Monetary Velocity in a Systemic Perspective: An Approach Towards More Accurate Currency Thinking[1]

Jens Martignoni*

Summary:

The concept of velocity of money also called velocity of circulation of money is part of the Quantity Theory of Money. One intention of this concept has been to connect price-based equilibrium theories (where money is de facto left out) to money. The idea was a variable velocity, which describes how fast the existing money (thought in pieces of gold or in bills) would circulate. To question it allows an insight into the paradigmatic base in economic thinking and leads to a different approach of the flow of money, which might help to better shape the task of money in today's economy.

The author tries to reconsider the "velocity-idea" by considering very carefully the real money-flow-phenomena in a simple small-scale complementary currency. By changing from a market-centred-view to a money-centred-view it is his aim to focus on the construction of currency. The reciprocal quality of currency and the time bound qualities of payment are described and the money supply is defined. By a time slice method the dynamic money-flow phenomena can be visualized. The results are then merged into the velocity-equation and discussed again.

This systemic approach allows a more accurate view on monetary flow phenomena of closed systems. Such a systemic approach could be further elaborated and might open some new perspectives for the understanding or simulation of monetary economies.

Key words: Monetary Theory / Social and Complementary Monetary System / Mutual Credit

JEL Classification: E42, E51, P49

1. Introduction

Today we have become used to the fact that one special type of currency[2], which I would call the *state based private*

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[2] The terms *money* and *currency* were used sometimes quasi synonymously in this article. As far as it was possible or helpful the following distinction was made: The term *money* was used as a more general or abstract description of the phenomenon. The term currency was used as a more specific technical or systemic description of practical forms of money.

[3] A compound-idea of the money system was suggested by Walter Eucken. He described money as tangible goods (becoming coins later), delivery of goods (obligations) and credits by trusted authorities (banks, state) and saw today's money as a clipped compound, see Eucken, 1941, pp.142-147

bank money or in short *the existing money-system - "tems"*, has succeeded in becoming the absolutely dominant or *monopoly money*. Whether it is called Dollar, Pound, Yen Swiss Franc or Lev, it is acually of the same construction. The Euro might be slightly different because it is supranational, but the differences are very small and moreover seem not to be in its favour as a stable and wealth-preserving instrument. So most of the time we talk about money, we think in fact only of one type of currency, the actual monopoly money and the features it has. We are rarely aware that we do not reflect on its construction. In fact, *tems* is a bundled type consisting of at least three components: Coins or minted money, bills and paper money. Other distinctions are possible and have been already suggested by economists[3]. Most of them try to describe existing topics of money or currencies, but rarely do economists care about the *construction of currency,* respectively *the design criteria of a currency* and maybe some would protest against an approach like this, which tries to highlight some crucial features of construction. Rather do most existing theories about money take the technical details of currencies as a somehow intangible or historically developed prerequisite and start with questions about the market. Then money appears in this market as a medium of exchange, a store of value and a unit of account. In this sense money becomes a very fascinating phenomenon popping out of history. This mystery has inspired hundreds of highly distinguished scientists to write about it, but until today it remained indistinctive, something neutral or even insignificant in economics.

Another main reason for that inexplicability might be the vast scope of the money-system. Many millions of users and therefore many billions of transactions every year had to be registered in society, as early as the beginning of economic science in the 18th century. From this sheer quantity and without the initial possibility of highly developed computing like the one today, reductionist methods had to be developed to at least get a glimpse at everything that was happening in the money system. Further reasons of ignoring the currency design might be the trade or market-centred view of most economists and the strong metallism or believe in money as a commodity in the past which continues to mislead not only scientists but especially politicians even today.

Nowadays the already highly developed money system has become even bigger and more complicated and so the initial assumptions have never been reviewed successfully since. By reconsidering the above mentioned issues the author tries to find out more about money's background. Therefore the research was based on the following premises:

1. Reduce the size and complexity of the money-system to make a better overview
2. Leave the market-centred view and focus on currency construction
3. Take a strictly nominal view of money

This did not have to be a reductionist and abstract theoretical method but has already become a reality through the introduction of alternative money, also called complementary currency. Through experiments made by practitioners, many such currencies started as a greenfield development during the last decades without many preconceptions about money. In fact many of these experiments revealed some very interesting topics about money particularly because they fullfill the above three points. The study of such alternative currencies or the development of new models allows a much deeper insight in the basic ideas behind money. This was a starting point of the author's research into small monetary systems during the past years.

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In this paper the author tries to reconsider the "velocity-idea" of money by looking very carefully at the real money-flow-phenomena in a small model-complementary-currency. To be successful in this, some unorthodox basic steps in defining the systemic circumstances had to be taken. Thus the article provides a bit of a different view on money. It does not pretend to provide conclusive information and many important views in the monetary discussion are not yet referenced. So its approach has to be further developed but still might be an incentive as to how monetary theory could be improved with the help of studying small-scale currency-systems.

2. The velocity-idea

One task in the general approach to past economic science was based on the idea of finding natural laws and mathematizing them in elementary formulas and terms. The idea was presumably strongly influenced by the very successful natural sciences, particularly physics. At the end of the nineteenth century the concept of the velocity of money, also called velocity of circulation of money was reintroduced by scholars. The idea was a variable velocity which should describe how fast the existing money (thought in pieces of gold or in bills) would circulate and which should serve as an indicator of fluctuating prices.

2.1 Preparatory steps

To prepare the further remarks we first take a look at the physical definitions of velocity. The simplest form of velocity in physics, the rapidity of motion is more precisely called speed:

$$v = \frac{s}{t} \qquad (1)$$

v speed in meters per second
s distance travelled in meters
t time used in seconds

Speed is a scalar quantity that refers to "how fast an object is moving." Velocity in contrast is a vector quantity that refers to "the rate at and the direction in which an object changes its position."

$$\vec{v} = \frac{\Delta \vec{s}}{\Delta t} \qquad (2)$$

v velocity in meters per second (vector)
Δs displacement in meters (vector)
Δt time used in seconds

Let us consider it into greater depth and get one step further to the instantaneous velocity.

We can express the instantaneous velocity of an object or a particle, at any particular time *t*, as the derivative of the position with respect to time:

$$v = \lim_{t \to 0} \frac{x}{t} = \frac{dx}{dt} \qquad (3)$$

This is true if $v = f(x)$ is a function which is differentiable at every point. Just to keep in mind that many functions are not differentiable:

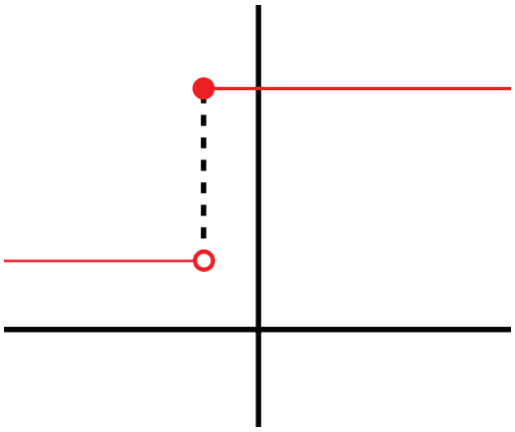

Fig. 1: Jump Function
Source: General scheme adapted by author

The function in Figure 1 does not have a derivative at the marked point, as the

function is not continuous there (it has a jump discontinuity). Later on we will reference differentiability in the case of money "velocity".

2.2 Quantity Theory of Money

Much of the first economic thought was targeting markets, work and trade phenomena. Especially the price and value topics were carefully examined[4]. Money therefore was considered as a neutral mirror of values. But apart from that it was difficult to explain the purchasing power of money and its effects like inflation, when expansion of the volume of money influences prices. So there had to be found a connection between prices and money to connect price-based equilibrium theories (where money is de facto left out) back to money. The first ideas of a quantity theory of money (QTM) were already discussed by Davanzati,(1588) and later Locke, Hume and Cantillon. All their findings were developed further in the 20th century by economists like Schumpeter and others and became today's "canonical form"[5] by Irving Fisher 1911[6]:

$$MV_T = PT \tag{4}$$

It is also called Fisher identity, because Fisher already mentioned that the equation might better be seen as an identity[7]

M total nominal account of money in circulation (money supply) in currency units

V_T velocity of money for all transactions in a given timeframe

P the price level

T the volume of transactions of goods and services

The velocity is then calculated by transforming the equation as follows:

$$V_T = \frac{PT}{M} \tag{5}$$

The equation looks very simple but integrates some quite fancy considerations:

The price level P for example is a largely abstract value which had to be filtered out of the total amount of all transactions by dividing it by something like an artificial "number of pieces sold" (T) which might become especially difficult when these are mixed product prices, service hours or packet-prices, etc. So it was obviously necessary to take the whole turnover or the total nominal amount of transactions in currency units per period instead, e.g. the GDP of the country. This transforms the equation into:

Velocity of Circulation = Total Spending in a given timeframe (S_T) divided by Amount of Money in circulation (M)

$$V_T = \frac{S_T}{M} \tag{6}$$

This seems a meaningful equation but it has already lost its link to prices and therefore to values of goods and services. Instead we see S_T the aggregated transactions in money-units per time.

So the velocity V_T becomes a measure for the *intensity of the use of money* or *use rate of money* instead, but remains a kind of fuzzy and indirect parameter because "the use of money" itself is not really defined but points back to the price and purchasing problem without really solving anything.

[4] e.g. by Adam Smith2007, p.26: *In order to investigate the principles which regulate the exchangeable value of commodities, I shall endeavour to show, First, what is the real measure of this exchangeable value; or, wherein consists the real price of all commodities, Secondly, what are the different parts of which this real price is com-posed or made up.[5] A compound-idea of the m*

[5] see Paul, 2012, p.114

[6] Fisher, 1912, p.24

[7] John Munro, Prof. at the Department of Economics, University of Toronto remarks: **This is more of an identity () or tautology than it is a causal equation:** it simply states that total spending, in terms of the money stock multiplied by the rate of its turnover or circulation, necessarily equals total spending in terms of the total volume of monetary transactions multiplied by the current price index. The two values on each side of the sign are necessarily identical https://www.economics.utoronto.ca/wwwfiles/archives/munro5/QUANTHR2.htm

So we arrive at a point where many other economists had already been and reflected on the inherent problems of the concepts of the quantity theory of money[8] and the velocity of money. Here we will not go again into the long history of the discussion but prepare for a different approach which will allow us to question the money supply and the velocity of this equation.

2.3 Taking a currency-centred view

As already mentioned: Economists usually take a market- or price-centred view to describe the economy and money and its role therein. The equilibrium theory, for example, tries to give an understanding of the whole economy using a "bottom-up" approach, starting with individual markets and agents.

If we want to understand the functioning of money, these approaches are not very useful because it always brings in the topic of value by the price. At that point money has to be preconsidered to realize this price, otherwise it would not be a real price. By realizing the price, money and value unite for a while. As interesting this might be, it is distracting from the construction of the used money itself. Value is a strongly fluctuating thing, tightly bound to human needs, thoughts or guesses. To avoid this difficult area a money-centred (or better currency-centred) view is proposed here. In fact, this is nothing new and such a distinction was proposed by Adam Smith (2007, p.224) where he remarked:

When, by any particular sum of money, we mean not only to express the amount of the metal pieces of which it is composed, but to include in its signification some obscure reference to the goods which can be had in exchange for them, the wealth or revenue which it in this case denotes is equal only to one of the two values which are thus intimated somewhat ambiguously by the same word, and to the latter more properly than to the former, to money's worth more properly than to the money.

If we consider Smith's words seriously and distinguish money (counting side) from money's value or purchasing power (value side), the following model is suggested:

A discussion of the value side is not the aim of this article. Instead we will focus on the counting side, the "mechanical part" of money,

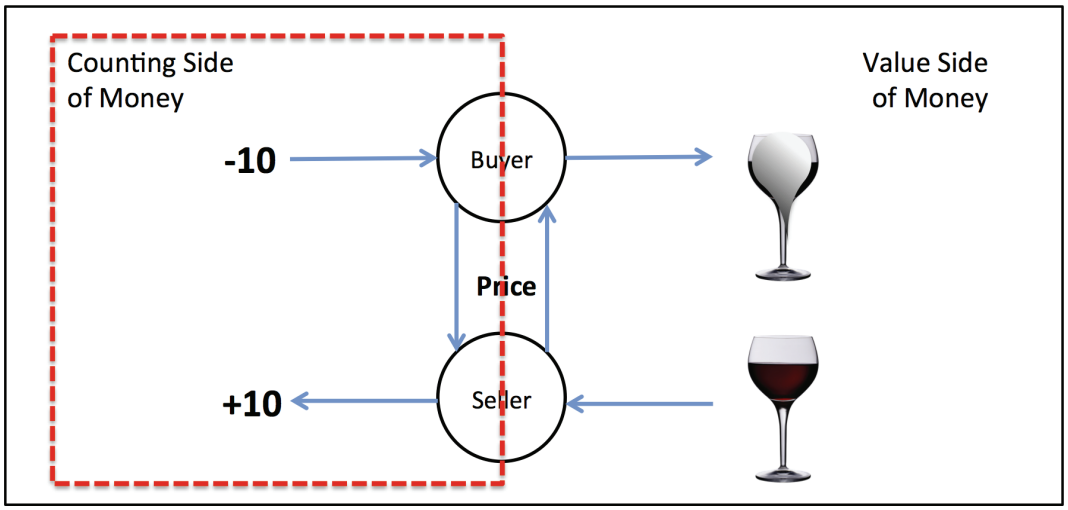

Fig. 2: Counting side of money as separate system to be handled

Source: Scheme by author

[8] e.G. Stadermann 2002, p.111-121

which appears to be very simple at first sight, but is probably not. This side seems to be only rigid and boring accounting but strangely enough it is not well recognized to be an optimal starting area to study money and its basic principles. It is usually taken for granted that using simple mathematics can treat the left side. But there are as far as we could see no mathematical definitions of the borders and assumptions of accounting operations. A sincere definition of accounting suggested more than hundred years ago by Duncan (1909, p. 84) says: *"Accounting is that science which treats the methods of recording transactions in business, and interprets the statements recorded in books and documents so that the layman may have a clear conception of the exact financial and managerial standing of the firm or enter- price both in parts and as a whole."* Here the use of mathematics is not even mentioned nor the presumption of money reflected. One more weak link are the exact explanations how the above two sides are connected and what interconnecting operations exist.

There has been such an approach to The Stock-Flow consistent model (SFC) of Copeland/ Tobin that is very interesting and the idea discussed here takes the same direction[9]. The main difference lies in the fact that SFC remains in the approach to explain the whole economy (value side) and just use the counting side as given and mathematically working, without first questioning or discussing the rules of that side.

Such a distinction between the two sides or a hybrid personality of money seems to be quite logical and might itself help to clarify functions and appearances of money or currencies. The research is continuing and might allow to present results at a later stage.

3. A Systemic approach

The advantage of a complementary currency concept is to be able to demonstrate the really systemic side of a currency because it can be defined from the bottom and it is very small compared to the real economies *tems*. By focusing on the construction of the system and by being aware that it might be better first to understand and adapt the characteristics of the system, we have a reversed view on economics: Currency therefore is seen as an operating system of the economy. It has to be designed optimally to serve the economic processes and therefore should be stable, bug-free and tested, to use an analogy from the IT-world.

3.1 Currency as a closed system

If we could demonstrate that a specific complementary currency scheme could be seen as a closed system, the determination of such a thing as "velocity" should be much easier.

Centralized models make it easier to state the unity or closeness of a currency-model but in fact it would be an interesting question if a non-closed currency ever was intended and what it would look like.

This approach was also selected by the theory of money emission (TME) developed in Dijon (F) and Fribourg (CH) under Bernard Schmitt (Rossi 2008, p.121). "Money is conceived as a purely numerical thing, namely a double-entry record in a bank's bookkeeping" (Rossi 2008, p.122) but the concept is then transferred straight to the existing economy and the problem of production, which complicates it again.

To make it easy we stick to accounting and start with a simple LETS[10]-model. LETS is usually pure book money. There is a central authority ("bank") which is doing the bookkeeping but should not be involved any further. The basic rules are:

- Every participant has exactly one account
- At the beginning everybody starts from zero, with the possibility to overdraw to a certain credit-limit.
- In the most basic version, the credit-limit shall be the same for each account

[9] see also Caverzasi/Godin, 2013

[10] LETS: Local Exchange Trading System, developed by Michael Linton 1983 in Canada, see Kennedy et. al., 2012, XXXX

- Every payment has to be registered or booked to become valid
- The sum of all accounts is always zero
- At the beginning there are no taxes or payment fees

The system described above is closed. If a first payment comes, the sum is drawn from the buyer's account and added to the seller's account. The buyer now is as much in the negative as the seller in the positive. For the following elaboration we assume an exemplary LET-System as a closed "economy" with 12 participants:

In this system a payment of 100 units from A (buyer) to G (seller) looks like this:

The simple accounting presented is really meant to be technically like the handling of bits and bytes in information technology (IT). This is not fully in accordance with usual accounting structures[11] because it does not (yet) consider the value side of currency.

3.2 Reciprocal quality of currency

The "money" in the above system appears as a symmetrical, reciprocal operation and in fact this is one basic feature of a currency, but is seldom recognized. It is true for every type of currency or money for the moment of payment but also like in debts and wealth. Here we confine ourselves to payments only:

- One party has to give the money, meaning it is subtracted from its wallet, account, wealth or maybe future (in case of a cheque or bill)
- The other party has to receive the money, meaning it is added to its wallet, account, wealth or store

3.3 Time-related quality of payments

Another very important feature of money as payment is time. The transfer of the payment from one account to the other in the LETS example will be quasi-simultaneous, only restricted by the computing velocity of the used

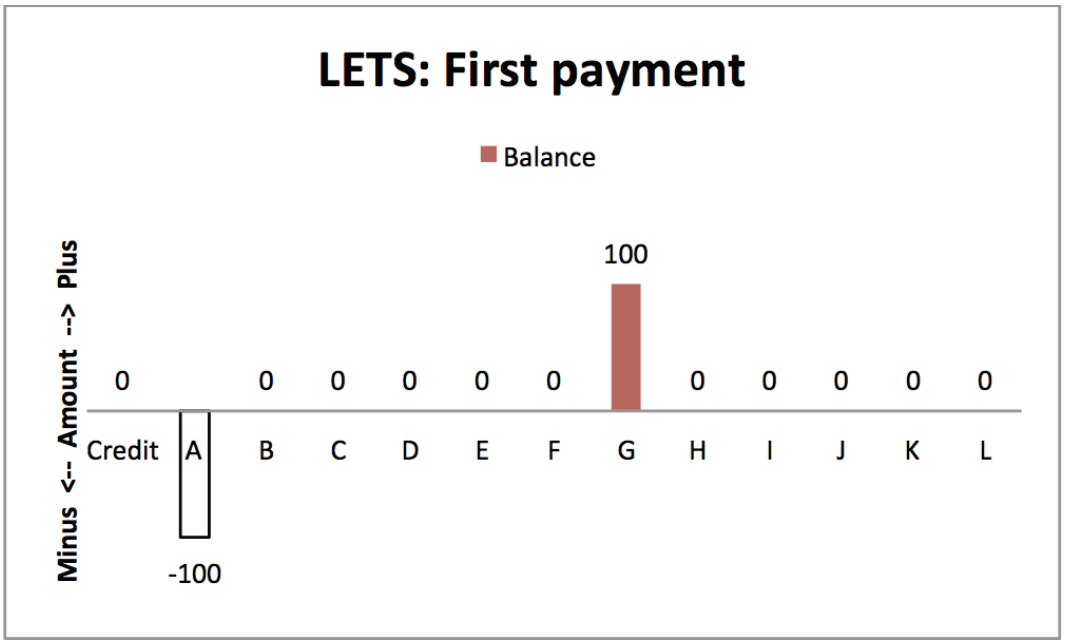

Fig. 3. First payment in a 12 members LETS system
Source: Display of exemplary data by author

[11] see Hughton Budd, 2015, p.6

PC. Subtraction from one account and addition to the other account are therefore assumed as instant (quasi timeless)[12] validation. The second important notion is: the time *when* this operation is made is crucial and has to be identified.

The immediate transfer is the ideal and systemically optimal version. In such a case of a closed system the total money supply is stable and remains constant. Should there be time gaps between payment and receipt of payment (or vice versa in case of some types of credits), this would change the system and it would have to be examined if it could be still taken as a closed system.

To conclude it in terms of a systemic principle:

Currency in a closed system appears in a strictly reciprocal operation between two parties when at a given time a certain number of units is subtracted at one side and added to the other side.

3.4 Currency supply (Money Supply)

Now we will have a look at the currency supply of such a LETS-system where we have accounts with overdraft facility up to a specified credit limit. The maximum potential (i.e. money supply) of such a LETS model-system could be calculated easily by:

$$M_{\max} = \sum_{i=1}^{n} (A_B + C_L)_i \qquad (7)$$

M_{max}: maximum possible money supply (units)
A_B: Account Balance (units)
C_L: Credit-Limit (units)
$A_B + C_L$ could also be seen as the *capacity* of the certain account

In our 12-member system with a given credit limit of 100 units for all accounts, the calculation for the initial situation (all accounts starting from zero) would be as follows:

$$M_{\max} = \sum_{i=1}^{12} (0+100)_i = 1'200 units \qquad (8)$$

This maximum money supply equals the maximum potential of the system for money transfer at a given time. This means the potential of transfer of the maximum sum of units (payment) per account, i.e. every owner of an account would spend the maximum amount he is allowed at the same time. If executed it might look like this:

The maximum money supply could also be seen as *the maximum imbalance* of the system.

As we already defined payment as an operation which simultaneously and reciprocally subtracts a certain number of units from one account (buyer) and adds it to another account (seller), the operation *payment* could be formalized as follows:

$$p_i : (a_i : k_m \Rightarrow k_n)_{T_x} \qquad (9)$$

p_i: defined payment (operation-identifier)
a_i: amount of transfer (number of units)
k_i: accounts between which the reciprocal operation is carried out
=>: Direction of transfer (buyer=>seller)
T_x: Time of execution of the payment

In the example shown in Figure 4, the array of operations for the execution at the given time T_x is as follows:

Table 1: Array of maximum payments at a time in a 12-members LETS system

p_i	a_i	k_m	k_n
1	100	A	L
2	100	B	L
3	100	C	L
4	100	D	L
5	100	E	L
6	100	F	L
7	100	G	L
8	100	H	L
9	100	I	L
10	100	J	L
11	100	K	L
12	100	L	K

Source: Sample of generic data by author

[12] This was also set as a definition of cash flow by Stuetzel, see „Gleichzeitigkeit von Buchung und Gegenbuchung", Stuetzel, W., 1978, p.57f.

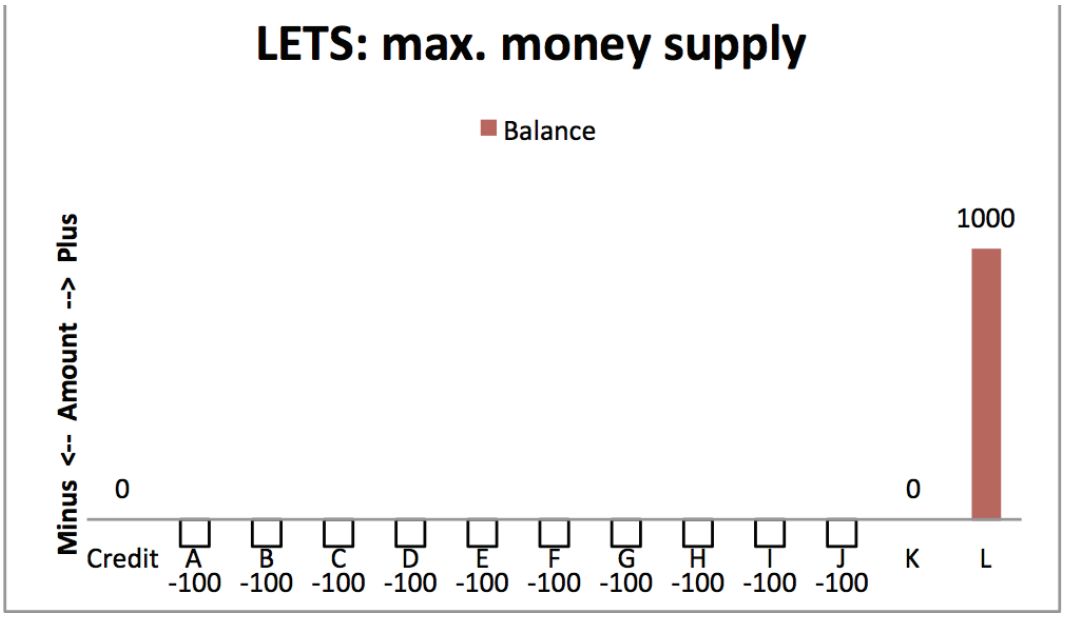

Fig. 4: Example of maximum money supply executed in a 12-members LETS system
Source: Display of exemplary data by author

This was a look at the situation in a closed money-system at a certain time. At such a time it is possible to calculate a maximum money supply. It is not yet possible to talk about velocity, because this needs an on-going period of time. But it is possible to see that the real amount of units used to pay at any time has to be lower than the maximum money supply at the same time:

$$(A)_{T_x} = \sum_{i=1}^{n} (a_i)_{T_x} \leq (M_{\max})_{T_x} \quad (10)$$

The same idea of reducing a currency to its payments was used by Greco (2009, pp. 130-135 and) with a main focus on clearing but with a different notion on money supply as being the extent of the outstanding accumulated credit in the system. But the money supply has to be the potential money in the system not only the used part of credits as can be more easily seen in cash based systems. Nevertheless, Grecos credit clearing ideas provide solid grounds for tackling basic money phenomena.

4. *Dynamic money-flow phenomena*

To talk about money-flow and maybe get our velocity out somewhere, we have to enhance the simple model. Until now we did not really consider that the payments take place at different times. Let's first take a simple version, when the payments are made one after another.

Table 2: Example of accounts and timeslices of 5 single payments in time in a 12-members LET-System

Person	t1	t2	t3	t4	t5
Cassa	0	0	0	0	0
A	20	0	0	0	0
B	-20	0	0	0	0
C	0	0	0	0	0
D	0	-50	0	0	0
E	0	50	0	-20	0
F	0	0	-30	0	0
G	0	0	0	0	0
H	0	0	0	0	60
I	0	0	30	0	0
J	0	0	0	0	0
K	0	0	0	20	0
L	0	0	0	0	-60

Source: Exemplary data by author

The above data in a graphic form by timeline:

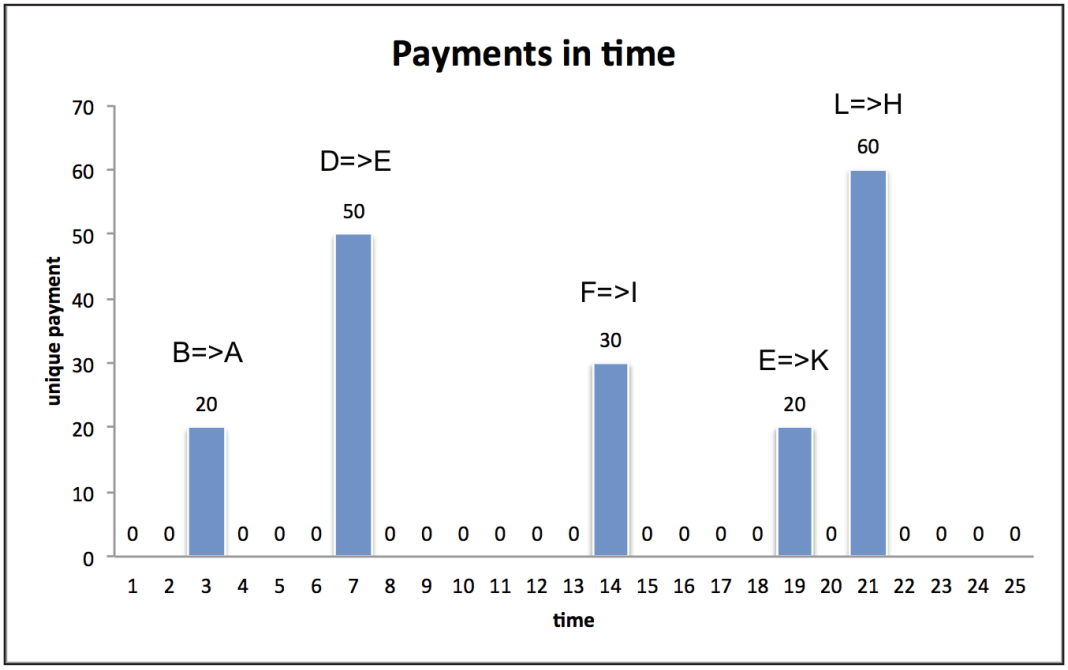

Fig. 5: Display of 5 single payments in time in a 12-members LET-System (two dimensions)
Source: Display of exemplary data by author

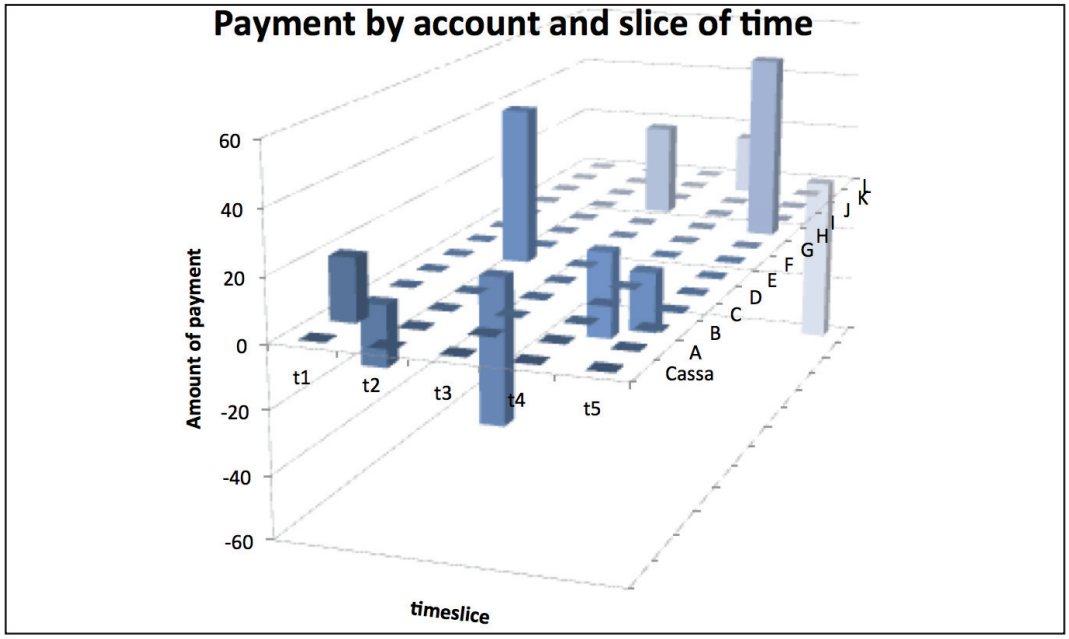

Fig. 6: Display of 5 single payments in time in a 12 members LET-System (three dimensions)
Source: Source: Display of exemplary data by author

Obviously each payment is made at a certain time and needs a certain slice of time[13]. If two were at the same time, additional rules had to be set to define how the paying would be processed[14].

An important point is that the validation of the payment shall be separated from the execution. The validation means the point where the buyer loses his ownership of the amount and the seller gains his. The method that is inherently present and is mostly used to guarantee the uniqueness of an amount of (especially electronic) money is basically the time-rate or slice of time method.

Usually we are used to a sequential, one after another, payment like at the supermarket cashdesk, but as more complex distribution systems like the clearing of banks or especially high frequency trade systems show, it needs a clocking system to be able to determine valid bookings.

To demonstrate this, the payments in Figure 5 are taken first into a 5'clocks slice of time grid. The second additional feature is to show the accounts and their real changes. Every payment needs a bidirectional operation on the two involved accounts. The plus at the sellers and the minus at the buyers, of the same amount of course

Now we have a real picture of "the money-flow" and see that it is not a flow at all but a sequence of impulse-like happenings in a matrix[15]. At the next step we not only look at the payments but also at the resulting balances of the accounts. The above 5 payments would produce the following accumulated balances during time:

Table 3: Resulting balances of the accounts per timeslice

Person	t1	t2	t3	t4
Cassa	0	0	0	0
A	20	20	20	20
B	-20	-20	-20	-20
C	0	0	0	0
D	0	-50	-50	-50
E	0	50	50	30
F	0	0	-30	-30
G	0	0	0	0
H	0	0	0	0
I	0	0	30	30
J	0	0	0	0
K	0	0	0	20
L	0	0	0	0

Source: Exemplary data by author

In the following picture with the above balance of the accounts for each slice of time it is much more difficult to see the changes even if all balances start from zero. But in a movie-like step by step slide-show it can be seen easily how the evolution of the balances advanced over time.

As we can clearly see in Figure 5 and 6 the payments occur as time bound "jumping" events. Every certain payment is limited by the boundaries of the "buyers" account. All payments of the same slice of time are limited by the "maximum money supply" of the same slice of time. If we want to calculate the "monetary velocity" the same way it is done in QTM but respecting the slice of time, then we would have:

$$V_T = \frac{S_T}{M} = \sum_{T_x=1}^{T} \frac{(A)_{T_x}}{(M_{\max})_{T_x}} \qquad (11)$$

This is the sum of all payments made divided by the maximum possible money supply at each timeslice and shows how the potential of existing money is transferred "into action", meaning payments in a certain time.

[13] *Precision regarding time: A model of short-run determination of macro-economic activity necessarily refers to a slice of time. It is one step of a dynamic sequence, not a repetitive equilibrium into which the economy settles.* Tobin, 1981, p.13

[14] Take a situation where at one and the same time A has 100 credit and shall pay 150 to B and B has also 100 credit and shall pay 50 to A. Sequentially processed it would only work if first B pays, then A. Done by a clearing process only one booking of the difference is made. So what will happen is dependent on the rules (configuration) of the syste,.

[15] The blockchain technology uses such an approach to register all payments.

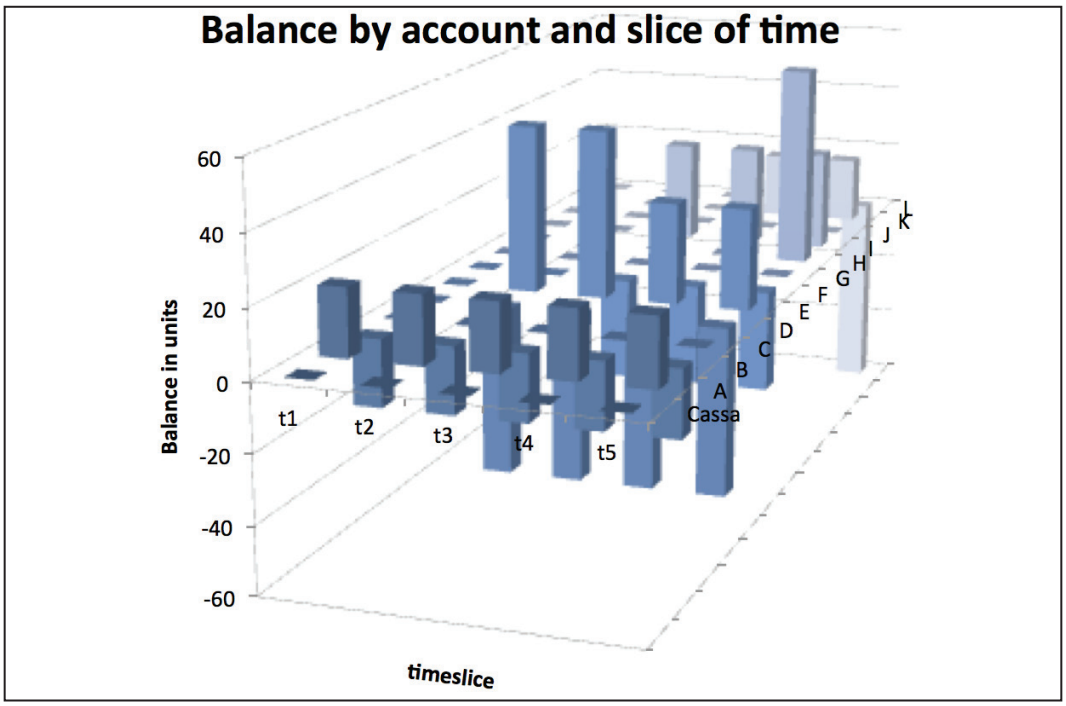

Fig. 7. Resulting balances of the accounts per timeslice in a 12-members LETS system (three dimensions)
Source: Display of exemplary data by author

5. Discussion

What about the "monetary velocity" after describing these steps? Isn't it still the same? The result might look the same at the end but two mayor differences were pointed out:

1. We demonstrated that we do not have a continuous mathematical function of the payments that would be differentiable at every point, but we have a disruptive function which is not differentiable at any point.
2. We demonstrated that payments are time bound and could only be processed in certain time steps.
3. We demonstrated that payments are dependent on the buyer's actual account balance.

It could be shown that the velocity does not actually resemble physical velocity and the variable V_T should better be called *intensity of use* or *use rate of money*.

Additionally, we defined the maximum money supply as the potential of how much spending would be possible at a certain time. This comes close to the definition of M1 the most central/national banks[16] are using but is much more basic and seems to be more accurate in its logic. This is true if not only our exemplary complementary currency but also today's *tems*-money would be a closed system. Further it could be shown that there must be a connection between actual liquidity of money and the payments to calculate a meaningful "monetary velocity". That indicates that the use of M2 or even M3 is, against common use[17], not very advisable.

The method of making visible the accounting system and all transactions helps to illustrate the real payments in a currency. Even in a case where we

[16] e.g. Swiss National Bank; M1: *Defined as currency in circulation (bank notes/coins), sight deposits at banks, postal accounts and transaction accounts of non-banks*, from http://snbchf.com/monetary-fiscal-policy/snb-definitions-of-money-supply/ at 12.10.2015,15:30
[17] compare De La Rosa, Stodder, J., 2015, p.116

have paper notes or coins it is possible to use the model by refining rules and boundaries.

Questions arising and remaining are:

- Are these findings really applicable to our existing money-system (*tems*)
- Is *tems* a closed system and if not, how does this come together with the rules of bookkeeping and basic mathematics?
- The main focus of the paper was on payments, but what about savings?
- What about the interaction of the effectively traded goods and services connected with the payments?

6. Conclusion

To establish a meaningful connection between market and prices, monetary velocity in its present interpretation is not useful but misleading. The nonlinear appearance of payments has to be considered carefully to get better result. This might lead to a general nonlinear approach to money flow and maybe money itself. A fascinating idea which might help to get new foundation for monetary theory. However limited the small system approach presented here is, the presented methodology could be very helpful to unravel useful insights:

- By a systemic view of a closed currency system the "velocity of money" could be examined much deeper and a more accurate view on monetary flow phenomena appears on a micro level.
- Such a systemic approach could be further elaborated and might open some new perspectives for the understanding or simulation of monetary economies.

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