International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 2 No. 3 Mar. 2013, pp. 196-215

http://www.issr-journals.org/ijias/

Fundamentals of crisis-proof economics

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ABSTRACT: The major problem of the current market economy is absence of appropriate mathematical description of processes taking place in it, which results in misunderstanding of these processes, as well as lack of efficient means of preventing economic crises. The manuscripts suggests such a mathematical description, making use of the circumstance that the 'black box' of market economy has the corresponding 'white box', which turned out to be the processes well known in radio-electronics. This approach allowed proving that the current market economy, due to the significant influence of the human factor, is described with parametric differential equations with random coefficients, the solutions of which are also random functions of time. Therefore, it is basically unpredictable and uncontrollable, which makes economic crises inevitable. In order for the economy to become crisis-proof, it has to be reformed. We suggest using the new economic tools which allow solving the problem. Here belong business-interfaces that can neutralize the internal human factor, and the new global/regional information network TV•net, which is completely free from the shortcomings of the Internet and is able to neutralize the external human factor. It is shown that after the implementation of reforms suggested in the manuscript economics will become an exact science able to successfully solve the tasks of analysis and synthesis of economic structures, the tasks of their simulation and improvement, as well as regulation of the economy in general. The new economy will become crisis-proof and rapidly developing.

KEYWORDS: Economic Crisis, Economic Reform, Crisis-Proof Economy, 'Invisible Hand', 'Goods-Money-Goods' Process, Human Factor.

1 INTRODUCTION

People, contrary to all other living beings on Earth, have one more environment – the economy. Everything we are engaged in – working, studying, doing business, paying taxes, etc. – is somehow or other connected with the economy. All our conscious activities take place in this environment. Nevertheless, we know the economy not any better than our physical environment [1].

Economics as an exact science which complies with the principles of fundamental sciences has not yet been developed. This is confirmed by the fact that the major economic phenomenon – economic crises known for centuries – still lacks a comprehensive explanation. In the opinion of Philip Kay, historian, Professor at Oxford University, the first economic crisis in world history occurred in the Roman Empire in 88 BC [2]. There are other opinions, as well. Most scientists believe the first economic crisis was the one that hit England in 1825, partially influencing the economies of the USA and France [3]. Since that time, economic crises have become inevitable concomitants of the human civilization. There are many theories of economic crises, although, certainly, only one of them can be true. In fact, none of them is actually true, since all of them failed to prevent any upcoming economic crises.

Over the past few decades, many new complicated mathematized concepts [4] have been developed in economics, and attempts of their application have been made. Here belong theories of extremal problems and specific methods of data analysis, which have become part of econometrics, as well as game theories, social choice theories, theories of general economic equilibrium, etc. Various branches of mathematics have been further employed to analyse economic

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here belong the fixed point theorem, differential topology, the stability theory, functional analysis, the theory of random processes, etc. There is hardly any branch of mathematics which scientists have not tried to apply to economics.

The above may seem to testify to the prosperity of economic science. However, this is not so, because there are apparent signs of a protracted crisis of economic theory, where the most general findings are definitely negative. These are the conclusions which may be formulated approximately as follows: "The answers to your questions depend on the circumstances which you did not take into account", and "The model you used is too general or irrelevant" [4].

This is why some authors [5] started to wonder whether the natural-scientific theories should be considered as an example for developing the economic theory, or whether the economic theory should be developed based on different standards. Opinions were expressed that, apparently, a large variety of economic phenomena cannot be accounted for based on a limited number of fundamental laws. Therefore, it was suggested to substitute the principle of a unified economic theory for the principle of coexistence of competing concepts [6].

The publication brought to the attention of the reader, however, attempts to suggest a concept of a unified economic theory which complies with the criteria of the exact sciences and will allow explaining and preventing economic crises.

2 APPROPRIATE MATHEMATICAL DESCRIPTION OF ECONOMIC PROCESSES

Despite numerous economic theories developed by Adam Smith (1723 – 1790), Thomas Robert Maltus (1766 – 1834), Jean Baptiste Say (1767 – 1832), David Ricardo (1772 – 1823), Jean-Charles Leonard Sismonde de Sismondi (1773 – 1842), John Stuart Mill (1806 – 1873), Karl Heinrich Marx (1818 – 1883), Alfred Marshall (1842 – 1924), John Bates Clark (1847 – 1938), Vilfredo Pareto (1848 – 1923), Ludwig Heinrich Elder von Mises (1881 – 1973), Joseph Alois Schumpeter (1883 – 1953), John Maynard Keynes (1883 – 1946), Nikolai Dmitriewitsch Kondratieff (1892 – 1938), Friedrich August von Hayek (1899 – 1992), Simon Smith Kuznets (1901 – 1985), Wassily Wassilevich Leontief (1905 – 1999), Milton Friedman (1912 – 2006), Walt Withman Rostow (1916 – 2003), Christopher Freeman (1921 – 2010) and many other outstanding scientists [3], [7], both local and global economic crises continue, and, thus, refute all the existing theories of economic crises.

Anticipating the following (see details below), we have to note that, in terms of mathematics, the task of explaining the nature of economic crises turned out to be quite extraordinary and complicated, because processes prevailing in the current economy are described with systems of parametric differential equations with random coefficients, which are not compatible to other sciences and have no analytical solution. Therefore, crises are inevitable in this economy, and it is impossible to prevent them using the economic tools available at present.

In order to develop a controllable crisis-proof economy, new economic tools described below are necessary. In other words, the current economy has to be reformed in such a way as to allow the use of mathematical tools enabling to solve the problem.

In order to understand what these new mathematical-economic tools must be, the new appropriate mathematical description of processes prevailing in the current economy has to be found. In this respect it is noteworthy that, first of all, an important peculiarity of economic processes is the fact that they are highly multi-factor, contrary to processes studied in the exact sciences. Indeed, almost all laws revealed so far in the exact sciences (perhaps, with the exception of Kepler's third law with Newton's amendments) are low-factor, although nature, certainly, does not restrict itself to the use of only these simplest natural-scientific laws. However, multi-factor laws in the exact sciences have yet to be discovered. As for economics, it has no low-factor dependencies, with a rare exception. This is a very important circumstance which is relevant to the situation under consideration. The matter is that human rational thinking is low-factor by nature [8], because people think with visual images which are not more than three-dimensional. Therefore, people are able to perceive low-factor dependencies. As for multi-factor dependencies described with functions of more than three variables (similar to objects having more dimensions), people are unable to perceive them with their rational thinking. You can make sure of it yourselves: just try to imagine the simplest four-dimensional object – a hypercube (or tesseract). Thus, human rational thinking itself, without computer support (see below for human-computer super-intelligence), is unable to perceive multi-factor economic dependencies.

To make these multi-factor objects of economic research at least somehow understandable, they are sometimes transformed into low-factor objects with the help of mathematical statistics. However, estimates received after statistical processing of economic data are too information-depleted, and, therefore, hardly suitable for practical application. For the same reason, for instance, a doctor would never use the average temperature, as well as averaged results of other analyses, to treat the patients.

Furthermore, an extremely important circumstance which must be taken into account correctly is the fact that economic processes, as follows from the fact that they are multi-factor, belong to the so-called mass phenomena. Currently, conclusions drawn from this circumstance are so wrong that they make it impossible to develop economic theory which would comply with the criteria of the exact sciences. Mass phenomena can be found in other science, as well, e.g., in physics and radio-electronics; however, this fact does not prevent them from being the exact sciences. As for economics, acknowledgement of the circumstance that economic processes belong to mass phenomena basically resulted in complete abandonment of any attempts to understand the fundamental processes in it and to suggest their appropriate mathematical description which defines its current state of development.

With all this in view, we can state that economics remains largely unknown. In the exact sciences, the term 'the black box', introduced by William Ross Ashby (1903 – 1972), is used to denote an object of research whose operational mechanism is unknown, but the result of its operation is known. Moreover, this result is unpredictable and mathematically indefinable.

This is why any regulatory activities of governments and top-managers of the current economy turn out to be inefficient. Indeed, in order to manage the object of regulation, it is necessary to be able to extrapolate its behaviour, which is impossible without its appropriate mathematical description.

In order to solve the problem, we must be able to turn the black box into 'the white box', whose operation mechanism, according to the definition introduced by Norbert Wiener (1894 – 1964), is known, and yields the same results as the black box. In other words, the white box is the mathematical counterpart of the black box, and mathematical description of processes in the white box is therefore appropriate for processes in the black box, although, in terms of physics, the black box and the white box can be completely different. For instance, in investigation of oscillations, a pendulum may be the white box, and a radio-electronic oscillation circuit, a piano or an earthquake may be the black box.

Thus, to be able to prevent economic crises, it is first of all necessary to find an appropriate mathematical description of processes prevailing in the economy. To this end, the corresponding white box has to be found, and then, based on the well-known results of its operation, processes in the black box of the economy can be improved.

However, such a white box has not yet been found.

Furthermore, mathematical analysis of different situations using the supply and demand curves, the production-possibility curves, etc., widely used in economics, is not at all suitable to describe processes and allows defining only a state, because the intersection points of curves mathematically correspond to graphical solutions of algebraic equations without consideration of time. Certainly, the results obtained using these curves are useful. They allow, in the first approximation, giving a more or less correct estimate of a certain economic situation. However, this is definitely not enough, since they do not allow understanding the processes prevailing in the black box of the global and even of any regional economy.

Low efficiency of the mathematical apparatus used in economics was pointed to by physicists at the end of the 20th century; they even founded a new science – econophysics (econophysics = econo*mics* + physics). They reasonably assumed that phenomena observed in economics have much in common with processes in physics, and, thus, suggested to use new mathematical tools in economics [9]-[12]. These new mathematical tools of econophysics included mostly the statistical methods borrowed from statistical physics. In particular, non-traditional for economics methods developed in the theory of self-organized criticality, in fractal analysis, in the theory of phase transitions, and in the percolation theory were widely used. However, these new mathematical tools also allow defining only states.

Processes in mathematics are described with differential equations – linear, non-linear or parametric, depending on the peculiarities of their behaviour in a particular object of research. Consequently, the appropriate mathematical description of economic processes must be made using differential equations. Unfortunately, attempts to use differential equations in economics [13], [14] were not aimed at understanding the contents of the black box of the economy. This must have led to the opinion that differential equations in economics are restrictedly useful.

However, this false conclusion is determined by the improper use of mathematics. Its improper use stems from the opinion prevailing in the economy that the behaviour of this or that market participant is completely impossible to predict (this statement is both true and false, depending on the circumstances – see below). For instance, Sir Isaac Newton (1642 – 1727) wrote that simulating people's behaviour is a much more complicated task that predicting planetary motion [11]. This is why, in economics, there is a tendency to assume that it makes sense to analyse only the behaviour of a large number of market participants, i.e., to investigate mathematically only mass phenomena.

3 DIFFERENTIAL EQUATION OF THE 'GOODS-MONEY-GOODS' PROCESS

The basic economic process is certainly the 'goods-money-goods' process.

Since it is a process, it must be described with a differential equation [15], [16]. To derive it, it is certainly necessary to describe mathematically the market behaviour of the vendor and the buyer separately (for a more complicated implementation of the market – of other market participants, as well), and then – their joint behaviour. Both the buyer and the vendor may be either an individual or a corporate body. However, the goods, which are a matter of their common concern, must be the same.

Thus, given the very general, but quite possible conditions, the behaviour of the generalized buyer (hereinafter referred to as the buyer) of the goods, who is often a wage worker, is described with the formula:

$$M_B(t) = \frac{1}{T_B}\int_0^t Q_B(t)P_B(t)dt \tag{1}$$

or the inverse formula

$$Q_B(t)P_B(t) = T_B\frac{dM_B(t)}{dt} \tag{2}$$

where $M_B(t)$ is the current expenses (the amount of circulating assets) of the buyer;

$P_B(t)$ is the current market price of the goods purchased by the buyer;

$Q_B(t)$ is the current quantity of the goods purchased by the buyer;

$P_B(t)Q_B(t)$ is the current assets flow of the buyer;

T_B is the useful life of goods purchased by the buyer;

t is time.

Consequently, according to formula (1), the expenses of the buyer equal to the accrued expenditures (the amount of circulating assets) for the purchase of the necessary amount of goods taking into account the price dynamics in time.

Similarly, the behaviour of the generalized vendor (hereinafter referred to as the vendor), who is usually a manufacturer and an employer, is described with the formula

$$P_V(t) = \frac{1}{Q_V(t)T_V}\int_0^t M_V(t)dt \tag{3}$$

which is equivalent to the formula

$$P_V(t)Q(t) = \frac{1}{T_V}\int_0^t M_V(t)dt \tag{4}$$

or the inverse formula

$$M_V(t) = T_V\frac{d[Q_V(t)P_V(t)]}{dt} \tag{5}$$

where $P_V(t)$ is the current market price of the goods;

$Q_V(t)$ is the current quantity of the goods manufactured by the vendor;

$P_V(t)Q_V(t)$ is the circulating assets flow of the vendor;

$M_V(t)$ is the current revenue of the vendor (the amount of circulating assets) covering the manufacturing costs and generating profit;

T_V is the production time per commodity unit;

t is time.

Thus, the price of goods, according to formula (3), equals to the accrued expenses of the vendor adjusted for the planned revenue, divided by the quantity of manufactured goods.

As can be seen, in expressions (1) – (5) the values of the circulating assets and payments flow (or the amount of circulating assets) of the vendor and the buyer have not an algebraic, but a differential-integral relationship, since the price formation process is influenced by the previous transaction history of the vendor with the buyer. When making a transaction on each commodity unit, both the vendor and the buyer, in accordance with formulae (1) and (3), use their average estimates. For a transaction to be made, the vendor and the buyer must reach an agreement on payments, i.e., despite their different considerations, they must reconcile their interests and agree upon the price.

It is interesting to note the mathematical similarity of formulae (1), (2), (4), (5), describing the market behaviour of the vendor and the buyer, on the one hand, and formulae describing processes in radio-electronic components – a capacitor and an induction coil – in electric circuits. For a better comparison, the corresponding formulae are presented in the table below.

Table 1.

In economics	In radio-electronics
The amount of current (circulating) assets of the buyer $M_B(t)=\frac{1}{T_B}\int_0^t Q_B(t)P_B(t)dt$	Voltage drop at the capacitor $U_C(t)=\frac{1}{C}\int_0^t I(t)dt$
The current (circulating) assets flow of the buyer $Q_B(t)P_B(t)=T_B\frac{dM_B(t)}{dt}$	Electric current through the capacitor $I_C(t)=C\frac{dU_C(t)}{dt}$
The amount of current (circulating) assets of the vendor $M_V(t)=T_V\frac{d[Q_V(t)P_V(t)]}{dt}$	Voltage drop at the inductance coil $U_L(t)=L\frac{dI_L(t)}{dt}$
The current (circulating) assets flow of the vendor $P_V(t)Q(t)=\frac{1}{T_V}\int_0^t M_V(t)dt$	Electric current through the induction coil $I_L(t)=\frac{1}{L}\int_0^t U_L(t)dt$

Formulae relating to radio-electronic components in the table use the following notations:

$U_C(t)$ is the voltage drop at the capacitor C;

$I_C(t)$ is the electric current through the capacitor C;

$U_L(t)$ is the voltage drop at the inductance coil L;

$I_L(t)$ is the electric current through the induction coil L.

At that, as shown in Fig. 1, both the economic components (the buyer and the vendor) and the radio-electronic components (the capacitor and the inductance coil) are combined in a similar way, forming similar functional links. Then, it is quite natural to expect that processes in them have a similar mathematical description.

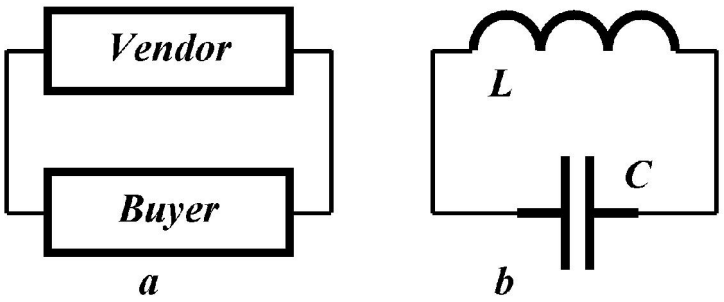
In economics the process, usually referred to as the 'goods-money-goods' process, must apparently correspond to the expression

$$M_V(t)=-M_B(t) \tag{6}$$

or

$$M_V(t)+M_B(t)=0 \tag{7}$$

Formula (6) reflects the fact that in the isolated economic link under consideration (Fig. 1a) one of the transaction always makes the payment, and the other party accepts the payment. As a result, the total amount of circulating assets,



according to expression (7), remains unchanged (zero for the example under consideration).

Fig. 1. Simplest oscillation links in economics and radio-electronics, where a sustained oscillation process is observed

Let us suppose, for the simplest case under consideration, when there is only one vendor and only one buyer, that $Q_V(t) = Q_B(t) = Q(t)$ and $P_V(t) = P_B(t) = P(t)$, then, using formulae (1), (3), we find from (7) the expression

$$T_V \frac{d[Q(t)P(t)]}{dt} + \frac{1}{T_B}\int_0^t Q(t)P(t)dt = 0 \tag{8}$$

Substituting (1), we get ***the second-degree linear differential equation describing the 'goods-money-goods' process*** under consideration.

$$T_V T_B \frac{d^2 M_B(t)}{dt^2} + M_B(t) = 0 \tag{9}$$

The solution of the equation has the form

$$M_B = A\sin\omega_0 t + B\cos\omega_0 t \tag{10}$$

where A and B are the constants of integration which are found from the initial conditions $M_B(t)\big|_{t=0}$ and $\left.\frac{dM_B(t)}{dt}\right|_{t=0}$;

$\omega_0 = 1/\sqrt{T_B T_V}$ is the resonance frequency of the simplest economic link under investigation.

It is easy to notice that the expressions (7) and (9) are very much similar to the expressions

$$U_L(t) + U_C(t) = 0 \tag{11}$$

$$LC\frac{d^2 U_C(t)}{dt^2} + U_C(t) = 0 \tag{12}$$

which, as is known, describe processes in the electric circuit (Fig. 1b) often referred to as an electric oscillation LC-circuit. Consequently, the economic circuit given in Fig. 1a can be referred to as an economic oscillation link.

Formula (11) in the electric circuits' theory is referred to as the second Kirchhoff's law (this is certainly its simplest notation). This is why in economic circuits' theory formula (7) can also be referred to as the second Kirchhoff's law in its economic interpretation. It is also possible to demonstrate that the first Kirchhoff's law is true for the economic circuits' theory, and formulae (1) – (5) correspond to the Ohm's law (also in their economic interpretation).

Moreover, the analogy described above holds true for more complicated situations, as well (see Fig. 2). Indeed, in oscillation links presented in Fig. 2 – both the economic and the radio-electronic ones – compared to the first case, additional, the so-called dissipating elements (from Latin *dissipatio* – dissipation), are present. They are called dissipating

the reason that they dissipate the energy of oscillations, causing the latter to become damped. In the radio-electronic oscillation link (Fig. 2b) this is the resistor R. In the economic oscillation link (Fig. 2a) here belong the elements which withdraw a part of circulating assets (a bank and a tax administration in the example under consideration).

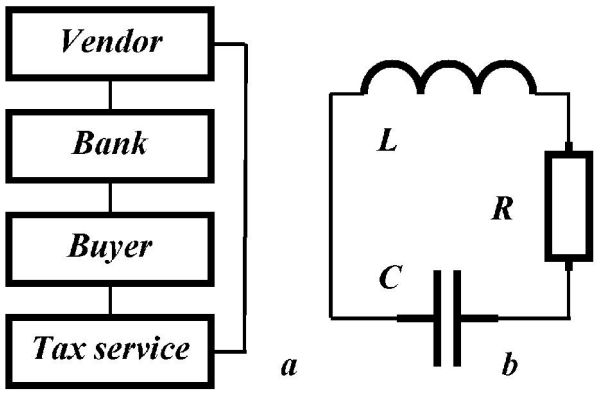


Fig. 2. Simplest oscillation links in economics and radio-electronics, where a damped oscillation process is observed

Therefore, processes in them are described with somewhat different, compared to (9) and (11), differential equations. For the radio-electronic oscillation link (Fig. 2b) this differential equation has the form

$$LC\frac{d^2U_C(t)}{dt^2}+RC\frac{dU_C(t)}{dt}+U_C(t)=0 \qquad (13)$$

and for the economic oscillation link – the following form (for simplicity, both differential equations are given without derivation)

$$T_V T_B\frac{d^2M_B(t)}{dt^2}+T_B(\alpha+\beta)\frac{dM_B(t)}{dt}+M_B(t)=0 \qquad (14)$$

Their solutions are damped oscillations, which are mathematically identical

$$M_B(t)=e^{-\sigma_0 t}(A\sin\omega_0 t+B\cos\omega_0 t) \qquad (15)$$

$$U_C(t)=e^{-\sigma_0 t}(A\sin\omega_0 t+B\cos\omega_0 t) \qquad (16)$$

where α is the relative current amount of the vendor's tax payments;

β is the relative current amount of the buyer's payments to the bank for making money transfers to the buyer;

A and B are the integration constants;

$\omega_0 = 1/\sqrt{T_B T_V}$ is the resonance frequency of oscillations in the economic oscillation link;

$\omega_0 = 1/\sqrt{LC}$ is the resonance frequency of oscillations in the radio-electronic oscillation link;

$\sigma_0 = (\alpha+\beta)/2T_V$ is the decay of oscillations in the economic oscillation link;

$\sigma_0 = R/2L$ is the decay of oscillations in the radio-electronic oscillation link.

As can be seen, the analogy between the economic and radio-electronic oscillation processes is indeed observed in the oscillation links plotted in Fig. 2. It is observed in many other situations, as well.

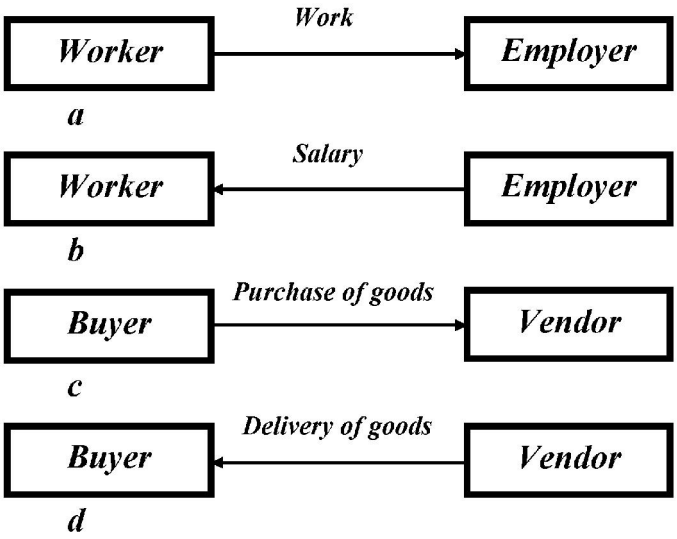


Fig. 3. The content of the oscillation process in isolated economic oscillation links plotted in Fig. 1a and 2a

Thus, ***radio-electronic devices and processes are***, indeed, the aforementioned ***white box with regard to the black box of economics and economic processes***. Recognition of this fact allows developing the economic theory which will completely meet the criteria of the exact sciences.

However, using this analogy requires being cautious and avoiding violating it as a result of certain incorrect actions. For example, in the electric oscillation circuit (Fig. 1b or 2b) the oscillation process in any of its phases has one and the same physical meaning determined by the motion of electrons. As for the isolated economic oscillation link (Fig. 1a or 2a), the oscillation period includes four successive processes with a different content, where business partners perform different functions. At first (Fig. 3a), the vendor is an employer and a manufacturer, and the buyer is an employee who manufactures goods at the vendor's enterprise. Then (Fig. 3b), the employer pays remuneration to the employee. After that (Fig. 3c), the employee turns into a buyer and pays the employer-vendor the cost of a purchase. Finally (Fig. 3d), the vendor delivers the purchased goods to the buyer.

Since the economic oscillation link under consideration (Fig. 1a) is assumed to be isolated for simplicity, the full oscillation period must include all the successive actions described above. For example, the condition is fulfilled if workers of an automobile plant purchase cars produced by it. If the condition above is not fulfilled, the oscillation process becomes impossible.

In more complex multi-link oscillation systems the content of the oscillation process can certainly be different; moreover, it can differ even in various links of the oscillation system.

However, even if the succession of actions described above is observed, the 'goods-money-goods' process in the economic link under consideration will not be oscillating, if all payments and deliveries are not enforced according to the sine law (e.g., made by a computer on a daily basis), which is never the case at present. Consequently, the economic links given in Figs. 1a and 2a are only potentially oscillating. In fact, the oscillation process described above has never been implemented in economics.

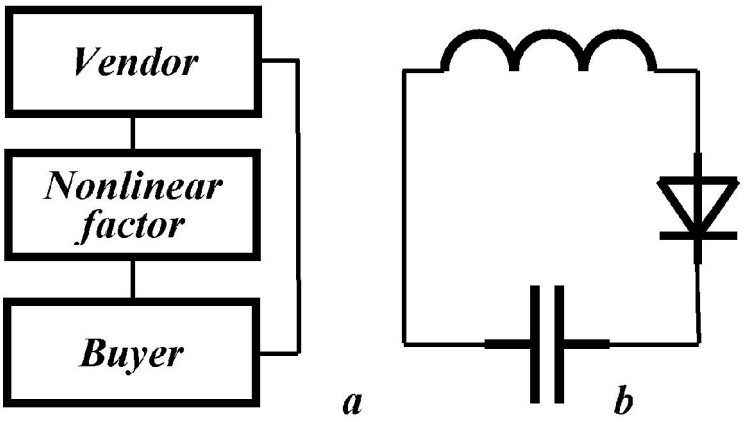


Fig. 4. Non-linear links

In this respect, it is natural to ask: what is the point of all these complications and does the economy need these oscillation processes? They turn out to be very necessary, because they provide for a more efficient use of circulating assets than currently observed. Indeed, given the current payment schedules in the form of infrequent (e.g., monthly or quarterly) payments, money works inefficiently, because the economy always experiences either surplus or shortage of it to solve its current tasks. This is why part of the money always remains idle. If sinusoidal payment schedules are used in economic oscillation systems, circulating assets will be fully used at any time and yield significantly larger returns.

Moreover, the economic oscillation systems described above will make it possible to use completely new processes which will significantly improve the efficiency of economic activity. For example, here belong processes widely used in resonant processes engineering, or processes used in wired structure systems, as well as many other processes known in radio-electronics and computer technology.

The most important point is that it is these complications that allow eventually developing the economic theory belonging to the exact sciences, which will be able to develop just as consistent and efficient systems as radio-electronics.

For better understanding of the following discussion, it is noteworthy that isolated economic and radio-electronic links may be non-linear, as well (their conditional examples are presented in Fig. 4). Processes in the non-linear economic link (Fig. 4a) and the non-linear radio-electronic link (Fig. 4b) are described with very similar non-linear differential equations:

$$T_V T_B \frac{d^2 M_B(t)}{dt^2} + T_B F[M_B(t)] \frac{dM_B(t)}{dt} + M_B(t) = 0 \quad (17)$$

$$LC \frac{d^2 U_C(t)}{dt^2} + CR[U_C(t)]C \frac{dU_C(t)}{dt} + U_C(t) = 0 \quad (18)$$

They (both the links and the differential equations) are referred to as non-linear for the reason that they include at least one non-linear element – $F[M_B(t)]$ or $R[U_C(t)]$, the value of which depends on the current value of the function under investigation – $M_B(t)$ or $M_B(t)$. In the radio-electronic link presented in Fig. 4b, the non-linear element is the diode. In the economic link given in Fig. 4a, the non-linear element is, for instance, the fact that the buyer, e.g., in a supermarket, always pays to the vendor, but the vendor never pays to the buyer. Non-linear circuits and the corresponding non-linear processes are often used both in economic and radio-electronic links which are not oscillating, and which are not the subject of the given research. This is why, in the economic link given in Fig. 4a, this circumstance is referred to as the 'non-linear factor', and not as the 'non-linear element', which is absent in the situation under consideration.

By the way, this example demonstrates very well that it is not easy to make the analogy between the economic and radio-electronic circuits.

4 "THE INVISIBLE HAND" OF ADAM SMITH

The problem of building crisis-proof sustainable economy is one of the major issues for governments of all countries and top-managers of the global economy. It is well known that both the abstract socialism as a fully regulated economy and the abstract capitalism (laissez faire) as a completely free economy, have their shortcomings and their advantages:

- socialist economy was developing very slowly, but experienced no crises;
- capitalist economy is developing much faster, but suffers from economic crises.

Thus, all countries are currently looking for their own intermediate ways of economic development, in the form of this or that variety of regulated capitalism (i.e., with elements of socialism). However, many existing economic schools [3], [7] have not reached an agreement upon this intermediate way. As a result, different countries have chosen different ways. However, an indisputable knowledge base necessary for any national leader to make a confident choice of a justified course of economic development is still lacking. This is why voters of all countries are still offered new and different economic agendas, none of which is capable of preventing economic crises for the reasons discussed above.

Therefore, a new approach towards solving the problem is suggested below. It will allow building the crisis-proof economy.

Economists often use the specific term 'the invisible hand' introduced by Adam Smith 1723 – 1790) [17], when they face manifestations of powerful and unclear forces driving the society in their unpredictable direction, often despite the efforts of government heads and top-managers of the economy.

For instance, in 1929 – 1930 the US gross national product suddenly dropped to 67% of the previous years. This became the national economic tragedy which is known in US history as the Great Depression.

Just think about it: both in 1929 and in 1930, the US economy had approximately the same labour force and approximately the same fixed assets. However, in 1929 huge growth of production was observed (stock quotations were exceptionally high), and in 1930 the stock market 'collapsed' and a 33% decline in production was recorded! Over these years, the country suffered neither a war, nor a natural disaster, nor an epidemic. Just somehow, one and the same economy was prosperous in 1929, and deteriorated in 1930. What was the reason? What drastic changes occurred in the US economy in 1930? There is still no answer. The Great Depression does not give in to any rational explanation [18].

Indeed, according to the Cobb-Douglas production function [19] $Q = AL^{\alpha}K^{\beta}$, the production volume Q depends on two slowly varying production factors: L (labour costs) and K (capital costs). Thus, the economy of any country is not supposed to experience any crises, and production volume is supposed to gradually increase year over year, following population growth (1-2% per annum) and fixed assets growth (3-4% per annum). However, in fact, something unpredictable keeps happening in economic development, and short-term sustainable growth is rather an exception than a rule.

The state of affairs means only one thing: there is the third, more powerful factor, which plays the role of a switchboard for progress or regress. This unknown third factor is, in fact, the major one defining the process of economic development. However, it is still unidentified by the economic science, despite all the efforts taken to define it.

This is why one of the major and urgent problems of theoretical economics is still to detect 'the third factor', to identify the mysterious 'invisible hand', which plays such an important part in the development of the global economy.

However, if long-term research failed to reveal the third factor among the objective circumstances influencing economic processes, it is possible to presume that it is the subjective, or, in other words, the human factor. This was the conclusion made as a result of research reported in [20]. Let us briefly review it.

As was demonstrated above, in the idealized simplest market link (Fig. 1a or 2a) the 'goods-money-goods' process is mathematically described with the linear differential equation (9) or (14).

Its obvious solution is an oscillation process, because the current assets must circulate between the buyer and the vendor. However, this oscillation process has nothing in common either with the Elliott waves [21], or with the seasonal fluctuations of business activity (e.g., in agriculture), or with the economic cycles of Kitchin, Juglar, Kuznets or Kondratiev [22], and it has nothing to do with economic crises.

Moreover, this oscillation process in economics is still unknown, because the conditions for its realization have never been created. They cannot be created in a random way. This is quite natural, because houses are not built in a random fashion, cars are not assembled at random, and computers are not made randomly. Constructive activities always require certain knowledge, which economics is still lacking.

This is why, the simplest links of the commodities market in Fig. 1a and 2a were said to be idealized and only potentially oscillating. Actual oscillation links always include (see Figs. 1a and 2a) not only the buyer and the vendor (as well as other market participants – third parties, banks, tax authorities, etc.), whose behaviour is described by functions (1) – (5), but 'the invisible hand', as well – the human factors they introduce, because actual market participants are common people with common human foibles, habits and other peculiarities. This is why, they are not always reliable, sometimes they are forgetful, often prone to emotions, illnesses, other random factors and unforeseen circumstances. As a result, for the actual links of the commodities market shown in Fig. 5a,b, the process will be described not with linear differential equation with constant coefficients (9) and (14), but with linear differential equations with variable coefficients (or, in other words, with parametric differential equations)

$$T_V T_B H_V(t)\frac{d^2 M_B(t)}{dt^2} + H_B(t) M_B(t) = 0 \tag{19}$$

$$T_V T_B H_V(t)\frac{d^2 M_B(t)}{dt^2} + (\alpha+\beta) T_B H_{B+TS}(t)\frac{dM_B(t)}{dt} + H_B(t) M_B(t) = 0 \tag{20}$$

where $H_V(t)$ is the human factor taking into account the behaviour of the vendor,

$H_{B+TS}(t)$ is the human factor taking into account the behaviour of the bank and the tax administration;

$H_B(t)$ is the human factor taking into account the behaviour of the buyer.

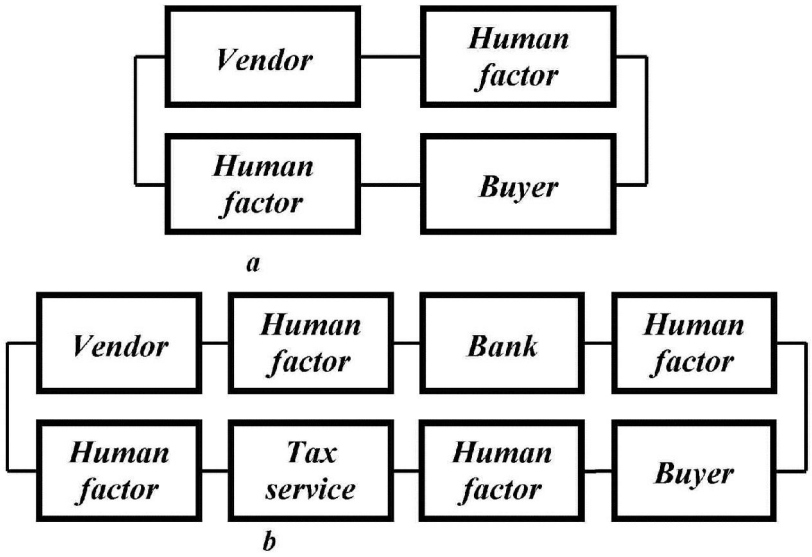


Fig. 5. Actual functional schemes of the simplest oscillation links in the economy

Since in the parametric differential equations (19) and (20) the coefficients $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ are different random functions of time, their solutions are also random functions of time. They cannot be found analytically.

Processes in the real capitalist economy generally comprise many similar unpredictable processes in simple economic links. Therefore, the global economy depends on the rapidly varying human factors $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ to a much greater extent than on the slowly varying production factors $L(t)$ and $K(t)$ mentioned above. Due to this fact, it is basically unpredictable and uncontrollable.

There is other evidence of the significant influence of the human factor on the economy. Thus, the social choice theory suggested by Arrow [23] argues that conciliation of social interests is provided for only by dictatorial regulations. Basically the same conclusion was made by Gibbard [24] after investigating other aspects of choice mechanism given the very general assumptions. In fact, this is just the statement of the conclusion made herein, worded using different terms.

Therefore, the conclusion that the Great Depression phenomena is accounted for by the human factor is quite justified.

The foregoing also fully explains the fact that the Soviet Union never suffered from economic crises. The matter is that the plan-based Soviet economy provided for the fulfilment of conditions minimizing the influence of the human factor $\lim H_V(t) \to const$, $\lim H_B(t) \to const$ and $\lim H_{B+TS}(t) \to const$, i.e., the functions $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ were almost constant. This is why parametric differential equations (19) and (20) in the Soviet economy were transformed into linear differential equations with constant coefficients, which made economic processes fully controllable.

5 NEW CRISIS-PROOF ECONOMIC TOOLS

Thus, ***in order to avoid economic crises in the capitalist economy, the influence of the human factor in it must be minimized***, i.e., fulfilment of the conditions $\lim H_V(t) \to const$, $\lim H_B(t) \to const$ and $\lim H_{B+TS}(t) \to const$ must be provided for. However, this has to be done in a different way than in the Soviet Union.

To find out how this can be achieved, let us specify that the human factor may be internal and external.

The internal human factor is understood as a spontaneous unpredictability of behaviour of market participants due to their unreliability, illnesses, forgetfulness, imperfections of contracts or verbal arrangements regulating their activities, rumours, panic, and other similar reasons.

The external human factor is understood as the unpredictable behaviour of market participants determined by random external influence upon them by other persons and companies – competitors, public officials, criminal structures and other similar reasons.

Therefore, it is obvious that, in, order to minimize the influence of the human factor in the market capitalist economy, some new economic tools [25] are necessary, because the existing economic tools have not been able to offset it. These tools must be different for the internal and the external human factors.

5.1 MINIMIZING THE INFLUENCE OF THE INTERNAL HUMAN FACTOR

Let us refer to the new economic tool aimed at minimizing the influence of the internal human factor as the business-interface [20], by analogy with a similar term used in computer engineering. Let us recall that an interface in computer engineering is understood as a hardware and software means of connecting various nodes and devices. It is clear that if, for instance, plugs and sockets of these devices are different, or even if the plugs are correct, but mismatching signals are fed to the matching pin of the plug and the socket, the computer will not operate. This is why all interfaces in computer engineering are strictly defined.

This is why we shall refer to business-interfaces as the payment (commodity-money) means of connecting market process participants, as a result of which, the vendor must supply the buyer exactly the goods ordered by the buyer, and get exactly the payment specified in the price-list. However, this is not enough. In order to avoid the destructive economic consequences caused by the human factor (remember the Great Depression), every detail of the business-interfaces must be defined; this will enable implementing oscillation processes in economic links. Thus, the corresponding contracts must contain all the details providing for:

- linearization of the economic process, which must be described with a linear differential equation with constant coefficients; to this end, all non-linear and parametric elements (or factors) must be respectively removed from the economic system;
- temporal variation of the circulating assets flow as close to the sine law as possible (it can be easily implemented using computers);
- strict and close adherence to contractual obligations by both the vendors and the buyers; breach of these obligations must inflict penalties as severe as those practiced in socialist countries for violation of labour discipline.

Thus, the primary function of the business-interfaces is to support and regulate the circulating assets flows. This is why an important part in their implementation will be played by banks, whose activity will also change the economic outlook of their clients. Moreover, certain amendments and clarifications will have to be made in the national and international legislation.

All vendors and all buyers inevitably have numerous business relationships with other vendors and buyers; for this reason, any actual economic system is multi-link and multi-related. This is why, it will be necessary to optimize the and parameters of these economic systems. In particular, an international system of operating frequencies must be

developed, tied to the natural cycles of agricultural works, forestry engineering, construction works, transportation, and other seasonal businesses. Similarly, computer engineering uses clock frequencies; television uses clock rates, etc.

Some particular examples of the business-interfaces for oscillation economic processes are discussed in [15], [16]. However, at least several hundred business-interfaces taking into account different particular cases relevant to business partners can be suggested. Therefore, it is advisable to publish a corresponding reference book, and introduce a special course of lectures teaching business-interfaces in economic schools.

Implementation of business-interfaces may bring up the question of whether their use can lead to the same grave consequences as the plan-based socialist economy due to the excessive regulation of economic activity, in particular, to the suppression of rights and freedoms. The answer is – no, it cannot, because business-interfaces will operate only for the term of a transaction, i.e., from the moment it is made to the moment it is settled, and only to the extent of the transaction, for the business partners indicated in the transaction. The latter, indeed, will have no freedom of disregarding the terms of the transaction; they will be committed to settle it. If you wish, after making a transaction, business partners will find themselves, to a certain extent, in socialism.

Similarly, nature, providing for the variety of lifestyles of various creatures, left them no choice of neglecting their duties of reproduction.

However, other people, as well as business partners beyond the extent of their transaction, will fully remain in capitalism. They will be completely free to choose what to buy or not to buy, to produce or not to produce, to hire and to fire; they will choose their occupation and place of residence, vote freely, and exercise their civil liberties and so on.

Therefore, the economy reformed as suggested above will be both capitalist and socialist: for the term of contractual obligations and to the extent of their settlement by the partners it will be socialist, and in all other respects for them and for all other people it will be capitalist. This economy will become ultimately fair and, thus, will ease social tension.

5.2 MINIMIZING THE INFLUENCE OF THE EXTERNAL HUMAN FACTOR

In order to minimize the influence of the external human factor, another economic tool is suggested, namely, the new global/regional information network TV•net [26], [27], which is free from all the shortcomings of the Internet. This information network will enable businesspeople to find business partners and make profitable transactions without having to resort to the unwanted third parties. Thus, businesspeople will have guaranteed confidentiality of their business connections, and will be able to avoid the unwanted influence of any third parties.

However, the only currently available global information network, the Internet, is hardly suitable for business purposes due to its numerous shortcomings. Indeed:

- it does not provide for guaranteed information security, i.e., protection from computer viruses, spyware, hackers, spam and other network threats;
- the www contains few if any promptly updated reliable serious information necessary for business and other intellectual activities, and, on the contrary, contains a lot of junk information;
- information retrieval time (not to be confused with information transmission time) is quite long, i.e., all search engines work not efficiently enough;
- copyright and proprietary rights (by hackers) are often infringed.

Due to the above, the Internet is often used, in fact, to resist (how else can we refer to the infringement of copyright and proprietary rights?) the fair capitalist business.

The TV•net, on the contrary, due to absence of packet-switched communication and use of one-way broadband (television or fibre-optic) communication lines:

- completely solves the problem of guaranteed information security, because it does not have the feedback communication lines used in the Internet for unauthorized access to information in the users' PCs;
- provides for zero information retrieval time, as information is broadcast to the users immediately as it is received and verified, and then stored in their personal data bases;
- provides for efficient noise reduction and protection from unauthorized access to communication lines due to noise-combating codes and cryptographic encoding;
- greatly enhances its functional capabilities due to the use of numerous new highly demanded services:

- the trading service which allows creating a global online-store;
- the exchange service which allows creating a global universal e-exchange;
- the administrative service which provides for efficient management of any institutions – ministries, banks, institutes, corporations, etc.;
- the educational service which offers mass education at the top level [28];
- the analytical service which allows implementing human-computer super-intelligence [8], [29], [30] – an alternative to the artificial intelligence whose development has faced a dead end; and so on.

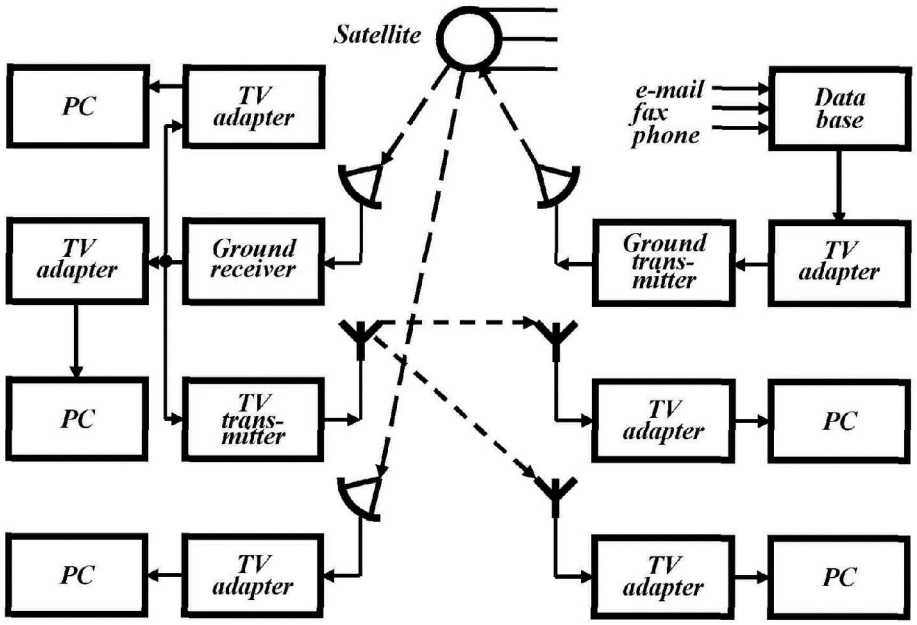


Fig. 6. An example of the simplest implementation of the TV•net information network without feedback lines

Let us briefly describe the new services offered by the TV•net information network.

The trading service of the TV•net information network is the most easy and low-cost to implement, because its deployment requires mostly organizational support. As can be seen (see Fig. 6), almost everything necessary for its implementation is already available in the market. Therefore, it can be quickly deployed in any region with a TV broadcasting network, both on-air and cable, and even away from cities, if satellite broadcasting channels are used. To deploy a small local network (e.g., for one particular city), there is no need to use satellite repeaters. For a comparatively large regional or global TV•net network, satellite repeaters are necessary. However, those used for TV broadcasting can be employed, just as well.

Nowadays, the TV broadcasting network, in particular, satellite network, is so well developed and available at any place on Earth, that the main expense item for the deployment of the TV•net network is no longer required. Owners of the TV•net network do not have to launch their own satellites, because almost every satellite repeater has back-up facilities and communication lines not used to their full capacity at night. Computer information can be broadcast via the TV•net network at any time, as it will be received by the users' PCs 24 hours a day, and will be stored until it is required.

The trading service operates as follows. The users-buyers, for a certain subscription fee, connect to the TV•net information network via TV adapters, similar to modems used to connect to the Internet. The procedure is identical to subscribing to the pay-tv network. The only difference is that instead of the TV channels, the users choose the headings from the classifier. At that, the users PCs may be connected to the TV•net network either via cable TV lines, or via on-air or satellite TV, at their discretion.

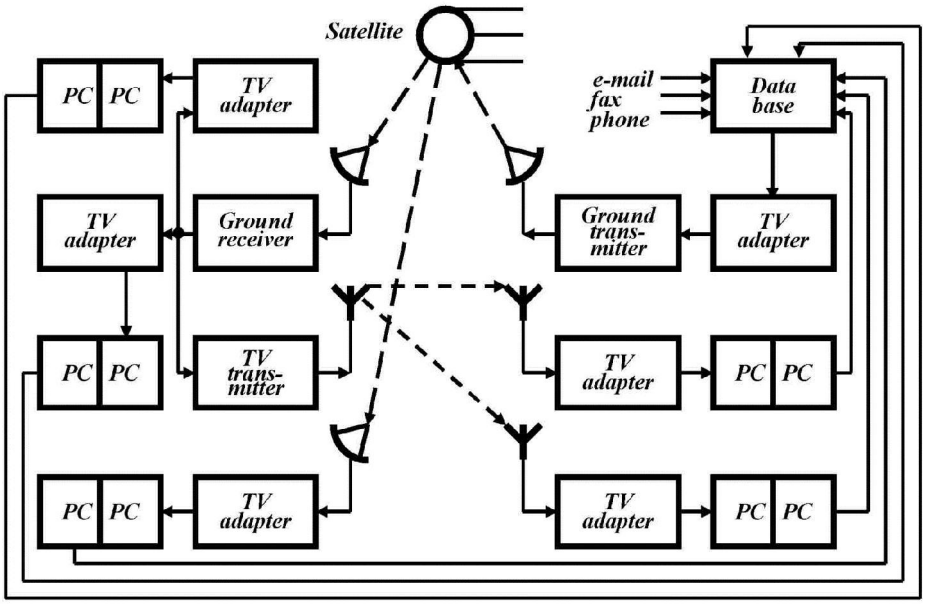


Fig. 7. An example of the simplest implementation of the TV•net information network with feedback lines

The subscribers-vendors are also connected to the TV•net for subscription fee, and regularly transmit (via any communication lines, including e-mail over the Internet) to the data base the most detailed information about the goods and services they offer. Similarly, offers of other forms of business partnership, including trade enquiries, can be submitted to the data base. In the data base, the information received is classified by the administration personnel and regularly broadcast via a TV adapter, where it is encoded and sent to a TV transmitter in the respective region (this link is not shown in Fig. 6 for simplicity). Then, via a television broadcasting network, it is transmitted to the users' PCs, and broadcast to users of other regions via satellite repeaters (Ground transmitter, Satellite, Ground receiver). The users can make their choices and purchases they need based on the corresponding criteria with the help of their PCs, either manually or using simple software.

In addition, guaranteed information security is provided for the users, since they are not connected to the Internet, and connected to the TV•net via one-way television broadcasting lines. Similarly, a TV viewer is not afraid that any information about him can be sent to the TV centre. If the users need to send any information via the Internet (e.g., order the delivery of the purchased goods), they will have to use a different PC (see Fig. 7). However, in this case, the protected PC connected to the TV•net, and the unprotected PC connected to the Internet must not have any communication between each other (except for removable disks and USB-cards).

Thus, services of the TV•net information network will be paid for by both the buyers and the vendors. Operating such a TV•net network will be quite a profitable business, may be, even more profitable, than TV advertisement.

It is easy to see that the suggested trading service, in terms of its purpose, is very similar to online-stores, and seems to be needless. However, the difference is in the amount of services offered: online-stores belong to small and medium business, and the trading service of the TV•net information network is large business and can result in the creation of a global 24/7 online-store. Therefore, as any large business, it allows generating higher profits. Consumer confidence to large business will also be higher.

The exchange service is almost identical to the trading service, with one exception: goods and services are traded not at fixed prices, but at auction prices and by the rules. Therefore, implementation of this service requires the TV•net information network to be deployed with feedback connection (Fig. 7).

Depending on the type and volume of bids, e-exchanges operating within the TV•net can certainly be both regional and global, commodity and stock, FX and others.

Naturally, the larger region the service covers, the more profit it can generate for its owners, similarly to the trading service.

The administrative service provides for guaranteed secure informational services for banks, public offices, corporations and any other large, medium and small market participants which currently are suffering from hacker attacks through the Internet, and are also vulnerable to other network threats. Therefore, the benefits of the administrative service are obvious.

A peculiarity of implementation of the TV•net information network in terms of the administrative service is tougher requirements to information security, which can be fully met due to additional use of cryptographic encoding and protected local area networks both at the input and at the output. The simplest example of implementation of such a TV•net network is given in Fig. 8.

Furthermore, in order for the top-managers of these institutions to make reasoned and highly efficient decisions, it is necessary:

- to quickly upload all available up-to-date information on any problem requiring a solution into the memory of their PCs; we shall thus refer to it as the personal memory;
- to quickly and correctly evaluate the information available in the personal memory in order to reveal the dominating trends in their respective field, which will enable them to make definitely successful decisions.

This task is addressed by another service – the analytical one.

The analytical service, thus, can help its users in revealing trends and regularities. However, within the context of conventional concepts, nothing else can be suggested to solve the problem but the interpolation and extrapolation algorithms; although, this is also quite useful.

Therefore, let us formulate the task in a different way – the analytical service, along with its other functions, is aimed at the development of the human-computer super-intelligence, as an alternative to the artificial intelligence. Since there is no conventional definition of intelligence – either human or computer – let us specify that hereinafter human intelligence is understood [8], [29], [30] as a set of intellectual sub-systems which includes the low-factor rational thinking, the multi-factor unconscious thinking and some other sub-systems. The most important one in the set is the sub-system of the multi-factor unconscious thinking. The term is used because many people at present do not even suspect it exists. This is confirmed by the fact that people still do not know why they go to sleep, because they believe that in sleep they are uselessly idle and, moreover, are more defenceless. However, nature is wiser than people and does not do anything useless. Therefore, it turns out that nature makes us go to sleep (when all human input and output senses, as well as the low-factor rational thinking governing human activities, are off) in order for us to use all our intellectual resources to process information accumulated in the wakeful state. This is why there is a proverb: “Take counsel with your pillow”, or “If you have a problem – sleep on it”. This is why, when you are sick, in the morning your temperature is lower than at night. This is why many scientific discoveries were made in sleep. And only for this reason humans have survived as a biological species.

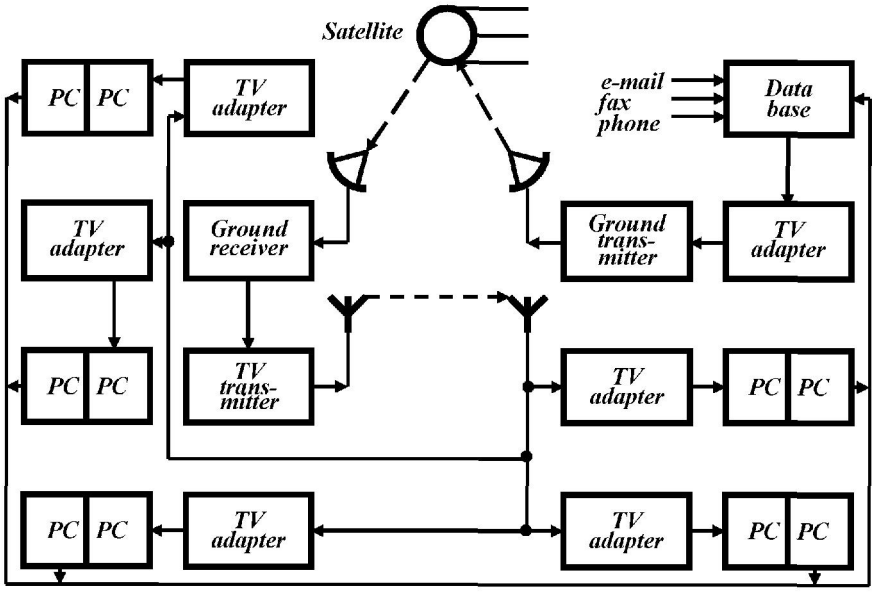


Fig. 8. An example of the simplest implementation of the TV•net information network using LANs

As for low-factor rational thinking, people need it for active day-to-day activities necessary for life support – getting food, doing work, and so on. It is referred to as low-factor for the reason that humans think with visual images (therefore people have dreams in the form of visual images and not in any other form) which are not more than three-dimensional. To make sure it is really so, try to imagine the simplest four-dimensional object – a hypercube. Processes in the real life, however, may depend on tens and hundreds, and even more factors (e.g., the economy, illnesses, weather, etc.).

Consequently, we can say that the rational low-factor thinking solves tactical tasks, and the unconscious multi-factor thinking performs strategic tasks.

Computer intelligence, usually referred to as the artificial intelligence, tries to simulate human low-factor thinking. Moreover, the artificial intelligence is often intended to meet the ambitious goal of surpassing human intelligence, i.e., to teach a computer to solve intellectual tasks without a human and instead of a human. However, this is a utopia. After 60 years of research devoted to the problem of artificial intelligence, scientists have not been able to teach a computer to tell, for instance, a dog from a cat.

Nevertheless, some scientist have developed the technological singularity concept [31], which reads that no later than 2030, following the successful solution of the artificial intelligence problem, an Internet-based computer civilization will emerge. It is not specified what this computer civilization will make of the human civilization; however, it is assumed that the process of development of the computer civilization is impossible to stop, because the countries which will try to hamper the process will be condemned to economic, military and technical underdevelopment, with all the respective consequences.

In fact, all these allegations are deceptive. Since humans possess the multi-factor thinking, and computers do not have it, humans will remain unattainably more advanced information machines than computers in the foreseeable future. The delusion about the superiority of computer intelligence seems to stem from the fact that computers are able to successfully solve complicated mathematical problems which cannot be solved by people either mentally or on paper. Many people believe that solving mathematical problems is an extremely intellectual activity. However, we should not forget that computers, contrary to humans, can solve only the tasks which are unambiguous and clear. Try to define clearly, for instance, how to tell a dog from a cat. Computers are unable to solve other, more ambiguous problems, which are prevailing in the real life. People, on the contrary, successfully solve them all the time. Therefore, computers are merely big and complicated calculators. Their intelligence is exactly at this level.

Donald Michie, Head of the Alan Turing Institute, wrote on the issue [32] that the current development of computer engineering makes it impossible even to try to approach the problem of artificial intelligence.

Many years later basically the same idea was expressed by V. M. Kuklin, Professor at Kharkov University [33]. He wrote that when solving the problem of artificial intelligence, scientists are unable to reproduce the attainments of nature even to the slightest degree.

Thus, the problem of artificial intelligence must be understood as it was formulated from the very beginning – as a research aiming at the investigation of human intelligence with the help of computer experiments. No more than that.

At present, given the phenomenal achievements of engineers and scientists in terms of computer advancement, it is time to define a new problem – the problem of human super-intelligence, which is understood herein as the development of human-computer systems able to solve multi-factor tasks. The matter is that human intelligence created by nature was not designed to use the multi-factor unconscious thinking to solve scientific and other intellectually demanding problems – centuries ago, people were busy with other things. If eventually people turned out to be able to solve intellectually demanding problems, this testifies only to the possibility of further substantial development of human intelligence, both by means of intellectual training (which is actually done by scientists) and by means of additional involvement of computer resources (which is suggested herein).

We will consider both possibilities, however, in the reverse order. We will first discuss the controllable and regular, contrary to the process of intellectual inspiration, use of the unconscious multi-factor human thinking in the wakeful state. What do scientists do when they are solving an intellectually demanding problem, i.e., when they are revealing a trend or discovering a regularity? They solve two problems in turn. First, they take all the imaginable multitude of factors and define the significant ones, which, if changed, noticeably influence the result under investigation. Then, having chosen the most significant of all the factors, they search for a mathematical relationship between them and the result under investigation. Finally, the result is taken down as a scientific law.

As can be seen, computer assistance in this research can be very helpful. Before commencing the research, a user first of all, to create in their PC a personal data base by quickly downloading from the information network all the reliable information relevant to the subject of the research. However, this is completely impossible given the current information

retrieval techniques in the WWW. On the other hand, this task can be quickly and easily performed by the TV•net information network in its realization sown in Fig. 6, except that the data base must contain the information necessary for top-managers, scientists, businesspeople, analysts of special services and other intellectual users.

Then, the corresponding software (e.g., factor analysis, or, in the simplest case, by key words) allows finding in all the ocean of information the pieces which presumably contain the significant factors. Next, these pieces of information must be studied and processed by human, in particular, multi-factor, thinking. Naturally, at this last stage of research, different software for enhancing the multi-factor intelligence can be helpful, similar to the existing software enhancing the low-factor rational intelligence.

Certainly, these tasks can be performed by supercomputers, as well. However, there are very few of them, they are very expensive and completely engaged in solving the most foreground problems. At the same time, these problems can be solved by personal computers, too, especially taking into account that important discoveries have often been unforeseen, spontaneous, and made by individual scientists. Here belong, for instance, discoveries of radioactivity, the DNA structure, the Internet, semiconductors and may other things. Let me at once answer those willing to object regarding the circumstances under which the semiconductor devices were discovered. I agree that after the World War II huge financing was allocated to the investigation of radio-electronic systems and components. In 1973 Leo Esaki, Ivar Giaever and Brian David Josephson won the Nobel Prize for discovering the tunnel diode. However, in fact, the first tunnel diode was made by physicist O.V. Losev back in 1922 [34]. It was even widely used at that time. However, no one was able to explain how it worked. Back then, even the term “semiconductor devices” did not exist.

This is why it is extremely important for the systems of human-computer super-intelligence to be accessible to all users, including talented individuals in their unplanned and ungoverned entrepreneurial, scientific and other intellectually demanding activities. Just as we need both small and large business, scientific research must also be performed not only by large groups of scientists, but by individual scientists, as well.

The educational service, in addition, is immediately relevant to the development of human super-intelligence, firstly, for the reason that creative thinking is developed in the course of education, and secondly, because creative people often have to get additional training or to be retrained.

The objectives of education can, certainly, be different – getting knowledge, mastering skills, intellectual or physical development, and so on. Therefore, taking into account that intellectual work is getting more and more demanding nowadays – even to stay rich, you must make certain intellectual efforts, otherwise you will turn poor – the major objective of education must, obviously, be the intellectual development of people.

The educational service which solves this problem operates as follows. Using the computer-television broadcasting network – the TV•net (see Fig. 6), its users, independently or via their educational institutions, receive and download to their PCs:

- textbooks and work-books supplied with a large number of hyperlinks to other sections of textbooks (other textbooks, as well) and FAQ sections;
- supplementary further reading;
- problem books with detailed solutions of typical problems and advanced problems;
- learning and developing, learn-as-you-play and other software.

As is well-known, the quality of education depends on how well individual peculiarities of students are taken into account. The point is that all people have a different body of mastered knowledge (due to individual differences in abilities, background, thinking, etc.). Thus, new knowledge is learned well only in the case it is based on the previously mastered knowledge. The art of teaching lies in the ability to take into account all these circumstances as much as possible. Naturally, the principle of learning based on the previously mastered knowledge is never fully observed in the process of collective education, because all people have different basic, well mastered, knowledge. It is poorly realized in self-education (there is no one to ask a question). At present it is best of all implemented in the process of individual education with a tutor.

However, the educational service of the TV•net allows implementing it even better, because a personal computer whose memory contains the information specified above can always help find the additional material explaining any unclear issues (basically what a tutor does). Therefore, education using the service under consideration in terms of its efficiency will be comparable to elite training on a one-to-one basis. This education will be most developing and aimed at further use of the human super-intelligence systems.

Thus, the service described above suggests new technical means aimed at the new strategy of education in order to improve the quality of education. The new strategy can be referred to as the developing learning, because, contrary to the

current teaching techniques, its objective is not merely to acquire knowledge, but to promote the skills allowing for the efficient creative application of this knowledge in further practical activity. Therefore, developing learning means of skills aimed at using the information obtained, as well as searching for the necessary information.

Developing learning will require new textbooks and workbooks. The currently available textbooks are not suitable for the purpose, because the material is often presented in an excessively dogmatic way in the form of, allegedly, absolutely true knowledge. However, developing learning requires textbooks which, first of all, teach to think. Therefore, they must not only present the knowledge, but explain the often difficult way this knowledge was obtained. Sometimes it is useful to analyse certain hypotheses rejected by science at present. It is necessary to explain that science has few absolute truths.

People who want to become super-intellectuals must not be deceived even in primary school, to say nothing about universities. They ought to know that groping for knowledge is an extremely hard work. Therefore, they must get used to not getting the ready-made knowledge, but to obtaining the knowledge themselves. In this respect, the learning process must resemble the process of a scientific research, except that at the very beginning it will take place under the supervision and with the help of teachers, then – academic advisors, and finally – independently.

People completing such a course will be prepared to the super-intellectual activity described above to the best advantage.

6 SUMMARY

Thus, it turns out that 'the invisible hand' of Adam Smith in economics is the human factor. It is its influence on the economy that makes processes in it be described with systems of parametric differential equations with coefficients in the form of random functions of time. For this reason, the current economy is unpredictable and cannot be efficiently managed, and economic crises in it are inevitable. In particular it is the human factor that accounts for the Great Depression phenomena in the US.

To be able to manage market economy, to make it crisis-proof, the influence of the human factor has to be minimized. To this end, new economic tools must be used. In order to minimize the influence of the external human factor, business-interfaces should be used. In order to minimize the influence of the internal human factor, it is advisable to use the new global information network TV•net, which is completely free from all the shortcomings of the Internet and offers numerous new business- and intellectually oriented services.

The economy reformed this way will be described mostly with systems of linear differential equations, i.e., it will have a mathematical description similar to the mathematical description of radio-electronic systems and processes. Therefore, this economy will become an exact science. It will be possible to use the methods borrowed from the theory of analysis and synthesis of linear electric circuits, from the simulation theory, from the automatic control theory and others. The reformed economy will allow widely using new, previously unknown oscillation processes which provide for significantly more efficient use of circulating assets.

Last, but not least – the economy reformed as discussed above will become crisis-proof and therefore rapidly developing.

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International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 2 No. 3 Mar. 2013, pp. 196-215

http://www.issr-journals.org/ijias/

Fundamentals of crisis-proof economics

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ABSTRACT: The major problem of the current market economy is absence of appropriate mathematical description of processes taking place in it, which results in misunderstanding of these processes, as well as lack of efficient means of preventing economic crises. The manuscripts suggests such a mathematical description, making use of the circumstance that the 'black box' of market economy has the corresponding 'white box', which turned out to be the processes well known in radio-electronics. This approach allowed proving that the current market economy, due to the significant influence of the human factor, is described with parametric differential equations with random coefficients, the solutions of which are also random functions of time. Therefore, it is basically unpredictable and uncontrollable, which makes economic crises inevitable. In order for the economy to become crisis-proof, it has to be reformed. We suggest using the new economic tools which allow solving the problem. Here belong business-interfaces that can neutralize the internal human factor, and the new global/regional information network TV•net, which is completely free from the shortcomings of the Internet and is able to neutralize the external human factor. It is shown that after the implementation of reforms suggested in the manuscript economics will become an exact science able to successfully solve the tasks of analysis and synthesis of economic structures, the tasks of their simulation and improvement, as well as regulation of the economy in general. The new economy will become crisis-proof and rapidly developing.

KEYWORDS: Economic Crisis, Economic Reform, Crisis-Proof Economy, 'Invisible Hand', 'Goods-Money-Goods' Process, Human Factor.

1 INTRODUCTION

People, contrary to all other living beings on Earth, have one more environment – the economy. Everything we are engaged in – working, studying, doing business, paying taxes, etc. – is somehow or other connected with the economy. All our conscious activities take place in this environment. Nevertheless, we know the economy not any better than our physical environment [1].

Economics as an exact science which complies with the principles of fundamental sciences has not yet been developed. This is confirmed by the fact that the major economic phenomenon – economic crises known for centuries – still lacks a comprehensive explanation. In the opinion of Philip Kay, historian, Professor at Oxford University, the first economic crisis in world history occurred in the Roman Empire in 88 BC [2]. There are other opinions, as well. Most scientists believe the first economic crisis was the one that hit England in 1825, partially influencing the economies of the USA and France [3]. Since that time, economic crises have become inevitable concomitants of the human civilization. There are many theories of economic crises, although, certainly, only one of them can be true. In fact, none of them is actually true, since all of them failed to prevent any upcoming economic crises.

Over the past few decades, many new complicated mathematized concepts [4] have been developed in economics, and attempts of their application have been made. Here belong theories of extremal problems and specific methods of data analysis, which have become part of econometrics, as well as game theories, social choice theories, theories of general economic equilibrium, etc. Various branches of mathematics have been further employed to analyse economic phenomena;

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here belong the fixed point theorem, differential topology, the stability theory, functional analysis, the theory of random processes, etc. There is hardly any branch of mathematics which scientists have not tried to apply to economics.

The above may seem to testify to the prosperity of economic science. However, this is not so, because there are apparent signs of a protracted crisis of economic theory, where the most general findings are definitely negative. These are the conclusions which may be formulated approximately as follows: "The answers to your questions depend on the circumstances which you did not take into account", and "The model you used is too general or irrelevant" [4].

This is why some authors [5] started to wonder whether the natural-scientific theories should be considered as an example for developing the economic theory, or whether the economic theory should be developed based on different standards. Opinions were expressed that, apparently, a large variety of economic phenomena cannot be accounted for based on a limited number of fundamental laws. Therefore, it was suggested to substitute the principle of a unified economic theory for the principle of coexistence of competing concepts [6].

The publication brought to the attention of the reader, however, attempts to suggest a concept of a unified economic theory which complies with the criteria of the exact sciences and will allow explaining and preventing economic crises.

2 APPROPRIATE MATHEMATICAL DESCRIPTION OF ECONOMIC PROCESSES

Despite numerous economic theories developed by Adam Smith (1723 – 1790), Thomas Robert Maltus (1766 – 1834), Jean Baptiste Say (1767 – 1832), David Ricardo (1772 – 1823), Jean-Charles Leonard Sismonde de Sismondi (1773 – 1842), John Stuart Mill (1806 – 1873), Karl Heinrich Marx (1818 – 1883), Alfred Marshall (1842 – 1924), John Bates Clark (1847 – 1938), Vilfredo Pareto (1848 – 1923), Ludwig Heinrich Elder von Mises (1881 – 1973), Joseph Alois Schumpeter (1883 – 1953), John Maynard Keynes (1883 – 1946), Nikolai Dmitriewitsch Kondratieff (1892 – 1938), Friedrich August von Hayek (1899 – 1992), Simon Smith Kuznets (1901 – 1985), Wassily Wassilevich Leontief (1905 – 1999), Milton Friedman (1912 – 2006), Walt Withman Rostow (1916 – 2003), Christopher Freeman (1921 – 2010) and many other outstanding scientists [3], [7], both local and global economic crises continue, and, thus, refute all the existing theories of economic crises.

Anticipating the following (see details below), we have to note that, in terms of mathematics, the task of explaining the nature of economic crises turned out to be quite extraordinary and complicated, because processes prevailing in the current economy are described with systems of parametric differential equations with random coefficients, which are not compatible to other sciences and have no analytical solution. Therefore, crises are inevitable in this economy, and it is impossible to prevent them using the economic tools available at present.

In order to develop a controllable crisis-proof economy, new economic tools described below are necessary. In other words, the current economy has to be reformed in such a way as to allow the use of mathematical tools enabling to solve the problem.

In order to understand what these new mathematical-economic tools must be, the new appropriate mathematical description of processes prevailing in the current economy has to be found. In this respect it is noteworthy that, first of all, an important peculiarity of economic processes is the fact that they are highly multi-factor, contrary to processes studied in the exact sciences. Indeed, almost all laws revealed so far in the exact sciences (perhaps, with the exception of Kepler's third law with Newton's amendments) are low-factor, although nature, certainly, does not restrict itself to the use of only these simplest natural-scientific laws. However, multi-factor laws in the exact sciences have yet to be discovered. As for economics, it has no low-factor dependencies, with a rare exception. This is a very important circumstance which is relevant to the situation under consideration. The matter is that human rational thinking is low-factor by nature [8], because people think with visual images which are not more than three-dimensional. Therefore, people are able to perceive low-factor dependencies. As for multi-factor dependencies described with functions of more than three variables (similar to objects having more dimensions), people are unable to perceive them with their rational thinking. You can make sure of it yourselves: just try to imagine the simplest four-dimensional object – a hypercube (or tesseract). Thus, human rational thinking itself, without computer support (see below for human-computer super-intelligence), is unable to perceive multi-factor economic dependencies.

To make these multi-factor objects of economic research at least somehow understandable, they are sometimes transformed into low-factor objects with the help of mathematical statistics. However, estimates received after statistical processing of economic data are too information-depleted, and, therefore, hardly suitable for practical application. For the same reason, for instance, a doctor would never use the average temperature, as well as averaged results of other analyses, to treat the patients.

Furthermore, an extremely important circumstance which must be taken into account correctly is the fact that economic processes, as follows from the fact that they are multi-factor, belong to the so-called mass phenomena. Currently, conclusions drawn from this circumstance are so wrong that they make it impossible to develop economic theory which would comply with the criteria of the exact sciences. Mass phenomena can be found in other science, as well, e.g., in physics and radio-electronics; however, this fact does not prevent them from being the exact sciences. As for economics, acknowledgement of the circumstance that economic processes belong to mass phenomena basically resulted in complete abandonment of any attempts to understand the fundamental processes in it and to suggest their appropriate mathematical description which defines its current state of development.

With all this in view, we can state that economics remains largely unknown. In the exact sciences, the term 'the black box', introduced by William Ross Ashby (1903 – 1972), is used to denote an object of research whose operational mechanism is unknown, but the result of its operation is known. Moreover, this result is unpredictable and mathematically indefinable.

This is why any regulatory activities of governments and top-managers of the current economy turn out to be inefficient. Indeed, in order to manage the object of regulation, it is necessary to be able to extrapolate its behaviour, which is impossible without its appropriate mathematical description.

In order to solve the problem, we must be able to turn the black box into 'the white box', whose operation mechanism, according to the definition introduced by Norbert Wiener (1894 – 1964), is known, and yields the same results as the black box. In other words, the white box is the mathematical counterpart of the black box, and mathematical description of processes in the white box is therefore appropriate for processes in the black box, although, in terms of physics, the black box and the white box can be completely different. For instance, in investigation of oscillations, a pendulum may be the white box, and a radio-electronic oscillation circuit, a piano or an earthquake may be the black box.

Thus, to be able to prevent economic crises, it is first of all necessary to find an appropriate mathematical description of processes prevailing in the economy. To this end, the corresponding white box has to be found, and then, based on the well-known results of its operation, processes in the black box of the economy can be improved.

However, such a white box has not yet been found.

Furthermore, mathematical analysis of different situations using the supply and demand curves, the production-possibility curves, etc., widely used in economics, is not at all suitable to describe processes and allows defining only a state, because the intersection points of curves mathematically correspond to graphical solutions of algebraic equations without consideration of time. Certainly, the results obtained using these curves are useful. They allow, in the first approximation, giving a more or less correct estimate of a certain economic situation. However, this is definitely not enough, since they do not allow understanding the processes prevailing in the black box of the global and even of any regional economy.

Low efficiency of the mathematical apparatus used in economics was pointed to by physicists at the end of the 20th century; they even founded a new science – econophysics (econophysics = econo**mics** + physics). They reasonably assumed that phenomena observed in economics have much in common with processes in physics, and, thus, suggested to use new mathematical tools in economics [9]-[12]. These new mathematical tools of econophysics included mostly the statistical methods borrowed from statistical physics. In particular, non-traditional for economics methods developed in the theory of self-organized criticality, in fractal analysis, in the theory of phase transitions, and in the percolation theory were widely used. However, these new mathematical tools also allow defining only states.

Processes in mathematics are described with differential equations – linear, non-linear or parametric, depending on the peculiarities of their behaviour in a particular object of research. Consequently, the appropriate mathematical description of economic processes must be made using differential equations. Unfortunately, attempts to use differential equations in economics [13], [14] were not aimed at understanding the contents of the black box of the economy. This must have led to the opinion that differential equations in economics are restrictedly useful.

However, this false conclusion is determined by the improper use of mathematics. Its improper use stems from the opinion prevailing in the economy that the behaviour of this or that market participant is completely impossible to predict (this statement is both true and false, depending on the circumstances – see below). For instance, Sir Isaac Newton (1642 – 1727) wrote that simulating people's behaviour is a much more complicated task that predicting planetary motion [11]. This is why, in economics, there is a tendency to assume that it makes sense to analyse only the behaviour of a large number of market participants, i.e., to investigate mathematically only mass phenomena.

3 DIFFERENTIAL EQUATION OF THE 'GOODS-MONEY-GOODS' PROCESS

The basic economic process is certainly the 'goods-money-goods' process.

Since it is a process, it must be described with a differential equation [15], [16]. To derive it, it is certainly necessary to describe mathematically the market behaviour of the vendor and the buyer separately (for a more complicated implementation of the market – of other market participants, as well), and then – their joint behaviour. Both the buyer and the vendor may be either an individual or a corporate body. However, the goods, which are a matter of their common concern, must be the same.

Thus, given the very general, but quite possible conditions, the behaviour of the generalized buyer (hereinafter referred to as the buyer) of the goods, who is often a wage worker, is described with the formula:

$$M_B(t) = \frac{1}{T_B}\int_0^t Q_B(t)P_B(t)dt \tag{1}$$

or the inverse formula

$$Q_B(t)P_B(t) = T_B\frac{dM_B(t)}{dt} \tag{2}$$

where $M_B(t)$ is the current expenses (the amount of circulating assets) of the buyer;

$P_B(t)$ is the current market price of the goods purchased by the buyer;

$Q_B(t)$ is the current quantity of the goods purchased by the buyer;

$P_B(t)Q_B(t)$ is the current assets flow of the buyer;

T_B is the useful life of goods purchased by the buyer;

t is time.

Consequently, according to formula (1), the expenses of the buyer equal to the accrued expenditures (the amount of circulating assets) for the purchase of the necessary amount of goods taking into account the price dynamics in time.

Similarly, the behaviour of the generalized vendor (hereinafter referred to as the vendor), who is usually a manufacturer and an employer, is described with the formula

$$P_V(t) = \frac{1}{Q_V(t)T_V}\int_0^t M_V(t)dt \tag{3}$$

which is equivalent to the formula

$$P_V(t)Q(t) = \frac{1}{T_V}\int_0^t M_V(t)dt \tag{4}$$

or the inverse formula

$$M_V(t) = T_V\frac{d[Q_V(t)P_V(t)]}{dt} \tag{5}$$

where $P_V(t)$ is the current market price of the goods;

$Q_V(t)$ is the current quantity of the goods manufactured by the vendor;

$P_V(t)Q_V(t)$ is the circulating assets flow of the vendor;

$M_V(t)$ is the current revenue of the vendor (the amount of circulating assets) covering the manufacturing costs and generating profit;

T_V is the production time per commodity unit;

t is time.

Thus, the price of goods, according to formula (3), equals to the accrued expenses of the vendor adjusted for the planned revenue, divided by the quantity of manufactured goods.

As can be seen, in expressions (1) – (5) the values of the circulating assets and payments flow (or the amount of circulating assets) of the vendor and the buyer have not an algebraic, but a differential-integral relationship, since the price formation process is influenced by the previous transaction history of the vendor with the buyer. When making a transaction on each commodity unit, both the vendor and the buyer, in accordance with formulae (1) and (3), use their average estimates. For a transaction to be made, the vendor and the buyer must reach an agreement on payments, i.e., despite their different considerations, they must reconcile their interests and agree upon the price.

It is interesting to note the mathematical similarity of formulae (1), (2), (4), (5), describing the market behaviour of the vendor and the buyer, on the one hand, and formulae describing processes in radio-electronic components – a capacitor and an induction coil – in electric circuits. For a better comparison, the corresponding formulae are presented in the table below.

Table 1.

In economics	In radio-electronics
The amount of current (circulating) assets of the buyer $M_B(t)=\frac{1}{T_B}\int_0^t Q_B(t)P_B(t)dt$	Voltage drop at the capacitor $U_C(t)=\frac{1}{C}\int_0^t I(t)dt$
The current (circulating) assets flow of the buyer $Q_B(t)P_B(t)=T_B\frac{dM_B(t)}{dt}$	Electric current through the capacitor $I_C(t)=C\frac{dU_C(t)}{dt}$
The amount of current (circulating) assets of the vendor $M_V(t)=T_V\frac{d[Q_V(t)P_V(t)]}{dt}$	Voltage drop at the inductance coil $U_L(t)=L\frac{dI_L(t)}{dt}$
The current (circulating) assets flow of the vendor $P_V(t)Q(t)=\frac{1}{T_V}\int_0^t M_V(t)dt$	Electric current through the induction coil $I_L(t)=\frac{1}{L}\int_0^t U_L(t)dt$

Formulae relating to radio-electronic components in the table use the following notations:

$U_C(t)$ is the voltage drop at the capacitor C;

$I_C(t)$ is the electric current through the capacitor C;

$U_L(t)$ is the voltage drop at the inductance coil L;

$I_L(t)$ is the electric current through the induction coil L.

At that, as shown in Fig. 1, both the economic components (the buyer and the vendor) and the radio-electronic components (the capacitor and the inductance coil) are combined in a similar way, forming similar functional links. Then, it is quite natural to expect that processes in them have a similar mathematical description.

In economics the process, usually referred to as the 'goods-money-goods' process, must apparently correspond to the expression

$$M_V(t)=-M_B(t) \tag{6}$$

or

$$M_V(t)+M_B(t)=0 \tag{7}$$

Formula (6) reflects the fact that in the isolated economic link under consideration (Fig. 1a) one of the transaction parties always makes the payment, and the other party accepts the payment. As a result, the total amount of circulating assets, according to expression (7), remains unchanged (zero for the example under consideration).

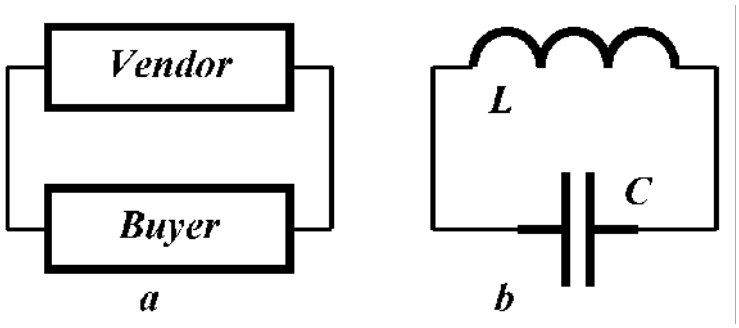

Fig. 1. Simplest oscillation links in economics and radio-electronics, where a sustained oscillation process is observed

Let us suppose, for the simplest case under consideration, when there is only one vendor and only one buyer, that $Q_V(t) = Q_B(t) = Q(t)$ and $P_V(t) = P_B(t) = P(t)$, then, using formulae (1), (3), we find from (7) the expression

$$T_V \frac{d[Q(t)P(t)]}{dt} + \frac{1}{T_B}\int_0^t Q(t)P(t)dt = 0 \tag{8}$$

Substituting (1), we get ***the second-degree linear differential equation describing the 'goods-money-goods' process*** under consideration.

$$T_V T_B \frac{d^2 M_B(t)}{dt^2} + M_B(t) = 0 \tag{9}$$

The solution of the equation has the form

$$M_B = A\sin\omega_0 t + B\cos\omega_0 t \tag{10}$$

where A and B are the constants of integration which are found from the initial conditions $M_B(t)\big|_{t=0}$ and $\left.\frac{dM_B(t)}{dt}\right|_{t=0}$;

$\omega_0 = 1/\sqrt{T_B T_V}$ is the resonance frequency of the simplest economic link under investigation.

It is easy to notice that the expressions (7) and (9) are very much similar to the expressions

$$U_L(t) + U_C(t) = 0 \tag{11}$$

$$LC\frac{d^2 U_C(t)}{dt^2} + U_C(t) = 0 \tag{12}$$

which, as is known, describe processes in the electric circuit (Fig. 1b) often referred to as an electric oscillation LC-circuit. Consequently, the economic circuit given in Fig. 1a can be referred to as an economic oscillation link.

Formula (11) in the electric circuits' theory is referred to as the second Kirchhoff's law (this is certainly its simplest notation). This is why in economic circuits' theory formula (7) can also be referred to as the second Kirchhoff's law in its economic interpretation. It is also possible to demonstrate that the first Kirchhoff's law is true for the economic circuits' theory, and formulae (1) – (5) correspond to the Ohm's law (also in their economic interpretation).

Moreover, the analogy described above holds true for more complicated situations, as well (see Fig. 2). Indeed, in oscillation links presented in Fig. 2 – both the economic and the radio-electronic ones – compared to the first case, additional, the so-called dissipating elements (from Latin *dissipatio* – dissipation), are present. They are called dissipating for

the reason that they dissipate the energy of oscillations, causing the latter to become damped. In the radio-electronic oscillation link (Fig. 2b) this is the resistor R. In the economic oscillation link (Fig. 2a) here belong the elements which withdraw a part of circulating assets (a bank and a tax administration in the example under consideration).

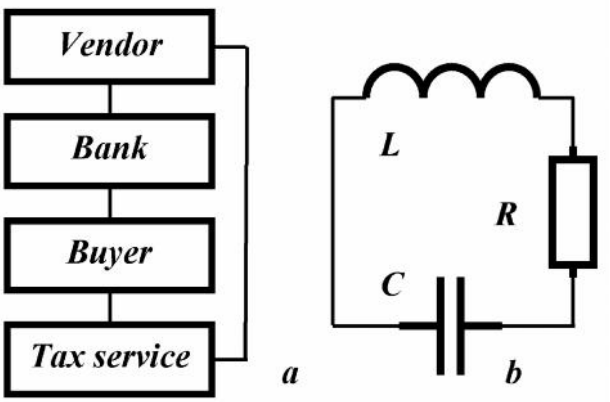

Fig. 2. Simplest oscillation links in economics and radio-electronics, where a damped oscillation process is observed

Therefore, processes in them are described with somewhat different, compared to (9) and (11), differential equations. For the radio-electronic oscillation link (Fig. 2b) this differential equation has the form

$$LC\frac{d^2U_C(t)}{dt^2}+RC\frac{dU_C(t)}{dt}+U_C(t)=0 \tag{13}$$

and for the economic oscillation link – the following form (for simplicity, both differential equations are given without derivation)

$$T_V T_B\frac{d^2M_B(t)}{dt^2}+T_B(\alpha+\beta)\frac{dM_B(t)}{dt}+M_B(t)=0 \tag{14}$$

Their solutions are damped oscillations, which are mathematically identical

$$M_B(t)=e^{-\sigma_0 t}(A\sin\omega_0 t+B\cos\omega_0 t) \tag{15}$$

$$U_C(t)=e^{-\sigma_0 t}(A\sin\omega_0 t+B\cos\omega_0 t) \tag{16}$$

where α is the relative current amount of the vendor's tax payments;

β is the relative current amount of the buyer's payments to the bank for making money transfers to the buyer;

A and B are the integration constants;

$\omega_0=1/\sqrt{T_B T_V}$ is the resonance frequency of oscillations in the economic oscillation link;

$\omega_0=1/\sqrt{LC}$ is the resonance frequency of oscillations in the radio-electronic oscillation link;

$\sigma_0=(\alpha+\beta)/2T_V$ is the decay of oscillations in the economic oscillation link;

$\sigma_0=R/2L$ is the decay of oscillations in the radio-electronic oscillation link.

As can be seen, the analogy between the economic and radio-electronic oscillation processes is indeed observed in the oscillation links plotted in Fig. 2. It is observed in many other situations, as well.

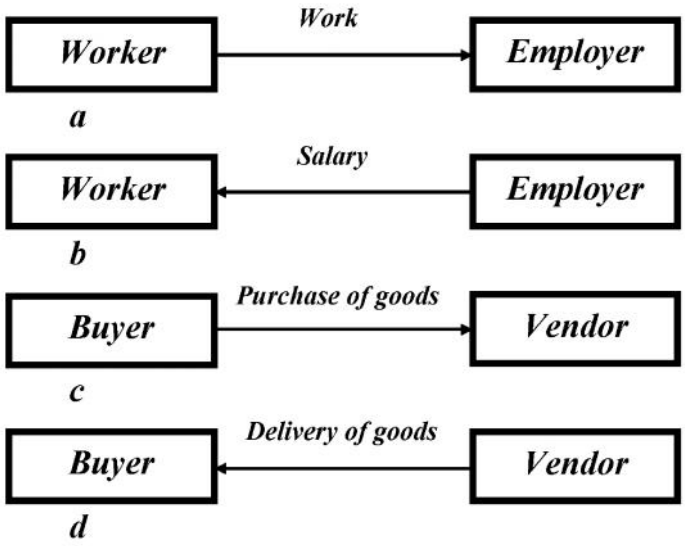

Fig. 3. The content of the oscillation process in isolated economic oscillation links plotted in Fig. 1a and 2a

Thus, ***radio-electronic devices and processes are***, indeed, the aforementioned ***white box with regard to the black box of economics and economic processes***. Recognition of this fact allows developing the economic theory which will completely meet the criteria of the exact sciences.

However, using this analogy requires being cautious and avoiding violating it as a result of certain incorrect actions. For example, in the electric oscillation circuit (Fig. 1b or 2b) the oscillation process in any of its phases has one and the same physical meaning determined by the motion of electrons. As for the isolated economic oscillation link (Fig. 1a or 2a), the oscillation period includes four successive processes with a different content, where business partners perform different functions. At first (Fig. 3a), the vendor is an employer and a manufacturer, and the buyer is an employee who manufactures goods at the vendor's enterprise. Then (Fig. 3b), the employer pays remuneration to the employee. After that (Fig. 3c), the employee turns into a buyer and pays the employer-vendor the cost of a purchase. Finally (Fig. 3d), the vendor delivers the purchased goods to the buyer.

Since the economic oscillation link under consideration (Fig. 1a) is assumed to be isolated for simplicity, the full oscillation period must include all the successive actions described above. For example, the condition is fulfilled if workers of an automobile plant purchase cars produced by it. If the condition above is not fulfilled, the oscillation process becomes impossible.

In more complex multi-link oscillation systems the content of the oscillation process can certainly be different; moreover, it can differ even in various links of the oscillation system.

However, even if the succession of actions described above is observed, the 'goods-money-goods' process in the economic link under consideration will not be oscillating, if all payments and deliveries are not enforced according to the sine law (e.g., made by a computer on a daily basis), which is never the case at present. Consequently, the economic links given in Figs. 1a and 2a are only potentially oscillating. In fact, the oscillation process described above has never been implemented in economics.

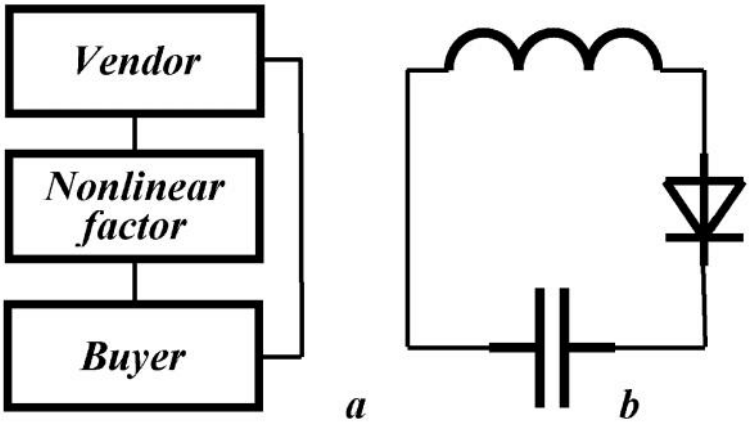

Fig. 4. Non-linear links

In this respect, it is natural to ask: what is the point of all these complications and does the economy need these oscillation processes? They turn out to be very necessary, because they provide for a more efficient use of circulating assets than currently observed. Indeed, given the current payment schedules in the form of infrequent (e.g., monthly or quarterly) payments, money works inefficiently, because the economy always experiences either surplus or shortage of it to solve its current tasks. This is why part of the money always remains idle. If sinusoidal payment schedules are used in economic oscillation systems, circulating assets will be fully used at any time and yield significantly larger returns.

Moreover, the economic oscillation systems described above will make it possible to use completely new processes which will significantly improve the efficiency of economic activity. For example, here belong processes widely used in resonant processes engineering, or processes used in wired structure systems, as well as many other processes known in radio-electronics and computer technology.

The most important point is that it is these complications that allow eventually developing the economic theory belonging to the exact sciences, which will be able to develop just as consistent and efficient systems as radio-electronics.

For better understanding of the following discussion, it is noteworthy that isolated economic and radio-electronic links may be non-linear, as well (their conditional examples are presented in Fig. 4). Processes in the non-linear economic link (Fig. 4a) and the non-linear radio-electronic link (Fig. 4b) are described with very similar non-linear differential equations:

$$T_V T_B \frac{d^2 M_B(t)}{dt^2} + T_B F[M_B(t)] \frac{dM_B(t)}{dt} + M_B(t) = 0 \tag{17}$$

$$LC \frac{d^2 U_C(t)}{dt^2} + CR[U_C(t)]C \frac{dU_C(t)}{dt} + U_C(t) = 0 \tag{18}$$

They (both the links and the differential equations) are referred to as non-linear for the reason that they include at least one non-linear element – $F[M_B(t)]$ or $R[U_C(t)]$, the value of which depends on the current value of the function under investigation – $M_B(t)$ or $M_B(t)$. In the radio-electronic link presented in Fig. 4b, the non-linear element is the diode. In the economic link given in Fig. 4a, the non-linear element is, for instance, the fact that the buyer, e.g., in a supermarket, always pays to the vendor, but the vendor never pays to the buyer. Non-linear circuits and the corresponding non-linear processes are often used both in economic and radio-electronic links which are not oscillating, and which are not the subject of the given research. This is why, in the economic link given in Fig. 4a, this circumstance is referred to as the 'non-linear factor', and not as the 'non-linear element', which is absent in the situation under consideration.

By the way, this example demonstrates very well that it is not easy to make the analogy between the economic and radio-electronic circuits.

4 "THE INVISIBLE HAND" OF ADAM SMITH

The problem of building crisis-proof sustainable economy is one of the major issues for governments of all countries and top-managers of the global economy. It is well known that both the abstract socialism as a fully regulated economy and the abstract capitalism (laissez faire) as a completely free economy, have their shortcomings and their advantages:

- socialist economy was developing very slowly, but experienced no crises;
- capitalist economy is developing much faster, but suffers from economic crises.

Thus, all countries are currently looking for their own intermediate ways of economic development, in the form of this or that variety of regulated capitalism (i.e., with elements of socialism). However, many existing economic schools [3], [7] have not reached an agreement upon this intermediate way. As a result, different countries have chosen different ways. However, an indisputable knowledge base necessary for any national leader to make a confident choice of a justified course of economic development is still lacking. This is why voters of all countries are still offered new and different economic agendas, none of which is capable of preventing economic crises for the reasons discussed above.

Therefore, a new approach towards solving the problem is suggested below. It will allow building the crisis-proof economy.

Economists often use the specific term 'the invisible hand' introduced by Adam Smith 1723 – 1790) [17], when they face manifestations of powerful and unclear forces driving the society in their unpredictable direction, often despite the efforts of government heads and top-managers of the economy.

For instance, in 1929 – 1930 the US gross national product suddenly dropped to 67% of the previous years. This became the national economic tragedy which is known in US history as the Great Depression.

Just think about it: both in 1929 and in 1930, the US economy had approximately the same labour force and approximately the same fixed assets. However, in 1929 huge growth of production was observed (stock quotations were exceptionally high), and in 1930 the stock market 'collapsed' and a 33% decline in production was recorded! Over these years, the country suffered neither a war, nor a natural disaster, nor an epidemic. Just somehow, one and the same economy was prosperous in 1929, and deteriorated in 1930. What was the reason? What drastic changes occurred in the US economy in 1930? There is still no answer. The Great Depression does not give in to any rational explanation [18].

Indeed, according to the Cobb-Douglas production function [19] $Q = AL^{\alpha}K^{\beta}$, the production volume Q depends on two slowly varying production factors: L (labour costs) and K (capital costs). Thus, the economy of any country is not supposed to experience any crises, and production volume is supposed to gradually increase year over year, following population growth (1-2% per annum) and fixed assets growth (3-4% per annum). However, in fact, something unpredictable keeps happening in economic development, and short-term sustainable growth is rather an exception than a rule.

The state of affairs means only one thing: there is the third, more powerful factor, which plays the role of a switchboard for progress or regress. This unknown third factor is, in fact, the major one defining the process of economic development. However, it is still unidentified by the economic science, despite all the efforts taken to define it.

This is why one of the major and urgent problems of theoretical economics is still to detect 'the third factor', to identify the mysterious 'invisible hand', which plays such an important part in the development of the global economy.

However, if long-term research failed to reveal the third factor among the objective circumstances influencing economic processes, it is possible to presume that it is the subjective, or, in other words, the human factor. This was the conclusion made as a result of research reported in [20]. Let us briefly review it.

As was demonstrated above, in the idealized simplest market link (Fig. 1a or 2a) the 'goods-money-goods' process is mathematically described with the linear differential equation (9) or (14).

Its obvious solution is an oscillation process, because the current assets must circulate between the buyer and the vendor. However, this oscillation process has nothing in common either with the Elliott waves [21], or with the seasonal fluctuations of business activity (e.g., in agriculture), or with the economic cycles of Kitchin, Juglar, Kuznets or Kondratiev [22], and it has nothing to do with economic crises.

Moreover, this oscillation process in economics is still unknown, because the conditions for its realization have never been created. They cannot be created in a random way. This is quite natural, because houses are not built in a random fashion, cars are not assembled at random, and computers are not made randomly. Constructive activities always require certain knowledge, which economics is still lacking.

This is why, the simplest links of the commodities market in Fig. 1a and 2a were said to be idealized and only potentially oscillating. Actual oscillation links always include (see Figs. 1a and 2a) not only the buyer and the vendor (as well as other market participants – third parties, banks, tax authorities, etc.), whose behaviour is described by functions (1) – (5), but 'the invisible hand', as well – the human factors they introduce, because actual market participants are common people with common human foibles, habits and other peculiarities. This is why, they are not always reliable, sometimes they are forgetful, often prone to emotions, illnesses, other random factors and unforeseen circumstances. As a result, for the actual links of the commodities market shown in Fig. 5a,b, the process will be described not with linear differential equation with constant coefficients (9) and (14), but with linear differential equations with variable coefficients (or, in other words, with parametric differential equations)

$$T_V T_B H_V(t)\frac{d^2 M_B(t)}{dt^2} + H_B(t) M_B(t) = 0 \tag{19}$$

$$T_V T_B H_V(t)\frac{d^2 M_B(t)}{dt^2} + (\alpha+\beta) T_B H_{B+TS}(t)\frac{dM_B(t)}{dt} + H_B(t) M_B(t) = 0 \tag{20}$$

where $H_V(t)$ is the human factor taking into account the behaviour of the vendor,

$H_{B+TS}(t)$ is the human factor taking into account the behaviour of the bank and the tax administration;

$H_B(t)$ is the human factor taking into account the behaviour of the buyer.

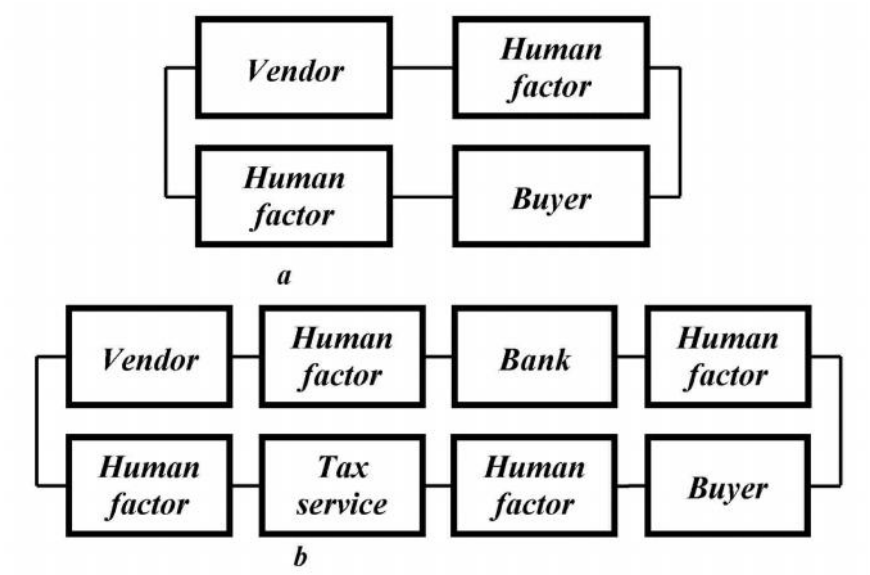

Fig. 5. Actual functional schemes of the simplest oscillation links in the economy

Since in the parametric differential equations (19) and (20) the coefficients $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ are different random functions of time, their solutions are also random functions of time. They cannot be found analytically.

Processes in the real capitalist economy generally comprise many similar unpredictable processes in simple economic links. Therefore, the global economy depends on the rapidly varying human factors $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ to a much greater extent than on the slowly varying production factors $L(t)$ and $K(t)$ mentioned above. Due to this fact, it is basically unpredictable and uncontrollable.

There is other evidence of the significant influence of the human factor on the economy. Thus, the social choice theory suggested by Arrow [23] argues that conciliation of social interests is provided for only by dictatorial regulations. Basically the same conclusion was made by Gibbard [24] after investigating other aspects of choice mechanism given the very general assumptions. In fact, this is just the statement of the conclusion made herein, worded using different terms.

Therefore, the conclusion that the Great Depression phenomena is accounted for by the human factor is quite justified.

The foregoing also fully explains the fact that the Soviet Union never suffered from economic crises. The matter is that the plan-based Soviet economy provided for the fulfilment of conditions minimizing the influence of the human factor $\lim H_V(t) \to const$, $\lim H_B(t) \to const$ and $\lim H_{B+TS}(t) \to const$, i.e., the functions $H_V(t)$, $H_B(t)$ and $H_{B+TS}(t)$ were almost constant. This is why parametric differential equations (19) and (20) in the Soviet economy were transformed into linear differential equations with constant coefficients, which made economic processes fully controllable.

5 NEW CRISIS-PROOF ECONOMIC TOOLS

Thus, ***in order to avoid economic crises in the capitalist economy, the influence of the human factor in it must be minimized***, i.e., fulfilment of the conditions $\lim H_V(t) \to const$, $\lim H_B(t) \to const$ and $\lim H_{B+TS}(t) \to const$ must be provided for. However, this has to be done in a different way than in the Soviet Union.

To find out how this can be achieved, let us specify that the human factor may be internal and external.

The internal human factor is understood as a spontaneous unpredictability of behaviour of market participants due to their unreliability, illnesses, forgetfulness, imperfections of contracts or verbal arrangements regulating their activities, rumours, panic, and other similar reasons.

The external human factor is understood as the unpredictable behaviour of market participants determined by random external influence upon them by other persons and companies – competitors, public officials, criminal structures and other similar reasons.

Therefore, it is obvious that, in, order to minimize the influence of the human factor in the market capitalist economy, some new economic tools [25] are necessary, because the existing economic tools have not been able to offset it. These tools must be different for the internal and the external human factors.

5.1 MINIMIZING THE INFLUENCE OF THE INTERNAL HUMAN FACTOR

Let us refer to the new economic tool aimed at minimizing the influence of the internal human factor as the business-interface [20], by analogy with a similar term used in computer engineering. Let us recall that an interface in computer engineering is understood as a hardware and software means of connecting various nodes and devices. It is clear that if, for instance, plugs and sockets of these devices are different, or even if the plugs are correct, but mismatching signals are fed to the matching pin of the plug and the socket, the computer will not operate. This is why all interfaces in computer engineering are strictly defined.

This is why we shall refer to business-interfaces as the payment (commodity-money) means of connecting market process participants, as a result of which, the vendor must supply the buyer exactly the goods ordered by the buyer, and get exactly the payment specified in the price-list. However, this is not enough. In order to avoid the destructive economic consequences caused by the human factor (remember the Great Depression), every detail of the business-interfaces must be defined; this will enable implementing oscillation processes in economic links. Thus, the corresponding contracts must contain all the details providing for:

- linearization of the economic process, which must be described with a linear differential equation with constant coefficients; to this end, all non-linear and parametric elements (or factors) must be respectively removed from the economic system;
- temporal variation of the circulating assets flow as close to the sine law as possible (it can be easily implemented using computers);
- strict and close adherence to contractual obligations by both the vendors and the buyers; breach of these obligations must inflict penalties as severe as those practiced in socialist countries for violation of labour discipline.

Thus, the primary function of the business-interfaces is to support and regulate the circulating assets flows. This is why an important part in their implementation will be played by banks, whose activity will also change the economic outlook of their clients. Moreover, certain amendments and clarifications will have to be made in the national and international legislation.

All vendors and all buyers inevitably have numerous business relationships with other vendors and buyers; for this reason, any actual economic system is multi-link and multi-related. This is why, it will be necessary to optimize the structure and parameters of these economic systems. In particular, an international system of operating frequencies must be

developed, tied to the natural cycles of agricultural works, forestry engineering, construction works, transportation, and other seasonal businesses. Similarly, computer engineering uses clock frequencies; television uses clock rates, etc.

Some particular examples of the business-interfaces for oscillation economic processes are discussed in [15], [16]. However, at least several hundred business-interfaces taking into account different particular cases relevant to business partners can be suggested. Therefore, it is advisable to publish a corresponding reference book, and introduce a special course of lectures teaching business-interfaces in economic schools.

Implementation of business-interfaces may bring up the question of whether their use can lead to the same grave consequences as the plan-based socialist economy due to the excessive regulation of economic activity, in particular, to the suppression of rights and freedoms. The answer is – no, it cannot, because business-interfaces will operate only for the term of a transaction, i.e., from the moment it is made to the moment it is settled, and only to the extent of the transaction, for the business partners indicated in the transaction. The latter, indeed, will have no freedom of disregarding the terms of the transaction; they will be committed to settle it. If you wish, after making a transaction, business partners will find themselves, to a certain extent, in socialism.

Similarly, nature, providing for the variety of lifestyles of various creatures, left them no choice of neglecting their duties of reproduction.

However, other people, as well as business partners beyond the extent of their transaction, will fully remain in capitalism. They will be completely free to choose what to buy or not to buy, to produce or not to produce, to hire and to fire; they will choose their occupation and place of residence, vote freely, and exercise their civil liberties and so on.

Therefore, the economy reformed as suggested above will be both capitalist and socialist: for the term of contractual obligations and to the extent of their settlement by the partners it will be socialist, and in all other respects for them and for all other people it will be capitalist. This economy will become ultimately fair and, thus, will ease social tension.

5.2 MINIMIZING THE INFLUENCE OF THE EXTERNAL HUMAN FACTOR

In order to minimize the influence of the external human factor, another economic tool is suggested, namely, the new global/regional information network TV•net [26], [27], which is free from all the shortcomings of the Internet. This information network will enable businesspeople to find business partners and make profitable transactions without having to resort to the unwanted third parties. Thus, businesspeople will have guaranteed confidentiality of their business connections, and will be able to avoid the unwanted influence of any third parties.

However, the only currently available global information network, the Internet, is hardly suitable for business purposes due to its numerous shortcomings. Indeed:

- it does not provide for guaranteed information security, i.e., protection from computer viruses, spyware, hackers, spam and other network threats;
- the www contains few if any promptly updated reliable serious information necessary for business and other intellectual activities, and, on the contrary, contains a lot of junk information;
- information retrieval time (not to be confused with information transmission time) is quite long, i.e., all search engines work not efficiently enough;
- copyright and proprietary rights (by hackers) are often infringed.

Due to the above, the Internet is often used, in fact, to resist (how else can we refer to the infringement of copyright and proprietary rights?) the fair capitalist business.

The TV•net, on the contrary, due to absence of packet-switched communication and use of one-way broadband (television or fibre-optic) communication lines:

- completely solves the problem of guaranteed information security, because it does not have the feedback communication lines used in the Internet for unauthorized access to information in the users' PCs;
- provides for zero information retrieval time, as information is broadcast to the users immediately as it is received and verified, and then stored in their personal data bases;
- provides for efficient noise reduction and protection from unauthorized access to communication lines due to noise-combating codes and cryptographic encoding;
- greatly enhances its functional capabilities due to the use of numerous new highly demanded services:

- the trading service which allows creating a global online-store;
- the exchange service which allows creating a global universal e-exchange;
- the administrative service which provides for efficient management of any institutions – ministries, banks, institutes, corporations, etc.;
- the educational service which offers mass education at the top level [28];
- the analytical service which allows implementing human-computer super-intelligence [8], [29], [30] – an alternative to the artificial intelligence whose development has faced a dead end; and so on.

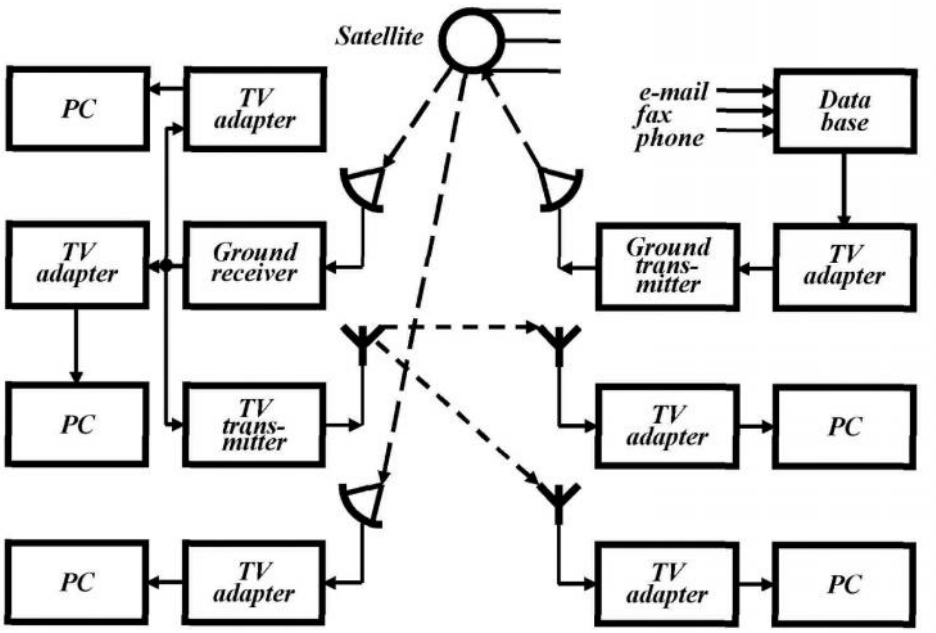

Fig. 6. An example of the simplest implementation of the TV•net information network without feedback lines

Let us briefly describe the new services offered by the TV•net information network.

The trading service of the TV•net information network is the most easy and low-cost to implement, because its deployment requires mostly organizational support. As can be seen (see Fig. 6), almost everything necessary for its implementation is already available in the market. Therefore, it can be quickly deployed in any region with a TV broadcasting network, both on-air and cable, and even away from cities, if satellite broadcasting channels are used. To deploy a small local network (e.g., for one particular city), there is no need to use satellite repeaters. For a comparatively large regional or global TV•net network, satellite repeaters are necessary. However, those used for TV broadcasting can be employed, just as well.

Nowadays, the TV broadcasting network, in particular, satellite network, is so well developed and available at any place on Earth, that the main expense item for the deployment of the TV•net network is no longer required. Owners of the TV•net network do not have to launch their own satellites, because almost every satellite repeater has back-up facilities and communication lines not used to their full capacity at night. Computer information can be broadcast via the TV•net network at any time, as it will be received by the users' PCs 24 hours a day, and will be stored until it is required.

The trading service operates as follows. The users-buyers, for a certain subscription fee, connect to the TV•net information network via TV adapters, similar to modems used to connect to the Internet. The procedure is identical to subscribing to the pay-tv network. The only difference is that instead of the TV channels, the users choose the headings from the classifier. At that, the users PCs may be connected to the TV•net network either via cable TV lines, or via on-air or satellite TV, at their discretion.

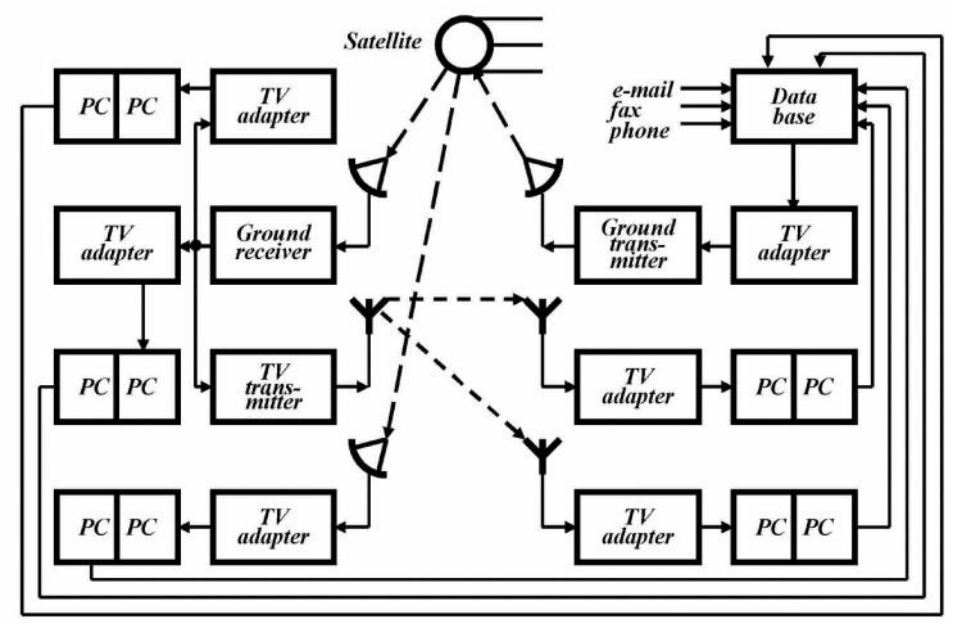

Fig. 7. An example of the simplest implementation of the TV•net information network with feedback lines

The subscribers-vendors are also connected to the TV•net for subscription fee, and regularly transmit (via any communication lines, including e-mail over the Internet) to the data base the most detailed information about the goods and services they offer. Similarly, offers of other forms of business partnership, including trade enquiries, can be submitted to the data base. In the data base, the information received is classified by the administration personnel and regularly broadcast via a TV adapter, where it is encoded and sent to a TV transmitter in the respective region (this link is not shown in Fig. 6 for simplicity). Then, via a television broadcasting network, it is transmitted to the users' PCs, and broadcast to users of other regions via satellite repeaters (Ground transmitter, Satellite, Ground receiver). The users can make their choices and purchases they need based on the corresponding criteria with the help of their PCs, either manually or using simple software.

In addition, guaranteed information security is provided for the users, since they are not connected to the Internet, and connected to the TV•net via one-way television broadcasting lines. Similarly, a TV viewer is not afraid that any information about him can be sent to the TV centre. If the users need to send any information via the Internet (e.g., order the delivery of the purchased goods), they will have to use a different PC (see Fig. 7). However, in this case, the protected PC connected to the TV•net, and the unprotected PC connected to the Internet must not have any communication between each other (except for removable disks and USB-cards).

Thus, services of the TV•net information network will be paid for by both the buyers and the vendors. Operating such a TV•net network will be quite a profitable business, may be, even more profitable, than TV advertisement.

It is easy to see that the suggested trading service, in terms of its purpose, is very similar to online-stores, and seems to be needless. However, the difference is in the amount of services offered: online-stores belong to small and medium business, and the trading service of the TV•net information network is large business and can result in the creation of a global 24/7 online-store. Therefore, as any large business, it allows generating higher profits. Consumer confidence to large business will also be higher.

The exchange service is almost identical to the trading service, with one exception: goods and services are traded not at fixed prices, but at auction prices and by the rules. Therefore, implementation of this service requires the TV•net information network to be deployed with feedback connection (Fig. 7).

Depending on the type and volume of bids, e-exchanges operating within the TV•net can certainly be both regional and global, commodity and stock, FX and others.

Naturally, the larger region the service covers, the more profit it can generate for its owners, similarly to the trading service.

The administrative service provides for guaranteed secure informational services for banks, public offices, corporations and any other large, medium and small market participants which currently are suffering from hacker attacks through the Internet, and are also vulnerable to other network threats. Therefore, the benefits of the administrative service are obvious.

A peculiarity of implementation of the TV•net information network in terms of the administrative service is tougher requirements to information security, which can be fully met due to additional use of cryptographic encoding and protected local area networks both at the input and at the output. The simplest example of implementation of such a TV•net network is given in Fig. 8.

Furthermore, in order for the top-managers of these institutions to make reasoned and highly efficient decisions, it is necessary:

- to quickly upload all available up-to-date information on any problem requiring a solution into the memory of their PCs; we shall thus refer to it as the personal memory;
- to quickly and correctly evaluate the information available in the personal memory in order to reveal the dominating trends in their respective field, which will enable them to make definitely successful decisions.

This task is addressed by another service – the analytical one.

The analytical service, thus, can help its users in revealing trends and regularities. However, within the context of conventional concepts, nothing else can be suggested to solve the problem but the interpolation and extrapolation algorithms; although, this is also quite useful.

Therefore, let us formulate the task in a different way – the analytical service, along with its other functions, is aimed at the development of the human-computer super-intelligence, as an alternative to the artificial intelligence. Since there is no conventional definition of intelligence – either human or computer – let us specify that hereinafter human intelligence is understood [8], [29], [30] as a set of intellectual sub-systems which includes the low-factor rational thinking, the multi-factor unconscious thinking and some other sub-systems. The most important one in the set is the sub-system of the multi-factor unconscious thinking. The term is used because many people at present do not even suspect it exists. This is confirmed by the fact that people still do not know why they go to sleep, because they believe that in sleep they are uselessly idle and, moreover, are more defenceless. However, nature is wiser than people and does not do anything useless. Therefore, it turns out that nature makes us go to sleep (when all human input and output senses, as well as the low-factor rational thinking governing human activities, are off) in order for us to use all our intellectual resources to process information accumulated in the wakeful state. This is why there is a proverb: “Take counsel with your pillow”, or “If you have a problem – sleep on it”. This is why, when you are sick, in the morning your temperature is lower than at night. This is why many scientific discoveries were made in sleep. And only for this reason humans have survived as a biological species.

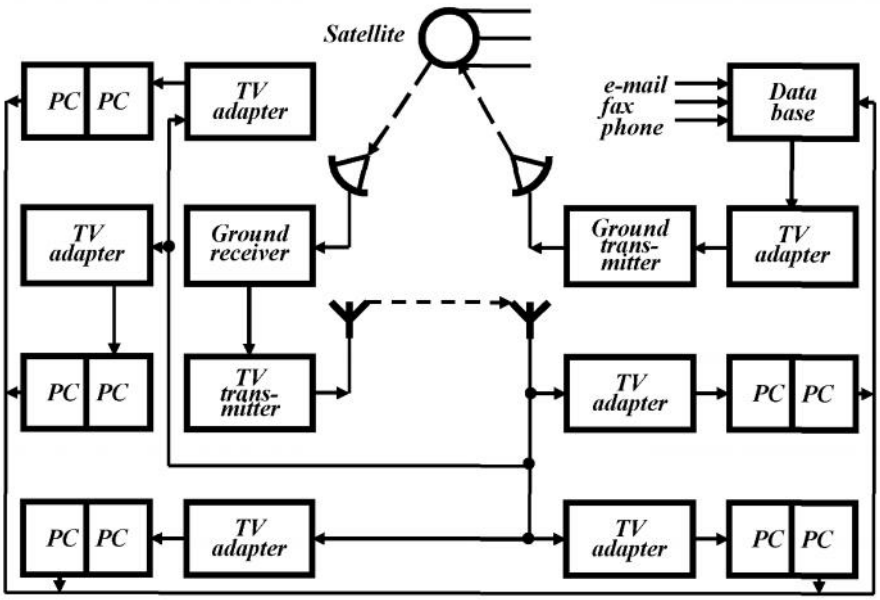

Fig. 8. An example of the simplest implementation of the TV•net information network using LANs

As for low-factor rational thinking, people need it for active day-to-day activities necessary for life support – getting food, doing work, and so on. It is referred to as low-factor for the reason that humans think with visual images (therefore people have dreams in the form of visual images and not in any other form) which are not more than three-dimensional. To make sure it is really so, try to imagine the simplest four-dimensional object – a hypercube. Processes in the real life, however, may depend on tens and hundreds, and even more factors (e.g., the economy, illnesses, weather, etc.).

Consequently, we can say that the rational low-factor thinking solves tactical tasks, and the unconscious multi-factor thinking performs strategic tasks.

Computer intelligence, usually referred to as the artificial intelligence, tries to simulate human low-factor thinking. Moreover, the artificial intelligence is often intended to meet the ambitious goal of surpassing human intelligence, i.e., to teach a computer to solve intellectual tasks without a human and instead of a human. However, this is a utopia. After 60 years of research devoted to the problem of artificial intelligence, scientists have not been able to teach a computer to tell, for instance, a dog from a cat.

Nevertheless, some scientist have developed the technological singularity concept [31], which reads that no later than 2030, following the successful solution of the artificial intelligence problem, an Internet-based computer civilization will emerge. It is not specified what this computer civilization will make of the human civilization; however, it is assumed that the process of development of the computer civilization is impossible to stop, because the countries which will try to hamper the process will be condemned to economic, military and technical underdevelopment, with all the respective consequences.

In fact, all these allegations are deceptive. Since humans possess the multi-factor thinking, and computers do not have it, humans will remain unattainably more advanced information machines than computers in the foreseeable future. The delusion about the superiority of computer intelligence seems to stem from the fact that computers are able to successfully solve complicated mathematical problems which cannot be solved by people either mentally or on paper. Many people believe that solving mathematical problems is an extremely intellectual activity. However, we should not forget that computers, contrary to humans, can solve only the tasks which are unambiguous and clear. Try to define clearly, for instance, how to tell a dog from a cat. Computers are unable to solve other, more ambiguous problems, which are prevailing in the real life. People, on the contrary, successfully solve them all the time. Therefore, computers are merely big and complicated calculators. Their intelligence is exactly at this level.

Donald Michie, Head of the Alan Turing Institute, wrote on the issue [32] that the current development of computer engineering makes it impossible even to try to approach the problem of artificial intelligence.

Many years later basically the same idea was expressed by V. M. Kuklin, Professor at Kharkov University [33]. He wrote that when solving the problem of artificial intelligence, scientists are unable to reproduce the attainments of nature even to the slightest degree.

Thus, the problem of artificial intelligence must be understood as it was formulated from the very beginning – as a research aiming at the investigation of human intelligence with the help of computer experiments. No more than that.

At present, given the phenomenal achievements of engineers and scientists in terms of computer advancement, it is time to define a new problem – the problem of human super-intelligence, which is understood herein as the development of human-computer systems able to solve multi-factor tasks. The matter is that human intelligence created by nature was not designed to use the multi-factor unconscious thinking to solve scientific and other intellectually demanding problems – centuries ago, people were busy with other things. If eventually people turned out to be able to solve intellectually demanding problems, this testifies only to the possibility of further substantial development of human intelligence, both by means of intellectual training (which is actually done by scientists) and by means of additional involvement of computer resources (which is suggested herein).

We will consider both possibilities, however, in the reverse order. We will first discuss the controllable and regular, contrary to the process of intellectual inspiration, use of the unconscious multi-factor human thinking in the wakeful state. What do scientists do when they are solving an intellectually demanding problem, i.e., when they are revealing a trend or discovering a regularity? They solve two problems in turn. First, they take all the imaginable multitude of factors and define the significant ones, which, if changed, noticeably influence the result under investigation. Then, having chosen the most significant of all the factors, they search for a mathematical relationship between them and the result under investigation. Finally, the result is taken down as a scientific law.

As can be seen, computer assistance in this research can be very helpful. Before commencing the research, a user needs, first of all, to create in their PC a personal data base by quickly downloading from the information network all the reliable information relevant to the subject of the research. However, this is completely impossible given the current information

retrieval techniques in the WWW. On the other hand, this task can be quickly and easily performed by the TV•net information network in its realization sown in Fig. 6, except that the data base must contain the information necessary for top-managers, scientists, businesspeople, analysts of special services and other intellectual users.

Then, the corresponding software (e.g., factor analysis, or, in the simplest case, by key words) allows finding in all the ocean of information the pieces which presumably contain the significant factors. Next, these pieces of information must be studied and processed by human, in particular, multi-factor, thinking. Naturally, at this last stage of research, different software for enhancing the multi-factor intelligence can be helpful, similar to the existing software enhancing the low-factor rational intelligence.

Certainly, these tasks can be performed by supercomputers, as well. However, there are very few of them, they are very expensive and completely engaged in solving the most foreground problems. At the same time, these problems can be solved by personal computers, too, especially taking into account that important discoveries have often been unforeseen, spontaneous, and made by individual scientists. Here belong, for instance, discoveries of radioactivity, the DNA structure, the Internet, semiconductors and may other things. Let me at once answer those willing to object regarding the circumstances under which the semiconductor devices were discovered. I agree that after the World War II huge financing was allocated to the investigation of radio-electronic systems and components. In 1973 Leo Esaki, Ivar Giaever and Brian David Josephson won the Nobel Prize for discovering the tunnel diode. However, in fact, the first tunnel diode was made by physicist O.V. Losev back in 1922 [34]. It was even widely used at that time. However, no one was able to explain how it worked. Back then, even the term “semiconductor devices” did not exist.

This is why it is extremely important for the systems of human-computer super-intelligence to be accessible to all users, including talented individuals in their unplanned and ungoverned entrepreneurial, scientific and other intellectually demanding activities. Just as we need both small and large business, scientific research must also be performed not only by large groups of scientists, but by individual scientists, as well.

The educational service, in addition, is immediately relevant to the development of human super-intelligence, firstly, for the reason that creative thinking is developed in the course of education, and secondly, because creative people often have to get additional training or to be retrained.

The objectives of education can, certainly, be different – getting knowledge, mastering skills, intellectual or physical development, and so on. Therefore, taking into account that intellectual work is getting more and more demanding nowadays – even to stay rich, you must make certain intellectual efforts, otherwise you will turn poor – the major objective of education must, obviously, be the intellectual development of people.

The educational service which solves this problem operates as follows. Using the computer-television broadcasting network – the TV•net (see Fig. 6), its users, independently or via their educational institutions, receive and download to their PCs:

- textbooks and work-books supplied with a large number of hyperlinks to other sections of textbooks (other textbooks, as well) and FAQ sections;
- supplementary further reading;
- problem books with detailed solutions of typical problems and advanced problems;
- learning and developing, learn-as-you-play and other software.

As is well-known, the quality of education depends on how well individual peculiarities of students are taken into account. The point is that all people have a different body of mastered knowledge (due to individual differences in abilities, background, thinking, etc.). Thus, new knowledge is learned well only in the case it is based on the previously mastered knowledge. The art of teaching lies in the ability to take into account all these circumstances as much as possible. Naturally, the principle of learning based on the previously mastered knowledge is never fully observed in the process of collective education, because all people have different basic, well mastered, knowledge. It is poorly realized in self-education (there is no one to ask a question). At present it is best of all implemented in the process of individual education with a tutor.

However, the educational service of the TV•net allows implementing it even better, because a personal computer whose memory contains the information specified above can always help find the additional material explaining any unclear issues (basically what a tutor does). Therefore, education using the service under consideration in terms of its efficiency will be comparable to elite training on a one-to-one basis. This education will be most developing and aimed at further use of the human super-intelligence systems.

Thus, the service described above suggests new technical means aimed at the new strategy of education in order to improve the quality of education. The new strategy can be referred to as the developing learning, because, contrary to the

current teaching techniques, its objective is not merely to acquire knowledge, but to promote the skills allowing for the most efficient creative application of this knowledge in further practical activity. Therefore, developing learning means promotion of skills aimed at using the information obtained, as well as searching for the necessary information.

Developing learning will require new textbooks and workbooks. The currently available textbooks are not suitable for the purpose, because the material is often presented in an excessively dogmatic way in the form of, allegedly, absolutely true knowledge. However, developing learning requires textbooks which, first of all, teach to think. Therefore, they must not only present the knowledge, but explain the often difficult way this knowledge was obtained. Sometimes it is useful to analyse certain hypotheses rejected by science at present. It is necessary to explain that science has few absolute truths.

People who want to become super-intellectuals must not be deceived even in primary school, to say nothing about universities. They ought to know that groping for knowledge is an extremely hard work. Therefore, they must get used to not getting the ready-made knowledge, but to obtaining the knowledge themselves. In this respect, the learning process must resemble the process of a scientific research, except that at the very beginning it will take place under the supervision and with the help of teachers, then – academic advisors, and finally – independently.

People completing such a course will be prepared to the super-intellectual activity described above to the best advantage.

6 SUMMARY

Thus, it turns out that 'the invisible hand' of Adam Smith in economics is the human factor. It is its influence on the economy that makes processes in it be described with systems of parametric differential equations with coefficients in the form of random functions of time. For this reason, the current economy is unpredictable and cannot be efficiently managed, and economic crises in it are inevitable. In particular it is the human factor that accounts for the Great Depression phenomena in the US.

To be able to manage market economy, to make it crisis-proof, the influence of the human factor has to be minimized. To this end, new economic tools must be used. In order to minimize the influence of the external human factor, business-interfaces should be used. In order to minimize the influence of the internal human factor, it is advisable to use the new global information network TV•net, which is completely free from all the shortcomings of the Internet and offers numerous new business- and intellectually oriented services.

The economy reformed this way will be described mostly with systems of linear differential equations, i.e., it will have a mathematical description similar to the mathematical description of radio-electronic systems and processes. Therefore, this economy will become an exact science. It will be possible to use the methods borrowed from the theory of analysis and synthesis of linear electric circuits, from the simulation theory, from the automatic control theory and others. The reformed economy will allow widely using new, previously unknown oscillation processes which provide for significantly more efficient use of circulating assets.

Last, but not least – the economy reformed as discussed above will become crisis-proof and therefore rapidly developing.

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