

Virtual Currencies and Virtual Worlds
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by John Beezer

Early experiences with virtual worlds have shown that economic behavior is an integral part of social interaction in virtual worlds, and that virtual world economies exhibit the ability to spontaneously mimic fundamental characteristics of real-world economies.

The purpose of this discussion is to investigate the ways in which virtual economies compare to real ones. For example: what minimum conditions are necessary to support a virtual economy? How can transactions occur between virtual and real-world economies? In what ways are virtual economies different from real-world economies?

Observations of spontaneous economic behavior were first documented by Randy Farmer, the creator of LucasFilm's Habitat project, which was the first commercial networked virtual environment. Farmer described what he saw in Habitat in a paper entitled From Habitat to Global Cyberspace:

"Economies exist everywhere in Cyberspace. These economies provide a mechanism for the communities to flourish.

"Habitat has an internal economy, complete with play money called "tokens". Citizens are granted tokens for connecting, and as prizes for planned events. Tokens can be used to purchase items from vending machines. These items can also later be recycled for somewhat fewer tokens using pawn machines. But this interaction with machines isn't really enough to establish the Token's real value. The most important use of tokens in Habitat is for trade between players. Habitat customers actually use tokens to gamble with each other, along with buying special objects and publications (like poems and stories) from each other.

"Unfortunately, the Habitat economy is inflationary, as tokens are added to the system at a higher rate than they can be consumed by the supplied machines. After a little while, everyone has all the objects they want. Vending machines can make infinite numbers of the items on sale with no production costs. As a result, there is a secondary economy in the Habitats: heads.

"In Habitat the primary way to change your appearance is by changing your head. You can buy new styles of head from a vending machine in the local "Head Shop", or you might win a unique head in a contest sponsored by the

service administrator. After a while, everyone has a copy of any interesting but common head that may be available from the vending machines, and there is nothing left to buy except the special one-of-a-kind prize heads. As a result, these rare heads trade for hundreds of times the price of the others. Without a doubt, the dominant symbol of wealth and stature in Habitat is a large collection of unique heads, proudly on display in your virtual living room."

From Habitat to Global Cyberspace
F. Randall Farmer, Chip Morningstar, Douglas Crockford
Electric Communities

<http://www.communities.com/paper/hab2cybr.html>

Although these examples of economic behavior seem unusual compared to the economic reality we're accustomed to, it's easy to recognize common economic forces, such as inflation and market formation, at work.

What we tend to see in the Habitat example and in other virtual worlds are natural economic forces at work within unnatural economic contexts. But even though virtual worlds may be economically unnatural they do appear to readily support the expression of economic behavior. This suggests the goal of constructing virtual environments to be better models of economic reality. And it hints that a virtual world which accurately mimics the fundamental elements of real world economies might have the ability to function in the same way a conventional real world economy does—to create wealth.

Certainly it will be possible to perform virtual work within a virtual environment for virtual pay, or even invest successfully and gain virtual profits. But will it be possible to trade wealth gained in virtual environments for wealth in the real world?

If it is possible, what would such synthetic economies be like?

It is impossible at this stage to answer this question, but the best way to begin studying the expression of economic forces in virtual worlds is to create a model based as closely as possible on a simplified version of a real world economy. Consider a simple mercantile economy, encompassing many of the basic economic parameters we're accustomed to: markets, market infrastructure, price fluctuations, interest rates, banking and debt, government, trade, manufacturing, agriculture, etc. A mercantile economy is a good case study because it resembles modern economies without becoming too complex to simulate.

Here's a list of minimum conditions that I believe will support a recognizable virtual economy for study.

As a starting point, these conditions can be divided into three categories: technical, natural and cultural. Technical conditions refer to hardware, software and networking standards. Natural conditions are those conditions within the virtual world that make up its unchangeable state. Cultural conditions refer to the ways people interact with each other inside the virtual world.

A. Technical

1. Low-latency communication

Excessive transmission and processing delays hamper the social interaction that surrounds economic behavior. Ideal latencies will be under 250 ms.

2. Security

The ability to use external means to impersonate others, falsify transactions, counterfeit currency or steal possessions and evade authority will invalidate the model. Security features must be designed into the system from the outset.

3. Monitoring

All transactions within the virtual world will need to be recorded and indexed to allow for detailed analysis.

4. Behaviors

Behaviors are complex aggregates of simple actions formed around intentions expressed by individual participants. As an example, if I walk down the street in real life, I perform a series of complex actions including synchronized body movements and various navigational maneuvers such as stepping over curbs or making room for other people to pass. But essentially, the only conscious decision that I've made is the decision to walk down the street. In a virtual world that supports behaviors, only such high-level decisions are transmitted across the network. Client software then translates these relatively simple intentions into a more complex series of predictable actions based on the context in which they occur.

Behaviors are most necessary in virtual environments as a means for reducing network traffic and maintaining a consistent state throughout the system, but they're also necessary in a modeled economic environment in order to maintain an accurate accounting of economic activity. That's because if there are thousands of possible action sequences I can implement in order to buy a product in a virtual world, it becomes very difficult for the central computer to determine for certain that a transaction has occurred and what its terms were. When the act of purchasing is aggregated into a single context-sensitive behavior, the system can easily acknowledge what has occurred.

5. Consistent state

This principle is closely related to the concept of behaviors. Essentially, if one participant destroys an object, it's important that no other participant be allowed to use the same object a half second later. For each self-contained zone of a virtual world, a centralized computer must maintain an orthodox

version of reality which each client references before allowing behaviors that result in modifications.

B. Natural Conditions

These conditions are the necessary immutable facts of life so fundamental to real-world economic behavior that they must be carried over into the virtual world in order to accurately implement a modeled virtual economy.

1. Constraints on life

In a realistically modeled economy, humans should be subject to mortality. Fear of death is a prime economic motivator in the real world. In essence, an economic good can be defined as any product or service that prolongs life or protects life from hostile elements.

Authentic mortality should maintain two characteristics: it must be permanent and it must be aversive. It's pretty straightforward to make death permanent, but virtual death must be made unpleasant enough that real-world participants will not choose to treat it lightly. In an experimental modeled economy, it may be necessary to offer a real-world survival bonus to those participants who live through the simulation. (Or, in a commercial version, a "mortality deposit" may be required of participants.)

Preventing natural mortality must also involve recurring behaviors such as eating, sleeping and maintaining shelter. It's easy to see that these physiological requirements directly motivate the majority of fundamental economic activities that take place in the real world.

Finally, as in the real world, participants must be able to take each other's lives. The ability to kill must be maintained primarily so that economic authorities can be prevented from abusing power--in other words, some form of armed rebellion must be possible.

2. Constraints on activity

There are a number of unavoidable conditions in the real world that are not necessarily present in virtual worlds. For example, places in cyberspace are arbitrarily close--every web page is one click away from any other page on the web--but places in the real world have fixed distances between them.

Many of these real-world constraints affect economic behavior. Considered together, they're referred to as transaction costs. For example, physical goods manufactured in one location must necessarily become more expensive the further away they're shipped. Transaction costs are pervasive and they shape real-world economic activity as we currently know it.

Therefore, effortless teleportation cannot be allowed. Transporting large amounts of goods should be more difficult than transporting small amounts. In addition, objects shouldn't be instantly cloneable, some foods should spoil over time, tools should wear out with use, buildings should require maintenance.

3. Ability to manipulate and possess objects

Participants in a virtual economy must be able to take sole possession of human-scale, inanimate virtual objects and move, modify or destroy them whenever appropriate.

4. Economic abilities

There are several abilities or powers--particularly involving the production of goods and financial transactions--which are fundamental to real-world economic activity which must be implemented within a modeled economy.

Many of these activities are very complex in the real world and can only be modeled in virtual worlds by using behaviors. Also, as described above, it's important that the parameters and results of these behaviors be easily recognized and cataloged by the system.

a. Growing food. One of the most essential real-world economic abilities which must be translated to the virtual world is the ability to grow food. This is an important complement to the requirement listed above that participants need to eat, and it's worth elaborating on it in detail here.

First of all--expanding on the requirement that people must eat to live--it should also be necessary that people must eat a variety of foods to live and that various foods have varying abilities to sustain life. In other words, it's not only important that people must eat food, it's also important that there be a diversity of foods and that people have options in choosing the foods and combinations of foods they prefer. Second, with respect to growing foods, it's important that different areas of land are differently suited to growing various types of food.

There are a number of reasons for these two requirements. The simplest is that these conditions are closely related to the most fundamental aspects of economic activity--such as trade, consumption, the value of real estate, and market formation. By modeling these particular elements as closely as possible to the real world, we ensure that the basic building blocks of real-world economies will come into being. For example, if all land is equally suitable for growing all foods, then trade between distant locations will not develop and significant variations in the value of real estate will not exist.

Consider the following basic cycle of economic activity: individuals within a community each grow a few types of food, and then trade most of their product at market to gain money for other types of food or necessities which they don't produce; then they use the goods they traded for to survive and maintain the energy to grow more food. This simple cycle of behavior repeats endlessly, and is at the center of all real-world economies.

Once this fundamental cycle is initiated, other basic economic institutions can be derived from it. For example, the value of various foods in the market will determine the value of the parcels of land which produced them. And since

this cycle generates predictable income streams from fixed assets, loans, payments and collateral come into existence and financial markets can form.

b. Manufacturing. In addition to growing crops, it must be possible to acquire raw materials and apply behaviors to them in order to assemble manufactured items. These items fall into three broad categories: shelter, tools and infrastructure.

Shelter should be a necessity, much like food, meaning that people will die of exposure if they go without it for too long. There must be a class of behaviors by which shelter can be constructed from simple found elements.

Tools are items whose possession can improve the performance of basic behaviors. Tools can also be used with other tools to enhance their performance. There must be some basic tools that exist naturally, but it must also be possible to manufacture tools in novel ways and for these ways to be discovered by trial and error. This will give rise to economic expansion and the development of industry.

Infrastructure items such as defensive barriers, roads, and land and sea transportation are similar to tools except that building them requires large amounts of concerted effort by groups of people. Money will need to be invested in order to pay people to commit time, and therefore a financial market must exist before they can be created. As described above, financial markets will emerge from real estate markets.

As the transportation infrastructure expands, then importing, exporting and further market growth can develop.

c. Transactions. Finally, a set of behaviors must be specifically implemented for all commercial transactions (buy, sell, loan, notarize), for accounting reasons which have been mentioned above.

5. Communication

Markets are information exchanges. And for markets to function, information must be communicated. There are four broad classes of communication that will need to be supported:

One-to-one communication is straightforward. It refers to direct communication between two individuals in close proximity.

One-to-many communication refers to the ability of one person to communicate to a group of people at one time in close proximity.

Written communication refers to messages that can be transported and which remain accessible after they have been originated. This includes contracts, ledgers, posters and mail.

Publishing is the ability to replicate written communication and distribute multiple copies of it over a wide area.

6. Authentication

Individuals must be able to recognize other individuals with a high degree of certainty. Currency and communication from economic authorities must also be verifiable with a high degree of certainty. There will need to be behaviors to reliably perform these verifications.

C. Cultural

In the real world, economies exist within a cultural context. It's necessary to support the formation of basic elements of culture within virtual worlds in order for a realistic economy to emerge. While most of the cultural context within virtual worlds is either carried over from the real world by the participants themselves (i.e. language, manners, conventions), or spontaneously developed over time within the virtual world by a consensus of the participants, some of the basic foundations of culture must be instituted by the world developers in order for a realistic modeled economy to form.

1. Initiation

People don't enter the real world knowing everything about it. For an accurately modeled virtual environment to exist, its interface must support a complex set of behaviors. And since there's no practical way to make the real-world interface to these behaviors entirely intuitive, participants will need to learn and practice them before they're able to apply them successfully.

If participants are forced to enter into full participation in a virtual world and learn to use the interface as they go, they will not be able to act as a true parallel to a real-world citizen. In the extreme case, if a new participant has difficulty figuring out how to eat food or acquire shelter, they might unfairly die in the virtual world as a result of problems encountered with the real-world interface.

New participants in a virtual world should literally be treated as infants. There should be a separate half-way environment where beginners gain experience in performing the basic activities of the virtual world such as navigating and communicating. They should enter the virtual world only when they are comfortable executing basic behaviors.

2. History and traditions

During the training period, beginners must learn to avoid communicating about the real world within the virtual world. When entering a virtual world, discussion topics that would ordinarily be of interest in the real world should be discouraged and replaced by issues of interest in the virtual world. While participants are learning how to use their interface to the virtual world, they should also be educated about customs and current events in the world they're about to enter.

3. Currency

One of the most interesting features of an experimental modeled economy will be the way participants choose to govern themselves--so they should be

allowed as much freedom as possible to develop their own forms of government.

The one exception is the establishment of currency. Currency needs to fulfill a number of specific technical requirements and must therefore be hardwired into the system. Primarily, as described above, it must be recognizable with a high degree of certainty, it must be very difficult or impossible to counterfeit and it must be easily tracked and monitored by the system developers.

4. Market infrastructure

As with the development of government, it will be interesting to see how participants spontaneously assemble infrastructure elements such as roads and marketplaces. However, in order to successfully jumpstart an economy, it will be necessary to build in the underpinnings of market infrastructure. A small number of roadways connecting small amounts of freely available food and natural resources, plus crude shelters and gathering places should be present from the beginning.

Once such a virtual economy is created, how can we study it?

For the sake of realistic modeling, authority to manage the currency must be entrusted to a politically accountable participant or committee of participants within the simulation. For realistic modeling, other participants in the simulation must be allowed to freely vote down or overthrow the authority, so the system administrators will not be in a position to protect or punish the fiscal authority.

The fiscal authority's ability to generate new currency must be restricted or modified by the system administrators without the need for them to interfere directly with decisions made by the authority. The best method for doing this will be to control the supply of a precious mineral on which the currency is based.

With these considerations in mind, the following section outlines nine basic economic variables that can be used to monitor and control virtual economies.

A. Dependent variables

Although most, if not all, economic variables may conceivably be manipulated by the system managers, there are a few that can't be directly controlled and a few more which probably shouldn't be externally controlled due to the disruption it would cause to the simulation. These variables are therefore defined as dependent variables—ones that are more easily monitored than directly altered by the system managers.

1. Prices

Unlike the real world, price levels in the virtual world can be accurately gauged and a wide variety of inflation rates can be derived from these figures. Prices cannot be directly manipulated by the system managers since prices are heavily determined by the combined attitudes of large numbers of

participants. Prices can be manipulated indirectly by changes in productivity and currency supply.

2. Spending

Again, like prices, aggregate spending can be easily monitored, but not so easily controlled. Indirectly, spending can be controlled by manipulation of the currency supply.

3. Debt

The creation of debt will expand the money supply in a virtual world the same way it does in the real world. As in the real world, this sort of economic activity is a grass roots effect--reflecting the innovation and confidence of investors and the surplus supply of currency. Debt level is a variable that should be closely studied, but not a variable that can be or should be directly controlled.

4. Tax rate

Tax rates are politically determined and cannot be directly manipulated by the system managers without intervening in the virtual world political process. This is possible, but generally not desirable.

5. Poverty rate

In real-world economics, the poverty rate is defined as a percentage of average income. For example, the poverty level is said to be anything below an income of x dollars a year and by definition a certain fixed percentage of the population will fall below it at all times. As such, it functions as an arbitrary indicator of economic status, but it does not necessarily indicate whether a person is receiving adequate resources to survive.

In the virtual world however, it will always be possible to know at any given time what financial resources the participants have, how well nourished and sheltered they are and what their earnings are.

In contrast to this, employment will be a much harder thing to quantify in the virtual world since employment cannot be a hard wired behavior--there must be room for innovation in the meaning of employment.

So the poverty rate derived from a virtual economy will substitute for the concept of the unemployment rate in the real world--essentially it will function as a misery index.

6. Interest rates.

Interest rates will be set by the financial markets and cannot be directly manipulated by outside intervention. They can be indirectly impacted both by the internal fiscal authority and by the system managers through manipulation of production and currency supply.

B. Independent variables

Independent variables can be directly influenced by the system managers without overtly disrupting the simulation. These will be the primary control

mechanisms by which experimental conditions can be imposed upon a virtual economy.

1. Currency

Cash in a virtual world can be created two ways: it can be distributed to participants either by the system managers or by the internal fiscal authorities. Participants will need to be given a fixed amount--determined by the system managers--to begin the game. As described above, the system managers should have the power to restrict the fiscal authority's ability to create and distribute new currency by managing the supply of a precious mineral which forms the currency base.

2. Production

Precise production figures will be available in real-time for every class of good that exists in the virtual world, including tools as they're discovered and enter into the economic picture. It will be possible for the system managers to indirectly control productivity by altering such things as the supply of raw materials, or the favorable nature of the climate relating to various crops. In extreme cases, the system managers should have the ability to arbitrarily create or eliminate large numbers of goods in order to study the effects of economic shock, though this type of experiment could be disruptive to the model.

3. Population

By controlling the number of participants in the simulation, the system managers simultaneously control the growth in aggregate demand and the supply of labor.

4. Exchange rate

This is the most interesting economic variable in virtual economies. It's defined in the same way that the exchange rate is defined between any two real-world currencies--except that one of the currencies is virtual.

The idea that there can be an exchange rate between a virtual currency and a real one is related to the concept of the mortality deposit. As described earlier, in order to make virtual death sufficiently aversive, participants must be required to pay a real-world mortality deposit which is forfeit upon the event of virtual death. Involvement in the simulation can be further motivated by correlating the real-world value of the mortality deposit to the amount of virtual currency each participant possesses.

This will require the system managers to set an exchange rate between virtual currency and real-world currency. This rate will fluctuate based on a variety of factors including the ratio of people entering and leaving the game, the amount of death that occurs in the virtual world, the size of increases in the money supply and debt within the game, and the real-world cash reserves of the system managers. The ratio of people entering and leaving the simulation will be the main variable that drives a market in virtual currency.

Whether the virtual exchange market is capable of generating significant real-world wealth will be among the most fascinating of several questions to be answered.