transferred to the investors' wallets since RealT retains tokens to ensure liquidity in the secondary market, based on the blockchain transaction data.[8] Therefore, it is a proxy for the pure time dimension of success. We consider a project more successful if it takes less time to secure funding. We sub-categorize the funding time into the *Funding Time until Success* for the sub-sample of successfully

[7] This assumption can be justified for several reasons. On the RealT platform, a user can only deposit one wallet at a time. Swinkels (2023) has submitted a request to the platform operator confirming the assumption. From an academic point of view, Fahlenbrach and Frattaroli (2021) have conducted tests in an ICO sample and found similar results.

[8] In Section 5.1, we vary and verify the 95% assumption for an STO in order for it to be considered successful.



	t_0	t_1	t_2
Buy in $	100	20	80
Sell in $	100	20	80
# Buys	1	2	1
# Sells	1	1	1

Fig. 2. Blockchain Analysis Scheme.
This Figure illustrates the calculation scheme for determining the buy and sell sides in Table 2. We used a daily balance calculation for each wallet to evaluate changes over time. An increase in balance represents a buy transaction, while a decrease indicates a sell transaction.

funded projects transferred to the investors' wallets. As the second sub-category of funding time, we simultaneously examine successful and unsuccessful projects regarding the *Funding Time until Dec 2021* to obtain a sample free of survivorship bias. We estimate the parametric accelerated failure-time (AFT) survival model to account for unsuccessful projects correctly and because the proportional hazards assumption is violated for the semi-parametric Cox model. We apply the lognormal and log-logistic distributions since both present the most appropriate statistical fit for the distribution of our dependent variable. The AFT model is an alternative to modeling survival times often used in crowdfunding (Jiang et al., 2020; Felipe et al., 2022).

The funding time may be positively related to higher amounts of *Total Investment*. Therefore, we alternatively consider the measure speed. It is the fraction of 95% of the *Total Investment* to the funding time. Thus speed measures the mean investment amount funded per day.[9] Successful projects have a higher speed, corresponding to a higher daily funding amount. Analogously to the analysis of the funding time, we sub-categorize speed in the first specification with the corresponding *Funding Time until Success* into the dependent variable *Speed until Success* for successful projects. In the second model specification, we examine all projects as of December 2021 with *Speed until Dec 2021*. For projects that have not been successfully funded until the end of our observation period and are on the market longer than the mean time of *Funding Time until Success*, we equate *Speed until Dec 2021* to 0 to proxy a low speed and prevent distortions from unsuccessful projects with a large *Total Investment*. For projects that have not been successfully funded until the end of the observation period and are on the market shorter than the mean time of *Funding Time until Success*, we use the actual amount of money raised instead of *Total Investment*.

In the baseline regression, we include the financial, property, and campaign variables which we expand in the second specification with crypto market-specific characteristics. We use robust standard errors that are one-way-clustered in all regressions and quarter-year dummy variables. The financial characteristics of the property include *Rent per Token p.a.* for the annual rent a token holder receives per token. The variables *Expected Yield* and *Total Investment* are data publicly available before funding. These variables are determined by the property characteristics and thus can be indirectly influenced by the token issuer. The financial ratio *Expected Yield* is given by the ratio of the net rent to the token price. *Total Investment* refers to the amount of money needed to secure successful funding. This variable is commonly used in the CF (Block et al., 2018; Mollick, 2014), ICO (Adhami et al., 2018; Fisch, 2019), and STO literature (Ante and Fiedler, 2020; Lambert et al., 2022) to determine project success and represents the funding amount actually collected. However, due to the technical procedure on the blockchain, the *Total Investment* in our context is always entirely issued as part of tokenization but not necessarily fully transferred to investors. At the same time, the issuer keeps the remaining tokens. Therefore, we do not apply this variable as a measure of success.

The property characteristics comprise the variables *Age, Lot Size, Section 8* as the percentage of the share of financially supported housing within one property, and the type of use with the dummy variable *Single Family* if one family is the only tenant. For a suitable location variable, we rely on the dummy variable *Detroit* and the metric variable *Distance DTWN* to account for location quality since these variables are easily accessible and straightforward to understand for a retail investor. Similar to Swinkels (2023), we assume that rental properties outside of Detroit are more attractive for investors for diversification reasons, as the majority are located in Detroit. In addition, we also measure the distance to downtown in miles with the variable *Distance DTWN* to incorporate the micro-effects of the location. The campaign characteristics related to the literature on crowdfunding include the number of pictures with the variable *#Pictures* and the length of the descriptive text with *#Characters* for the particular property project.

For market-specific variables, we include for the crypto environment the variable *Gas Fees* for transaction costs on the Ethereum blockchain, converted to USD. Additionally, we include the S&P Case-Shiller Home Price Index with the variable *Housing Market* for the respective regions corresponding to the particular cities where the properties in our sample are located (Detroit, Chicago, Cleveland, New York, and Florida), lagged for one month. Since investors participate in the value depreciation or appreciation of the property with the value of their token, they care about the growth potential of the real estate market. They may be more willing to pur-

[9] This definition is analogous to the average velocity in physics, based on the investment amount instead of distance.

chase a token if the regional real estate market grows. All variables are defined in Table A.1 in the Appendix.

3.4. Method: Multivariate analysis funding determinants

With the multivariate analysis of STO success determinants, we analyze the STO at that specific point in time. However, when considering the crypto market over time, we must detach from mostly time-invariant STO characteristics and move on to the macro-level view of real estate token market activity. Hence, we can additionally account for daily fluctuations, notably for short-term particularities and shocks. In concrete terms, this shifts our models from the STO perspective to a daily view of capital inflows and outflows over time. To account for unobserved effects regarding individual characteristics and time, we employ a two-way fixed effects panel regression to analyze the determinants of daily inflows and outflows per property.

The dependent variables, daily *Inflow* and *Outflow* per property, are calculated based on the blockchain transaction data. *Inflow* indicates how much money investors spent during the STO or on the secondary market per property on a given day. *Outflow* measures which amount of money the investors sold from a property on the secondary market on a given day.[10] The *Inflows* and *Outflows* in the market for real estate tokens may be influenced by determinants and shocks both in the crypto market and the macroeconomy. Therefore, to account for the peculiarities of the crypto market, we consider from the sentiment perspective the five-day cumulative return of the native token of the Ethereum blockchain, Ether (ETH), with the variable *ETH Price* denominated in USD. The market capitalization of ETH is the second largest after Bitcoin on the cryptocurrency market as of December 31, 2021, and Ethereum is the primary platform for security tokens. Since the cryptocurrency market is still in its infancy and the general conditions are changing, it is characterized by high volatility. To incorporate short-term shocks in the crypto market, we include the dummy variables *ETH Shock* and *Gas Shock*. *ETH Shock* equals one if the cumulative return of five days prior to the observation decreased by more than 5% and *Gas Shock* which equals one if the cumulative return of *Gas Fees* increased by more than 5% in five days. For the macroeconomic environment, we include the *One-month Treasury, Ten-year Treasury*, and the *Aruoba-Diebold-Scotti* Business Conditions Index (*ADS Index*) of Aruoba et al. (2009). According to the Federal Reserve Bank of Philadelphia, the *ADS Index* covers seasonally adjusted macroeconomic indicators, including, among others, initial jobless claims (weekly), payroll employment (monthly), industrial production (monthly), and real GDP (quarterly). The index offers the advantage that, unlike, e.g., GDP or the unemployment rate, the data is provided daily, corresponding to the daily frequency of our dependent variables. Due to its high frequency, the index is increasingly used in academic research (see, e.g., Caporin et al., 2022; Da et al., 2014).

3.5. Descriptive statistics

The descriptive statistics for analyzing success determinants are displayed in Table 1 in Panel A. In our total sample of 173 real estate STOs, 72% were successful, which indicates that 95% of the tokens were transferred to investors. The sub-sample of successful STOs has a mean *Funding Time until Success* of 48.72 days and a median value of 26.92 days. In contrast, the *Funding Time until Dec 2021* for the entire sample is correspondingly longer, with 73.01 days in the mean. The minimum of 2.63 indicates that some very attractive projects sell off quickly. The money-oriented variable *Speed until Success* has a mean of 10,550 USD/day for successful projects and a median of 4190 USD/day. When considering successful and unsuccessful projects regarding the *Speed until Dec 2021*, the mean of 8300 USD/day is subsequently lower. The minimum *Speed until Dec 2021* of 0 represents projects not fully funded within the mean of *Funding Time until Success* of 48.72 days.

For the *Expected Yield*, the mean is at 11%. The mean property value measured by the highly skewed *Total Investment* at 168,020 with a median of 66,500 shows that most properties have a relatively low value. Among the housing characteristics, we observe that 80% of the properties are located in *Detroit* and 64% are *Single Family*. The campaign variables show that the offers, on average, are illustrated with four pictures and described in 205.65 characters. We do not consider the variable *#Characters* further in our multivariate analysis since the median value is zero because the platform did not provide any descriptive text at the beginning. The *Gas Fees* at the day of the STO range from a minimum of 1.11 to a maximum of 16.85, with a mean of 6.68, highlighting that blockchain-related transaction costs fluctuate and can be of crucial interest to token investors.

Panel B presents the descriptive statistics for the analysis of funding determinants. The unbalanced panel data set consists of 26,940 daily *Inflow* and 26,016 daily *Outflow* observations per property per day over our observation period of about two and a half years as of December 2021. On average, *Inflows* have a mean of 1,189.39, highly distorted by the maximum of 493,278.90 from an expensive and quickly sold property. The daily *Outflows* per property amount to a mean of 218.44. The medians of daily *Inflows* and *Outflows* are in a similar magnitude range at 16.01 and 13.80. The daily *Gas Fees* range between a minimum of 0.76 and a maximum of 18.00 throughout the observation period. The mean of *ETH Price* is 1,266.96 with a median of 387.98. The latter two variables illustrate the high volatility of the crypto market, which is why an additional examination of short-term shocks is required. A *Gas shock* is present in 38% and a *ETH Shock* in 30% of the daily observations. Table A.2 in the Appendix displays the Bravais-Pearson correlation coefficients for all of the variables we consider in the analysis of STO determinants. The correlation coefficients between the explanatory variables are moderate and provide initial evidence for our hypotheses.

4. Main analyses

4.1. Analysis of blockchain transaction

Based on 238,433 blockchain transactions related to all real estate tokens in our sample, we identify 6806 unique wallets representing the corresponding number of real estate token investors. The different number of observations per variable is due to different transactions and filtering methods, both of which serve to derive the respective variable of interest. From the wallet-investor perspective in Table 2 in Panel A, we document that one single investor invests in 10.2 properties on average. However, at least 25% of all investors have invested in only one property. One reason for this observation could be the novelty and peculiarity of real estate tokens. The respective investors do not yet hold a diversified real estate token portfolio. This result is in line with a previous study of ICO investors which finds that the main reason for a token investment is technological motives, followed by financial reasoning (Fisch et al., 2021). The maximum of 171 distinct properties out of 173 exemplifies that there are also investors who have invested in almost every property and have well-diversified tokenized real es-

[10] *Inflows* are the aggregated *STO Buy* and *Secondary Market Buy* and *Outflow* is *Secondary Market Sell* per project, reported in Table 2. The difference in the number of observations is due to the fact that there were no sales on some days. The difference in the mean is caused by *STO Buy* transactions and represents the capital that investors actively hold in tokens.

Table 1
Descriptive Statistics.

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Panel A: Variables for STO success determinants								
Dependent variables								
Funding Success	173	0.72	0.45	0	0	1	1	1
Funding Time until Success	125	48.72	49.53	2.63	9.87	26.92	82.29	226.70
Funding Time until Dec 2021	173	73.01	67.03	2.63	11.91	56.53	121.00	323.00
Speed until Success	125	10.55	20.38	0.27	0.95	4.19	9.22	128.48
Speed until Dec 2021	173	8.30	18.45	0.00	0.27	1.78	8.64	128.48
Explanatory variables								
Rent per Token p.a.	173	5.98	1.59	3.96	5.53	5.81	6.08	21.82
Total Investment	173	168.02	205.54	48.08	60.58	66.50	144.45	985.91
Expected Yield	173	0.11	0.01	0.07	0.11	0.11	0.12	0.13
Age	171	85.02	18.48	2	74	84	94.5	134
Lot Size	166	5,338.20	2,951.67	871	3920	4792	5,644.5	29,620
Section 8	173	0.18	0.37	0.00	0.00	0.00	0.00	1.00
Single Family	173	0.64	0.48	0	0	1	1	1
Distance DTWN	173	4.70	1.73	1.08	3.61	4.51	5.40	9.63
Detroit	173	0.80	0.40	0	1	1	1	1
#Pictures	173	4.34	4.77	1	2	3	5	35
#Characters	172	205.65	305.82	0	0	0	364.2	1654
Gas Fees	173	6.68	4.53	1.11	1.78	6.79	9.42	16.85
Housing Market	173	150.67	24.35	127.56	139.63	148.45	155.38	343.64
Panel B: Variables for funding determinants								
Dependent variables								
Inflow	26,940	1,189.39	11,201.43	0.00	5.00	16.01	117.98	493,278.80
Outflow	26,016	218.44	1,484.38	0.00	4.87	13.80	65.50	71,819.98
Explanatory variables								
Gas Fees	654	4.37	4.23	0.76	1.41	1.78	8.11	18.00
ETH Price	654	1,266.96	1,392.49	110.61	202.23	387.98	2,232.96	4,812.09
Gas Shock	654	0.38	0.49	0	0	0	1	1
ETH Shock	654	0.30	0.46	0	0	0	1	1
One-month Treasury	627	0.53	0.77	0.00	0.05	0.09	1.52	2.26
Ten-year Treasury	627	1.29	0.44	0.52	0.84	1.43	1.63	2.13
ADS Index	654	- 0.47	5.64	- 26.33	- 0.31	0.18	0.86	8.99

This table reports the descriptive statistics (number of observations, mean, standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum) for the full sample. For the analysis of STO success determinants, the number of observations of 125 of *Funding Time until Success* and *Speed until Success* refers to the successful projects in the sample; the remaining variables represent the entire sample of 173 observations. For the analysis of the funding determinants, the number of observations differs between *One-month Treasury, Ten-year Treasury*, and the remaining explanatory variables, as these data are not provided on bank holidays. All variables are defined in Table A.1 in the Appendix.

Table 2
Blockchain Transaction Analysis.

	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Panel A: Wallet-investor perspective								
Properties per Investor	6806	10.2	20.7	1	1	3	9	171
Holdings per Investor as of Dec 2021	6544	4,029.35	32,319.99	0.00	57.96	259.45	1,398.34	1,439,474.00
Holding Period all Investors as of Dec 2021	165,161	244.51	160.59	0	133	221	286	850
Panel B: Token-property perspective								
HHI* STO	173	0.03	0.06	0.01	0.01	0.02	0.04	0.68
HHI* as of Dec 2021	172	0.03	0.04	0.01	0.01	0.02	0.04	0.28
Investors per Property	173	401.2	201.2	31	258	328	501	1173
Panel C: Buy side								
STO Buy	87,048	317.82	2,467.28	0.00	35.98	57.96	162.60	155,010.00
Secondary Market Buy	35,351	88.70	721.13	0.00	2.92	6.72	25.43	58,462.74
Secondary Market Buy/Existing Exposure	35,351	0.38	11.67	0.00	0.01	0.03	0.10	2,104.88
Panel D: Sell side								
Secondary Market Sell	31,697	99.97	802.28	0.00	3.00	7.65	25.69	58,462.74
Secondary Market Sell/Existing Exposure	31,697	0.09	0.16	0.00	0.01	0.02	0.07	1.00
Holding Period Sellers	31,638	105.09	86.06	1	36	86	155	701

This table reports the descriptive statistics (number of observations, mean, standard deviation, minimum, 25th percentile, median, 75th percentile, and maximum) for the wallet-investor perspective (Panel A), token-property perspective (Panel B), as well as the buy side (Panel C) and sell side (Panel D). The sample includes 238,433 blockchain transactions from 2019 to 2021. Figure 2 illustrates the calculation scheme of the buy and the sell side. All variables are defined in Table A.1 in the Appendix.

tate portfolios.[11] After converting the number of tokens into dollar holding amounts, we find that the mean of *Holdings per Investors as of Dec 2021* is 4,029.35 USD, and the median is 259.45 USD. The mean of *Holding Period all Investors as of Dec 2021* is 244.51 days with a maximum of 850 days, indicating that investors of the first STO are still holding the tokens.

If we switch to the token-property perspective in Panel B, we see a high dispersion and less concentration of ownership based on the mean of the normalized HHI^{*} of 0.03 both after the STO and as of December 2021. This result indicates that not only a few investors hold the majority of tokens, but that tokenization, in practice, provides broad access to real estate ownership for many small investors. This result aligns with the evidence of Swinkels (2023), who utilizes a smaller sample. The maxima of both HHI^{*} can be attributed to a not fully transferred project with a single investor who sold off large parts of the investment after the STO. Apart from the maxima, the overall distributions remain the same, suggesting that secondary market trading does not change the ownership structure. Digitized properties are held in the mean by 401.2 different investors. Even though we obverse extreme cases, such as one property in 1173 wallets, this variable is affected by the amount of *Total Investment*, since most issued tokens amount to around 50 USD and a higher *Total Investment* enables more investors to invest in a particular property.

The analysis of blockchain transactions on the buy side in Panel C shows that investors spend 317.82 USD in the mean during the STO and a median amount of 57.96 USD, which approximately equals the value of one token. With a mean *Secondary Market Buy* amounting to 88.70 USD, investors appear to acquire tokens mainly during the STO, while secondary market purchases play a subordinate role. This finding is underpinned by the ratio *Secondary Market Buy/Existing Exposure*, which indicates that investors raise their investment by a median value of 3% on the secondary market compared to their existing exposure.

Lastly, in Panel D, we examine the sell side. The *Secondary Market Sell* has a mean value of 99.97 USD. However, there exists a disparity in the number of observations between *Secondary Market Buy* and *Secondary Market Sell* due to the calculation of the daily balance, as explicated in Section 3.2. At the transaction-based level, each buy transaction corresponds to a sell transaction facilitated by the blockchain. Notably, in certain instances, a single sell transaction is associated with multiple buy transactions from different wallets (refer to transactions between wallet #2 and wallet #3 in Fig. 2). Consequently, we observe a lower number of *Secondary Market Sell* observations compared to the number of *Secondary Market Buy* observations, alongside a higher mean value for *Secondary Market Sell*. Additionally, the distribution of *Secondary Market Buy* and *Secondary Market Sell* exhibits similarity from the maximum to the 25th percentile.[12] The ratio *Secondary Market Sell/Existing Exposure* reveals that, in the mean, 9% of the existing exposure is sold, while the median value is 2%. The latter two variables highlight that most real estate token investors tend to hold their tokens and do not liquidate the investment quickly. The *Holding Period Sellers* shows that investors who sell their tokens hold them for 105.09 days in the mean before. This result is also consistent with Auer and Tercero-Lucas (2022), who find evidence of the increasingly popular *"hodling strategy"* among crypto investors who buy-and-hold tokens for a long time to avoid exposure to the short-term volatility in the crypto market.

Table 3
Determinants of Funding Time.

	Dependent variable:			
	Funding Time until Success *OLS*		Funding Time until Dec 2021 *AFT*	
			lognormal	*loglogistic*
	(1)	(2)	(3)	(4)
Rent per Token p.a.	10.05***	9.92***	0.20**	0.19**
	(2.71)	(3.15)	(2.00)	(2.20)
Expected Yield	−1,392.25	−519.07	−57.31***	−67.48***
	(−1.53)	(−0.55)	(−3.18)	(−3.72)
Total Investment	−0.004	−0.03	0.001	0.001*
	(−0.13)	(−0.91)	(1.47)	(1.78)
Age	0.05	−0.07	0.01	0.01*
	(0.17)	(−0.27)	(1.08)	(1.74)
Lot Size	0.002	0.002	−0.0000	0.0000
	(1.16)	(1.13)	(−0.32)	(0.35)
Section 8	−13.04	−3.56	0.12	−0.06
	(−1.45)	(−0.38)	(0.39)	(−0.22)
Single Family	24.84**	21.68**	0.47	0.58**
	(2.28)	(2.24)	(1.53)	(2.00)
Distance DTWN	0.83	0.70	0.01	0.002
	(0.39)	(0.34)	(0.12)	(0.05)
Detroit	7.10	5.03	1.05***	1.27***
	(0.46)	(0.36)	(3.21)	(3.83)
#Pictures	−0.89	−0.09	−0.03	−0.01
	(−0.56)	(−0.06)	(−0.96)	(−0.37)
Gas Fees		3.15**	0.10***	0.09***
		(2.27)	(4.04)	(3.56)
Housing Market		0.54**	0.01	0.01
		(1.96)	(0.88)	(0.78)
Constant	126.00	−44.36	6.53**	7.02**
	(1.30)	(−0.36)	(2.26)	(2.50)
Quarter-Year FE	*Yes*	*Yes*	*Yes*	*Yes*
Observations	122	122	164	164
R^2	0.48	0.52	/	/
Adjusted R^2	0.38	0.42	/	/
Log Likelihood	/	/	−577.14	−573.64
χ^2 (df = 21)	/	/	178.48***	193.30***

The table reports the results for the sub-sample of successfully funded STOs with the dependent variable *Funding Time until Success* in Models 1–2 estimating OLS regression with robust standard errors. Models 3–4 present the results of the Accelerated Failure-Time (AFT) models with a lognormal and loglogistic distribution for all STOs, including unsuccessful ones with the dependent variable *Funding Time until Dec 2021*. The table contains the coefficient estimates and the corresponding *t*-statistics; the coefficients for the AFT model need to be exponentiated to interpret them as time ratios. All of the models include quarter-year dummies for time fixed-effects. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Table A.1 in the Appendix.

4.2. Analysis of STO success determinants

To test our hypotheses for STO success, we run different regression specifications for the two success variables: funding time and speed. First, we sub-categorize funding time into *Funding Time until Success* for the successfully funded projects with OLS regressions (Models 1–2) and *Funding Time until Dec 2021* for all projects with parametric accelerated failure-time survival models with a lognormal distribution (Model 3), and loglogistic distribution (Model 4). We report the results in Table 3.

In the block of property characteristics for Hypothesis 1, only *Single Family* is positively related to the funding time of successfully funded and all projects. Based on the regression estimations, we find that *Single Family* increases the funding time of successfully funded projects by over 20 days in Models 1–2 and delays the success by around 79% ($e^{0.58} - 1$) for all projects in Model 4.

[11] Due to the pseudonymity of wallets on the blockchain and the fact that we can only trace back the issuing wallets of RealT, we cannot completely rule out the possibility that our maxima are influenced by other wallets used for handlings and shifts by the token issuer.

[12] This observation suggests that the aggregation of sell transactions occurs within the range of transaction volumes below 3 USD (roughly the 25th percentile of both variables). To substantiate this claim, we conducted an unreported analysis utilizing kernel density plots for *Secondary Market Buy* and *Secondary Market Sell* observations across different transaction volume ranges. The plots reveal a large overlap between the two distributions. Consequently, the mean value of *Secondary Market Sell* is influenced by fewer observations.

The coefficients of *Detroit* and *Age* are significant for all projects in Model 4 and delay the success by 256% and 1%, respectively. Thus properties outside of *Detroit* – a city suffering from an enduring economic decline and shrinking population – are funded more quickly for reasons of diversification. In sum, we find supportive evidence in favor of Hypothesis 1 for funding time, i.e. that, the variables *Single Family, Detroit*, and *Age* are positively related to the success of an STO. However, since the remaining property-specific variables *Lot Size, Section 8*, and *Distance DTWN* are insignificant in all model specifications, we cannot provide further empirical support for Hypothesis 1. Particularly interesting is the irrelevance of the factors of size and location, which are typically important predictors in the real estate sector.

The campaign variable *#Pictures* is insignificant in all four models.[13] Therefore, we cannot provide empirical evidence for Hypothesis 2 and the common finding in CF that a more detailed description reduces information asymmetries and, hence, increases project success. The reason for this could be that, in contrast to conventional CF, in which information asymmetries are high (Courtney et al., 2017), the quality of a property can be determined more easily. Thus information asymmetries are, in general, lower for real estate tokens than for CF projects.

The coefficient of *Gas Fees* is significant and positively related to both sub-categories of funding time. For example, higher transaction costs delay the success by around 9% for all projects in Model 4. This finding aligns with Momtaz et al. (2022), who find that investors limit their token trading activity when transaction costs are high. In sum, we find supportive evidence for Hypothesis 3b that investors reduce their trading activity when blockchain-related demand-driven transaction costs increase, which makes real estate STOs less successful.

The *Housing Market* coefficient is only significant and positively connected to *Funding Time until Success* in Model 2. However, funding time positively correlates with *Total Investment* and, as both *Total Investment* and *Housing Market* increase in our sample over time, we observe a positive coefficient for *Housing Market*. Among the financial controls, *Expected Yield* is significant for all projects and decreases the funding time strongly since a higher *Expected Yield* makes a project more attractive for investors. In contrast, *Rent per Token p.a.* positively impacts the funding time in all models. This result emanates from the fact that *Rent per Token p.a.* is in the same range for most observations due to the setting of the token issuer; however, just a few STOs above the 75% percentile (see Table 1) have not been successful and are the reason for the counterintuitive direction of effect of the *Rent per Token p.a.* coefficient. The *Total Investment*, which is significant for all projects with a loglogistic distribution, delays the success by merely 0.1%.

Models 1–2 consider only successful projects, and the estimations could be subject to a survivorship bias. However, comparing the results of the models of the successfully funded projects (Models 1–2) with those of all projects (Models 3–4), we do not observe apparent differences in signs and significances of the coefficients that would indicate a bias. The results of the two AFT models with different distribution assumptions are similar.

To obtain the complete picture of STO success and to rule out effects caused by the magnitude of the *Total Investment* amount, we study the newly-constructed dependent variable speed and present the results in Table 4. Since the STO is more successful if it raises more money within a certain period, the signs' interpretation of the coefficients should be opposite to the previous analyses of the funding time. Again, we sub-categorize the dependent variable into *Speed until Success* in Models 1–2 and *Speed until Dec 2021* in Models 3–4 and run OLS regressions.

Table 4
Determinants of Speed.

	Dependent variable:			
	Speed until Success		Speed until Dec 2021	
	(1)	(2)	(3)	(4)
Rent per Token p.a.	−3.60	−3.94*	−2.84	−3.92*
	(−1.60)	(−1.74)	(−1.32)	(−1.75)
Expected Yield	656.78*	737.05	481.33	666.49*
	(1.71)	(1.43)	(1.53)	(1.73)
Age	−0.04	−0.03	0.004	0.07
	(−0.36)	(−0.25)	(0.04)	(0.61)
Lot size	0.003**	0.003**	0.002*	0.003**
	(2.00)	(2.12)	(1.83)	(2.19)
Section 8	−2.79	−3.58	0.19	−1.91
	(−0.54)	(−0.72)	(0.04)	(−0.44)
Single Family	−2.96	−2.34	−0.84	−1.41
	(−0.64)	(−0.53)	(−0.24)	(−0.42)
Distance DTWN	−1.28	−1.19	−0.24	−0.18
	(−1.51)	(−1.47)	(−0.31)	(−0.22)
Detroit	−28.70***	−26.08***	−16.79***	−13.26**
	(−3.30)	(−3.02)	(−2.77)	(−2.36)
#Pictures	0.63	0.57	0.88	0.45
	(0.78)	(0.71)	(1.34)	(0.73)
Gas Fees		−0.92**		−1.24***
		(−2.13)		(−3.14)
Housing Market		0.12		0.18
		(0.76)		(1.29)
Constant	−19.75	−43.90	−31.76	−66.76
	(−0.42)	(−0.54)	(−0.71)	(−1.08)
Quarter-Year FE	*Yes*	*Yes*	*Yes*	*Yes*
Observations	122	122	164	164
R^2	0.59	0.61	0.43	0.48
Adjusted R^2	0.51	0.53	0.36	0.41

The table reports the results for the sub-sample of successfully funded STOs with the dependent variable *Speed until Success* in Models 1–2 and for the whole sample with *Speed until Dec 2021* in Models 3–4 estimating OLS regression with robust standard errors. The table reports the coefficient estimates and the corresponding *t*-statistics; all of the models include quarter-year dummies for time fixed-effects. The dependent variable *Speed until Success* is the fraction of *Total Investment/Funding Time until Success* and *Speed until Dec 2021* is the fraction of *Total Investment/Funding Time until Dec 2021*. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Table A.1 in the Appendix.

Lot Size and *Detroit* are significant variables within property characteristics in all models for the speed variables. *Lot Size* is positively associated with both speed variables. Properties in *Detroit* have a lower *Speed until Success* of 26,080 USD/day for successful projects and a lower *Speed until Dec 2021* of 13,260 USD/day for all projects. In line with the traditional real estate literature on location, this determinant is relevant, particularly for successfully funded projects. Since the majority of property characteristics are insignificant, we find only statistical support in favor of Hypothesis 1 for *Lot Size* and *Detroit*.

The campaign variable *#Pictures* is also insignificant for the speed variables.[14] The reason for this is probably the same as outlined above for the funding time. Consequently, we find no empirical evidence for Hypothesis 2.

We find a significant and negative relationship between the transaction costs *Gas Fees* and both speed variables, indicating that higher transaction costs are related to a lower level of STO success. For example, a one-standard-deviation increase in *Gas Fees* is associated with a 5617 USD/day decrease in the *Speed until Dec 2021*. Compared to Model 2, the effect is more pronounced in terms of significance and magnitude of the coefficient for Model 4, which considers the whole sample. This finding is reasonable because this specification additionally considers unsuccessful projects whose

[13] We do not anymore consider *#Characters* in the multivariate analysis, as outlined in Section 3.5; however, we find in unreported analysis that it is also insignificant.

[14] The same applies if we include *#Characters*.

Table 5
Funding Determinants.

	Dependent variable:	
	Inflow (1)	Outflow (2)
ETH Price	139.72***	2.65
	(3.39)	(0.52)
Gas Fees	−1.28***	−0.10***
	(−11.04)	(−6.78)
ETH Shock	−607.06***	−33.96
	(−2.81)	(−1.29)
Gas Shock	−489.47**	49.25*
	(−2.20)	(1.81)
One-month Treasury	1, 202.02*	64.15
	(1.86)	(0.73)
Ten-year Treasury	315.63	−28.49
	(0.51)	(−0.37)
ADS Index	−32.89	−8.99**
	(−0.90)	(−2.01)
Individual FE	*Yes*	*Yes*
Time FE	*Yes*	*Yes*
Observations	18,182	17,606
R^2	c0.062	0.049
Adjusted R^2	0.053	0.040

This table presents the analysis of funding determinants based on OLS regressions. It reports the coefficient estimates and the corresponding *t*-statistics. The dependent variable is either daily *Inflow* or daily *Outflow* per property in a fixed-effects panel regression with individual and time-fixed effects. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Table A.1 in the Appendix.

success is more negatively affected by high transaction costs. Thus we find strong empirical support for Hypothesis 3b.

As assumed after taking the *Total Investment* into account for the dependent variable, *Housing Market* is insignificant. Among the financial characteristics, *Rent per Token p.a.* again has a negative impact in Models 2 and 4. The coefficient of *Expected Yield* is significant and positive on the 10% level in Models 1 and 4 and highly increases the speed of funding.

The adjusted R^2 ranges from 0.36 to 0.53. In summary, we observe that concerning both speed sub-categories, the traditional property characteristics of size and location (*Lot Size* and *Detroit*) are relevant determinants of STO success in addition to transaction costs on the crypto market (*Gas Fees*) and financial controls. The coefficient of *Lot Size* has the same magnitude for all models, *Detroit* shows a larger effect when restricting to only successfully funded projects. The unattractive location of the city of *Detroit* reduces the speed for successfully funded projects. *Gas Fees* is the only variable with a stronger effect when considering the entire sample, including unsuccessfully funded projects whose success is more negatively affected by high transaction costs. In line with Table 3, we do not observe apparent differences in the signs and significances between the models relying only on successfully funded projects and those comprising all projects.

4.3. Analysis of funding determinants

In the following, we study the funding determinants to analyze the entire crypto market on the macro-level and to account for its particularities over time. In Model 1 of Table 5, we present the regression estimations for the dependent variable daily *Inflows* per property from investors purchasing tokens. Model 2 exemplifies the daily *Outflows* per property from investors selling tokens.

At first, we analyze the determinants that relate specifically to the crypto market. Model 1 exhibits a significant and negative coefficient of the *ETH Price* for *Inflows*, and no significance for *Outflows*. An increase of 1 USD in the *ETH Price* is associated with an increase of 139.72 USD in daily *Inflows* per property. Consequently, the crypto market sentiment appears to be a relevant predictor for capital *Inflows* on the market for real estate tokens, probably because crypto investors are subject to herding behavior caused by the sentiment on the crypto market. The results of *ETH Price* for *Inflows* provide statistical support for Hypothesis 3a, whereas we find no evidence of *Outflows* for Hypothesis 3a. Further, the coefficients of *Gas Fees* are negatively related to both capital *Inflows* and *Outflows*. The results of *Gas Fees* are consistent with Hypothesis 3b, that investors limit their trading activity to avoid high transaction costs, regardless of whether *Inflows* or *Outflows* are considered. It is worth noting that the crypto market sentiment *ETH Price* is not significantly related to *Outflows*, but crypto market transaction costs are. The reason for this could be that investors who have already decided to liquidate the tokens are timing the sale depending on transaction costs, as these directly affect their return on investment. Both dummy variables for short-term shocks on the crypto market are significant and negatively associated with *Inflows*, although with low or no significance for *Outflows*. To be more precise, the coefficient of *ETH Shock* decreases *Inflows* for 607.06 USD when the cumulative Ether return decreased for five days prior to the *Inflow*. The effect for a *Gas Shock* is less pronounced and implies that the occurrence of a *Gas Shock* decreases *Inflows* by 489.47 USD. The shock results for *Inflows* align with our crypto-market related Hypotheses 3a and 3b since a shock of the crypto market sentiment and the transaction costs reduce *Inflows*. Interestingly, short-term shocks in the crypto market do not seem to play a major role in *Outflows*. Possibly this is because regular cash flows from the tokens are based on rent payments and are not affected by short-term crypto shocks, so there is no incentive to sell and cause an *Outflow*. Consequently, we cannot provide empirical evidence for *Outflows* and the shock variables for our Hypotheses 3a and 3b.

Regarding the macroeconomic factors *One-month Treasury, Ten-year Treasury*, and the *ADS Index*, we find occasional and low significances for both *Inflows* and *Outflows*. The short-term interest rate has a positive and significant influence on *Inflows*, whereas long-term interest is insignificant for both capital flows. An increase in the *ADS Index*, indicating progressively better-than-average conditions for doing business, significantly reduces *Outflows*. Thus the macroeconomic situation does not appear to be an essential criterion in the decision-making process of a real estate token investor. Our finding is consistent with Yermack (2015) and Bianchi (2020), who conclude that macroeconomic events and factors do not drive trading volumes and daily exchange rates of the main cryptocurrencies.

In sum, we find that the crypto market-related transaction costs, sentiment, and the corresponding short-term shocks are relevant predictors of daily *Inflows* for purchasing tokens rather than daily *Outflows* of selling tokens.

5. Robustness and further analysis

5.1. Adjustment of financing threshold

It is common practice that RealT retains around 5% tokens of a property to ensure liquidity on secondary markets in the future, which is why we define the success of a project as transferring 95% of the tokens. We vary the threshold for the definition of "successfully" funded between 90% and 100% in unreported analyses. Our results remain qualitatively unchanged and robust for these adjustments.

5.2. Analysis of the determinants of total investment and expected yield

Digging deeper into the structure of the projects offered in the STO, we investigate the determinants of the money-oriented variable *Total Investment* and present the estimations in Models 1–2 in Table A.3 in the Appendix. Regarding the financial variables, the coefficient of *Expected Yield* is significant and negative in both model specifications. When considering the property characteristics, we find that lower quality properties, which are older and have higher risk diversification among tenants, are offered with a lower *Total Investment*. The variables *Lot Size* and *Section 8* have a significant positive impact across all models. The lower risk of a rent default of *Section 8* supported rents is associated with a higher *Total Investment*. The coefficient of the CF variable *#Pictures* is insignificant, probably because this variable is less relevant to the token issuer. Both market-related variables *Gas Fees* and *Housing Market* are insignificant. In the next step, we switch from the dollar amount of *Total Investment* to a return perspective and study the determinants of *Expected Yield* in Models 3–4 in Table A.3. As expected, the *Rent per Token p.a.* is positively related to the *Expected Yield*. In line with the previous results for *Total Investment*, the coefficient for *Single Family* is also negatively related to *Expected Yield*. The coefficient of *Distance DTWN* indicates that a higher distance from downtown reduces the yield due to lower rent in more unattractive locations further afield. The *Housing Market* is negatively associated with the *Expected Yield*. A higher housing index is connected with higher housing and token values and, consequently, a lower *Expected Yield*.

In summation, only for *Single Family* do we find consistent signs and significances for both *Total Investment* and *Expected Yield*, while the evidence for the remaining variables is mixed. While crypto-market transaction costs are significantly related to the success of the STO as measured by funding time and speed, see Section 3.3, they are not related to the *ex-ante* set structure of the offered projects by the token issuer.

6. Conclusion

Digitization is transforming various industries, including the financial and real estate sectors. We highlight the new way of securitizing assets, using the blockchain and digital security tokens and their issuance processes through STOs. Real estate has been identified as a suitable market for tokenization due to this technical innovation overcoming the drawbacks of direct real estate investments, such as high entry barriers and illiquidity. Technical features facilitate the investment of small amounts of money, eliminate the need for financial intermediaries, and increase transaction speed, consequently lowering the costs for all parties involved. Thus investors can diversify their portfolios more easily among asset classes and countries. The tokens can be traded after issuance on secondary markets, which enables liquidity. Even though the possibility of fractional ownership already exists in indirect investment instruments, such as funds or REITs, real estate tokens come closer to direct ownership with controlling rights.

Based on STO data of 173 real estate tokens and more than 238,433 blockchain transactions, we analyze investor behavior, the determinants of STO success, and capital flows over time. During our observation period, real estate token investors hold a mean of 10 different tokens and an investment amount of 4030 USD, which shows that investors do not yet hold well-diversified real estate token portfolios. Ownership of the properties is not concentrated on some large investors emphasizing that tokenization provides broad access to real estate ownership for many small investors. Further, we conclude that investors acquire tokens mainly during the STO, while the secondary market plays a subordinate role in token purchases and sales. This study's primary success variable of interest is the mean funded investment amount per day (*Speed*). Property-specific fundamentals and crypto market-related transaction costs are positively related to STO success, along with financial characteristics. In line with the well-known explanatory power of location factors in real estate, we find that location is another important determinant of STO success. The success of STOs appears to be independent of crowdfunding characteristics, probably because a property's quality can be determined more easily, and information asymmetries are lower than for conventional crowdfunding projects. Investors seek diversification possibilities through location choice to reduce the idiosyncratic cash flow risk of the investment and try to evade high transaction costs that reduce their return. From the perspective of capital inflows (token purchases) and capital outflows (token sales) per day, we find that real estate token investors pay equal attention to the crypto market-specific sentiment and transaction costs when purchasing tokens. In contrast, only the transaction costs directly reducing the return on investment are relevant for sales. Both short-term shocks have a strong negative impact on capital inflows. Macroeconomic factors appear to have little effect on capital flows in general. These results highlight the importance of considering the specific crypto market environment and the characteristics of the underlying asset class for real asset tokenization.

A limitation is our small sample size of 173 projects, resulting from the fact that tokens are becoming the focus of public attention. Our results may not be generalized, as they are derived from observing a small but growing number of crypto enthusiasts familiar with the technical background. Therefore, there is an avenue for future research to test and verify our results in a broader sample regarding other asset classes, periods examined, geographic scope related to different jurisdictions and implementation options, and the number of investors.

Our study has practical and policy implications. As discussed at the G-7 meeting in May 2022, various regulators and politicians have called for accelerating global crypto regulations for better financial stability to enable innovative digital finance solutions and investor protection. Our findings contribute to the last two objectives of this regulatory effort. We find that the particularities of the crypto market are essential determinants for the success of real estate STOs and capital flows. This result may raise the concern that token investors mainly follow trends that do not reflect the fundamental asset characteristics, implying a high need for consumer protection. Such technical innovation can also support investors in building more diversified portfolios. However, according to our results, this possibility has not been used sufficiently until now. Regulators must find a compromise to achieve investor protection and foster the development of digital finance products without suppressing the opportunities for technology and innovation.

Declaration of Competing Interest

One author bought a few digital tokens issued by the company RealT so that they could describe the process of tokenization. The current value is lower than 200 USD. The other authors have no commercial relationship with the company or management whose data we mostly rely on.

CRediT authorship contribution statement

Julia Kreppmeier: Conceptualization, Methodology, Visualization, Writing – original draft, Writing – review & editing. **Ralf Laschinger:** Conceptualization, Data curation, Methodology, Software, Formal analysis, Writing – review & editing. **Bertram I. Steininger:** Conceptualization, Methodology, Writing – original draft. **Gregor Dorfleitner:** Supervision, Funding acquisition, Writing – review & editing.

Data availability

Data will be made available on request.

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Appendix A.

Table A.1
Definition of all Variables.

Blockchain transaction analysis		
Properties per Investor	Number of distinct real estate tokens per unique wallet	Own calculations
Holdings per Investor as of Dec 2021	Dollar Holdings per Investor as of 31 Dec 2021	Own calculations
Holding Period all Investors as of Dec 2021	Holding Period of all Investors in Days as of 31 Dec 2021	Own calculations
HHI	Herfindahl-Hirschman Index per property	Own calculations
HHI STO*	Normalized Herfindahl-Hirschman Index per property after the tokens have been transferred during the STO, based on the actual quantity of issued tokens comprising successful and unsuccessful STOs (between 0 and 1)	Own calculations
HHI as of Dec 2021*	Normalized Herfindahl-Hirschman Index per property as of 31 Dec 2021 (between 0 and 1)	Own calculations
Investors per Property	Number of unique wallets per real estate token	Own calculations
STO Buy	Amount of money of buy transactions during the STO in USD	Own calculations
Secondary Market Buy	Amount of money of secondary market buy transactions in USD	Own calculations
Secondary Market Buy/Existing Exposure	Percentage ratio of the *Secondary Market Buy* to the existing exposure	Own calculations
Secondary Market Sell	Amount of money of secondary market sell transactions in USD	Own calculations
Secondary Market Sell/Existing Exposure	Percentage ratio of the *Secondary Market Buy* to the existing exposure	Own calculations
Holding Period Sellers	Holding Period of investors selling tokens in days	Own calculations
Analysis of STO determinants		
Dependent variables		
Funding Time until Success	Number of days until all tokens (95 percent, since RealT keeps around 5 percent to themselves) are transferred to wallets. For this variable, only successful projects are considered. The start date of the funding period is derived from the HTML code on the website and the end date from the blockchain explorers.	Own calculations
Funding Time until Dec 2021	Number of days until all tokens (95 percent, since RealT keeps around 5 percent to themselves) are transferred to wallets. For this variable, both successful and unsuccessful projects are considered. The start date of the funding period is derived from the HTML code on the website and the end date from the blockchain explorers.	Own calculations
Speed until Success	95% of *Total Investment* divided through *Funding Time until Success*, (in thousands USD/day) for the sub-sample of successful projects	Own calculations
Speed until Dec 2021	95% of *Total Investment* divided through *Funding Time until Dec 2021* (in thousands USD/day) for all projects. For projects that have not been successfully funded until the end of our observation period and are on the market longer than the mean time of *Funding Time until Success*, the *Speed until Dec 2021* is equated to 0. For projects that have not been successfully funded until the end of the observation period and are on the market shorter than the mean time of *Funding Time until Success*, the actual amount of money raised is used instead of *Total Investment*.	Own calculations
Explanatory variables		
Rent per Token p.a.	Rent per token per year	RealT
Total Investment	Amount of money required for the funding, technically the number of tokens multiplied by the token price (in thousands USD)	RealT
Expected yield	Expected income calculated as net rent divided by token price	RealT
Age	Difference between the publication date of the project and the construction year	RealT
Lot Size	Size of the real estate (in square foot)	RealT
Section 8	Percentage of rents supported by Section 8 in the whole property	RealT
Single Family	A dummy variable for the property type of use that shows whether the building is a single-tenant property, 0 otherwise.	RealT
Distance DTWN	Distance to downtown in miles	Walk Score
Detroit	A dummy variable that shows whether the property is located in Detroit, 0 otherwise.	RealT
#Pictures	Absolute numbers of pictures of the property published on the platform	RealT
#Characters	Absolute number of characters of the descriptive text of the project on the platform	RealT
Gas Fees	Transaction costs on the Ethereum blockchain on the day the project is published online or on the day of the observation, converted to USD	Coinmarketcap
Housing Market	S&P Case-Shiller Home Price Index for the corresponding region, lagged for one month	S&P Dow Jones Indices
Analysis of funding determinants		
Dependent variables		
Inflow	Daily capital inflows per property per day in USD (STO and secondary market buy transactions)	Own calculations
Outflow	Daily capital outflows per property per day in USD (secondary market sell transactions)	Own calculations

(*continued on next page*)

Table A.1 (*continued*)

Explanatory variables		
One-month Treasury	Market yield on US Treasury Securities at 1-month constant maturity, quoted on an investment basis	FRED, Federal Reserve Bank of St. Louis
Ten-year Treasury	Market yield on US Treasury Securities at 10-year constant maturity, quoted on an investment basis	FRED, Federal Reserve Bank of St. Louis
ADS Index	Aruoba-Diebold-Scotti (ADS) Business Condition Index based on Aruoba et al. (2009) to measure macroeconomic activity at a daily frequency	Federal Reserve Bank of Philadelphia
ETH Price	Cumulative return of Ether over a period of five days before the observation	Coinmarketcap
ETH Shock	A dummy variable that equals one if the cumulative return of *ETH Price* decreased by more than 5% over a five-day window before the observation, 0 otherwise.	Own calculations
Gas Shock	A dummy variable that equals one if the *Gas Fees* cumulatively increased by more than 5% over a five-day window before the observation, 0 otherwise.	Own calculations

List and definitions of all variables and the corresponding sources. RealT as a source corresponds to information obtained from RealToken's website.

Table A.2
Correlation Table.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Total Investment	1													
(2) Expected Yield	−0.03	1												
(3) Funding Time until Success	0.01	0.06	1	1										
(4) Funding Time until Dec 2021	0.01	0.06	1	1										
(5) Speed until Success	0.43	0.01	−0.37	−0.37	1	1								
(6) Speed until Dec 2021	0.43	0.01	−0.37	−0.37	1	1								
(7) Rent per Token p.a	0.26	0.42	0.29	0.29	−0.04	−0.04	1							
(8) Age	0.12	0.03	−0.17	−0.17	0.24	0.24	−0.24	1						
(9) Lot Size	0.55	0.24	0.13	0.13	0.36	0.36	0.60	−0.17	1					
(10) Section 8	0.19	−0.19	−0.23	−0.23	0.08	0.08	0.06	−0.02	0.05	1				
(11) Distance DTWN	−0.08	−0.02	0.03	0.03	−0.13	−0.13	0.13	−0.02	0.08	0.03	1			
(12) #Pictures	0.30	0.05	−0.18	−0.18	0.38	0.38	0.14	0.11	0.32	−0.02	−0.01	1		
(13) Gas Fees	0.19	−0.03	0.39	0.39	−0.12	−0.12	−0.16	0.12	−0.01	−0.28	0.04	−0.11	1	
(14) Housing Market	0.34	−0.49	0.06	0.06	0.24	0.24	−0.28	0.29	−0.08	−0.09	−0.12	0.01	0.27	1

This table reports the Bravais-Pearson correlation coefficients of the dependent and explanatory variables. All variables are defined in Table A.1 in the Appendix.

Table A.3
Determinants of Total Investment and Expected Yield.

	Dependent variable:			
	Total Investment		Expected Yield	
	(1)	(2)	(3)	(4)
Rent per Token p.a.	−1.61	−8.84	0.002**	0.002***
	(−0.11)	(−0.56)	(2.47)	(3.91)
Expected Yield	−6,629.80**	−4,471.23*		
	(−2.55)	(−1.77)		
Age	−2.74**	−2.31*	0.0001**	0.0000
	(−2.40)	(−1.82)	(2.33)	(0.60)
Lot Size	0.02***	0.02***	0.0000	−0.0000
	(2.84)	(3.02)	(1.57)	(−0.07)
Section 8	139.29**	149.49***	−0.002	−0.003
	(2.56)	(2.75)	(−1.27)	(−1.64)
Single Family	−240.42***	−238.69***	−0.004***	−0.003**
	(−5.74)	(−5.75)	(−2.73)	(−2.25)
Distance DTWN	−8.08	−6.60	−0.001**	−0.001***
	(−1.25)	(−1.04)	(−2.18)	(−2.82)
Detroit	−10.88	6.95	0.01***	0.004**
	(−0.22)	(0.13)	(3.30)	(1.99)
#Pictures	5.99*	3.67	−0.0002	0.0002
	(1.67)	(0.89)	(−1.01)	(0.65)
Gas Fees		3.11		−0.0001
		(1.19)		(−1.09)
Housing Market		1.42		−0.0002***
			(1.53)	(−4.17)
Constant	1,289.40***	887.10**	0.09***	0.11***
	(3.95)	(2.32)	(5.54)	(9.90)
Quarter-Year FE	*Yes*	*Yes*	*Yes*	*Yes*
Observations	165	165	165	165
R^2	0.58	0.70	0.65	0.66
Adjusted R^2	0.54	0.66	0.61	0.61

This table presents the results of OLS regression for the dependent variables *Total Investments* and *Expected Yield* with robust standard errors. The table reports the coefficient estimates and the corresponding *t*-statistics; all models include quarter-year dummies for annually and quarterly fixed-effects. The dependent variable *Total Investment* is measured in thousands USD. The symbols *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. All variables are defined in Table A.1 in the Appendix.

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