



From my perspective

Technological perspectives of Metaverse for financial service providers

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ABSTRACT

Most banking institutions are inadequately prepared for the ongoing integration of technology, including the digitalization of financial services, the advent of the Metaverse, and the emergence of Web 3.0. While other sectors are making strides in navigating virtual environments, financial institutions appear to be trailing. Concurrently, the nascent ecosystem of the Metaverse presents promising opportunities for businesses and industries, potentially revolutionizing economic models, governance frameworks, and ethical paradigms. This study aims to contribute to the emerging discourse on the provision of financial services within the Metaverse. The paper envisages virtual reality's future financial services landscape using a scenario-based technological foresight approach. This research is the first attempt to map the comprehensive landscape of financial services in the Metaverse, both in the present context and the foreseeable future. The paper delineates the economy of the Metaverse, its key sectors, and its enablers. It overviews the initial experiences with virtual financial services and proposes potential prospects for financial institutions operating within the Metaverse. This study, therefore, serves as a foundational reference for understanding the evolving dynamics of financial services in the virtual realm.

*Curiouser and curiouser!**- Lewis Carrol, Alice in Wonderland*

1. Introduction

Throughout history, individuals have sought escape from life's challenges by imagining idealistic worlds free from hardship and inequality. The emergence of the Metaverse signifies a modern progression, providing people with new opportunities to deal with ordinary reality and nurture their imaginative and inventive capacities. Expanding beyond the confines of the physical realm, the Metaverse introduces a paradigm shift, forming novel ecosystems, business models, and socio-ethical norms. Despite its nascent stage, the Metaverse transcends mere escapism, generating notable opportunities across various sectors such as entertainment, education, commerce, and governance. Citi Group's projection anticipates that the Metaverse will encompass a user base of 5 billion individuals by 2030, with its market value estimated to range between \$8 and \$13 trillion (Citi, 2022). Consequently, the concept of the Metaverse has attracted considerable attention from

business leaders, consulting companies, and financial service providers.

Similarly, academia has responded to this trend by generating substantial literature. Fig. 1 illustrates the evolution of academic interest in the Metaverse over the past two years, showing a notable surge in publications since 2021.

On January 24, 2023, a search in the Scopus database for the term "Metaverse" yielded 1225 documents, with the majority (934) published in 2022. Among these, 31.1 % were categorized under computer science, followed by engineering (16.2 %) and social sciences (10.6 %). At the same time, economics, econometrics, and finance represented 12.4 % of all publications (See Fig. 2).

Despite the surge in Metaverse publications, academic papers focusing on financial service providers within the Metaverse remain relatively sparse. However, given the expanding scope of Metaverse and its economy, providing robust financial services becomes imperative. Supported by launching the Metaverse enablers like cryptocurrencies, non-fungible tokens (NFTs), smart contracts, and recent FinTech innovations, the infrastructure for financial services in virtual reality is being solidified (Bhat et al., 2023). Consequently, this paper seeks to outline the main developments of financial services in the Metaverse and

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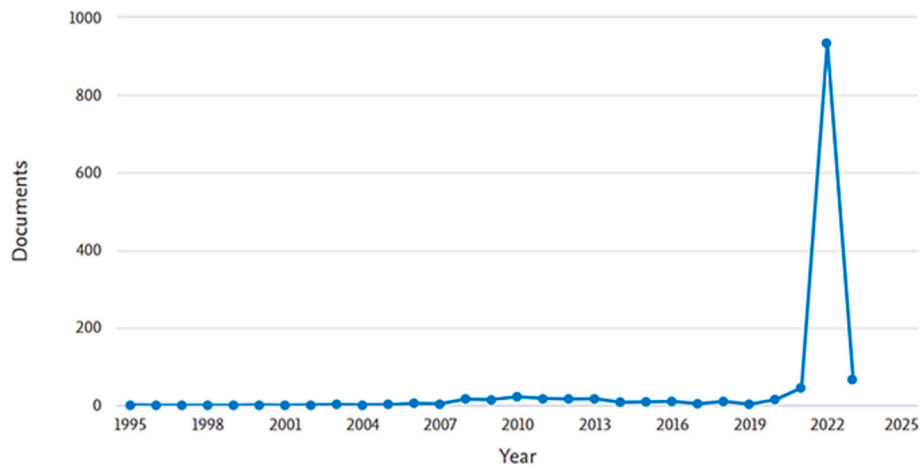


Fig. 1. The number of documents on the topic of Metaverse. (Source: The Authors (extracted from the Scopus database).)

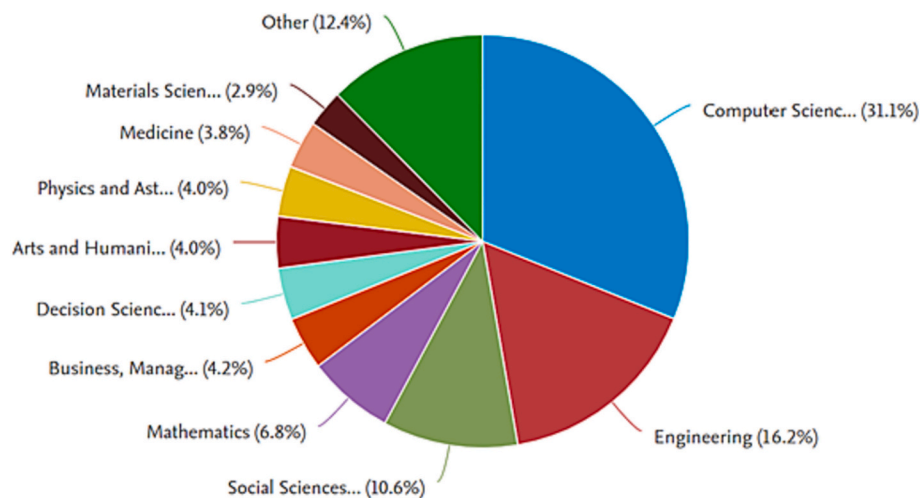


Fig. 2. Documents by subject area. (Source: The Authors (extracted from the Scopus database).)

define their future trajectories, aiming to bridge the existing gap in the literature.

In doing so, the paper seeks to answer the following research question: *What are the future perspectives of financial service providers in the Metaverse?* The study attempts to answer this question by building on the insights from pioneering financial service providers, integrating technological perspectives, and leveraging existing scholarly discourse.

Due to the developing status of the Metaverse, the majority of existing literature predominantly focuses on envisioning its potential future trajectories and addressing associated challenges (Belk et al., 2022; Koohang et al., 2023; Riva and Wiederhold, 2022; Vidal-Tomás, 2023). However, forecasting the future in such contexts is inherently challenging, given the nascent stage of development, limited data availability, and complexity of driving factors, including novel technologies (Raskin et al., 2002). Consequently, accurately predicting the future trajectory of the Metaverse remains an elaborate and challenging task.

Considering those mentioned above, the paper utilizes a future foresight approach as a research method to delineate a possible future for financial service providers within the Metaverse. Foresight can be described as the comprehension of future developments and the corresponding forces that shape such developments (Martin, 2010). In contrast to forecasting, frequently utilized for future scenarios, foresight

is characterized more as a process than a collection of techniques, often applied to short-term academic research with limited policy involvement (Miles, 2010). Given its close association with innovation studies (Andersen and Andersen, 2014), this paper adopts a foresight approach to delineate the potential technological future for financial service providers in the Metaverse.

Strategic foresight typically pursues dual objectives: firstly, to identify and analyze the factors causing future changes, and secondly, to evaluate these changes from the viewpoints of practitioners and regulators (Iden et al., 2017). While aiming for both objectives, the study combines strategic foresight with creating basic future scenarios (Durance and Godet, 2010; Ringland, 2010). A scenario depicts a potential outcome contingent upon realizing specific conditions or events necessary for its occurrence. Closely linked with prospective developments, scenarios can aid in comprehending complex systems and, more precisely, delineating the future roles of diverse stakeholders. Finally, defining the driving forces shaping future scenarios is closely connected to using the morphological method in crafting potential scenarios (Durance and Godet, 2010).

The research process employed to offer technological foresight for financial services in the Metaverse is depicted in Fig. 3. Initially, the study assesses the current state of the Metaverse and defines its principal driving forces of future transformation. Subsequently, the research

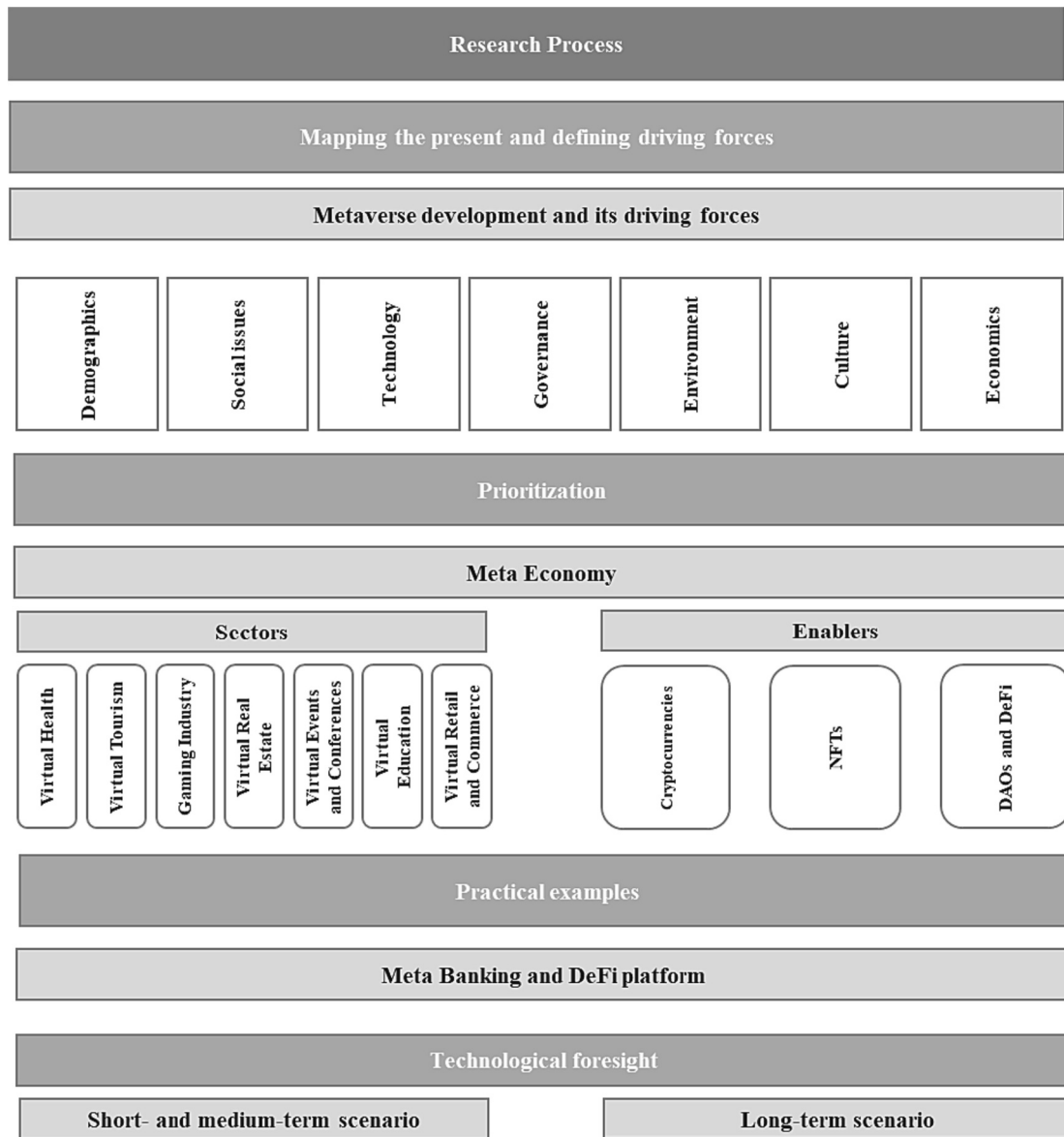


Fig. 3. Research process.
(Source: The Authors.)

identifies the domain where financial services are implemented and focuses on defining the Metaverse economy and its enablers as pivotal drivers for future financial services. By employing the specified drivers and practical instances of extant financial services within the Metaverse, the paper delineates short-, medium-, and long-term technological foresight scenarios for financial service providers. Finally, recommendations for practitioners and regulators and potential areas for future research are formulated based on the proposed scenarios.

The rest of the paper is organized as follows. Section 2 overviews the historical progression, evolution, and main driving forces behind the Metaverse and its advancement. Section 3 outlines the primary sectors and enablers underpinning the Metaverse economy. Section 4 examines case studies of financial service providers operating within the Metaverse. Subsequently, Section 5 presents scenario-based technological foresight for financial advancement within the Metaverse. Finally, Section 6 concludes with policy recommendations and avenues for future research.

2. Navigating the Metaverse

This section provides an overview of the Metaverse, encompassing its historical events, the driving forces shaping the Metaverse and its surroundings, and the developmental stages that characterize its progression.

2.1. A brief history of the Metaverse

The term “Metaverse” is multifaceted, evolving, and interdisciplinary. Coined by Neal Stephenson in 1992, it signifies a realm beyond reality, with various definitions encompassing virtual environments where users interact as avatars facilitated by technologies such as virtual reality (VR), blockchain, and augmented reality (AR) (Davis et al., 2009; Dwivedi et al., 2022; Hill, 2021; Merriam-Webster, 2021; Park and Kim, 2022; Tan et al., 2022).

The study employs the definition of the Metaverse developed by developed by Ritterbusch and Teichmann (2023) in their systematic literature review of Metaverse definitions:

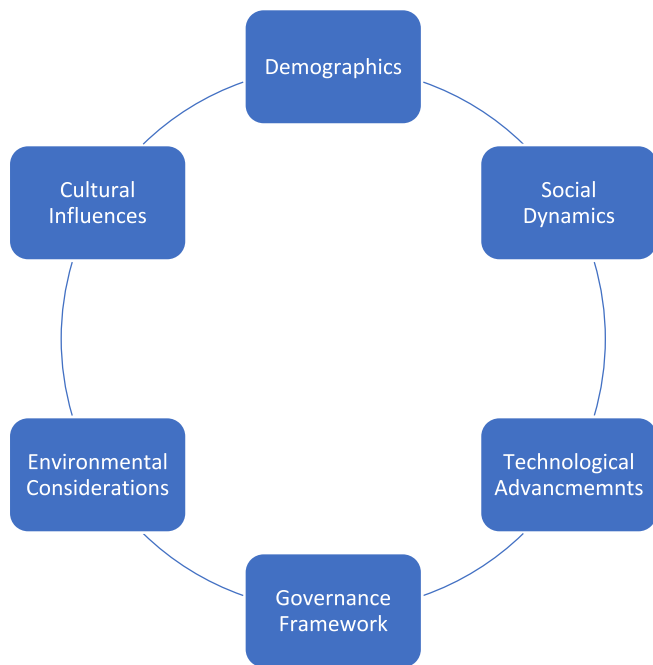


Fig. 4. Driving forces of the Metaverse.
(Source: The Authors.)

A (decentralized) three-dimensional online environment that is persistent and immersive, in which users represented by avatars can participate socially and economically with each other creatively and collaboratively in virtual spaces decoupled from the real physical world.

(Ritterbusch and Teichmann, 2023, p.12373)

In addition to the term “metaverse,” this study employs the term “platform” to refer to various virtual worlds or universes, such as Second Life, Decentraland, or the Sandbox. In this context, the term “metaverse” encompasses all such virtual worlds, platforms, and universes.

Although pinpointing the precise birth of the Metaverse concept is challenging, the launch of the Second Life platform in 2003 marked one of the earliest endeavors to actualize the presence of the Metaverse. The Second Life is a multiplayer online virtual platform that is open to users known as residents. It allows active social interaction, virtual construction, shopping, and trading (Papagiannidis et al., 2008). The world’s currency, the Linden Dollar, was exchangeable with real-world money. Many companies, including BBC, BMW, and IBM, rushed to buy land and established their presence on the platform, anticipating its future development. Because of these initial activities, in January 2007, 2.67 million Second Life residents spent \$805,096 in 24 h, demonstrating the importance and potential of this virtual platform (Papagiannidis et al., 2008). However, despite its original popularity, Second Life failed to gain prominence due to various obstacles primarily related to technology and Internet development.

2.2. Metaverse’s driving forces

The rapid digitalization and its consequential impact on communication, commerce, and business practices suggest an ongoing paradigm shift towards a novel global system driven by the emergence of the Metaverse. This transition towards a new virtual immersive reality resembles significant historical shifts like the Industrial Revolution. Concurrently, the Metaverse has started shaping and forming new economic models, social structures, behaviors, and values. Drawing from the framework proposed by Raskin et al. (2002) and following the morphological approach to scenario building (Durance and Godet, 2010), several driving forces underpin significant transitions that

reshape existing systems and mold future societies. Following this framework, the transition towards the Metaverse is propelled by factors encompassing demographics, social dynamics, technological advancements, governance frameworks, environmental considerations, and cultural influences (see Fig. 4).

2.2.1. Demographics

The Metaverse extends beyond gaming and younger demographics, offering burgeoning business and employment prospects expected to expand alongside virtual world advancements, evidenced by Dubai’s anticipation of 40,000 new Metaverse jobs in the next five years (Al-Rashdan, 2022). However, concerns regarding children’s interactions and the potential social and psychological implications of virtual reality content necessitate careful attention, while discussions on managing overpopulation through virtual parenting pose ethical and societal considerations (Brodsky, 2022; Chesney et al., 2009).

2.2.2. Social issues

The promise of the Metaverse to provide better education and healthcare services for underprivileged populations in remote areas is tempered by the requirement for users to possess electronic devices, high-speed internet, and financial resources, perpetuating issues of inequality. Additionally, while the Metaverse may offer new opportunities for creative talent, its transition from the physical to the virtual realm may exacerbate global unemployment rates, potentially increasing anti-social behavior and posing risks to vulnerable populations, particularly children, in terms of mental health and wellbeing (Dwivedi et al., 2023).

2.2.3. Technology

Technology is the primary driving force behind the Metaverse, with its progression heavily reliant on Web 3.0, which integrates semantic web technologies into large-scale web applications. However, challenges such as the affordability of VR and AR sets, interoperability between platforms, and technological scalability must be addressed to facilitate the development of a unified virtual reality world influenced by stakeholders such as big techs, political institutions, and consumers and further advancing the Metaverse (Falchuk et al., 2018).

2.2.4. Governance

The decentralization trend in global governance is expected to extend to the Metaverse, potentially leading to governance by large transnational corporations or big tech companies such as Meta and Microsoft, which have heavily invested in Metaverse technologies (Bary, 2022; BCG, 2023; Raskin et al., 2002). Alternatively, decentralized autonomous organizations (DAOs) could govern different virtual worlds within the Metaverse, while governments are also positioning themselves to play a role in Metaverse governance, as evidenced by South Korea’s substantial investment in Metaverse projects and plans to offer governmental services within the virtual realm (Jha, 2022; P. Lee, 2022; U.K. Lee, 2022).

2.2.5. Environment

The Metaverse’s environmental impact is twofold: while virtual interactions, exemplified by the COVID-19 lockdowns, can reduce CO2 emissions, transitioning to a meta-economy could alleviate pressure on natural resources. However, the infrastructure demands of a global network, particularly the energy-intensive nature of blockchain technologies, pose environmental challenges, highlighting the need for sustainable energy solutions (Shah et al., 2022).

2.2.6. Culture

Globalization and the Internet have fostered a homogenization of world culture, particularly among younger generations, with consumerism emerging as a predominant cultural trait affecting the planet’s future (Raskin et al., 2002). While the Metaverse is poised to perpetuate

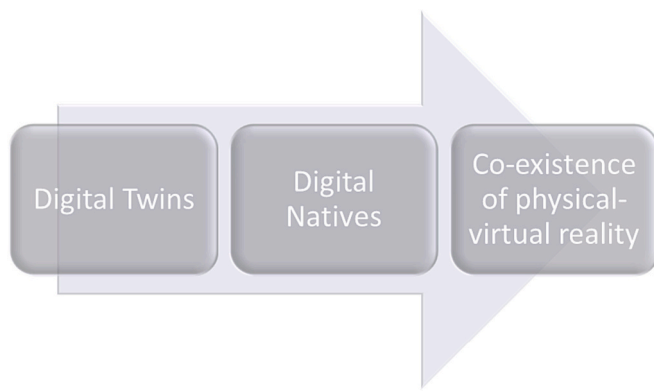


Fig. 5. Stages of development of Metaverse. (Source: The Authors (prepared based on Lee et al., 2021).)

consumerism, its virtual manifestation may mitigate resource burdens, potentially addressing issues of loneliness and individualization through enhanced communication accessibility, particularly highlighted by the COVID-19 pandemic's reliance on virtual interactions as viable alternatives to physical presence. Moreover, ethically conscious businesses envision opportunities within the Metaverse to explore cultural and educational aspects, exemplified by initiatives such as Islamic-focused virtual experiences (Obaidullah, 2021).

2.3. Stages of the Metaverse development

Following Lee et al.'s (2021) developmental stages of the Metaverse offers insights into its present state and future trajectories, which are pivotal considerations for forecasting endeavors (see Fig. 5).

As Fig. 5 presents, the unfolding of “digital twins” characterizes the initial stage of Metaverse development. At this stage, the digitalization of the physical world starts with creating digital duplicates that feature the properties of original “analog” prototypes. The data provides relatedness between physical and virtual twins (Lee et al., 2021). The next stage – “digital natives”- is defined by creating digital content when the virtual world disconnects from its physical counterpart. The forming of new ecosystems is linked to this stage of the Metaverse, and the Metaverse is expected to become a fully independent and autonomous alternative world at this stage. At the same time, some of the disconnected digital worlds are expected to merge into a single, interconnected world. Finally, the digitized real and virtual worlds combine to produce an entirely surreal reality, which authors call the “co-existence of physical-virtual reality.” The current development of the Metaverse aligns with the digital twins stage, with a transition underway towards the digital native stage.

3. Key sectors and enablers of meta-economy

The study must first outline its application area to define the future of financial services in the Metaverse. Consequently, this section provides an overview of the Metaverse ecosystem, describing its key sectors and primary enablers.

Industry experts are highly optimistic about the future Metaverse perspectives, expecting the virtual economy to overgrow the real-world economy (Ooi et al., 2023). The emerging Metaverse economy, comprised of digital assets and markets, is estimated to create a market opportunity of \$8 - \$13 trillion with five billion unique Internet users by 2026 (Citi, 2022). Furthermore, the Metaverse expands access to its market for customers around the globe (Vidal-Tomás, 2023), and by 2026, 25% of the global population is anticipated to spend at least 1 h in the Metaverse (Gupta, 2022). Such active and massive virtual performance entails certain economic and financial conditions, like currency linked to real-world payments, assurance of fair trade and exchange of virtual

goods, protection of ownership rights, and financing virtual purchases. Starting with the outline of the gaming industry and virtual real estate, notably attractive sectors for financial service providers due to their maturity and potential, this section mentions the less prominent yet promising sectors such as virtual commerce, education, tourism, healthcare, and the organization of virtual events. Emphasizing the roles of crucial Metaverse enablers such as cryptocurrency, NFTs, decentralized finance (DeFi), and artificial intelligence (AI), the discussion underscores their contributions to advancing the Metaverse economy.

3.1. Gaming industry

During the COVID-19 pandemic, online gaming emerged as one of the most popular activities, with global gaming time witnessing a substantial increase of 39% (Statista, 2022). By the conclusion of 2022, it is projected that the number of online players will reach 3 billion, accounting for approximately 38% of the global population. It is estimated by Microsoft to surpass 4.5 billion by 2030 (P. Lee, 2022; U.K. Lee, 2022). Projected revenue from in-game advertisements is expected to achieve \$18.4 billion by 2027, with an annual expenditure of \$54 billion already allocated to virtual goods, including a substantial \$40 billion dedicated solely to gaming skins (JPMorgan, 2022; Yousaf et al., 2022). Thus, this promising sector of the meta-economy requires creating the in-game economic system, which implies sustainable and effective financial services (Vidal-Tomás, 2023).

The interoperability of different platforms will be essential for advancing the Meta economy. When users are allowed to “relocate” their assets to other virtual platforms, the level of trade in the Metaverse is expected to grow exponentially (Lee et al., 2021). Another vital step in further developing the gaming industry could be monetizing efforts and time spent on games. The gaming industry is moving from a pay-to-play mode (i.e., buying games to play them) to a play-to-earn mode (i.e., gamers can earn money by playing games) (Citi, 2022). Such emerging modes of gaming require financial systems to allow effortless conversion of virtual earnings into real money (Ooi et al., 2023).

Advancements in VR and AR technologies can potentially add to the global GDP of \$1.5 trillion (Vidal-Tomás, 2023). Moreover, while there are complaints from the users' side about the ergonomics and affordability of these sets, the anticipated world launch of Apple's Vision Pro device demonstrates that it will be prevalent among the population.

3.2. Virtual real estate

Participating in any activity within the Metaverse, whether commercializing goods or organizing virtual events, necessitates dedicated virtual spaces, thereby mandating the acquisition of virtual land. Since the era of Second Life, buying and selling virtual land and properties have emerged as a profitable entrepreneurial endeavor, evidenced by top players on the Second Life platform earning as much as \$1.5 million annually (Parloff, 2006). Furthermore, real estate sales exceeded \$1.4 billion in 2022 (Parcel, 2023).

Virtual land can be defined as a non-fungible token (NFT) characterized by a unique digital piece of real estate identified by coordinates (Nakavachara and Saengchote, 2022). Trieu and Nguyen (2022) observe that the total volume of virtual land transactions in Sandbox, the largest virtual platform, reached \$350 million in 65,000 transactions in 2021, followed by Decentraland, which reported 21,000 transactions worth \$110 million in 2021. Furthermore, the average price of land on Sandbox grew from \$100 in January 2021 to \$15,000 in December 2021. Despite the growing volume of activities, the value of virtual real estate transactions (\$100 million per month) still constitutes a small fraction of broader monthly NFT transactions (\$2 billion) (Trieu and Nguyen, 2022), indicating the future potential of real estate transactions in the Metaverse.

According to Ante et al. (2023), the price of virtual land is usually defined by its location, meaning its proximity to famous landmarks or

neighbors. Typically, the landowners in the Metaverse are Asians holding large portfolios of NFTs and participating in purchasing/selling activities seasonally. Other buyers include popular retail brands like Adidas and consultancy firms like PwC and Makensey (Trieu and Nguyen, 2022). Interestingly, according to Trieu and Nguyen (2022), most purchases of virtual land are either long-term investments or speculations, with fewer purchases leading to the development of virtual land.

Considering the increasing interest in the virtual property, certain firms, such as TerraZero, have introduced virtual mortgage solutions. In this setup, buyers obtain virtual assets through a long-term commitment and agree to regular cryptocurrency payments over a set period. Upon the final payment, buyers gain full ownership rights, streamlining the acquisition process for virtual real estate.

The scarcity of resources, which defines real economy, may not apply to the Meta economy. Thus, land restrictions offered by platforms like Decentraland might be called artificial. Therefore, it will be interesting to observe how the future development of virtual lands may affect the secondary market. Furthermore, some authors assume that the number of transactions in the Metaverse economy will reach significant volumes, potentially creating problems with their storage and maintenance on the blockchain (Yang et al., 2022).

Financial service providers can be specifically interested in the virtual estate sector due to the mortgage possibilities it provides. Smart contracts and AI can facilitate more transparent and inclusive financing of virtual land and space (Kumar et al., 2024).

3.3. Other sectors of meta economy

Expanding the meta economy creates the opportunity for the advancement of other sectors, firstly for the growth of virtual shopping and commerce. In addition, the recent COVID-19 pandemic catalyzed the development of virtual events and meetings. At the same time, virtual education and healthcare also gained recognition. Other emerging sectors of the Meta economy are as follows:

- **Commerce and retail shopping.** Commerce in the Metaverse progresses rapidly and includes user-to-user and business-to-user traders (Lee et al., 2021). YouGov research established that 10 % of consumers are willing to shop in the Metaverse (Nguyen, 2022), and virtual fashion will reach \$50 billion by 2030 (M.F., 2022). Big names such as Gucci, Burberry, and Adidas started operating within the Metaverse by opening virtual offices and selling virtual attire (Citi, 2022). Targeted advertising that utilizes the massive amount of data collected in the Metaverse will further benefit the rapid expansion of virtual commerce.
- **Virtual healthcare and education.** Virtual healthcare and education are promised to improve public health and the ability to obtain an education (Marini et al., 2022), including providing medical services for populations in remote areas and self-training for various occupations. For example, Microsoft's HoloLens program offers multiple remote medical services, including remote surgeries (Citi, 2022).
- **Virtual tourism.** P. Lee (2022) and U.K. Lee (2022) have confirmed that virtual tourism can promote and, in some instances, substitute actual travel. In addition, virtual reality can provide additional features such as vividness and interactivity, significantly increasing customer satisfaction. Virtual reality also allows more freedom and easier customization of travel preferences (P. Lee, 2022; U.K. Lee, 2022). Furthermore, this type of tourism is cheaper and environmentally friendlier than traveling in real life.
- **Virtual events and meetings.** As with many other sectors of the Meta economy, virtual meetings and events gained popularity during the COVID-19 pandemic. Even after removing physical distancing restrictions, demand for hybrid work remains, proving that it will continue (Choudhury, 2020). Tech giants such as Meta (Horizon

Workrooms) and Microsoft (Mesh for Microsoft Teams) heavily invest in the advancement of virtual meeting and conference platforms (Frier and Bass, 2022). In addition, major sporting events like the Australian Open are already in the Metaverse (Citi, 2022).

All sectors of the Metaverse economy will be a part of a virtual financial system and will require established financial transaction systems. The subsequent sections describe the primary enablers of the Metaverse, including cryptocurrency, non-fungible tokens (NFTs), decentralized autonomous organizations (DAOs), decentralized finance (DeFi), and artificial intelligence (AI). All these enablers operate on distributed ledger technology (DLT), also known as blockchain technology, which ensures data storage, security, and decentralized management concerns within the Metaverse (Lee et al., 2021). Blockchain technology offers transaction transparency (Bhat et al., 2023). It secures essential aspects of the existence of digital assets, such as standardization, composability, traceability, and immutability (Citi, 2022).

3.4. Cryptocurrency

The virtual economy within the Metaverse revolves around the management of virtual or digital assets. Consequently, securing and transferring the ownership of these assets is central to the Metaverse economy. The two types of tokens, which serve as distinct digital representations of assets on the blockchain, address these issues. Fungible (interchangeable) or non-fungible (unique) tokens set the financial relationships in the Metaverse (Birch and Richardson, 2023). This subsection of the paper focuses on fungible tokens, also known as cryptocurrency.

Like any traditional economy, the meta-economy necessitates a medium of exchange for conducting transactions involving goods and services. In many virtual platforms, this currency is cryptocurrency, which operates on blockchain technology (Shi et al., 2020). For instance, Sandbox utilizes a currency known as Sand, a distinct cryptocurrency exhibiting notable volatility (like most cryptocurrencies), fluctuating between \$1 and \$5 per unit (Trieu and Nguyen, 2022). Nakavachara and Saengchote (2022) analyzed transactions conducted within Sandbox. They found that users are willing to pay approximately 3.4 % more when using Sand than Ethereum (ETH) cryptocurrency. Upon exploring potential reasons for Sand's recent appreciation relative to ETH, the researchers suggest that Sandbox represents an example of an open economy characterized by a flexible exchange rate and absence of capital controls (Nakavachara and Saengchote, 2022).

An illustration of liquidity dynamics within the virtual realm can be found in Decentraland, a prominent Metaverse platform, and its native currency, MANA. Initially, MANA supplied 2,644,403,343 units (NFT Plazas, 2022). Despite the MANA contract originally stipulating an 8 % inflation rate, community consensus resulted in a 0 % inflation rate, rendering MANA's supply deflationary. Concurrently, a 2.5 % marketplace fee facilitates a reduction in circulation through "burning" after each MANA purchase.

Drawing from the European Central Bank's definition of virtual currency schemes, Vidal-Tomás (2023) suggests three distinct categories:

- Closed virtual schemes, wherein the cryptocurrency is confined to platform-specific use and cannot be converted into real currency;
- Virtual currency schemes with unidirectional flow, allowing purchases with real currency but precluding conversion back to real money;
- Virtual currency schemes with bidirectional flow permit conversion to and from real currency based on exchange rates.

Financial service providers can be particularly interested in the latter category, which encompasses exchanges between different virtual currencies. While cryptocurrency can serve as the currency of the

Metaverse, significant concerns arise regarding these fungible tokens. For instance, in his analysis of fungible tokens within the Metaverse, [Vidal-Tomás \(2023\)](#) observed, using Decentraland's MANA as an example, that while cryptocurrencies may exhibit specific store of value attributes, their suitability as a unit of account and medium of exchange is hindered by their highly volatile nature. Consequently, the author proposed stablecoins as a more suitable currency for the Metaverse.

In addition to the high volatility of cryptocurrencies, some researchers raise questions about money supply and deflation in decentralized finance ([Böhme et al., 2015](#); [Lee et al., 2021](#); [Liu et al., 2020](#)). Introducing a new virtual currency requires high trust from platform users, requiring their approval. As highlighted by [Lee et al. \(2021\)](#), a virtual banking system could facilitate the creation of additional money supply through lending activities utilizing a fractional reserve system. However, implementing a virtual banking system raises regulatory concerns. It may impose a "lender of last resort" burden on authorities within the volatile financial landscape of the Metaverse. Another approach to currency regulation involves pegging the virtual currency to one or several real-world currencies or commodities. Resolving these and other issues related to virtual currency will rely on innovative solutions from cryptocurrency pioneers as the market evolves. Furthermore, cryptocurrency exchange for another cryptocurrency can be cumbersome in specific gaming environments ([P. Lee, 2022](#); [U.K. Lee, 2022](#)), necessitating interoperability measures that facilitate seamless cryptocurrency exchanges within platforms or through financial service providers.

Finally, cryptocurrencies raise concerns due to their integration into alternative financial systems, often linked with high-risk financial ventures. [Mackenzie \(2022\)](#) examines prevalent types of cryptocurrency-related frauds and underscores the potential for such activities to infiltrate the Meta economy.

3.5. Non-fungible tokens (NFTs)

Another critical factor in developing the Meta economy was the introduction of non-fungible tokens (NFT), which can be defined as a representation of digital ownership recorded in a blockchain ([Hill, 2021](#)) that cannot be exchanged like-for-like ([Vidal-Tomás, 2022](#)). One of the essential features of NFTs is the ability to use them to create value for digital products, allowing for virtual ownership and trade. In a world where economic value does not always define the value of products, NFTs provide a solution to determining the price of digital art, virtual designer clothes, or virtual parcels of land. Currently, the most popular NFTs are collectibles, followed by NFTs representing the ownership of digital art ([Howcroft, 2022](#)).

The profitability of NFTs is another factor defining their popularity ([Vidal-Tomás, 2022](#)). According to [Howcroft \(2022\)](#), sales of NFTs reached a staggering \$25 billion in 2021. The "Bored Ape Yacht Club" collection set of 101 NFTs was sold for \$24.4 million ([Vidal-Tomás, 2022](#)). Since all NFT-related processes (e.g., minting, storing, and exchanging) are recorded in a blockchain, they are claimed to be secure and protected from corruption or fraud.

NFTs offer an effective solution to a problem that has existed for artists since the beginning of the internet era: value creation in the absence of scarcity ([Kaczynski and Kominers, 2021](#)). For instance, a digital work of art is infinitely reproducible. While an indefinitely replicated file should cost \$0, NFTs trade at non-zero prices due to their ability to create artificial scarcity through digital ownership, where purchasing an artist-certified copy signifies ownership.

However, similar to cryptocurrencies, NFTs are often highly volatile. On a raw basis, the average return on the first day of trading NFT is 130 % ([Mazur, 2021](#)). The average annualized volatility of NFTs' daily returns is 175 %, compared to 30 % for oil and 15 % for the S&P 500 index. For example, the price of a CryptoPunk, which was \$100,000 in July 2021, reached \$500,000 in November 2021 and fell to \$350,000 in December 2021 ([Howcroft, 2022](#)).

At the same time, proponents of NFTs highlight the ease of defining ownership, which allows for transparent and fast transactions. The clearance process can be avoided when working with NFTs; the settlement takes only a few seconds. Nevertheless, while the ownership of NFT can be easily verified, forgery of underlying objects can be problematic since the price of a virtual object is defined by its uniqueness and rarity. Therefore, the NFT community must decide how to protect these characteristics of traded objects ([Lee et al., 2021](#)).

3.6. Decentralized autonomous organizations (DAOs) and decentralized finance (DeFi)

Blockchain technology is behind the DAOs, which coordinate and manage independent platforms within the Metaverse ([Fernandez and Hui, 2022](#)). A DAO can be defined as an organization in which governance is executed through codes and smart contracts ([Citi, 2022](#)).

In the decentralized setting, the allocation of voting authority usually relies on the tokens held by individual users. Furthermore, any member of a DAO can participate in a transparent voting system, which defines DAO systems as genuinely democratic.

DeFi can be defined as the decentralized provision of financial services through blockchain technology ([Zetzsche et al., 2020](#)). Initially aimed at eliminating financial intermediaries, DeFi has evolved into a sophisticated system, guaranteeing the composability and programmability of applications to enhance and modify initial protocols. [Citi \(2022\)](#) highlights how DeFi's collateralized lending and farming protocols can enable crowdfunding and microfinancing, while JPMorgan Chase investigates the ways to incorporate institutional-level funds into DeFi protocols by tokenizing significant assets like U.S. treasury funds as collateral in DeFi pools ([Juneja, 2022](#)). Presently dominated by decentralized exchanges, DeFi will evolve by utilizing NFTs as collateral and fractionalizing them to enhance liquidity within the Metaverse ([Citi, 2022](#)).

3.7. Artificial intelligence

Generative AI emerges as a promising tool in advancing the Metaverse, offering significant potential for accelerating its growth and development. By utilizing algorithmic techniques, generative AI is pivotal in expediting and simplifying the process of constructing virtual environments, including cities, landscapes, and architectural designs. Moreover, it empowers users of all levels of technical expertise to engage in creative activities, enhancing the overall user experience while simplifying the coding processes. Additionally, features such as chatbots and digital guides provided by generative AI offer personalized assistance and immediate feedback to users, facilitating the improvement of their creations. AI algorithms can aid in optimizing payment operations, enhancing efficiency, and expediting their processing times. They can also contribute to risk assessment and fraud detection by analyzing historical data and customer behavior within instant payment networks and infrastructures ([Andronie et al., 2023](#); [Lăzăroiu et al., 2023](#); [Nica and Vahancik, 2023](#)). In summary, generative AI promises to seamlessly integrate physical and virtual realities within the Metaverse, as [Activate Consulting \(2023\)](#) highlighted.

At the same time, the advancement of AI raises numerous ethical concerns, including the potential harm associated with the complete removal of human involvement in financial processes, such as loan approval.

4. New Metaverse perspectives for financial service providers

Although financial services in the Metaverse are in their nascent stage, there is a growing array of instances showcasing financial institutions' efforts to leverage technological innovations and economic opportunities introduced by the Metaverse. This section outlines some initial initiatives financial institutions undertake within the virtual

Factors Defining the Short- and Medium-term Scenarios		
Driving Forces	Description	Implications for Financial Service Providers
Demographics	Younger generations are known for their creativity, technological proficiency, relatively affluent financial standing, and active engagement in the gaming sector. A notable influx of wealthier investors and entrepreneurs. Dealing with factors such as gender diversity, geographical representation, and socioeconomic backgrounds is also a significant consideration in delineating the demographic landscape of the Metaverse.	Tailoring financial products for younger and more technologically aware customers, attracting wealthier customers, promoting gender diversity, increasing financial inclusion, and investing in customer demographics research.
Governance	Decentralization, community governance models, regulatory frameworks, technological standards, interoperability protocols, and legal frameworks for virtual property rights. The role of artificial intelligence in decision-making processes. Decentralized finance (DeFi), the tokenization of governance structures, and the dominance of major technology corporations as critical stakeholders and influencers.	DeFi and tokenization, navigating regulatory complexities, dealing with cybersecurity and other frauds, navigating money supply, and dealing with virtual currencies.
Technology	Web 3.0, immersive technologies, scalability and interoperability, data processing and storage issues, AI integration, network infrastructure	Adopting Web 3.0 standards, utilizing the latest immersive technologies, leveraging on the lack of interoperability, dealing with data analysis and storage, integrating AI, dealing with the complexity of the technology
Social Issues and Culture	Virtual identity, social interaction, and behavior, formation of new communities, inequality, data privacy, online safety and wellbeing	Virtual identity concerns adapting and promoting new forms of social communication, addressing inequality, and safeguarding data privacy.
Environment	Virtual landscaping, resource management, pollution, and energy consumption	Addressing environmental aspects when dealing with data storage and processing and promoting financial services

Fig. 6. Factors defining the short- and medium-term scenarios. (Source: The Authors.)

realm to better understand possible trends in this domain.

4.1. Meta banking: early attempts

Korean financial institutions were among the first to embark on the Metaverse ventures by establishing their virtual offices. For instance, KB Kookmin Bank, one of South Korea's largest financial institutions, launched the KB Metaverse VR branch. Similarly, the Industrial Bank of Korea (IBK) plans to establish a virtual IBK Dotori Bank on the Cyworld Z platform, offering financial services using the platform's virtual currency, Dotori (Park, 2021). According to the Vice President of the Tech Group at KB Kookmin Bank, leveraging virtual reality as an educational platform for customers and employees is an immediate advantage of Metaverse engagement (Zealelem, 2021).

This early embracing of the Metaverse enables banks to explore future prospects and identify the necessary technological infrastructure to support their virtual presence. Following the lead of Korean financial institutions, prominent entities like HSBC and JP Morgan have acquired parcels of land in Decentraland, intending to expand their virtual presence. For example, JP Morgan Chase opened the Onyx lounge in a virtual

shopping district in Tokyo (Birch, 2022). HSBC launched a Metaverse portfolio for its Asian clients (Reuters, 2022). In addition, Standard Chartered acquired virtual land in the Sandbox in March 2022 (Smith, 2022) to create a Hong Kong-inspired cultural club for its customers.

Interestingly, as traditional banks shutter physical branches, the Metaverse aims to provide banking services through virtual "in-person" interactions, reflecting a response to the need for personal contact. However, banks might face challenges attracting customers to virtual spaces like the Onyx Lounge, where activity levels remain minimal (Ooi et al., 2023).

4.2. Financial services and the DeFi platform

A good illustrative example defining the prospective directions of virtual financial services is EQIBank, which was founded as a digital bank in 2015 (EQIBank, 2022). This institution offers conventional banking services alongside decentralized finance (DeFi) within a unified platform. By pioneering the EQIFI DeFi platform while maintaining a regulated banking license, EQIBank effectively bridges conventional financial assets and digital assets, providing customers access to both

realms (P. Lee, 2022; U.K. Lee, 2022).

Cardholders of EQIBank can utilize virtual currencies for purchases in physical environments and fiat currencies for acquiring digital assets within virtual realms (Harvey et al., 2021; Makarov and Schoar, 2022). Moreover, EQIBank enables users to acquire land on the Polka City platform using highly liquid cryptocurrencies instead of the native POLC tokens, with an option to exchange them for Bitcoin through the secondary POLC market (Su et al., 2020). EQIBank does this to overcome the low liquidity of NFTs and some cryptocurrencies. Similarly, POLC tokens can be converted into fiat money, allowing the owners of debit cards to transact in the physical world. Furthermore, EQIBank offers customers loans to buy virtual property against their physical property (P. Lee, 2022; U.K. Lee, 2022). The bank plans to open branches on various platforms to ensure a more effortless transfer of values between different NFTs and provide better interoperability between other platforms.

Another illustration of financial service innovation is the crypto investment platform Index Coop, which introduced the Metaverse Index (MVI). Leveraging the Ethereum ERC20 protocol token, MVI comprises a collection of Metaverse-related tokens spanning virtual sports, gaming, and business ecosystems. MVI aims to aid investors in navigating the virtual economy, offering streamlined processes, risk mitigation, cost-effectiveness, and transparency (Tao et al., 2021). Ultimately, platforms similar to NFTfi have commenced offering virtual mortgage loans backed by NFT collateral (Birch and Richardson, 2023).

5. Scenario-based technological foresight for financial development in the Metaverse

The economic and financial developments in the Metaverse and its driving forces, described in previous sections, act as the basis for the technological foresight of future financial services. Financial services in the Metaverse aim to maintain the flawless processes of buying and selling virtual assets, ensuring access to financial resources and instant transactions (Ooi et al., 2023). This entails providing immediate virtual payment systems, fair digital exchange rates, managing complicated virtual wealth portfolios, and dealing with customers' mega-data. Considering these primary goals, technological foresight presents two scenarios: the short- and medium-term and the long-term.

5.1. Short- and medium-term foresight

The ongoing phase of Metaverse evolution is progressing towards the achievement of "digital twins" and eventual transition into the "digital natives" stage (refer to Fig. 5). The "digital twins" phase involves the creation of virtual replicas mirroring physical entities and objects. The implementation of this stage can be witnessed in various sectors of the Meta economy in the creation of digital replicas of famous cities, districts, and landmarks.

Furthermore, prominent brands, corporations, and financial institutions establish virtual footholds in the Metaverse to mirror their physical presence in the real world. However, the next stage of Metaverse development introduces novel virtual realms and worlds devoid of physical counterparts. Both stages create significant demand for digital assets and virtual real estate, amplifying financial transactions and impacting storage and management. At the same time, there is an anticipation of further emergence of detached virtual worlds or platforms, each featuring distinct cryptocurrencies and protocols. The schematic overview of the short- and medium-term scenario for the trajectories of Metaverse development and associated financial prospects is depicted in Fig. 6.

This scenario of Metaverse evolution predominantly caters to younger demographics drawn to virtual reality by their involvement in the gaming sector.

Considering the predominant user demographic as youthful, potentially including minors, financial service providers should remain

mindful of ethical considerations and the potential for customer manipulations. Moreover, the rapid evolution of the Metaverse suggests the possibility of expanding its reach to diverse geographic regions, thereby enabling significant growth and diversification of its customer base. Financial institutions must be prepared to accommodate this diverse range of consumers. The customers need to be allowed more creativity with the opportunity to create their own highly customized financial products. Banks attract their current customers into the virtual realm by providing comprehensive education, simplifying onboarding procedures, and offering additional incentives for long-term customers.

The Metaverse finance is expected to run on decentralized systems based on DeFi. DeFi must function alongside traditional and centralized finance (CeFi) protocols to form collateralized. Financial institutions can play the conventional role of intermediary when dealing with the complex DeFi system, at least in the initial stage.

In the short term, the Metaverse economy has to deal with significant volatility of digital financial assets like cryptocurrencies and NFTs due to the lack of centralized oversight and regulations; nevertheless, these markets are anticipated to mature, displaying more stable behavior over time. The NFTs and fungible tokens can be developed into asset baskets to deal with their volatility and work as collateral.

The decentralized structure of the Metaverse, envisaged as a collaborative community effort, raises questions about its governance and management. Furthermore, the substantial investments by major technology firms in Metaverse hint at a future where giant corporations dominate virtual world ownership. Established corporations like Microsoft and Meta could pose barriers to entry for smaller firms, potentially fostering an oligopolistic atmosphere within the Metaverse.

The money supply in the Metaverse, represented by cryptocurrencies, can be problematic without central banks and other financial institutions regulating it or providing additional liquidity. Financial institutions should support the provision of liquidity, which might help to stabilize the market of numerous digital assets. Moreover, financial institutions should be ready to deal with digital money, such as in-game tokens, stablecoins, and central bank digital currencies (CBDCs).

Data management is expected to remain a critical issue throughout all phases of Metaverse development due to the generation of significant volumes of valuable data. Consequently, protocols governing data collection, ownership, and distribution are anticipated to profoundly influence the future trajectory of virtual finance. Furthermore, recent advancements in open banking and finance offer insights into the potential transfer of data ownership to customers, facilitating the customization of financial products. Similarly, within the Metaverse, the data ownership should be clearly defined to ensure its ethical usage. Financial service providers might also consider assisting with storing and maintaining the increasing number of transactions related to purchasing digital assets.

Dealing with enormous data volumes might require specific technical procedures such as K-means clustering (vector quantization) and fault detection algorithms. Artificial intelligence (AI) could be a helpful tool in processing big data and related activities, which usually require substantial human efforts. For example, AI can assist with Know-your-customer procedures, predict market trends, and develop customized financial products.

The Metaverse development will depend on instant financial transactions between decentralized platforms. Financial service providers must assist in dealing with various independent cryptocurrencies and wallets to ensure smooth financial flows within the Metaverse. One of the ways to address the existing interoperability issue is establishing the presence of the financial institution on several Metaverse platforms simultaneously. This way, the financial institution will ensure easy exchange of cryptocurrencies and NFTs.

This stage of the Metaverse development requires a seamless transition between real and virtual worlds and different platforms within the Metaverse. Financial service providers must focus on delivering products that serve both worlds. For example, debit and credit cards must

operate simultaneously in fiat and virtual currencies, allowing customers to pay for a digital asset in the Metaverse or petrol in the physical world. Thus, the digital wallets should be linked to real bank accounts. Similarly, virtual asset mortgages should be loaned against physical assets or against NFTs. Moreover, “real-world” NFTs can tokenize physical objects into digital ones, allowing purchasing a physical thing in the Metaverse or borrowing a DeFi loan against real asset collaterals.

Increasing technological complexity is expected at all stages of the Metaverse development. It necessitates comprehensive education for customers and financial professionals. Financial institutions are expected to continue launching virtual offices and employing avatars to communicate with customers in the Metaverse. This necessitates proficiency with cutting-edge immersive technologies like virtual reality (VR) and augmented reality (AR) devices. However, to attract customers to the virtual offices, the banks need to engage the system of active advertisement or create additional attractions in the same space, like gaming or selling virtual commodities.

This stage of the Metaverse development requires effective management of complex investment portfolios comprising non-fungible tokens (NFTs), cryptocurrencies, and other digital financial assets. Given the potential confusion stemming from the multitude and complexity of available digital assets, financial institutions can leverage robo-advisory services and AI to aid in portfolio management.

In the realm of avatars, authenticating individuals for secure financial transactions poses a challenge. Within the Metaverse, persistent and verifiable credentials can replace personal identity. For instance, a unique, non-transferable token could be a transparent and permanent curriculum vitae for individuals. Additionally, a zero-knowledge proof mechanism could authenticate events without disclosing private information. Financial institutions, in conjunction with other trusted entities, can offer critical escrow services to assist customers in securing access to their digital wallets, similar to how traditional banks safeguard customers' valuables in bank vaults. Traditionally, trust constitutes the cornerstone of the relationship between customers and financial institutions. To establish a secure environment in the Metaverse, financial service providers may allocate resources to develop technologies such as trusted execution environments (TEEs). TEEs offer segregated and safe execution of code and data processing, thus augmenting customer confidence.

Ethical considerations demand attention throughout every phase of Metaverse evolution. Attracting conscientious and ethically driven businesses and financial service providers could offer a pathway to mitigating such concerns. Furthermore, readiness to leverage blockchain technologies and quantum computing, offering enhanced data storage and transfer security, is imperative for addressing cybersecurity challenges.

Finally, financial service providers must anticipate competition from significant tech entities like Meta, Amazon, and Alphabet, who are already delving into financial services in the physical realm and are poised to expand into the Metaverse finance domain. In light of the challenges above and the dynamic nature of the ecosystem, financial institutions should prioritize upskilling and reskilling initiatives for their workforce while concurrently investing in novel technological solutions.

5.2. Long-term foresight

The long-term foresight of the Metaverse corresponds to the last stage of its advancement (see Fig. 6). It expects merging separate Metaverse platforms into a singular, interconnected virtual world. The foresight regarding this phase of Metaverse development emphasizes the speculative nature of the discussion rather than providing more accurate forecasts.

At this stage, Metaverse users are expected to be deeply immersed in this virtual realm, conducting most of their primary activities, like studying, working, and communicating, within its bounds. New cultural and moral norms will emerge to reflect this novel reality, shaping

consumption and communication patterns. The Metaverse economy is expected to evolve into a unified platform catering to users worldwide, fostering a singular global market. While this unified platform promises enhanced customer accessibility, heightened competition may emerge, potentially leading to a concentration of market dominance among a select few companies. Simultaneously, technological progress and the advent of AI are anticipated to revolutionize workflows so that the human element may be marginalized or eliminated in various occupations.

Like many others, the financial sector is expected to be significantly impacted by these developments. Over the long term, integrating payment services into the Metaverse is anticipated to be comprehensive, enabling users to seamlessly access real-world amenities, such as food delivery, without leaving the virtual realm. Furthermore, as the Metaverse evolves, there is a growing expectation of increased utilization of AI and algorithmic processing technologies, potentially including applications leveraging Brain-Computer Interface (BCI) technology, which establishes direct communication between the brain and computer systems. Integrating BCI into the Metaverse could streamline payment transactions and automate the processing of customer data and delivery of financial services, diminishing the need for human intervention. Ultimately, while financial services are expected to be present in the Metaverse in the long term, the conventional model of financial service providers may become obsolete as AI and other technological advancements lead to the complete automation of financial processes within digital applications and gaming environments.

6. Conclusion

The emerging Metaverse is expecting to change how we communicate, consume, or travel, shaping the trajectory of the global future. Despite being early, the Metaverse has garnered significant stakeholder interest, including major technology firms and investors. Concurrently, although the digitization of financial services has existed for some time, banks and other financial institutions appear inadequately prepared to adapt to the evolving virtual reality ecosystem. Additionally, industry barriers are becoming increasingly porous, with numerous non-financial entities providing financial services. To navigate this changing landscape effectively, financial service providers must adopt a proactive approach, seizing the new opportunities arising from changing realities, including those presented by the Metaverse.

Based on the foresight scenarios presented in previous sections, financial practitioners should consider the following recommendations:

- Actively embrace technological innovation: Proactively adopt cutting-edge technologies such as blockchain, AI, AR, and VR to enhance service offerings, data management, and customer experiences.
- Foster interdisciplinary collaboration: Collaborate with experts from diverse fields such as technology, law, and psychology to develop financial products addressing innovative solutions and complex challenges of the virtual realm.
- Continue to prioritize customer trust and security: Implement robust cybersecurity measures and transparent practices to ensure the security and trustworthiness of financial transactions in the virtual realm.
- Adapt to possible regulatory changes: Stay informed about possible regulatory developments and adapt practices and operations to ensure compliance and mitigate regulatory risks in the virtual realm. Participate in proposing and developing new regulatory frameworks.
- Enhance customer engagement: Prioritize personalized experiences, virtual assistance, and interactive platforms to enhance customer engagement and foster stronger relationships in the virtual realm.
- Invest in training and education. Prioritize comprehensive and ongoing education and training of both employees and clients.

Suggested Areas of Future Research	
Topic	Research Questions
Governance in the Metaverse	Who rules the Metaverse? Differences and similarities of governance and regulations in physical and virtual worlds. Distribution of rights and responsibilities in the Metaverse. Possible governance models and principles in the Metaverse.
Artificial Intelligence	Role of AI in providing financial services.
Ethics	Ethics of governance, AI, financial services, advertisement, extensive data management in the Metaverse. Metaverse, financial services, and privacy.
Big Data and its Analysis	Ethical ways of dealing with Big Data. Storage, processing, and Analysis of the Big Data
NFTs and Crypto	How do you stabilize the market of digital assets in Metaverse?
Cybersecurity	Financial services and cybersecurity in the Metaverse.

Fig. 7. Suggested areas of future research. (Source: The Authors.)

Moreover, despite their constrained role within the decentralized framework of the Metaverse, regulators, and policymakers may still benefit from the recommendations extrapolated from the earlier presented scenarios.

- The regulators must deal with customers’ privacy, data, and security protections, thus allocating resources for enforcing consumer protection laws, enhancing transparency by mandating clear product information and deploying advanced fraud prevention technologies.
- To address constantly emerging and changing challenges and opportunities in virtual financial services, regulators must establish mechanisms for regular reviews and consult stakeholders for feedback.
- Regulators can assist in further promotion of financial inclusion by investing in digital infrastructure, supporting financial literacy programs, and encouraging innovation in inclusive finance tailored to the needs of underserved communities.
- Additionally, invest in research, collaborations, training, and technological innovations.

While presenting foresight scenarios for future opportunities within financial services, this paper underscores the imperative of conducting an in-depth analysis of the significant technological, ethical, and social challenges inherent in the Metaverse. These proposed scenarios can serve as a foundational framework for further research endeavors, aiding financial institutions and regulators in formulating strategic plans tailored to the unique dynamics of the Metaverse landscape.

The emerging concept of the Metaverse presents a multifaceted landscape for extensive research and analysis across various disciplines. While academic literature on the Metaverse is currently in its early stages, it is poised for significant expansion, with numerous opportunities for exploration across different domains. As illustrated in Fig. 7, each of the driving forces within the Metaverse ecosystem offers perspectives for future research endeavors.

Additionally, the pursuit of the following research inquiries can contribute to the enhancement of financial services within the Metaverse:

- How can the ethics of the Metaverse be effectively categorized and addressed, particularly concerning business practices and financial transactions?
- What factors contribute to the stability of cryptocurrency and NFT markets, especially considering recent events such as the FTX cryptocurrency exchange crash, and how can standardization of NFT protocols potentially enhance market stability without compromising decentralization principles?
- How can decentralized finance (DeFi) coexist with centralized finance (CeFi) within the Metaverse governance framework?
- How can the stability of the Metaverse market be evaluated through the analysis of Metaverse indices and related factors, and what insights can be gained from such assessments?
- What are the challenges and potential solutions regarding money supply regulation in a decentralized Metaverse environment, considering the existing theories of money governance are based on centralized principles that may not align with Metaverse governance principles?
- What new tools and methodologies can be developed to manage money supply in the expanding Metaverse economy, ensuring sufficient liquidity to support the growing volume of transactions while adhering to decentralized governance principles?

CRedit authorship contribution statement

Ahmet Faruk Aysan: Supervision, Writing – original draft. **Giray Gozgor:** Formal analysis, Writing – original draft. **Zhamal Nanaeva:** Conceptualization, Writing – original draft.

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No data was used for the research described in the article.

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