

A Systems Engineering Approach to Formal Monetary and Financial Stability Without the Vagaries of “Austerity” *

Marc GAUVIN

Sergio DOMINGUEZ, PhD Eng.

Abstract: *Currency units (\$, €, ¥, ₪, etc.) are not specified nor defined formally. Nonetheless, account entries and balances in terms of such units are routinely assigned the role of records/measures of the “value” of “assets”, without any formal adherence to the requirements of the most elementary logic and math of “measure”. In all domains other than finance and economics, the application of mathematical expressions in terms of units that are not both conceptually defined in valid logic and mathematically specified unequivocally with respect to the reality to which such expressions are expected to be applied, are necessarily in all cases indeterminate (i.e. inapplicable). This paper establishes how such indeterminacy is translated into systemic “financial” risk in terms of formal stability as defined in dynamical systems theory and engineering.*

The real economy is made up of goods and services (factories, farms, infrastructure, intellectual property i.e. non-financial assets on balance sheets) all of which are dependent on the independent physical nature and properties of real material and human resources. The “financial economy” on the other hand, is made up purely financial assets (securities, mutual funds and other financial instruments in the hands of households, corporations, governments and other direct owners).

Economic risk and liability is determined predominantly according to the mathematics of finance as applied to both the financial and real economies that determine the dynamics of account balances over time in currency units. While all economic accounts are ultimately resolved in terms of real assets, outcomes are determined by both the real and financial economies. The real economy being ultimately dependent on objectively determinable physical/scientific criteria while the (predominant) financial economy on purely (arbitrary) mathematical criteria with, as mentioned above, no determinate relation to any reality other than itself (i.e. according to circular logic).

This paper explores how the current state of affairs described above is logically and mathematically unresolvable and hence wholly unmanageable, precluding any rational judicial solution and thus requiring ultimately arbitrary, unknown and/or occult criteria for “resolution” as in the application of penalties and losses under the guise of “austerity”.

The paper also demonstrates how at no cost or penalty to any agent public or private and by merely defining currency formally as an arbitrary unit-measure of “value” and strictly adhering to the math of measure, the financial system can be rendered “Passive” pursuant to dynamical systems theory with increased transparency and functionality.

Finally, the paper illustrates how by virtue of the aforementioned principles of a Passive financial system, all risk inherent in the real economy, can be mitigated by optimally and judiciously managing the relations of the aggregate “system balance” (aggregate risk) in terms of the full array of possible transaction type permutations, without any need for “controlling” access to or “circulation” of currency that lead to the vagaries associated with the politics of “austerity”.

*Submitted December 2020 to Monetary Research Centre (MRC) University of National and World Economy (UNWE) Sofia Bulgaria



Preliminary Considerations

Unit Definitions and Currency Units

Mathematical expressions in terms of units that are not unequivocally defined and specified are indeterminate in any independently observable and quantifiable reality.

Definition of unit symbols in terms of a common reality or domain e.g. the physical world, require being assigned the role of representing some or other independently observable phenomenon of that domain and mathematically specified in terms of other relations of the domain¹.

For example, mass is defined as the commonly observable relation of resistance to acceleration (aka inertia) that material objects are observed to possess. The SI unit of mass is the kg specified in terms of other observable relations in physical reality, i.e. 1 kg corresponds to the unit of mass (inertia) in terms of the volume of a compound (1 litre of H₂O), at a particular temperature (4°C) and at a certain pressure (1 atmosphere).

While currency units are not formally defined/specified there nonetheless exists a commonly assumed notion associated with the day to day use of “money” denominated in those units. This notion conflates money as an annotation/account/measure of “value” [1][2] and as a tradable commodity carrying its own independent value in transactions, without noticing how and when these two concepts are logically mutually exclusive.

This logical incongruence referred to herein as “money’s common logical misrepresentation” or simply “money’s misrepresentation” is illustrated as follows:

Let $A \geq 0$ be the annotated value of goods/services transacted
Let $B \geq 0$ be the independent value attributed to the annotation of value as an object of trade.

For the annotation of value to represent the value of goods and services in transactions and not have its own value as an object of trade ignored, then $A + B$ must equal A . But,

If $A > 0$ and $B > 0$, then $A+B \neq A$
Therefore for any A , $A+B = A$ if and only if $B = 0$!

That is, the value B of the object annotating/recording the value of some other object or thing A , cannot have or be ascribed any value other than zero in the transaction, otherwise the total transacted value would no longer coincide with the value of the goods and services being represented. [3]

The cubit was a conceptually valid unit of measure and its use was consistent with that notion as it was specified i.e. cubit rods. So too with the different other measures of old of lesser precision and scopes as standards. The question with currency units is that they are not defined conceptually in valid logic let alone specified to render any calculation in terms of them in any way determinate.

This indeterminacy is not just due to the imprecision or lack of specification but due to its conceptual logical inconsistency leading to its conceptual misuse i.e. if money were only defined as a record of measure of the relative value of goods and services transacted and pending reciprocation, with no specification, but ONLY used according to the logic of its conceptual definition (unit of measure) i.e. not also as a tradable commodity, then it would serve as a valid albeit imprecise reference of value over time.

¹ Note, the requirement to express one phenomenon in terms of other relations in a domain precludes circular logic.



There are different related issues/questions:

1. Conceptual definition: Establishes a dimension that can be commonly assessed without any unit. E.g. distance, mass and relative value (estimated utility or importance).
2. Specification: Given a valid conceptual definition the precision and scope of units are determined, i.e. at one time people measured their horses by “hands”, while of lesser precision to metres, hands are still conceptually valid as there does exist a bounded range of sizes of human hands that all can more or less estimate to some or other precision.
3. Use: The use of the unit must be logically consistent at the very least with the conceptual definition in the first instance and to some or other minimum specification in the second instance.

The most fundamental problem with currency units is that there exists no valid conceptual definition of currency units to begin with, rendering any consistent specification and use of units impossible.

Systems

“A set of elements in interaction” [4]. Here we refer to “system” as any set of logical and/or physical entities (elements) whose interactions represent a whole that performs a coherent set of at least one function.

Stability

For Linear Time Invariant (LTI) systems, stability of a system is determined by the bounded nature of its inputs and outputs measured in some or other (valid) units, such that if for any bounded input the system produces a bounded output the system is determined to be BIBO stable. While any system that produces an unbounded output for some bounded input is BIBO unstable. [5]

Passivity

Passivity refers to the special case of BIBO where not only is the output bounded for any bounded input but output is also less than or equal to input. [6]

Some Common Misconceptions:

A: For a linear system, is an output of constant slope stable? No, stability for linear systems is not determined by the type of function nor its sign but by whether or not the function is bounded or not.

B: If the unbounded output of system A is dampened by some external element B, does that render system A bounded? No, system A continues to be unbounded the combination of A plus B represents a new different system say W that cannot be evaluated in terms of A alone. [7]

C: Is the bounded output of a system sufficient to determine its stability? No, stability requires knowing that the inputs are bounded.

The Money System

The "money system" is a logical system made up of relations between entities in terms of mathematical operations over "balances" in currency units (\$, €, ¥, ~~₩~~, etc.) related to a broad domain of commonly and independently observable "transactions" of goods and services and financial instruments within both the "real economy" (factories, farms, infrastructure, intellectual property i.e. non-financial assets on balance sheets) AND the "financial economy" made up purely of financial assets (securities, mutual funds and other financial instruments in the hands of households, corporations, governments and other direct owners).

Risk

Currently, economic "risk" refers to the probability of "obtaining" sufficient quantities of units over time, according to both determinate and indeterminate criteria related to both the so called "real" and "financial" economies. While both sharing common (arbitrary) financial criteria the "real" and "financial" economies each ultimately respond to different sets of risk criteria. That is, while the real economy is constrained by both real world material/physical constraints and imperatives, the financial economy is not. Yet, all risk in the system is expected to be ultimately resolved in terms of real economy assets (goods and services) even though the real economy typically only represents about a third of all financial assets [8].

Currency Unit Stability

Since money is used as an annotation/record of value and indeed that role being its only rational role [9] [10], we can determine its stability or lack thereof with respect to that role as well as determine the effect of money's misrepresentation as discussed above. Because, in absence of any formal definition and specification of currency units, "money" denominated in such units is commonly conceived as both a record of value AND a "commodity" or object of trade subject to "supply" and that notion is what conceptually underlies ALL math of finance as commonly applied today.

As a consequence, *each unit of money within any sum is rationalised as a marketable "product"* like a glass, pencil or eraser. Thus, "cost" for the "use of "money" directly in currency units and/or indirectly in quantities of goods and services evaluated in said currency units, is rationalised to be proportional to the quantity of units used and or required resulting in charges on a percentage bases of the value being measured - either as a one time percentage commission "service charge" over sums of units used in a transaction, or as a product of time based (geometric/exponential) functions over outstanding balances as in the case of mortgage contracts.

While it is trivial to conclude how time based positive exponential functions are unstable and by the principle of superposition, so too any system made up of n such functions [9], the case of n percent based service charges is not so trivial, as for this, certain observations often overlooked must be made. Namely, the effect of applying percent charge costs over balances that are passed on, both over links within value chains as well as over reiterations of value chains [3][12][13]. Thus, since this latter case can be considered more fundamental and not so trivial, we illustrate it here as follows:

Let G be any object of trade, let " a " be the cost of G in currency units and " u " the per unit cost for each unit used to represent the value $V_i, i = 1, \dots, n$ of G in any of n transactions of G .

Then,

$$V_1 = a(1 + u)$$

$$V_2 = a(1 + u)^2$$

$$V_n = a(1 + u)^n$$

And $V_n > V_{n-1}$ for $u > 0$

Since increase in value attributed to G requires the arbitrary summation of units independent or exogenous of the measure of value of G, then it can be affirmed that any such exogenous “interference” is the sole cause of instability of value measure in the system because in the absence of such interference i.e. $u \leq 0$, the system is stable by default! And the [Stable Currency Unit Theorem](#) holds [3]

The above demonstrates how a system founded on money’s misrepresentation will by superposition render the whole system unstable. But more importantly, because of how such an error produces/imposes an “interference” exogenous to the sum of the value of goods and services² transacted, we see exactly how to resolve the current otherwise irresolvable systemic instability.

As explained in the “The Beast of Compounding You Might Not Have Noticed” [13], the afore mentioned instability is due to:

“...applying the notion that each unit of the numbers that represent the value attributed to those goods and services are products in and of themselves and thus have a unitary value if not cost, such that their use can be charged:

1. Not based on the measure of value of the service of providing the units, but on the value of the object being transacted measured by those units.
2. And applied over several subsequent transactions.“

Thus by simply preventing the first bullet and by conceiving money as a mere record of value not subject to “supply”, the entire system can be rendered BIBO Passive stable by virtue of eliminating the unitary cost of each currency unit and instead, accounting solely for the service of annotating money as a finite (bounded) measure of the “value”/“merit” of that service on its own, just as is the case with all other goods and services.

Risk Without Austerity

The instability of the system as described above ultimately renders debt and liability/risk unmanageable over time. This in turn leads to last ditch dire measures in the form of extreme across-the-board contraction of economic activity and diversity in the real economy. Such “austerity”, leads to serious real world consequences, that in the light of the revelation of money’s misrepresentation are wholly unnecessary and

² Note that while G is a constant i.e. all real goods and services summed into a value chain’s final product cost are constants (bounded sums) for any given value chain instance, the cost of using money $(1 + u)^n$ represents an ever increasing variable (unbounded) sum over time.



therefore cruel and unusual, constituting a powerful legal imperative to correct said misrepresentation [10] [17] [18].

Moreover, this risk is mostly associated with arbitrary financial criteria without which, the “real” economy would only bear real world material and physical risk criteria, keeping in mind that typically purely financial assets represent two thirds of the total financial risk in the economy [8]. Finally, *all financial risk is ultimately founded on the misrepresentation of money in that without it, financial mathematics as we know it would be impossible and so too would most of the “financial” economy without any harm to the economy.*

However, in a scenario where as explained previously, money is defined logically as SOLELY the annotation of sums of value in terms of a common (arbitrary) unit attributed to each instance of goods and services, by judicious management of the different permutations of transaction types that we illustrate below, we can illustrate how such severe “austerity” measures are not only not required, but ultimately increase risk over time towards total system failure.

Transaction Type and System Balance dynamics

As explained above in a Passive BIBO stable system, “currency” units arise as mere annotations of the absolute value attributed to goods and services in transactions, where the positive and negative signs applied to account entries, serve only to determine the direction of value (goods and services) transacted between parties.

That is, all parties/agents are initiated in the system with zero balance and only by participating in one or other transaction of goods and services can any balance in the system be altered in either the positive or negative direction as the case may be.

To better understand this, consider the very first transaction in such a system for a population of two agents “U” and “I”:

“I” provides a horse to “U” with a mutually agreed upon value of 100 units. Since I provides the horse, I’s account goes from zero to +100 and since U receives the horse U’s account goes from zero to -100. Units do not precede the transaction but arise out of the transaction. In such a system only U has received value corresponding to the exact same measure of value relinquished by I. Clearly, the total measure of value pending reciprocation i.e. “risk” recorded in the system at this point in time is 100 units or:

Total System Risk (System Balance) = *the absolute value of the sum of either all positive or all negative balances in the system.*

This “risk” represents “credit” for the estimated value pending future reciprocation of goods and services and NOT for currency units as tradable objects. That system risk, remains until U reciprocates in the future with some or other good or service of equivalent value, at which point all accounts including the System Balance return to zero.

In such a system, there are only four possible permutations of transaction types as follows:

- A. Positive buys from negative (reduces system balance)
- B. Negative or zero buys from positive or zero (increases system balance)
- C. Negative or zero buys from negative (system balance unaffected)
- D. Positive buys from positive or zero (system balance unaffected)

To understand how this is the case, we can contemplate the following example of a community whereby positive and negative balances are generated as a function of solely transacting goods and services between agents:

Transaction	Type	Mary		Jim		John		Julie		System Balance (Total Value "Risk" pending reciprocation)
		Entry	Balance	Entry	Balance	Entry	Balance	Entry	Balance	
			0		0		0		0	0
1	B	-30		+30						
			-30		+30		0		0	30
2	D			-10		+10				
			-30		+20		+10		0	30
3	B					+10		-10		
			-30		+20		+20		-10	40
4	C	-10						+10		
			-40		+20		+20		0	40
5	A	+20		-20						
Final Balances			-20		0		+20		0	20

Fig. 1 Transaction Type Dynamic

All agents begin with a zero balance. Transaction 1 of value from Jim to Mary necessarily corresponds to type B (negative or zero buys from positive or zero), as a consequence the “System Balance” (total value pending reciprocation in the System) is the absolute value transacted (30 units). Transaction 2 is type D (Positive buys from positive or zero) from John to Jim while decreasing Jim’s positive balance by 10 units it increases John’s by that same amount such that the total sum of positive balances remains unchanged and equal to the sum of negative balances in the system (Mary’s -30). The third transaction is again type B (negative or zero buys from positive or zero) from John to Julie, adding 10 units to the sums of positive and negative balances in the system, thus increasing the System Balance (total absolute value pending reciprocation) to 40 units. The fourth transaction of value is of type C from Julie to Mary both with negative balances, as a consequence and similarly to Transaction 2 (type D) the absolute value of the sums of either positive or negative balances i.e. the System Balance remains unchanged. Finally, Transaction 5 being of type A (Positive buys from negative) from Mary to Jim reduces the System balance by 20 units.

Notice that of the four types of transactions, only type B increases the net system balance or level of unreciprocated value or measured risk in the system while in all other transaction types, no risk whatsoever is added to the system. [14]

Understanding the above in a system so defined to be Passive (stable) by virtue of money being defined as ONLY a mere record of value in terms of a common arbitrary unit (e.g. \$, €, ¥, ~~W~~, etc.), avoids any need to ever paralyse or exclude any agents from the system, because as long as overextended agents are capable of generating and trading new goods and services, ALL can continue to operate with unlimited C, D and A type transactions, not only without ever increasing risk in the system but reducing risk progressively over time with any number of type A transactions as required.

Finally, although transitioning to a Passive money system from current practises, will no doubt evolve the nature of agent roles and even system topology, immediate uptake requires no penalisation nor sacrifice to

any agent or entity in the system nor any cost or loss. The reason this is certain, is because the change is at the conceptual rather than the mechanical level. That is, once the conceptual change is assumed and requirements for Passivity satisfied, the same principles illustrated above will apply no matter what the initial starting balances are. The topic of transition to and parametrisation of a Passive BIBO system will be fully explored and discussed in a subsequent paper.

Requirements for a Passive Money as a Record/Measure of Value

Definitions

Account: A record of positive and negative entries of currency units and the corresponding Balance resulting from currency unit Transactions of Wealth.

Balance: The net value of currency units in an account at any given point of time. This value can be positive, null or negative.

BIBO stability: A system is said to be BIBO Stable when for any bounded input the output is also bounded. For continuous Linear Time Invariant systems, a system is considered BIBO Stable if the input response signal is absolutely integrable for $t = 0 \rightarrow \infty$.

Bounded: Any function $f(t)$ where there exists some value $B > 0$ such that $|f(t)| \leq B \forall t \in \mathbb{R} > 0$.

Community: A set of two or more Members.

Credit: The adding to one's Balance of currency units's resulting from delivering Wealth in a transaction.

Currency(aka money): Unit measure of value attributed to independent instances of goods and services pending reciprocation and denominated in a common arbitrary symbol e.g. \$, €, ¥, ~~₩~~, etc.

Currency-System: A set of one or more Transactions adhering to particular rules and definitions that determine the behaviour of Balances in Accounts.

Debit: The subtracting of currency units from one's Account Balance resulting from receiving Wealth in a Transaction.

Debt: A commitment vis-à-vis the Community resulting from a negative Balance, to continue delivering Wealth in the Future through Transactions Accounted in currency units until the Balance is no longer negative.

Input: Aggregate value of Currency System Wealth in Transaction measured in Currency.

Linear System: A system is considered linear, if it satisfies the principle of superposition and scaling. Given a linear operator $H \{x(t)\}$ with inputs $x_1(t)$ and $x_2(t)$ and corresponding outputs $y_1(t) = H \{x(t_1)\}$ and $y_2(t) = H \{x(t_2)\}$, then for any scalars α and β , $H \{\alpha x_1(t) + \beta x_2(t)\} = \alpha y_1(t) + \beta y_2(t)$.

Member: Any uniquely identifiable human or group of humans holding one or more Accounts in currency units.

Output: Aggregate Currency System Debt.

Passive: A system or process where output \leq input.

Passive BIBO Currency: A Currency system where the absolute value of the sum of outstanding Debits is less than or equal to the sum of input Prices.



Price (Input): The number of currency units recorded in Accounts representing the Value of Wealth in any given Transaction.

System Balance: The sum of unreciprocated value in the system, note this balance is either negative or zero never positive.

Time Invariant: A system in which all parameters governing the system's behaviour remain constant with time, so that the system's response to a given input does not depend on the time it is applied. If the input signal $x(t)$ produces an output $y(t)$ then any time shifted input, $x(t + \partial)$, results in a time-shifted output $y(t + \partial)$. **Transaction:** The process by which Wealth is transferred and Accounted for in a finite sum of currency units resulting in a Credit to the provider of the Wealth and a Debit of equal magnitude to the receiver(s) of wealth.

Value: The relative worth, utility or importance attributed to any given instance of goods and services.

Wealth: Any discretely measurable goods and services whose value can be transferred between two or more parties.

Premises

[15]

The following list of affirmations that serve to scientifically define and delimit the generic notion of "money"/"currency" or any other means of representation of value requiring the annotation and communication of records of stable measures of the value attributed to unique instances of goods and services.

1. "Money" (currency units) is an output of a system that can be represented by "Sampled Linear Time Invariant (LTI)" processes and therefore the stability of such systems can be affirmed by the BIBO criteria (Bounded Input Bounded Output).
2. Money has the function of measure for which it is required to satisfy not only BIBO criteria but it must also be Passive.
3. Money cannot be both a measure and a scarce commodity, given that these definitions are mutually exclusive. Logically, money cannot be scarce given that it is nothing but the measure of the value of goods and services in transactions.
4. There is no need for money to be a physical object given that it is a logical entity, its only rational function being to measure and record value.
5. According to the ["Stable Currency Unit Theorem"](#) and for there to be stability in measure it is sufficient that: A) All units arise out of transactions of goods and services. B) All transactions are Passive BIBO processes. Nothing else matters.
6. Previous "circulation" of money is not a requirement for the realisation of transactions but rather money is a subsequent result or product of transactions. Such that the dependence over previous "supply" and "circulation" is as delirious as the transfer of a score between athletes.
7. The stability of money does not have to do with whether or not debts can or cannot be paid, but rather it has to do with the rules that govern transactions and corresponding balances. For example, the unbounded growth of debt as a function of time. Another example is the increase of value of an obligatory unit as a function of its relative inaccessibility or scarcity, given that a withdrawal from "circulation" of "scarce units" (technically an oxymoron) would result in an unbounded increase of value in the unit as a function of that relative scarcity. For which it becomes clear that the value of



money must not be subject to the law of supply and demand because it is not a commodity but rather it is a logical entity.

8. The circulation of the support of an account entry (cash) does not alter the locality and value relation with the corresponding good/service the value of which the account entry is a measure of and if it does alter it, then the original measure must also be altered.
9. The agent that implements a money system, public versus private, is irrelevant to the issue of credibility of the money system mechanism and function, which is entirely dependent on the practical nature of and adherence to logical and mathematical definition.
10. Passive money systems cannot compete with non passive systems for a common resource base. The latter will starve the former.

Normative Requirements:[16]

1. The Currency shall be Abundant (unlimited): A Currency unit is an abstract unit of measure of value with no necessary or particular physical properties and therefore has no physical limit i.e. it is absolutely abundant and units are generated solely by transactions of Wealth.
2. The Currency System shall be Passive Stable:
3. Magnitude of unit Debits at all times is equal to that of unit Credits and the sum of all existing Balances equals zero at all times.
4. The Currency System shall serve Transactions not determine them: A Passive BIBO Currency System is inert as it has no effect on the creation of Wealth, i.e. its use cannot deter or provoke the creation of Wealth, rather it is the creation of wealth and the free spontaneous desire to trade that wealth that generates unit Debits and Credits.
5. Transactions shall be free of coercion by virtue of monopoly of units: No side of any Transaction may derive an advantage over the other by virtue of availability of currency units. No Member can exercise control over access or use of currency units by other Members. Both sides of any Transaction have equal and opposite influence over Price in terms of availability of the currency units. All Transactions in units are fully voluntary and free of any coercion.
6. Units shall represent not determine the value of Wealth in Transactions: Creation and transfer of Wealth does not depend on units but rather use of units depends on the previous existence of Wealth. Therefore, it is the value that determines the quantity of units not the units that determine the value.
7. Units shall be accessible to anyone or any entity: Anyone can open an account with zero balance.
8. Units shall be accessible to any location: Any Passive BIBO transaction that can be recorded is valid.
9. Units shall not be subject to counterfeiting or falsification: Only units resulting from identifiable transactions by authenticated users are recognised.
10. Units may only come into use as the direct result of representing Debits and Credits in Transactions.
11. A Member may open and hold one or more Accounts in units.



12. A Member may close an Account in units provided the balance is null.
13. An Account may exist without an Account holder (i.e. a deceased member's account).
14. All Members' Account Balances as well as the System Balance are public.
15. All Transaction details are private (unless required to be divulged by law).
16. Any consenting Member has the right to freely partake in any Transaction of Wealth denominated in units.
17. A Member is free to deny performing a Transaction with another Member.
18. The Price of a given Transaction can only be determined by Members who are parties to the Transaction.
19. A Transaction may involve any number of Members.
20. Units are equally available to any Member at any time.
21. Units may not be assigned a Price in units.
22. Units may be donated.
23. Wealth is represented in Transactions only as positive unit numbers (i.e. you may not buy wealth by adding a Debt to the seller).
24. No function may be applied to any Balance other than subtraction and addition.
25. No entity may operate within the Currency System other than as determined herein.
26. Currency System administration service rates cannot be charged as a percentage of the Price of transacted goods and services, but rather any charge must be related to the cost of service delivery.
27. Currency unit symbols shall be used exclusively to represent the absolute value of goods and services transacted and pending future reciprocation in future transactions of goods and services.
28. Each transaction shall generate its own independent units to be subsequently resolved against existing balances.
29. Signs shall be used to represent the direction of transacted goods and services, positive account entries applied to the balance of the party providing the goods and services transacted and the negative account entry to the balance of the party receiving the goods and services.
30. At all times the sum of the absolute value of all positive balances in the system shall be equal to that of the absolute value of the sum of all negative balances and shall represent the sum of non reciprocated value (risk) in the system.
31. The absolute value of all unreciprocated value at all times shall be equal or less than the sum of all prices (inputs) conforming to the criteria for Passive BIBO stability of sampled LTI Systems.
32. Value expressed in "Prices" shall be determined by all parties to any transaction.
33. Relative value is determined by the sum of transactions within the collective.

34. Possibility of any unilateral systemic manipulation of value attribution shall be precluded.

Discussion

To Control or to be Controlled

Control only makes sense for dynamic systems, weights and measure are not dynamic systems but constants by definition. Thus control should not be applied to measure systems (i.e. meters or seconds need not be controlled) but on the functions and agents operations subject to measure (e.g. drivers exceeding speed limits). Therefore, no control should be applied on currency as a measure, but rather on the behaviours of agents and functions that determine the value of assets to be recorded.

The prevalent (purely intuitive) assumed notion of “control” as when “austerity” is imposed, is one where “credit” as in “trust” “confidence” or “credibility” is allocated in terms of the ability to recuperate or generate money denominated in units and as currently misrepresented (see above) over and beyond any real world ability to produce value. Said “control” is manifest through exclusive authoritative prerogatives of allocating a said “money supply”.

The problem with this approach, is that given money is not properly specified as required by fundamental requirements of applied mathematics, the real world economy becomes subject to unknown, undeclared or occult financial criteria with no determinate relation to the real world economy.

If there is no clear separation between the real world economy and the financial economy at the conceptual level³ then circular or self referential effects become unavoidable such that the “remedy” becomes the cause of what is to be remedied, requiring more remedy and so forth until the system collapses. That is, when credit is denied, by applying austerity that in turn weakens the ability to operate in the real economy, the subject becomes progressively less credit worthy. Such a scenario creates a nightmare for those “controlling” credit and goes a long way to explaining why the financial sector itself, has fallen prey to its very own paradigm, requiring it to be bailed out of the very system it itself is charged to oversee for those it ostensibly serves.

The indeterminate relation between real world and financial risk, with the unseen or untracked systemic compounding of financial costs predicated on money’s logical misrepresentation and rendering the system exponentially unstable, is central to the challenges faced by the world today. Current political economy responses to these challenges differentiate themselves across a spectrum of an intuitive and scientifically flawed notion of “control”, based on constraining behaviour of the agents using the system without any consideration of the systemic effects of the system itself that are independent of user behaviour.

It is like trying to prevent an expanding balloon from bursting by applying counter pressure on all points of its surface area without any awareness of how to limit the air input (systemic risk) in the first place. The problem with this approach, is that without regulating the systemic risk, regulation of each point on the surface must always equal or exceed in force commensurately to the force of expansion, rendering the whole exercise unfeasible.

Given the ubiquitous nature of money’s misrepresentation due to it being universally assumed by all active agents, the sources of systemic risk become equally ubiquitous. Moreover, the more each entity no matter how big or small struggles to counter mounting risk under money’s misrepresentation, the more risk is added to the system. This leads to a hyper competitive non cooperative environment of unenlightened peer

³ Note: while Glass-Steagall attempts to make such a distinction such is conceived on top of and in terms of money’s misrepresentation and therefore cannot stabilise the system as it intends to.



interaction wholly predicated on the fear and distrust seeded by money's logical misrepresentation as opposed to real world conditions, requirements and any measured value potential.

Enlightened Peer Interaction

In systems where money is no longer misrepresented, i.e. where 'currency' cannot effectively be used as a surrogate to the value it represents, but rather is limited to recording the value of transacted goods and services pending future reciprocation and as outlined in the requirements above, there exists no possible means for systemic compounding of risk (see Currency Unit Stability above). Thus constituting a "by default" Passive BIBO System.

By virtue of this, no control over money as an object is required to preserve its role as a valid stable record of value provided [12]:

- All money on account is the product of transactions of discrete measures of goods/services.
- All transactions are passive in nature.

The above in no way affects the incentive on the part of most, if not all agents, to continue to limit real world risk in their interactions with each other. Such can be achieved by all peers having access to both the knowledge of each others balances in conjunction with the aggregate system balance at any point in time (see requirement 14 above). Thus and in combination with particular knowledge of the nature and quality of habitual social, business, and trade relations, peers can organise themselves to self regulate risk, by being able to identify and avoid if required, Type B transactions.

Essentially, when currency function is purely that of providing stable and reliable information that all have access to vis a vis how agents attribute "value" to goods and services, users will have an incentive to use that information to curtail risk rather than multiply it as is the case with the current paradigm where currency is a commercially negotiable exclusionary commodity.

Note, that to the degree users of such a Passive currency are exposed to non passive systems (in terms of access to resources), such sound peer control becomes increasingly undermined.

Conclusion

Currency units and “money” denominated in said units are not defined nor specified as required in order for mathematical expressions denominated in said units to be determinate when applied to the real economy or any common reality for that matter. In common practices, two mutually exclusive concepts are conflated to form an informal unreasoned de facto notion of “money” denominated in currency units namely money as a record of value AND money as an object of trade (commodity) with independent value on par with any goods and services, constituting a logical misrepresentation. This misrepresentation assumed as a foundational axiom, renders the financial system inherently unstable by creating the pretext for the application of a unit cost factor $(1 + u)^n$ without which, the system is Passive BIBO Stable by default. Total financial risk encompasses both risk inherent in real world economic activity as well as that corresponding to arbitrary financial imperatives of the so called “financial” economy said to represent two thirds of that total [8]. Yet it is the assets of the real economy that are expected to resolve all financial risk. The notion that judicial control of currency unit “supply” and “distribution” may serve as a valid means of financial “control” is shown to be untenable and to lead to dire “austerity” measures and subsequent extreme social and economic exclusion as a systemic effect (i.e. not caused by user behaviour). By defining money conceptually as a mere record of the value attributed to transacted goods and services and strictly adhering to the requirements of “Passivity”, the system is rendered inherently stable by default. In such “Passive” money systems aggregate economic “risk” is represented by the absolute value of either positive or negative balances in the system, such that when real world circumstances and conditions require, said risk (system balance) can be mitigated without any need for “austerity” but by virtue of the judicial management of four fundamental transaction types A,B, C, D, where only type B increases risk, type A reduces risk and types C and D, while permitting continued and unlimited participation have no affect on the aggregate risk. Finally, transitioning to a Passive money system from current practices, without prejudice to clear legal imperatives to do so, requires no penalisation nor sacrifice to any agent or entity in the system.

References

- [1] BoE Quarterly Bulletin 2014 Q1 Money in the modern economy: an introduction By Michael McLeay, Amar Radia and Ryland Thomas of the Bank’s Monetary Analysis Directorate.(1)
- [2] BoE Quarterly Bulletin 2014 Q1 Money creation in the modern economy By Michael McLeay, Amar Radia and Ryland Thomas of the Bank’s Monetary Analysis Directorate.(1)
- [3] Money: Commodity or Measure Not Both (www.bibocurrency.com) 21/4/2014 rev. April 2015, Aug. 2015, rev. June 2016, rev. May 2017, rev. June 2018 M. Gauvin.
- [4] von Bertalanffy, L. 1968. General System Theory: Foundations, Development, Applications. Revised ed. New York, NY, USA: George Braziller, Inc.
- [5] <https://cnx.org/contents/nVZ6PKeG@4/BIBO-Stability-of-Discrete-Time-Systems>
- [6] [http://dictionary.sensagent.com/Passivity%20\(engineering\)/en-en/](http://dictionary.sensagent.com/Passivity%20(engineering)/en-en/)
- [7] Gunter Stein “Respect the Unstable” IEEE Control Systems Magazine (Volume: 23, Issue: 4, Aug. 2003)
- [8] A WORLD AWASH IN MONEY Capital trends through 2020 Bain and Company. 2012 fig. 1.1. page 7.
- [9] Narayana R. Kocherlakota, The Technological Role of Fiat Money* Research Department Federal Reserve Bank of Minneapolis.
- [10] A proposal for harmonising current disparate (scientific and legal) definitions of money towards greater decidability in the provision of Justice according to universal principles of contract law Jorge Meira Costa and Marc Gauvin, 2015
- [11] Formal Stability Analysis of Common Lending Practice, 2009 M. Gauvin, S. Dominguez
- [12] Stable Currency Unit Theorem (www.bibocurrency.com) 2011, M. Gauvin, S. Dominguez
- [13] The Beast of Compounding You Might Not Have Noticed (www.bibocurrency.com), Jan 10th 2020, M. Gauvin
- [14] Austerity Fallacy (www.bibocurrency.com) 05/2015 rev. 7/2015, rev. 10/6/2018, M. Gauvin
- [15] Passive BIBO Currency Distinguishing Claims www.bibocurrency.com Passive BIBO Currency Project 2013 Marc Gauvin, Sergio Dominguez.
- [16] Formal Passive BIBO Currency Specification www.bibocurrency.com, Passive BIBO Currency Project 2011-2019



[17] Legal Curriculum (<https://www.moneytransparency.com/legal-principles>)

[18] MSTA Resolution (<https://www.moneytransparency.com/msta-resolutions>) January-April 2020.