Mieczysław Dobija*

How to convert economics to science

K e y w o r d s: economic theory, labor, capital, money

S u m m a r y: Sciences characterise some special quality. Each science saves expensed action, that is to say time and energy. Moreover, professionals are responsible for their action and they can be suing if their work fails. Bridge or plain constructors are responsible for their work, as well medical doctors, and other similar professions. It is also met among some economic disciplines. Who is able to measure periodical income of company faster, cheaper, and better than double entry accounting system? This is not a case of macroeconomics, particularly the most important domain, namely the theory of money. This is economic domain where fundamental law of energy conservation is not respected, despite the fact that in sciences this principle is known since 150 years. Each professional takes into regard the fact that ability of doing work cannot be created. The present theory of money admits action against this never broken rule. Therefore it is not a science. This fact is damaging for societies and for that reason possible economic progress is blocked by budget deficits and taxes.

1. Why economics mostly fail?

Economics and especially macroeconomics are too often unsuccessful in their practical actions. Crises come suddenly and it seems that subsequent crisis like events are still ahead. Therefore a question appears. Is economics a scientific activity? Is it the activity, where professionals are responsible for their theories as it is the case of electricity, constructions, and quantum mechanics and so on? In case of science and techniques professionals use their theories in order to attain to aim. Theory is a guide leading to success. A failure can happen provided the professionals did not hold to standards designed by their theory.

How our reality manifests itself to us? There is no clear and simple answer to such a question. We can assume some points of view: self made or borrowed from other

* Prof. Mieczysław Dobija, PhD—Faculty of Management, Department of Accountancy, Cracow University of Economics.

thinkers. In my personal opinion economists ought to use the most general concepts elaborated in sciences, particularly in physics, where scientists have discovered many fundamental principles and fundamental constants. Values of the identified constants are the manifestation of firm reality; for instance the gravitational constant enables computation of the Earth acceleration. Having computed the acceleration, engineers can calculate gravitational forces and are able to plan contemporary buildings. The truth of the theory is a guarantee of the construction stability. In case of a failure the consistence with the theory is examined. There are many such constants that link elaborated knowledge with unrecognisable reality. They are anchors holding relation between scientific theories and reality.

Other anchors are established by the fundamental principles. Nobody proved a theorem that energy cannot be created from nothing. Our human reality does not allow for such godlike capabilities. We can use existing energy from limited resources by applying work and effort. Humans have to strive to extract and convert the energy, and they can succeed on some fields, thanks to the efforts of many scientists, as Nicolai Tesla among others. There are more fundamental principles. The famous Second Principle explains that time flows, and nothing can stop it, although decline of the concentrated potential of ability for doing work included in the objects can be restrained to some extent.

A question arises. How should a researcher take into consideration the existence of the constants and significant position of the fundamental principles? Marcelo Gleiser[1] (1, p. 124) proposes remarkably modest attitude. The sciences create a description of the world that manifests itself to humans by constants and fundamental principles. To illustrate, we can see our theories as descriptions where the constants are the letters of alphabet, and the fundamental principles are the grammatical rules determining the legitimate, correct sentences. Of course, we originate our descriptions applying scientific methods. Thus, the scientific approach, the constants, and the fundamental principles are indispensable factors of the theory origination.

The above consideration leads to a conclusion that there are serious differences between proper sciences and economics. The latter has not recognised constants and fundamental principles determining the very nature of reality. This is a principal difference. It is significant that economics, economists, and policy makers are not held responsible for the economic crises. It is considered normal that the economists talk and make policy decisions without serious consequences when they get it wrong. This is not the case in proper sciences. If a construction fails then builders are sued carrying full responsibility because they had proper theory and they failed to apply it correctly. By contrast, when the workers lost a significant chunk of their pension funds in a stock market crash nobody was responsible, despite the fact that workers had worked as usual day after day transferring their human energy into products.

[1] What if we look at science as a narrative, a description of the world that has limitations based on its structure? The constants of Nature are the letters of the alphabet, the laws are the grammar rules and we build these descriptions through the guiding hand of the so-called scientific method.

Eventually they are told that it is the market that is responsible and that it should be charged. In economic talk the personified Mr Market is the main convenient actor since this "person" is not tangible.

2. Do we see any signals of progress?

Fortunately the long lasting quest for the correct concept of capital, the key economic notion, is close to the end. Research has explained (2) that *capital is the abstract ability of doing work*. Consequently *labour is a transfer of human capital to object*. This transfer involves also capital embodied in technical means used in the labour. For that reason *money is receivable for labour done* and it arises as a record of wage receivables. Money as such is information, which arises correctly as quantitative confirmation of work done.

The above definition is pillars of correct economic thought and fundamental limitations stem from them. Capital cannot be created. Labour can be accomplished provided capital is concentrated in working persons. Money comes to existence only by labour. Money is immaterial and value of the compensation should be equal to capital transferred by the labour. Money unit is the labour unit.

The error of economics that poisons economy becomes apparent. *Money cannot be created by fiat*. Despite it is everyday practise of central banks and sick theory of money lets for it. It is a sin against the fundamental principle that ability of doing work cannot be created from nothing. Inflation and crises resulting from this incorrect actions are not the merely one evil. The worse is lack of understanding that labour is always self financing. Therefore the existence of the budget deficits and significant part of taxes manifests as result of economic theory malfunction (3).

This understanding of the capital has been manifested in the research of many economists, especially those who accepted the capital capabilities of the machines, not just the machines. They did not pursue the model of capital to the end since it required taking into regard the fundamental principles that govern our reality and it needed recognition and introduction of the associated constant. Ultimately, the capital seen as ability of doing work (doing work requires in case of an individual to be alive) is the fundamental category of the economics as energy is in physics, and it was recognised by Lord Kelvin as the absolutely most important category. Capital understood as abstract capacity to perform labour is the most important category of the economy. Capital is located in different resources such as natural, material, immaterial, or institutional resources. The capital category has its roots in labour being a transfer of capital to products. Labour is therefore the capital in use. Workers transfer human capital resulting in a product. Therefore labour is only a transfer of capital and as such these notions are tightly connected.

Considering economy as capital flows one can ask about the mandatory fundamental principles governing economics. It is clear that scientific framework for eco-

nomics is the same as for the other intellectual considerations. Economics is not beyond time and space since economy is a part of our reality. It is noticeable that at least three fundamental laws of reality established in physics materialise the scientific framework for the economic considerations. The first is a statement that capital does not arise from nothing. It is equivalent to the first law of thermodynamics. The second is that all concentration of the capital spontaneously disperses, that is to say it behaves due to thermodynamic arrow of time. It is the economic equivalent of the famous second law of thermodynamics. The last is the principle of the least action.

The present interpretations of the second law are deep indeed. According to Scott Sampson (4, p. 48), "… the second law of thermodynamics represents the unwavering propensity of energy to disperse and, in doing so, transition from high quality to low quality forms…" More generally speaking, nature does not maintain gradient, where a gradient is simply a difference over a distance—for example, in temperature, or pressure, or value. In economics the second law is for the most part interpreted as the arrow of time, which causes a diffusion of capital and depreciation of assets. In economics however, the most basic formulating of the second law made by Sir Kelvin is the most useful. It is well explained by Peter Atkins (5, Chapter 6) who has pointed out the abstract heat engines working in human body. It implies that some part of human capital diffuses to environment. Therefore the human capital research shows that the fair pay is an equivalent of the diffused capital.

Contemporary economics is different than sciences since some macroeconomic theories admit violation of the fundamental law of the capital conservation (the first principle). In fact when the Central Bank creates paper money known as cash for commercial banks lending, the fundamental law of capital preservation is violated. Money should arise only as a result of performed labour, represented by abstract pay receivables and of course payables. Therefore issuing cash money by the Central Bank, without proper regard for labour done, leads to financial instability. The wage receivables arise as a result of the transfer employees' energy while cash money arises in the current system by *fiat*. The injection of the cash money into economy by the commercial bank credits disturbs the natural equilibrium between mass of products and money matched against these products. It enables, among other things, that stock indexes grow too high for long periods, when natural potential rate of growth is determined by the constant $p = 8\%$. Eventual adjustment to the long term rate of return is unavoidable.

There is not merely one drawback. Principal reforms of the Central Bank are crucial for the economic stability and friendly economy. Incorrect theories of money and central banking are artificial limitations of the economic life and natural economic development. The most apparent manifestation of these theories inadequacy is the budget deficit. It arises from the lack of understanding that it is the labour process which creates our money. Someone's money is a certification of labour done, therefore labour is always self-financing. Governments do not need to collect taxes in order to finance work performed by the public sector. Understanding of the phenom-

enon of the self-financing of labour liberates economies from the budget deficits and correspondingly it allows for tax reduction (6). Moreover, it liberates the unused resources of labour that is to say it decreases unemployment.

The economy is subject to one essential limitation. It is labour productivity that has to be maintained at least at the achieved level. The labour productivity ratio Q determined roughly as the quotient of the real GDP to total wages should grow constantly. Therefore, political efforts should aim for a small regular growth of the Q. Declining Q would lead to inflation. Thus, the level of the ratio Q determines the size of the total compensation for the public sector. This is the essential change. The public sector is not limited by the ability to collect taxes but by the necessity of maintaining and improving its labour's productivity. Assets used by the public sector are financed by taxes.

The paper presents the theory of deficit-less economy. It proves that the budget deficit is a result of misunderstanding of money and in particular of the fact that labour process creates money. Therefore it is easy to make a well governed economy free of the budget deficit. But the deficit arises also when an employee earns less than a fair minimum pay. Then employee's human capital suffers deterioration and it adds to the deficit in a given economy.

3. Where and when did some inaccuracy appear in economics?

Where did the problem originate? It seems that economic theory malfunction is caused by a weak recognition of the triad: capital—labour—money, where the understanding of the role of labour is the weakest link. The problems with categories of capital and money follow naturally from there. Adam Smith wrote that "…What is bought with money or with goods is purchased by labour as much as what we acquire by the toil of our own body. That money or those goods indeed save us this toil. They contain the value of a certain quantity of labour which we exchange for what is supposed at the time to contain the value of an equal quantity. Labour was the first price, the original purchase-money that was paid for all things. It was not by gold or by silver, but by labour, that all the wealth of the world was originally purchased; and its value, to those who possess it, and who want to exchange it for some new production, is precisely equal to the quantity of labour which it can enable them to purchase or command…" (7, Book I, Chapter V).

The most considerations included in this chapter have the same thread of the labour embodied in the commodities and the labour determining exchange value. Then comes a passage (1.5.6) when this great economist wrote: "… But when barter ceases, and money has become the common instrument of commerce, every particular commodity is more frequently exchanged for money than for any other commodity…" Then after some butcher-baker consideration author concludes that " … Hence it comes to pass, that the exchangeable value of every commodity is more frequently

estimated by the quantity of money than by the quantity either of labour or of any other commodity which can be had in exchange for it…"

This is the moment when Adam Smith abandons the former strong view about labour-based nature of money and instead accepts silver coins as money—the most common good. At that moment the author gives silver coins the status of money and the idea of the labour and work receivable as the only correct concept of money is lost. He does not consider what is labour and what is correct labour unit and its eventual relationships to the money unit. He also does not develop an agenda for measuring labour, and its relation to human capital, although it is A. Smith who correctly said that human capital is all human ability of doing work.

Measuring abstract capital by a number of coins is like measuring capital by a number of bricks. It shows the principal contradiction by equating abstract capital with material bricks. It is like trying to measure electric energy by bricks or weighing soul in kilograms. Electricity is measured correctly in unit of labour since labour is energy in transfer. Of course A. Smith lived in times when the correct way of thinking was not yet developed. He published the great book at the time when steam engine was first built and the theory of energy and labour was not known.

Abandoning of the correct way of developing the economic thought made the societies unable to reach much more benefits. Namely a self financing of labour had not been discovered. Economists did not understand that labour is always self financing and that is the only correct process of money creation. Therefore taxes were necessary for the public sector financing, and budget deficits have appeared as strong limitation of economic development. The last factors caused unemployment and leaving a part of working force (human capital) not used for society wellbeing.

4. What is beyond the economics and economists responsibility?

Considering economy as capital flows one can ask about mandatory fundamental principles for economics. It is noticeable that at least three laws established in physics create scientific framework for economic considerations. The first is a statement that capital does not arise from nothing. The second is that all concentration of the capital spontaneously diffuses, provided the diffusion is not congested by aimed action. The last relates to law of the least action, which points out requirement of optimisation.

There are many countries in the world that have all premises of sustainability in the long run. First of all a country and economy need a right structure of capital located in the four main resources. It is cognitively fruitful to perceive economy as a continuously reshaped system with changing proportion between capital embodied in natural, human, physical and intellectual resources as it is expressed in Figure 1. The last resources involve social norms, standards, constitution, legal acts, scientific achievements and all elaborated by years of experience structures enriching a state. The institutional and intellectual capital is indispensable component that as-

sures growth of a state socio-economic performance. Insufficient institutional capital can be a reason of socio-economic catastrophes.

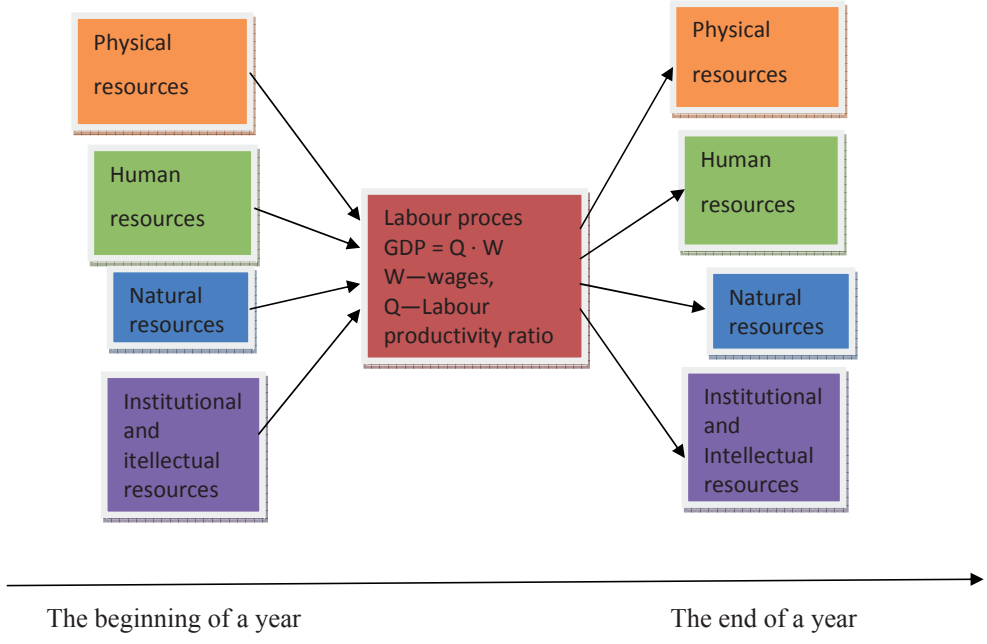

Figure 1. Economy as continuously restructuring capital

S o u r c e: author's own study.

In a year, structure of these four resources is changing under influence of different factors where natural forces and productive labour are the most important among others. The arena of these processes is Nature, which is one more factor of welfare. It is not located in Figure 1, since Nature is not under human control although it is significant wealth creating factor as well. It is labour process that reshapes the initial structure to the end of year structure. An aim is ever-increasing of the social sustainability in the state. A future of a country is uncertain when introduced structure is not adequate in respect to aimed level of sustainability. Capital located mainly in human resources without parallel growth of other resources can be a reason of a bloody revolt as was the case at Rwanda conflict. Instead, a growing number of citizens are a positive factor in Japan where structure of resources is maintained close to equilibrium. In conclusion, much is beyond control of economic theory and policy.

Labour placed in the centre of Figure 1 involves all the labour accomplished in the private sector, in the public sector, and in the households. Assuming real GDP as a measure of a year performance, we see that it depends on two factors. The first one is cost of labour or wages (W), and the second is labour productivity ratio Q. The

ratio Q currently does not exceed 3.5 in case of the USA. This means that $1 of wages produces $3.5 of real GDP. It is not the highest issue, since Luxemburg or Norway has the higher ratio. There is however a group of countries with low Q not much over 1. Poland operates with the ratio less than two.

5. A wisdom hidden in the compound interest

What factors are able to change the initial capital? Capital does not arise from nothing, but it has an ability to multiply in compounding processes. It can grow steadily, because the Earth is an energetically open system, where there is a continuous inflow of energy from the Sun. The average rate of growth is almost constant, since the Earth moves on a constant orbit at a constant tilt. Marvellous process of photosynthesis absorbs the Sun energy and makes it accessible to humans use. These facts explain why the economic constant exists, whose size is 8% of initial capital. It determines average capital growth in environment of wisely managed economic activities. It manifests itself by the so-called *Ibbotson standard* (8) concerning the risk premium size manifested on the capital market, theory of human capital measurement and fair compensations, as well as parallel problem of return on capital invested in assets. Research shows real economy being the none zeros game; it is in fact the p% game. Here $p = 0.08$ [1/year], and it denotes the fundamental economic constant.

Thus, thanks to the constant flow of the Sun energy, the Earth's economy is a non--zero game. Without this inflow, in line with the First Law establishing that energy and capital do not arise from nothing, the economy as a game would have the sum equal to zero. One agent would gain more only if the second agent loses an equivalent value. In non-zero games, each participant can benefit, humanity can succeed and capital incorporated in all resources can grow, too. As Robert Wright (9, p. 13) wrote, these are not easy processes since greed, hate and other low feelings make many troubles and these forces are powerful.

Despite that, companies can benefit from the law of exponential growth of the invested capital. This opinion results from the fact that companies have mostly positive ROA so that in long run the capital grows in line with the compound interest formula. The mentioned formula is the basic natural model of a capital growth where time denoted by letter t plays role of the growth factor. Let us note that it is a formula: $C_t = C_0 e^{at}$, where the initial capital has to appear, thus the formula is consistent with the law of energy (capital) conservation. Albert Einstein[2] is credited with statement often repeated in Business Schools. Referring to compound interest formula this great scientist told that it is "… the greatest mathematical discovery of all time." Nobody can deny that the formula works well. Possibly A. Einstein had discerned deeper sense of the compound interest as the main economic model.

[2] http://www.ruleof72.net/rule-of-72-einstein.asp. [online, accessed: 2011-06-18].

There is some rationale for the wide acceptance of the compound interest formula. Many great people expressed a high esteem for the concept of the compound interest. Jesus introduced a parallel (Mt 25:14) about a king and his three servants whose task was to multiply the initial capital. The highest price was given to the man who achieved the highest rate of return. Warren Buffett is well known for his admiration of the compound interest, and what is more important he was able to use this power in practice. Millions of people use this model for controlling growth of their deposits and for capital projects evaluation. If not the greatest, the formula is the most commonly used and extremely practicable.

But the true scientific challenge is a theory of the rate of growth. Discerning compound interest formula as an economic growth model, we see that it is essential law indeed, provided understanding the complexity of the rate of growth. According to the present knowledge (7; 10), the rate of growth has three factors structure. Namely $a = p - s + m$. It denotes that an initial capital C_0 is influenced by the three factors. These factors are: the economic constant that expresses a potential of growth given by natural forces, the factor s expressing natural and spontaneous diffusion of initial capital, which is a consequence of the Second Law, and third factor denoting inflow of capital through work. In line with the model a corn sowed on the field grows thanks to natural forces but farmer has to work in order to collect healthy grains of corn, otherwise the time arrow would disperse concentrated wealth.

6. Nature and model of capital

In English language the term "science" does not encompass "economics". Economics is beyond science so a question arises why? One of the reasons is the never completed research in respect to the category of capital. In 1963 year Robert Solow (11, p. 10) wrote about capital: "… when a theoretical question remains debatable after 80 years there is a presumption that the question is badly posed—or very deep indeed …" Although the term is widely used in economics, accounting and finance, and has been researched by recognised economists, their efforts basically failed, and in 1975 Christopher Bliss (12, p. 7) wrote: "… When economists reach agreement on the theory of capital they will shortly reach agreement on everything. Happily, for those who enjoy a diversity of views and beliefs, there is very little danger of this outcome. Indeed, there is at present not even agreement as to what the subject is about…" The mentioned author presents an important opinion, since understanding of the capital category allows understanding of labour and money as well.

The category of capital and the whole triad *capital—labour—money* is no longer debatable, since its constitutive features were described in papers (13; 14; 15; 2, Chapter 4), and numerous papers written in the Polish language. Capital is an abstract ability of doing work, whereas value of an object is a concentration of capital in this object. Labour is a transfer of capital to products, and money is a work receivable

for labour done. Essence of capital is captured by the model showing forces, which change initial capital in a given time *t*. Besides labour that causes inflow of capital to object there are, among others, natural forces causing its spontaneous, and random diffusion. Explanation of these forces is tightly related to the nature of the flow of time. There is also an economic constant of potential growth.

Let us remind the main steps leading to the formulation of the theory of capital. The concept of capital is, as it is commonly known, the most important idea in economics. In accounting, capital is a totally indispensable category. Double entry accounting can be seen as the theory of measurement of changes of the initial capital invested in economic unit and its changes by business activities. Outstanding premises of the understanding of capital have been formulated by Yuji Ijiri (16), who focuses our attention on the abstract nature of capital:

> … "Capital" and "resources" are the two financial sides of the same entity … Since current liabilities … are for the most part generated in the process of managing resources, they are often netted against assets. Following this practice, we state equality of capital and resources as:
>
> Resources = Capital
>
> … Capital is abstract, aggregated, and homogenous, while resources are concrete, desegregated and heterogeneous. The double entry bookkeeping system that has been the backbone of accounting in more than five countries has since its inception recorded resources and capital in tandem.

Luca Pacioli (17) used in 1494 the concept of economic power as the crucial category, when introducing a conceptual system for measuring capital and its periodical changes in an economic unit. The earliest concept of bookkeeping used the abstract category of capital and the duality principle as fundamental for double entry recording of business transactions. This system is presently called "accounting" and it turned out to be indispensable for conducting business.

In fact it is the duality principle that is the most important rule of accounting theory, which allows explain the profound meaning of capital. The fundamentals of the double-entry accounting is the equation $A = E + D$, where A denotes assets, E denotes owner's capital, and D denotes debt capital. Let us get rid of the ownership so that the equation has the simplest form $A = C$, where C denotes capital in general. To discover the very nature of capital we ask: what the variable C means if the A is the only one machine? Then the answer is clear that the variable C represents *an ability of this machine for doing work*! This interpretation is consistent with the understanding of capital as introduced by John Bates Clark, who perceived capital as abstract category, not the machine being an asset but its capacity of serving as the machine.

Therefore the fundamental clarification of the capital introduced, among others, in the paper (2: 89) explains this category as *abstract ability of doing labour*. Importance of capital is underlined by the fact that in case of a living creature who has abil-

ity for work, he/ she has after all ability for maintaining his/ her life. In addition, the *ability of doing work* is crucial category in physics (it is called energy) as explained by Peter Atkins (5, p. 118), who writes that: "… energy deserves for special attention because it is significant for the Universe, for all structures inside the Universe, and for all events, which happen. The two fundamental pillars supporting the sciences are cause–effect relationships, and energy. Causality decides about consistency of the chain of events, which determines an evolution of the Universe; instead energy works always as a guard who controls whether causality leads to correct activities. Therefore energy is the adequate money in cosmic bookkeeping because energy cannot be created but only transferred by labour …" Therefore capital in economics and energy in physics are the fundamental scientific categories indispensable in depictions of reality.

Capital in economics is an abstract category and energy in physics is an abstract notion, too. Many researchers, as discussed by Philip Mirowski (18) and others, have investigated similarity of these two notions in the past. This author carried out an outstanding research on the appearance of energy-related metaphors and concepts in economic thought. Although the outcome from P. Mirowski's analysis discloses that many economists conceived value and utility in physical terms of energy, and mechanics was recognised as a benchmark and framework for economic science, the idea of capital still remained tangled, unsolved and unclear. The key problem was inherent in correct interpretation of the thermodynamic laws in respect to economic matters.

The concept of energy in physics and concept of capital in economics belong principally to the same abstract category. We should agree that understanding energy and capital as the ability of doing work can be far from satisfactory explanation not fulfilling all expectations. Why? Human cognition is limited. Our experience should help to agree with constraints. Words cannot express the deepest secrets of the world. Ability of doing work is all that can be said about energy in physics (5, p. 116) and about capital in economics. It does not mean that we cannot strive for better cognition. Nevertheless we should agree that designates of the concept expressed as *ability of doing work* belong to the world of physics, world of economics, and they are also present in the esoteric considerations (Prime Energy).

Physicists have developed their own fundamental theoretical approaches and measurements of the ability of doing work. There is evidence that this category is subject to the laws of dynamics and thermodynamics. There is a set of original constants related to energy behaviour. But economics has its own cosmos since capital is embodied in many material and immaterial resources. Among them human resources, natural resources, physical resources, and institutional resources are the most important. Physicists deal with micro- and macrocosmos but human capital or institutional capital do not belong to their field of study. It is exclusive space for economics. It is original field of study which can be perceived as exclusive domain of economic consideration. Therefore economics have some common part with physics (abstract abil-

ity of doing work and derivative concepts) but building economic theories is an original occupation. Economists have to have respect for the fundamental laws of reality, nevertheless economic theories describe their own world of capital flows.

The one of the most essential questions is how to interpret the law of thermodynamics in the field of economics and accounting? Double entry bookkeeping, which does not admit an increase of capital in internal operations (such operations are illegal), represents conservation principle conforming with the first law of thermodynamics but its domain is narrowed to economic unit, instead of the whole Universe, as is the case in physics. Increase of capital can happen in case of external exchanges only. Accountant using double entry will not allow for increasing value of production (Debit) without parallel decreasing of some kind of assets (Credit). In case of operations that is a sale of product double entry system matches outlays and realised price for sold product showing eventually increase of capital from outer space of the economic unit. Product with unit cost of $50 sold for the price of $70 in double entry will capture $20 as an increase of capital. But capital as well as energy does not arise from nothing thus double entry accounting shows outer space as a source of capital increase. Double entry accounting operates in its own cosmos namely its economic unit.

Therefore double entry accounting invented ages ago is an effective measurement system quantifying changes to initial capital and reporting them periodically. It shows whether capital controlled by economic unit grows. Many historians have recognised this system as vital in the development of capitalism and democracy; particularly Nathan Rosenberg and Luther Earle Birdzell (19, p. 186–189). The awareness of the role of double entry accounting and financial statements shows a growing tendency.

Thus, the fundamental limitation is expressed in the first law of thermodynamics which points out that energy does not arise from nothing; the initial capital can be merely changed with the flow of time. The compound interest formula $C_t = C_0 e^{rt}$ is one of the most important patterns known in economy since it includes initial capital C_0, which has to exist. The initial capital can only be changed by natural forces and human labour, as it is explained by the model of the capital growth (2, p. 89).

Initial capital and time are the essential factors of the compound interest formula. But a true challenge is the theory of rate (r). Recognising this structure we obtain powerful model indeed. According to the research done and the present knowledge, the rate of growth has three factors structure. Namely $r = p - s + m$. It denotes that an initial capital C_0 is influenced by the three subsequent factors as follows:

$$C_t = C_0 e^{pt} e^{-st} e^{mt} = C_0 e^{(p-s+m)t} \text{ and } p = E(s) = 0.08 \text{ [1/year]}.$$

The variables are defined as follows:

– t—is the coordinating (calendar) time measured by chosen cyclical movements, particularly of the Earth

– e^{pt}—is the factor of natural potential growth determined by the economic constant $p = 0.08$

– e^{-st}—is thermodynamic arrow of time

– s—is the rate of spontaneous random diffusion of the initial capital

– e^{mt}—is an influence of human labour and management, which can offset the natural diffusion of capital and it can save the potential for growth, changing it to profit.

To answer why $p = E(s)$ lets us note that p is deterministic constant and s is the random variable. The s is random since the Second Law introduces uncertainty explaining that each concentration of ability of doing work diffuses spontaneously and randomly. The s cannot on average exceed p because growth would be impossible. On the other hand without human work and management (inflow of m) economic value would not arise. Thus conclusion is that s can entirely disperse p. Having $s < p$, $s = p$, p—deterministic, s—random we conclude that $s = E(p)$. Let us note in addition that the first thermodynamic principle is mainly respected by the variable of the initial capital C_0. The initial capital can only be changed or transferred but never created. Central Banks pretend that they are able to do it. But instead of a *perpetuum mobile* economies suffer from growing confusion.

Robert Solow (11) was right supposing deepness and complexity of the capital category (8). The powerful forces determining our reality appear in the model of the initial capital changes. We see how the Earth and the Sun guarantee essential potential for growth ($p = 8\%$), how this potential can be damaged by the forces described by the famous Second Rule being simultaneously the motor of changes. At last, we see how humans can prevent the diffusion by wise, productive labour, setting off dispersion forces and causing that potential growth becomes the real one. The model shows, among others, that economy is a non-zero sum game, and the added value can achieve the average rate of 8%, and this value concentrates in different resources, both material (goods, soil, devices) and immaterial as intellectual and institutional resources (laws, procedures among others). Albert Einstein had a good intuition in respect to the significance of the compound interest formula.

To illustrate how the model works we consider human capital in order to compute a fair minimal pay in case of the USA.[3] Let us note that variables s and m represent active work of the natural forces (the $-s$) and active work that can restrain the dispersion (the m). Instead the constant p symbolises potential. The potential p can yield fruits provided the diffusion s is counterbalanced by the work m. Let us assume that a child is born in an American family (four persons). This child would die soon, if parents and society did not care for it. Fortunately, they do this and the m at least

[3] Theory of human is presented among others in the paper by Iwona Cieślak and Mieczysław Dobija (20).

offsets the s. Therefore human capital of the child can grow at the rate p = 8%. This human capital is funded by outlays for the cost of living[4] that is estimated at $450 per month per person. We compute human capital and adequate fair pay taking into regard that legal minimal pay in the USA is presently $7.25 per hour.

Future value of stream of outlays $5400 for 17 years capitalised at the rate 8% = $195,456.

Fair pay is equal to yearly diffusion of employee's human capital: 0.08 · $195,456 = $15,638.

Monthly pay = $15,638/12 months = $1303 per month.

Hourly pay = $1303/176 hours = $7.40 per hour.

Taking into account roughness of the estimations the right conclusion is that the current minimal pay in the USA is fixed at a fair level.

The presented model discloses some of mysteries of capital. Hernando de Soto (21) reminds that centuries ago a scholar speculated that we use the word "capital" because the head is where we hold the tools with which we create capital. The author (13, p. 65) writes: "… This suggests that the reason why capital has always been shrouded in mystery is because, like energy, it can be discovered and managed only with the mind …" We needed time, more than three centuries in order to grasp the abstract substance of capital.

Having determined the model of capital one can compute its yearly increase (ΔC) in order to find a model and interpretation of periodic income.

$$\text{Income} = \Delta C = C_1 - C_0 = C_0 (p - s + m).$$

Thus, the sources of income are the initial capital working by year. The product of capital and time is called action, so the first source of income is to conduct the action. The second factor is impact of the potential constant of growth p. Without p nothing can grow. But C_0p is declined by diffusion s, so that profit would be close to zero C_0 $(p - s)$. Fortunately, human labour and management assure an inflow m, which can restrain s to its actual value s_a. Ultimately we get formula $C_0 = C_0 (p - s_a)$. Briefly speaking, we attain to income thanks to action and labour, which set off forces of uncertainty and of diffusion. If labour and management m limit the loss ratio s, the variable $p - s + m$ should be greater than zero. If this is the case, the model of capital will show growth of the initial capital.

The tendencies to disperse the initial value and loss-generating random events are—as it is commonly known—a manifestation of the Second Law. Exchanges made in a free market economy disclose, however, that there exists a premium, which allows preventing the natural processes of initial capital diffusion. This category is commonly known as the risk premium. Its existence is a reaction of the free market

[4] Cost of living denotes the minimal outlays needed in order for a child to develop personal human capital according to standards.

to the uncertainty of reality. The most of research about the risk premium value has been done in relation to the capital markets.

The Second Law helps us to explain the nature of reality, which has an unavoidable but random dispersion of capital, that is to say the phenomenon of uncertainty. This explanation complies with Frank Knight's (22) well-known consideration of uncertainty as the source of profit. We can say that income is created in the game between uncertainty and constant $p = 0.08$. Moreover, the Second Law and the estimated value of the constant p realise that there exist fair values in economy, in the form of fair compensation and fair prices in particular.

7. Assessment of the economic constant of potential growth

Many studies estimate the size of the constant p. Research is still ongoing. There are different approaches to the issue, e.g. case studies and statistical estimation. Interesting evidence comes from the past. The constant $p = 8\%$ manifested as legal yearly interests in the ancient republican Rome (23, p. 41) where the fair size of interest had been established as 1/12 of the initial capital. Therefore the interest rate was 8.3% per year (let us know that $e^{0.08} = 0.083$).

Capital market is a regular field of study for testing the constant p. There the p is called risk premium or capital premium and has a long history of research. In my opinion the most comprehensive general research has been systematically provided by Roger Ibbotson and co-workers. Results from one of the issues (8) are presented in Table 1.

Table 1

Summary Statistics for Total Returns in U.S. Stocks, Bonds, Bills and Inflation 1926–2004

	Arithmetic Mean	Geometric Mean	Standard Deviation
Stocks	12.39%	10.43%	20.31%
Long Term Government Bonds	5.82%	5.44%	9.30%
T-Bills	3.76%	3.72%	3.14%
Inflation	3.12%	3.04%	4.32%

Source: (8).

Using the data (Table 1) we obtain an assessment of the risk premium for the US capital market. This market can be seen as highly free and efficient, to a greater extent than the others. To compute the risk premium, we should deduct inflation 3.12% from the stock returns. Thus, the risk premium is equal to 9.27% (12.39 – 3.12 = 9.27)—using arithmetic return, and 7.39 (10.43 – 3.04 = 7.39)—according to geometric return. The range [7.39, 9.27] can be discerned as the range covering the true value of the constant that is called the risk premium. It can also be proved that the value 9.27

computed as arithmetic mean is too high. It is drawn from inequality: $\ln(1 + x) < x$, for $x > 0$. Thus the true value of the premium is covered by narrower interval. Taking the arithmetic mean we get 8.33. Thus the constant is close to 8% since after a year: $e^{0.08} - 1 = 0.08328$. The data used for the risk premium estimation represented values at the end of the year.

Bartosz Kurek (24) conducted a statistical research concerning the rate of return for companies' assets. The author attained to adequate definition of the ROA ratio, which could serve as an estimator of the constant p. Data was taken from financial statements of 1500 American companies covering period of 20 years. Confidence interval included the obtained mean value 0.0832.

Wojciech Kozioł (25) in his recent study examined the manifestation of the constant *p* using data from employees' work agreements of selected companies. Examination of 702 data points taken from two companies yielded mean value 8.13%, standard deviation 1.91% and 95 percent confidence interval [7.99%, 8.27%]. The author made also assessment of compensation earned by academics employed by universities (26). Research concerned the pay structure established by university and government administration. The study showed that the bottom limit of compensation assigned to a given position is not less than pay computed in line with human capital theory where the constant *p* is applied twice: at computing human capital and determining the salary (see section 8).

Human capital and adequate compensation are convenient fields of study for assessing the value of constant *p*. Because labour creates products so prices are also a good field for the constant *p* examination. The earliest assessment has been made by Mieczysław Dobija (27; 13). The author examined earnings or prices when employees or farmers had organised protests against inadequate wages. The studies always showed that the actual prices were lower than these derived with the use of 8% constant *p*.

The more systematic studies have been done by Iwona Cieślak and Renata Dyląg (28). The authors have examined job seekers. Interested people were questioned about their expected pay. The author assumed that job seekers are limited in their pay requests. On the other hand they expect a fair pay for their work. Having the expected pay W and some personal data allowing for computing human capital $H(p)$ the authors computed the p from the equation $pH(p) = W$. The average value of the p was 8.07%. It is clear that the constant should also manifest itself in the prices of goods. Many cases of farmers' protests in Poland have been examined. The study concerning the corn prices made by Iwona Cieślak and Małgorzata Kucharczyk (29), among others, has showed that the prices of wheat were significantly lowered in respect to indispensable costs of production. In case of the product prices the constant appears in human capital computations, then adequate pay, and as the third manifestation it settles on the expected profit.

Existing of the constant of the potential growth is a reason of an important opinion. Namely, all theories of the rate of return with an assumption of normality of

distribution and linearity of regression lines do not work well. The same can be uttered about linear relationship between risk and profit, when the risk is understood as pointed above. These reflections lead to graphic illustration of the rate of return in respect to different portfolios as it is introduced in Figure 2.

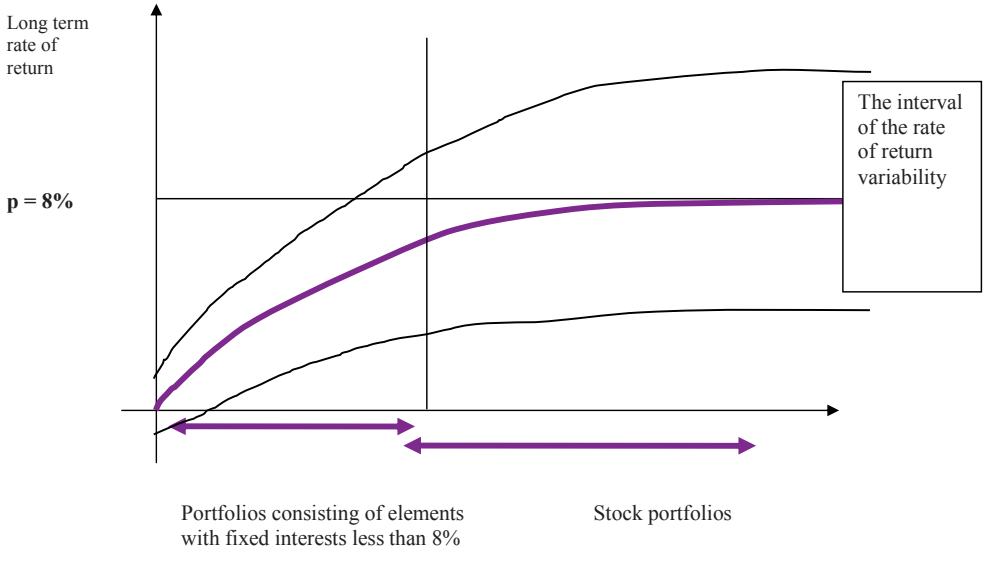

Figure 2. Graphic model of the different portfolios rate of a return in long term

S o u r c e: author's own study.

Figure 2 shows on the left side that an investor can accept the rate less than the risk premium $p = 8\%$ choosing a fixed interest and shorter terms. On the right side there are portfolios consisting mainly of stocks chosen in line with some theory. These portfolios yield average long run rate close to 8%, provided a lack of global destruction of capital like wars and global catastrophes. A given portfolio can have less or greater rate of return since the existence of randomness that can be measured by variance. A choice of stock is significant for the rate of return but the greatest influence belongs to sufficient number of different stocks. Then the theory of capital can be adequately applied.

The model of capital in Figure 2 explains that the long term average rate of return is close to economic constant $p = 8\%$. If, for example, Down Jones goes up more than 8% by some subsequent years, then one can expect the unavoidable fall in order to the average rate of return has been close to 8%. It results from R. Ibbotson and B. Kurek computations and the above introduced general theory of capital.

The reasons of stock exchange sudden fall of indexes (as was the case in October, 2008) are strictly macroeconomics and monetary in particular. Creating money

without relationship with human labour by monetary institution *is an action against nature*. It is in opposition to the fundamental law of conservation. Understanding that the true source of money is human labour and labour productivity ratio is responsible for purchasing power of money as it is explained in (30) opens ways of stable economic development.

The model showed in Figure 2 explains why there are so many troubles with CAPM. Peter Bernstein (31, p. 165) wrote: "… Here is a paradox. In today's world of investing, the Capital Assets Pricing Model has turned into the most fascinating and perhaps the most influential of all the theoretical developments described in Capital Ideas. Yet repeated empirical tests of the original Sharpe-Treynor-Lintner-Mossin CAPM, dating all the way back to 1960s, have failed to demonstrate that the theoretical model works in practice …" There is an answer for this paradox. Risk is not a kind of variability but spontaneous diffusion of capital concentrated in human related assets. It is not the risk as a source of income but the natural potential of growth as an attribute of Nature. It is determined by the economic constant p. Productive labour leads to the 8% long term average rate of growth per year. It is confirmed by R. Ibbotson and B. Kurek research in respect to the American economy. Such tests would never fail provided wars and catastrophes do not destroy peaceful economy and the Earth will maintain its constant orbit.

Introduced model of capital authorises to recognition the formula $C_t = C_0 e^{(p-s+m)t}$, $p = E(s)$, as the fundamental law of economic growth, where the flow of time denoted as t is creative factor as well. It is truth since natural forces represented by the constant p cause a growth, provided natural diffusion (assets' depreciation) of capital is limited by productive work m. These considerations lead also to an enlightenment of a fairness of the Physiocrats thought. There was a true kernel in François Quesnay's claims that Nature is the only source of wealth. Studying introduced model of capital one can detect that the source of a growth of wealth is the potential of the Nature determined by constant p. Every work by definition is only a transfer of capital and as the model shows, the labour only sets off the destructive forces determined by the thermodynamics arrow of time. Afterwards potential of Nature can change to a real growth and therefore economy is a non-zero sum game. This emphasis on nature can also be found in modern environmental economics as for example (32) that formulates "sustainability criteria" on the basis of the idea that Nature is the original source of wealth. Quesnay was right underlying creative nature of agriculture but was not right claiming that only the farmers' work is productive. Photosynthesis, which enables for capturing the Sun energy, belongs to all the humans, and not only to farmers.

8. Conclusion

Considerations presented above show economics on the crossroad. The old way is continuing old habits and maintaining a strong separation from fundamental laws

of reality. It is a way of producing cash money in order to inflame inflation with all bad and harmful effects for the economy. In such case economists and economics are pretending to care about right theory in service of society but they avoid discussion of the most significant concept as capital, labour and money. They do not bother such a concept as energy conservation principle. Therefore the border between economics and science is left intact. Economists are still beyond responsibility for their works and empty talking in media replaces real achievements.

The new road is the way of integration with science and holding responsibility for effects in practice. This is the road of respecting fundamental principles. Therefore a reform of the Central Bank to an institution that transfers salaries to public sector employees is a starting point. Consequently, as it is shown (10; 33), the economy with the new theory becomes deficit less and balanced. In the next step taxation of the fair compensations is withdrawn, unemployment disappears. Past experiences become only never repeating nightmare.

Bibliography

1. G l e i s e r M. 2008. "Nie ma nic złego w tym, że nie wiemy wszystkiego". In: *Niebezpieczne idee we współczesnej nauce*. Ed. J. Brockman. Sopot and Warszawa: Smak Słowa and Wydawnictwo Academica. ISBN 978-83-925897-3-0.
2. D o b i j a M. 2007. "Abstract Nature of Capital and Money". In: *New Developments in Banking and Finance*. Ed. L. M. Cornwall. New York: Nova Science Publishers. Chapter 4, pp. 89–114.
3. D o b i j a M. 2009. "Theoretical grounds of public finance reform". *Argumenta Oeconomica Cracoviensia*, no. 5, pp. 6–20.
4. S a m p s o n S. D. 2006. "The purpose of life is to disperse energy". In: *What is your dangerous idea*. Ed. J. Brockman. Edge Foundation. Polish edition: *Niebezpieczne idee we współczesnej nauce*. Sopot and Warszawa: Smak Słowa and Wydawnictwo Academica, 2008. ISBN 978-83-925897-3-0.
5. A t k i n s P. 2005. *Palec Galileusza: Dziesięć wielkich idei nauki*. Transl. by T. Hornowski. Poznań: Dom Wydawniczy Rebis. ISBN 83-7301-541-8. [translated from: *Galileo's finger: The ten great ideas of science*. New York: Oxford University Press, 2003].
6. D o b i j a M. 2005. "Financing labour in the public sector without tax funds". *Argumenta Oeconomica Cracoviensia*, no. 4, p. 20.
7. S m i t h A. 1776. *An inquiry into the nature and causes of the wealth of nations*. Ed. E. Cannan. London: Methuen and Co., 1904, Book I, 1.5.2. Library of Economics and Liberty. [online, accessed: 2011-06-18]. Available from Internet: http://www.econlib.org/library/Smith/smWN2.html.
8. G o e t z m a n n W. N., I b b o t s o n R. G. 2005. "History and the equity risk premium". *Yale ICF Working Paper*, April 6. [online, accessed: 2011-06-18]. Available from Internet: http://ssrn.com/abstract=702341.
9. W r i g h t R. 2005. *NONZERO. The logic of human destiny*. Polish edition: *Nonzero. Logika ludzkiego przeznaczenia*. Transl. by T. Łomnicka. Warszawa: Prószynski i S-ka. ISBN 83-7469-028-3.
10. D o b i j a M. 2010. "Open source currency and balanced credit size". *The Małopolska School of Economics in Tarnów Research Papers Collection*, iss. 2 (16).
11. S o l o w R. 1963. *Capital theory and the rate of return*. Amsterdam: North-Holand Publishing.
12. B l i s s J. Ch. 1975. *Capital theory and the distribution of income*. Oxford: North-Holland Publishing.

13. Dobija M. 2000. "Human resources costing and accounting as a determinant of minimum wage theory". *Zeszyty Naukowe*. Cracow University of Economics, no. 553.
14. Dobija M., Śliwa M. 2001. "Money as an intellectual venture". In: *Intellectual product and intellectual capital*. Ed. S. Kwiatkowski, Ch. Stowe. Warszawa: Wydawnictwo Wyższej Szkoły Przedsiębiorczości i Zarządzania. ISBN 83-86846-65-8.
15. Dobija M., Kurek B. 2006. "The nature of capital and the money-goods economy in a contemporary energetics approach". Paper presented at IEA 14th World Congress, Marrakesh, Moroco, August 2005. [online, accessed: 2011-06-18]. Available from Internet: http://ssrn.com/author=518110.
16. Ijiri Y. 1995. "Segment statements and informativeness measures: Managing capital vs managing resources". *Accounting Horizons*, vol. 9, no. 3.
17. Pacioli L. 1494. *Summa di arithmetica, geometría, proportioni et proportionalità*. Venetia: Paganinus de Paganinis.
18. Mirowski P. 1989. *More heat than light, economics as social physics: Physics as nature's economics*. Cambridge: Cambridge University Press.
19. Rosenberg N., Birdzell L. E. 1994. *Historia kapitalizmu*. Transl. by A. Doroba. Kraków: Signum 1994. ISBN 83-7006-306-3.
20. Cieślak I., Dobija M. 2007. "Teoretyczne podstawy rachunkowości kapitału ludzkiego". *Zeszyty Naukowe*. Cracow University of Economics, no. 735, pp. 5–24.
21. De Soto H. 2000. *The mystery of capital. Why capitalism triumphs in the West and fails everywhere else*. New York: Basic Books.
22. Knight F. H. 1921. *Risk, uncertainty, and profit*. Boston: Hart, Schaffner & Marx, Houghton Mifflin Company. [online, accessed: 2011-06-18]. Available from Internet: http://www.econlib.org/library/Knight/knRUP7.html.
23. Pikulska-Robaszkiewicz A. 1999. *Lichwa w państwie i prawie republikańskiego Rzymu*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego. ISBN 83-7171-255-3.
24. Kurek B. 2008. "The risk premium estimation on the basis of adjusted ROA". In: *General accounting theory: Evolution and design for efficiency*. Ed. I. Górowski. Warszawa: Wydawnictwa Akademickie i Profesjonalne. ISBN 978-83-60807-94-1.
25. Kozioł W. 2010. *Pomiar kapitału ludzkiego jako podstawa kształtowania relacji płac*. Doctoral thesis. Cracow Universioty of Economics. Unpublished. Available at the Library of the Cracow University of Economics.
26. Kozioł W. 2009. "Kształtowanie wynagrodzeń podstawowych nauczycieli akademickich na podstawie pomiaru kapitału ludzkiego i intelektualnego". In: *Nierówności społeczne a wzrost gospodarczy. Spójność społeczno-ekonomiczna a modernizacja gospodarki*. Ed. M. G. Woźniak. Rzeszów: Wydawnictwo Uniwersytetu Rzeszowskiego, iss. 16, pp. 280–290.
27. Dobija M. 1998. "How to place human resources into the balance sheet". *Journal of Human Resource Costing & Accounting*, vol. 3, no. 1 (Spring).
28. Cieślak I., Dyląg R. 2005. "Płace godziwe jako zasada zachowania kapitału ludzkiego". *Zeszyty Teoretyczne Rachunkowości*, no. 26 (82).
29. Cieślak I., Kucharczyk M. 2007. "Theory of capital in fair pricing of agriculture products". In: *General accounting theory: Towards balanced development*. Ed. M. Dobija, S. Martin. Kraków: Cracow University of Economics. ISBN 83-918932-6-X.
30. Dobija M. 2008. "Labour productivity ratio and international comparison of economic performance: Formalization of the PPP theory and preliminary examinations". *EMERGO*, no. 1, pp. 3–19. Paper presented at IEA 15th World Congress, Istanbul, Turkey, June 2008. [online, accessed: 2011-06-18]. Available from Internet: http://ssrn.com/abstract=1159729.
31. Bernstein L. P. 2007. *Capital ideas evolving*. Hoboken: John Wiley and Sons. ISBN 9780471731733.
32. Krabbe J. 1993. "A 'Physiocratic' Approach to Sustainability". *International Journal of Social Economics*, vol. 20, no. 9, pp. 15–21.

33. D o b i j a M. 2010. "Economy sentenced for growing budget deficit versus the balanced by labour self financing". Second International Conference ICE—TEA: *The global economy after the crisis: Challenges and opportunities*, Gyrne, North Cyprus, September 1–3, 2010. [online, accessed: 2011-06-18]. Available from Internet: http://ssrn.com/abstract=1673071.

Jak przeistoczyć ekonomię w naukę

S t r e s z c z e n i e: Cechą nauk fizycznych jest dążenie do oszczędności czasu i energii, czyli działania. Nauki całkowicie respektują fundamentalne prawa rzeczywistości. W naukach ekonomicznych spotykamy działania, jak tworzenie pieniądza gotówkowego, które są sprzeczne z fundamentalną zasadą zachowania energii. Odkrycie stałej ekonomicznej potencjalnego wzrostu, zrozumienie natury kapitału i pracy stwarza nowe warunki do ustanowienia naukowych podstaw teorii ekonomicznych, zwłaszcza teorii pieniędzy. Praca stanowi transfer kapitału, a pieniądze powstają jako potwierdzenie wykonanej pracy, czyli należności z tytułu pracy. Zrozumienie kapitału i pieniędzy prowadzi do odkrycia zjawiska samofinansowania się pracy, co pozwala na bezdeficytową gospodarkę z mniejszymi obciążeniami podatkowymi.

S ł o w a k l u c z o w e: teoria ekonomii, praca, kapitał, pieniądz