Heterodox Economics and the Theory of Coenoses.

The next 10-25 years.

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Summary. In the first half of this paper we use a set of assumptions from the classical economics as a basis for developing a new heterodox theory, "a theoretical explanation of the historical process of social provisioning…" (Lee, 2007). It is then used as an underlying platform for bridging several bitterly contested, but, as we'll show, perfectly commensurable views of reality. While providing new insights into such concepts as *survival, reproduction, wealth of nations, currency, labor-derived value vs marginalist concept of utility* etc, this exercise supports the argument of (Lee, 2007; Soderbaum, 2007; Waller, 2007) that the current acrimony in economics is rather politically motivated.

In the second half we present and analyze our theory of coenoses. History is seen as a succession of domesticating 6 distinct geoclimatic zones: from the deltas of the great rivers of the first civilizations to, most recently, the huge territory of the US. Within a zone, an economy advanced stadially, defying the popular concept of "chaotic" history. Falsification of this theory would thus entail using the persistent patterns of the past for predicting the future.

We summarize our theory with a conclusion that a new era looms on the horizon. To unleash the true potential of the emerging world there may be a need in a brand new economy/technological style, radically different from the current mode of mass production. The old, tried and true recipe of increasing the level of energy consumption served the humankind for millennia. It may be well outdated at our age of global warming.

Keywords: pluralism, economics, energy, energy consumption, energy resource, geoclimatic zone, labor theory of value, marginalist theory of utility.

Introduction. Once upon a time, 7 wise sages were led to an elephant and asked to describe it. Not to be fooled by elusive ephemera, each of them grabbed a part – a tusk, a leg, an ear, a trunk…, and diligently itemized its every tangible manifestation. Little wonder that they are still arguing today. We wouldn't know why, in their infinite wisdom, both the sages and most economists, who have so faithfully emulated them, chose to close their eyes and discard the elusive grand picture. But, since the elephant is still here, begging for our attention, a look at the whole is open even today, holding a promise of reconciling the warring schools. Most of their findings seem to be relevant, as soon as we accept their spatial-temporal limitations. Even the neoliberal economics must have been right in its heyday, as the practical steps taken under its guidance did succeed in spreading the US-style capitalism all over the globe, while its nemesis, the Soviet Union, crumbled under the weight of its outdated economy. Today, however, the old tried and true recipes have obviously stopped working in the new environment of globalization that its own success has ushered in[1]. Perhaps, as soon as we grasp the elusive whole, it will reward us with a new understanding for familiar concepts of economics, such as *currency, value,*

[1] Michael Mandel. Can Anyone Steer This Economy? Business Week. November 20, 2006, cover story.

resource elasticity, utility… A fresh viewpoint may provide unexpected insights into dire problems in our near/midterm perspective as the world around us is changing rapidly.

1. *The Search for a Common Thread and the Theory of Coenoses.*

In an attempt to grasp the mysterious main object of the economic research – the said elephant of the eastern tale, we looked at the entirety of the written history, trying to find a common thread that would unite it and hold true regardless of endlessly shifting historical realities. Three conventional classical assumptions provided the overall guidance.

1. The classical belief in the overall ***rationality*** of human behavior implies self-regulation of business activities through the supply-demand interplay – the consumers attempt to maximize their ***utility*** on the demand side and income-constrained businesses respond by trying to maximize their ***profits*** on the supply side.
2. It seems hard to deny the overwhelming evidence for the existence of ***cycles*** of various size and intensity, during which, in turns, societies were enriched and ravaged through millennia[2]. The great periods in human history, on the scale of antiquity or feudal era, appear so starkly distinct from their temporal neighbors as to earn a special name. In their turn, the smaller cycles within these great periods, such as the Kondratieff (or K) price waves, were observed since at least the industrial era. According to J. Schumpeter, three smaller Kuznets waves are nested within a single K-wave and, in each of the former, there are also about two Juglar waves, with about six Juglars fitting within one K-wave. Such short business cycles still influence our daily lives despite the emergence of institutions, such as the Federal Reserve System, purportedly to deal with them. The recurring busts stress the ***fleeting nature of equilibria/efficiencies/optimums***, be they described according to Walras, Pareto[3] or Nash. While these certainly may occasionally exist, the persistence of cycles in history gives credence to an alternative viewpoint of development seen as a ***transfer of disequilibria***, in the manner of a gait, when, in order to stop a fall, one has to extend a leg[4].
3. Since such cycles were noticed across ages and formations, both within capitalism and much earlier (Fischer, 1996), they must have been ***endogenous*** for their particular economies, though, perhaps, occasionally sped up and amplified by exogenous influences. Then, all we need to find is their triggers and ***the inner engine*** that would force otherwise rational human beings to engage in violence and destruction, both of lives and valuable property.

Using the extensive body of research regarding the longer cycles, we looked for a general engine of development, non specific for economic formations. Most historians seem to agree that there were about six grand periods, on the scale of the first civilizations, the classical antiquity of Greece-Rome, the Medieval Era, the Age of Exploration, the Industrial Era, and the current age

[2] Stages of development were noticed by both A.Smith and K.Marx. R.Sutch (1990) argued for incorporating a life-cycle perspective into all economic history.

[3] And their many versions, such as the Walras-Cassel and the neo-Walrasian model.

[4] Similar to the Austrians and contrary to the neoclassical focus on equilibria, we stress dynamics – there is little evidence of stability in our turbulent history. Reconciliation of these two positions seems, however, possible if we accept the fleeting nature of equilibria. Development then would advance through a series of dynamic equilibria, with the entire flow being balanced through the second derivative. Using the earlier example of a gait, this scenario achieves stability through growth. The end of growth would usher in a chaotic period of instability as it happened indeed many rimes in history. The alternative position of stressing equilibria per se seems akin to a reliance on a stopped clock. It would certainly show the correct time, twice a day – the only problem would be to find when.

of the US-style mass production. Each of them was unique, with a noticeable ***break of continuity*** between them – more or less prolonged and destructive "***dark ages***". While there is certainly no shortage of wars in history, events between these periods were so extraordinary and accompanied by such great upheavals and migrations on the scale of a massive *Volkswanderung* that they stuck in the memory of generations as, respectively, the Catastrophe of the Bronze Ages of the 13th century BC; the immense tide of barbaric invasions, from the fall of Rome in the 4th century and up to the Viking raids of the 9th-10th century; the tumultuous period bookended by the 1348 Black Death and wars of Reformation; the American Revolution and the Napoleonic wars before industrialization; the great revolutions and the two world wars before the rise of the mass society of the 20th century, and, most recently, a wave of terrorism that may be announcing the start of yet another period of insecurity unfolding on the backgrounds of massive human movements, where entire countries seem to be supported by the cash sent home by migrants laboring elsewhere.

The distinctiveness of temporal-spatial locations where these great historic periods took place provided a valuable hint as to their nature. It turns out that each of them unfolded in its specific geoclimatic zone by evolving a unique economy complete with appropriate power institutes/ownership structure in order to maximize the utility of its innate geoclimatic features.

1. The first civilizations flourished in the tiny area of the ***deltas of the great rivers*** by developing the *communal economy* of the irrigation agriculture, with harvests presumably greater than in modernity. (3400BC, Uruk – 1190BC, the Catastrophe of the Bronze Ages). This economy was powered by *large human gangs.* Thus, it was dependent on the superior productivity of the irrigated alluvial mud-soils as the means to assure the prerequisite high density of population.
2. The classic civilization of Greece-Rome rose in the ***arid Mediterranean***. This area, unsuitable for widespread irrigation projects, proved to be perfect for the *market economy* of the *poleis* based on the olive/vine. The classic antiquity thrived on orchards grown for profit, with grain supplied from the older zone, i.e. Egypt. (479 BC, the end of the second Persian invasion to Greece – 378 AD, the battle at Adrianople at the start of Germanic invasions). Technologically, it was based on applications of mechanics and was powered by oxen, with slave labor used for high value production aimed at market.
3. Following the "dark age" of invasions and disarray, the ***forests of Medieval Europe*** had been cleared. The heavy clay soils, which had little value within the Roman market-oriented economy powered by oxen, were tilled with the heavy wheeled plough. The *manor based subsistence economy of feudalism* was powered by *the horse*, fed with affordable *oats* as opposed to the more expensive barley. (800, Charlemagne – the 1348 Black Death)
4. With most of the wastelands cleared off, the growing demand for products, such as fish, meat and wood, previously collected in the forest, led to the rise of commercial husbandry/fishing of ***the Atlantic coast.*** This economy provided an alternative to farming, which these lands were ill-suited for. The gun-armed caravel of the North Atlantic enabled the European Age of Exploration, with *economy based on water-wind power of shipbuilding and mills*. (1415 Ceuta, 1517 Reformation – the 1775-83 American revolution)
5. Britain lacked rivers and timber, the main resource of the previous era, but she more than made up for her shortages by using the local substitute, *coal*, the inelastic resource of the *Industrial Revolution*. First the railway and then the steamship opened up the ***land-locked*** territories, enabling white settlements all over the global ***temperate zones***. (1815– the 1860s, Britain lost its technological edge at the first inflationary peak of coal (Hobsbawm, 1999))

6. The huge territory of the US was mostly in the ***zone of the extreme climate***, previously out of the reach of the farmer. The zone was domesticated as the US developed its unique *oil-based economy of the mass car*, with artificial irrigation, cheap rural electrification, massive use of fertilizers, herbicides and pesticides and speedy transfer to the market. (the 1920s – the 1973-81 double Oil Shocks, when limitations of its oil-based economy showed up for the first time).

Each new period evolved on its unique territory feeding off its specialized economy so as to better utilize the distinct features of its terrain. As soon as the zone in question was fully domesticated, its winning technological/economic style spread to its margins. The latter, less suitable for the dominant economy of the time, would form the nuclei of the next zone, when trying to survive in their harsher place. The grand historic sequence above gives validity to a geography-based outlook of such noted researchers as J. Diamond, who saw the origin of economic diversity in geoclimatic conditions of the related areas (Diamond, 2005). Similar understanding is pursued also by ***evolutionary economics***, which attempts to look at the man and society as yet another biological ecosystem[5].

There seems to be wealth of supporting data for explaining historical rhythms through activities aimed at domesticating a progression of ever larger and harsher geoclimatic zones. A Dutch historian, Jan Romein, quoted in (Kindleberger, 1996, 36), suggested "the law of interrupted progress", somewhat resembling the Schumpeterian "punctuated evolution" (Schumpeter, 1939) – "any country pioneering in a new, more highly developed phase of civilization reaches a threshold or barrier beyond which it is extremely difficult to proceed, with the result that the next step forward has to be made in another part of the world". This stance helps to explain the "dark ages" between great periods as the time of transition. Contrary to Malthusian pessimism[6], there is ample evidence for teleology in history. Despite occasional setbacks and bloodshed, populations grew more or less relentlessly, both through the increase of farmland and its productivity. The amount of accumulated wealth, though not necessarily happiness, rose throughout history steadily and spectacularly. This view is indirectly supported by the Ricardian "comparative advantage". Taken to its extreme in a seclusion of a new location it provides an evolutionary edge, and may form the foundation for a brand new economy of the future leader.

If we accept this viewpoint, the process of domesticating the next zone may present a suitable ***unifying*** topic for branches of economics and ***bridge their disagreements***. Domestication transcends merely populating a place and means a lot more – ***creation of a specific highly productive and mutually dependent ecosystem, which we call coenosis***. It stands out in its age and time because of the unsurpassed efficiency of exchange flows between its basic level of producers and the controlling level of consumers, aimed at maximizing the ***utility*** of its resources per unit of ***labor,*** and the overall ***wealth*** of the system. This biology-tinged understanding is loaded with important implications listed below:

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[5] The mutual interdependency of its levels is modeled by the Lotka-Volterra equation of predator-prey interaction (Silverberger, 2006).

[6] At the first glance, our theory of domesticating ever new zones may look like a rehash of the classical Smith-Ricardo-Malthus or, even mustier, physiocrat-style economics, with irresolvable limitations placed by one's environment. There is only this tiny detail. Stressing that each coenosis is, first and foremost, an open system in the sense of Bertalanffy (1950), our theory turns into their direct opposite. The Malthusian "curse" is resolved in principle: by constantly opening up to new opportunities that didn't even exist before.

1. ***A break of continuity between coenoses.***

- For example, a shift to a new geoclimatic zone would imply the exhaustion of the growth potential within the previous one as most people wouldn't leave their lifestyle willingly.
- A *Volkswanderung* and upheaval at the start of a new era can be explained by a natural assumption that, at the end of the previous coenosis, as its own resources gradually dwindle, its wealth would spill out in exchange for faraway human and natural resources. The availability of this wealth during this period of getting "out" translates to more food at the margins starting an unsupportable demographic spurt. Typically, this led to the phenomenon of the "invading barbarians" drawn in by the manpower needs of the core[7].

2. ***Creation of a new specialized economy.***

- Since marginal "wastelands" are usually ill suited for the dominant economy of the time, the said "barbarians"[8] have to create a new economy, more suitable for their zone.
- Note that, within the previous coenosis, the new zone was generally unable to return initial investments. Its efficient domestication historically implied a switch to more powerful, energy-wise, technologies. This explains the well-known paradox of "uncivilized barbarians" – compared to their "civilized" predecessors, they tended to be higher up the energy consumption ladder.

3. ***The existence of a dominant inelastic resource for a coenosis.***

- A succession of ever more difficult zones was historically domesticated as its inhabitants learned how to use their calorically richer sources of energy[9]. Each historical coenosis can thus be characterized through its main ***inelastic resource of energy***, the indispensable ***centerpiece*** of its unique economy. Among the latter were oil of the 20th century, coal of the 19th century, timber/water of the "long 16th century" with economy dependent on the ocean ship/mill, horse power for the forest clearings of the 9th-13th centuries, oxen of the classical period and work gangs of the first civilizations.

4. ***Labor and utility.***

- Giving credence to the ***labor theory of value***, domestication of a new zone would thus mean creation of objects of value where before there could be found none. This understanding helps in bridging the labor theory of value with the ***marginalist*** concept of ***utility***. Obviously enough, within a given economy, a population would go extinct, if a unit of spent labor doesn't produce sufficient utility for this labor's reproduction. ***Statistically, reproduction of labor through adequate creation of utility per unit of spent effort serves as the <u>only</u> criterion for survival.***

[7] This concurs with Wallersteinian "world systems", as we also single out a dominant, its close and far peripheries, albeit rather stressing technological and economic components than military domination, which becomes increasingly pronounced closer to the last, "imperialistic" stages of a coenosis.

[8] As pointed by Richard Cowen, these barbarians who are sent to colonize wastelands are just as likely to be home-grown as drawn in from outside: Roman legionaries given land on the periphery when they retired; Viking colonists of Iceland, Greenland, etc. were often outlaws or outcasts; the Spanish colonists of the New World were home-grown Spaniards; the religious fanatics (Pilgrim Fathers) who settled the US from Britain; British convicts sent to Australia; Russian convicts sent to Siberia; and the massive proletarian masses from Eastern Europe to the US late in the 19th century and early in the 20th.

[9] 1. The first civilizations mostly relied on muscle power, evolving in highly productive areas that could support great densities of population. 2. Arid islands of Greece couldn't support such densities and relied instead on mechanics and oxen, while using highly trained slaves in production for market. 3. The medieval Europe relied on the horse (White). 4. The Age of Exploration started using natural forces of wind and water, both in its early industrial mills and sail ships. 5. The British domination was based on coal, with extensive coaling stations all over the world. 6. The mass economy of our times is dependent on oil.

- The well known ***law of diminishing utility*** may thus be at work as the underlying cause of a fall in reproduction rates typical for the rich society of the ageing dominant. Meanwhile, a simultaneous growth of utility (from practically zero) on its much less affluent borders exhibits itself through a population surge. Such a demographic disparity, leading to a *Volkswanderung*, seems characteristic for the twilight of the older coenosis. As the rich society of the dominant of its times, from Rome to modernity, slows its reproduction rates, its poor neighbors tend to accelerate them.

5. Price.

- The criterion of survival through growth of utility provides an insight into the process of ***pricing***. In the most generic form, which would apply both to human and natural coenoses, the unit price of the main inelastic product of an era must measure the cost in production of its ***last and costliest indispensable unit***, since, to assure its arrival to the market, the less expensive units must also be sold at that price. This allows both determining the current price level for a product by assessing the cost of procuring its last indispensable unit and the start of its ***substitution***, as its growing costs stop being justified by its utility. In its turn, the start of substitution may lead to developing a related Ricardian advantage, possibly in a new place, thus starting a new cycle of domestication.
- While a new energy source may be abundant in the next zone, for using it to its full advantage a new specialized infrastructure must be built. The ***cost of this infrastructure***, such as, in the case of oil, highways and byways, filling stations, refineries, global trade/financial networks, wars etc, may be ***born by the society at large***, but it ***adds up to the overall costs of the resource, reducing its marginal utility***. As this infrastructure permeates the entire existence of the dominant society, it merges with it, becoming part of its identity, both economically and socially. At its twilight, the older zone is increasingly rigid, solidifying around its infrastructure. For example, the US is synonymous with its roads, while England is still the land of railroads. The place taken up by a working infrastructure can't be vacated easily – historically, substitutions with less expensive energy source per calorie meant the end of an era. Even if there were no other underlying reasons, a switch to the next zone seems necessary in order to provide a ***room for the next infrastructure***.

6. *Currency as the means to monetize the newly created value within a coenosis.*

- Within a given society, its ***currency*** serves as the main means of exchange, by ***monetizing*** the value created within its zone[10]. Thus, the amount of currency in circulation can help to gauge the overall size of the related zone. At the end of a coenosis the sum total of its currency tends to explode commensurate to the great expansion of its zone. This produces the well known phenomenon of "***price revolutions***" during ***globalization***[11], well before the inflationary peak at the start of a new coenosis. After reaching this point (homologous to 1913) it tends to devolve into rampant inflation – such as the one that brought Hitler to power. During this follow-up period, the amount of printed money stops corresponding to the real products of the zone, signaling the collapse of global trade, replaced then with autarky and economic fragmentation. Despite the accompanying poverty and disarray,

[10] Here we don't differentiate between fiat, commodity, paper, credit and other important categories of money.

[11] I.e., the price revolution of the Age of Exploration is conventionally dated from the second half of the 15th century. The species came from European silver mines, depleted after 1610. This surge well preceded the post 1545 flow of gold/silver from America upon discovery of mercury at Huancavelica, Peru (Richards, 1983). Proving the concept, today, money supply is swelling once again, providing an unfailing reply to global demand, even though, instead of mines, the modern financiers have to resort to such rather artificial means as the so called derivatives. Thus, given due demand, the "credit" money can easily replace the role of the earlier "metallurgic"/ species money.

autarky is the season for novel adaptations. They grow in a seclusion of their locality, away from buffeting global winds.

7. *The cyclical nature of development.*

- The concept of a coenosis evolving within limitations of its zone gives an insight to the ***cyclical nature*** of historic development[12]. Apparently, anything once born must advance through pronounced and logically arranged stages of development: youth, maturity, and, eventually, aging and death or, in societies, its close equivalent, the state of homeostasis[13]. A coenosis usually has two distinct stages of life, "in", feeding off its native zone, and "out", when it must reach outside of its zone for new sources of its vital resource[14].

2. A Historic Era Seen as a Lifecycle of its Main Inelastic Resource.

Each historical society rose feeding around ***its main inelastic resource***, which formed the fulcrum of its existence, defining nearly all of its aspects, from the prevailing forms of ownership (Badalian, Krivorotov, 2006, 2007) to popular lore. It can be argued that the economic fortune of a coenosis turns on the hairpin of its resource's availability, passing through a sequence of stages. Entry to a virginal zone means abundance of this resource, which, as a rule, was not considered valuable before – i.e., coal and oil were known, but not used for millennia. After learning how to use it, the locality in question begins to thrive long before the arrival of more advanced technologies. For example, the population of Britain surged starting from the 17th century, time of the so called Agrarian revolution, long before its industrial machinery could bear any fruits[15].

Historically, there is indirect but well pronounced and persistent relationship between the following trifecta[16]: ***substitution*** of the older resource with a new and much cheaper, calorie-wise, energy resource, increase in ***food availability/affordability*** and ***demographic boom***. The start of energy substitution brings better food availability and a subsequent increase in reproduction rates, as the new, yet poor zone develops its young, rapidly rising economy. The demographic curve for the aging wealthy zone tends to show a reverse relationship. The shortages of its main energy resource along with a ***fall of its marginal utility per unit of spent labor*** coincide with the rising costs of the increasingly ***global infrastructure*** for its retrieval and

[12] Carlota Perez provided a brilliant proof for the cyclical nature of technological innovations. Among other things, she showed that the so called lasting "gold ages" of success were typically preceded by busts related to the first appearance of the same technology. (Perez, 2002)

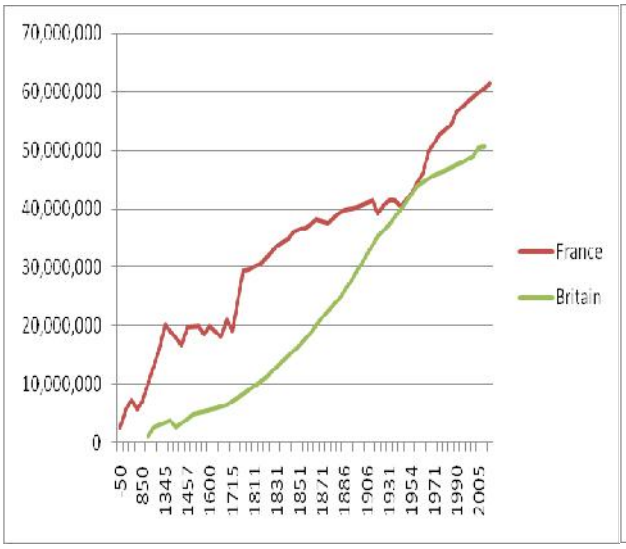
[13] The end of a coenosis doesn't necessarily mean extinction as it happened for example with the Maya. Historically, societies tend to shrink to the size of their optimal/initial zone, i.e. Britain.

[14] (Ackland, 2007) described a process of "cultural hitchhiking". In the wave of advance of beneficial genes, any preexisting traits are carried along, forming a cultural package. Geographic inhomogeneity produces 2 boundaries. The temporary "diffusion boundary" holds the wave's advance into poorer areas until its gradient becomes sufficiently large – in our terminology this corresponds to the periphery. Then comes the "subsistence boundary," in our terms, the far edges of the "out" zone. This land is so poor that the wave of advance is halted. At diffusion boundaries, the winning technology may pass to indigenous people, allowing their population to grow and resist further encroachment. Ultimately, this adoption of technology leads to the halt in spread of the hitchhiking trait and establishment of a permanent "cultural boundary" between distinct cultures with equivalent technology.

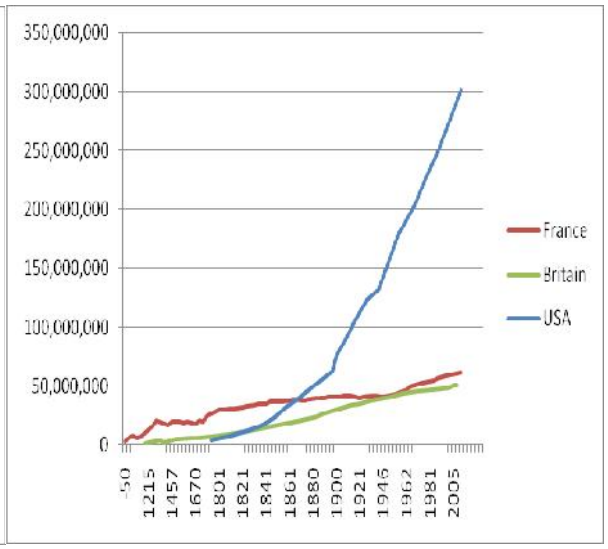
[15] Gregory Clark (Clark, 2002) estimates that about a third as much of the arable could be put in cultivation with a simple substitution of wood with coal for heating uses.

[16] Just like in horse betting, this sequence is ordered, appearing gradually, from the first to the third.

distribution[17]. These costs were more than covered by rapidly rising seigniorial rents, levied both on its population and, most importantly, on the faraway margins. Despite its relentlessly growing wealth, this strained the older economy, increased its labor costs and social stratification, causing outsourcing and a fall in birthrate[18].



Pic.1



Pic. 2

Note that, at the beginning, the functionality of a new energy source is rather limited, as there is no specialized infrastructure for its use/retrieval. The benefits, however, show up from the start – even a relatively small fall in demand may significantly reduce resource inelasticity and lower the overall price pressure[19]. Historically, an entry to a new zone resulted in an exponential growth[20], visible on demographic charts below – considerably more food was produced by freeing resources, such as land and labor, previously devoted to procuring energy.[21] The ageing society, meanwhile, slows its reproduction rates as the search for its increasingly inelastic

[17] Historically, building the ever more evolved infrastructure was perceived as growth of wealth, since this infrastructure helped to satisfy ever more sophisticated demands of the members of the leading society. See, for example, the Roman baths, running water in cities etc These basic needs of public health were perceived as incredible luxury by Rome's neighbors.

[18] A suitable metaphor would be nested rooms. After gradually using up resources within a room, one looks through its windows and builds a door to reach out for more. It is not a zero sum game. The outside "wilderness" gains access to the leader's advanced technologies, even while its resources are taken away. Historically, this caused a Volkswanderung, with a pronounced demographic spurt at the margins of the older zone, whose population already stopped growing, because of the impact of the law of diminishing utility.

[19] By reducing the total amount of the resource needed, the cost of its last indispensable unit tends to fall drastically.

[20] Most notably in the case of the US, this was amplified by attracting immigrants.

[21] Gregory Clark (Clark, 2002) showed that burning coal instead of wood for heating, kiln firing, beer brewing etc brought benefits well before the industrial revolution. By allowing to cut down the so called coppice woods the arable land could be increased by about a third. A similar substitution of draught animals with tractors in the US during the 1920s freed about 160 million acres of pastures for other agricultural uses.

resource becomes all consuming[22]. As we see, this demographic disparity, typical for the end of a coenosis presents a perfect storm, a confluence of many mutually reinforcing trends[23].

According to Pic.1, France had three periods of growth, interspersed with periods of relative homeostasis – 900-1345, 1715-1811, 1954-1971, accounting respectively for medieval forest clearings; French absolutism with its *dirigiste* government; and the European Union. The specialized economies were based on horse power; mills/canal building; and the US-type oil economy, amended by a search for oil substitutes, in the case of France mostly nukes. Similarly, population growth in 1811-1954 Britain (Pic. 1) was supported by its coal economy. Meanwhile, the unprecedented population curve for the US (Pic.2) reached its top speed during the 20th century, exhibiting 3 periods of especially steep ascent: 1850-1900, 1920-1930, 1946-1962. Respectively, they account for the post-civil war development related to the industrial revolution, which opened the country to the railroad traffic; the "roaring" twenties; and the post WWII baby boom, with the last two of these great spurts within its unique oil economy.

Some may object, when we see the "dominant" inelastic resource of an era, such as oil today or coal before, as the fulcrum of its economy. Even today, according to most economists, oil, despite its growing dearness, accounts for barely a few digits of the overall economy. Contrary to negligible numbers, it in fact permeates the entire existence. The economic importance of the inelastic resource can't be measured directly through its costs, but rather through boost or erosion of the overall productivity. It is not only that its absence would bring the economy to standstill as it happened indeed during the 1973-81 Oil Embargo. Even more important is the necessity to obtain oil from any source, at any cost, which drives up the costs of living. Aside from wars, substitution of oil with biodiesel already led to doubling and tripling of prices for corn/sugar with commensurate increases in costs of raising livestock (meat, eggs, milk). The cost of vegetables and fruit is also up, due to raising transportation costs. Such a raise in costs of commodities isn't limited to our age and oil, but is typical for the end of a historic era. For example, in the 18th century England, shortage of wood led to dramatically more acreage under "coppice" woods, driving up the cost of food. Even more drastic example presented the Netherlands, which was digging up its peat and selling it to buy grain, which was also rising in price, but less swiftly than fuel. A corn exporting country became a net corn importer. Thus, increasing dearness of a "dominant" resource of an era drives up the costs of living until the older economy becomes unsustainable and breaks up in a widespread turmoil.

(Fischer,1996) studied inflationary peaks from the 13th century to the 1980s and noticed their amazing similarity. While the price for food and commodities was driven up by the increase in seigniorial rents, not all prices were increasing. Prices for industrial products actually fell, rapidly, as more people were pushed to cities, which led to accelerated technological advance. ***During an inflationary run, the consumer goods' basket excluding "volatile" food and fuel***

[22] This would equal Smith-Ricardo-Malthus economics if not for a small detail – it is an open system. This turns our theory into their direct opposite – and the Malthusian "curse" is resolved by opening up ever new opportunities.

[23] Among the variables contributing to demographic disparity is the contrast between the danger and uncertainty of new places as compared to the rigidity of the older one. In biology, rapidly changing conditions increase procreation and speciation. Similarly, in early industrial England, deterioration of the "old time" male occupancy in the field and at the loom along with the rise of factory jobs for children caused a demographic explosion. Just as it is the case today in the third world, as mass factory jobs disappear, having kids, the more the merrier, helped to assure a family's survival.

tends to distort the overall picture. As it is indeed the case today, falling prices for industrial goods, such as flat-screen televisions and PCs, compensate for rising seigniorial rents (tuition, insurance), while the dangerous inflationary pressure of fuel/food is dismissed altogether.

3. *The lifecycle of a coenosis.*

On the chart below (Pic.3), the blue S-curve graphs the utility of the dominant resource, while the Hubbert's bell-curve[24] (H in red) measures the growth of its production. The Hubbert's curve thus corresponds to the marginal utility of the resource[25] calculated as its first derivative, since it maps the growth potential, derived from a particular resource in the context of its zone. Apparently, the more room for unhindered growth the higher its marginal utility. The black double-curve E of the second derivative represents the speed of this growth throughout the entire lifecycle of the resource, with critical breaking points x_0, x_1, x_2. The pace of growth reaches its maximum at x_0 and then slows down. After reaching 0 at x_1, it turns negative until x_2, and then slowly goes up. The curve E represents our concept of marginal inelasticity[26] of the dominant resource within a zone, as calculated for each point within the lifecycle of this resource.

In their turn, the short periods delineated by points x_0, x_1, x_2 have their important functionality in the lifecycle of a coenosis.

1. Left to the ***maximum of inelasticity*** at x_0 there is a period of strong growth, with easy pickings for the leader, while the resource price isn't yet too high. Two possibilities exist, depending on the stage in the lifecycle. In the start of a coenosis, while everyone else is fighting for the diminishing supplies of the older resource, the leader develops a ***Killer App*** enabling it to use a cheaper substitute. Or, in the middle of a coenosis, the winning economy radiates to the close periphery of its initial geoclimatic zone. Prosperity increases along with trade flows.
2. The maximum of inelasticity at x_0 marks the start of destabilization. At least some customers reject the older resource. Unable to justify its exorbitant prices, they resort to substitutions,.

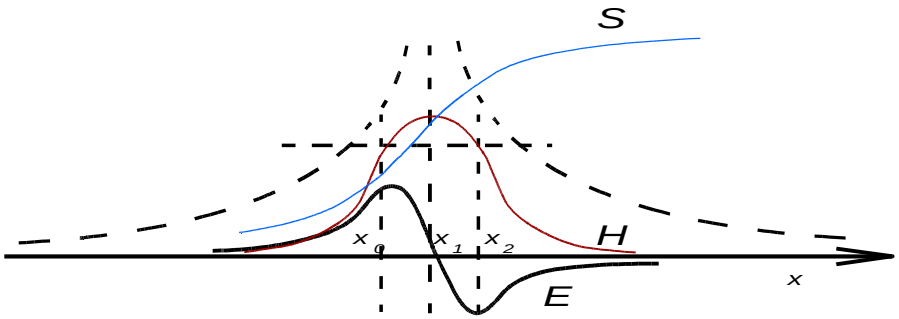
[24] In the 1950s, King Hubbert, a geologist, used this curve to predict oil shortages of the 1970s.

[25] Hubbert's approach used the output of a single oil well for modeling the entire oil industry, first within the country. After that, his disciple Deffeyes used this approach for the globalized world. (Deffeyes, 2001). In fact, Hubbert saw the lifetime output of a single well as its utility spread over the period of its exploitation. At the same time, the amount already produced by a well represents a point in its lifecycle as a point in its lifetime output. Hubbert used two axes, t (time in years) horizontally and y, the yearly output (mln of barrels), vertically. If we replace t with x (mln of barrels) and measure y in mln of dollars, the curve would preserve its bell shape, while mapping marginal utility represented through the yearly output. In this way a point on a curve corresponds yearly out put in dollars to yearly output in barrels representing the unit price at a specific point of a lifecycle. This curve would estimate the marginal utility of oil resource for the entire geoclimatic zone of the US, while correcting it according to Deffeyes's, allows modeling it for the larger world.

[26] Elasticity is usually presented as $\frac{dQ}{Q} / \frac{dP}{P}$ the ratio of relative changes per unit of resource to its price per unit. By averaging to units of quantity and price, this measure aims to represent the aggregated market response to price movements and other changes in market parameters related to revenues, incomes etc. In contrast, marginal inelasticity or partial derivative of $\frac{\partial P}{\partial Q}$ introduced above by the authors reflects the localized measure of inelasticity related to the current quantity of resource and its price. In the style of the Austrian school, this measure relates to elasticity in the same way as marginal utility to general utility.

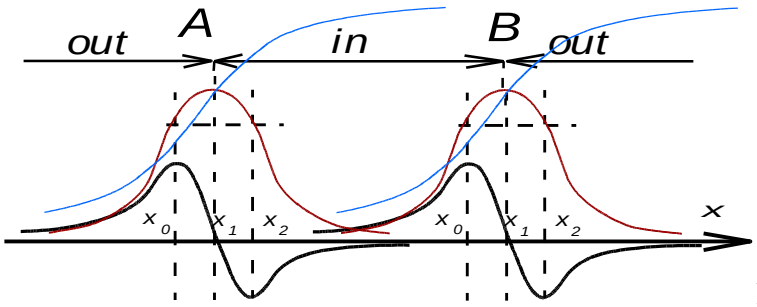
That is why, between x_0 and x_2 ***inelasticity*** steadily decreases until its ***minimum*** at x_2. Thus is overstretched the old infrastructure. Its grip on the economy breaks at the inflationary peak x_1, when the resource turns elastic again. This is the time of an ongoing switch, of finding uses for any available substitution. Note its start well before the inflationary price peak at x_1.

3. Right of x_2, the easy substitutions come to their limit. It becomes necessary to build a new specialized infrastructure for the brand new resource (during the in period) or expand the infrastructure of the older resource outside the initial geoclimatic zone (out). For example, the US developed the Model T, its unique Killer App, promoting a switch to oil, in 1908, well before good roads. Meanwhile, the Great Depression coupled with the environmental disaster of the Dust Bowl caused by the tractor[27] spelled the need in infrastructure, such as the one built during the New Deal in the 1930s. It included rural roads, rural electrification and irrigation, enabling thus the mechanized agriculture. The second-stage (out) of globalized oil infrastructure fully functioned from the 1990s, as a sophisticated network of oil refineries, tankers etc, connected through the Internet and financed by the petrodollar.



Pic. 3

If we accept the Hubbert's curve as a loose approximation for a K-wave of prices, which tend to follow the utility of a product, a full coenosis can be depicted as a sequence of two curves. Its heyday AB (in) starts with the destabilization at the inflationary peak A of the older resource. It ends with the inflationary peak B of its newfound resource that marks the exhaustion of its inner resources along with the necessity to get "out", searching far and wide for more of the same.



Pic. 4

Both A and B mark a switch to a new (right of A) or wider (right of B) zone in order to exploit its resource. However, the situation right of B seems significantly less dramatic – the resource itself doesn't change, even though it has to be retrieved from a much larger zone. While it means a need in globalized infrastructure, to be built at a great cost and effort, the related turmoil can't be

[27] In the 1920s an additional 5.2 million acres were added to the 20 million acres in cultivation. 50,000 acres a day were being stripped of prairie grass that held the soil when the winds came sweeping down the plain. (Egan, 2006)

compared with a massive switch to a totally new resource. The latter tends to be accompanied with destructive events on the scale of two world wars of the 20th century. The new ownership/power institutes are shaped by and during this power struggle.

4. *The Amazing Synchronicity of Historic Stages.*

Historical coenoses displayed amazing synchronicity as they advanced through stages of their lifecycle, which gives validity to our 6-step model (Pic. 4). We illustrate these stages on the example of two coenoses: the industrial age of the 19th century and the mass society of our days.

1. ***The early period of growth***.

The demographic charts on Pic. 1-2 show that both Britain and the US had a growth spurt well before the inflationary peaks of 1812 and 1914, which marked the birth of their respective coenoses. The period of growth at the beginning of the 20th century is thought to be an "economic revolution, analogous … to industrial revolution" (Berry, 1987, 100) In the US from 1880 to 1910 wealth increase reached 250% together with 220% rise in industrial output, seeding new industries – chemical, rubber processing, production of combustion engines, turbines etc. Similarly, in England the industrial revolution from its very beginning before the Napoleonic Wars was fueled by the textile industry, while seeding a number of new industries related to steam. In both cases, there was a dramatic increase in the arable land, facilitated by the new energy resource. In the case of Britain, substitution of wood, which was scarce, with coal, which was plentiful, became economically important as early as the Agrarian revolution of the 17th century (Clark, 2002). Among other things, coal provided an alternative to firewood of communal forests, enabling widespread enclosures of commons. Despite inhuman workhouses, more food translated to rapid population growth (Pic. 1) The US, in its turn, never even entered the coal age, but jumped to the oil age straight from using wood. Prior to WWI, oil's economic importance grew based on the immensely popular Model T, gas powered small machinery on the farm, substitutions of whale oil for lighting, a cheap alternative for town gas infrastructure...

2. ***Destabilization: entry to a new zone: a newfound dominance.***

After the first inflationary peaks of their periods (WWI and the Napoleonic wars), both the US and Britain acquired new importance, as the creditor and the workshop of the world respectively. During WWI the Turks stopped the flow of Russian grain by closing the Dardanelles. The US filled the gap. Its prairie land, which was practically inaccessible to mule teams, was cleared off with the help of the tractor from the 1920s. A noted historian, Roberts (Roberts, 1989), explained the lengthy turmoil between the two world wars as caused by a switch from coal to oil economies. Apparently, this could be only noticed in hindsight. Even as coal infrastructure was in shambles after WWI, the 1919 Versailles conference was concerned with guaranteeing sufficient coal resources to former belligerents, seen as essential for a lasting peace.

3. ***The end of "cheap" substitutions: building a full-scale specialized infrastructure***.

The end of substitutions "on the cheap" hit especially hard in the US during the Great Depression. The advent of the infamous Dust Bowl pushed towards building a specialized oil based infrastructure, complete with rural roads to the market, rural electrification/ irrigation. Similarly, Britain in the grip of the post Napoleonic deflation faced the necessity of building a railway infrastructure. As, with the disappearance of early industrial jobs, the real income per head was steadily falling down in the 1830-40s, "the age of (cheap) industrialization based on such things as textiles was giving way to the age of railways, coal, iron and steel… In the 1840s

the spectre of communism haunted Europe" (Hobsbawm, 1999, p. 75-78). In the 20th century, 4 countries, the US, Germany, the USSR and Japan, despite their fierce ideological differences built their unique versions of oil-based infrastructure[28]. Their relative merits would be checked out during WWII. In the 19th century, Britain had no peers. Historically, the 19th century was the only coenosis, when a homologous equivalent for WWII was avoided. Apparently, a series of European revolutions in 1848 sufficed by clearing out the vestiges of the "ancien regime" to make a room for the nascent European industrialization[29].

4. ***Radiation of the winning economy to its close periphery***.

The Marshall Plan, albeit more institutionalized, had an eerie resemblance to the post 1848 industrialization, which also spread the winning model of the then dominant to its close periphery. The European resurgence, both in the 1840s and 1940s, was funded by the dominant, based on its winning technology and the related economy and lifestyle (to a degree). The exchange flows enriched both the dominant and new entrants, just as its zone was filled in.

5. ***The 2nd inflationary peak : the dominant loses its technological edge***.

Following the inflationary peaks of the 1860s and the double Oil Shocks of 1973-81 respectively, the dominant of the time, be it Britain or the US, lost its technological edge to the countries of the "second echelon". In the 19th century, Germany and the US developed their unique specialized economies, based on chemistry/electricity and oil respectively. Similarly, Germany and Japan, followed by Dragons/Tigers etc, led in electronics and offered their versions of fuel-saving technologies.

6. ***Globalization: the expansion of the size of the zone, its wealth and commercial flows***.

Soon, the upstarts would lose their spark, since the age of the dominant resource of the time was not yet passé. Closer to the end of century, both for the case of the 19th and the 20th centuries, the dominant produced its "Swan Song", a technological breakthrough, the basis for building the global infrastructure of its dominant resource – the iron steamship and the Internet respectively. The giant exchange flows of our oil-based globalization were enabled by the container ship and modern financial/communication networks. The PC and the Internet, both coming from the US, made outsourcing both possible and profitable. Similarly, Great Britain reached its full might at the corresponding stage of the previous century[30]. The British-built global coal infrastructure consisted of a dense network of coaling stations, British navy patrolling the seas, and global railroads. The river-like dendrites of railroads collected goods from far and wide to the ocean's shore, so great steamships would carry them off to London. Turning every exchange, regardless of its parties, into a three-way trade centered in London added significant seigniorial fees. Even as British industry stagnated because of outsourcing, the empire grew rich, making it into the fervent proponent of free trade. Today, the direct control from the US may be faltering. But, just as it was the case a century earlier, the global exchange flows are supported by the three-way trade based on oil flows and paid for with the petrodollar. China plays an important role, as it sells its products to the US and uses its dollar-denominated profits to buy supplies and

[28] The New Deal programs of rural irrigation and electrification eerily resembled similar projects across the ocean, pursued by the Soviet Union and Germany. At about the time of the Great Depression, Stalin presided over the infamous Holodomor in the Ukraine, where small holders were replaced with tractor-powered collective farms.

[29] Railway mileage. (Hobsbawm, 1999, p. 93)

YearUKEurope +UKAmericaRest of world1840-506,00013,000 7,000--- 1850-604,00017,00024,000 1,0001860-705,00031,00024,000 7,0001870-802,00039,00051,00012,000

[30] The Queen Victoria crowned the Empress of India (1877). The Boers were crushed in the second Boer war (1899-1902). Just the direct payments from India amounted to two fifths of the British budget (Hobsbawm, 1999), while the South Africa became a rich source of gold and diamonds.

technologies elsewhere. Currently, as the military mishaps weaken the dollar, the euro-zone, led by the Great Britain, is positioning itself to inherit the central role.

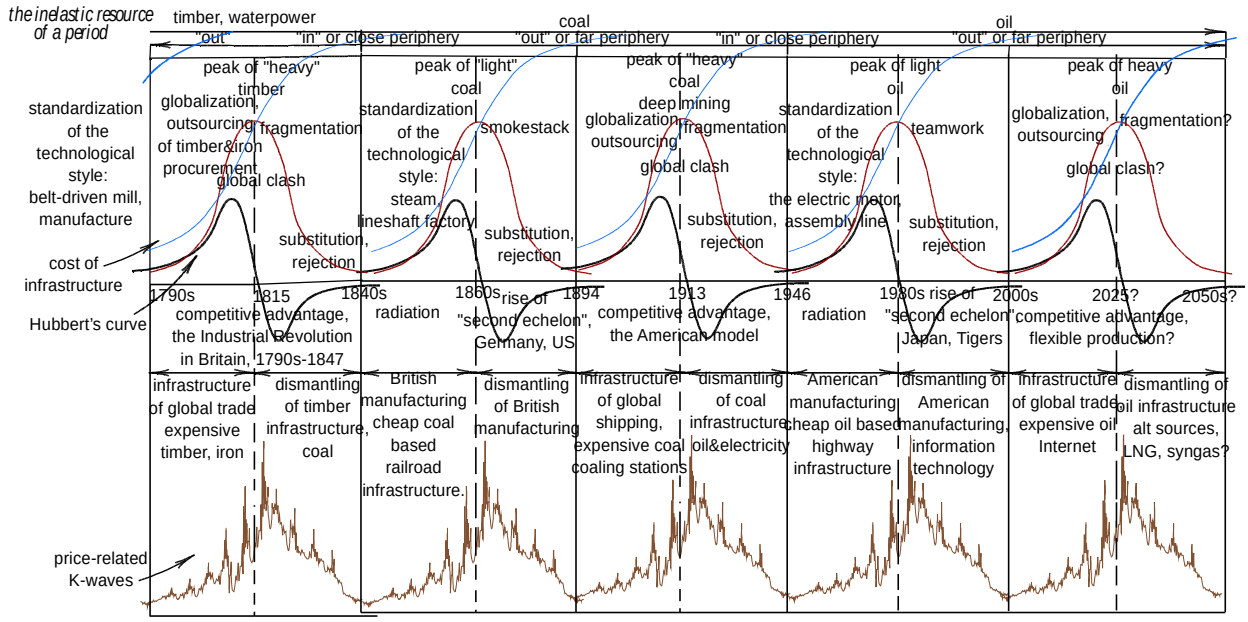
5. The end of a coenosis.

As the mass production coenosis, based on the US-style oil economy, approaches its geoclimatic limits and gradually begins to wane, the universal currency for global trade comes front and center. Its stability becomes paramount for monetizing the diverse smorgasbord of the vastly larger globalized world, so it could be run smoothly within the dominant economy of the time. Amazingly, this functionality stays basically the same regardless of whether the dominant is the creditor (Britain) or the debtor (the US). At the first glance the differences seem stark. In the case of the British empire, its satellite-countries run economies of deficits and the dominant thrived on the enormous interests it charged for its loans. Today, both the raw-material-suppliers (the Saudi Arabia, Russia etc) and industrial and service powers (China and India) run surplus economies of ***proficits***, essentially lending their earnings to the developed world (including the euro-zone), so their citizens can buy more imported products. It would seem that China that pollutes its environment as it industrializes for the sake of the developed world or Russia that trucks away its natural resources to more or less the same address would be able to dictate their conditions to their debtors. The reality is, of course, the direct opposite. Neither China nor Russia nor any other supplier-satellite can easily divest of their paper "profits" and thus must support the leading currencies as long as they can, if they don't want to lose the accumulated value. The most they can do is diversify their holdings among a basket of currencies. There is no sensible way China can use a trillion dollar it holds – 10% of US GDP. Not that it can freely buy US companies it fancies without asking the US Congress for consent.

Immanuel Wallerstein, the author of the "world systems" theory, found that in 500 years of European dominance there wasn't a single instance of "periphery" moving up to the "core". As the dominant country of the time fades, its central position is usually taken up by a "near-core" one. The universal currency happens to serve as an important means of further strengthening the asymmetries of global exchange. I.e., in Russia, its currency reserves deter the development of its domestic industries, since it is easier and cheaper to buy things abroad. Joseph Stiglitz demonstrated the asymmetrical nature of global markets and proposed ways to make them more equitable. But there is a serious systemic problem, which hardly can be corrected by any policy changes. Historically, a new coenosis presented "wastelands", unsuitable for the dominant economy/technological style. To unleash its true potential it had to develop its unique adaptation (economy+technology) to the specifics of its zone. This, along with the unbearable burden of the growing seigniorial rents charged by the dominant for its crucial infrastructure of the global trade, was, perhaps, the most important reason for the "break in continuity" typical between coenoses.

Today, in the age of global warming on the backgrounds of growing arms proliferation, the old recipe of increasing the energy consumption seems outdated and in the need of dramatically new solutions. In our next work we show that the switch to technologies of the future may be alleviated by something so simple (and incredibly hard to pull through intense human resistance) as an orderly replacement of the dominant currency with carbon credits, suggested by Stiglitz as a means to promote energy saving technologies/lifestyles. A precedent for such a switch already

exists (the euro). With the right implementation it might be made Pareto-efficient for both the creditors and the debtors helping them towards a soft landing. Meanwhile, the authors would be happy to falsify their theory by voiding its dire predictions of a fiery global conflagration in about 10-25 years or so.



Pic. 5

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