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Summary: The natural or physical laws of spatio-temporal entropy are applicable to monetary production economies. Money quantizes and dualizes, mechanically and thermodynamically, the energetic entropy of spatio-temporal economic production; the fiat emissions of credit (x interest) in the fractional reserve banking system are the root cause of cyclical economic crisis in market capitalism. A 100% monetary system is a physical necessity to separate money from credit; some polities will, according to their natural resources of precious metals, even opt for a gold ratio. This radical decentralization of the money and banking system has also to allow for the market self-emergence of alternative currencies by law. The physical duality of the monetary quantum moves the production system and checks economic development via cybernetic emission, payment and bookkeeping. An international clearing currency unit for national payments should be based on a natural index of clean energy, to manage the monetary quantum into a more sustainable economic future.

Key words: money, production, space, time, entropy

JEL: B41

Money supervenes on physics, every individual bit of behavior of money is describable in terms of physical laws; there is no monetary difference without physical difference and no monetary value, an irreducible addition to money, without physical value. A scientific theory of monetary economics can be derived from basic biophysical laws, regarding the validity of non-equilibrium thermodynamic theory of life systems, because systemic economic organization, i.e. the working body economic, will not converge to an equilibrium state. The basic economic quantum of the modern market societies is the monetary unit, not the internal market of the nation states (to which the dominating majority of economic literature is dedicated, since its inception as a research discipline); economic production quantizes time and the economic value of human knowledge is related to the amount of energy (entropy) that has been expended in the course of obtaining it, i.e. even knowledge is an economic commodity with physical properties. However, human capital, accumulated technology and book money lose their value when basic biophysical laws are violated as happened historically always with the natural collapse of high consumption societies that did not understand the entropic tendency towards increased dissipation and randomness in nature, i.e. the monetary quantum should possess negentropic properties. Consequently, the monetary practice of fractional reserve banking and the two-sided accounting operations of banks allow inflation artificially to rise; this type of monetary emission, a fiat flow-reflow of payments as double-entries in bank ledgers, causes financial over- inflation and economic production suffers. Any formulation of the production function is mainly for heuristic purposes (e.g. capital=K, labor=L , easily generalizable by additional factors, like: natural resources, entrepreneurship, money), but it goes without saying that banks should not be able to lend more money than they have income deposited, not more than the amount of income generated by production; concerning future bookkeeping, a technical separation of money (emission), income (deposits/dividends) and fixed capital (profits) has to be achieved and an international currency clearing unit, in real-time, should settle payments between nations. Money must regain its natural function of circular and vehicular means of payment for the temporal period of economic

production; it does itself not exist in continuous time, but monetary circulation is a discrete event, e.g. saving and investment are logical identities, but do not perform in equilibrium conditions. Empty monetary emissions, that do not reflect the quantitative relationship of combined productive factors in a given period of time, are a toll on economic growth; in other words, the current monetary and accounting practice does exactly reflect the ignorance of spatio-temporal entropy, i.e. there is no physical evidence in the natural laws of economic production for this kind of numerical artifacts. In addition, Goodhart's law applies to central banking: an observed empirical and statistical regularity will tend to collapse once pressure is placed upon it for control purposes; in other words, the nature of monetary management cannot be controlled by artificial means since equilibrium states in nature are impossible.

Mathematical objects have to follow precise rules, but physical laws work by evidence; consequently, we can only reduce actual objects, but of course not the hidden truth or construction principles of 'reality'. An exemplary reduction of monetary units to properties is the best method to eliminate artificial objects and to formulate a collection of basic sets, governed by similar physical laws. However, money definitely obeys 'new' laws at higher levels; high-level laws are simply not reducible to low-level laws, but the laws of each level above follow from laws of the level below, i.e. the physics of socio-economic systems, e.g. monetary systems, cannot be easily reduced to some kind of classical textbook thermodynamics and/or statistical mechanics. In this case, we would commit a grave methodical error; the interplay of natural law, human behavior and ethical principles is a bit more complicated, due to the temporal fact of evolutionary life processes that did not take place in the plane physical world. In addition, the social world of economic action is based on natural law, but it works via a circular feedback of objective facts and subjective perception; remember the traditional saying: reality is no-thing, perception is every-thing.

The scientific method is the technical way to develop from perception to observation and measurement, to obtain reasonable and workable results; consequently, modern monetary economics shares a common foundation with quantum physics. Our money is a quantum currency, the value is not constant and extremely driven by what people think it is worth; it leads an indeterminate probabilistic existence as do quantum states, but it does behave in no way neutral to the functions and factors of production. ‘Reality’ is created through our perception and is therefore not independent of us; the equivalent principle of uncertainty is operating in quantum physics. Modern monetary production economies have to find a scientific and methodical balance between Newtonian deterministic monetary mechanics and probabilistic quantum uncertainty; the only physical means to define currency value is by comparison with a known quantity; therefore informative transparency and a defined yardstick are necessary to ending the opaque techniques of private and central shadow banking. Financial markets and monetary economics offer the only social scientific possibility for experimentation and observational testing of economic theories in order to obtain solid data; the thermodynamic laws of energy conservation and entropy increase are phenomenological statements and general principles to formulate macroscopic empirical facts of physical evidence for practical applicability, i.e. mathematical formalization contributes little to the understanding of physical principles of economic action, especially of monetary behavior on production (e.g. the velocity formula of: MV=PQ is a misleading relict from the time of coin circulation). The natural fundamentals of space (P=production) and time (M=money) are interchangeable explanations of reality; the interplay of physical production and monetary processes moves the economic system. Today, M has become the space for decision making, monetary policy is defined in M and commanded to P; M regulates business activity and accounting standards, i.e. the uncertainty at the micro-level is created at the macro-level via central monetary planning agency. According to the law of monetary velocity (of profit, loss, cash) only a mega bill can absorb net profits to date as time behaves never neutral! Inflation is maybe the economic signal of entropy?

M is actually a balance sheet; the standard model of M as ‘reality’ of cash and assets is indeed a money illusion because the true elements of M can never be seen, but they can be identified by cause and effect, i.e. real money does not exist and only a relativistic theory can explain the ‘reality’ of modern money markets. Monetary velocity behaves in quantum waves of profit and loss; everybody can experience this quantum duality of P and M at a coin operation machine and observe the particle nature of money. For each physical transaction in P, at successive periods of time, a consolidation of M entries of past transactions is taken, to measure the financial position of the economic agent in stock magnitudes. In P, processes are time dependent, but in M, time is not continuous, it is being quantized; the connected chains of payments and accounting operations and the consistent recording of book-keeping entries never behave in real time, they behave as whole numbers to count monetary units. Any monetary reform that will be worth its name, has to resolve this disturbing duality of P and M; currently, banking operates in financial probability waves that try to quantize their financial mass faster to the rest of the monetary universe ; however, only the road of organic physical growth can assure sound financial institutions and companies. Therefore, the monetary economics of spatio-temporal entropy, the physicality of money and book-keeping have to be better understood, especially the harmful effects of M on P; the dynamic and efficient interplay of physics (laws), psychology (behavior) and ethics (principles) has to be reviewed for a possible remedy of the current financial mischief; at the center of these exact observations is monetary behavior. It is our guess that the monetary practice of fractional-reserve banking will be exchanged for better tools of monetary management, leading to 100%money and/or a ratio of precious metals; as a lot of politics is involved in this heuristic process, let us hope that pragmatic reasoning will prevail on the level of physical evidence in monetary affairs: it is indeed not easy to catch a fox in the woods without deforesting it. Economics as an established profession, does not suffer from specialized particles of scientific knowledge and research practice, but from a cognitive lack of a unifying

methodical approach, i.e. the methodical measurement and physical evidence of economic and especially monetary phenomena lies in between hermeneutic interpretation and mathematical formalization. Among the ethical principles of the Hermetic Corpus, one can study the equivalence principle: as above, so below-as below, so above; most ethical principles of time-tested wisdom literature are actually a plain reflection of natural or physical laws in simple language to guide human behavior (in order to reduce the amount of disorder in a social system). In our perception, the temporal duality of the production (P) process for marketing and the monetary (M) process for payments is a cognitive problem of socio-physical entropy, i.e. it refers to a probability distribution of uncertainty in a cybernetic duality of random variables and it is methodically difficult to quantize this temporality of P and M: (1) Money is not continuous, it flows in discrete monetary units; (2) Money behaves both as payment and a signal for future production; (3) Money movement is random; (4) Money locus and momentum cannot be known at the same time as, for example, the realtor principle teaches; (5) The nature of economic 'reality', concerning P and M, is very different from what we expect rationally. The monetary quantum works like a frequency in an economic hologram and moves the temporal duality and entropy of P and M in feedback circulation. Consequently, the general principles of quantum mechanics (below) and quantum thermodynamics (above) can be wisely applied to understand the cause and effect of the monetary quantum on P; the physics of the monetary system (M) has an economic effect on P (production system) and can cause an eminent monetary bias in the marketing cycle. The industrialization of the advanced monetary production economies was financed via private fractional reserve banking, leading ultimately to the shadow command policy of central monetary planning agency; in any case, it is time to reform this monetary trend via the physical practice of 100% money and banking, setting a clear economic mark between the polity and the market, i.e. the mathematical gambling of financial artifacts and electronic digits causes harmful physical effects to the economic production function of human societies and to the exercise of human freedom.

How can monetary economics move from a profession to a science? Is there any scientific proof, physical evidence or experimental design available for this research problem or are we condemned to imperfect but prudent intelligent guesses? How has the physics of the monetary system for the information age to be operated? Is there any financial method to eliminate human influence on base money? Must we return to the yellow brick road or are there more modern techniques in reach to control monetary quanta? Do industrialized and industrializing countries actually apply central command monetary planning to save the capitalist market economy of private fractional reserve banking or can monetary state capitalism only survive by socialist financial planning? These are puzzling questions, concerning the monetary problem, but we need a more scientific method to prove theoretical theorems and ideological claims; we strongly promote 100% money and banking, to keeping the monetary quanta as constant as possible, in order to reach more economic sustainability. As we already explained, our experimental attention is focused on the entropic or negentropic interplay of space (physics/production/P) and time (money/quantum/M); even the much lauded Deutsch Mark of the Bundesbank had lost almost half of its purchasing power in the 50 years before the Euro, due to fractional reserves and we have to count with an equal fluctuation and decrease of purchasing power (1-2% annually) under a gold ratio, because economic productivity and precious metal quantity are never in a behavioral balance, according to quantitative economic history. In a 100% money and banking system, only savings can be lent out and bankers become mutual fund managers; any socio-economic system that uses the market as knowledge gathering instrument for human exchange cannot function without monetary stability or robustness, i.e. the monetary quantum must be hold as constant as possible to guarantee economic growth and prosperity for the general populace of a sovereign territorial polity.

The physical behavior of monetary systems works on three inter-connected levels of operation:

A: Spatio-temporal entropy, i.e. quantum thermodynamics of production/P and money/M, e.g. duality of bad credit that drives out good money, according to Gresham's law;

B: Monetary quantum behavior, i.e. quantum mechanics of the monetary production economy, i.e. duality of M and P, e.g. chain of single payments as market signal;

C: Bookkeeping, i.e. accounting measures of M and P, e.g. duality of entries; these operation level is very crucial for global trade as there is no real clearing unit for international settlements, e.g. as a measure of renewable or clean energy.

Political feasibility suggests that a radical 100% money and banking reform has to be designed as a systemic mix of central banking (currency emission and stability) and private banking (narrow deposits and investment), i.e. a clear legal distinction between money and credit. Alternative currencies (local currencies, gold ounces, precious metals, barter, etc.) should be allowed by law whenever there is an operating market, to decentralize money gradually and to strengthen its original role as a market replicator. The shadow Ping-Pong of private vs. central banks and the dangerous trend to a central command monetary economy must be stopped as it is as unsustainable as any centralized administrative planning of socio-economic systems. The 'new' monetary system will put a high wall between the monetary quantum of an independent public authority and the credit quantum of private commercial banks; countries with appropriate natural gold resources or precious metals (e.g. South Africa, Russia) might even opt for a 'yellow brick' standard, to stabilize their economies for the future. However, empirical data show no statistical evidence for the superiority of 'yellow bricks'; the golden period from 1870-1914 was at least as volatile for inflation and output as

‘papyrus’. The cruelty of macro-economic decision-making will not magically vanish via the rational application of precious metals, but the decentralization of economic decision-making is the decisive point as no human oracle can know ‘it’ all. According to mathematical law, the current debt chain system will abolish itself (implosion or explosion?); in order to circumvent the final margin call, it is necessary to research into the movement and development of the monetary quantum in our electronic age, starting from the physical basis of natural-law monetary science (monetophysics). It is indeed timely to finalize the financial religion of monetary alchemy in economic science and to strategically move economics from a profession to a science; human economic action is the result of biophysical, socio-psychological and ethical decisions that are governed by the construction principles of ‘reality’. Ultimately, we are discussing the future of human civilization on this planet; as all human societies are no more natural economies, it is vital to attack the money problem on a physical scale. Our proposal is also not about seigniorage for a grand leviathan, but about restoring legality to financial transactions and to rectify a violation of natural law that causes harmful effects to the working body economic and politic. The polity and the market evolved as a social duality of economic systems control and human monetary behavior must submit to immutable laws of nature.

Before we can embark on more precise observations of the monetary quantum, let us take a cognitive walk on the origin and nature of interest. Debt changes through the continuum of time and is modified by interest: 1) Why is interest fluctuating? 2) Why does interest exist at all? 3) What happens with interest, once it is paid, booked or transferred? Our answer: Interest occurs because the monetary quantum at time1 possesses less value than at time0; between time0 and time1, the life time of the creditor has become shorter and less time remains for her/him, to redeem the money for a purchase. Without mortality there would be no interest; quantitative economic history reveals that interest is very high in social

periods of fast alternating scarcity (i.e. extreme price fluctuation) and low life expectancy; when price fluctuations stabilize and life expectancy rises, you can observe a decrease of the interest level (e.g. in the golden 19th century, European interest on capital was about 2% for English and Prussian securities). In any case, the debtor always has to deliver a plus-payment via the market; the quantum duality of the market works as a place of exchange and payment (+ plus-payment=interest, repayment of credit, eventual redemption of debt); the destabilization of every human society has its roots in the non-performance of payments (such social events did also happen under a commodity credit system when open claims could not be redeemed). Debt causes always more debt and the debt process is nothing else than the entropy of an economy; any economy that allows for debt accumulation, exchanges real economic productivity with artificial interest-pushing (today: electronic banking computation). Consequently, productive income declines and income via interest-pushing increases; according to mathematical law, inflation can never catch up with debt and progressive insolvency or bankruptcy become pathological systemic behavior. However, this current practice of fiat credit and interest, driven by non-natural fractional reserve banking, has nothing to do with real interest on credit (based on 100%money). Scripture was probably invented by Sumerian bookkeepers, but it is no coincidence that all holy books of humankind (e.g. the monotheist literature of Torah, Gospel, Qur'an) contain explicit warnings against the non-natural multiplication of interest; nevertheless, this author has found no textual evidence against natural or real interest (e.g. folk tales of the exponential multiplication of a corn on a chess board are another source of ancient human wisdom about the working of mathematical principles in 'reality'). A human economy is the productive result of space/production/P, time/money/M and energy/entropy/E; economic production quantizes time and money quantizes economic production, the monetary quantum consequently checks economic productivity. Therefore, in a monetary production economy, money has to be an exact physical representation of economic production in temporal and energetic terms, i.e. 100%money. In the physical laboratory, when energy is at zero-point level, time is eliminated and entropy is absent; ultimately, energy

(or condensed energy=matter) derives from light as a temporal product, i.e. time is the duration/difference between cause and effect, light permeates space, time and energy as causal agent. The monetary quantum has to embody these physical relationships of economic production time; in the economic laboratory of production, money is the decisive signal for human action; physical abuse of the monetary signal causes harmful effects on human economic productivity, i.e. the non-natural multiplication of fiat credit and interest is the root cause of economic crisis and breakdown (e.g. the collapse and systems change of the Soviet Empire was the simple result of a liquidity run by accepting the terms of trade of the 'West'=fractional reserve banking; for example, the consumer gulyas communism of Janos Kadar in Hungary was a pure credit bubble that was physically not backed by economic productivity). This only goes to prove our basic dictum that the monetary quantum supersedes the internal market and polity of a nation state and that no economy is a monetary island (remember Iceland).In one sentence: money quantizes economic production time.

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