ЭКОНОМИЧЕСКАЯ ТЕОРИЯ

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UNCOVERING NATURE'S REAL ECONOMY AND ITS IMPACTS ON HUMAN SOCIETY BY OBSERVATION AND HEGEL'S PHILOSOPHY

Approach

Based on observation and philosopher *Georg Friedrich Wilhelm Hegel's* (1770–1831) concept of generating an overall picture the author uncovers the structure of Nature's real economy by raising questions and providing hypothetical answers (equal intuition) and by testing whether those hypotheses fit both principles of economics and natural laws (equal analytic tools). An innovative element is the consideration of biologic production and reproduction of creatures as an economic production; thus economic theory is expanded from mankind to the entire ecosystem of Earth. This approach is contrary to those of ecologists who think market models of economic theory are not applicable to model ecological transfers, and it confutes this opinion. It is different from general equilibrium models because it concludes theoretic and empiric results directly from observation and economic principles and does it not via data. However, its results reflect in statistical data of social and natural challenges of mankind and confirm new insights.

New cognition

A dual view on Earth, axioms: The natural state is our solar system, its population is the entirety of creatures and species on Earth, its laws are the natural laws, its top aim is conservation of life and survival, means of payment equal real money is energy, markets occur as dual markets, creatures equally are enterprises, customers and products, the central bank is the sun, taxes are energy transfers from creatures to environment, subsidies are energy transfers in reverse direction. Implications: Any good has a price, creatures include a bank, they act with incomplete information, species equal industries, they can establish sub-states with own laws subjected to natural laws, the natural state finances its activities by energy from sun, natural resources and by taxes from creatures, Nature's real economy works after principles of economic theory subjected to natural laws (Maier, 2014, p. 12–13).

Evidence

Uncovering energy as means of payment, dual structure of markets, and transfer of payments: Imagine the natural micro-phenomenon of *deer grazing on a meadow*. An economist could realize that it seems to be a food market, demand is determined by deer population, supply by grass population, market place would be the ground of the meadow, and the good the food (grass). However, crucial questions arise: What does a deer pay for the food? And how is its payment transferred to the grass population? As the author cannot detect any means of payment, we continue empirically. We observe a deer moves with grazing. What does a deer need for moving? Isaac Newton's (1643–1727) answer

would be: A deer needs force. Where does force come from? According to him in general a force is impact of another force, but in the end a force is gained by degradation of the potential energy[1]. Therefore, while grazing a deer loses a particular amount of energy, gains force and from it move. Substituting paying for losing leads to the hypothesis: The deer pays with energy which is a real means of payment in the natural world.

We apply Hegel's concept and change the perspective to the supplier' point of view. Because the author has no idea how to accomplish this, we follow the deer after grazing to the resting places in the near forest. There we detect grass! How it is possible that grass plants with roots can walk from the meadow to these places where the deer rest? A plausible answer is: By seeds of grass. Now we realize the perspective from grass population. This phenomenon has a *dual face* which is *seeds of grass are waiting for transport to settle at a distant location* that is with point of view of grass population a deer equals a bus. This dual face seems to be a transport market with changed roles of demand and supply: Demand is determined by grass population, supply by deer population, market place is the ground of the meadow, and the service is transport. Both populations of deer and grass have benefits, the deer through food, and the grass through transport of seeds. Both sell what they can produce and they buy what they can't produce but need for survival. It reminds to David Ricardo's (1772–1823) theory of comparative cost advantages applied to trade between different species instead of nations.

The question now arises is: Who has to pay, the deer population for food or the grass population for transport of seeds? We have to find Hegel's consistent overall picture. So we put the two faces like upper and down side of the same coin, or like Yin and Yang of Chinese philosophy of Daoism inseparably together and conclude: Both populations have to pay, the deer population on the food market, and the grass population on the transport market. And by observation we realize the transfer of both invisible payments: By eating deer get chemical energy from the food grass where seeds are included like in a parcel. And by being eaten (or entering the deer) grass seeds get kinetic energy from the deer like passengers in a bus. Thus the eating procedure includes both transfers of payments in energy units made in different types like currencies.

Let us consider both dual markets as a coupled and closed system, overlay supply and demand curves of both (Fig. 1) and conclude: In general equilibrium, all curves intersect in the same point and the payment in kinetic energy per mass unit transferred from deer to the grass population equals the payment in chemical energy per mass unit transferred from grass to deer population. If this balance of mutual payments would not hold either the deer would pay more kinetic energy for the food grass than they can regain from its chemical energy, or the grass population would pay more chemical energy for transport of seeds than the new grass population of seeds can regain at a distant location. In the long run firstly one population would become poorer and finally extinct because of lack of energy, then the other. But we observe both exist which contradicts this impact hence this balance of mutual payments must hold within a period.

Is this economic result compatible with natural laws? Fig. 1 illustrates that in general equilibrium the quantity of food (here: grass) sold to deer equals the volume of transport services sold to the grass population (both measured in mass units), and the price of food equals the price of the transport service (both measured in energy units per mass unit). This result reflects the laws of conservation of mass and energy in a closed system. If we interpret the activity of grass population to produce and sell food as an action and the complementary activity of deer to provide and sell transport service as a reaction or vice versa, then the dual

[1] The relation is $F = -\text{grad}\ E$ where F is a conservative force, a three-dimensional vector function, E is energy, a scalar function, and grad is the operator gradient; F and E depend from local position and time.

structure of natural markets reflects the natural law of action and reaction. Thus compatibility of economic principles with natural laws is given within this micro-phenomenon.

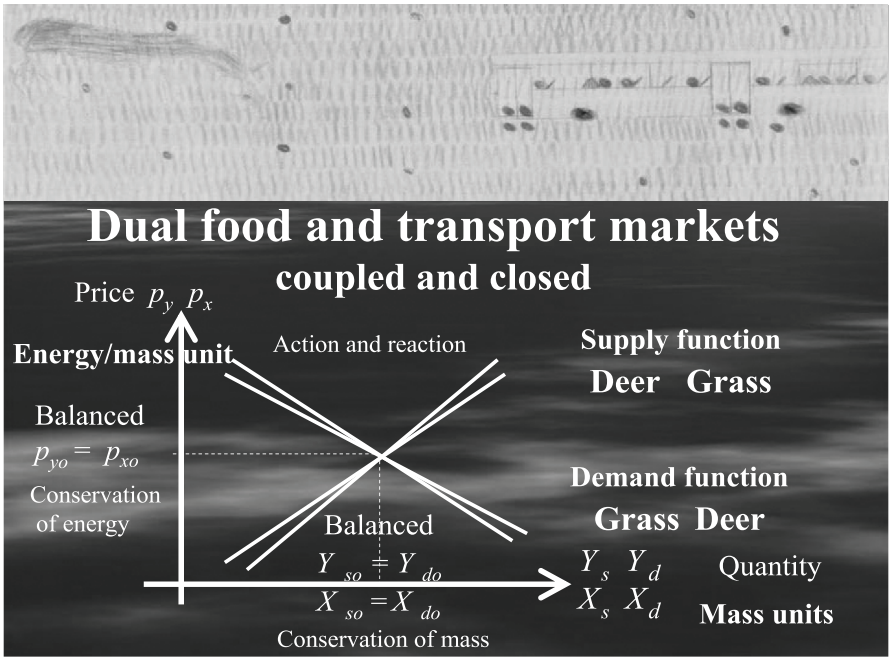

Fig. 1. Dual micro-phenomena of grazing deer and *waiting seeds*, Hegel's consistent overall picture of economic and biologic production

Legend *Horizontal axis*: Quantity axis, either supply of food grass, X_s, or demand for food grass, X_d, or supply of transport for food grass, Y_s, or demand for transport for food grass, Y_d; all in mass units. Balanced quantities of supply *s* and demand *d* on food and transport market denoted by subscript *o*: $X_{so} = X_{do}$, and $Y_{so} = Y_{do}$; balance of quantities of coupled dual food and transport markets is given if $X_{so} = X_{do} = Y_{so} = Y_{do}$ holds. *Vertical axis*: Price axis, either price of a mass unit of food grass, p_x, or price to transport a mass unit of grass to a distant location, p_y, both in energy units. Balanced price on food and transport market denoted by subscript *o*: p_{xo} and p_{yo}; balance of prices of coupled dual markets is given if $p_{xo} = p_{yo}$ holds. Note: The linear course of supply and demand functions is not decisive.

Empirical confirmation

Since 2002 the author checked whether the dual structure of markets with exchange of goods and services, mutual benefits and energy payments, holds with other micro-phenomena where agents of same or different species including humans meet, he didn't find a counterexample thus confirmed this characteristic empirically listed as axiom. Parallel he looked for reference of dual structure of markets in economic theory and textbooks with (Henderson, Quandt, 1973; Mankiw, 2004) and others, throughout history of economic thought after (Söllner, 1999; Roncaglia, 2009), without success. However, as humans and their markets are part of the ecosystem this result must reflect in markets of human society, too. Below we demonstrate this empirical confirmation within eight selected micro-phenomena.

(1) Micro-phenomenon: *Bees are gathering nectar from blossoms*, Dual phenomenon: *Pollen is transferred from blossom to blossom*, Market place: Inside blossoms with nectar and pollen, Market participants: Populations of plants with blossoms and of bees, First market: Food market, Good/Service: Good nectar, Supply: Plant populations with

blossoms, Demand: Population of bees, Means of payment: Kinetic energy, Payment transfer: Pollen glued to bees get kinetic energy of those, Dual market: Transport market, Good/Service: Service moving pollen from blossom to blossom, Supply: Population of bees, Demand: Plant populations with blossoms, Means of payment: Chemical energy, Payment transfer: By taking nectar from blossoms bees get chemical energy included in it, Mutual benefits: Bees get food for restoration, plants with blossoms a service for reproduction, Conclusion from Hegel's consistent overall picture in case of market balance: The price in kinetic energy units the bee pay for a unit of food nectar equals the price in chemical energy units plants with blossoms pay for transport of a unit of pollen from blossom to blossom, or: The amount of kinetic energy the bee pay for food nectar during a period equals the amount of chemical energy plants with blossoms pay for transport of pollen from blossom to blossom during this period. Note: These markets are seasonal markets; by taking nectar bees can't avoid taking pollen as well; good smell and nice colors of blossoms is good advertising.

(2) Micro-phenomenon: *Picking and eating apples from a tree by humans during off time*, Dual phenomenon: *Kernels within apple wait for transport to settle at a distant location*, Market place: Location of the apple tree, Market participants: Population of apple trees and humans, First market: Food market, Good/Service: Good apple, Supply: Population of apple trees, Demand: Human population, Means of payment: Kinetic energy, Payment transfer: Being picked and eaten the kernels included in the apple get kinetic energy of humans, Dual market: Transport market, Good/Service: Service moving kernels, Supply: Humans, Demand: Population of apple trees, Means of payment: Chemical energy, Payment transfer: By picking and eating apples humans get chemical energy of its fruit flesh, Mutual benefits: Humans get food for restoration and kernels get kinetic energy for reproduction of apple trees at a distant location, Conclusion from Hegel's consistent overall picture in case of market balance: The price in kinetic energy units a human pays for an apple food equals the price in chemical energy units the apple tree pays for transport of kernels of this apple to a distant location, or: The amount of kinetic energy humans pay for food apple during a period equals the amount of chemical energy the apple trees pay for transport of kernels of these apples to a distant location during this period. Note: No human money included because off time of humans is considered; nice colors and good taste of apples is good advertising.

(3) Micro-phenomenon: *People buy potatoes at a market stall*, Dual phenomenon: *Traders wait for money of people*, Market place: Market stalls, Market participants: People and traders on the market, First market: Food market, Good/Service: Good potatoes, Supply: Traders, Demand: People, Means of payment: Human money, Payment transfer: By handing out money to traders, Dual market: Money market, Good/Service: Good Money, Supply: People, Demand: Traders, Means of payment: Chemical energy of potatoes, Payment transfer: By handing out potatoes to people, Mutual benefits: The visitors get food for restoration and the trader gets money for buying other goods and services for its restoration etc. according the purchasing power of this money. Conclusion from Hegel's consistent overall picture in case of market balance: The price in money units people pay for 1 kg of potatoes must equal the price in chemical units the trader pays by handing out 1 kg of potatoes to people, or: The amount of human money people pay for food potatoes during a period must equal the amount of chemical energy of these potatoes. Note: By introducing human money the original balance in energy units within natural world is replaced by a hybrid balance referring to energy and money. Whether the real purchasing power of this amount of money ensures this coverage stays open. In order to avoid distortion on this markets, requirement from Hegel's overall picture is: The price in money units for 1 kg of potatoes must reflect the real value in chemical energy units of this 1kg, in other words: There must be coverage of human money by energy.

(4) Micro-phenomenon: *A little bird picks leavings around the teeth in open mouth of a crocodile*, Dual phenomenon: *Teeth cleaning of crocodiles,* Market place: Open mouth of crocodile, Market participants: Populations of crocodiles and little birds, First market: Food market, Good/Service: Good Leavings, Supply: Crocodile, Demand: Little birds, Means of payment: Kinetic energy, Payment transfer: Picked leavings inside mouth between teeth of crocodile move away, Dual market: Service teeth cleaning, Good/Service: Service teeth cleaning or moving leavings around teeth away, Supply: Little birds, Demand: Crocodiles, Means of payment: Chemical energy of the leavings between the teeth, Payment transfer: By picking the leavings little birds get chemical energy from crocodiles, Mutual benefits: Food for little birds for restoration and a service of healthcare for crocodiles. Conclusion in case of market balance from Hegel's consistent overall picture: The price in kinetic energy units little birds pay for eating one mass unit of leaving equals the price in chemical units crocodiles pays for cleaning teeth, or: The amount of kinetic energy little birds pay with flying and picking leavings during a period equals the amount of chemical energy little birds get from leavings of crocodiles during this period. Note: Obviously outsourcing of teeth cleaning is cheaper in respect to energy for a crocodile than doing it itself; reversely eating these little birds a crocodile would regain less energy than it would need to clean its teeth by itself. This is an understandable answer to the question why a crocodile doesn't eat those little birds.

(5) Micro-phenomenon: *Wolves chase a herd of deer and get one*, Dual phenomenon: *Deer's training of velocity for survival*, Market place: Chasing area of wolves equal living area of deer, Market participants: Wolf and deer populations, First market: Food market, Good/Service: Good one deer, Supply: Population of deer, Demand: Population of wolves, Means of payment: Kinetic energy, Payment transfer: Indirectly, the loss of kinetic energy of wolves during chasing reflects in the higher Net Present Value NPV in energy units of surviving deer's bodies afterwards, Dual market: Training of velocity, Service: Chasing and training, respectively, Supply: Wolf population, Demand: Deer population, Means of payment: Chemical energy, Payment transfer: By eating this one deer which is got, Mutual benefits: Food for restoration of wolves and training of velocity for survival for deer. Conclusion in case of market balance from Hegel's consistent overall picture: The price in kinetic energy units the wolves pay for chasing equals the price in chemical energy units of the one got and eaten deer, the herd of deer pays for training of velocity, or: The amount of kinetic energy wolves pay for chasing during a period equals the amount of chemical energy of got and eaten deer, herd of deer pays in chemical units for training of velocity during this period. Note: The advantage for deer population is given but not for the single deer which is eaten; a comparable payment in human society is repaying a debt of a community of property owners by one owner, only.

(6) Micro-phenomenon: *An ivy-clad maple*, Dual phenomenon: *Sublease of location*, Market place: Location of maples, Market participants: Populations of maple trees and ivy plants, First market: Rental market, Good/Service: Service sublease of location, Supply: Population of maples (forced supply), Demand: Population of ivy, Means of payment: Energy, Payment transfer: By cladding maple, Dual market: Information market, Good/Service: Service information, Supply: Population of ivy, Demand: Population of maples (forced demand), Means of payment: Energy, Payment transfer: Energy profits of ivy during use of maple infrastructure, trunk and branches, Mutual advantages: By being ivy-clad maple gets information that it is too weak to prevent it and may improve this weakness during evolution or let and suffer it; ivy gets higher energy profits from maple's location and infrastructure, trunk and branches. Conclusion in case of market balance from Hegel's consistent overall picture: The price in energy units the population of ivy pays for sublease of location at one tree by cladding equals

the price in energy units the population of maple trees pays for information of this tree, or: The amount of energy population of ivy pays for sublease of location at maple trees by cladding during a period equals the amount of energy the population of maples pay for information during this period. In other words: The energy profits of the ivy equal the energy losses of the maples. Note: Observably the production of ivy-clad maples doesn't close-down by being ivy-clad, the economic conclusion is, either maple trees continue to live and produce under this restriction, or they develop improvements to escape these forced dual markets in the long run. Forced markets occur in human society also, readers may think of forced sales.

(7) Micro-phenomenon: *A working person*, Dual phenomenon: *A working place*, Market place: Inside of an enterprise, Market participants: Enterprises and private households, First market: Labor market, Good/Service: Service Labor, Supply: Private households, Demand: Enterprises, Means of payment: Human money, Payment transfer: By transferring salary, Dual market: Working place market, Good/Service: Good working place, Supply: Enterprises, Demand: Private households, Means of payment: Energy of labor force, Payment transfer: Via labor at working place, Mutual benefits: Enterprises get labor force for production, and private households get money for living. Conclusion in case of market balance from Hegel's consistent and overall picture: The price in money units the enterprises pay for labor force of a private household equals the price in energy units this labor force and private household, respectively, pays for a working place, or: The amount of money enterprises pay for labor forces during one period equals the amount of energy of private households pay for working places during this period. Note: Like in example (3) there is a hybrid balance referring to money and energy. Whether the real purchasing power parity of a salary ensures this coverage stays open again. In order to avoid distortion on this market requirement from Hegel's overall picture is: The price and salary in money units, respectively, for a labor force must reflect the real value in energy units a labor force pays for the working place and loses during labor, respectively, in other words: There must be coverage of human money by energy.

(8) Micro-phenomenon: *Surfing the net with PC at home including buying*, Dual phenomenon: *Advertising firms wait for money of surfers*, Market place: At home, Market participants: Surfers and internet firms, First market: Information, entertainment, and advertising market, Good/ Service: Service free information and entertainment, any advertised good and service, Supply: Internet firms, Demand: Surfers, Means of payment: Money, Payment transfer: By money transfer for internet infrastructure and for internet buying, Dual market: Money market, Good/Service: Any advertised good or service, Supply: Surfers, Demand: Advertising enterprises, Means of payment: Money, Payment transfer: By money transfer for advertising, information, entertainment, and for advertised and sold goods and services, Mutual benefits: Internet firms get money from sales thus balance their expenses for free information and entertainment, and surfers get free information and entertainment and payable goods and services if necessary. Conclusion in case of market balance from Hegel's consistent and overall picture: The price in money units a surfer pays for her/his internet infrastructure and one internet purchase equals the price in money units this internet firm pays for information, entertainment, and this one good or service it sells, or: The amount of money surfers pay for internet infrastructure and purchases during one period equals the amount of money, internet firms pay for information, entertainment, and their goods and services they sell via internet during this period. Note: As all prices are paid in money, requirement from Hegel's overall picture is coverage of money by energy. The problem of internet dependency of surfers because of high elasticity of internet firms with advertising is discussed with (Maier, 2009b, p. 6–7).

Explaining social phenomena

Nature's cause of crowding of world population: We replace in Fig. 1 *deer* and *grass population* by *mankind* and *other species*, thus we consider the entirety of dual markets between mankind and all other species of the ecosystem of Earth, which is a coupled and closed system indeed. We focus the crowding phenomenon of world population of Fig. 2 in this different overall or entire picture of Hegel. Due to a non-stable development of number of human world population between the years 1000 and 2150, we realize that this phenomenon indicates economic imbalance on those dual markets. If we apply Alfred Marshall's (1842–1924) stability criterion to the case of imbalance, see (Henderson, Quandt, 1973, p. 121–136) and (Maier, 2007, p. 30–35), we conclude that mankind's price or energy elasticity (of demand on the one and of supply on the other market) by absolute value must be bigger than those of all other species. It means that mankind's demand for goods and services of other species and mankind's supply of goods and services for other species can react more flexible than all other species on small energy changes. It implies that in the economic competition between species on Earth mankind is currently predominant. Thus the production of human biomass and population increases, and the biomass of other species decreases; the latter phenomenon is empirically well-known as species extinction of present. In order to test this theoretical result in a particular case, we assume that temperature on Earth is lightly increasing or decreasing (which induces a light change of prices in energy units), and we ask for the impact on human and other species. We observe: Humans are able to make a fire if it is too cold, the author does not know any other species with this quality. In addition, a human is able to draw or withdraw clothes piece by piece to prevent more heat or cold inside his body, other species like deer or dogs have not this scope of possibilities, a fur in summertime, and a second in wintertime is all. Both examples illustrate and confirm mankind's superior energy elasticity, indeed. Furthermore, this quality of mankind also explains, among others, the phenomenon of industrial and technical revolution of 19th century of modern era as well as the domestication of other species (because mankind rules these markets) which indicates that those dual markets started to run out of balance long before year 1000.

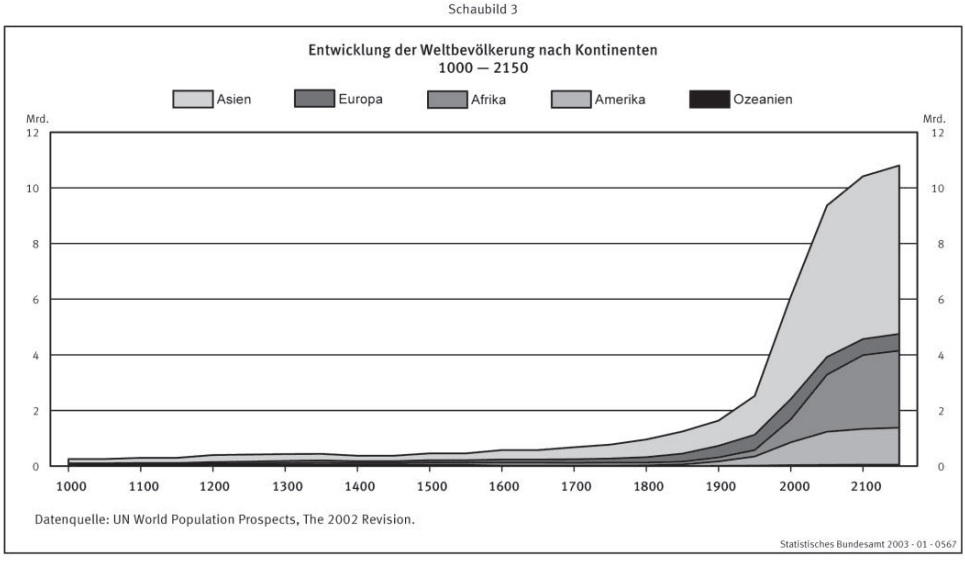

Fig. 2. Development of world population after continents in billions, 1000–2150. Source: Höhn, 2003; Statistisches Bundesamt Federal Republic of Germany
Data: United Nation, World Population Prospects, The 2002 Revision.

Nature's cause of wealth and poverty: Using data of World Bank of 2000 Fig. 3 shows the geographical distribution of wealth and poverty of humans in nearly all countries of the world measured by the indicator *Income 1998 per capita in US $*, classified in groups: Low ($760 and less, red color), Lower middle ($761–3030, flesh-colored), Upper middle ($3031–9350, sandy), High ($9360 and more, bright), and No data (white). Using the same colors, this graph shows the geographical distribution of man's biological production measured by the indicator *Percentage of world population*, classified in groups: 60% of world population (red color), 15% of world population (flesh-colored), 10% of world population (sandy), and 15% of world population (bright)[1]. Thus Fig. 3 illustrates Hegel's overall picture of human material and biological production within the ecosystem of Earth. The message is: Countries that are wealthy in terms of material production are poor in terms of biological production and vice versa, hence wealth and poverty are dual phenomena. As cause we realize the natural law of conservation of energy: Either a human can allocate its restricted energy budget per year to produce more human biomass (and less material goods), or a human can allocate this energy budget to produce more material goods (and less human biomass). Thus distribution of global wealth and poverty turns out as long-term impact of different allocation of Nature's real money energy by humans in different societies, under different regional and social conditions which are natural resources of environment, climate, state interventions and laws, cultural and social habits, and others. Note, Hegel's overall picture offers a response to poverty: Poor countries could shift their real money energy away from biologic reproduction towards material production, and wealthy countries vice versa. By its population policy China applies this response since the 1980th successfully (Maier, 2013a, p. 3–17).

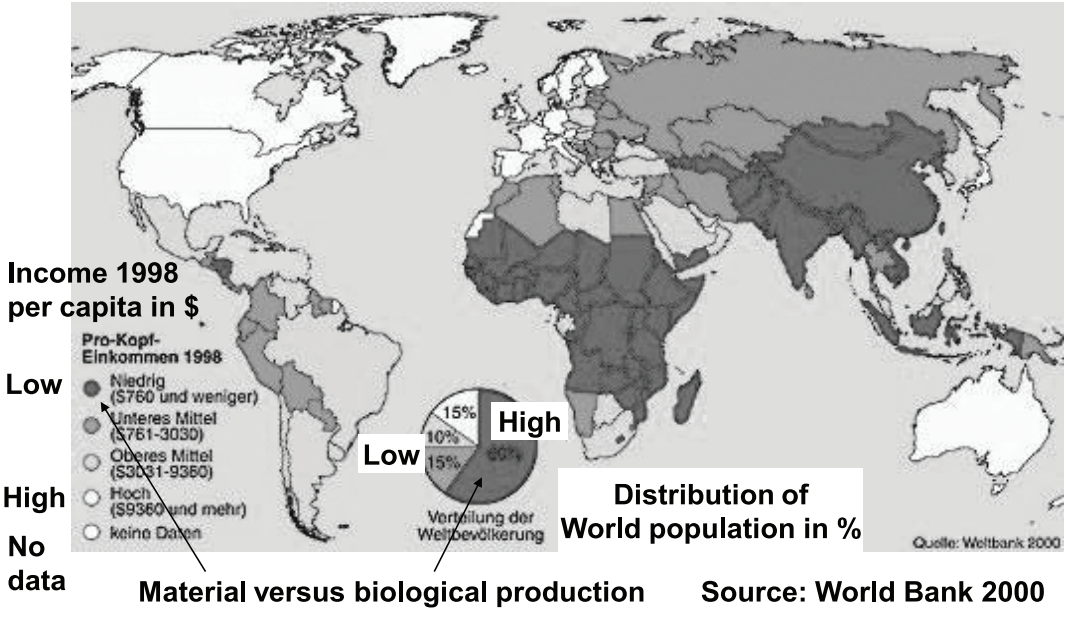

Fig. 3. The dual phenomena of wealth and poverty: Hegel's overall picture of human production

We add **Nature's solution of poverty**: Observably material goods of developed countries flow into developing countries, reversely humans (which equal bio-products) in opposite direction. As the superior bio-products can and will reproduce themselves after migration

[1] Subordinate is that this graph and data refer to year 1998, in present this situation is worse because world population exceeded in 2011 number of 7 billion people and was below 6 billion people in 1998.

(what material products can't do) future generations of the present poor in developing countries step by step will replace missing future generations in wealthy countries, thus will participate in their (material) wealth. This solution maps in the phenomenon of demographic change of wealthy societies and countries already in present. It culminates in present flows of refugees from areas of conflicts, mostly in developing countries, to developed and wealthy countries in Europe and elsewhere.

Nature's cause of demographic aging: This phenomenon shown in case of Germany in Fig. 4 is highly visible in modern social states; the percentage of older people is increasing, parallel the percentage of younger people is decreasing. We realize: The energy detracted from economic active population either forced to provide public transfers mostly social ones, amongst others to the previous generation, or voluntary for self-realization, is missing for care of the succeeding generation, the top aim within Nature, and it is responded by gradually extinction. Again we identify the natural law of conservation of energy within a closed human society as cause.

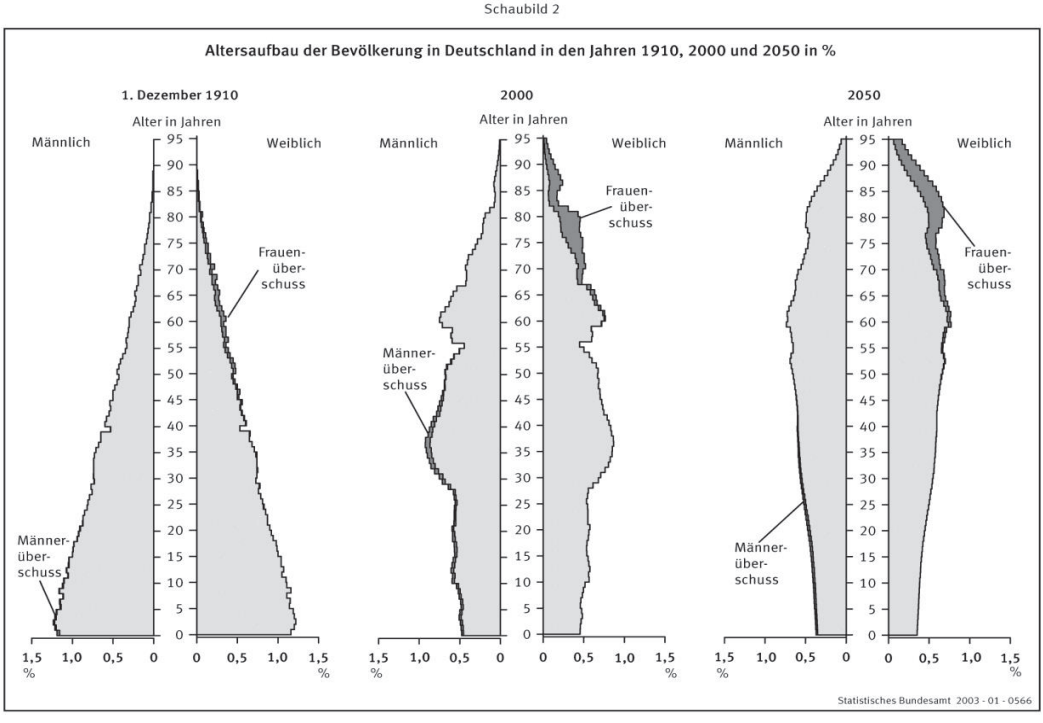

Fig. 4. Age distribution in Germany 1910, 2000, and 2050 in %

Source: Höhn, 2003; Statistisches Bundesamt Federal Republic of Germany
Legend: Alter in Jahren = Age in years, Männlich = Male, Weiblich = Female, Dezember = December, Männerüberschuss = Overplus of men, Frauenüberschuss = Overplus of women

Other insights

a) The paradox of biologic self-production and its financial solution: Fig 5 illuminates the paradoxical situation of any creature within the biological production process caused by the observable fact that it is product (its own living body), producer (or enterprise), and final user (or customer) of its own body in one and the same subject. This coincidence is not subject of traditional economic theory. How can it work with view from financing? Fig. 6 demonstrates the solution of this paradox. Any creature balances its energy cost of self-production by four money equal energy sources which are energy returns from

central bank sun via sunlight, from primary inputs taken from environment, from mutual trade with other creatures on dual markets, and from the surplus energy or energy profit it gains by producing its own living body. The latter source reflects the gross added value gained by economic production, its existence is substantiated via observation and the consistency of Hegel's overall picture of economic and biologic production (Maier, 2014, p. 14–16).

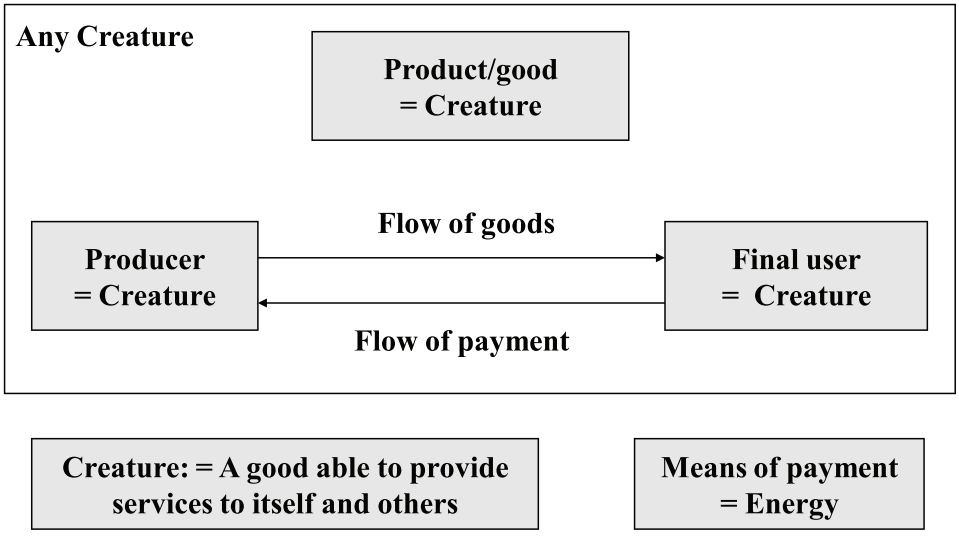

Fig. 5. Production process in biology a paradoxical situation

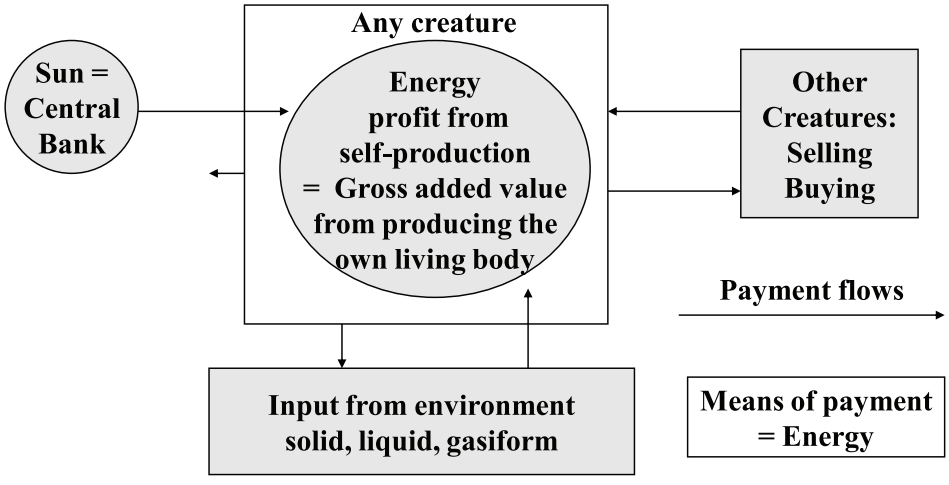

Fig. 6. Economic solution of financial paradox of biological self-production

b) Driving forces of Nature's real economy are the supply of energy by the central bank sun via sunlight and the demand of all creatures and species for the surplus energy from producing their own life. This insight is result of a description by means of a static and open ended Leontief-model. Furthermore, the allocation of goods and services for production of life (by creatures) like "breathing in" causes traces which we observe as deconstruction of environment, and the distribution of goods and services of consumption of life (by creatures) like "breathing out" causes traces which we observe as pollution of environment. Thus deconstruction and pollution of environment is unavoidable in the end, it is the dual (and unpleasant) face of the (pleasant) phenomenon of creation of life (by creatures). Both faces and phenomena without statistical figures represent and

visualize the total economic output of the ecosystem of Earth, like upper and down side of a coin they can't be separated (Maier, 2014, p. 16–19).

c) Social and biometric indicators of human society are not subordinate, quite the contrary they are the decisive economic indicators within Nature's real economy. The development of the net reproduction rate of a human society and country indicates economic growth and decline, see Table *Net reproduction rate in selected countries*, and the population number indicates the achieved level of production. Using these measures instead of leading indicators of System of National Account SNA of United Nations the distribution of wealthy and poor countries and societies looks quite different (Maier, 2014, p. 19–21).

Table. Net reproduction rate in selected countries *)

Country/Year	1950/55D	1965/70D	1980/85D	1995/2000D	2010/15D
Europe					
Germany	0,85	1,02	0,70	0,64	0,63
Belgium	1,06	1,10	0,76	0,75	0,71
Denmark	1,19	1,04	0,69	0,83	0,78
Estonia	0,93	0,95	0,98	0,59	0,61
Finland	1,37	0,98	0,81	0,83	0,74
France	1,26	1,23	0,90	0,83	0,89
Greece	1,02	1,07	0,91	0,62	0,60
Italy	1,09	1,15	0,74	0,58	0,59
Latvia	0.90	0,85	0,94	0,53	0,56
Lithuania	1,20	1,07	0,97	0,66	0,57
The Netherlands	1,41	1,30	0,73	0,74	0,73
Poland	1,52	1,05	1,11	0,70	0,63
Portugal	1,24	1,27	0,93	0,70	0,69
Romania	1,27	1,35	1,06	0,62	0,65
Russian Federation	1,25	0,95	0,96	0,58	0,56
Sweden	1,04	0,99	0,79	0,73	0,65
Spain	1,17	1,34	0,84	0,55	0,54
Turkey	2,29	2,12	1,74	1,23	0,99
United Kingdom	1,02	1,20	0,87	0,82	0,77
Africa					
Egypt	2,07	2,28	1,95	1,52	0,99
Algeria	2,30	2,73	2,69	1,45	0,98
Cameroon	1,57	1,95	2,35	1,87	1,54
Kenya	2,32	2,87	2,97	1,77	1,30
Nigeria	1,90	2,12	2,36	2,16	1,76
South Africa	2,10	2,32	1,94	1,30	0,84
Tunisia	2,21	2,50	2,05	1,05	0,99
Uganda	2,09	2,40	2,45	2,33	2,50
America					
Argentina	1,37	1,37	1,47	1,24	1,05
Brazil	2,27	2,16	1,60	1,05	0,98
Costa Rica	2,68	2,53	1,65	1,35	1,16
Jamaica	1,72	2,50	1,68	1,18	1,00
Canada	1,74	1,20	0,78	0,77	0,79
Colombia	2,44	2,56	1,65	1,30	1,12
Mexico	2,49	2,81	1,92	1,28	1,04
Panama	2,22	2,43	1,62	1,23	1,03
Paraguay	2,76	2,75	2,36	1,91	1,51
United States	1,60	1,20	0,87	0,98	0,92
Asia					
Afghanistan	1,76	2,01	2,09	2,07	2,03
Bangladesh	1,81	2,16	1,89	1,54	1,28
China [1)]	1,85	2,44	1,12	0,80	0,88
India	1,63	1,87	1,68	1,38	1,01
Indonesia	1,56	1,88	1,65	1,16	0,99
Japan	1,19	0,97	0,85	0,68	0,69
Dem. People's Rep. Korea	1,22	1,91	1,31	0,92	0,97
Republic of Korea	1,79	1,83	1,10	0,70	0,79
Pakistan	1,80	2,05	2,27	2,17	1,77
Philippines	2,51	2,57	2,11	1,67	1,10
Thailand	2,41	2,48	1,37	0,99	0,89
Australia [2)]	1,48	1,35	0,93	0,85	0,86
New Zealand	1,63	1,51	0,93	0,94	0,90

*) Data of United Nations, medial variant; Revision 2000. The net reproduction rate informs to which extent a generation of women is replaced by daughters born by these women under certain birth and mortality conditions. A rate of 0,64 for example means that there were born 36% less daughters to replace the full female population.
1) Without data of Hong Kong, Macao, and Taiwan. 2) Including Christmas islands, Cocos islands, Norfolk islands.
Source: World Population Prospects, UN, New York. Taken from: Statistisches Bundesamt, Statistisches Jahrbuch 2002 für das Ausland, p. 200.

d) **Major challenges of current human societies are due to ignorance of Nature's real economy**. In principle there are two possibilities to respond to those challenges, either mankind adapts its own rules to Nature's superior real economy, or it resists as long as possible trusting on its superior flexibility and energy elasticity. Both behaviours are result of a duopolistic consideration of mankind on the one and the remaining ecosystem on the other side within Stackelberg's theory of oligopolistic competition (Maier, 2014, p. 30–31).

e) **Human money and currencies are insufficient copies of energy**. The real value of energy is substituted by an assigned money value. Via the link between money and energy as means of payment natural laws enter monetary and fiscal policy of central banks and governments and restrict their area of operation and independency. Insofar human money is involved in market transactions Hegel's consistent overall picture of (biological and material) production requires the re-convertibility of money into energy and coverage of human money by energy, respectively. The latter is not self-evident rather it is replaced by the metaphor *confidence in the market*, and it is source of crises when misused, for instance of the financial crisis of 2008 (Maier, 2014, p. 27–28; 2013b, p. 175–176; 2009a, p. 141–153).

f) Core of **Nature's health controlling system** are periodic attacks of virus populations on the immune system of any creature which is forced to respond to them for adaptation

to new conditions and survival as long as possible. As these attacks are executed within dual markets in case of market equilibrium the cost are covered by the returns. From this point of view an illness of a human equals a period of further education until his body is adapted to new conditions (Maier, 2014, p. 28–30).

g) **In a magic square of human economic, social, environmental, and energy goals and policies, energy policy is decisive for a sustainable development of mankind** (Maier, 2014, p. 31–32 including sources). Starting point of the substantiation of this thesis is the so-called magic square of the four competing macro-economic goals, of steady growth of economics, of high employment, of stability of price level, and of external balance, to be addressed by economic policy simultaneously and under the cognition that a one way enhancement of a single goal may impair or support others because they are interrelated. Economic policy includes regulatory, structural, and procedural policy. Regulatory policy supports achievement of economic goals by providing frame conditions, especially those of economic competition. Structural policy supports achievement of these goals by infrastructure policy viewing regional and/or industry aspects. Procedure policy denotes direct market interventions of state institutions; besides monetary and financial policy especially fiscal policy they include labour market policy, trade policy, and stabilization policy. Monetary policy of a central bank supports independently achievement of these goals mainly by supervision of volume of money in circulation, of rates of interest, of inflation, and of money exchange if necessary. Fiscal policy of governments on different levels supports achievement of these goals via taxes and public expenditures including economic stimulus programs. An efficient economic policy is given when monetary measures of central bank, fiscal measures of governments, and other measures of regulatory, structural, and procedure policy of governments achieve these goals as good as possible, in justified situations a goal may be preferred or disadvantaged. A transmittance of these four economic goals to Nature's ecosystem including all competing species has to consider that steady growth of economics reflects in steady growth of biomass of species, high employment reflects in a high number and density of species, price level stability reflects in energy level stability, and external balance reflects in a balance of mutual energy payments on dual markets between two species. So the author places the goal of conservation of an intact environment which serves as basis for a sustained development of all species in one edge of this square, the social goal of conservation of human domestic population in a second edge, human economic goals in a third edge, and the goal of energy stability in the fourth edge. He considers four policies to supervise these goals which are economic policy including monetary and fiscal policy, social policy including population policy, environmental including climate policy, and energy policy. These four policies as well as the four goals they focus are interrelated: Monetary and fiscal policy cannot be separated from energy policy, because of energy is identified as absolute reference of money and it is the link by which laws of natural science enter monetary and fiscal policy and thus restrict the room for manoeuvre of central banks and governments. Economic measures to promote growth of economics cannot be separated from population policy because of any economic production with limited energy budget focused on material production and related services needs energy of labour force as input thus impairs biological reproduction of domestic population. And economic policy can't be separated from environmental policy especially climate policy because of creation of life and other material products including related services leave traces of allocation and distribution of life on earth which appear as deconstruction and pollution of environment and in long term change climate. As Nature's ecosystem is driven by supply of energy from sun and by demand of creatures for energy for their own self-realization, energy policy turns out as the decisive policy for a sustained development of mankind on earth. But any government should be aware

that neither it nor other institutions on urban, regional, national, and supranational level represent this second driving force for human life on earth, rather this driving force is a social one, it is the population itself because people (like all other populations) want to live. Insurgencies and revolutions confirm this cognition empirically.

Roots in history of economic thought

Referring to (Roncaglia, 2009) and (Söllner, 1999) a strong root of this approach points to *Wassili Leontief* (1905–1999). Using the design of his input-output table as it appears in official statistics as guide and replacing commodities by creatures the author was able to describe the entire production of all species within the ecosystem of Earth. Moreover, the input-output frame uncovers the key how creatures solve the financial paradox within biological self-production (imbedded in the gross added value of their self-production in the end), it uncovers supply of energy by sun as well as demand for energy of any creature (for sake of survival) as driving forces of Nature's economic system, and it serves to explain Nature's health controlling system including its financial aspects. A second root points to *Heinrich Freiherr von Stackelberg's* (1905–1946) theory of oligopolistic competition from which the author derived the two possible behaviors of man's species how to react on natural challenges (by adapting its behavior to the superior natural eco-system, or by trusting on its superior energy elasticity and flexibility compared with different species in present as long as possible). A strong root points to *Piero Sraffa* (1898–1983), too. His cognition that man produces commodities by means of (different) commodities is enlarged by author's findings and gets a new quality: Even there are commodities called creatures which make self-production by means of other commodities and creatures. As Sraffa excluded biological production from economics he couldn't detect it. Although he recognized that money is subordinate with production he viewed at energy as a commodity like any other which the author confutes by his findings. Two roots point to *Alfred Marshall* (1842–1924). One is his cognition that the ratio of price elasticity of demand and supply determines the feature whether a market tends to market balance or runs out of it. The author used it to explain the crowding phenomenon of world population. The second is the ceteris paribus condition attributed to him; the author used it during the quantitative analysis of dual markets. One root points to *Vilfredo Pareto* (1848–1923). It is his empiric confirmed law of 1896 which relates the number of families to those with minimum income in societies; independently it confirms author's finding from Hegel's overall picture of human production that material wealth impairs biological reproduction. Three roots at least point to *Karl Marx* (1818–1883). One is his cognition that economic activity can be measured in terms of labor force. As the latter is gained by degradation of worker's bio-energy his measure is very close to author's measure in super ordinate energy units, but he didn't identify energy as means of payment finally like the author. A second root is Marx' approach to think in the categories of thesis, antithesis, and synthesis but this reflects Hegel's philosophical concept of drawing an overall picture by composing views from different sides. A third root is his cognition that the surplus value of labor is not fairly distributed between workers and entrepreneurs within human economy and leads to impoverishment of workers. But this root stops with creatures: They are workers and entrepreneurs in one and the same subject thus the problem of a fair distribution of this surplus value is observably solved. One root points to *Thomas Robert Malthus* (1766–1834); it is his cognition of principles of population growth and decline. Author's contribution is that the energy elasticity of a species is the decisive characteristic in this context. One root points to *David Ricardo* (1772–1823). It is his cognition that foreign trade pays. His theory of comparative cost advantages for both trading partners of different

countries reflects in the win-win situation of species exchanging goods and services on dual markets. Although there is no energy profit in case of market balance, this foreign trade between two species pays because of both sell goods and services they can produce, they buy goods and services which they cannot produce, and they pay with currencies they have and the partners have not but need. So grass species can produce food and sells it to deer species, coevally deer species can produce transport service and sells it to grass species. Grass species pays with chemical energy which it has and deer species needs but doesn't have, and deer species pays with kinetic energy which it has and seeds of grass species need but don't have, in case of balance both energy payments though made in different types of energy are of same amount if converted. At least four roots point to *Adam Smith* (1723–1776). One is his basic description of markets with demand and supply for goods and services the author applied with both dual markets. However, the feature that all markets are dual markets which the author detected by applying Hegel's philosophy Smith and his followers disregard. A second is his cognition that the value of any commodity, to the person who possesses it and who wants to exchange it, equals the quantity of labor which enabled him to purchase it; author's results reflect this evaluation but he measures the quantity of labor in energy units and does it not in labor time. A third is the metaphor of an invisible hand ruling the markets Smith used several times[1]. In Nature's ecosystem this invisible hand appears as invisible transfer of energy from central bank sun via rays of sunlight to Earth which enables and drives creation of life and related economic activities of creatures. A fourth is his description of accumulation of wealth of nations by coactions of different elements (division of labor, number of workers, size of markets, technological progress, labor productivity, institutional factors, policies, and others). But focusing material production (and related services) he did not detect the social dimension of wealth which is the decline of population in wealthy societies in long term, and which is outcome of Hegel's overall picture of human production. Two roots point to *François Quesnay* (1694–1774) and the physiocrats. The first is the accentuation of agriculture as the only productive sector within Quesnay's Tableau Economique. With view from author's results this accentuation is a hint to the importance and productivity of the entire ecosystem without man which is base of man's existence. The second is his comparison of circulation of blood within a human body with an economic cycle which reflects in author's result that any creature is a well organized enterprise. Cross passages to natural sciences: Author's substantiation of economic and financial order within the natural ecosystem confutes the opinion of ecological economists that market models of economic theories are not applicable with ecological transfers of biomasses. Quite opposite, author's finding that energy serves as means of payment within the ecosystem enriches *Charles Robert Darwin's* (1809–1882) theory of evolution with view from economics. It supports the EROI-principle of ecological economists which postulates an energy return on energy investments of creatures, and in the end it confirms *Frederick Soddy's* (1877–1956) criticism of the 1920th that economists should not treat energy like any other commodity.

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[1] Stone sculptures of Amarna period in Egypt history (1400 B. C.) show these hands at end of sun rays, too, URL: http://en.wikipedia.org/wiki/File:Akhenaten,_Nefertiti_and_their_children.jpg

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