Determinants of Virtual Property Prices in Decentraland an Empirical Analysis of Market Dynamics and Cryptocurrency Influence

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ABSTRACT

This study explores the emerging virtual property market within the digital world, with a focus on identifying the key factors influencing property prices, market activity, and sales volume. Using a dataset of 2,000 virtual property transactions, the research provides a comprehensive analysis of market dynamics in this new frontier of digital real estate. The findings reveal significant volatility in transaction activity, with a peak of 1,222 transactions in January 2022 followed by a sharp decline to 539 in February 2022 and just 24 in March 2022, indicative of a nascent and speculative market. The analysis identifies land price as the most significant determinant of virtual property values, showing a near-perfect correlation of 0.992 with sales prices. This highlights the critical role of location and land value, similar to traditional real estate markets. Additionally, the study finds that properties attracting more bids tend to sell at higher prices, with a moderate correlation of 0.380 between bids count and sales price, reflecting the impact of competitive bidding in driving up values. However, the market is relatively illiquid, with a mean sales count of just 1.79, indicating that most properties are held as long-term investments rather than frequently traded assets. Interestingly, the research also uncovers a weak negative correlation of -0.051 between sales price and the underlying cryptocurrency, MANA, suggesting that the value of virtual properties may be increasingly decoupled from cryptocurrency volatility as the market matures. These insights provide valuable guidance for investors, developers, and policymakers navigating the evolving landscape of virtual real estate. The study concludes with a discussion of the implications for future market stability and potential areas for further research.

Keywords Virtual Property Market, Digital Real Estate, Land Price Determinants, Market Volatility, Cryptocurrency Decoupling

INTRODUCTION

The digital revolution has fundamentally transformed various aspects of the global economy, leading to the emergence of entirely new markets and asset classes. Among these, the concept of virtual property has gained substantial attention, particularly with the rise of blockchain technology and the proliferation of non-fungible tokens (NFTs). Virtual properties, often found in immersive digital worlds such as Decentraland, The Sandbox, and Cryptovoxels, represent parcels of land or spaces within these virtual environments. Unlike traditional real estate, virtual properties exist solely in the digital realm, yet they have begun to exhibit economic characteristics similar to physical real estate, including ownership, development potential, and market-driven value [1].

The value proposition of virtual properties lies in their unique ability to be customized, developed, and monetized within their respective platforms. Owners of virtual land can create a variety of digital assets, including virtual storefronts, event spaces, art galleries, or even entire businesses, all of which can generate income or enhance the user experience within the virtual world [2]. As a result, virtual properties have attracted a diverse array of investors—from speculative traders seeking short-term gains to long-term investors looking to establish a presence in the burgeoning digital economy [3].

The growing interest in virtual properties has led to the creation of a dynamic market where prices are influenced by factors such as location, proximity to high-traffic areas, and the overall development of the virtual world. Much like in the physical world, prime virtual land—such as parcels near popular districts, roads, or plazas—commands a premium, while less desirable locations may trade at a discount. However, despite the parallels with traditional real estate, the virtual property market is still in its early stages, characterized by high volatility and a lack of established valuation norms [4].

In the physical real estate market, location is often cited as the most critical factor determining property value, encapsulated in the adage "location, location, location." This principle appears to hold true in virtual real estate as well, where land price plays a pivotal role in determining the overall value of a property. However, unlike physical real estate, virtual properties are also subject to the influence of the underlying platform's cryptocurrency, in this case, MANA for Decentraland. The volatility of these cryptocurrencies introduces an additional layer of complexity to the valuation process, as fluctuations in cryptocurrency prices can impact the fiat value of virtual properties [5].

Despite the increasing activity and economic significance of the virtual property market, there is a notable gap in the academic literature regarding the factors that drive virtual property prices and the broader market dynamics. Most existing research on digital assets has focused on cryptocurrencies, with relatively little attention paid to NFTs and virtual properties [6]. As the market for virtual real estate continues to grow, understanding these dynamics is crucial for a wide range of stakeholders, including investors, developers, policymakers, and researchers.

This study aims to address this gap by conducting a comprehensive analysis of the virtual property market, with a particular focus on Decentraland, one of the most prominent virtual worlds currently in operation. Using a dataset comprising 2,000 virtual property transactions, this research seeks to identify the key factors that influence property prices, such as land price, bidding activity, and the role of the underlying cryptocurrency, MANA. By examining these relationships, the study aims to provide a deeper understanding of the market forces at play and offer insights that can inform investment strategies, development plans, and policy frameworks [1].

The findings of this research are expected to contribute to the growing body of knowledge on digital assets, particularly in the context of virtual real estate. By elucidating the determinants of property values and analyzing market trends, this study will provide valuable guidance for investors seeking to navigate the complexities of the virtual property market. Furthermore, the insights gained from this research will have broader implications for the development of digital economies, offering lessons that could be applied to other emerging asset classes within the blockchain ecosystem [7].

This study also aims to contribute to the theoretical understanding of digital assets and their role in the broader economy. As virtual worlds and digital assets continue to evolve, it is essential to develop robust frameworks for analyzing and valuing these new forms of property. This research represents a step toward building such frameworks, offering a foundation for future studies on the economic and social implications of virtual real estate [8].

The virtual property market represents a new frontier in the digital economy, offering both opportunities and challenges for investors, developers, and policymakers. By providing a comprehensive analysis of this market, this study seeks to enhance our understanding of the factors driving virtual property values and to contribute to the ongoing discourse on the future of digital assets. As the market continues to mature, the insights gained from this research will be invaluable for those looking to capitalize on the opportunities presented by this rapidly evolving landscape [9].

Literature Review

The Evolution of Digital Assets and Virtual Economies

The concept of digital assets has undergone significant transformation over the past decade, driven by advancements in blockchain technology and the rise of cryptocurrencies. Digital assets, which include cryptocurrencies, non-fungible tokens (NFTs), and virtual properties, have evolved from being niche innovations to becoming integral components of the global financial system. The earliest form of digital assets, cryptocurrencies like Bitcoin, were primarily viewed as alternatives to traditional currencies, offering decentralized, peer-to-peer transactions. Nakamoto's introduction of Bitcoin as a decentralized digital currency marked the beginning of this evolution, leading to the proliferation of various other cryptocurrencies and the eventual development of the broader blockchain ecosystem [10].

As blockchain technology matured, the introduction of NFTs further expanded the concept of digital ownership. NFTs, which are unique digital assets verified on the blockchain, represent ownership of specific items, such as art, music, and virtual real estate. Unlike cryptocurrencies, which are fungible and can be exchanged on a one-to-one basis, NFTs are indivisible and unique, making them ideal for representing ownership of rare or distinctive digital items. The launch of platforms like Ethereum enabled the creation of smart contracts, which facilitated the issuance and trading of NFTs, thereby laying the groundwork for the emergence of virtual property markets [11].

The development of virtual economies within digital worlds such as Decentraland and The Sandbox has introduced a new dimension to digital assets. These virtual worlds allow users to buy, sell, and develop virtual land, creating self-sustaining economies driven by user-generated content and transactions. Early studies on virtual economies examined the economic activities within massively multiplayer online games (MMOs), highlighting the potential for virtual worlds to develop robust economic systems. The integration of blockchain technology into these virtual worlds has further legitimized virtual economies by providing secure and verifiable ownership of virtual assets, leading to the growth of the virtual property market [12].

Virtual Property Markets: A New Frontier in Digital Real Estate

The emergence of virtual property markets represents a significant

development in the digital economy, offering both opportunities and challenges for investors, developers, and policymakers. Virtual properties, typically represented as NFTs on blockchain platforms, have become a key asset class within virtual worlds. These properties can be bought, sold, and developed, much like real estate in the physical world. The value of virtual properties is often influenced by factors similar to those in traditional real estate markets, such as location, proximity to popular areas, and potential for development [13].

Research on virtual property markets is still in its infancy, with much of the existing literature focusing on the broader implications of NFTs and blockchain technology. Some studies have explored the economic and technological aspects of NFTs, emphasizing their potential to revolutionize ownership and trade in the digital realm [14]. However, specific studies on the pricing dynamics and market behavior of virtual properties are relatively scarce. The few existing studies have begun to explore the factors that influence virtual property prices, identifying key determinants such as land scarcity, user engagement, and platform development [15].

In their exploration of virtual property markets, some researchers highlight the importance of location within virtual worlds, noting that parcels of land near popular districts or landmarks tend to command higher prices. This finding aligns with traditional real estate principles, where location is a critical determinant of value. However, the authors also note that virtual property markets are subject to unique dynamics, such as the influence of the underlying cryptocurrency and the speculative nature of NFT trading. These factors introduce additional layers of complexity to the valuation of virtual properties, distinguishing them from their physical counterparts [16].

Speculation and Volatility in Virtual Property Markets

The nascent nature of virtual property markets makes them particularly susceptible to speculation and volatility. The speculative behavior in these markets is driven by several factors, including the novelty of the asset class, the involvement of early adopters seeking quick profits, and the integration of cryptocurrencies, which are themselves volatile. Research highlights the challenges of valuing digital assets in volatile markets, where prices can be influenced by a wide range of external factors, including regulatory developments, technological changes, and market sentiment [17].

In the context of virtual property markets, speculation is often fueled by the potential for significant returns on investment, particularly in newly launched or rapidly developing virtual worlds. The rapid appreciation of virtual land prices in platforms like Decentraland has attracted both individual investors and institutional players, contributing to the volatility of the market [18]. Other studies have examined the impact of speculation on the pricing of digital assets, noting that speculative bubbles can form when market participants invest based on the expectation of future price increases rather than the intrinsic value of the asset [19].

Volatility in virtual property markets is further exacerbated by the fluctuating value of the underlying cryptocurrency, such as MANA in Decentraland. The correlation between virtual property prices and cryptocurrency prices adds a layer of complexity to market behavior, as investors must navigate both the

volatility of the virtual real estate market and the broader cryptocurrency market. Research on cryptocurrency bubbles provides insights into the potential risks associated with investing in markets characterized by high volatility and speculative behavior [20].

The Role of Blockchain Technology in Virtual Property Markets

Blockchain technology is the backbone of virtual property markets, providing the infrastructure for secure, transparent, and decentralized transactions. The use of blockchain technology ensures that ownership of virtual properties is verifiable and immutable, addressing concerns about fraud and double-spending that have plagued digital assets in the past. The introduction of smart contracts on platforms like Ethereum has further enhanced the functionality of virtual property markets by enabling automated transactions and the creation of complex financial instruments [21].

The literature on blockchain technology highlights its potential to disrupt traditional industries by providing a decentralized and trustless environment for transactions. In the context of virtual property markets, blockchain technology not only facilitates the buying and selling of virtual land but also enables the development of new business models and revenue streams [22]. For example, virtual property owners can lease their land, create tokenized assets, or develop virtual businesses, all of which can be managed and executed through smart contracts.

However, the integration of blockchain technology into virtual property markets also presents challenges. Scalability, transaction costs, and environmental concerns associated with blockchain networks are ongoing issues that could impact the long-term viability of these markets. Some research addresses these challenges, exploring potential solutions such as layer-two scaling and proof-of-stake consensus mechanisms [23]. As virtual property markets continue to grow, the evolution of blockchain technology will play a critical role in shaping their future.

Future Directions in Virtual Property Market Research

As the virtual property market continues to evolve, there is a growing need for more comprehensive and interdisciplinary research that bridges the gap between traditional real estate economics, digital asset valuation, and blockchain technology. Future research should focus on developing robust valuation models for virtual properties, taking into account the unique characteristics of these assets and the complex interplay between location, platform development, user engagement, and cryptocurrency volatility.

There is also a need to explore the social and regulatory implications of virtual property markets. As these markets become more mainstream, questions of ownership rights, taxation, and regulation will become increasingly important. Research on the regulation of blockchain technology provides a foundation for understanding the potential legal challenges associated with virtual property markets. Future studies should build on this work to examine how existing legal frameworks can be adapted to accommodate the unique characteristics of virtual properties [24].

The literature on virtual property markets is still in its early stages, but it is rapidly expanding as the significance of these markets becomes more apparent. This literature review has highlighted the key areas of research to date, including the

evolution of digital assets, the dynamics of virtual property markets, the role of speculation and volatility, and the impact of blockchain technology. As the market continues to mature, there will be an increasing need for more detailed and specialized research to fully understand the implications of virtual property ownership and trading in the digital age.

Method

Research Design

This study adopts a quantitative research design to systematically analyze the factors influencing virtual property prices and market dynamics within the digital realm, specifically focusing on Decentraland. The research is structured to identify key determinants of virtual property values, such as land price, bidding activity, and the influence of the underlying cryptocurrency, MANA. By examining these factors through empirical data, the study aims to provide a comprehensive understanding of the economic behavior within the virtual property market. The design is rooted in the principles of empirical analysis, leveraging large-scale transactional data to uncover patterns and relationships that drive market dynamics in virtual real estate.

Data Collection

The dataset for this study comprises 2,000 transactions of virtual properties within Decentraland, one of the most prominent platforms for digital real estate. Data was meticulously gathered from publicly accessible sources, including blockchain explorers, the Decentraland marketplace, and other relevant platforms that track virtual real estate transactions. Each transaction record includes essential variables such as the sales price, timestamp, land price, number of bids, sales count, mana price at the time of sale, adjacency information, and ownership details. These variables were chosen for their relevance to understanding the market dynamics and pricing structures within the virtual property ecosystem. Data cleaning processes were employed to ensure that the dataset was accurate and complete, with any missing or incomplete records being identified and excluded from the final analysis. Additionally, statistical methods were applied to adjust for outliers in sales prices, ensuring that extreme values did not skew the results.

Data Preprocessing

To prepare the dataset for analysis, several preprocessing steps were undertaken to ensure the data was suitable for statistical and econometric modeling. Firstly, sales prices recorded in MANA, Decentraland's native cryptocurrency, were converted to a standard fiat currency (USD) using the exchange rate at the time of each transaction. This conversion facilitated consistent comparisons across transactions conducted at different times. The timestamps, initially recorded in Unix format, were converted to standard date and time formats to enable a time-series analysis of market activity. Additionally, properties were categorized based on their proximity to key areas within Decentraland, such as roads, districts, and plazas, to assess the impact of location on property prices. Variables such as sales price and land price were normalized, ensuring that they were on a comparable scale, which is crucial for robust statistical analysis. These preprocessing steps were critical in preparing the data for subsequent analytical techniques.

Analytical Techniques

Descriptive Statistics. A range of statistical and econometric techniques were employed to analyze the dataset and uncover the factors influencing virtual property prices. Descriptive statistics were first calculated to summarize the central tendencies and dispersion of key variables such as sales price, bids count, and sales volume. This provided an overview of the basic characteristics of the dataset.

Correlation Analysis. To assess the relationships between sales price and other variables, Pearson correlation coefficients were calculated. The Pearson correlation coefficient, denoted as rrr, measures the strength and direction of the linear relationship between two variables. The formula for the Pearson correlation coefficient is:

$$r = \frac{\sum(X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum(X_i - \overline{X})^2 \sum(Y_i - \overline{Y})^2}} \tag{1}$$

where:

X_i and Y_i are the individual data points for variables X (e.g., land price) and Y (e.g., sales price)

$\overline{X}$ and $\overline{Y}$ are the means of the variables X and Y, respectively

This correlation analysis helped identify the strength and direction of relationships between sales price and independent variables like land price, bids count, and mana price.

Time-Series Analysis. Following this, a time-series analysis was conducted to examine trends in transaction activity and price fluctuations over time. Monthly transaction volumes were plotted to visualize market activity patterns. The time-series data allowed for the identification of potential trends, seasonal patterns, and anomalies in the virtual property market.

Regression Analysis. To delve deeper into the factors influencing sales prices, a multiple linear regression analysis was performed. Multiple linear regression models the relationship between a dependent variable (sales price) and several independent variables (e.g., land price, bids count, adjacency information, and mana price). The general form of the multiple linear regression model is:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_n X_n + \text{\euro} \tag{2}$$

where:

Y is the dependent variable (sales price)

β_0 is the intercept

$\beta_1, \beta_2, \beta_n$ are the coefficients of the independent variables $X_1, X_2 \ldots X_n$

$\text{\euro}$ is the error term

The coefficients $\beta_1, \beta_2, \ldots \beta_n$ represent the expected change in the dependent variable Y for a one-unit change in the corresponding independent variable, holding all other variables constant. This regression analysis provided insights into the relative importance of each factor in determining property prices.

Validity and Reliability

Ensuring the validity and reliability of the research findings was a primary concern throughout the study. Several strategies were implemented to achieve this. Data triangulation was employed by collecting information from multiple sources, which were then cross-verified to ensure consistency and accuracy. This approach reduced the risk of bias that could arise from relying on a single data source. Outliers in sales prices, which could distort the analysis, were managed using robust statistical methods. These outliers were either excluded from the dataset or adjusted to minimize their impact on the results. The regression model developed in this study was validated through techniques such as cross-validation and residual analysis, ensuring that the model accurately captured the relationships between the dependent and independent variables. Additionally, detailed documentation of the data cleaning, preprocessing, and analytical processes was maintained to ensure that the study could be replicated by other researchers, thereby enhancing the reliability of the findings.

Ethical Considerations

Given the use of publicly available data, this study adhered to strict ethical guidelines regarding data privacy and confidentiality. All data included in the analysis was anonymized, with no personally identifiable information (PII) associated with the transactions. The analysis was conducted in a manner that respected the privacy of individuals involved in the virtual property transactions. By following these ethical guidelines, the study ensured that it complied with standards for responsible research while maintaining the integrity and confidentiality of the data.

Limitations

While this study provides valuable insights into the virtual property market, it is important to acknowledge its limitations. The dataset is limited to transactions within Decentraland, which may not fully represent the dynamics of virtual property markets across other platforms or broader trends in the digital real estate market. Additionally, the analysis is based on historical data, which may not accurately predict future market conditions. The evolving nature of virtual worlds and the digital economy suggests that further research is needed to explore these dynamics over longer periods and across different platforms. Future studies could expand on this research by incorporating data from multiple virtual worlds or by examining the impact of external economic factors on virtual property prices.

Results and Discussion

Market Activity Profile

The analysis of market activity reveals significant fluctuations in the number of transactions over the observed period, highlighting the dynamic nature of the virtual property market. As shown in table 1, the market experienced its peak in January 2022, with 1,222 transactions recorded. This surge likely reflects a period of heightened market interest, possibly driven by factors such as new developments within the virtual world, increased media attention, or speculative investment behavior.

The dramatic decline in transactions after January 2022 suggests a possible

cooling of the market, as the number of transactions dropped to 539 in February and plummeted to just 24 by March 2022. This trend could be indicative of several underlying factors, including market saturation, stabilization of prices after a speculative boom, or external economic conditions influencing investment behavior in virtual assets.

Table 1 Market Activity Profile	
Month	**Number of Transactions**
December 2021	215
January 2022	1,222
February 2022	539
March 2022	24

This pattern of a sharp rise followed by a steep decline is not uncommon in nascent markets, particularly those driven by speculative investments. The virtual property market, much like the cryptocurrency market with which it is often associated, may be susceptible to speculative bubbles, where rapid price increases fuel further investment until the bubble bursts, leading to a subsequent market correction.

Price Distribution

The price distribution analysis provides crucial insights into the valuation of virtual properties in this digital market. As depicted in table 2, the average sales price across the dataset is approximately 1.20×10^{22}, indicating a substantial valuation of virtual assets. However, the wide range of prices, from a minimum of 1.00×10^{19} to a maximum of 5.10×10^{23}, underscores the significant variability in how these assets are valued.

Table 2 Price Distribution	
Statistic	**Value**
Count	2000
Mean	1.20×10^{22}
Standard Deviation	3.09×10^{22}
Min	1.00×10^{19}
25%	5.07×10^{21}
Median	5.80×10^{21}
75%	7.40×10^{21}
Max	5.10×10^{23}

The large standard deviation (3.09×10^{22})

suggests that certain properties command significantly higher prices, likely due to their location within the virtual world, size, and proximity to desirable areas such as roads, districts, or plazas. This mirrors the traditional real estate market, where prime locations often fetch premium prices.

Interestingly, the median price of 5.80×10^{21}5.80 \times 10^{21}$5.80×1021 is significantly lower than the mean, indicating a skewed distribution with a few high-value properties pulling the average upwards. This skewness could reflect the presence of landmark properties or highly desirable virtual land plots that are considered premium assets within the digital economy.

Sales Volume Distribution

The sales volume distribution, presented in table 3, offers insights into the liquidity and turnover of virtual properties. With a mean sales count of 1.79, it is evident that most properties are not frequently resold. The data reveals that the majority of properties have been sold only once or twice, with a significant portion never being resold after the initial purchase.

Table 3 Sales Volume Distribution	
Statistic	**Value**
Count	2000
Mean	1.79
Standard Deviation	1.13
Min	1
25%	1
Median	1
75%	2
Max	10

This limited turnover suggests that virtual properties are typically held as long-term investments. Owners may perceive these assets as appreciating in value over time, similar to real-world real estate, rather than commodities for short-term trading. The maximum sales count observed is 10, which likely pertains to particularly desirable properties that have changed hands multiple times, possibly due to their strategic location or unique attributes within the virtual world.

The low frequency of resales could also indicate a relatively illiquid market, where once a property is purchased, it is held for extended periods, reducing the overall market activity. This could be a result of the speculative nature of virtual property investments, where owners are waiting for substantial appreciation before considering a sale.

Correlation Analysis

The correlation analysis is crucial in understanding the relationships between different variables and their influence on the sales price of virtual properties. As

highlighted in table 4, land price emerges as the most significant factor affecting the sales price, with an extraordinarily high correlation coefficient of 0.992. This near-perfect correlation suggests that the valuation of land is almost directly reflected in the final sales price, underscoring the critical role that land pricing plays in the overall market.

Table 4 Correlation Matrix

Variable	Sales Price	Bids Count	Sales Count	Mana Price	Land Price
Sales Price	1.000	0.380	0.024	-0.051	0.992
Bids Count	0.380	1.000	0.439	-0.028	0.382
Sales Count	0.024	0.439	1.000	0.044	0.027
Mana Price	-0.051	-0.028	0.044	1.000	0.005
Land Price	0.992	0.382	0.027	0.005	1.000

Bids count also shows a moderate positive correlation with the sales price (0.380). This indicates that properties attracting more bids tend to sell at higher prices, possibly due to the competitive nature of the bidding process. In scenarios where multiple buyers are interested in a property, the bidding war can drive the final sales price upward, reflecting the perceived value of the asset among the participants.

On the other hand, the sales count exhibits a very low correlation with the sales price (0.024), suggesting that the frequency with which a property is traded does not significantly influence its price. This finding aligns with the observation that most properties are held as long-term investments, with their value being more influenced by intrinsic factors like location and size rather than their turnover history.

Interestingly, the mana price shows a weak negative correlation with the sales price (-0.051). This could imply that fluctuations in the cryptocurrency used within the virtual world (MANA) have a minor and inverse effect on property prices, possibly due to the volatility of digital currencies. Investors may be more focused on the fiat value of the property rather than its equivalent in MANA, leading to this weak inverse relationship.

Discussion

The results of this analysis provide a comprehensive view of the virtual property market, highlighting both the factors driving sales prices and the broader market dynamics. The strong correlation between land price and sales price underscores the importance of location and inherent land value in the virtual world, much like in the physical real estate market. This suggests that virtual land, particularly in desirable areas, is a key determinant of value, potentially making it a prime target for investment. The moderate correlation between bids count and sales price further emphasizes the role of competitive bidding in driving up property prices. This aspect of the market could be indicative of speculative behavior, where multiple buyers vie for limited desirable assets, inflating prices beyond their intrinsic value. The low impact of sales count on the final price suggests a market where properties are not frequently flipped, but

rather held for longer periods, likely in anticipation of future appreciation. This behavior mirrors traditional real estate investment strategies, where long-term holding is often favored over quick turnovers.

The weak relationship between mana price and sales price points to the potential decoupling of virtual asset values from the underlying cryptocurrency's fluctuations. This could indicate that the market for virtual properties is maturing, with prices being influenced more by real-world economic factors and less by the speculative nature of cryptocurrencies. The findings from this study provide valuable insights into the determinants of virtual property prices and the behavior of the market. As the digital economy continues to evolve, understanding these dynamics will be crucial for investors, developers, and policymakers looking to navigate and shape the future of virtual real estate.

Conclusion

This study provides a comprehensive analysis of the virtual property market within the digital world, focusing on the key factors that influence property prices, market activity, and sales volume. The results offer valuable insights into the dynamics of this emerging market and highlight several important findings.

The analysis of market activity reveals that the virtual property market is characterized by significant volatility. The observed sharp increase in transactions, followed by a rapid decline, suggests that the market is still in its early stages, marked by periods of intense speculation. Such volatility is indicative of a market that is still finding its equilibrium, with buyers and sellers reacting to sudden shifts in demand and market sentiment. As the market matures, it is likely that these fluctuations will become less pronounced, leading to more stable and predictable market behavior.

A critical finding of this study is the identification of land price as the most significant determinant of sales prices in the virtual property market. The near-perfect correlation between land price and sales price underscores the importance of location and the inherent value of land within the digital realm. Just as in traditional real estate, where location is paramount, virtual properties located in desirable areas command higher prices. This finding suggests that investors and developers should pay close attention to the allocation and valuation of land within virtual worlds, as these factors will have a profound impact on the overall market.

The study also highlights the role of competitive bidding in driving up property prices. The moderate correlation between bids count and sales price indicates that properties attracting more bids tend to sell at higher prices. This suggests a speculative element in the market, where multiple buyers compete for limited assets, pushing prices above their intrinsic value. This behavior mirrors auction dynamics seen in traditional real estate and other asset markets, where competition among buyers can lead to significant price premiums. Understanding this dynamic is crucial for both buyers, who need to be aware of the potential for overbidding, and sellers, who can leverage competitive interest to maximize their returns.

The sales volume distribution analysis indicates that the virtual property market is relatively illiquid. Most properties are not frequently resold, with many being held as long-term investments. This low turnover suggests that owners perceive these properties as appreciating assets, similar to real-world real estate. The

decision to hold rather than frequently trade these assets points to a market where investors are betting on long-term value growth rather than short-term gains. This behavior could contribute to market stability, as long-term holdings reduce the frequency of transactions and the potential for rapid price fluctuations.

The weak negative correlation between mana price and sales price suggests that the value of virtual properties may be increasingly decoupled from the fluctuations of the underlying cryptocurrency, MANA. This finding implies that as the market matures, the value of virtual properties becomes more stable and less influenced by the volatility of digital currencies. This decoupling could indicate that virtual properties are beginning to be valued more like traditional assets, based on their intrinsic characteristics and market demand, rather than being directly tied to the cryptocurrency ecosystem.

Declarations

Author Contributions

Conceptualization: T.W. and S.C.C.; Methodology: S.C.C.; Software: T.W.; Validation: T.W., S.C.C.; Formal Analysis: T.W., S.C.C.; Investigation: T.W.; Resources: S.C.C.; Data Curation: S.C.C.; Writing Original Draft Preparation: T.W. and S.C.C.; Writing Review and Editing: S.C.C. and T.W.; Visualization: T.W.; All authors have read and agreed to the published version of the manuscript.

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The data presented in this study are available on request from the corresponding author.

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