The economics of the metaverse: A comparison with the real economy

Yongwei Chen1*, Hua Cheng2

1 Comparative Magazine, Research Department, Beijing 100871, China. E-mail: chenyongwei1982@126.com
2 School of Economics, Renmin University of China, Beijing 100872, China.

ABSTRACT

The economic system is an important component of the metaverse as a virtual world. At the macro level, the metaverse economy operates in three cycles: the inner cycle, the outer cycle, and the virtual-real cycle between the real world and the metaverse. At the micro level, the user is the most important subject of economic activity, acting both as a demander and as a producer of user generated content (UGC). In the metaverse, market demand is based on the use value and scarcity of goods, and market supply is driven by a combination of economic and non-economic motives. The smooth functioning of the metaverse economy relies on property rights and monetary systems, and blockchain technology is increasingly becoming the basis for both of these systems.

Keywords: metaverse economy; user generated content; NFT; blockchain; DeFi

1. Introduction

In March 2021, Roblox, the “first metaverse stock”, was launched on the capital market and its share price performed well; in October of the same year, Facebook changed its name to Meta. Since then, the metaverse concept has been sought after by large domestic and international Internet companies such as Microsoft, Apple, Nvidia, Tencent, and Byte Jump. On the one hand, these companies have increased their investments in metaverse-related technologies, and on the other hand, they have accelerated their acquisitions of metaverse start-ups in a bid to take advantage of the next Internet boom. Meanwhile, some government agencies are also actively embracing the metaverse. In the 14th Five-Year Plan of Shanghai, it is explicitly proposed that the city will “strengthen the forward-looking research and development of the underlying core technology and basic capabilities of the metaverse, and promote the development of new terminals that deepen perception and interaction and the construction of systematic virtual content”[1]. The Japan Financial Services Agency (JFSA) is working with virtual currency exchange platforms such as FXcoin and CoinBest to build market infrastructure with the goal of making Japan a developed country in the metaverse. The Seoul government in South Korea has even explicitly launched the Five-Year Plan for the Meta-Universe, announcing the creation of a meta-universe administrative ser-
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The term “metaverse” comes from the English metaverse, which first appeared in science fiction author Stephenson’s novel Snow Crash [2], a virtual world that transcends the real world. New technologies, digital virtualization, and mapping of the real world are essential elements of the metaverse. According to Chen and Dong [3], the metaverse is a virtual world that is mapped and interacted with the real world using technological means to link and create, and a digital living space with a new social system. The New Media Research Center of Tsinghua University [4] defines the metaverse as a new type of virtual-real Internet application and social form resulting from the integration of multiple new technologies, which provides an immersive experience based on extended reality technology, relies on digital twin technology to generate a mirror image of the real world, and builds an economic system through blockchain technology to closely integrate the virtual world with the real world in terms of economic system, social system, identity system, and allows each user to produce and edit content. The characteristics and elements of the metaverse given by Chen and Dong [3] include social & spatial attributes (Social and Space), technology empowered transcendental extension (Technology Tension), human, machine & AI co-creation, realism & reality mapping nature (Reality & The Roblox prospectus explains that the metaverse is a virtual world with a series of elements, which are referred to as “eight elements”, including These include Identity, Friends, Immersive, LowFriction, Variety, Anywhere, Economy and Civility.

From the above definitions it can be noticed that the economic characteristics of the metaverse as a virtual world are all mentioned. So, how does the economic world in the metaverse operate, and how is it similar to and different from the economic operation of the real world? This paper attempts to explore and analyze the metaverse economics by observing and sorting out metaverse projects that have been running successfully for a period of time, and by combining the features of new technologies such as blockchain and digital twins.

2. Several existing metaverse projects

Second Life was launched in 2003 and was created by Linden Research. Second Life introduced the then-advanced concept of user generated content (UGC), which allowed users to use the tools provided by the platform to design, create and trade various buildings or scenarios. Second Life had a built-in currency, the Linden Dollar, which could be topped up or earned by “working” and selling content they created. Users can earn Linden Dollars by topping up or by working and selling their own content. Linden Dollar is interchangeable with US Dollars and use a floating exchange rate. During the Second Life boom, a large number of users earned income from the provision of content. According to statistics from March 2007, there were 32,000 users earning net income from Second Life, with an average monthly income of over $1,000.

Minecraft is a sandbox game launched in 2009, with a high degree of openness and autonomy for players. On the one hand, users can play in a wide variety of ways, with three modes of play: survival, creation and adventure. On the other hand, the game is open source, with many official development tools available so that users can easily write their own maps and develop the gameplay they want. Minecraft has a complex economic system that allows players to accumulate online Axie Infinity is an NFT game built on Ethereum. Before starting to play the game, the user hours and collects within the game to obtain various resources and use them as elements to produce or exchange for the products they need. Real-world currency can also be exchanged for in-game currency and used to buy advanced props and materials. Currently, players can exchange in-game wealth for real-world wealth in a number of special ways. As of August 2021, Minecraft had over 238 million total downloads, 141 million monthly active users, over 1 billion cumulative player hours online and over $350 million in revenue generated by developers.
Roblox is a gaming platform, but it does not provide users with games per se, but only with the tools to make them. Roblox has a built-in currency, Robux, that circulates within the platform and can be earned by users by topping up or creating games, which can be used across all games within the platform to buy props, equipment and characters, while developers can sell User Generated Content (UGC) in their games in exchange for Robux, which they can use as the basis for a share with the Roblox platform, creating a complete economic system.

Sandbox is a mobile game launched by Pixowl in 2013, featuring a high level of freedom and UGC gameplay. There are two modes of play: story mode and free mode. The story mode is the equivalent of a tutorial, where players can follow the plot and instructions to complete tasks. In 2018, Pixowl ported the “sandbox” to Ether, making it one of the first “chain-touch” meta-games. One of the first metaverse projects to “touch the chain”. Once on the chain, the internet front-end marketplace allows users to upload, publish and sell the work they produce. In the blockchain version of the Sandbox, the token used is called a SAND, which players can use to buy UGC content, in-game properties or UGC assets. Users can also exchange their SAND tokens for other tokens such as Ether, or directly into US dollars if they wish. Currently, the Sandbox has the highest ‘land price’ of any metaverse project, with one of its plots being auctioned for $4.3 million in November 2021, setting a metaverse land price record.

Started in 2015, Decentraland is a metaverse project native to the blockchain world that has since gone through three phases: the Stone Age, the Bronze Age and the Iron Age. Essentially, Decentraland is a proof of concept for allocating digital real estate ownership to users on the blockchain, and in August 2017, Decentraland’s pass MANA was launched for crowdfunding, allowing users to use MANA to buy land and interact with other users. In February 2020 Decentraland launched its “Iron Age” version with VR support. Developers will be able to create apps that can be shared between users and monetize them accordingly. The Iron Age also started implementing peer-to-peer communication, a scripting system to support the execution of interactive content and a fast payment system for cryptocurrencies in virtual world transactions. In Decentraland, the Land is the vehicle of value for all creation and innovation, with a total of 92,598 plots, of which 43,689 can be sold, and the rest including 33,886 neighborhood plots, 9,438 roads and 3,588 squares. As in the real world, the location of the land determines its value, with the better the location the more expensive the land. Once purchased, the land can be converted for various uses as required.

Axie Infinity is a non-fungible token (NFT) game built on Ethereum. Before starting the game, users need to buy at least 3 Axies in order to download the application. While playing the game, users can compete, sell or trade game assets, and at the same time, they can multiply new Axies and build their own kingdoms, which are divided into several levels and consist of different body parts, each belonging to a corresponding level. In simple terms, Axies are non-fungible token. The reproduction of new Axies is an important part of the game, and the process is carried out according to certain rules. In addition, Axies live in Lunacia, a Land, which is divided into 90,601 tokenised plots. Landholders can find Axie InfinityShards tokens or other resources on their land, which can be used to level up the Land or Axie. Land plots are also an NFT and users can sell them. The current market value of land in circulation is approximately 19,130 ETH. a comparison of the characteristics of the above seven metaverse is shown in Table 1.
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Table 1. Comparison of the characteristics of the seven metaverse

<table>
<thead>
<tr>
<th>Description</th>
<th>VR</th>
<th>Blockchain</th>
<th>Governance</th>
<th>Economy</th>
<th>Entertainment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Life</td>
<td>Early meta-astronomical collectors</td>
<td>Not in use</td>
<td>Not in use</td>
<td>Platform rules + community governance</td>
<td>Weak (deliberately diluted)</td>
</tr>
<tr>
<td>Minecraft</td>
<td>“The way the metaverse should be”</td>
<td>Not required, may be used</td>
<td>Not necessary, version support available</td>
<td>Community governance-based (server decentralization)</td>
<td>Strong</td>
</tr>
<tr>
<td>Roblox</td>
<td>The triggers of the meta-universe concept</td>
<td>Not required, may be used</td>
<td>Not necessary, version support available</td>
<td>Platform rules dominate</td>
<td>Strong</td>
</tr>
<tr>
<td>Sandbox</td>
<td>Block chaining the metaverse</td>
<td>Not in use</td>
<td>In use</td>
<td>Blockchain governance</td>
<td>Strong</td>
</tr>
<tr>
<td>Decentraland</td>
<td>Blockchain’s original metaverse</td>
<td>Not required, may be used</td>
<td>In use</td>
<td>Blockchain governance, DAO</td>
<td>Weak</td>
</tr>
<tr>
<td>Axie Infinity</td>
<td>The meta-universe growing on NFT</td>
<td>Not in use</td>
<td>In use</td>
<td>Blockchain Governance</td>
<td>Very strong</td>
</tr>
<tr>
<td>Horizon Worlds</td>
<td>Facebook’s new generation metaverse</td>
<td>Must be used</td>
<td>No in use</td>
<td>At this stage the platform rules are mainly used</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

3. The triple cycle of the meta-cosmic economy

Real-world economic cycles are generally abstracted into the structure shown in Figure 1. The process of economic functioning consists of two levels of circulation, internal and external: internal and external. Of these, the internal cycle considers mainly the trade and allocation of final goods and factors of production within a country or region, while in the external cycle, goods and factors move across national borders and between international boundaries.

In the meta-universe, the economy operates both in the same way and in a different way from the real economy. Figure 2 roughly depicts the economic cycle in the meta-universe, which is first described in this section.
3.1. Macro analysis of the meta-universe economic cycle

At a macro level, the economic cycle of the metaverse will be threefold rather than twofold. The first cycle is still the inner cycle, representing the economic cycle within each metaverse.
For example, whether in Second Life, Minecraft or the newer Sandbox or Decentraland, there is first and foremost an internally. There is a self-consistent economic cycle, with goods and market demand, production behavior and market supply, as well as the outlines of a market for final consumer goods and factor markets. Under extreme conditions, this economic cycle can be sustained if there is no communication with the outside world.

The second level is the outer loop between metaverse which portrays the interoperability of economic systems between different metaverses. In the early days, economic interoperability between metaverse was relatively rare. Although the interoperability of different metaverse has been discussed by scholars for more than a decade, in reality it is difficult to exchange Linden Coins from Second Life directly for emeralds from Minecraft due to differences in the underlying architecture. However, as the use of blockchain and cryptocurrencies becomes more widespread, this kind of economic interoperability across metaverse is becoming easier and easier. Not only do many exchanges support the trading of tokens between different metaverse, but some DeFi apps can even automate the exchange of tokens. With the support of these underlying technologies, metaverse have moved out of the closed economy era and become interconnected open economies.

The third dimension is the cycle between the virtual and the real. The metaverse, as a virtual world, is not completely isolated and opposed to the real world. As technology advances, the economic link between these two worlds shows a gradual intensification. In some early metaverse practices, the real world and the metaverse were interconnected in one direction. For example, in the earliest Second Life, people could buy Linden Dollars in US dollars, but Linden Dollars could not be converted to US dollars. Currently, however, US dollars and Linden Dollars are freely convertible and the exchange rate is floating. With the development of blockchain and the pass-through technology on top of blockchain technology, it is becoming easier to move goods and money between the real and imaginary worlds. With the development of technologies such as augmented reality, artificial intelligence, digital twins and the Internet of Things, it is becoming easier and easier to interact between the real and the imaginary. The different stages of production of a commodity may be completed separately in the real and imaginary worlds.

3.2. A micro-analysis of the meta-universe economic cycle

At a micro level, the economic agents in the meta-universe also consist of three parts, namely users, companies and platforms, whose organization and behavior differ somewhat from the real world.

The first concerns users in the metaverse. In the real world, micro-economic agents include householders, businesses and governments. In the metaverse, the role of the household is replaced by that of the user. As a literal change, users in the meta-universe are more autonomous in their decision-making than households, without having to consider the collective decisions of the family. On the other hand, in the real economy, the household is becoming less and less visible as a unit of production, but in the metaverse the trend is the opposite. As the market evolves, more and more users gradually move from being pure content consumers to content providers. In many metaverse, UGC products have become the most important commodity, while users have replaced companies as the most important unit of production.

Secondly, about enterprises in the metaverse. In the metaverse, there are also productive organizations that resemble corporations. In Axie Infinity, for example, there is a “funding model”. Some professional Axie Elf investors will work with players to give their invested Elves a “scholarship” to take them into battle. However, when these players are victorious, they need to share the rewards with these sponsors. This organizational model is in fact somewhat akin to a real-world business, with Axie Elf investors acting as bosses, buying equipment (elves) and hiring workers (metaverse players) to
work for them and make a profit. However, at least for now, this does not seem to be the most popular way of organizing collective production in the metaverse. Decentralized Autonomous Organizations (DAOs) are much more popular than the traditional hire-and-hire—a hierarchical organizational structure for distributing tasks and organizing production. Thanks to blockchain technology and the pass-through incentive system built on top of it, DAOs can organize production activities in a distributed manner. In the future, this could become the most important way to organize mass production and collaboration in the metaverse.

Thirdly, it is about acting as a platform for quasi-governmental roles. In the real world, governments are the most important coordinators and administrators. In the metaverse, on the other hand, there is no such thing as a government. So how are many of the tasks that need to be done by the government in the real world, such as public goods provision and macroeconomic regulation, accomplished? A study of the more representative metaverse reveals that the solution to this problem has undergone a great deal of evolution. In the early metaverse practices, the role of government was usually played by the platform providing the service. In Second Life, for example, Linden Lab was similar to the government in that it had the final say in the provision of infrastructure, the development of UGC sharing schemes, and the control of monetary policy. However, in some recent metaverse projects, there seems to be a preference for blockchain-based DAOs to orchestrate the general policy of the economy. With blockchain technology, people can easily vote on economic solutions, making it easier to achieve “free association of free people”, while the role of centralized regulator gradually gives way to a broader public choice.

In summary, the economic cycle of the metaverse, compared to the real economic cycle, has an additional cycle between the virtual and real worlds in addition to the inner and outer cycles in the macro perspective, which is closely linked to the parallel existence and mapped interaction between the virtual and real worlds of the metaverse. In a micro perspective, compared to households in the real economy, the users of the metaverse not only act as demanders of goods for purchase and consumption, but in many cases also create UGC products and have a productive function. The platform, as the creator of the metaverse, can regulate the economy either in a “planned economy model” with administrative intervention or in a “free market model” with blockchain-based DAOs.

4. Commodities and demand in the metaverse

The existence of demand and supply is the basic precondition for the creation of an economic cycle. Demand and consumption are to satisfy the demands of households to increase their level of utility, while supply and production are functions that production units undertake autonomously based on profitability or other purposes. The metaverse is a virtual world, and the goods that circulate and are allocated in the economic cycle are also virtual goods. The virtual nature of the metaverse leads to some differences between the demand and supply of goods in the metaverse and the supply and demand of goods based on the physical existence of the real world.

In the real world, the value of a commodity is determined by a combination of two factors. On the one hand, commodities must have a use value and be able to be used to satisfy some aspect of people’s needs. On the other hand, commodities must be scarce. If there is no scarcity of a certain type of good, then it will not have value, even if it is very useful. In other words, the simultaneous existence of use value and scarcity is a necessary condition for the existence of demand for goods in the real world. And this can be found in the same economic logic in the metaverse, the difference being only that the specific manifestations of use value and scarcity are unique in some respects.
4.1. The use value of virtual goods

Lehdonvirta and Castronova\cite{5}, the pioneers of “virtual economics”, consider that the use value of virtual goods consists of three aspects: functional, hedonic and social values. In the metaverse, all three types of values can be found in correspondence.

**Functional values**

Although virtual goods are formally virtual, there are many functional values that cannot be ignored. For example, Lehdonvirta and Castronova\cite{5} point out that users can purchase certain virtual goods to obtain information, perform performance, or complete certain activities in the virtual world, and uses like these are functional in value. Of all the functional uses, helping users to gain the attention of others is probably the most important one.

Attention is a scarce resource\cite{6}. Generally speaking, the purchase or use of a product begins with the knowledge of the product. If the product does not attract attention, then there is nothing to follow. However, people’s attention span is limited, so it is a matter of concern for businesses to successfully attract this limited attention. In practice, advertising, promotions and event marketing are, in the final analysis, all about attracting the attention of users and gaining their attention\cite{7}. In the digital economy, the value of attention has been magnified, and digital giants are competing for users’ attention in order to prolong their use. Once they have succeeded in gaining the attention of users, the digital giants can successfully realize a large amount of revenue through advertising, targeted recommendations, and so on. It is for this reason that those companies that are most successful in the attention market, such as Facebook and Google of the four US tech giants GAFA, also typically generate the most significant revenues\cite{8}.

In the metaverse, the value of attention cannot be ignored. The metaverse is a virtual space in which people observe in a similar way to the real world, so it is natural that the elements that can capture people’s attention in reality can also capture attention in the metaverse. For example, in reality, location is an important factor in the acquisition of attention, and this holds true in the metaverse as well.

Similarly, in a large virtual space like the metaverse, zones can also influence people’s concerns to a large extent. In metaverse projects such as Second Life and Decentraland, when people enter the metaverse, they first enter a staging area, through which they are transported to various zones. In a sense, this staging area is similar to the center of the capital city in reality, and all users entering the metaverse will first see the perimeter of this center. From the point of view of attention acquisition, this surrounding land is the most valuable. Both the sale price and the lease price of the advertising space should be the highest. In addition to this general entrance, there will be a staging area for each sub-district on the map, which is similar to the city center of every city in the real world. All users touring this sub-district will inevitably pass through it. The value of the land in the center of these stations is therefore not as high as in the “capital city center”, but it is still considerable. Of course, in addition to these natural hubs, there are also specially created themed areas that can easily attract attention. Current news reports indicate that the major land deals in the metaverse are concentrated in central locations and popular themed areas.

**Hedonic values**

Unlike functional value, which emphasizes “usefulness”, hedonic value emphasizes “fun”. In other words, it emphasizes the pleasure and pleasure that a good can bring to a person. In the metaverse, the same holds true. For example, the many and varied buildings in Minecraft created by the users themselves are not meant to be lived in, nor do they provide any realistic use. But when you look at them, and think of the solidarity and cooperation behind them, you can’t help but feel a sense of admiration and affection. This is the hedonic value of these works, even if they have no functional value in themselves, and it is this hedonic value that determines their potential to become a com-
modity and to fetch a high price.

**Social values**

If functional and hedonic values are concerned with buying things for oneself, then social values are concerned with buying things for others. In reality, there are many things that are “bought for others”. The economist Van Buren\(^9\) has analyzed this consumer mentality in depth. In his book “The Theory of the Leisure Class”, he named this “buying for others” consumption as “Conspicuous Consumption”. In his view, the purpose of such consumption is to show one’s social status and to satisfy one’s vanity and self-esteem. Unlike ordinary consumption, when people consume conspicuously, they are not as careful with their money, but rather they are wasteful, or “don’t buy the right thing, just buy the expensive thing”.

As a virtual space with freedom of access, the metaverse largely provides a better venue for people to show off. In this world, showy goods may work better than in the real world when they perform their show-off function. Understanding this, it is easy to see why a virtual Gucci bag sells for an even higher price in the metaverse than in the real world.

**Programmable value**

It is worth noting that, in addition to the three types of use values identified by Lehdonvirta and Edward, virtual objects in the metaverse have a very important use value, namely programmable value. Programmability means that assets can be freely set, edited, and executed to suit the needs of the user. Programmable value is the value that comes from programmability.

In the real world, the programmability of assets is relatively poor. For example, Zhang San wants to run a business and needs a loan from a bank. The bank’s condition is that there needs to be collateral, and Zhang San decides to mortgage his house to the bank. This process of changing the use of the house from use to collateral is very complex and requires many procedures such as appraisal and certification, and costs the appropriate fees.

In contrast, many virtual assets are much more programmable than real assets. Thanks to the development of blockchain technology, many virtual assets are built on top of the underlying architecture of the blockchain, which allows them to be easily converted for use according to the needs of the user. Consider the example of Zhang San, but suppose his house is a virtual property that exists in the metaverse. Since the condition of the property is already written into the blockchain at the time of his purchase, not only is it visible to everyone, but it cannot be changed, so Zhang San does not have to spend a large amount of time appraising and valuing the property. Nor does the recipient of the mortgage have to fear that if Zhang San fails to repay the money, it will be difficult to confiscate the property, as the ownership of the property will automatically change upon default, as long as the transaction is triggered by a smart contract in advance.

With programmability, it becomes easier for people to use and allocate assets, and this feature, naturally, becomes unique to the use of virtual assets based on blockchain technology.

4.2. Scarcity of virtual good

As in the real world, an object, even if it has numerous functions, cannot have value or be a commodity in the true sense of the word if it is not scarce in itself. So, where does the scarcity of virtual goods come from?

First, the production of virtual goods requires material input. Although virtual worlds are made up of bits rather than atoms, it is, after all, the material input that is needed to make these bits work. In this sense, the laws of scarcity in the material world also act on the world of bits. For example, in many metaverse projects, such as Minecraft, users often report that the display quality is poor. But in fact, it is possible to improve the quality of the graphics by purchasing the appropriate materials and effects. Why, then, does Minecraft not choose to improve
the quality of its graphics across the board, instead of selling them as a way of improving them? This is partly due to the operator’s profitability, but more importantly because the servers would not be able to cope if the entire game was upgraded. It is for this reason that a virtual commodity such as image quality, which seems to be in infinite supply, has become a scarce item that needs to be purchased by users on demand.

Second, scarcity is artificially constructed. More often than not, operators of metaverse projects construct an artificial scarcity, even if it does not physically occur\(^{10}\). For example, in the better known metaverse projects such as Sandbox, Decentraland and Axie Infinity, the number of plots available is deliberately limited. In addition, with the use of digital watermarks, DRM, and NFT, many virtual props that could have been mass-produced have been branded as unique, going from non-scarcity to scarcity.

So why do the operators of the metaverse deliberately create scarcity? There are various reasons for this: on the one hand, the existence of such scarcity creates a better sense of experience for the user. Humanly speaking, everyone likes to have their own personality, and having differentiated items is a projection of that personality in the outside world. Imagine how boring the world would be if everyone could only eat the same things, wear the same clothes and live in the same houses. Therefore, even though it is technically possible for people to get anything they want in a virtual world, differentiation and scarcity must be artificially created.

On the other hand, artificially created scarcity is a means for metaverse projects to gain revenue and ensure continued operation. Bronfman, the former chairman of Warner Music Group, once said that “the ubiquity of music is detrimental to the music industry”\(^{11}\). Bronfman’s meaning of this statement is straightforward; although it is desirable for every listener to have their favorite music available for free, if all music was really made available for free, then no one would want to create music and the whole music industry would collapse as a result. By the same token, the development of the metaverse requires constant building and a constant investment of human and material resources. Obviously, this can’t be done by just “love”. Therefore, people have to create scarcity, so that virtual goods that would otherwise be free are no longer free. In this way, the providers of resources and goods are rewarded and the platform or organization running the metaverse project takes a percentage of this, which is used to support the ongoing development of the project.

Through the above analysis, it is easy to understand that once there is use value and scarcity, then the goods in the virtual world also have a value basis, and a series of real-world economic laws such as the law of demand will also break down the dimensional wall and enter the meta-universe.

5. Production and supply in the metaverse

In the metaverse, the user himself is the primary unit of production and the UGC product is the most important output. As such, the content and form of the product provided by the user, as well as the time spent on it, can be mastered by the user. Of course, in some of the more ambitious UGC products, it is difficult for individual users to produce them on their own, so they need to collaborate with others. The basis of this production collaboration is largely voluntary, and each user will have a great deal of freedom in what they do and for how long in this production process, and will not be directed by a manager from on high, as is the case in real-world businesses. In this case, the quantity and quality of UGC products supplied in the metaverse depends largely on the willingness of users to supply them.

5.1. Supply motive

In the real economic world, firms in the main production units are motivated by profit maximization in their supply production behavior. In the me-
ta-universe, the motivations of users to provide UGC products are diverse and may be economic or non-economic\textsuperscript{[12]}. In the meta-universe, the motivations of users for providing UGC products are diverse and may be economic or non-economic\textsuperscript{[12]}. The so-called economic motivation is, in short, the provision of UGC products as a means of making a profit. With this motivation, users will behave very much like a profit-maximizing business, carefully considering and weighing the costs of production against the possible benefits of production. With this motivation, lean may not be the optimal choice for users, as an overly elaborate production process may not be economical from a cost-income perspective.

Non-economic motives are those that do not use the provision of UGC products as a means of making a profit, but rather to satisfy some other purpose. Non-economic motives can also be further classified. For example, some users provide UGC products mainly to gain attention and praise from others as a way to satisfy the need for respect. These users generally put more thought into their products and give more consideration to the preferences and comments of their audience than users who monetize their UGC products. Other users create UGC products to express their own thoughts and passions. For this group of users, it’s all about having fun and it doesn’t matter if they can make money or if people are paying attention. From an economic point of view, the production activities of this group of people can be broadly classified as consumption of leisure.

The social welfare that may be generated by UGC products driven by different motivations is different. Generally speaking, those UGC products produced to gain the attention of others can generate significant positive externalities, and thus are most likely to enhance total social welfare. UGC products that are produced for economic motives can satisfy some people’s needs, but at the same time, they may also generate certain externalities. The overall welfare consequences depend on the direction of the externality and the degree of control over it. The social impact of products that are offered purely for personal preference is harder to judge.

5.2. UGC product offerings in different economic systems

Since users have different motivations for providing UGC products, the design of different economic systems will therefore have a significant impact on the quantity and quality of UGC products supplied in the metaverse\textsuperscript{[13]}. Specifically, if the whole economic system in a metaverse is well developed and UGC products are easy to realize, the proportion of users who produce for economic motives will increase, while those who provide UGC products for non-economic motives may feel uncomfortable and gradually leave. If the UGC products in a meta-universe are difficult to cash in on, but often give some moral encouragement to the creators, then the meta-universe may have a greater number of socially motivated users, and the number of products will be smaller than in the previous meta-universe, but the quality may be higher. Of course, both the quality and quantity of UGC products are important for a meta-universe, and must be weighed in the design of the economic system.

From observation, it can be seen that the better developed metaverse projects almost always have a more elaborate economic system designed to achieve a better balance between UGC creators with various motivations. It is important to note that different metaverse projects have evolved different economic incentive schemes for UGC products due to their different qualities.

**UGC product direct trading model**

The first model allows for direct trading of UGC products, i.e. a marketplace for UGC products where users can buy UGC products created by other users, often in a currency that can be exchanged directly or indirectly with the wealth of the real economy. For example, Second Life has adopted this option, allowing users to trade in the in-game
currency, Linden Dollars, which can be exchanged with the US Dollar at a floating exchange rate. interchangeable.

The advantage of this model is that it provides an incentive for financially motivated users to create more UGC products, and it promotes trading activity in the virtual world due to the direct injection of real money, but the disadvantage is that it hurts the enthusiasm of non-financially motivated creators. After allowing UGC products to be traded, Second Life experienced an explosive growth in the number of UGC creators. However, this growth quickly stalled. The reason for this was that the act of trading had a repulsive effect, causing some users, who were primarily creating for non-financial reasons, to lose interest in Second Life. However, this is not the key. The more damaging problem was the influx of “kryptonite users” as the Linden Dollars in Second Life were freely convertible with US dollars. These users will buy UGC products directly with Linden Dollars, rather than creating their own products in exchange for Linden Dollars, which they can then use to buy the products they want. With the impact of these users, only those who produce exclusively for profit will remain, making it difficult to maintain the quality of UGC products in the entire Second Life ecosystem.

Indirect trading model for UGC products

The second model is to provide a channel for UGC products to be displayed, so that the creators can get paid from other channels, which is actually a roundabout way to make money. Although trading of UGC products is allowed in Minecraft, it is mainly limited to homemade MOD and maps, and the ease of trading is not too high, while it is difficult for users to get direct rewards for the various buildings they create. This high threshold for realizing UGC products has led to a low proportion of professional creators in Minecraft. According to the domestic operator, NetEase, only about one in a thousand content creators can earn direct income from Minecraft. In comparison, the proportion is higher abroad, but still much lower than in other metaverse projects.

Such a design has attracted a lot of criticism. Some argue that the high barrier to realizing UGC products discourages people from creating. However, the opposite is true. Compared to other metaverse projects, Minecraft produces not only a high number of UGC products, but also a very high quality. Why is this the case? In this paper, we argue that the mystery lies in the fact that it deliberately blocks the economic circulation within and outside the metaverse.

Because the buildings people create in Minecraft are difficult to trade for real-world currency, the game’s internal circulation is ensured—players have to gather resources themselves in order to get the buildings they want, without too many “Kryptonite users” to upset the balance. Under these conditions, users who create out of non-economic conditions are motivated, and thus many fine works are created.

However, what about the users who create for financial gain? Although their needs are not adequately met on the main Minecraft server, they can use their creations to showcase their talents in the larger world. In addition to the main server, Minecraft has many commercial servers, which are themselves hired to create, and they hire creators who have done well on the main server. In this way, if a person’s work becomes famous on the main server, subsequent commercial interests will follow. In this way, Minecraft succeeds in balancing the various creative motivations of its users and better stimulates creativity.

Platform model

The third model is the platform model[^14], represented by Roblox, in which the project operator only provides the underlying authoring platform and all content is created by the users themselves as UGC products, and the users have a very high say in deciding the profit model, etc. However, all user UGC products are separate from each other. In Roblox, a UGC product is a separate game, Roblox just presents them, and it is people’s choice to decide who plays which game. With this structure,
creators are highly motivated to improve their products and get more traffic, whether they are creating for financial gain or for non-financial gain. And with their efforts, they are simultaneously contributing to the success of Roblox.

**NFT cash-in model**

The fourth model is the NFT cash-in model. In a blockchain-based metaverse, users can create UGC products and then trade them as NFT products. This trading can even be done across platforms, so it is very easy for users to cash in on their creations. In a sense, this model is very similar to that of Second Life, except that Second Life uses a centralized settlement for transactions, whereas the blockchain-based metaverse project allows for peer-to-peer transactions, which is much more efficient. This is a very hot model, and many of the UGC products are already trading at a much higher volume than earlier metaverse projects such as Second Life.

But is this boom a result of the creators’ own enthusiasm for creation, or the urge to “speculate” on coins? What impact does it have on the health of the metaverse itself, and will it have any negative effects like those seen in Second Life? More time is needed to test all of this.

6. Property rights systems in the metaverse

Alchian, the founder of modern property economics[^15], defined property rights as a right to choose between multiple uses of an economic good that is realized through social enforcement. In this definition, Alchian focuses on two points: First, property rights are not only rights in the legal sense, but must also be socially recognized and enforceable in society. Conversely, if a right cannot in fact be recognized and enforced by society, then it cannot be considered a property right, even if it is legal.

The consensus among many economists is that property rights are the foundation that allows transactions to run smoothly and are therefore the cornerstone of the entire market economy. In the real world, the smooth conduct of transactions is strongly dependent on the definition of property rights, their initial allocation, and the rules for transferring transactions. So, in the metaverse, are there property rights, and what structure and rules are their system of property rights based on? Indeed, on the one hand, property rights are as important in the economic dimension of the metaverse as they are in the real world. On the other hand, the property rights system in the metaverse presents a more diverse character, and various experiments on property rights are still being explored in different metaverse.

6.1. The property rights system in the early metaverse

In early metaverses such as Second Life and Minecraft, the maintenance of the property rights system relied heavily on a centralized administrator. Most early metaverse was provided by a single company or platform, so that all transactions of virtual items were recorded on a central server. The so-called transactions of items, the transfer of property rights, are ultimately changes in the numbers on the server. In this case, if someone disputes the change of ownership, they can directly complain to the company or platform providing the service. For example, if someone finds out that their Second Life props have been lost or stolen, they can contact Linden Lab directly, and they will be dealt with accordingly once the facts have been ascertained. In such a centralized system, the service provider has the final say and the means of direct control, making it unlikely that the real-world situation of “laws that are in place but difficult to enforce in reality” will ever arise. In this sense, the system of property rights in these early meta-universes operated more efficiently than in the real world.

However, this system of property rights also has its problems. It is difficult for people to divide or create property rights as needed. In practice, people often want to trade only some of their prop-
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Property rights, while leaving others untraded. For example, in ancient China, the right to land was divided into various sub-rights such as the “right to the bottom of the field” and the “right to the face of the field”, and people were free to trade one of these rights^{16}. In the real world, the division and trading of these rights could be supported and guaranteed by social custom, but under a centralized system of property rights, it would have been very costly to carry out a similar division of property rights. Thus, in the early metaverse, while the property rights system could also function efficiently, its institutions were less resilient.

6.2. A blockchain-based property rights system

Unlike the earlier metaverse, some of the more recent metaverse projects are built on blockchain and their property rights systems are naturally supported by blockchain technology. In a blockchain-based metaverse, someone’s property rights over something can be carved out in terms of NFT. In a more non-technical sense, it can be thought of as a digital proof of property rights, with all kinds of information and transaction history of this property itself being recorded on the blockchain. Nowadays, people can easily make NFTs of pictures, music or other objects they have created with the help of websites such as OpenSea and NFTCN, which can also be traded.

In a blockchain-based metaverse, transactions can be carried out peer-to-peer, and the ownership of the NFT corresponding to an item change after the transaction is completed. Instead of being stored on a centralized server, the corresponding result would be broadcast to the entire network and deposited in the blockchain, whose characteristics would ensure that this result would be difficult to tamper with and difficult to violate. In other words, such metaverse can also achieve strong protection of property rights through a similarly decentralized system of transactions.

However, the benefits of a blockchain-based property rights system over a traditional centralized property rights system do not stop there. It is very difficult to create new rights in a centralized property rights system. It can be very costly for centralized administrators to maintain all kinds of newly created rights, and thus even if rights are created, they are difficult to protect. In a blockchain-based property system, it is easy to create rights. One just needs to create a corresponding NFT with the corresponding rights independently, and then this corresponding right can be protected in theory. In fact, there are now a large number of NFTs on the market which do not represent “ownership” in the traditional sense, but are simply part of a system of property rights. Many years ago, some jurists predicted that the property rights system would move from “legal rights” to “freedom of rights” as the cost of defining and protecting rights continued to decline^{17,18}. Now, with the maturation of blockchain and NFT technology, these predictions seem to be becoming a reality.

In addition, blockchain-based property rights systems can also help to solve the problem of the “anti-tragedy of the commons” in the metaverse. The so-called “anti-tragedy of the commons” refers to the problem of too many people owning the property rights of an item, which makes it difficult to coordinate the transaction^{19}. In the real world, there are many similar examples. For example, at the beginning of the country, the state allocated a large number of courtyards to residents as housing. In this way, a single courtyard could be jointly owned by many households, which in turn led to a complex property rights issue. Generally speaking, it is very difficult to trade such complex properties in the market, because if one of the families does not agree to the sale, the transaction will be suspended. Similarly, in the metaverse, the ‘anti-commons tragedy’ can also exist. For example, in Minecraft, many large buildings are made by a large number of users working together. If these buildings were to be traded, they could suffer from problems similar to those experienced in the real world when trading quadrangles. With NFT technology, this problem can be easily solved. By creating a batch of NFTs based on the contributions of the creators of a
whole work, those who wish to trade can sell their NFTs, while those who do not wish to trade can choose to keep their NFTs. In this way, the transaction can be carried out almost perfectly.

7. Currency in the metaverse

If we disregard the use of banknotes and coins, the issuance and use of money in the real economy can be made possible by the “virtual” system constructed by electronic information technology. Just as there are centralized fiat currencies, decentralized cryptocurrencies and stable currencies in the real economy in the context of digital technology, there are also three broad types of currency in the metaverse.

First, centralized currencies issued by platforms. Early metaverse was essentially provided by a platform or corporation, and the platform providing the service acted as a government in these metaverse. For example, in Second Life, Linden Lab is similar to the real world government in that it can determine the amount of fiat currency issued in the game, the Linden Coin, and can regulate it with monetary policies just like the real world government. In Second Life, for example, Linden Lab is similar to the real-life government in that it can determine the amount of fiat currency issued in the game, the Linden Coin, and can use monetary policy to regulate and stimulate the economy, just like the real-life government[20].

Secondly, decentralized cryptocurrencies, such as Bitcoin and Ether. In some recent metaverse projects, centralized cryptocurrency systems have fallen out of favor, and the reasons for this phenomenon are manifold. Some users believe that the right to issue currency in a metaverse should not be exclusive to one platform, as this could be detrimental to their rights. Other users are reluctant to rely on a centralized intermediary in the transaction process, as this could lead to many problems such as privacy breaches. Users would prefer to trust a decentralized monetary system than a centralized one, and blockchain and cryptocurrencies bring the possibility of making this happen. Bitcoin, Ethereum, etc., which are accepted in the real world, can be equally used in the metaverse.

Third, platforms issue stable coins, i.e. each meta-universe develops separate pass-throughs anchored to some stable asset. In order to achieve efficiency in transactions, these pass-throughs do not necessarily need to be built on the same blockchain technology as Bitcoin. Instead, in order to ensure the stability of the value of the coin, these passes could be issued using some asset anchor, with the asset as the storage and allocation. The assets here could be real-world currencies or a basket of cryptocurrencies, and the criteria for selection should be that they have a relatively stable value.

These three types of currencies are used in the metaverse in the same way as they are in the real world, with their own advantages and drawbacks. Centralized currencies have the characteristics of convenience and efficient transactions, but suffer from the flaws of non-anonymity and inflationary devaluation, while cryptocurrencies have the advantages of being decentralized, anonymous and programmable, but the flaws are also obvious. On the one hand, the coin value of cryptocurrencies is too unstable, which makes it difficult to meet the need as a circulating currency. On the other hand, cryptocurrencies are, at least for the time being, very inefficient in terms of transactions. Both the throughput and the efficiency of transactions are hardly adequate for large-scale transactions. Bitcoin, for example, has a network throughput of 7 TPS, which means that it can process 7 transactions per second at the same time, and the transaction time takes 1 hour; Ether is a bit stronger, with a throughput of 25 TPS and a transaction time of 6 minutes.

Stable coins in the real economy emerged to reconcile the instability of cryptocurrencies’ coinage with the difficulty of meeting the demand for transactions in the digital world with traditional currencies. Likewise, pass-throughs issued by platforms tied to stable assets in the metaverse can
Solve these problems. Stable coins can use blockchain technology to ensure the security and decentralization of transactions, or they can be used without a blockchain and focus on improving the efficiency of transactions. In this case, the security of transactions may be compromised, but perhaps a system of spot checks could be introduced to guard against this. That is, a percentage of all transactions would be taken as a check, and if a transaction is found to be falsified, a heavy penalty would be imposed. In theory, if the penalties were set high enough, this would effectively discourage people from committing counterfeiting. However, this inconsistent punishment strategy may not hold true in the real world, but it may be more adaptable in a virtual world like the metaverse.

8. Economics across metaverse

Here we analyze the second level of the “trans-universe outer loop” and the third level of the “virtual-real loop” between the meta-universe and the real economy. However, the meta-universe projects already in operation in reality hardly show any clear behavior and corresponding rules for inter-universe transactions, so this is only an attempt to make a deductive analysis based on the logic of the real economy.

Just as in the real world there are many separate and closely connected countries, so in the virtual world the metaverse is more likely to be built up one after another in the form of many separate projects, large and small. However, just as isolated websites have no value, if each metaverse project is independent of each other and cannot be connected to each other, then their value will ultimately be limited. The only way the value of the metaverse can be truly realized is to connect it to each other and between the metaverse and the real world, so that people can travel freely between them.

However, once metaverse that has developed independently of each other is to be interconnected, there are many issues involved. Among these problems, apart from the technical difficulties, there are equally economic issues to be explored. As each metaverse project is built independently, with different builders and building specifications, how will the value of the passes between them be exchanged? By what percentage should the wealth one has in universe A be converted to universe B?

Unlike the early days, the current meta-universe project is increasing and thus the economic circulation across meta-universes becomes a real issue that must be attended to. In the real world, the economic cycle between countries includes two main branches: international trade and international finance. Similarly, the economic circulation between metaverse would also include cross-metaverse trade and cross-metaverse finance.

8.1. Cross-metaverse trade

Theories of international trade have been developed for centuries, starting with Smith. Of all the theories, the most influential is still Ricardo’s theory of comparative advantage. In his book Principles of Political Economy and Taxation, Ricardo discusses an interesting example: suppose that it takes 100 people to produce tweed and 120 people to produce wine in the UK, while it takes 90 people to produce the same amount of tweed and 80 people to produce wine in Portugal. Portugal is then more efficient than the UK in both tweed and wine production. However, in contrast, Portugal has more advantages in the production of wine than it does in the production of tweed. So, if Portugal specialized in wine production and Britain specialized in tweed, it would raise the welfare of people in both countries.

This example, although very simple, makes an important argument that in international trade the most important factor in what a country produces is what it has a comparative advantage in. This theory also holds true among meta-universes. However, direct exchange of goods across metaverse may be difficult because the architecture between different metaverse is not the same, and it is not possible for a building in “Minecraft” to be transported to Decentraland, or the “sandbox in the “sandbox”.
However, a division of labor based on comparative advantage may manifest itself in a different way.

For example, if User A’s comparative advantage is building buildings in Minecraft, and User B’s comparative advantage is raising sprites in Axie Infinity, then A can build a house in Minecraft and trade it for gems, which can be exchanged for SLPs and AXSs in Axie Infinity. A can then build houses in Minecraft and trade them for gems, which can then be exchanged for SLP and AXS in Axie Infinity, which can then be used to speed up sprite development; while B can, on the other hand, develop sprites and win more SLP and AXS, which can then be exchanged for SLP and AXS in Minecraft. B can then exchange them for Minecraft gems to buy buildings in Minecraft. If the scope for this kind of inter-universe arbitrage through division of labor is relatively substantial, it may even be possible to see organized groups engaging in this activity.

8.2. Trans-universe finance

In early practice, there was no question of opening up across metaverse, as the projects in metaverse were provided by a single operator and had a strong closed nature. However, the operators of the metaverse still have to deal with the issue of interoperability with the real world. For example, during the operation of Second Life, the problem of converting Linden Dollars to US Dollars had to be solved. Initially, Linden Lab opted for a fixed exchange rate system, whereby the exchange rate between the US dollar and the Linden dollar was fixed. However, in practice, it became clear that maintaining this fixed exchange rate system was costly and had many drawbacks, so the system was changed to a floating exchange rate system. These Linden Lab initiatives were probably the earliest financial experiments across the meta-universe.

However, there are now a much larger number of metaverse projects than there were more than a decade ago. However, some of the newer metaverse projects are built on the blockchain, and thus it is not difficult to exchange currencies between different metaverse. In terms of the choice of exchange rate, metaverse projects nowadays generally opt for a floating exchange rate system. In the beginning, the exchange of currencies (passes) between metaverse was mainly carried out on a number of centralized exchanges. However, in recent times, with the development of DeFi, similar exchanges have become much easier. With DeFi products such as Uniswap, one can already easily exchange between different blockchain projects.

However, it is also important to note that while DeFi will bring great convenience to finance across the meta-universe, at the same time, its potential risks are also significant. In reality, there have been cases where people have taken advantage of the design differences between different blockchain products to design arbitrage schemes using a combination of multiple DeFi products to blatantly siphon off large amounts of wealth. Precautions should be taken in advance for similar situations. Otherwise, there is a risk of a “cross-universe” financial risk if you are not careful.

9. Conclusions

Like the real world, the economic system is an important component of the virtual world of the metaverse. This paper provides an economic analysis of the economic system of the metaverse based on observations of existing mainstream metaverse projects and an understanding of the means that digital technology can provide.

Firstly, at the macro level, the author believes that because of the parallel existence of the real world and the meta-universe, the economic operation of the meta-universe has an additional virtual and real cycle than the real national economy, i.e. the economic interaction between the meta-universe and the real world, in addition to the inner and outer cycles. At the micro level, there are also some differences between the demand and supply behavior in the metaverse market and the real world. At the demand level, users’ utility is obtained not only from the functional, hedonic and social values of
virtual goods, but also from programmable values, while the necessity of material inputs for the production of virtual goods and the artificially created limits ensure the existence of scarcity. At the level of supply, the main actors of supply are mainly users or groups of users who collaborate on their own production, and the goods are mainly in the form of UGC products. The motives for supply include not only the economic motive of profit, but also the non-economic motive of gaining attention and praise.

Secondly, property and monetary systems are necessary and important in a metaverse economy. As blockchains are widely used in the digital world, decentralized property and monetary systems based on digital trust mechanisms are more widely used in the metaverse, in addition to centralized property and “fiat” systems similar to those in the real economy.

Finally, the currently operating metaverse projects basically do not show an outward loop across metaverse and an imaginary loop between the metaverse and the real economy, but this paper argues that as the metaverse projects mature and the number of intervening users increases, there is a basis for the formation of division of labor and transactions between different metaverse, wealth transfer and arbitrage between the metaverse and the real world to exist.

Of course, this article is a preliminary analysis and speculation on the economic system of the metaverse. A more in-depth and objective analysis needs to wait for further developments and innovations in the metaverse when key technologies mature.

Conflict of interest

The authors declare no conflict of interest.

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