Blockchain Research Lab

Scientific Report

LAND Ho! Digital Real Estate in the Metaverse as an Emerging Asset Class

Source: The Sandbox

This report highlights digital real estate (or virtual land) in the metaverse as an emerging asset class. It examines the price drivers of digital real estate and whether it represents a new and unique asset class. The analysis shows that, similarly to traditional real estate markets, neighborhood effects play a crucial role in the pricing of virtual land. Furthermore, the price of digital real estate has no significant correlation with those of other asset classes. Thus, it can be concluded that digital real estate is an emerging asset class in its own right and could potentially be used to diversify or optimize risk-adjusted portfolios.

August 2022

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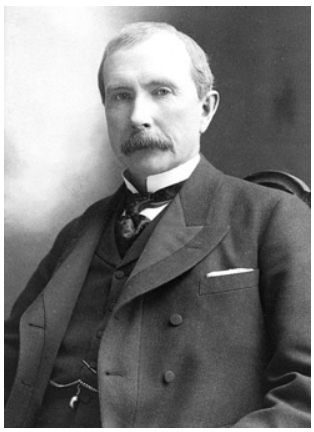


"The major fortunes in America have been made in land."

—John D. Rockefeller

Foreword

Digital real estate in the form of digital parcels of land in virtual worlds is emerging as a new asset class. Similarly, to traditional, physical real estate, virtual land owners can build on it, use it, sell it or rent it out. The demand and attention for virtual land has increased sharply since 2021, suggesting that it may represent a significant aspect of future digital social interaction, identity on the internet, the metaverse and financial markets.

Like many new markets and innovations, **digital real estate may be a difficult concept for newcomers to grasp.** What is the point of owning land that I cannot physically walk on? Why should some piece of land be worth more than another? And can't you just copy that land? This report sheds light on such questions, explores the motivation to own virtual land and examines its pricing. A full understanding of the potential of digital real estate requires knowledge of topics such as traditional real estate and financial markets, blockchain, crypto assets, metaverse or *non-fungible tokens (NFTs)*. This report aims to provide a working understanding of these diverse fields as they relate to digital real estate.

The report analyzes the market for digital real estate in general and looks in detail at one of the largest projects, *The Sandbox*. The overarching aim is to investigate digital real estate (or virtual land) as a new asset class. Following a broad introduction to the metaverse and virtual worlds, we pursue a data-driven approach using validated quantitative methods to investigate the drivers of returns and pricing of virtual land, such as geographical proximity or users, and how virtual land interrelates with other asset classes, such as cryptocurrencies, stocks, gold or traditional real estate. We think **the results will provide asset managers, land owners, advertisers and other stakeholders with exciting insights.**

Finally, **we would like to thank *The Sandbox* for funding this study.** Apart from the specification that the report should evaluate virtual land as a new asset class, based on data from The Sandbox, the sponsor did not influence the design or content of the study.

Dr. Lennart Ante

CEO, Blockchain Research Lab

August 2022

Eight key takeaways

1) Digital real estate is a billion-dollar market

On the *Ethereum* blockchain alone, **digital parcels of *LAND* have already reached a trading volume of over $1.2 billion.** Here, most of the volume is shared among the three largest projects, *The Sandbox*, *Otherside*, and *Decentraland*. The virtual property of these three projects is conservatively estimated to be worth over $1 billion. By June 2022, *The Sandbox* is the most significant project in the sector, with a minimum valuation of at least $400 million. Less conservative estimates value the virtual land parcels in The Sandbox at over $1 billion.

2) LAND prices do not correlate with other assets

While we find significant correlations among the prices of all other asset classes we investigated, the price of *LAND* does not correlate with any of them (cryptocurrency, stock indices, gold, bonds and real estate). This suggests that **digital real estate can offer diversification benefits and could even serve as a safe haven**. This underscores the point that digital real estate is, at least in its initial phase, an asset class in its own right.

3) Location is a major driver of LAND pricing

Data on seventeen brand and other high-profile owners of *LAND* in *The Sandbox* show that the price of a piece of *LAND* significantly depends on its (*Manhattan*) distance to these celebrity parcels. This suggests that **users specifically seek pieces of *LAND* in desirable neighborhoods.**

4) You want to live next to media personalities / celebrities

***LAND* near media personalities** such as *Snoop Dogg* or *Steve Aoki* **carries a price premium of up to $25,509** and $17,233, respectively. *LAND* right next to *Snoop Dogg*'s appreciated in value by up to 4,137% after the partnership between the musician and *The Sandbox* was announced. Similar though somewhat smaller effects are found for other high-profile *LAND* owners such as large brands or crypto companies.

5) High-profile partnership announcement are most influential in the short term

The results suggest that **new partnership announcements and primary LAND sales attract significant attention**, whereas the price effect of older parcels of high-profile owners tends to decline over time. However, this may also be due to the fact that very little trading of *LAND* occurs around the plots of the early partners, making any price effect difficult to detect, i.e., without a seller there is no market price.

6) Digital real estate or virtual land is a high-performing asset

Compared to selected other assets or asset classes, such as *Bitcoin*, *Ether*, stocks, gold, traditional real estate or bonds, *LAND* performed excellently. The return of *LAND* is significantly above all these assets—with the exception of *SAND*, the native cryptocurrency of The Sandbox. However, these high returns are associated with high risks. *LAND* is also the asset with the highest individual losses in individual quarters (up to 484%) (*based on data until June 2022*).

7) LAND ownership drives LAND prices and vice versa

We identify significant interactions between unique blockchain wallets and *LAND* returns for *The Sandbox*. When *LAND* prices increase by 1%, the number of *LAND* holders drops by 0.03% to 0.04% on each of the following three days. Vice versa, an increase in owners by 1% results in a negative price effect of 0.05% a few days later. This suggests that land ownership depends on price: The higher (lower) the price, the fewer (more) want or can afford it.

8) There is much more to investigate

We hope this study can contribute to a better understanding and assessment of digital real estate for both internal and external stakeholders as well as society. Yet the findings we present are but **the tip of the iceberg**. There are so much more interesting research questions to explore to better understand digital real estate and its risks, returns, challenges, effects and potentials. In a market that evolves at an incredible pace, exciting times lie ahead for users and researchers alike.

Section 1

The Metaverse

What's the metaverse?

At least since *Facebook*'s rebranding to *Meta* (the Greek term for *beyond*), **"the metaverse" has been on everyone's lips**. However, metaverse is by no means a clearly defined concept, but rather a complex compilation of various characteristics that have their basis in the science fiction literature. In this context, **the metaverse is often understood as a virtual world, as portrayed in films such as *The Matrix*.**

When *Tim Berners-Lee* invented the *World Wide Web* in 1989, it was impossible to foresee its implications and significance in the years to come and what it would look like in 2022. It is still a challenge to estimate how and where the Internet will develop in the next few years. We are currently seeing a similar development with cryptocurrencies such as Bitcoin and, even more recently, with the metaverse.

Metaverse core attributes

Ball (2020)[1] identifies several core attributes of the metaverse:

Persistence	It never stops, pauses, resets or ends.
Synchronization	It is a living, real-time experience.
Openness	The number of users is unlimited. Everyone can be part of the metaverse—at the same time.
Economics	Users can create, own, invest in and sell valuables.
Operating range	It is an experience that spans both digital and physical worlds, it includes private and public networks, as well as open and closed platforms.
Interoperability	Data, items, content and value is interoperable across experiences.
Diversity	The content and experiences are created and operated by a wide range of contributors.

While this overview is by no means a complete description of the attributes of the metaverse, it provides a suitable basis for the big picture. "The metaverse" is a complex digital experience that encompasses a wide variety of technical,

economic, and social aspects, and given its ongoing evolution, it is unlikely to ever fit any single definition.

Web 2.0 vs. Web 3.0

The following table provides a summary comparison between **yesterday's metaverse (*Web 2.0*) and the currently emerging form of the metaverse (*Web 3.0*)**, based on the JP Morgan report *Opportunities in the metaverse*[2].

	Web 2.0	Web 3.0
Example virtual worlds:	• Second Life • World of Warcraft	• The Sandbox • Decentraland
Organizational structure:	• Centralized ownership	• Community ownership (governance tokens and decentralized consensus)
Data storage:	• Centralized	• Decentralized
Payment infrastructure:	• Traditional (e.g. credit card/debit card)	• Cryptocurrency and tokens
Digital assets ownership:	• With platform (centralized ownership)	• With decentralized platform / community
Digital assets portability:	• Locked within platform	• Transferable
Content creators:	• Game developer	• Game developer • Community
Activities:	• Socialization • Multi-player games • Game streaming • Competitive games	• Play-to-earn games • Experiences • Web 2.0 activities
Identity:	• Platform avatar	• Self-sovereign or interoperable identity • Pseudonomous
Payments:	• In-platform virtual currency	• Cryptocurrency and tokens
Content revenues:	• Developers and app store	• Content creators • Users • Royalties on secondary trades

The metaverse? Why now?

Since games such as *World of Warcraft* or *Second Life* have existed for many years, **the metaverse is not a new phenomenon**. However, there are signs of disruptive

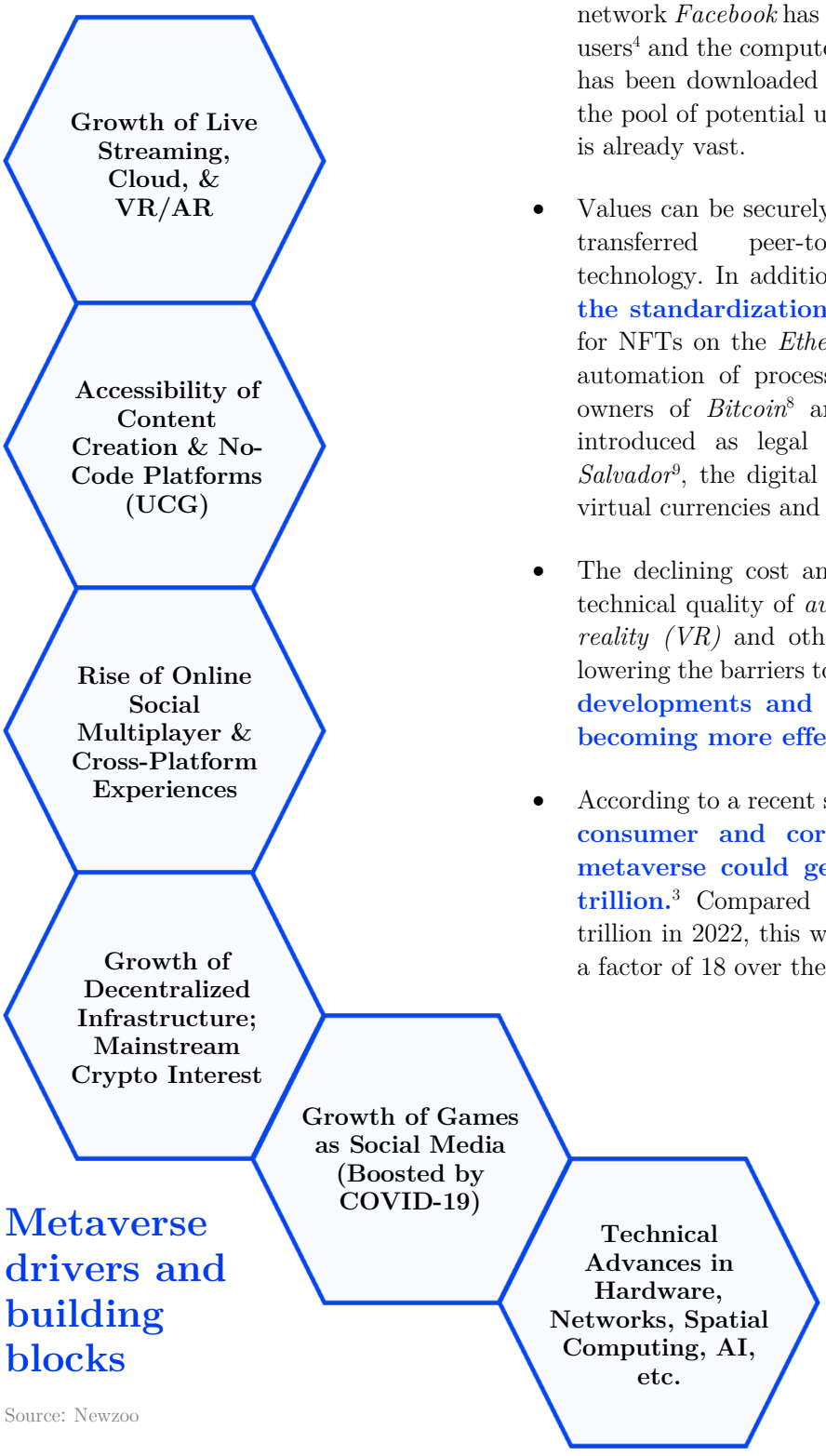
market growth that is driven by technological progress, economic growth and social change:

- Not least due to the *COVID-19* pandemic, **the level of digitalization and digital interaction is constantly increasing**. For example, social network *Facebook* has over 2.9 billion monthly active users[4] and the computer game *PUBG: Battlegrounds* has been downloaded over 1.2 billion times.[5] Thus, the pool of potential users of metaverse applications is already vast.

- Values can be securely mapped on the Internet and transferred peer-to-peer using blockchain technology. In addition, **smart contracts enable the standardization** (e.g., the *ERC-721* standard for NFTs on the *Ethereum* blockchain) and partial automation of processes.[6,7] With over 106 million owners of *Bitcoin*[8] and the cryptocurrency being introduced as legal tender in countries like *El Salvador*[9], the digital society is skilled at handling virtual currencies and goods.

- The declining cost and increasing ease of use and technical quality of *augmented reality (AR)*, *virtual reality (VR)* and other technologies are gradually lowering the barriers to entry, so **user experiences, developments and programming options are becoming more effective**.

- According to a recent study by *McKinsey*, **by 2030, consumer and corporate use cases in the metaverse could generate between $4 to $5 trillion.**[3] Compared to the value of $0.2 - $0.3 trillion in 2022, this would imply market growth by a factor of 18 over the next eight years.



Metaverse drivers and building blocks

Source: Newzoo

Section 2

Virtual Worlds, NFTs and Virtual Land

Virtual worlds

Long before blockchain became relevant, Internet users were spending considerable time in virtual worlds such as *Second Life* or *World of Warcraft*. The level of online gaming retention is evidence of the economic potential of such applications. With blockchain-based virtual worlds such as *The Sandbox* or *Decentraland*, traditional centralized applications are replaced with decentralized value and settlement layers, allowing direct economic participation and permissionless access. **For the first time, users can own a part of the world (i.e., *LAND*) and design, build on or rent it out.** They are thus economically empowered and gain "skin-in-the-game" (or rather *LAND-in-the-game?*)

Just as in traditional real estate, digital real estate markets are characterized by scarcity of land, immobility and heterogeneity.

The Sandbox virtual world

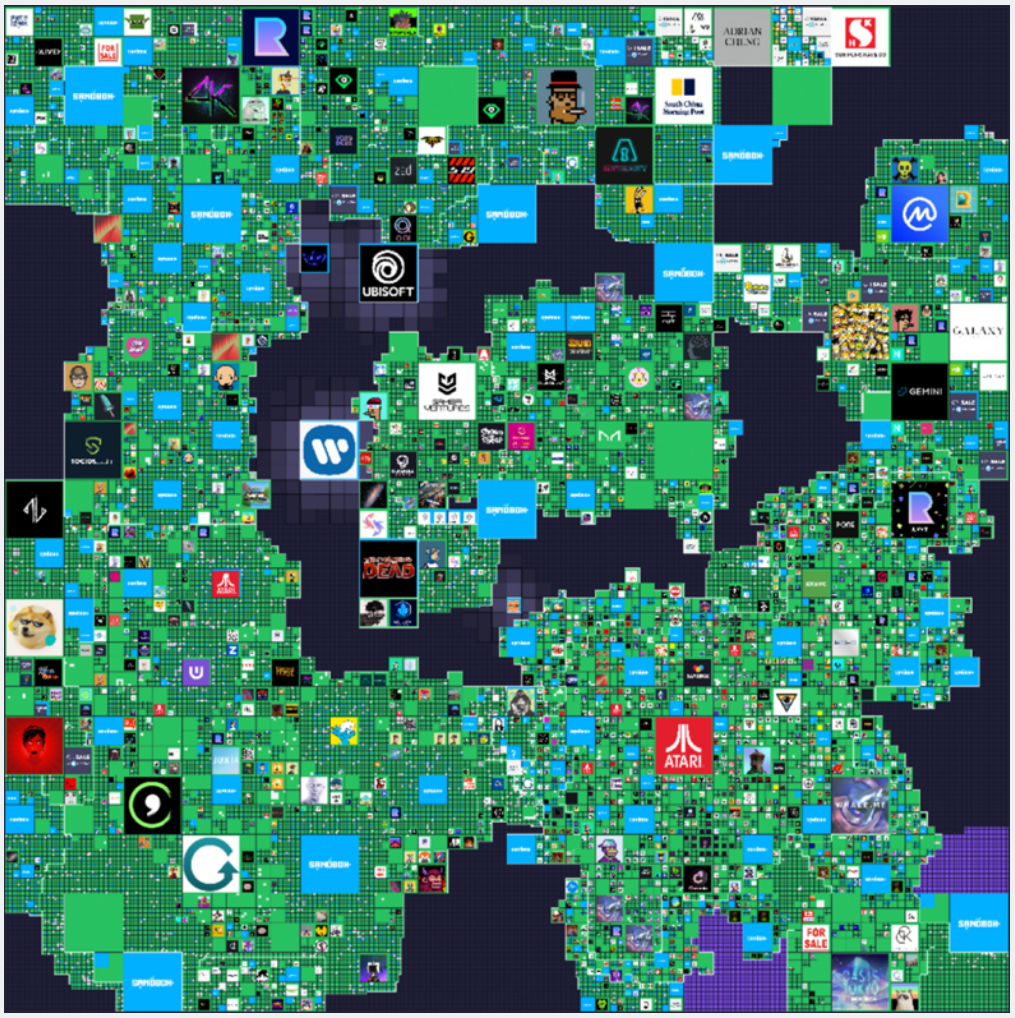
The virtual world of *The Sandbox* comprises 166,464 *LAND* parcels. Individual *LAND* can be merged to form larger *ESTATEs*.

LAND parcels are represented as NFTs that are anchored on the *Ethereum* blockchain. Owners can build on them or trade them on marketplaces such as *OpenSea* or *LooksRare*.

As of July 2022, over 21,000 people own *LAND* in *The Sandbox*.

The digital world has attracted major entertainers, brands and companies that have bought and built *ESTATEs*. Examples include *Atari, adidas Originals, Gucci, Ubisoft, Snoop Dogg*, and *Steve Aoki*.

SAND is the native fungible token of *The Sandbox*. It is used as means of payment, for governance and staking.



Source: The Sandbox

Non-fungible tokens (NFTs)

NFTs are **transferrable rights to digital or analogue assets**, such as art, in-game items, collectables or music. NFTs are unique certificates of authenticity on blockchains that are usually issued by the creators of the underlying assets. Examples from the analogue world include items of artistic or historical significance (including real estate), or rare trading cards—all of which have a long history of trading in auctions and other marketplaces. In the digital world, NFTs include, for example, profile pictures and online avatars, digital trading cards or virtual land parcels. While two land parcels or trading cards can have exactly the same properties, they will at least differ by a unique identifier, such as an ID or the geolocation in a virtual world. Prior to the dawn of NFTs, it was difficult to trade and auction non-fungible goods, as their authenticity was hard to verify. **NFTs now pave the way for the digitization and trade of unique values on the internet**[10].

Virtual land

Virtual land is a use case of NFTs. Each piece of virtual land has unique characteristics, such as its geographic location or ownership history. Even though two virtual *LAND* parcels may be the same in every other respect, the geographic location on the digital map of the virtual world makes them unique and thus non-fungible. In this way, they are basically similar to traditional real estate, which in cadastral terms is demarcated by its respective parcel with its own number.

LAND

LAND possesses different characteristics and rights, including gaming, development, entertainment, empowerment or financial rewards.

Hosting Games

One of the primary functions of *LAND* is to allow games designers, whether experienced of not, to design, build, publish and monetize digital experiences such as games and dioramas.

Playing Games

Gamers can play the games or explore the dioramas that designers publish onto *LAND*. Some of these experiences are *free-to-play (F2P)* while others are not.

Rental Management

LAND owners can choose to rent out their *LANDs* to game designers if they do not wish to develop their own *LANDs*.

Staking

By owning *LAND*, owners are able to stake tokens in the *LAND* to earn passive rewards.

Governance

Owning *LAND* gives users a voice in the governance of the metaverse. *LAND* owners will be involved in shaping the future of the platform.

Source: The Sandbox

In *The Sandbox*, **ownership of *LAND* entails various rights and opportunities**, which are described on the left. Owners can use their *LAND* for digital (and self-designed gaming) experiences or to create digital dioramas (e.g., visualizations of static landscapes or scenes). Parcels can be aggregated to form larger landholdings (so-called *ESTATEs*). Owners of virtual land may furthermore participate in economic activities such as renting or staking. Finally, *LAND* ownership comes with a range of governance rights regarding the entire metaverse. In this respect, the opportunities differ

significantly from those in the traditional real estate industry.

Virtual worlds and virtual land—where do we stand?

As of July 2022, various virtual worlds with NFT-represented virtual land have launched. The table below shows a selection of digital real estate or virtual world projects on the Ethereum blockchain and their statistics from the *OpenSea* marketplace. Note that *OpenSea* is only one option for trading digital real estate. However, being a very important trading platform, it makes for a good proxy of the overall market.

Selected virtual world projects on the Ethereum blockchain

Ranked by implied minimal valuation in USD

	All-time sales in ETH	All-time sales in million USD	Number of owners	Number of items	Floor price per item in USD	Implied minimum valuation in million USD
The Sandbox	172,400	204.45	21,500	159,000	2,609	414.84
Otherside	314,900	373.45	35,100	100,000	3,368	336.80
Decentraland	241,700	286.64	7,400	97,600	2,751	268.53
NFT Worlds	46,800	55.50	780*	10,000	4,056	40.56
Treeverse Plots	15,000	17.79	3,500	10,400	1,376	14.31
Voxels	25,100	29.77	2,400	7,900	1,020	8.06
Worldwide Webb Land	24,800	29.41	4,500	9,500	617	5.86
Netvrk Land	4,700	5.57	3,200	10,200	451	4.60
Somnium Space VR	26,900	31.90	4,600	5,800	534	3.10
Arcade Land	18,200	21.58	5,400	10,000	249	2.49
Matrixworld	2,200	2.61	1,000	1,800	510	0.92

Source: *OpenSea* data for the *Ethereum* blockchain, obtained in early July 2022. The number of parcels refers to the amount of transferable assets in circulation. * The actual number of owners is likely over 4,700.

The projects have a **combined trading volume of over $1.2 billion** based on *Ethereum*'s daily rate in early July, 2022. **With a minimum valuation of all its of parcels of *LAND* of over $400 million, *The Sandbox* is the most valuable virtual world.** Two other projects—*Otherside* and *Decentraland*—have a similarly high valuation. Importantly, note that **this minimum valuation is a conservative estimate**, having been obtained by multiplying the number of items or digital parcels only by the so-called floor price. The floor price is the value at which a *LAND* can be sold immediately at a given point in time (i.e., it is based on the highest "buy-now" price for *LAND* on NFT marketplaces). This price is significantly lower than the price expectations and implied values of all *LAND* parcels or special parcels, which will carry a higher value for a variety of reasons.

For example, considering that the actual average price paid for *LAND* in *The Sandbox* over time through April 2022 is approximately $6.639, it seems unlikely that *LAND* will trade at the floor price, which in July 2022 stands at $2.609. **Using the average price paid for *LAND* in *The Sandbox* yields a valuation of over $1 billion.**

LAND ownership concentration varies widely

If we divide the number of virtual parcels by the number of their users or owners, we see that **in the case of *The Sandbox*, users own an average of 7.4 *LANDs*.** This value is almost twice as high (13.2) for *Decentraland* but significantly lower (2.85) for *Otherside*. Interpretation of these figures is difficult due to a lack of historical experience and data. On the one hand, less *LAND* per user may indicate more widespread or retail use; on the other hand, *The Sandbox*, for example, uses the feature of *ESTATEs*, in which multiple *LAND* parcels are grouped and sold together. Thus, the level of ownership concentration may primarily be a function of the idiosyncracies of each virtual world. One possible interpretation would be that different motives for ownership prevail in the different worlds. If the goal is to build up a digital identity or online presentation, then one parcel could be enough. But if on the other hand the goal is to invest or speculate, there is no obvious reason to stop after the first one.

Section 3

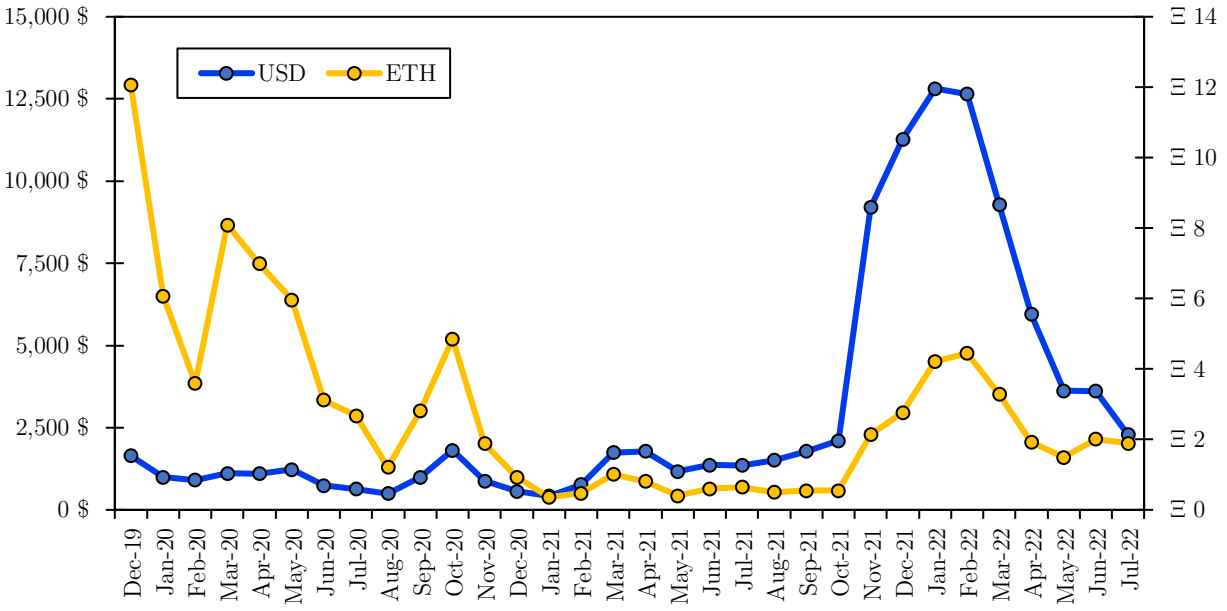
Returns of LAND

The price of LAND

The figure below shows the average monthly price of Sandbox *LAND* in USD (blue) and in ETH (gray), based on data from *NFTPort*. ETH is the prevalent currency on the decentralized NFT exchange *OpenSea* and many LAND sales take place via ETH payments.

The USD price of *LAND* rose at a moderate pace following the launch in December 2019 but then spiked at the end of 2021. The spike in *LAND* pricing can likely be explained due to the attention and hype from *Facebook* rebranding to *Meta* and the fact that *The Sandbox* conducted many primary sales of *LAND* during this phase. ***LAND* prices clearly benefited from the overall growth of the NFT market but subsequently dropped again.** NFT markets are highly interrelated, which means that the price, use and trading volume of *LAND* are (also) driven by spillover effects from other NFT projects.[11] Yet, **regardless of the extraordinary spike in late 2021, a positive price trend for *LAND* is evident.** *LAND* traded below $1,700 on average in December 2019 and was priced more than twice that on average by May 2022 ($3,600).

LAND price in USD and ETH per month



In terms of ETH, the price of *LAND* declined, with some fluctuations, until October 2021, at which point it experienced the same spike, though less pronounced, as in USD.

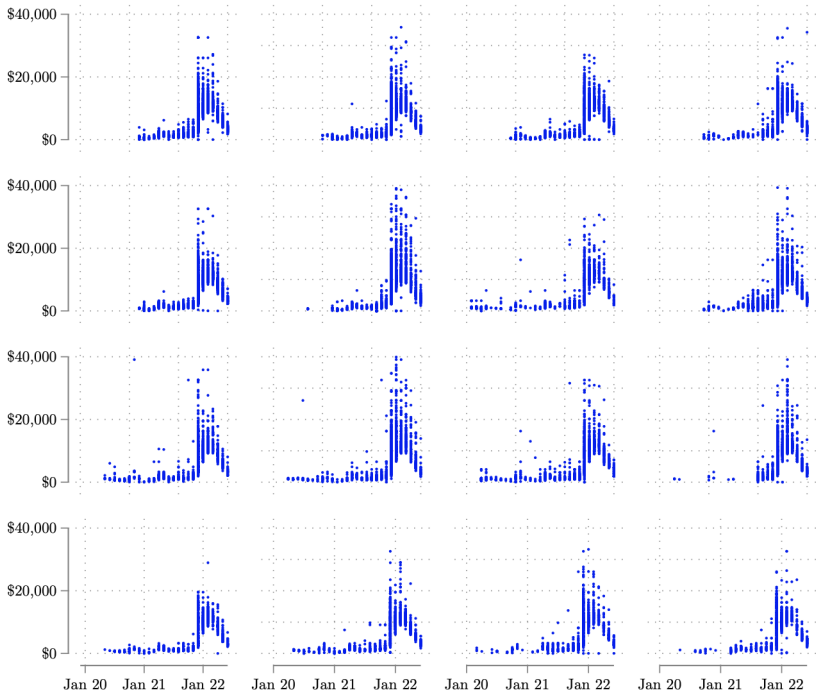
Subdivision into sectors

To investigate any spatial patterns in the pricing of *LAND*, we divided the square map of *The Sandbox* into 16 equal-sized sectors of 102 x 102 (or 10,404) LAND each. This allowed us to verify whether the geolocation of *LAND* affects its pricing. Similarly to traditional real estate markets, it is conceivable that sectors / neighborhoods with a longer or in some sense more distinguished history are valued differently from younger sectors. the same time, it must be pointed out, that the land in *The Sandbox* was not made available all at once but rather continues to expand.

LAND prices over time by sector

Each square shows the unit price of *LAND* sales by sector over time, with each blue dot representing a sale.

The price trends in the sectors are clearly quite similar. The highest prices were achieved around January 2022, after which there has been some decline. Before that, prices rose steadily, with the speed of increase and the prevalence of outliers differing from sector to sector. It is also evident that *LAND* trading began much earlier in some sectors than in others.

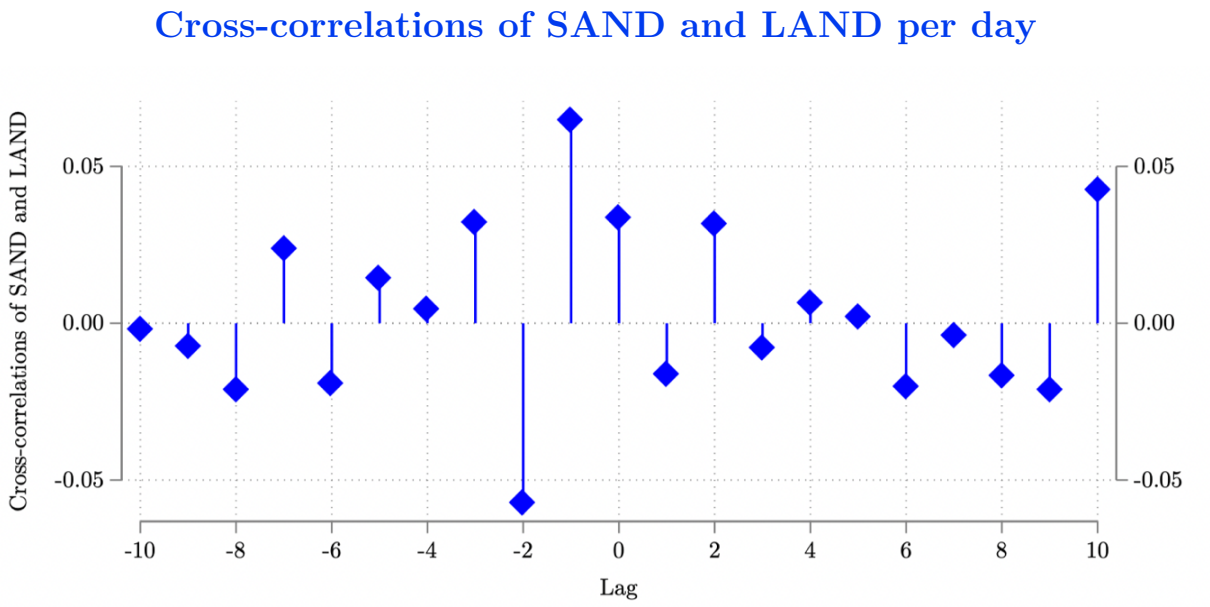


Are LAND and SAND returns related?

SAND is the native crypto asset of *The Sandbox*, and it can be used to buy new *LAND*, for example. This relationship suggests that ***LAND* returns may correlate with *SAND* returns**. For example, it is conceivable that rising *SAND* prices serve to improve the liquidity of *The Sandbox* community, and that this has a positive effect on *LAND* prices and thus returns.

The following figure shows cross-correlations between *LAND* and *SAND* based on daily data. **Cross-correlation is a measure of the similarity between two variables' time**

series as a function of the displacement of one relative to the other. It can be used to objectively determine how well two time series—such as *LAND* and *SAND* returns—match up and at what point (i.e., lag) they best match.



At lag 0, there is positive immediate correlation between *LAND* and *SAND* returns, which indicates that price increases in *SAND* are associated with an immediate price increase in *LAND*. The largest effect occurs at lag -1, indicating a positive relationship between *SAND* returns and *LAND* returns of the previous day. However, **the cross-correlations are very small, so the mutual impact between the two crypto assets is clearly limited.**

Are LAND returns causally influenced by SAND returns or vice versa?

A statistical relationship (i.e., correlation) does not imply causal influence. We therefore applied a further statistical approach, *Granger causality*, to examine any causal interactions between *LAND* and *SAND* returns. Ultimately, we identify that **there is no causal relationship between the returns of the two crypto assets**. *SAND* returns do not influence *LAND* returns, nor vice versa. The detailed results of this non-finding are not presented here.

Do LAND owners drive LAND returns?

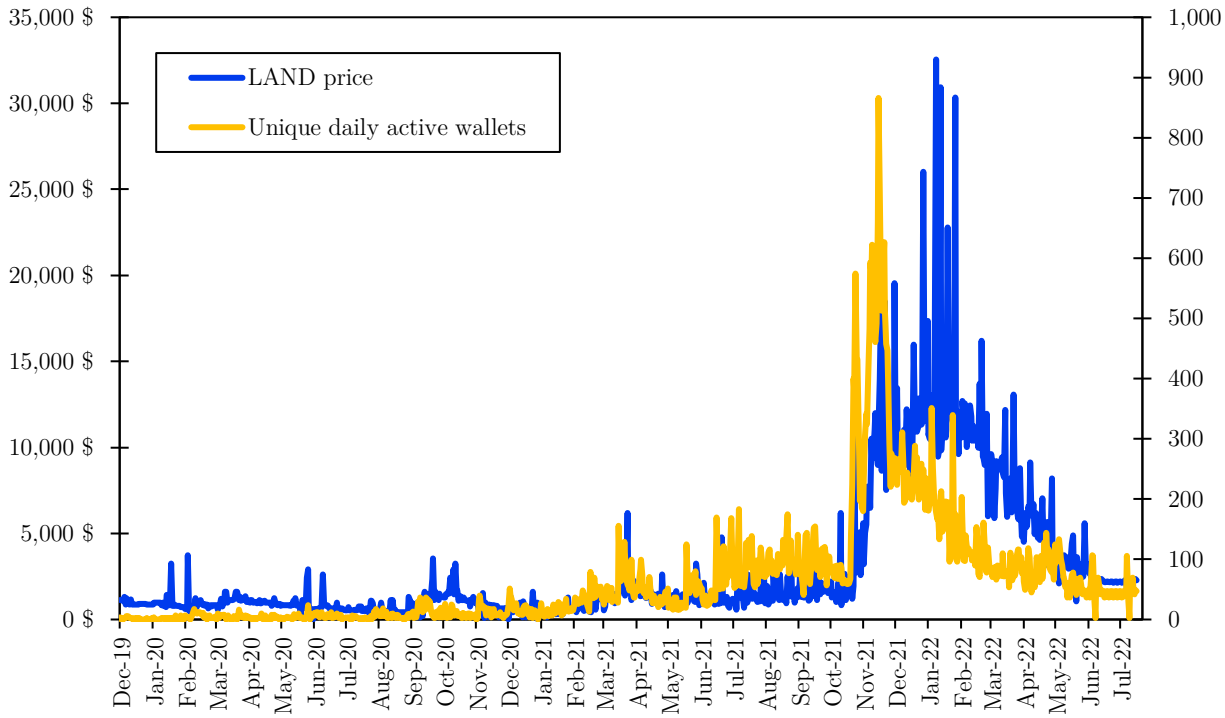
The transparency of blockchains allows us to identify the number of blockchain wallets that own *LAND*, and use this as a proxy for the number of *LAND* owners - subject to the

condition that a user can have multiple wallets or that multiple users may share a wallet.

As the figure below shows, **the number of unique wallets (i.e., users) of *The Sandbox* that are active each day increased continuously until December 2021**, at which time over 850 unique wallets bought or sold *LAND* on a single day. The average value over the whole period is about 67 unique blockchain wallets per day—32 unique sellers and 35 unique buyers. Over time, the graph shows an increasing trend of the function 0.2139x – 9,401.

Interestingly, **the peak in *LAND* price occurred well after the peak in the number of users.** This suggests the possibility of a causal relationship, which we explore further.

Unique daily active wallets and LAND prices per day

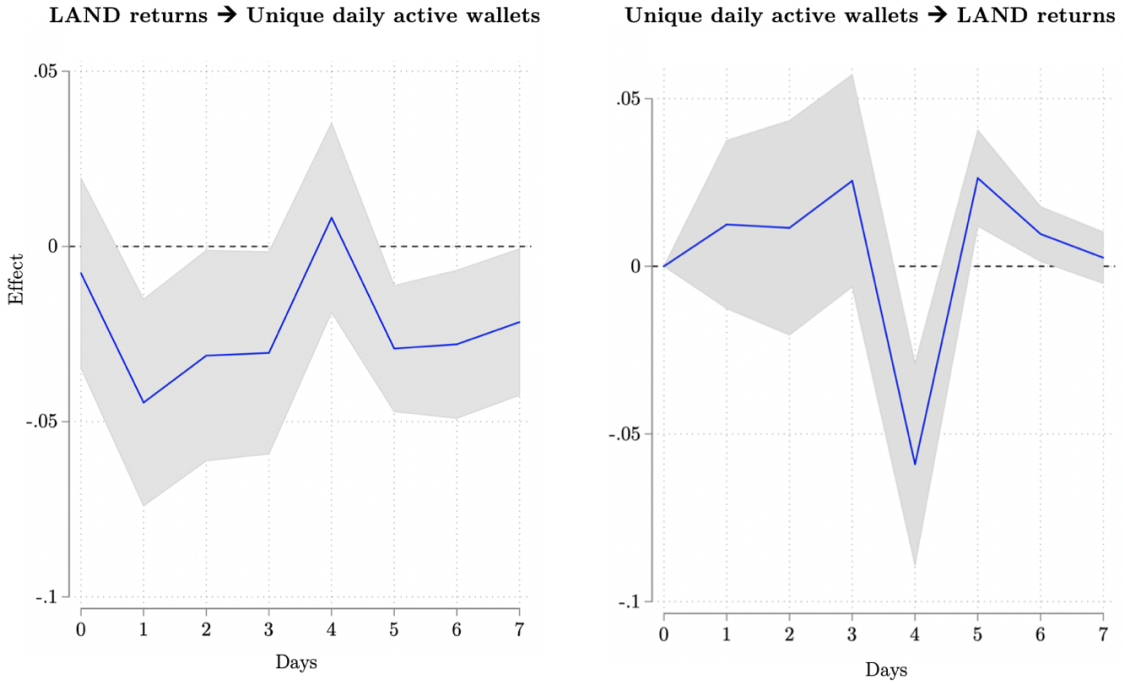


Estimating the causal effects between unique wallets and LAND returns

As above with respect to the cryptocurrency *SAND*, we looked for *Granger causality* between *LAND* returns and unique wallets. This time, however, we found significant interactions. ***LAND* returns have a causal impact on unique daily active wallets, and vice versa**.

Since *Granger causality* can only identify a causal relationship but not its direction (i.e., positive or negative), ***impulse response functions* are visualized below**. As the name suggests, they indicate how an impulse of one variable affects the other variable over time (here seven days). The blue line shows the mean value, while the gray area represents a 95% confidence interval.

The causal effect of LAND returns on unique daily active wallets and vice versa



We identified that positive *LAND* returns tend to reduce the number of unique active wallets. **A price increase of 1% for *LAND* results in a reduction of unique wallets by about -0.04% on the following day**. With the exception of the fourth day, the effect remains consistently negative and significant over seven days.

Conversely, an increase in unique wallets initially leads to a (statistically insignificant) increase in *LAND* prices, which reverts on day four and goes significantly negative before turning positive again on day five and leveling off thereafter. **In summary, we find significant interaction between the two metrics, which can help market participants, users and traders to better assess prospective developments, potentials or risks.**

Section 4

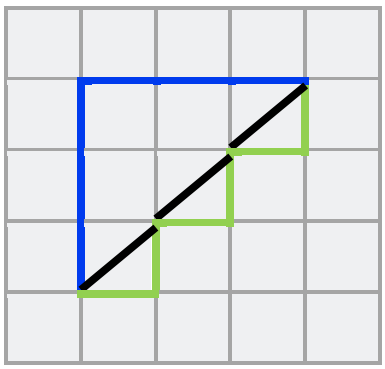
The role of geography in LAND pricing

The drivers of LAND prices

This section uses the example of *The Sandbox* to examine the influence that fundamental aspects of virtual worlds have on the prices of virtual land. Therefore, we focused on an internal characteristic of *LAND*—geographic location. More specifically, we identified potentially influential clusters of land—so-called *ESTATEs*—in the virtual world and analyzed their impact on the prices of the surrounding virtual land.

Measuring distance in a virtual world

The digital world of *The Sandbox* consists of a square matrix of 408 x 408 (=166,464) *LAND* parcels. Two alternative measures of the distance between any two parcels suggest themselves:



The blue and green paths indicate *Manhattan Distance*, the black path shows *Euclidian Distance*.

- **Manhattan Distance**, also called *city block distance*, is calculated as the sum of the absolute differences between two vectors, which can be formally expressed as $d(x,y) = \sum_{i=1}^{n} |x_I - y_i|$. As visualized on the left, both the blue and the green path have a distance of 6. *Manhattan distance* is particularly suited for grid structures through which there are no diagonal paths.

- **Euclidian Distance**, visualized as the black line, is the straight-line distance between two points and calculated according to the *Pythagorean theorem* as $d(x,y) = \sqrt{\sum_{i=1}^{n}(x_I - y_i)^2}$.

Since the two metrics are very highly correlated, we limited ourselves to presenting results for *Manhattan distance*. Nevertheless, the question of whether distance can or should have any relevance at all in a digital world has its justification. The following analysis aims to contribute to a better understanding of this phenomenon.

Identification of high-profile ESTATEs

Most likely, a crucial reason for the rapid growth in adoption and popularity of The Sandbox is that **a large number of companies, brands and well-known people own *LAND*** and use it for various purposes, such as marketing, digital concerts or online stores.

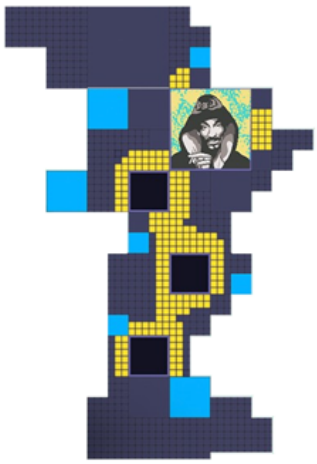
In many cases, these 'celebrity' *LAND* holdings involve official **partnerships that result in official primary *LAND* sales in the geographic vicinity**. For example,

High-profile LAND owners in The Sandbox

(Selection, sorted A-Z)

adidas Originals	(*Sportswear manufacturer*)
Atari	(*Entertainment electronics*)
Binance	(*Cryptocurrency exchange*)
Bored Apes Yacht Club	(*NFT project*)
Care Bears	(*Comic franchise*)
Coinmarketcap	(*Crypto data provider*)
deaudmau5	(Music producer)
Gemini	(*Cryptocurrency exchange*)
Gucci	(*Fashion company*)
Pranksy	(*NFT investor*)
Smurfs	(*Comic franchise*)
Snoop Dogg	(*Rapper*)
South China Morning Post	(*Newspaper*)
Steve Aoki	(*DJ*)
The Walking Dead	(*Television series*)
Ubisoft	(*Video game company*)
Warner Music Group	(*Entertainment label*)

the partnership with *Snoop Dogg*[12] resulted in two official *LAND* sales where different types of *LAND* were offered by *The Sandbox*. In such a primary sale, *LAND* prices are set by the Sandbox or an auction mechanism is used.



- 598 regular *LAND* parcels were offered for a fixed price of 1,011 *SAND* each.
- 212 *premium LAND* parcels (**yellow**) were offered for a price of 4,683 *SAND* each. All of these parcels are in close proximity to larger *ESTATEs*.
- Finally, 6 small, 3 medium and 1 large *ESTATEs*, i.e., *LAND* bundles were sold by auction on the NFT marketplace *OpenSea*. **Blue** *LAND* parcels are reserved for *The Sandbox* organization for future use.

This example shows that the initial sale of "regular" or "premium" *LAND* parcels by *The Sandbox* defines geographic location as highly relevant. **If certain parcels already catch higher prices on the primary market, it can be assumed that higher prices will also be demanded or paid on the secondary market.**

On the left side, the **17 *ESTATE*-owning prominent brands and individuals are listed that we selected to investigate their effect on *LAND* pricing**. While this selection could clearly be expanded, we think that this sample allows a representative evaluation of the relationship between particular *ESTATEs* and *LAND* pricing. For *Atari* and *Binance*, we found two major *ESTATEs* each, whereas the other entities are only associated with one *ESTATE* each. They may, however, have additional holdings in *The Sandbox*.

LAND pricing near high-profile ESTATEs

The table below shows *Pearson* **correlation coefficients between *LAND* prices and proximity to the high-profile *ESTATEs***. For each *ESTATE*, we consider only sales that occurred after the announcement of the partnership, where applicable. For non-partnership *ESTATEs*, we start from the mint/purchase date on the blockchain. The data are from *NFTPort*.

Correlation coefficients between LAND prices and proximity to high-profile ESTATEs

Statistically significant results at the 95%-level are highlighted in blue.

Correlation is a statistical metric that describes the degree to which two variables are linearly related, i.e., whether they tend to move together, or in opposite directions. For example, the positive and significant correlation of 0.17 between the 24 x 24 *Atari ESTATE* and *LAND* prices up to 10 blocks away indicates that ***LAND* is valued more highly the closer it is to the *ATARI* estate**.

	Proximity to ESTATE (Manhattan distance)					
	≤ 2	≤ 5	≤ 10	≤ 20	≤ 50	≤ 100
adidas Originals	-	-	0.27	0.33	0.11	0.02
Atari (24 x 24)	0.21	-0.01	0.17	0.12	0.05	0.05
Atari (12 x 12)	0.32	0.23	0.30	0.24	0.09	0.00
Binance (North west)	-	0.27	-0.05	0.38	-0.07	0.11
Binance (South east)	0.25	0.16	0.06	0.11	0.08	-0.03
Bored Ape Yacht Club	0.40	0.34	0.27	0.11	0.10	0.09
Care Bears	0.33	0.16	0.09	0.02	0.03	-0.05
Coinmarketcap	0.32	0.21	0.06	0.03	0.05	0.04
deaudmau5	-0.26	0.51	0.24	0.04	0.08	0.08
Gemini	0.18	0.09	0.17	0.09	0.04	0.06
Gucci	-	-	-0.05	0.53	-0.18	0.26
Pranksy	0.17	0.24	-0.10	-0.03	-0.12	-0.05
Smurfs	0.24	0.07	0.20	0.04	0.04	-0.03
Snoop Dogg	0.02	0.32	0.40	0.44	0.50	0.33
South China Morning Post	0.10	0.18	-0.01	0.11	0.19	0.03
Steve Aoki	-0.10	0.52	0.19	0.36	0.46	0.31
The Walking Dead	0.58	0.32	0.20	0.21	-0.02	-0.07
Ubisoft	-	-0.31	-0.41	0.20	0.08	0.03
Warner Music Group	-	-	-	0.39	0.34	0.06

We identify significant results for 16 of the 19 *ESTATEs* considered, suggesting that distance to high-profile *ESTATEs* is indeed a price driver. Regarding *Care Bears*, for example, we find that proximity to the *ESTATE* is a significant correlate of higher prices. Within a distance of two

blocks, the correlation coefficient is 0.33; at up to five, 0.16; and at up to ten, 0.09—all statistically significant. Similar results are obtained, e.g., for *Binance (South east)*.

However, within two blocks of the high-profile *ESTATEs*, these two projects are the only ones to feature significantly positive coefficients. This is probably because in the entire transaction history of *The Sandbox*, very few *LAND* sales have taken place within such a small radius. Within five blocks, the data basis is much stronger, allowing us to identify consistently positive significant correlation coefficients in eight projects here. This number increases to nine within ten blocks and even to eleven within 20 blocks, where **all significant effects are positive, suggesting a positive link between the proximity to high-profile *ESTATEs* and *LAND* pricing.**

At greater distances, we find even more significant values, but these are smaller and, in some cases, even negative. This is probably because above a certain distance, other *ESTATEs* also influence *LAND* prices, hence blurring the identified effect. Additional variables which this analysis does not account for, such as other influential neighbor *ESTATEs*, timing, NFT or cryptocurrency momentum or investor attention may also influence *LAND* pricing. Thus, consistent and/or significant correlation results should be seen as an indicator that a) there is a relationship that b) may be worth exploring in more detail.

In the table above, the classes of distances overlapped in that the larger distances also encompassed the smaller ones, i.e., each 'larger' model includes the former 'smaller' ones. Consecutive columns of the table thus represented ever larger circles around an *ESTATE*. On the contrary, the second correlation table below shows distinct bands of distances, i.e., rings around an *ESTATE*. For example, the '3 to 5' column shows results for *LAND* parcels located within a *Manhattan distance* of 3, 4, or 5. Generally, however, **the results are similar to those presented above**. Within these narrower bands of distances, the significant results are consistently positive, although less pronounced (only 5 projects).

The *ESTATEs* of *Atari*, *Coinmarketcap*, *South China Morning Post*, *Smurfs*, *Snoop Dogg*, *Bored Ape Yacht Club*, and *Steve Aoki* exhibited strong and significant positive correlations, which indicates that they could be particularly influential.

Correlation coefficients between LAND prices and proximity to high-profile ESTATEs

Statistically significant results at the 95%-level are highlighted in blue.

	Proximity to ESTATE (Manhattan distance)				
	3 to 5	6 to 10	11 to 20	21 to 50	51 to 100
adidas Originals	-	0.27	0.07	-0.05	0.02
Atari (24 x 24)	0.32	0.22	0.15	-0.00	0.05
Atari (12 x 12)	0.21	0.03	0.02	0.04	-0.07
Binance (North west)	0.09	0.10	0.03	0.07	0.13
Binance (South east)	-0.15	0.08	0.02	0.07	0.01
Bored Ape Yacht Club	-0.07	0.33	-0.06	0.08	0.09
Care Bears	0.00	-0.02	-0.04	-0.01	-0.06
Coinmarketcap	0.26	0.12	-0.01	0.02	0.13
deaudmau5	0.35	-0.09	0.12	-0.05	0.00
Gemini	-0.13	0.17	0.19	-0.09	0.02
Gucci	-	-0.00	0.17	-0.24	0.30
Pranksy	0.09	0.17	-0.03	-0.07	-0.05
Smurfs	0.07	0.21	-0.06	0.01	0.05
Snoop Dogg	0.07	0.24	0.18	0.13	0.00
South China Morning Post	0.32	-0.07	0.13	0.13	-0.06
Steve Aoki	0.33	-0.07	0.23	0.21	-0.02
The Walking Dead	-0.28	0.16	0.15	0.02	-0.01
Ubisoft	-0.50	-0.21	-0.08	0.01	0.05
Warner Music Group	-	-	0.16	0.25	0.11

The findings indicate that **it could pay off to own or purchase *LAND* next to *ESTATEs* owned by well-known people, brands or entities.** This question will be further explored in the next section.

Section 5

The impact of high-profile LAND owners

Enter the Snoopverse: Snoop Dogg's ESTATE consists of 144 LANDs (12 x 12)

The effect of high-profile LAND owners on digital real estate prices

This chapter uses the example of *The Sandbox* to examine the extent to which individual high-profile *LAND* or *ESTATE* owners have an impact on the prices of nearby *LAND*.

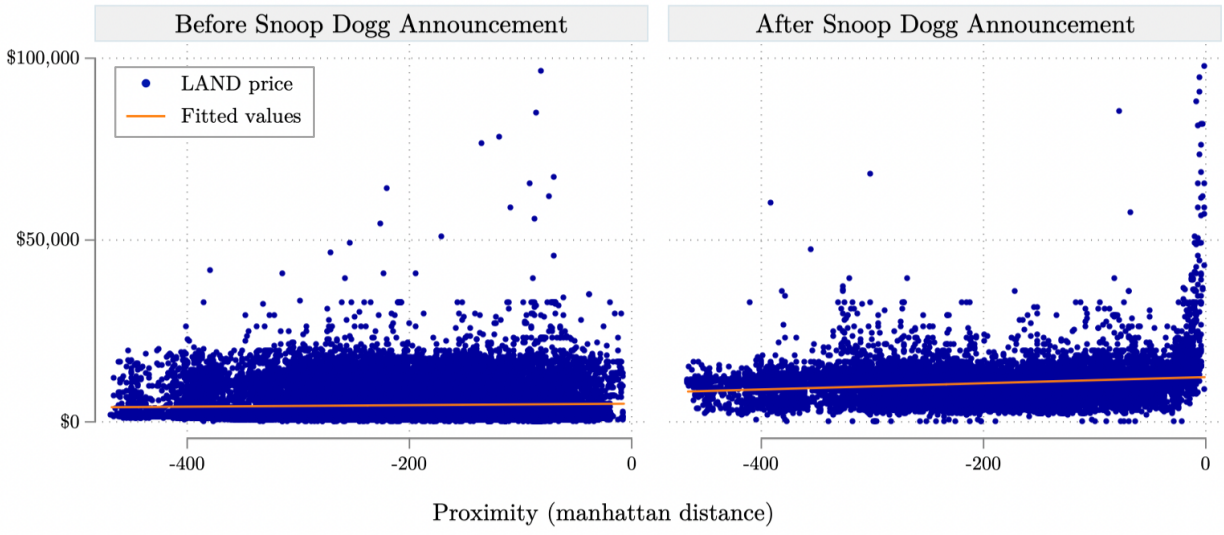
Having Snoop Dogg for a neighbor

On September 23, 2021, it was announced that **rapper *Snoop Dogg* partnered with *The Sandbox* on creating his virtual mansion**[12]. For this purpose, he has received 144 *LANDs* in the *Sandbox*—whether they were bought, given or rented is not subject to public information. Using *Manhattan distance* as a measure, we analyze how the prices of *LAND* near *Snoop Dogg*'s mansion changed in response to the announcement.

The figure below plots the prices of **all *LAND* sales before and after the partnership announcement against the distance to *Snoop Dogg*'s *ESTATE***. A few *LAND* sales with prices in excess of $100k are excluded from the plots, but are reflected in the orange lines of fitted values. The lines intuitively show that proximity to *Snoop Dogg*'s *ESTATE* raised *LANDS* prices after the announcement, as also evident from the many sales of high-priced *LAND* located very near the *ESTATE*.

LAND prices before and after the Snoop Dogg partnership announcement

Prices are mapped in relation to the proximity to *Snoop Dogg*'s *ESTATE*.



The orange line results from linear regression, which after the announcement (right-hand figure) yields **a statistically significant effect of $8.51** (95% confidence interval between $7.79 and $9.24) **per *LAND* as we move closer to *Snoop Dogg*'s *ESTATE* by one unit of distance.** Prior to the announcement, the effect was insignificant. Proximity to *Snoop Dogg*'s *ESTATE* thus constitutes a significant driver of *LAND* prices in *The Sandbox*.

The results can also be described, or rather approximated, by way of examples as follows:

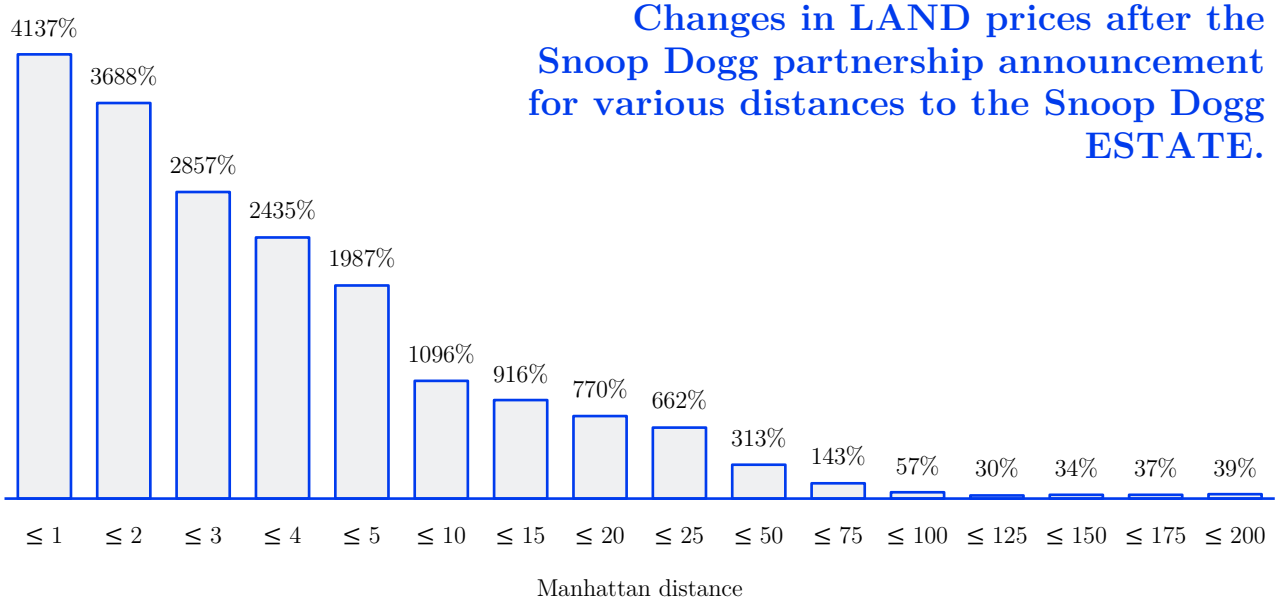
- ***LAND* that is directly adjacent to *Snoop Dogg*'s *ESTATE* is predicted to be worth $12,291** (the constant term of the regression model).

- **For each unit of distance that a parcel of *LAND* is located away from his *ESTATE*, its price drops by $8.51.**

- **The price of a piece of *LAND* at distance x equals $12,291 - x * $8.51**. *LAND* that is 10 units away from the *ESTATE* is therefore predicted to be worth $12,291 - 10 * 8.51 = $12,205.9.

- At 100 units out, the value drops by $851 relative to *Snoop Dogg*'s immediate neighbors, and **at a distance of 400, average *LAND* prices are lower by $3,404.** Although the result is technically correct, it can be assumed that the price of *LAND* at a distance of 400 from *Snoop Dogg*'s *ESTATE* is predominantly driven by other influencing factors. Hence, these figures should be interpreted with caution.

For another piece of analysis, we adjusted the prices for the average increase before and after the announcement: *LAND* traded for an average of $1,398 before September 2021 and $9,114 after the announcement, a 652% rise. ***LAND* within a distance of 25 traded for $1,368 before versus $17,979 after the *Snoop Dogg* announcement, a gain of 1,314%.** From this we subtract the market return of 652% to arrive at an **abnormal return of 662%**, which we attribute to the proximity to *Snoop Dogg*. For shorter distances (≤20), we use the historic overall market return as a basis, due to the low number of transactions.



Changes in LAND prices after the Snoop Dogg partnership announcement for various distances to the Snoop Dogg ESTATE.

Close proximity to *Snoop Dogg*'s *ESTATE* clearly entailed a significant price effect, which declines with distance but remains consistently positive. The greater the distance, the greater the role that other factors are likely to play in price formation. For example, *Steve Aoki*'s *Playhouse* and the Atari and *Smurfs ESTATEs* are comparatively close.

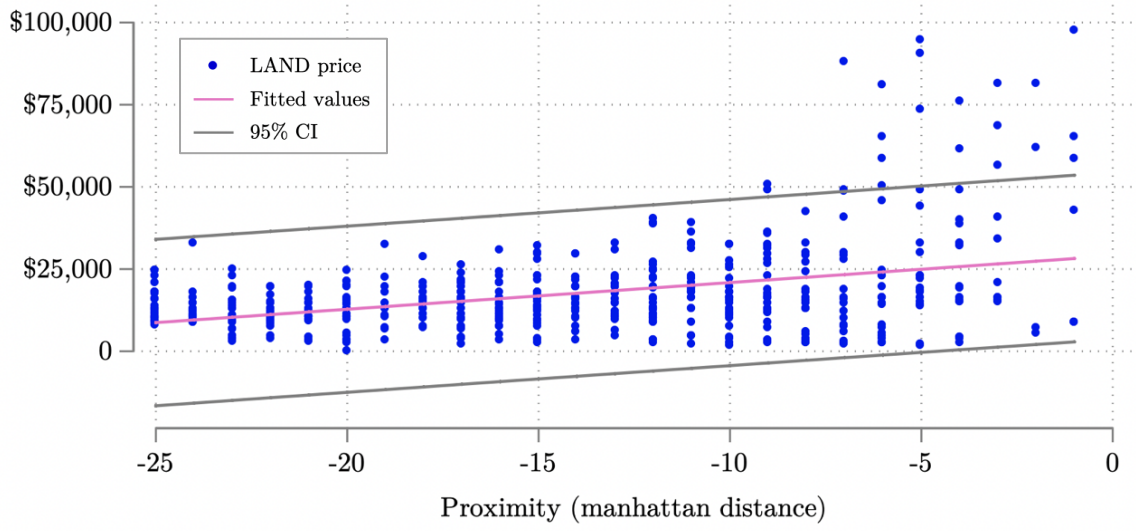
***LAND* with a distance of 1 from *Snoop Dogg*'s *ESTATE*, i.e., direct neighbors, sold for an average value of $66,951, which translates to an abnormal price effect of 4,137%.** The effects decline steadily, yet remain very large—over 1,000%—inside a distance of 10 to the *ESTATE*.

In the figure below, the results of a linear regression of the price of *LAND* (dependent variable) on the distance to the *ESTATE* of *Snoop Dogg* (independent variable) are visualized. Within the study, only *LAND* sales after the announcement and within a *Manhattan distance* of 25 are examined. Each blue dot indicates the price and distance of a *LAND* sale. The pink line shows the linear trend of the regression analysis, the gray lines visualize 95% confidence intervals.

In this sample, **for each unit decrease in distance, the price of *LAND* increases by an average of $811.** The result is statistically highly significant. Thus, it can be concluded with a high degree of certainty that **for each unit decrease in distance, the *LAND* price increases by $645 to $978.** If the sample is, e.g., extended to a distance of 50, this also yields a highly significant result ($284 per unit of distance).

Regression of LAND prices on the proximity to Snoop Dogg's ESTATE

The sample only includes *LANDs* inside a radius of 25 from *Snoop Dogg*'s *ESTATE*.
N = 534 | R-squared = 0.15 | Coef. (SE) = 811 (85) | t = 9.6



Location as a quality signal

This first glimpse at the pricing of *LAND* has revealed that **location is a crucial factor in the virtual world of *The Sandbox***. In light of the laws of traditional real estate markets, this comes as no surprise. In virtual worlds, however, transportation or travel, which are determining site factors in the traditional real estate industry, are not an issue. Accordingly, it can be assumed that, e.g., **proximity to high-profile *ESTATEs* is a quality signal that makes *LAND* more valuable**, as suggested by *Signaling Theory*[13].

The social psychology concept of *transference* means that past information and relationships are transferred to future relationships[14]. Thus, when potential *LAND* buyers see a well-known personality such as *Snoop Dogg* acquire *LAND* in *The Sandbox*, they transfer their view of this person onto *The Sandbox* or the specific area within it. If one assumes that people have rather positive views of *Snoop Dogg*, this may explain why they are willing to pay a premium for being in his neighborhood, or buyers hope that the popularity of *Snoop Dogg* will also have an impact on their reputation and thus the value of their *LAND*. This way of thinking does not necessarily mean that the buyers actually like *Snoop Dogg*. Following the concept, the only thing that matters is that others like him.

The project Weedbits is located directly next to Snoop Dogg's ESTATE.

A homogeneous community and collective digital identity?

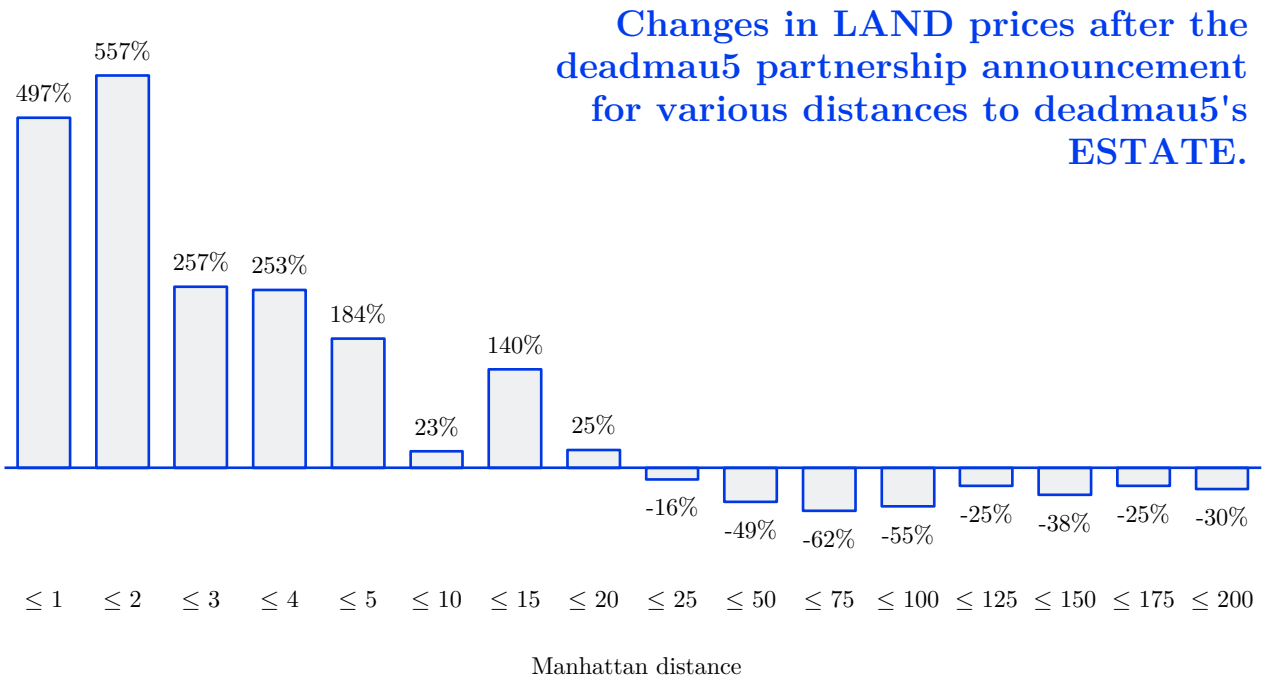
Another possible phenomenon is that, similar to a *halo effect*, *LAND* owners in the neighborhood of significant *ESTATES* hope that spatial proximity will transfer to proximity in terms of other properties. Having bought and built on *LAND* next to *Snoop Dogg*, the NFT project *Weedbits* may be able to make potential NFT buyers feel that they possess similar values as *Snoop Dogg*. LAND around *Snoop Dogg*'s *ESTATE* may represent a homogeneous community with a collective digital identity towards, e.g., cannabis. While identity and community development in general takes a long time, the fact that *Snoop Dogg* now owns an *ESTATE* in *The Sandbox* can cause existing online or offline communities to regroup and reassemble in a new venue (the digital world of *The Sandbox*).

If you don't like rap, how about electronic music?

deadmau5's ESTATE "only" covers 9 LANDs (3 x 3)

In October 2021, *The Sandbox* announced a **partnership with electronic music producer *deadmau5***[15]. Similar to the previous analysis, we assessed how *LAND* prices in various distances around the *deadmau5 ESTATE* were affected by the announcement. The relative price changes after the announcement, adjusted for the general market return, are shown in the diagram below.

In close proximity to the *ESTATE*, we again find large positive effects, yet they are much smaller than in the case of *Snoop Dogg*, and they already turn negative beyond a distance of 20. It appears that *deadmau5*'s arrival simply did not garner quite as much attention as *Snoop Dogg*'s. The *deadmau5 ESTATE* is located in the northwest of the map, while *Snoop Dogg*'s *ESTATE* is significantly further south.



When regressing the price of *LAND* sales inside a radius of 25 on proximity to the *ESTATE*, we obtain a positive yet statistically insignificant effect. This suggests that the overall impact or relevance of *deadmau5*'s *ESTATE* in *The Sandbox* is limited.

Enter Aoki's playhouse

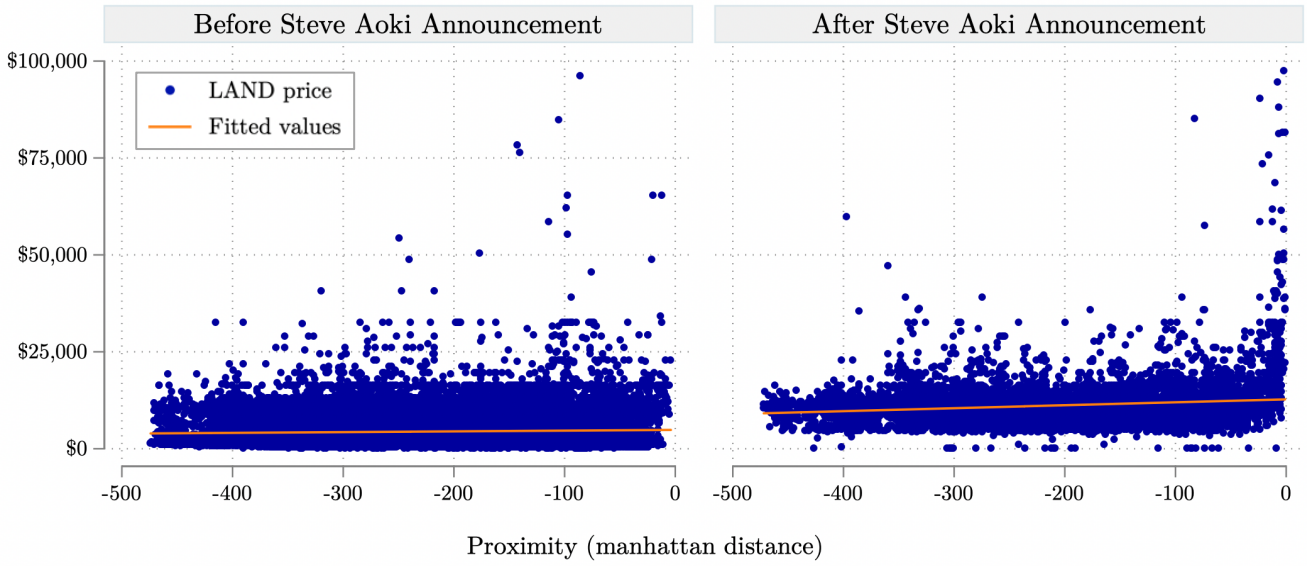
Another electronic music artist or DJ in *The Sandbox* is *Steve Aoki*, whose partnership was announced in December 2021. He retweeted *The Sandbox* announcement, asking "*won't u be my neighbor??? 😉*".

In the figure below, *LAND* sale prices are again visualized as a function of proximity to *Steve Aoki*'s *ESTATE*, both before and after the announcement of the partnership. Interestingly, **both graphs produce statistically significant results, indicating that *Aoki* settled in an area that was already particularly expensive before he arrived.** *LAND* prices averaged $5,094 across more than 31,000 sales prior to the announcement and about $10,402 across over 13,000 sales afterwards.

Per unit of *Manhattan distance* that we move closer to the *ESTATE*, prices increase by $2.28 pre-announcement and by $6.85 post-announcement. **Accordingly, *LAND* right next to *Aoki*'s *ESTATE* costs $2,740 more on average than *LAND* at a distance of 400.** We can thus conclude that the partnership further raised the already high *LAND* prices in this particular part of *The Sandbox*.

LAND prices before and after the Steve Aoki partnership announcement

Prices are mapped in relation to the proximity to Aoki's Playhouse.



Most LAND beside the adidas Originals ESTATE is still vacant.

The right shoes for the metaverse

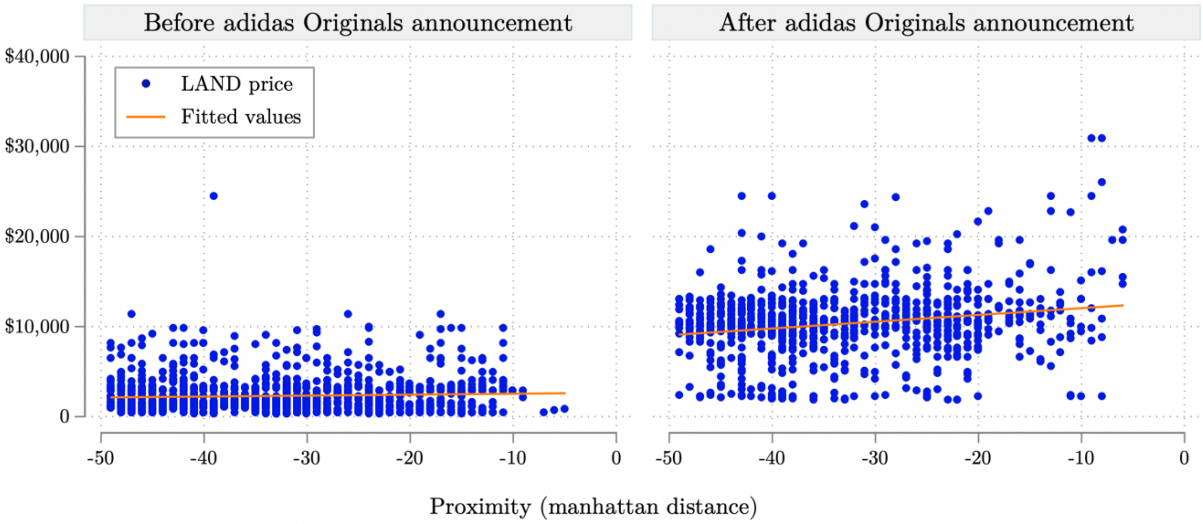
Adidas is one of the major brands with a presence in *The Sandbox*. Its arrival was announced in November 2021[16] and drew lots of attention from news and media sites[17].

As the figure on the left shows, most of the *LAND* directly adjacent to the *adidas ESTATE* is still vacant. For this high-profile dweller, too, we find a significant positive correlation between proximity to the *ESTATE* and *LAND* prices.

The visual representation below shows *LAND* sales near the *adidas Originals ESTATE*. Sales prices after the partnership announcement are significantly higher on average, mostly because of the overall market growth of *The Sandbox* and/or the market for NFTs and cryptocurrencies. Specifically, **the average price of *LAND* was $2,602 before the partnership and $10,270 after the partnership.** Yet, the trend line is significantly steeper after the announcement. Indeed, we identify a highly significant correlation coefficient of 0.20 between *LAND* prices and proximity to the *ESTATE*. Before the partnership, at 0.06, the value was statistically insignificant.

LAND prices before and after the adidas Originals partnership announcement

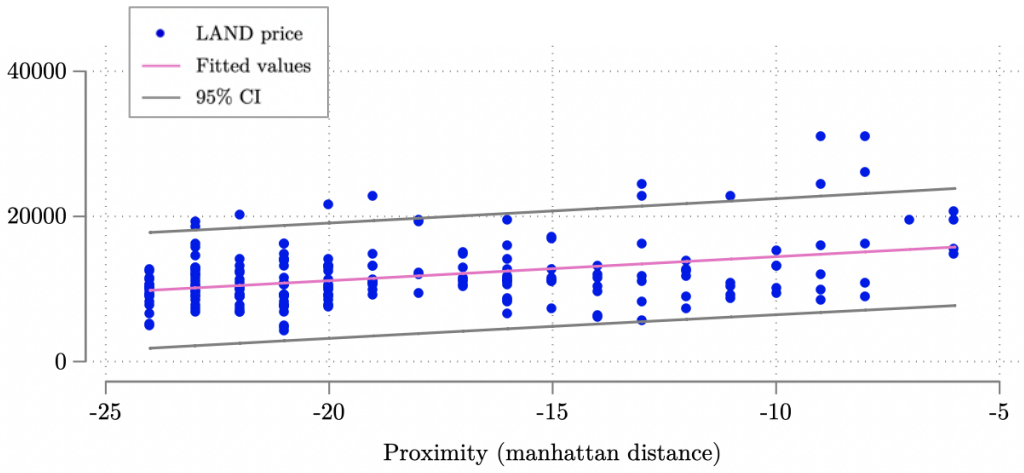
Prices are mapped in relation to the proximity to the *adidas Originals' ESTATE*.



Per unit of distance that a piece of *LAND* is closer to the *adidas ESTATE*, the price increases by $331—a highly significant result. Note that the lowest *Manhattan distance* of the *LANDs* in the sample is 6.

Regression of LAND prices on proximity to the adidas Originals ESTATE

The sample only includes *LANDs* inside a radius of 25 around the *adidas Originals ESTATE*.
N = 199 | R-squared = 0.14 | Coef. (SE) = 331 (58) | t = 5.67

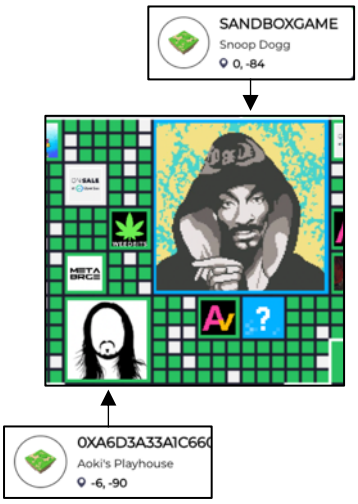


Base price + proximity premium = LAND price

The table below shows regression results that allow us to estimate *LAND* prices within various distances from each of the 19 high-profile *ESTATEs*. The base price represents an approximation of the overall value of *LAND*, while the proximity premium is what the *LAND* is worth on top of that for being close to the respective *ESTATEs*.

	Base price of LAND	Price premium attributed to proximity to the ESTATE				
		≤ 5	≤ 10	≤ 20	≤ 50	≤ 100
Atari (24 x 24)	$6,766	$7,810	$5,751	$2,164	$864	$814
Atari (12 x 12)	$6,780	$4,787	$2,045	$567	$239	$182
Care Bears	$6,903	$201	-$229	-$235	-$572	-$293
Binance (North west)	$6,913	-$1,607	-$1,377	-$1,766	$529	-$262
Binance (South east)	$6,910	$404	$379	-$400	-$624	-$366
Coinmarketcap	$7,043	$692	$19	-$135	-$324	-$396
Smurfs	$7,039	$1,609	$384	$308	$55	$829
Pranksy	$7,186	-$1,758	-$1,148	-$1,162	-$257	-$193
Gemini	$7,758	$2,345	$1,367	$1,514	$748	$256
Bored Apes Yacht Club	$7,789	$8,126	$1,486	$229	-$1,165	-$1,905
South China Morning Post	$8,283	$567	$951	$240	-$1,170	-$1,509
The Walking Dead	$8,802	$2,750	$1,063	-$308	$321	$1,529
deaudmau5	$9,886	$3,776	$1,391	$2,058	$266	-595
adidas Originals	$11,199	-	$5,118	$1,510	-$158	-$198
Snoop Dogg	$10,537	$25,509	$17,057	$11,428	$4,641	$2,621
Steve Aoki	$10,454	$17,223	$15,130	$10,950	$4,388	$2,599
Warner Music Group	$9,014	-	$10,168	$4,059	$175	$679
Ubisoft	$8,154	$147	$1,735	$150	-$271	-$232
Gucci	$8,086	$8,746	$9,030	$3,389	$4,825	$2,369

Each row shows the coefficients of five univariate regressions, starting from the day each partnership was announced / each *ESTATE* was minted. Results that are statistically significant at the 95%-level are highlighted in blue. The base price is the average of the constant term of all five models. *ESTATE* variables represent the Manhattan distance to the respective *LAND* sale. All models control for the occurrence of resales, previous *LAND* prices, the price of Ether and time-specific effects per months.



For *Atari (24 x 24)*, *LAND* inside a radius of 5 is valued on average at \$6,766 + \$7,810 = \$14,576. Of that amount, **\$6,766 is the basic value of the *LAND*, and \$7,810 can be attributed to the proximity to the *Atari ESTATE*.**

For the two *Atari ESTATEs*, *Gemini*, *Snoop Dogg*, *Steve Aoki* and *Gucci* we find exclusively significant positive effects. *Snoop Dogg* and *Steve Aoki* are associated with the highest premia. The individual results are not directly comparable, nor it is possible to calculate a grand average, as they relate to different time periods. Results that can be compared over time follow in the next section.

***LAND* within a *Manhattan distance* of 5 around *Snoop Dogg*'s *ESTATE* is on average worth \$25,509 more than the base price of about \$10,500.** At greater distances, the effects remain large. For example, within a radius of 20 (50), the premium still stands at \$10,950 (\$4,641). **For *Steve Aoki*'s *ESTATE*, we identify a similarly strong price effect.** Within a distance of 5, *LAND* is worth \$17,223 more. This value drops to \$15,130 at a distance of 10, to \$10,950 at 20, to \$4,388 at 50, and finally to \$2,599 at 100.

It is important to keep in mind, however, that **the *ESTATEs* of *Snoop Dogg* and *Steve Aoki* are directly adjacent to each other**, which makes it difficult to disentangle their effects on the prices of surrounding *LAND*. What we can definitely say—based on our analysis of historic data—is that this is a highly valued area of *The Sandbox*. **Prospective high-profile newcomers to *The Sandbox* may therefore do well to choose an *ESTATE* near another high-profile dweller.** By settling in a high-value neighborhood, prices may remain at a high level, even if the market would not positively react to the news.

However, besides high positive price effects, we also identify negative effects. Notably, the ***Pranksy ESTATE* is associated with significant negative proximity premia at all distances**. This result may not only be attributable to the *ESTATE* itself but also to the fact that it is located in the far southwestern corner of *The Sandbox* where there are few other high-profile *ESTATEs*.

Section 6

Pricing LAND

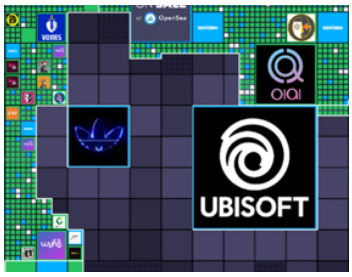
The bigger picture

In the last chapter we solely focused on geographic location in relation to one *ESTATE* at a time. In this chapter, we build on multiple *ESTATEs* in the virtual world and analyze the extent to which they have an impact on virtual land prices in their neighborhoods. In other words, we now switch from univariate to multivariate analyses, which allows us to control for reciprocal or otherwise hidden influences.

While our previous analysis of how individual high-profile *ESTATEs* affect the prices of nearby *LAND* yielded exciting results, it was severely limited by its inability to control for any joint effect of multiple *ESTATEs*. For example, ***adidas Originals* and *Ubisoft* are located quite close to each other and should therefore be analyzed jointly**.

Step by step

Since each *ESTATE* was formed at a different time, **we use a stepwise approach to regression models, incorporating new *ESTATEs* into the statistical calculations from their respective announcement dates**.



The ESTATEs of adidas Originals and Ubisoft are located in "close" proximity.

In March 2021, *Atari* was announced as the first partner, so the first model, includes only the distances to the two *Atari ESTATEs* as explanatory factors for *LAND* prices in *The Sandbox*. In the following model, the next partnership announced (i.e., *Care Bears*; September 2, 2020) is additionally included, and only *LAND* sales from this period onwards were analyzed. This process is repeated all the way to the last *ESTATE*, *Gucci* (February 9, 2022). For the sake of brevity, not all 17 models are shown. The presentation is limited to **six selected models, which are presented on the following page**. Each of the six columns represents one model.

Regression models estimating the effect of proximity on LAND prices in USD

	(1) Mar 20 – Dec 20	(2) Mar 20 – May 21	(3) Mar 20 – Oct 21	(4) Mar 20 – Dec 21	(5) Mar 20 – Feb 22	(6) Mar 20 – May 22
Atari (24 x 24)	$1.18	$1.91	$3.52	$8.65	-$0.59	$2.61
Atari (12 x 12)	$0.36	-$0.83	$1.20	$5.54	$3.43	-$7.66
Care Bears		$1.49	-$7.55	-$10.35	$2.17	$13.04
Binance (North west)		-$0.79	-$5.91	-$11.85	-$23.10	-$15.92
Binance (South east)		-$2.19	-$4.92	$1.69	$6.43	-$2.09
Coinmarketcap		-$1.58	-$0.23	-$2.25	$19.78	$29.38
Smurfs		$0.01	-$9.49	-$13.56	-$11.65	-$24.00
Pranksy			$4.27	$8.97	$3.80	-$1.93
Gemini			$7.35	$12.25	$5.31	-$17.04
Bored Apes Yacht Club			$11.03	$6.30	$39.32	$6.05
South China Morning Post				$1.17	$8.71	$2.14
The Walking Dead				-$6.97	$6.37	$8.65
deaudmau5					-$13.47	$9.69
adidas Originals					$26.55	$2.51
Snoop Dogg					$19.20	$14.92
Steve Aoki					$36.85	$52.40
Warner Music Group						$21.28
Ubisoft						-$42.75
Gucci						-$11.41
Constant (base price)	$1,431.04	$438.44	$4,010.26	$4,186.67	$9,822.27	$4,173.74
No. of LAND sales	1,211	6,796	16,228	30,882	38,390	44,266
R-squared	0.138	0.285	0.104	0.583	0.558	0.559

Results that are statistically significant at the 95%-level are highlighted in blue. ESTATE variables represent the Manhattan distance to the respective LAND sale. All models control for the occurrence of resales, previous LAND prices, the price of Ether, and time-specific effects (month dummies).

Interpreting the regression results

The coefficients shown in the table demonstrate how a one-unit reduction in distance affects the price of *LAND*. Solely the blue values are statistically significant and therefore worth a closer look. For example, the coefficient of $1.18 for the *Atari (24 x 24) ESTATE* in model (1) means that "**for every reduction in *Manhattan distance* to the *Atari ESTATE* by one unit, the price of *LAND* increases by $1.18 on average**—while holding all the other variables included in the model constant". The constant term can be interpreted as base cost of *LAND* at the time. The base prices obtained here are lower than those from section 5 due to the inclusion of more variables that explain part of the price (e.g., the previous price of the *LAND*, the price of *ETH* or the month of the sale). Thus, between **March and December 2020, the base price of *LAND* amounted to $1,431. By May 2021, it dropped to $438 before rising to $4,010 by October 2021.**

R-squared is the coefficient of determination. It indicates to what degree the distance to the *ESTATE* and the control variables are able to explain the price of *LAND* (with 0 being no explanatory value and 1 indicating 100% explanatory value). Overall, **the models fit the data quite well**. Of course, there are many other factors (e.g., momentum, market sentiment, etc.) that influence *LAND* prices, which is why an *R-squared* value above 0.5 is fully satisfactory.

Atari's rise and fall in influence?

We find that proximity to the *Atari (24 x 24) ESTATE* has significantly positive and indeed increasing price effects in each of the first three models, i.e., in the first year and a half. The price premium per unit of proximity rises from $1.18 in model 1 to $1.91 in model 2, $3.52 in model 3 and $8.65 in model 4. The first three models are statistically significant. Thereafter, however, we identify only insignificant results.

This could be interpreted as an indication that the neighborhood around the *Atari ESTATE* is no longer considered special, for which several explanations are conceivable. For example, there may be *Sandbox*-unrelated outside reasons (e.g., a decline in the image of the *Atari* brand—a hypothetical example) or virtually all *LAND* in the vicinity of the *ESTATE* has been purchased and no one is interested in selling it. Without a seller, there is no market price. The most convincing explanation, however, is that *LAND* buyers may turn their attention to other, newer *ESTATEs*, so that the effects of a new partnership are (partly) temporary.

New high-profile ESTATEs are influential

The models suggest **that newer *ESTATEs* are often associated with significant price effects**. For example, we find that the significant effects of *adidas Originals* and *Snoop Dogg* in model 5 vanish in the following model. However, significant price relationships emerge for all new *ESTATEs* (*Warner Music Group*, *Ubisoft* and *Gucci*).

This may indicate that—similarly to *Atari*—**older projects lose their price impact over time as market attention shifts to newer projects.** In this context it is important to mention that *The Sandbox* sometimes allows new partnerships to go hand in hand with individual *LAND* sales on the primary market, which additionally reinforces such an effect—or may actually cause it in the first place.

Results for LAND prices in ETH are similar compared to USD

Since *LAND* is much more commonly traded for ETH than for USD, we repeat the above analysis for the latter currency. The regression table below is essentially the same as above, except that all prices are now in ETH, which is therefore no longer used as a control variable. For model 6, for example, the results can be read as follows:

- The base price of *LAND* is 7.7093 ETH.
- Per unit of distance that a piece of *LAND* is located closer to the *ESTATE* of *Steve Aoki*, its price rises by 0.0189 ETH.
- Per unit of distance that a piece of *LAND* is located closer to the *ESTATE* of *Gemini*, its price decreases by 0.0057 ETH.

The results are generally comparable in terms of their relative strength and statistical significance to those obtained above.

Regression models estimating the effect of proximity on LAND prices in ETH

		(1) Mar 20 – Dec 20	(2) Mar 20 – May 21	(3) Mar 20 – Oct 21	(4) Mar 20 – Dec 21	(5) Mar 20 – Feb 22	(6) Mar 20 – May 22
	Atari (24 x 24)	0.0034	0.0044	0.0044	-0.0006	-0.0011	0.0010
	Atari (12 x 12)	0.0012	-0.0021	-0.0005	0.0013	0.0003	-0.0030
	Care Bears		0.0036	-0.0026	0.0032	0.0004	0.0038
	Binance (North west)		-0.0026	-0.0055	-0.0047	-0.0078	-0.0054
	Binance (South east)		-0.0057	0.0005	0.0006	0.0015	0.0011
	Coinmarketcap		-0.0037	0.0005	0.0001	0.0057	0.0100
	Smurfs		0.0002	-0.0058	-0.0007	-0.0022	0.0100
	Pranksy			0.0026	0.0030	0.0018	0.0001
	Gemini			0.0028	0.0035	0.0016	-0.0057
	Bored Apes Yacht Club			0.0066	-0.0002	0.0120	0.0025
	South China Morning Post				0.0047	0.0053	0.0018
	The Walking Dead				-0.0021	0.0011	0.0068
	deaudmau5				0.0021	0.0064	0.0013
	adidas Originals					0.0072	0.0026
	Snoop Dogg					0.0091	0.0041
	Steve Aoki					0.0136	0.0189
	Warner Music Group						0.0067
	Ubisoft						-0.0145
	Gucci						-0.0077
	Constant (base price)	2.4849	8.9886	7.6911	7.8022	14.1612	7.7093
	No. of LAND sales	1,211	6,796	16,228	30,882	38,390	44,266
	R-squared	0.159	0.285	0.304	0.346	0.431	0.451

Results that are statistically significant at the 95%-level are highlighted in blue. ESTATE variables represent the Manhattan distance to the respective LAND sale. All models control for the occurrence of resales, previous LAND prices and time-specific effects (month dummies).

Section 7

LAND and other asset classes

How does LAND compare to other assets?

If virtual land or digital real estate is (becoming) an asset class in its own right, the question arises as to **how exactly this asset class compares to other forms of investment**. To address this question, we have collected data for **eight other assets and asset classes to examine how LAND compares and whether we can identify correlations or causal relationships**. We supplemented our existing blockchain and crypto asset data with publicly available data from investing.com.

In addition to the three cryptocurrencies *Bitcoin (BTC)*, *Ether (ETH)* and *SAND (SAND)*, the points of comparison include the global equity index *MSCI world*, the *S&P 500* as an American equity index, *U.S. 10-year bonds*, *gold*, and *real estate investment trusts (REITs)*. **The table below shows the returns of the selected assets.** They are calculated on the basis of daily close prices at the end of each quarter.

Quarterly asset returns

	LAND	SAND	BTC	ETH	MSCI World	S&P 500	US 10YB	Gold	REITs
Q1 2020	25%	-	-11%	3%	-21%	-20%	1%	4%	-30%
Q2 2020	-46%	-	42%	70%	19%	20%	< 1%	13%	11%
Q3 2020	474%	-	18%	59%	8%	8%	> -1%	6%	< 1%
Q4 2020	-84%	-23%	168%	105%	14%	12%	> -1%	1%	12%
Q1 2021	305%	2,226%	103%	161%	5%	6%	> -1%	-10%	9%
Q2 2021	-49%	-70%	-40%	19%	7%	8%	< 1%	4%	10%
Q3 2021	29%	231%	25%	32%	< 1%	< 1%	> -1%	-1%	< 1%
Q4 2021	662%	620%	5%	23%	7%	11%	> -1%	4%	15%
Q1 2022	17%	-42%	-1%	-11%	-6%	-5%	> -1%	6%	-5%
Q2 2022	-83%	-75%	-55%	-67%	-18%	-19%	> -1%	-4%	-21%
All	1,249%	2,867%	254%	392%	14%	21%	1%	22%	1%

A first finding is that all the assets considered have generated positive returns over the period, though at 1% each, those on *U.S. 10-year bonds* and *REITs* are comparatively low. It should be noted that possible distributions or dividends are not taken into account here. **At 1.249%, *LAND* achieved the second-highest returns after *SAND*.** However, *LAND* also has the largest quarterly price losses of -83% and -84%. This shows that the high returns are accompanied by a high level of risk.

LAND returns do not correlate significantly with other assets!

The figure below visualizes the correlation between the daily returns of the nine assets. Statistically significant correlation coefficients are highlighted in blue.

Correlations of daily returns across assets

	LAND	SAND	BTC	ETH	MSCI World	S&P 500	US 10YB	Gold
SAND	0.033							
BTC	-0.026	0.375						
ETH	-0.021	0.397	0.829					
MSCI World	-0.026	0.193	0.383	0.373				
S&P 500	-0.024	0.195	0.362	0.355	0.973			
US 10YB	0.005	0.063	0.118	0.115	0.274	0.296		
Gold	-0.024	-0.030	0.134	0.130	0.127	0.088	-0.213	
REITs	-0.012	0.118	0.249	0.256	0.810	0.812	0.192	0.104

A truly remarkable result is that all correlations with *LAND* are statistically insignificant. *LAND* returns correlate only between -0.026 (*BTC* and *MSCI World*) and 0.033 (*SAND*) with the other assets. **By contrast, all other assets have at least one**

significant relationship with other assets. For example, as is to be expected, the two stock indices *MSCI World* and *S&P 500* are highly correlated, as are *Bitcoin* and *Ethereum*.

Why does non-correlation matter?

Investors are always looking for diversification, i.e., to reduce the correlation among the assets in their portfolios. Our results suggest that a **crypto investor** holding *Bitcoin* and *Ether* will tend to see the prices of these assets rise and fall together. Adding *SAND* to the portfolio will not help this respect, given the strong correlation among these three cryptocurrencies. *LAND*, however, is virtually uncorrelated to the other assets and therefore potentially offers diversification benefits**. To date, there is no reason to expect that *LAND* prices will also drop in negative market phases of the three cryptocurrencies.** This gives *LAND* a unique selling proposition and suggests that virtual land or virtual real estate is an asset class in its own right.

From the perspective of an investor with a diversified portfolio, virtual land and cryptocurrency are therefore different types of investment. Scientific evidence has already shown that holding cryptocurrency can have positive effects for investment strategies or portfolio diversification[18,19]. ***LAND*, on the other hand, is distinct from cryptocurrencies and may therefore offer diversification benefits**—pending more thorough statistical confirmation, of course.

Section 8

Conclusion and Outlook

Where are we now?

The metaverse is under construction and growing fast. While there will probably never be a "final" metaverse (just as the Internet is constantly evolving), certain core components and standards will significantly shape its development. Blockchain-based digital worlds with **crypto economies and digital real estate represent such a building block of the metaverse, which clearly has a pioneering role** due to its financialization and option for speculation and investment, resulting in retail interest and adoption.

Digital worlds like *The Sandbox* allow their users to play, build, interact, and participate. Given that fundamentally similar projects have been around for decades (e.g., Second Life), **the level of financial participation is likely the main driver of *The Sandbox*'s success**. It enables a new form of networking and participation. "Simple" users become stakeholders with a long-term interest in seeing the virtual world grow and prosper. This paves the way for long-term success of users, owners, issuers and investors in digital real estate.

While digital real estate or *LAND* is emerging as a new asset class with an uncertain future, it shares certain characteristics with traditional real estate. As with physical property, the value of *LAND* in *The Sandbox* hinges on its location on the map. Specifically, we have shown that *LAND* prices differ based on the distance to high-profile *ESTATEs*. In the metaverse, where major location factors of traditional real estate markets are non-existent (e.g., public infrastructure or cost of travel), this comes as some surprise. However, as in the real world, location is directly associated with prestige and social affiliation or alignment. An exciting example of this is the cannabis project *Weedbits* setting up shop right next to *Snoop Dogg*'s *ESTATE*—most likely to enjoy a spillover effect. The fact that we mention it here proves them right.

Another exciting finding is that **digital real estate does not (yet) correlate with other assets—not even cryptocurrency—and is a unique new asset class.** Therefore, it could potentially constitute a diversification option or even a safe haven for investors. It should be noted that the results of this study base on a comparatively small data set, which should be seen as a limitation. In the period under review, an average of just under 50 LAND sales per day took place, which is of course vanishingly small compared to other asset classes—but still sufficient for a comprehensive analysis.

It is also important to note that digital real estate may likely be a low velocity asset class. Similar to traditional real estate, owners of digital real estate may only very rarely buy and sell *LAND*, which is why a longer-term view of the asset, its returns, its trading and individual investors will be necessary. Particularly for questions relating to proximity effects or the formation of communities with digital identities, a long-term view is likely also needed. At present, there have occured many purchases of *LAND* next to high-profile *ESTATE*s, but there have been comparatively few sales or resales. Furthermore, we have not yet observed any market reaction to "negative" events, such as when a high-profile *ESTATE* is sold by a brand.

Where do we go?

Digital real estate is already a billion-dollar market that attracts a wealth of companies, artists and investors. The next few years will show whether digital real estate remains a niche or develops into a vibrant part of the digital economy. At the moment, we cannot yet fathom which additional use cases and services are conceivable or will establish themselves. Furthermore, **it is unclear how mainstream investors and other individuals will approach the topic of the metaverse and digital real estate** and when and how they will join in - will they develop the metaverse further, shape it and participate in it financially?

At first glance it may seem that digital real estate will take longer to be accepted as an asset class by (institutional) investors than *Bitcoin* and other cryptocurrencies. However, it is important to keep in mind that:

a) **Digital real estate is no substitute and therefore no competition to traditional real estate even though they could potentially complement each other** (e.g., in the context of mapping an existing building in the metaverse). In general, the two forms of investment serve different needs and purposes, so no industry needs to feel threatened, as may currently be the case with *Bitcoin*, *decentralized finance (DeFi)* and traditional finance.

b) **We already see a plethora of companies, brands and individuals participating and investing in digital worlds and digital real estate.** This took considerably longer with cryptocurrencies, possibly for regulatory or administrative reasons.

For these reasons, **digital real estate need not fear significant resistance from traditional sectors, which should allow it to gain widespread acceptance much**

faster. To achieve this, however, existing users must be retained while new users must be attracted to the network. This is a challenge, since **financial interests clash with practical interests**: The finite amount of *LAND* in the major digital world projects stands in the way of the idea of an ever-expanding network. If at some point all *LAND* is gone, where will new partnerships come from? Ultimately, however, such challenges are solvable, for example by a *LAND* split (similarly to a stock split), i.e., digital redensification. Since *The Sandbox* has kept *LAND* up its sleeve, this "problem" is likely irrelevant for the near future.

Disclaimer

Please note that trading or holding crypto assets is associated with significant risks. Crypto assets are very volatile, potentially illiquid, and there is a risk of losing the entire invested capital. Please consider carefully whether trading or holding cryptocurrencies is suitable for you given your financial situation. The information provided in this report are not, and should not be construed as, professional investment, legal, tax or other advice or service. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser. This material is strictly for illustrative, educational, or informational purposes and is subject to change.

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About

The **Blockchain Research Lab** promotes independent science and research on blockchain technologies and the publication of the results in the form of scientific papers and contributions to conferences and other media. The BRL is a non-profit organization aiming, on the one hand, to further the general understanding of blockchain technology and, on the other hand, to analyze the resulting challenges and opportunities as well as their socio-economic consequences.

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