Retailing and Customer Engagement in the Metaverse: An Empirical Analysis

Mitchell Goldberg* Fabian Schär* Dario Thürkauf*

First Version: June 30, 2023
This Version: November 22, 2024

Abstract:
This paper uses avatar locations and transactional data to offer one of the first quantitative analyses of retailing and customer engagement in a social virtual world. We develop a comprehensive framework to filter blockchain transactions relevant to retailing, identify participating business sectors, and examine spatial and temporal retailing patterns. Key findings reveal that economic activity is concentrated around major events, such as music festivals and fashion shows, with prominent companies leveraging the platform for marketing and engagement. Our research provides valuable insights into current opportunities and challenges for practitioners, and outlines future research directions in metaverse retailing.

Keywords: Blockchain, Customer Engagement, Metaverse, NFT, Retailing, Web3

*Center for Innovative Finance, Faculty of Business and Economics, University of Basel, Switzerland. mitchell.goldberg@unibas.ch; f.schaer@unibas.ch; dario.thuerkauf@unibas.ch

1 Introduction

The *metaverse* has received a lot of attention and is frequently mentioned as an important extension of the traditional retail business environment (Bourlakis et al., 2009). Originating from Neal Stephenson's science fiction novel *Snow Crash*, the term lacks a precise definition in practice. Kim (2021) describes the metaverse as an "interoperable, persistent network of shared virtual environments where people can interact synchronously through their avatars with other agents and objects." *Metaverse retailing* is an evolution of online retailing (Bourlakis et al., 2009), allowing consumers to navigate, interact, and engage in commercial activities with other consumers or retail personnel through their avatars (Donath, 2002; Yoo et al., 2023; Mehrotra et al., 2024). We extend the scope beyond retailing to *customer engagement* – a firm's deliberate effort to motivate, empower, and measure a customer's voluntary contribution to its marketing functions beyond a core economic transaction (Harmeling et al., 2017). Numerous large companies across a wide range of industries already use metaverse environments to promote their brands, sell products, and engage with new and existing customers. Yet, many critics point toward low adoption rates, technological limitations, and question the general need for another distribution channel. While both sides present compelling arguments, the debate is generally purely qualitative and lacks empirical evidence.

Similarly, the existing academic literature on metaverse retailing is focused on the development of research agendas, theoretical frameworks, and qualitative empirics – typically employing user interviews and surveys. We assessed the current state of the research field based on the literature review presented in Section 2. Notably, most research agendas on metaverse retailing emphasize the need for empirical work in this area (Giang Barrera and Shah, 2023; Bilgihan et al., 2024; Dwivedi et al., 2023; Yoo et al., 2023). For instance, Giang Barrera and Shah (2023) highlight the unique opportunities provided by the data-rich metaverse ecosystem, pointing out the importance of determining which types of data to prioritize, when to collect them, and how to analyze them. Furthermore, Ahn et al. (2024) stress the need for a comprehensive investigation of metaverse participants and their behaviors. Addressing these research gaps, this study is among the first to integrate geospatial and transactional data from a metaverse platform to draw quantitative insights into retailing and customer engagement.

Specifically, we collect user location and transaction data over a nine-month period, compiling a novel data set that allows us to investigate all metaverse retailing events within this virtual world. Using these data, we conduct an exploratory analysis to assess the current state, opportunities, challenges, and limitations of retailing and customer engagement. Our analysis addresses three key research questions: (1.) How is the metaverse currently shaping retailing and customer engagement? (2.) Which business sectors are actively involved in metaverse retailing and customer engagement? (3.) What impact do virtual events have on retailing activity within the metaverse? Thus, our paper provides new insights into geospatial targeting and marketing spillovers, which were identified as one of 27 research opportunities by Yoo et al. (2023).

The virtual world we study is called *Decentraland* (Ordano et al., 2017), the first large-scale blockchain-based virtual world. From July 16, 2022, to April 23, 2023, we observe a total of 473,927 users, with an average of 1,689 daily active users. During this period, these users received 6,287,852 non-fungible tokens on Ethereum Mainnet or Polygon PoS. Decentraland is well-suited for our empirical analysis of retailing activity for two reasons: *First*, it has gained significant attention from large companies such as Tommy Hilfiger, Samsung, PepsiCo, Diesel, Adidas, Netflix, among others. The presence of these companies makes Decentraland an ideal candidate for our analysis of metaverse retailing. *Second*, Decentraland builds on public blockchain networks. Goods are implemented as semi-fungible or non-fungible tokens, transferred via the Ethereum or Polygon PoS networks. These goods include in-world assets such as avatar wearables, merchandise, and tickets, as well as tokenized vouchers that can be redeemed for real-world goods or services. Both Ethereum Mainnet and Polygon PoS are public, permissionless blockchains, allowing us to analyze the entire transaction history and derive information about the users' economic activity. Similarly, Decentraland's open architecture allows us to compile snapshots of user activity, including the locations of avatars within the metaverse. With 6.9 million snapshots, this unique data set provides valuable insights into retailing and customer engagement in the virtual world.

Our paper reveals four key findings: *First,* there is notable business activity by prominent firms across a diverse range of sectors. *Second,* we observe unexpected cross-sector interactions and innovative customer engagement strategies. *Third,* activities predominantly cluster around plazas and significant landmarks, with evident spillover effects in adjacent areas. *Fourth,* while there is a relatively stable baseline level of activity, the majority of customer engagement and retail transactions occur during large-scale events.

In Section 2, we summarize the existing literature on metaverse retailing. In Section 3, we introduce our data set and describe how we collect, clean, and merge the information. In Section 4, we use our data to explore how economic activity is split into primary and secondary market transactions (4.1), how it is spread across various business sectors (4.2), and to what extent the economic activity is time-sensitive (4.3) and driven by events (4.4). Section 5 discusses our results, findings, and limitations. In Section 6, we conclude and derive managerial implications as well as a future research agenda.

2 Literature Review

Following the categorization framework proposed by Giang Barrera and Shah (2023), we structure our literature review in Table 1 into three categories: (1.) early versions of virtual worlds such as *Second Life*, (2.) technological elements of the metaverse, and (3.) the retailing potential of the metaverse and associated research agendas.

An early analysis of Second Life by Bourlakis et al. (2009) examines the evolution of retailing from traditional to electronic and, finally, to metaverse formats, laying the groundwork for future studies on virtual retail environments. Building on this, Papagiannidis and Bourlakis (2010) employ a case study approach to explore the unique characteristics of metaverse retailing. Similarly, Guo and Barnes (2011) develop and test a conceptual model of purchase behavior in virtual worlds through an online survey conducted within Second Life. Further exploring consumer behavior in virtual worlds, Domina et al. (2012) study the factors influencing consumer intentions. Complementing this, Kuntze et al. (2013) conduct interviews to gather and summarize customer perspectives on metaverse retailing behavior. In addition, Gadalla et al. (2013) analyze the service quality of metaverse retailing. Expanding the scope to retail atmospherics, Hassouneh and Brengman (2015) examine 27 virtual stores in Second Life, highlighting the importance of the virtual store environment. Finally, Jung and Pawlowski (2014) conduct a study of 154 Second Life users, employing core-periphery analysis to investigate how users perceive virtual goods consumption.

Focusing on singular technological elements, Belk et al. (2022) show how blockchain can be used in a metaverse context to represent tokenized goods. Vidal-Tomás (2023) analyzes metaverse-related tokens and sales on external marketplaces, while Trujillo and Bacciu (2023) specifically examine Decentraland wearable mints and sales, finding that most wearables are given away for customer engagement and that prices are primarily driven by the rarity of the wearable. Joy et al. (2022) investigate how new technological trends, such as the metaverse and non-fungible tokens (NFTs), impact the fashion industry. Bilgihan et al. (2024) propose a metaverse engagement model for brand development. Focusing on augmented reality (AR) and virtual reality (VR) aspects, Flavián et al. (2024) analyze the positive and negative user experience aspects of a cultural event held in the metaverse. Ruusunen et al. (2023)

examine how imagination compensates for the lack of touch when consumers shop in a virtual store, while Rauschnabel (2021) investigates consumer acceptance of holographic augmented reality substitutes for real products. In an analysis of land prices in the metaverse, Goldberg et al. (2024) show that location matters even in the absence of transportation costs and describe the metaverse as an attention economy, where businesses compete for the best locations.

Investigating the potential of metaverse retailing, Mehrotra et al. (2024) study various aspects of metaverse retailing and their impact on customer experience to help companies identify areas for improvement and propose possible research directions. Ahn et al. (2024) survey 248 individuals with metaverse experience to understand what attracts users to the metaverse and why they purchase intangible virtual goods. Additionally, they investigate whether participants purchase more virtual items as their visit frequency increases. They find that participants' perceived interactivity (i.e., playfulness and connectedness) strengthens their perception of an expanded self, which in turn enhances their purchase intentions toward virtual items. Eggenschwiler et al. (2024) analyze metaverse retailing from a managerial perspective, employing three qualitative studies to identify key managerial considerations for entering the metaverse and important design factors for customer experience. Klaus and Manthiou (2024) highlight several research areas for metaverse retailing, while Park and Lim (2023) explore the metaverse as a marketing platform for fashion brands and propose a theoretical framework to evaluate its impact on brand equity.

Expanding the scope to the overall potential of the metaverse, Yoo et al. (2023) provide an in-depth literature review and summarize various ways the metaverse is conceptualized, deriving a research agenda focused on retailing in the metaverse. They also identify 27 opportunities for retailing in the metaverse, including geospatial targeting and marketing spillovers, which are central subjects of our paper. Hollensen et al. (2022) explore the metaverse's building blocks and customer benefits through a case study of Nike's offering on the metaverse-enabled video game platform called Roblox. Additionally, Giang Barrera and Shah (2023) conduct an extensive literature review and Dwivedi et al. (2023) apply an industry expert interview approach to propose a definition, organizing framework, and research agenda for metaverse marketing. A similar approach is employed by Dwivedi et al. (2022) to examine the challenges and opportunities of the metaverse for practice and policy.

Research Paper	Research Question and Main Findings
Early Versions of Virtual Worlds (Second Life)	
Bourlakis et al. (2009)	Study the evolution of retailing from traditional commerce to the metaverse. They conclude that retailers must employ an integrated approach when setting promotional strategies across various channels.
Papagiannidis and Bourlakis (2010)	Describe the evolution from product- to customer- and experience-oriented retailing. Employ case studies and coin the term "retail theater".
Guo and Barnes (2011)	Propose a conceptual framework to study purchase behavior in virtual worlds. Use a survey in Second Life to derive practical recommendations.
Domina et al. (2012)	Study factors influencing consumer intentions to shop in a virtual world, through lab experiments and surveys. They find that consumers' perceived enjoyment and control positively influence their shopping intentions.
Gadalla et al. (2013)	Conceptualize the determinants of service quality in metaverse retailing, arguing that service quality in the metaverse is distinct from service quality in a web store.
Kuntze et al. (2013)	Conduct avatar-by-avatar-interviews to gain information on the past and present of virtual reality retailing. They conclude that the demand for virtual goods does not extend to a demand for real-world goods via a virtual channel.
Jung and Pawlowski (2014)	Use a broad definition of the term consumption and conduct interviews to study the potential factors influencing purchasing behavior in virtual worlds.
Hassouneh and Brengman (2015)	Study the impact of virtual store atmospherics on in-world shopper behavior as well as on the performance of metaverse retailers. They find that the use of atmospherics is closely related to real world stores and varies depending on characteristics such as store size, location, and product type.
Technological Elements of the Metaverse	
Goldberg et al. (2024)	Models the metaverse as an attention economy and provides empirical evidence that location matters for retailers and other firms, even when consumers can teleport.
Rauschnabel (2021)	Surveys 1,078 US consumers to investigate their acceptance of holographic AR substitutes for real products, finding high acceptance rates for some product categories (e.g., Post-it notes) and low acceptance rates for others (e.g., pets).
Belk et al. (2022)	Explore the meaning of digital ownership, study different representation models and discuss what may affect the willingness to pay.
Joy et al. (2022)	Explore how NFTs, metaverse, and AI affect the fashion industry through practical examples of luxury brands.
Ruusunen et al. (2023)	Interview 900 consumers to draw insights on their attitudes toward virtual shopping, showing that imagination, i.e., the capability of humans to envision things and events through mental imagery, compensates for the lack of touch in 360-virtual stores.
Trujillo and Bacciu (2023)	Collect and analyze Decentraland wearable mints and sales data. They find that the most important factor determining an item's price is its rarity and only a small fraction of primary sales occurs on the platform‘s marketplace, with the majority being given away to promote other cryptoasset or Metaverse projects.
Vidal-Tomás (2023)	Conducts an empirical study at the intersection of metaverse governance and commerce. Uses governance token data from multiple platforms and concludes that stablecoins and fiat currencies are better-suited candidates for metaverse payment infrastructure.
Ahn et al. (2024)	Survey 248 metaverse users to examine how perceived interactivity affects purchase intention through self-expansion, moderated by access frequency. Playfulness and connectedness boost self-expansion, increasing purchase intentions for virtual items, while frequent access weakens these effects due to hedonic adaptation.
Bilgihan et al. (2024)	Propose a metaverse engagement model and framework to analyze brand strategies, enhance visibility, and boost customer loyalty by considering both engagement and immersiveness.
Flavián et al. (2024)	Employ a mixed-methods approach including three focus groups to study user experience in a cultural event held in the metaverse. They find that users' inability to focus their attention creates a negative affect that diminishes the ability to imagine cultural events, while gamification elements effectively mitigate these negative effects.
Trujillo et al. (2024)	Investigate how the online poker project "ICE Poker" influences the overall dynamics of Decentraland wearables and in-world visits, using transactional wearable data and geospatial user positions. They find that the influence of this project is substantial for transfers and sales of wearables, as well as for daily unique visitors and time spent in the virtual world.
Metaverse Retailing Potential and Research Agenda	
Hollensen et al. (2022)	Explain the metaverse concept through a Nike-Roblox case study, exploring the customer benefits provided.
Dwivedi et al. (2023)	Examine the marketing implications of the hypothetical widespread adoption of the metaverse, identify new research directions and propose a framework for academia, practice and policymakers. Includes a checklist clarifying how the metaverse can be beneficial for a wide range of marketing aspects.
Giang Barrera and Shah (2023)	Review 164 articles and insights from 78 business professionals to identify emerging themes, and propose a framework for firms to enhance consumer experiences through immersiveness, sociability, and environmental fidelity, with implications for future marketing research.
Park and Lim (2023)	Explore the metaverse as a marketing platform for fashion brands through thematic analysis of trade journals and industry articles. Provide a typology of metaverse marketing strategies and propose a theoretical framework on their impact on brand equity, along with future research directions.
Yoo et al. (2023)	Present a new four-dimensional conceptualization of the metaverse (online collaboration, high consumer immersion, unique digital assets, and digital personas), and identify 27 future research directions with a focus on retailing.
Eggenschwiler et al. (2024)	Develop and validate a metaverse entry framework via semi-structured interviews with retail experts and refine it using metaverse user feedback. Propose a research agenda for retailers to strategize consumer-focused activities in the metaverse.
Klaus and Manthiou (2024)	Identify seven research avenues for metaverse retailing.
Mehrotra et al. (2024)	Explore the impact of metaverse retailing on customer experience by linking twenty latent topics under four themes to Uses and Gratification Theory 2.0. Discuss advancements in consumer research and propose future research directions and theoretical models for metaverse retailing.

Table 1: Metaverse retailing literature structured by general categories as proposed in Giang Barrera and Shah (2023).

While the literature on metaverse retailing has grown into a substantial branch, the analysis of geospatial data and retailing events remains sparse. To the best of our knowledge, only one concurrent paper by Trujillo et al. (2024) has explored this topic, primarily focusing on the dominance of gambling applications in Decentraland and their influence on avatar wearable sales. This is rather surprising, given that blockchain-based virtual worlds offer publicly available data ready for exploration. Addressing this research gap, we focus on the quantifiable aspects of identifying participating business sectors in metaverse retailing and analyzing patterns over time.

3 Data Collection and Preparation

In this paper, we explore a social virtual world called *Decentraland* (Ordano et al., 2017). Decentraland is a platform where individuals can create, explore, and trade within a visually stylized digital landscape. Users navigate through various themed districts, each offering a unique design and experience. Within this world, participants can purchase virtual land, construct buildings and applications, host events, and interact with others through customizable avatars. The platform emphasizes user ownership and decentralization, utilizing blockchain technology to enable the ownership and exchange of digital assets such as land and avatar wearables.

To get a comprehensive overview of the current state of metaverse retailing, we collect and merge data from two sources within Decentraland. *First,* we retrieved activity snapshots of avatars in Decentraland spanning from July 16, 2022, to April 23, 2023, by regularly querying a publicly available Application Programming Interface (API) and writing the data to a local database. The snapshots contain locational data for each avatar active in the virtual world. Notably, we observe 473,927 unique users, identified by their Web3 addresses. In total, we have 6,985,842 snapshots, each containing information on the locations of *all* users active at the time, resulting in an average of one snapshot every 3.47 seconds. *Second,* we use the users' Web3 addresses to gather transaction data from two public blockchains – Ethereum Mainnet and Polygon PoS – through our own local nodes and Infura.[1] The transaction data contains information on economic activity: Whenever a user receives or sends a token (i.e., an asset), it is recorded in the data. Tokens are

[1]Ethereum Mainnet is the chain on which much of the Decentraland infrastructure has been deployed. Polygon PoS is a so-called sidechain, closely associated with Ethereum mainnet and used for scaling. Both blockchains are Ethereum Virtual Machine (EVM) based, meaning they employ the same execution logic and user address schemes.

represented in a standardized way, allowing us to check for transfer receipts[2]. These receipts include the *sender* and *recipient* addresses, as well as a *token ID*.

We then utilize the users' Web3 addresses to connect spatial information from the virtual world with transaction data from the blockchain. By combining these two data sources, we establish a link between in-world activity and blockchain transactions. The former provides the location of each avatar, while the latter includes information on economic activity, such as retail events (e.g., purchases) and customer engagement events (e.g., free token-based merchandise).

Our initial focus is on the NFTs received by these addresses during the nine-month period. These tokens can represent in-world items, such as wearables for an avatar, tickets, or claims (e.g., a proof of attendance or membership). Similarly, they can represent vouchers that can be redeemed for real-world goods or services. We collect all transfer receipts throughout the observation period and filter them based on receipts where one of our addresses is recorded as the recipient of the underlying token. In total, we identify 6,287,852 events, corresponding to 108,273 of our original user addresses. This means that 22.846% of all Web3 addresses from our original set received at least one NFT between July 16, 2022, and April 23, 2023, on the Ethereum and/or Polygon PoS blockchain.

Note that these NFT transfers do not necessarily have to be metaverse-related. To determine if a user was active in Decentraland at the time of an NFT transfer, we use the timestamp associated with the transfer receipt. If the user was active, we retrieve the last known position from our snapshot data, as well as the start and end times of the user's in-world session. Since the actual login and logout times are unavailable, we employ a heuristic approach to define user sessions. For each user, we retrieve all recorded snapshot timestamps and compute the time intervals between observations. We set a tolerance of 5 minutes. If, at any point, two user-specific timestamps have a time difference greater than the defined tolerance, we consider this indicative of a new session.

Our sample includes a significant amount of transaction data that is not relevant to our analysis of metaverse retailing and customer engagement. Moreover, due to the open and permissionless nature of the blockchain, the issuance of tokens cannot be restricted. Consequently, our transfer receipt data is inflated with various tokens deployed for testing purposes or indi-

[2]Note that these transfer receipts are generally referred to as *events*. To avoid any confusion with retail events and other types of events discussed later in this paper, we use the distinct term *transfer receipts*.

vidual use. To address these issues, we apply a filtering process to exclude tokens that are not relevant to our analysis. Specifically, we only consider token contract addresses with at least 50 transfer receipts, at least 10 unique sender-receiver pairs, and a metaverse in-session rate of at least 0.05. The in-session rate is the ratio of transfer receipts associated with a metaverse user session to all transfer receipts. In other words, for at least 5% of all transfer receipts, the receiving user was active in Decentraland at the time of reception. Additionally, we eliminate contract accounts that do not specify a ‘tokenName‘ because such tokens cannot be categorized for a proper analysis of business sectors and large-scale metaverse events.

The cleaned sample consists of 878,716 transfer receipts, 296,985 of which occurred when the recipient was in an active in-world session (33.80% in-session rate). The data correspond to 1,395 individual token contracts and 49,098 user addresses, accounting for approximately one-tenth of our original snapshot data. For these addresses, we observe a median of 102 sessions over the nine-month period. We summarize all filtering criteria, the underlying motivations, and the effects on the total number of observations (i.e., transfer receipts) in Table 2.

Figure 1 shows all in-session retail events in our data. This naïve visualization already suggests a few interesting patterns. Several clusters of retail events are apparent, indicating popular points of sale. The existence of these hotspots is unsurprising and aligns with expectations from traditional retailing. Moreover, a careful observer may notice that some observations correspond to out-of-bounds (oob) retail events.[3]

Since blockchain transactions are not instantly confirmed, analyzing the location of individual transactions can be challenging, but aggregating the data should mitigate these issues. On average, users who claim tokens from the same collection within the virtual world are likely to be located in the same area. Consequently, we employ several strategies to treat out-

[3]Please note that this is not a mistake. Users may leave the intended area and roam the outer rim of the metaverse. The reason we observe some retail events in this area is twofold. *First,* the apparent oob clusters in the northeast of the map are actually part of a district expansion. As suggested by the cluster, there is content deployed on these parcels. While these parcels are not part of the initial landmass, there is clearly economic activity occurring on them. We therefore decided to include these parcels into our data set and visualize the landmass accordingly. *Second,* depending on the blockchain's transaction queue (mempool) and the parameters of the user transaction, it may take several seconds for the transaction to be confirmed. Consequently, the obtained timestamp lags, resulting in some variance in the positioning of the retail event if the user moved during this period. Similarly, if users indicate their activity in Decentraland through a browser window or tab, while simultaneously minting or purchasing an NFT on a different frontend, such as OpenSea, the location becomes meaningless.

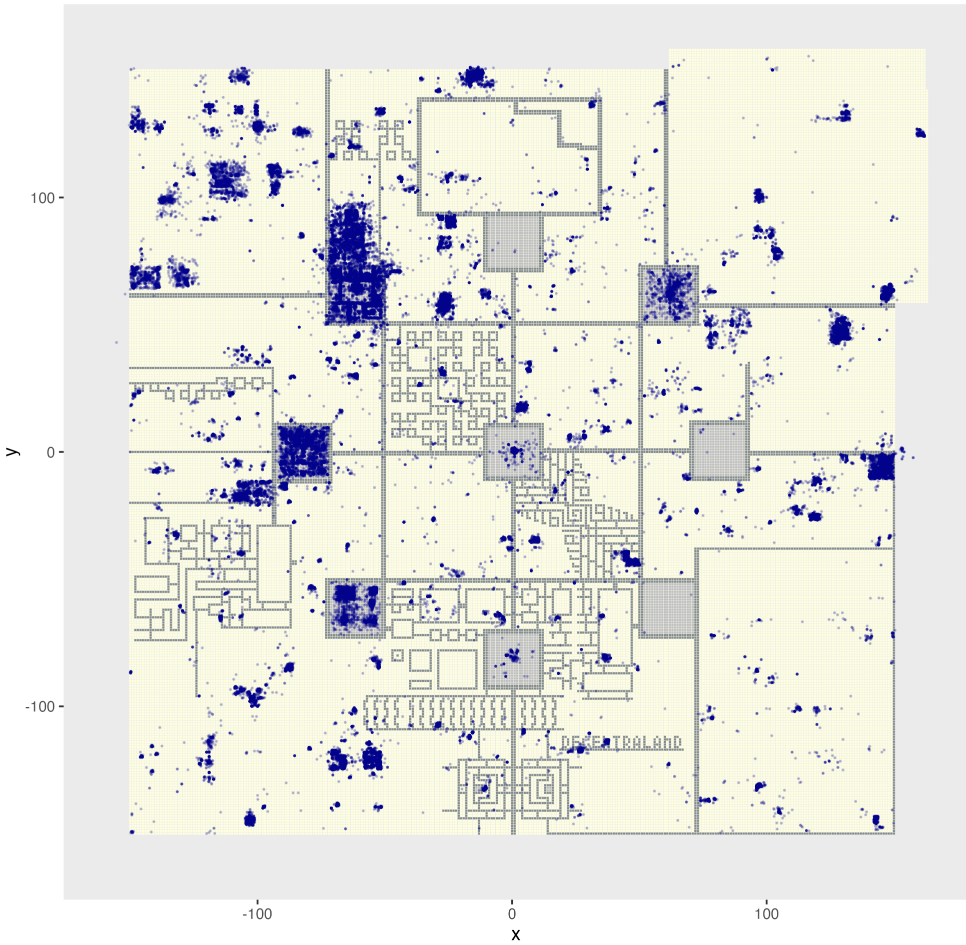

Figure 1: Map of Decentraland With All Retail Events

liers throughout our data analysis (e.g., by computing centroids and spatial variability). Even if some outliers persist, we can still gain a comprehensive understanding of the geospatial aspects of retailing events in the metaverse.

4 Data Analysis

In this section, we take a closer look at four critical areas of the dataset: in-session retail events, asset categorization by business sector, and time-based activity patterns, particularly during large-scale events. *First,* examining in-session retail events – filtered to exclude secondary market transfers – provides insights into direct consumer interactions within the metaverse, revealing authentic purchase and customer engagement behaviors. *Second,* categorizing tokens and assets by business sector allows us to identify which industries are most actively engaging in metaverse commerce, offering a sectoral analysis crucial for understanding the distribution of economic activity. *Third,* analyzing time-based activity patterns highlights how transaction volumes fluctuate around major metaverse events, helping to understand the temporal dynamics of consumer engagement and market activity within this digital landscape. *Fourth,* we identify two large-scale events that substantially affect retailing activity and further analyze their impacts.

4.1 Primary and Secondary Market

The token transfers in our data set include both primary and secondary market transactions. If Alice buys or claims a token from a retailer, this primary market transaction will be part of our data. Similarly, if Alice buys a token from another user, this secondary market transaction will also be reflected in our data. While secondary market data can provide insights for other research questions, the main focus of this paper is retailing and customer engagement. Therefore, we develop a strategy to identify and exclude secondary market data.

Depending on how the token contract is implemented, this differentiation is straightforward. The most common pattern is direct-to-customer (DTC) retailing, where the token contract "mints" and transfers the token directly to the customer. By convention, transfer receipts for these minting events contain the zero address in the sender field. For example, consider Alice, who interacts with a merchant in the metaverse by claiming or buying an NFT. The corresponding transfer receipt would contain Alice's address as the recipient and the zero address (`0x00`) as the sender. This allows us to easily identify any DTC retailing activity implemented in line with this convention.

However, some implementations do not follow this convention. For instance, an NFT collection may be pre-minted to another address owned by the issuer or a third-party retailer. If the tokens are subsequently transferred to a customer, the transfer receipt will not show the zero address as the sender. Similarly, a token contract may disregard the zero address convention and use an entirely different sender address to indicate token minting. Transfers in this category correspond to either DTC or indirect retailing activity. Both are clearly relevant in the retailing context. Yet, we must carefully distinguish this scenario from true secondary market activity, where a token transfer occurs between two users.

Figure 2 summarizes the different types of retailing and secondary market activity. Subfigures `a` and `b` correspond to two retail scenarios, while Subfigure `c` represents a true secondary market transfer.

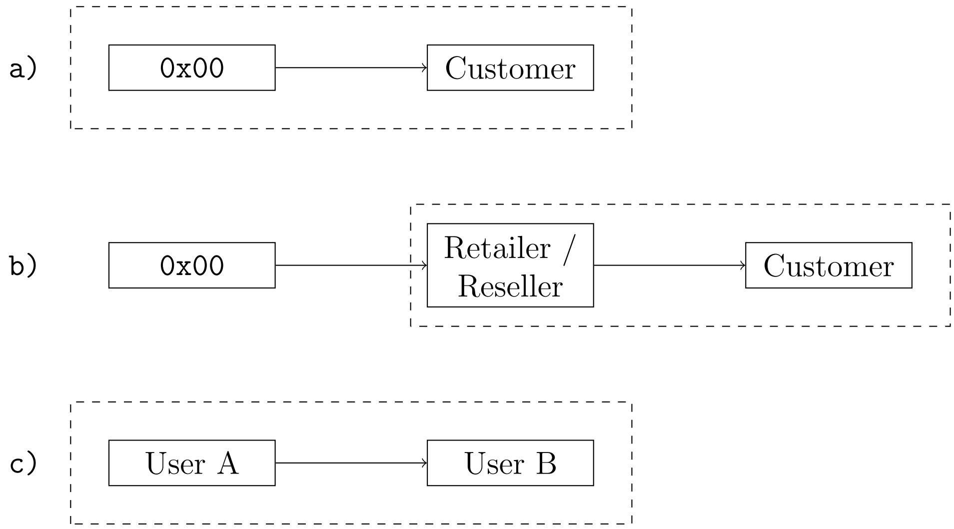

Figure 2: Different Types of Retailing and Secondary Market Activity

To differentiate between the second and third cases, we propose and implement a classification scheme based on the variability among sender addresses and the receivers' respective location at the time of the transfer. After classifying all *zero address sender transfers* as primary market events, we apply our standard filter and remove any transfer receipts for tokens with fewer than 50 remaining observations. For the remaining token contracts, we identify the most frequent sender address and compute its proportional share of transfer events. This allows us to identify if a non-zero address accounts for most of the transfers. We then use this address to compute the centroid $(\bar{x}, \bar{y})$ and the mean spatial deviation across the token receivers' locations at the time of their respective transfers. We define *spatial variability* as the average Euclidean distance from the centroid, $\frac{1}{N}\sum_{i=1}^{N}\sqrt{(x_i-\bar{x})^2+(y_i-\bar{y})^2}$, where N represents the number of remaining transfers for that collection in our data.

The approach of employing a measure of spatial variability is based on the observation that primary market transactions tend to have a much lower mean absolute deviation than secondary market transactions. The former occur at a specific in-world location, while the latter mostly take place through bilateral agreements (OTC) and tend to be widely spread across the map. We illustrate this exemplarily with two tokens in Figure 3, where the blue retail events are associated with a high-spatial-variability-token (1,492.17 meters), and red retail events are associated with a low-spatial-variability-token (2.78 meters). This suggests that the red retail events were sold or claimable at a specific location within the virtual world, representing metaverse retailing. In contrast, the blue retail events likely correspond to claims by users who were active in the virtual world but accessed the token through another frontend, such as a different browser window. Alternatively, the tokens may have been offered independently of the users' in-world location.

We classify tokens part of the primary sales set if the most frequent sender ratio is greater or equal to 0.5 and the mean spatial variability is below 750. Figure 4 visualizes the data and reveals a natural break that separates the cluster in the upper left corner from the rest of our observations. For clarity, the previous examples from Figure 3 are colored in red and blue. The classification of primary and secondary market transactions is shown in Figure 5. The filtering process from all in-session transfer receipts to primary market retail events is summarized in Table 2.

Idea	**Criteria**	**Observations**
Collect NFT transfer receipts	Metaverse user received ERC-721 or ERC-1155 token between July 16, 2022 and April 23, 2023 on Ethereum Mainnet or Polygon PoS	6,287,852
Remove irrelevant tokens	Number of transfer receipts $\geq$ 50 per token *AND* unique sender-receiver pairs $\geq$ 10 per token *AND* in-session rate $\geq$ 0.05 per token *AND* token name must be specified	878,236
Only consider in-session transfer receipts	Timestamp of transfer within user session window	296,961
Select primary market (retail) events only	Number of non-`0x00` senders $\geq$ 50 per token *AND* most frequent sender ratio $\geq$ 0.5 per token *AND* mean spatial variability $\leq$ 750 meters per token *OR* sender is `0x00`-address	264,481

Table 2: Data Filtering Process

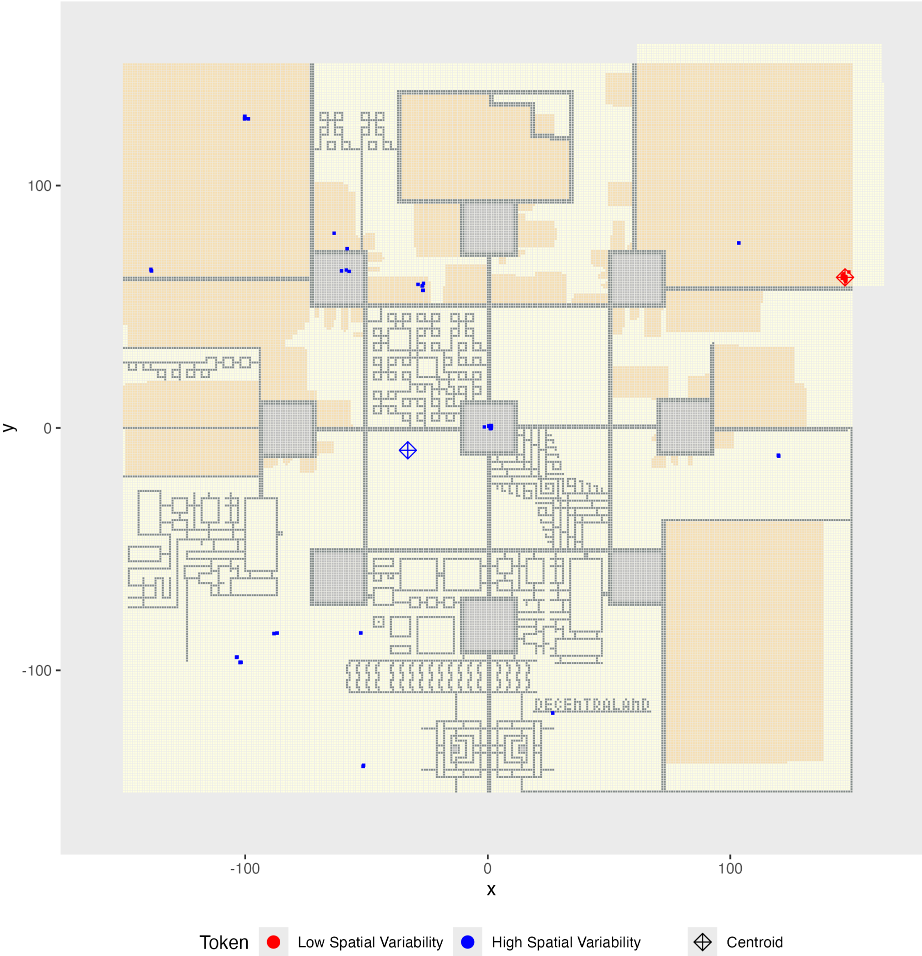

Figure 3: Examples of Low vs. High Spatial Variability Tokens

4.2 Participating Business Sectors

We categorize the remaining tokens by examining their names and contract addresses to classify them according to their brands and business sectors.

This process involves identifying well-known brands and verifying the legitimacy of the projects by referencing brand-specific press releases, social media posts, and, when relevant, consulting the Decentraland Wearables

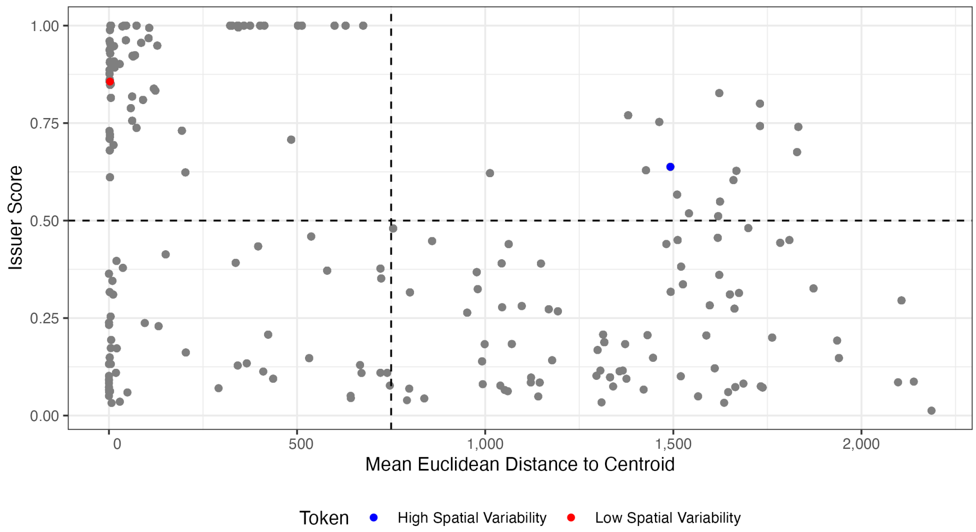

Figure 4: Most Frequent Sender Ratio and Spatial Variability for All Unclassified Token Collections Including Two Examples from Figure 3

Committee forum for additional information and validation.[4]

After categorizing a significant number of tokens, we create sector-specific keyword lists to facilitate the automatic assignment of token names. For example, in the 'Music' category, we initially include generic keywords such as 'Festival', 'Music', 'MVMF', and 'Stage', as well as the names of known participating artists. In the next step, we use *ChatGPT* to extend the list by proposing additional generic keywords and brands within the music category. We repeat this process for each category, and new categories are added iteratively based on the remaining unassigned token names. To minimize false positives, we conduct a thorough manual review of the sectors. Tokens that cannot be definitively assigned to a sector are placed in the "unknown" (i.e., "Other") category. This category contains tokens primarily from Web3-native NFT communities or generic (non-branded) wearables and emotes. A token can be assigned to multiple sectors (1 to n mapping, with $n \geq 0$), allowing for cross-sector collaboration. One example is the NFT collection *Grey Goose® US Open Wearables*, which spans both the Sports and the Food & Beverages sectors. Our sector definitions do not take into account

[4]The Wearables Committee plays a crucial role in approving or denying community-proposed wearables. This control mechanism ensures that no wearables are created that have a negative visual impact on the virtual world, violate the platform's rules, or infringe upon intellectual property rights. By maintaining this oversight, the committee helps preserve the integrity and quality of wearables within Decentraland.

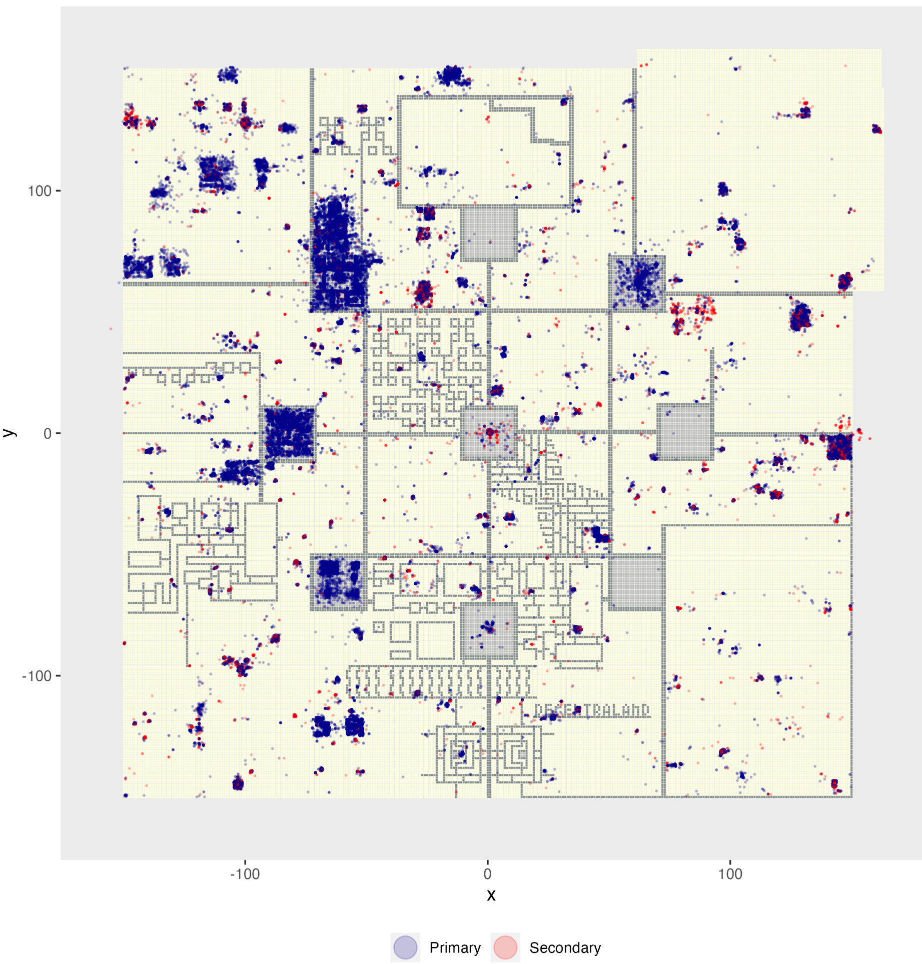

Figure 5: In-Session Transfers Classified in Primary and Secondary Market Transactions

the underlying asset type.

We identify three major asset types among tokens. First, a notable portion of tokens consists of Decentraland-specific wearables, intended to be worn by avatars within the virtual world. Second, we identify tokens that can be classified as tickets or passes, which provide holders with access to special events or experiences and serve as evidence of admission. Third, we observe tokens that function as proof of attendance, allowing users to demonstrate their participation in specific events.

In total, we successfully categorize 35% (423/1,207) of the relevant tokens. We identify 11 business sectors: Fashion, Music, Food & Beverages, Gaming, Sports, Financial Services & Consulting, Crypto/Web3, Art, Technology, Movies & Television, and Media. Figure 6 shows the connections between sectors and their relative size. Each circle represents a sector, with its size reflecting the number of retail events. The connections between the circles indicate brands active in multiple sectors and cross-sector cooperations between two or more brands. The thickness of each link represents the number of retail events. We find the highest retail activity from companies in the Gaming, Music, Food & Beverages, and Fashion industries, with strong connections within these sectors and with the Technology, Sports, TV & Movies, and Crypto sectors. In contrast, retail activity within the Financial Services & Consulting, Art, and Media sectors appears to be much less pronounced and interconnected.

4.3 Time-based Analysis

To gain deeper insights into metaverse retailing, we plot the time series of daily retail events in Figure 7. Building on the categorization in the previous subsection, we differentiate between tokens from different sectors. In cases where tokens belong to multiple categories, such as the NFT collection *Grey Goose® US Open Wearables*, the events are proportionally assigned to all respective categories, ensuring an accurate reflection of the daily retail event counts in the time series. For instance, a single retail event linked to the aforementioned NFT collection contributes 0.5 to the count of retail events in both the "Food & Beverages" and "Sports" categories.

While there is retail activity throughout the nine-month observation period, a significant portion of it is concentrated in short, thematic periods. Notably, the graph shows several pronounced peaks that are predominantly attributed to specific sectors. The highest peak, occurring at the end of November 2022, aligns with the *Metaverse Music Festival*. The second-highest peak

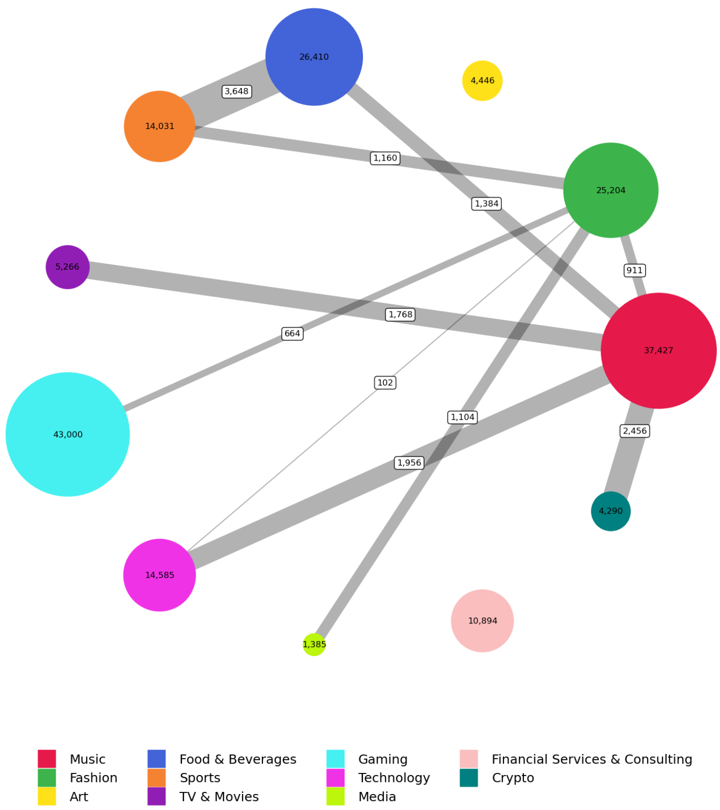

Figure 6: Size of and Connections Between Business Sectors

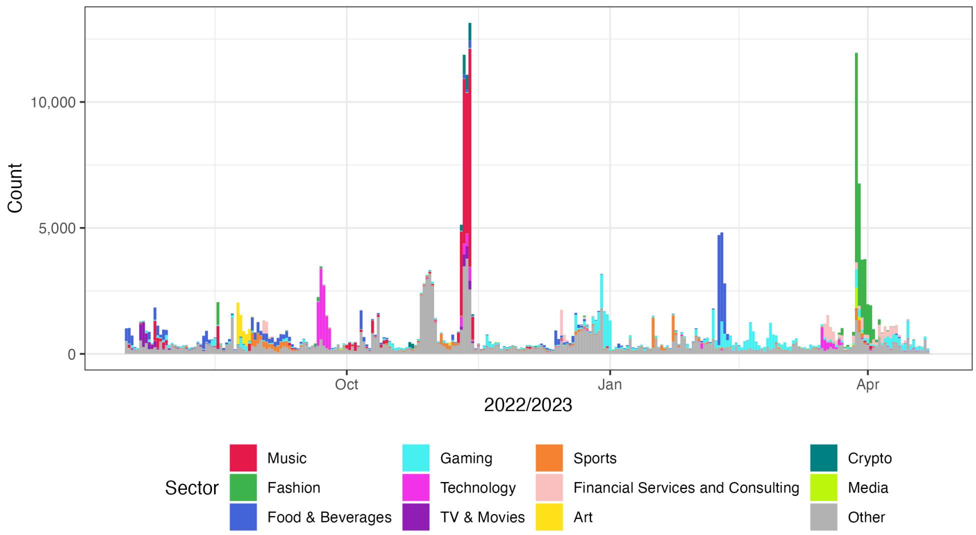

Figure 7: Primary Market Retail Events Over Time

corresponds to the *Metaverse Fashion Week*, while other notable peaks are linked to events organized by *Samsung* and *Doritos*. Additionally, the elevated peaks in retail activity within the "Other" category can be attributed to either generic, unbranded holiday-themed wearables during Halloween and Christmas or proof of attendance tokens, such as *SHOAP*.

Retail activity in Decentraland appears to be driven by events that often resemble trade shows. For these events, developers and designers create temporary, festival-like settings where various brands, both from the physical world and the metaverse, showcase their offerings. These brands offer different types of NFTs, such as avatar wearables and emotes, which users can obtain either for free or through purchase.

In the case of music festivals or fashion shows, these events typically feature stages and runways that attract users interested in live performances by their favorite artists or the launch of new products, such as clothing lines from various brands. Brands may not only utilize token offerings for retailing but also as a customer engagement tool to interact with a larger audience and promote themselves effectively within the metaverse environment.

To gain further insights, we analyze two events in detail using our geospatial and transaction data. Figure 8 showcases the festival grounds of the *Metaverse Music Festival 2022*, emphasizing the 10 tokens with the highest retail activity during the event. It is important to note that due to the lag in blockchain transaction confirmations, the precise locations of individual points may not accurately depict where specific retail events occurred. However, the clusters shown in the figure provide a clear representation of notable areas within the festival grounds. To enhance the visualization, we overlay the original festival map onto our figure, allowing for a more comprehensive understanding of the event's spatial layout and associated spillovers.

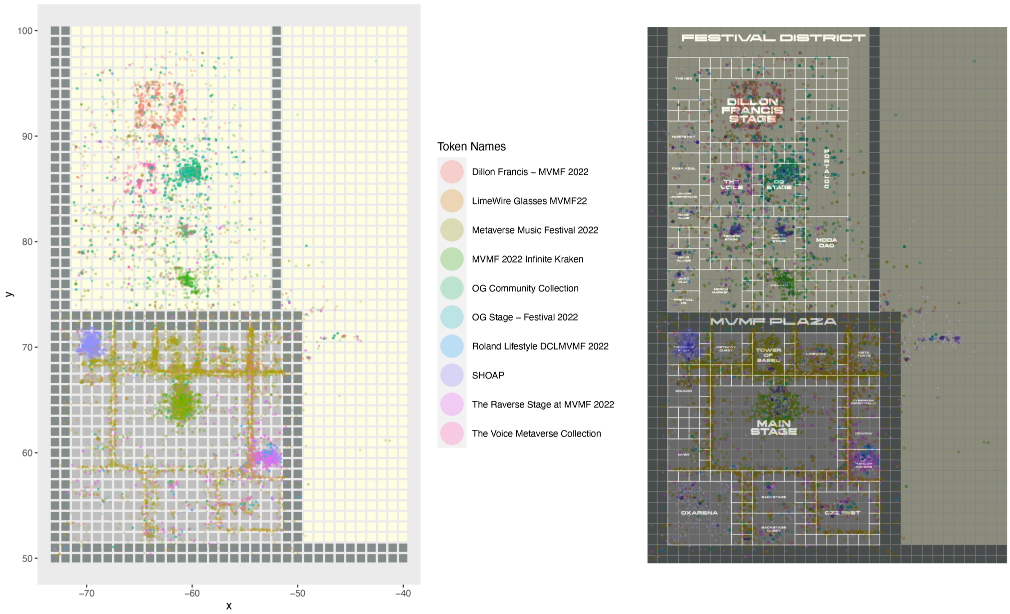

Figure 8: Metaverse Music Festival 2022

While the *Metaverse Music Festival 2022* was confined to a single main area, the *Metaverse Fashion Week 2023* encompassed multiple distinct venues. In Figure 9, we present the primary market retail events that occurred during the event and provide a closer look at the two specific areas. The western area included the *Luxury District* on the plaza, and the *NEO PLAZA* south-west of the plaza, while the southern area was known as *Organic Origins*. By zooming in on these venues, we can gain a more nuanced understanding of the retail activity that unfolded within each venue. A notable observation from the figure is the overlap among tokens with the highest frequency of retail events in their respective areas. While it is conceivable that these tokens were offered in both locations, the differences in concentration and dispersion suggest an alternative scenario. For instance, a distinct cluster representing the *Tabby Collection* is clearly visible in the southeastern part of the *Luxury District*, whereas only scattered points are observable at *Organic Origins*. This suggests a high level of interrelation in user activity between the two venues.

Considering the inherent delay in blockchain transaction confirmations, the dispersed points at *Organic Origins* may correspond to users who initially initiated a retail event at the *Luxury District* and subsequently teleported to *Organic Origins* while still awaiting confirmation of their transaction. This finding highlights a noteworthy aspect of metaverse retailing: transportation costs in social virtual worlds are negligible, enabling events to seamlessly span multiple venues without concerns about physical transportation. This insight can inform the planning of future events that encompass various areas within the same virtual world.

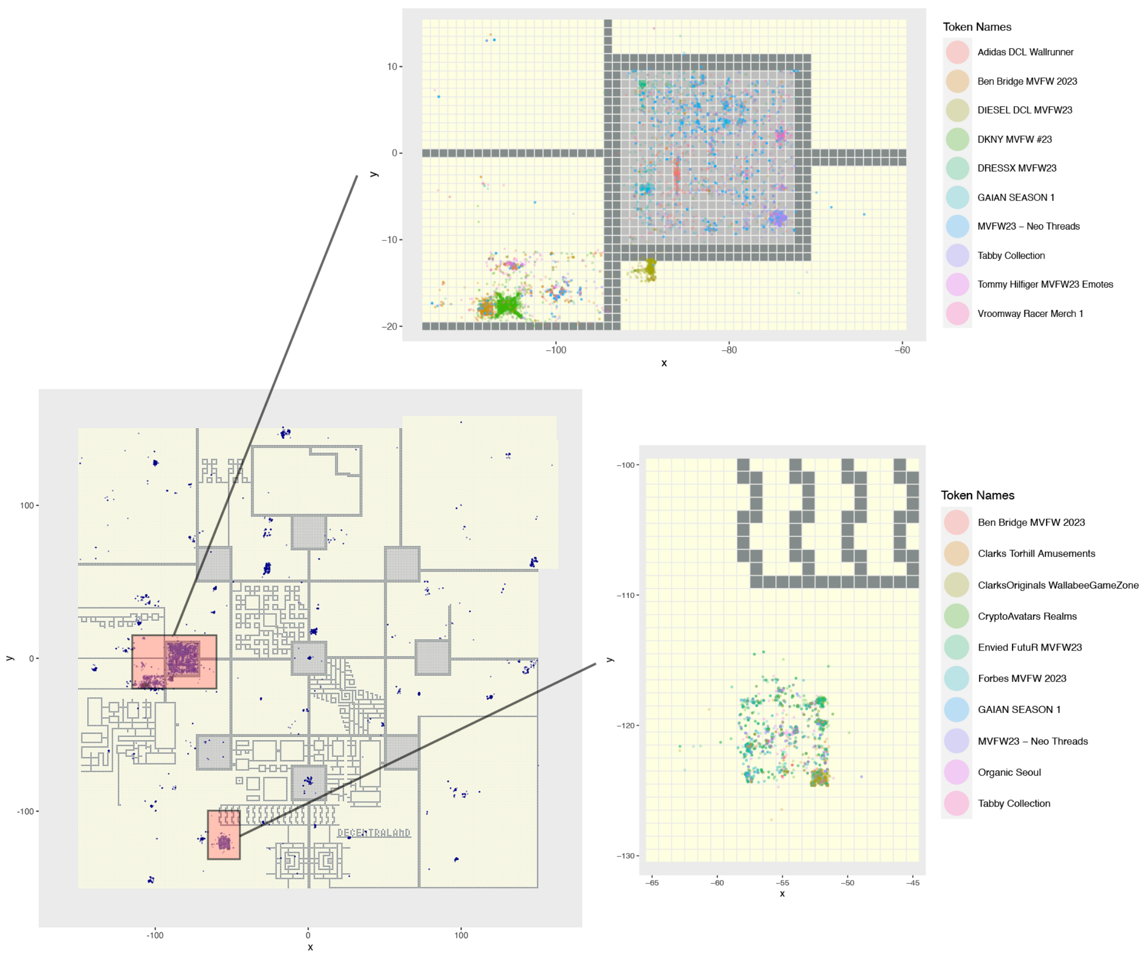

Figure 9: Metaverse Fashion Week 2023

4.4 The Effects of Festivals on Retailing

To further investigate the potential causal relationship between festivals and the number of retail events illustrated in Figure 7, we estimate the following two-way fixed effects model:

$$Y_{i,t} = \alpha_i + \omega_t + \beta_1 \text{MVMF22}_{i,t} + \beta_2 \text{MVFW23}_{i,t} + \epsilon_{i,t}. \tag{1}$$

In this model, $Y_{i,t}$ represents the number of retail events occurring on parcel i on day t. The terms α_i and ω_t account for location-fixed effects (i) and time-fixed effects (t), respectively. The variable $\text{MVMF22}_{i,t}$ is an indicator that equals 1 for parcels associated with the *Metaverse Music Festival 2022* on the days of the festival, while $\text{MVFW23}_{i,t}$ is an indicator that equals 1 for parcels associated with the *Metaverse Fashion Week 2023* on the days of that event. The *Metaverse Music Festival* encompasses parcels shown on the festival map in Figure 8, and the *Metaverse Fashion Week 2023* comprises parcels at the *Luxury District*, *NEO PLAZA*, and *Organic Origins*, as illustrated on the map in Figure 9.

We estimate this model for a balanced panel data set that includes the previously filtered data on primary retail events using OLS. The sample consists of 26,112,354 observations across 282 days, spanning from July 16, 2022, to April 23, 2023, and covering 92,597 parcels. The mean number of retail events per parcel per day, $\overline{Y}_{i,t}$, across the entire sample is approximately 0.01.

The coefficients of interest, β_1 and β_2, measure the increase in retail events per parcel per day during the respective festivals in the relevant areas, while controlling for location- and date-fixed effects. The location-fixed effects, α_i, account for parcels that consistently have a high number of retail events, while the date-fixed effects, ω_t, control for days with generally higher retail activity across the entire virtual world.

For comparison, we also estimate the model using first differences:

$$\Delta Y_{i,t} = \phi_t + \gamma_1 \Delta \text{MVMF22}_{i,t} + \gamma_2 \Delta \text{MVFW23}_{i,t} + u_{i,t}. \tag{2}$$

In this model, $\Delta Y_{i,t}$, $\Delta\text{MVMF22}_{i,t}$, and $\Delta\text{MVFW23}_{i,t}$ are first differences in our previous variables of interest. The term $\phi_t = \omega_t - \omega_{t-1}$ captures the change in time-fixed effects, and $u_{i,t} = \epsilon_{i,t} - \epsilon_{i,t-1}$ represents the differenced error term. Since the location-specific effect α_i does not vary over time, it is eliminated in the first differences model.

The results in Table 3 indicate a substantial increase in daily retail events per parcel. For the *Metaverse Music Festival*, we estimate an increase of 7.917 in the *Levels* model and 6.465 in the *First Differences* model. For the

	Number of Retail Events, $Y_{i,t}$	
	Levels	First Differences
	(1)	(2)
MVMF22	7.917***	6.465***
	(1.492)	(2.298)
MVFW23	2.634***	2.898*
	(0.832)	(1.500)
Time-Fixed Effects	Yes	Yes (differenced)
Location-Fixed Effects	Yes	No
Observations	26,112,354	26,019,757

Table 3: Twoway-Fixed Effects Model Estimates. Twoway-clustered standard errors in parentheses. Time-fixed effects are included in both models. Location-fixed effects are included in the first model only. Confidence levels: *p<0.1; **p<0.05; ***p<0.01

Metaverse Fashion Week, we find an increase of 2.634 and 2.898, respectively. However, the estimated coefficient in the *First Differences* model for the *Metaverse Fashion Week* is only statistically significant at the 90% confidence level. The differences in the estimates between the two models likely arise from dynamic effects that cannot be fully captured by the fixed effects, α_i and ω_t. For example, retail events may temporarily increase outside the official festival areas during other (unobserved) temporal events. While the location-fixed effects, α_i, and the time-fixed effects, ω_t, capture some of this variance, they do not account for all of it.

Figure 10 further illustrates these dynamic effects. Parcels with higher location-fixed effects, α_i, tend to have greater unexplained variance, reflected in a higher standard deviation $\sigma(\epsilon_i)$ of the residuals $\epsilon_{i,t}$ for location i. Thus, a higher location-fixed effect does not necessarily indicate a consistently elevated level of retail activity. Instead, it is strongly correlated (correlation coefficient = 0.85) with $\sigma(\epsilon_i)$, suggesting that a higher location-fixed effect is often linked to a higher degree of temporal fluctuations. However, some locations with medium to high location-fixed effects α_i and low residual variance $\sigma(\epsilon_i)$ demonstrate that a few locations maintain consistently high levels of retail activity.

Figure 11 presents the time-fixed effects ϕ_t from Model (2). The spikes in retail activity generally align with those in Figure 7, corresponding to the two

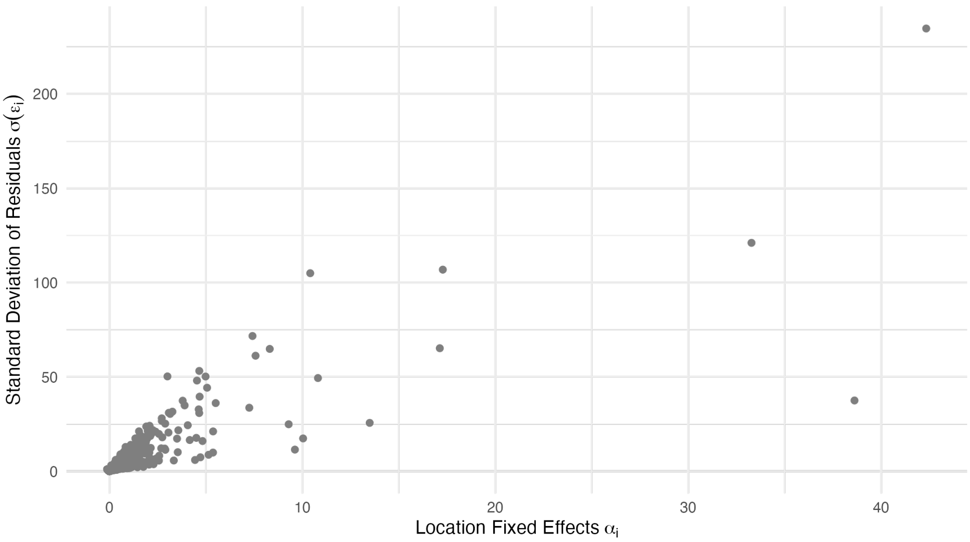

Figure 10: Location-Fixed Effects vs. Standard Deviation of Parcel-Specific Residuals

festivals and other significant temporal events. However, the sign of the differenced time-fixed effects ϕ_t is bidirectional, offering intriguing insights. For instance, at the onset of the *Metaverse Music Festival*, retail activity across the virtual world, excluding the festival area, initially drops substantially before recovering. This pattern suggests that the festival may temporarily draw retail activity away from other areas, concentrating it within the festival zone. In contrast, the *Metaverse Fashion Week 2023* shows a sharp increase in retail activity at its start, indicating a broader surge in virtual world commerce, potentially driven by festival spillovers and related side events.

5 Discussion

Our data suggest that, in its current form, metaverse retailing is primarily influenced by thematic events. While there is a baseline level of activity, the majority of economic transactions occurs during trade shows and festivals at the respective locations. Small, temporary spillover effects are also observed from or to these festivals. Similar to the physical world, our data suggest that retail activity during these festivals can extend to multiple side events. This effect may be more pronounced in the virtual domain due to the negligible transportation costs of avatars, which allow easy access to remote locations through teleportation. We anticipate that retailers will increasingly capitalize

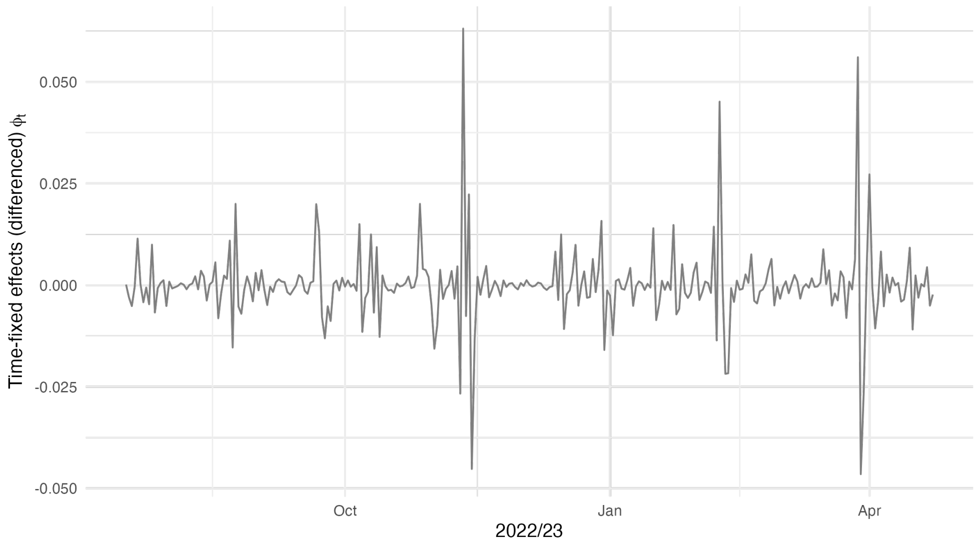

Figure 11: Time-fixed Effects ϕ_t

on these teleportation opportunities in the coming years, as it enables them to promote their products in easily accessible locations without the spatial constraints imposed by crowded areas.

Despite these large events having a specific theme, we are surprised to see seemingly unrelated brands and companies participating. The products offered often result from unique collaborations across different sectors, fostering unexpected connections among communities and industries. Interestingly, significant differences exist between sectors. For example, while financial services and consulting firms appear to be active in metaverse retailing and customer engagement initiatives, they do not participate in crossovers with other sectors. The reasons for this may require further research.

Metaverse retail transactions primarily involve virtual items, including avatar wearables, tickets, and digital merchandise. We also observe a few instances where companies have sold NFTs that can be redeemed for goods and services in the real world. While these tokens are still relatively uncommon, they illustrate the potential of NFTs distributed throughout the metaverse to serve a purpose in both the physical and virtual domains.

Our data suggest that the majority of goods in the metaverse have been offered for free, allowing users to claim these tokens. Companies appear to be primarily focused in customer engagement and promotional activities. These activities align with the concept of experiential customer engagement, as introduced by Harmeling et al. (2017), and are characterized by shared, interactive experiences that go beyond economic transactions to create voluntary, autonomous customer contributions to a brand's marketing efforts. Experiential engagement initiatives are particularly effective at fostering heightened positive emotions, enjoyment, and psychological connections with the firm or brand (Harmeling et al., 2017). On the one hand, this is a positive outcome, as it indicates that companies are embracing the metaverse's potential for engaging customers. The virtual environment, unrestricted by real-world limitations, may foster greater creativity and enable the creation of unique and memorable customer experiences. On the other hand, our findings suggest that the potential of experiential engagement in the metaverse is not yet fully realized. The dominance of major events indicates that, while brands are experimenting with these new forms of customer engagement, the broader adoption and integration of metaverse retailing into everyday consumer behavior remain limited. This observation highlights an opportunity for firms to expand their use of experiential engagement initiatives in the metaverse, potentially by developing more frequent and varied events that encourage ongoing participation and deeper customer-brand interactions. It is important to note that, for these engagement activities to be truly effective, they must be integrated across multiple channels, as emphasized by Lee et al. (2019). In the context of retailing activities in the metaverse, this outcome is somewhat disappointing. If most metaverse transactions indeed stem from free merchandise, the observed transactions may primarily reflect marketing efforts and customer engagement rather than actual sales. Overall, we anticipate a convergence between retailing and customer engagement activities, leading to a blurring of boundaries between the two. Just as promotional activities are common in brick-and-mortar stores and e-commerce, virtual customer engagement events may play a significant role in metaverse retailing. However, our findings align with previous studies, which emphasize the important role of customer experience in the context of the metaverse, offering companies a unique platform to craft interactive and engaging purchasing experiences (Mehrotra et al., 2024). Such initiatives can improve customers' quality perceptions (Anderson and Laverie, 2022) and loyalty (Molinillo et al., 2022).

Unfortunately, differentiating between pure retailing and customer engagement activities proves challenging since we cannot observe all payment streams. We have encountered various instances of retail events where only the purchased goods are recorded on the blockchain, while the actual payment occurs through traditional channels, such as credit cards, which are not traceable on the blockchain. Consequently, the data does not allow for reliable figures regarding the proportional breakdown between retailing and customer engagement. While we are confident in the contribution of our data and empirical work toward enhancing the understanding of retailer and customer engagement activities in the metaverse, distinguishing between the two will require further research.

Other future research could expand the scope of data sources to further explore retailing and customer engagement in the metaverse. For example, gaining access to off-chain payment data would enable researchers to differentiate more clearly between retailing and customer engagement. Additionally, examining how specific user characteristics, such as demographic or psychographic factors, impact user behavior, retail activity, and customer engagement within the metaverse could provide valuable insights for developing targeted marketing strategies in social virtual worlds. Research could also investigate other (blockchain-based) virtual worlds, compare different retailing strategies across these platforms or between companies and brands, analyze long-term trends in customer engagement within the metaverse, or explore spatial spillovers in greater depth. Nonetheless, the most significant challenge remains collecting the comprehensive data required for these topics, as such data are typically owned by various companies.

The future trajectory of metaverse retailing remains uncertain, particularly regarding its ability to evolve beyond its current event-driven phase. We argue that the primary challenges hindering its growth are technological limitations and constraints related to user engagement. While the potential of social virtual worlds is widely recognized, these environments often fall short compared to the immersive experiences offered by contemporary traditional video games or the tangible physical world. This discrepancy may contribute to the relatively low rates of user adoption, as the majority of virtual environments lack engaging content and vibrant community interactions, resulting in a sense of emptiness among users. During major events, however, these interactions and content offerings increase significantly, with activities such as live concerts, fashion shows, and presentations drawing temporary attention. While these events can briefly boost user traffic and engagement, there is limited evidence to suggest that they have a lasting impact on user adoption or sustained activity within the metaverse retail space.

In the current landscape of metaverse retailing, practitioners are advised to consider large-scale events as a key component of their strategy. To strengthen brand loyalty and foster community interaction, retailers can implement customer engagement strategies, such as interactive games, virtual meet-ups, fashion shows, or concerts, potentially incorporating features like free NFT wearables or other proof-of-attendance mechanisms. To follow a more retail-driven approach and facilitate direct sales or transactions, retailers may consider launching virtual storefronts offering in-world assets, e.g., avatar wearables, tickets, or even tokenized vouchers redeemable for real-world goods or services. While some companies, such as Samsung and Doritos, have successfully generated significant retail and customer engagement independently, this approach may not be feasible for all firms. Participating in major community events can create novel retailing and customer engagement opportunities by leveraging the strong network effects associated with these festivals. Additionally, collaborations with firms from different sectors have shown some promise, and brands have also effectively engaged in festivals that are unrelated to their core themes, benefiting from the increased user traffic even without a direct thematic connection.

6 Conclusion

Over a span of nine months, we have gathered snapshot data on user locations in Decentraland and transaction data from the Ethereum and Polygon PoS blockchains. The combination of these data sets enabled us to conduct an empirical analysis of retailing and customer engagement activities in the metaverse. Our findings suggest that metaverse retailing remains in its early stages and is predominantly driven by major events, such as music festivals and themed trade shows.

We have discovered a significant presence of popular companies actively participating in the metaverse. However, their involvement appears to be primarily motivated by marketing and customer engagement objectives. The activities analyzed suggest an early alignment with the principles of experiential customer engagement.

To the best of our knowledge, this paper is the first metaverse study to combine geospatial and transaction data to analyze retailing, potentially laying the groundwork for a more profound understanding of geospatial targeting in the metaverse. We are confident that this work will attract the interest of both researchers and practitioners.

Practitioners may find value in the insights derived from our empirical analysis and the visual representation of retail events. These insights can serve as a foundation for strategic decision-making and provide a quantitative perspective on the ongoing debate about the merits of establishing a presence in the metaverse. Additionally, our analysis and visual representation of retail events can help companies benchmark their metaverse presence more effectively. Retail managers can use these insights to analyze user behavior patterns, such as timing and locational preferences. By accessing all payment streams, they can link these behavioral insights to sales performance, thereby refining and optimizing their metaverse retail strategies.

Researchers may be interested in extending our approach, refining the proposed methods, or applying them to a wide range of alternative research questions. There are numerous opportunities for further exploration. For instance, conducting an in-depth analysis of micro-level retail locations or controlled experiments to examine the impact of atmospheric or locational changes represents promising avenues for future research. Similarly, investigating the influence of specific user (account) characteristics on avatar shopping behavior could open up a multitude of new research directions.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to expand the list of sector and brand-specific keywords used to categorize token names. This is also mentioned in the manuscript itself. Moreover, the authors used a local LLM and the Texifier autocorrect feature for proofreading. After using these tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

Ahn, S., Ellie Jin, B., Seo, H., 2024. Why do people interact and buy in the metaverse? self-expansion perspectives and the impact of hedonic adaptation. Journal of Business Research 175, 114557.

Anderson, K.C., Laverie, D.A., 2022. In the consumers' eye: A mixed-method approach to understanding how vr-content influences unbranded product quality perceptions. Journal of Retailing and Consumer Services 67, 102977.

Belk, R., Humayun, M., Brouard, M., 2022. Money, possessions, and ownership in the metaverse: Nfts, cryptocurrencies, web3 and wild markets. Journal of Business Research 153, 198–205.

Bilgihan, A., Leong, A.M.W., Okumus, F., Bai, J., 2024. Proposing a metaverse engagement model for brand development. Journal of Retailing and Consumer Services 78, 103781.

Bourlakis, M., Papagiannidis, S., Li, F., 2009. Retail spatial evolution: paving the way from traditional to metaverse retailing. Electronic Commerce Research 9, 135–148.

Domina, T., Lee, S.E., MacGillivray, M., 2012. Understanding factors affecting consumer intention to shop in a virtual world. Journal of Retailing and Consumer Services 19, 613–620.

Donath, J.S., 2002. Identity and deception in the virtual community, in: Communities in cyberspace. Routledge, pp. 37–68.

Dwivedi, Y.K., Hughes, L., Baabdullah, A.M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M.M., Dennehy, D., Metri, B., Buhalis, D., Cheung, C.M., Conboy, K., Doyle, R., Dubey, R., Dutot, V., Felix, R., Goyal, D., Gustafsson, A., Hinsch, C., Jebabli, I., Janssen, M., Kim, Y.G., Kim, J., Koos, S., Kreps, D., Kshetri, N., Kumar, V., Ooi, K.B., Papagiannidis, S., Pappas, I.O., Polyviou, A., Park, S.M., Pandey, N., Queiroz, M.M., Raman, R., Rauschnabel, P.A., Shirish, A., Sigala, M., Spanaki, K., Wei-Han Tan, G., Tiwari, M.K., Viglia, G., Wamba, S.F., 2022. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management 66, 102542.

Dwivedi, Y.K., Hughes, L., Wang, Y., Alalwan, A.A., Ahn, S.J.G., Balakrishnan, J., Barta, S., Belk, R., Buhalis, D., Dutot, V., Felix, R., Filieri, R., Flavián, C., Gustafsson, A., Hinsch, C., Hollensen, S., Jain, V., Kim, J., Krishen, A.S., Lartey, J.O., Pandey, N., Ribeiro-Navarrete, S., Raman, R., Rauschnabel, P.A., Sharma, A., Sigala, M., Veloutsou, C., Wirtz, J., 2023. Metaverse marketing: How the metaverse will shape the future of consumer research and practice. Psychology & Marketing 40, 750–776.

Eggenschwiler, M., Linzmajer, M., Roggeveen, A.L., Rudolph, T., 2024. Retailing in the metaverse: A framework of managerial considerations for success. Journal of Retailing and Consumer Services 79, 103791.

Flavián, C., Ibáñez-Sánchez, S., Orús, C., Barta, S., 2024. The dark side of the metaverse: The role of gamification in event virtualization. International Journal of Information Management 75, 102726.

Gadalla, E., Keeling, K., Abosag, I., 2013. Metaverse-retail service quality: A future framework for retail service quality in the 3d internet. Journal of Marketing Management 29, 1493–1517.

Giang Barrera, K., Shah, D., 2023. Marketing in the metaverse: Conceptual understanding, framework, and research agenda. Journal of Business Research 155, 113420.

Goldberg, M., Kugler, P., Schär, F., 2024. Land valuation in the metaverse: Location matters. Journal of Economic Geography 24, 729–758.

Guo, Y., Barnes, S.J., 2011. Purchase behavior in virtual worlds: An empirical investigation in second life. Information & Management 48, 303–312.

Harmeling, C.M., Moffett, J.W., Arnold, M.J., Carlson, B.D., 2017. Toward a theory of customer engagement marketing. Journal of the Academy of Marketing Science 45, 312–335.

Hassouneh, D., Brengman, M., 2015. Retailing in social virtual worlds: developing a typology of virtual store atmospherics. Journal of Electronic Commerce Research .

Hollensen, S., Kotler, P., Opresnik, M.O., 2022. Metaverse – the new marketing universe. Journal of Business Strategy 44, 119–125.

Joy, A., Zhu, Y., Peña, C., Brouard, M., 2022. Digital future of luxury brands: Metaverse, digital fashion, and non-fungible tokens. Strategic change 31, 337–343.

Jung, Y., Pawlowski, S.D., 2014. Understanding consumption in social virtual worlds: A sensemaking perspective on the consumption of virtual goods. Journal of Business Research 67, 2231–2238.

Kim, J., 2021. Advertising in the metaverse: Research agenda. Journal of Interactive Advertising 21, 141–144.

Klaus, P., Manthiou, A., 2024. Metaverse retail: Pioneering research avenues for tomorrow's marketplace. Journal of Retailing and Consumer Services 78, 103782.

Kuntze, R., Crudele, T.R., Reynolds, D., Matulich, E., 2013. The rise and fall of virtual reality retailing in second life: an avatar's perspective. Journal of Management and Marketing Research 13, 1.

Lee, Z.W., Chan, T.K., Chong, A.Y.L., Thadani, D.R., 2019. Customer engagement through omnichannel retailing: The effects of channel integration quality. Industrial Marketing Management 77, 90–101.

Mehrotra, A., Agarwal, R., Khalil, A., Alzeiby, E.A., Agarwal, V., 2024. Nitty-gritties of customer experience in metaverse retailing. Journal of Retailing and Consumer Services 79, 103876.

Molinillo, S., Aguilar-Illescas, R., Anaya-Sanchez, R., Carvajal-Trujillo, E., 2022. The customer retail app experience: Implications for customer loyalty. Journal of Retailing and Consumer Services 65, 102842.

Ordano, E., Meilich, A., Jardi, Y., Araoz, M., 2017. Decentraland: A blockchain-based virtual world.

Papagiannidis, S., Bourlakis, M.A., 2010. Staging the new retail drama: at a metaverse near you! Journal of Virtual Worlds Research 2, 425–446.

Park, H., Lim, R.E., 2023. Fashion and the metaverse: Clarifying the domain and establishing a research agenda. Journal of Retailing and Consumer Services 74, 103413.

Rauschnabel, P.A., 2021. Augmented reality is eating the real-world! the substitution of physical products by holograms. International Journal of Information Management 57, 102279.

Ruusunen, N., Hallikainen, H., Laukkanen, T., 2023. Does imagination compensate for the need for touch in 360-virtual shopping? International Journal of Information Management 70, 102622.

Trujillo, A., Bacciu, C., 2023. Toward blockchain-based fashion wearables in the metaverse: the case of decentraland, in: 2023 IEEE International Conference on Metaverse Computing, Networking and Applications (MetaCom), pp. 653–657.

Trujillo, A., Bacciu, C., Abrate, M., 2024. Dressed to gamble: How poker drives the dynamics of wearables and visits on decentraland's social virtual world.

Vidal-Tomás, D., 2023. The illusion of the metaverse and meta-economy. International Review of Financial Analysis 86, 102560.

Yoo, K., Welden, R., Hewett, K., Haenlein, M., 2023. The merchants of meta: A research agenda to understand the future of retailing in the metaverse. Journal of Retailing .