The global higher education market (GHEM), perfectly competitive educational market and entropy concepts

El mercado global de educación superior (GHEM), conceptos de entropía y mercado educativo perfectamente competitivos

Ecaterina Daniela Zeca*
University "Dunarea de Jos" of Galati - ROMANIA
dzeca@ugal.ro

ABSTRACT

The notion of entropy should be used for the study of some characteristics of Global Higher Education Market (GHEM). In this approach, explaining market imbalance, is going to be applied the fundamental principles of thermodynamics dealing with entropy, the Second Law of Thermodynamics. Entropy is a degree of disorder, and for this reason, being yet unschooled, is to consider whether such a notion is applicable to analyze the character of order for GHEM structures. From this point of view, it should be wise to analyze the market of perfect competition, in as much as in modern global educational market. This kind of market serves as the corner point in the comparative analysis of educational market architecture. The article concerns questions about HE stability, complexity and the occurrence of a sustainable system and, thus, give an example of the applicability of the synergetic paradigm for Global Higher Education Market(GHEM).

Keywords: global higher education market, market of perfect competition, entropy concepts, character of order

RESUMEN

La noción de entropía se debe utilizar para el estudio de algunas características del Mercado Global de Educación Superior (GHEM). En este enfoque, explicando el desequilibrio del mercado, se aplicarán los principios fundamentales de la termodinámica que se ocupan de la entropía, la Segunda Ley de la Termodinámica. La entropía es un grado de desorden, y por esta razón, aún sin haber sido escolarizada, es considerar si tal noción es aplicable para analizar el carácter del orden de las estructuras GHEM. Desde este punto de vista, debería ser prudente analizar el mercado de la competencia perfecta, tanto como en el mercado educativo global moderno. Este tipo de mercado sirve como punto de esquina en el análisis comparativo de la arquitectura del mercado educativo. El artículo trata sobre cuestiones relacionadas con la estabilidad de la Educación Superior, la complejidad y la aparición de un sistema sostenible y, por lo tanto, da un ejemplo de la aplicabilidad del paradigma sinérgico para el Mercado de Educación Superior Global (GHEM).

Palabras clave: mercado global de educación superior, mercado de competencia perfecta, conceptos de entropía, carácter del orden

*Corresponding author.

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Introduction

Higher Education, more complex than other ecosystems, may nevertheless be on the cusp of a revolution, leading to a new Higher Education ecosystem.

Major changes occurring in the world are redefining the metrics of excellence for Global Higher Education, for Universities.

The confluence of cost and funding pressures, technology-enabled learning innovations and new paradigms of quality and teaching will continue to force higher education institutions to redefine their value. However, higher education institutions are unwilling to embrace new definitions of value and quality as valid, even when they can see that students increasingly prefer the new value offerings, notes a report from TIAA-CREF Institute (Vozna L., 2016). At its basic level, the innovation process focuses on „doing new things and doing existing things better," according to the European Commission's Study on Innovation in Higher Education. The study notes, „The blockages for innovation can be found both at the institutional level, such as the lack of institutional support for innovative practices, and at national and regional, for example influenced by different degrees of autonomy of higher education institutions. Regulatory frameworks are also a crucial potential blockage to some innovative practices." (Vozna L., 2016) Universities collaborate on research and academic publications, create campuses across borders, and allure well-known scholars. The barriers to Global Higher Education Market (GHEM) are blurring, and the trend is upward. These are both for prestige, for tuition revenue and to increase global university rankings. These are due to Globalizations which are redesigning all sectors. Beyond this, the conditions favoring more intense competition from the universities of other countries are growing. But competition among universities is good, resulting institutions that better serve students' needs and equip them to gain a foothold in an harsh workforce, a workforce reshaped by shifting business models and nature of work.

Table 1. WHERE and FOR WHAT field most focus on students from abroad

EU	Romania
Iceland, 39,8 %, Humanity and Arts	7,7%
Luxembourg, 60, 8%, Social Sciences and Law	18,2%
Sweden,19,7%, Science, Mathematics and Computing	2,9%
Finland, 31% Engineering, Manufacturing and construction	12,3%
Romania, 13,4%, Agriculture and Veterinary	13,4%
Romania, 42,5%, Health and Welfare, Medicine	42,5%
Poland, 9,7%Services	2,9%

But how does such a Global Higher Education Market behave, and what are the terms of its sustainability in the sense that we are talking about about 35% of the skills demanded for jobs across industries will be changed by 2020 (Wildavsky, 2011)? In this context dealing education, it is opportune to analyze a service that universities currently provide, but which has effects in the future. The above reasons underlie the decision to analyze GHEM from the perspective of a market with perfect competition, the analysis being based on the theory developed by Roengen Nicholas Georgescu in The Entropy Law and the Economic Process in Retrospect.

Almost All About Entropy

a) Entropy as an energetic process. Entropy is associated with the process of the transformation of a useful energy into a low-quality energy. Quality of energy, in its turn, is determined by its ability to do useful work. The principal way to decrease entropy is to do work through the expenditure of free energy. If free energy is available and is expended to do useful work, then the system becomes more orderly and entropy decreases. But if all available energy has been expended, then no more work can be done, and entropy will either remain constant or increase (Bailey, 2009).

b) According to the 2th Law of Thermodynamics, the total entropy of any isolated thermodynamic system take to remain constant or increase over time, tackling a maximum value. Entropy is seen as a measure of disorder, so that an isolated system will gradually become more and more disordered.

c)Probabilistic approach. In thermodynamics the calculation of entropy is based on following Boltzmann's formula for an isolated system at thermodynamic equilibrium:

$S = k \ln W$, (1)

k is the Boltzmann constant,

k = 1,38 • 10-23 J/K

W is the number of distinct microscopic states consistent with the given macro-state, such as a fixed total energy E.

The Boltzmann formula shows the relationship between entropy and the number of sorts the atoms of a thermodynamic system can be settled. With the growth of the number of microscopic states W entropy increases.

According to this approach, the maximal entropy characterizes the structure that consists of homogeneous elements (Melnik, 2003). Also the maximum of the entropy function is the logarithm of the number of possible events, and occurs when all the events are equally likely (Carter, 2011, p. 30). W in Boltzmann's formula is sometimes called the thermodynamic probability since it is an integer greater than one, while mathematical probabilities are always numbers between zero and one. Leon Brillouin wrote in Scientific Uncertainty and Information"Let us examine the evolution of some isolated system. This unstable system left on its own will be destroyed, gradually converting into more probable and stable states. At the same time both probability and entropy are growing" (Brillouin, 1964, p. 28).

d) The maximum of entropy is featured by the invariance of the macro-state in relation to changes at the level of the microelements. A probabilistic approach of the invariance of the macro-state in relation to changes at the level of the microelements, was used by Stephen Hawking for description of the thermodynamic arrow of time. In his work A Brief History of Time, in particular, he depicted: „ The second law of thermodynamics results from the fact that there are always many more disordered states than there are ordered ones. For example, consider the pieces of a jigsaw in a box. There is one, and only one, arrangement in which the pieces make a complete picture. On the other hand, there are a very large number of arrangements in which the pieces are disordered and don't make a picture" (Hawking, 1998, p. 148).

e) Entropy as the opposite of information. Statistical entropy is a probabilistic measure of uncertainty or ignorance; information is the measure of reduction in that uncertainty. According to Brillouin,"additional information about the system under consideration is a consequence of the reduction of entropy. Thus, the information is a negative contribution to entropy and is the equivalent of negative entropy". According to Brillouin," additional information about the system under consideration is a consequence of the reduction of entropy. Thus, the information is a negative contribution to entropy and is the equivalent of negative entropy". According to Brillouin despite entropy usually being described as measuring the amount of disorder in a physical system, a more precise statement is that entropy measures the lack of information about the actual structure of the system. Lack of information introduces the possibility of a large kind of distinct structures, which we are unable to distinguish from one another. Since any one of these different microstructures can actually be realized at any given time, the lack of information corresponds to actual disorder in the hidden degrees of freedom. Also of note, in thermodynamics the maximum entropy describes the structure that consists of homogeneous elements, according to the concepts of information theory, the same type of a structure is related with zero (minimum) information (Melnik, 2003)

The Global Higher Educational Market With Perfect Competition = Ideal, Theoretical Model

The work asserts international academic market being interpreted as a market with perfect competition. If we compare different entropy concepts with the main characteristics of a market with perfect competition, we must conclude that the latter is a structure with the maximum level of entropy. This means, in particular, that a market with perfect competition is totally disorganized and chaotic. The main goal of the work, concern questions about GHEM ecosystem stability, complexity and the phenomenon of global educational ecosystem, thus, give a real example of the applicability of the synergetic paradigm in Higer Education.

- Perfect Atomicity - refers to the existence of a large number of universities and students, so that none can influence the price.
- The homogeneity of the educational services - an educational product must have the same characteristics irrespective of the university that produces it.
- Perfect transparency - both universities and students know perfectly the demand and supply so that they can get the best educational services at the best „price".
- „Market entry and exit" of the universities - a university enters the Global Higer Educational Market when the selling price of own services is higher than the unit cost and comes out of the market when the price is lower than the cost of the educational services.
- The perfect mobility of the universities - the economic agents have unlimited access to the educational ecosiystem and they are used it with maximum efficiency

The Global Higher Educational Market (GHEM) with

perfect competition = ideal, theoretical model. On the educational market with perfect competition, the "price" is formed by the interaction between demand and supply. The equilibrium price corresponds to the level at which

demand equals supply at the highest level of purchases educational services. Students demand, in this particular situation, is designed, influenced by work market request.

Probabilistic approach; Homogeneous Ecosystem; Information Point of View.

a) Probabilistic approach. A market with perfect competition is totaly deconcentrated. It appear a very large number of universities and students who offer totally identical educational services and cannot affect the „price". An equilibrium price in such a market is recognized under the influence of work market at the level of the average cost. Thus, the price differences on GHEM are minimal; theoretically they non-exist. For this cause, in such a situation, if we consider a single university that delivers certain educational services at a value, there is a high probability that all such educational services are being offered at the given charge. Or, from another point of view, there is a high probability that every university sells educational services at a given value (ve) and gets a given rate of „profit". As indicated above, the maximum entropy occurs when all of the possible states of a system are equally probable. In the case of a global educational market with perfect competition, we also deal with events that are equally likely. For the model studied, since all universities in the market offer unitary educational servics at the same value, the student is indifferent about which university he deals with. This means that a university in such a GHEM cannot have steady students. The probability that a student S1 will „buy" a certain educational service from a university U1 equals the probability that he will buy the same educational service from another university U2 or from another U3, and so on. What is the general number of combinations of students distributions between GHEM ? If the number of GHEM equals (n) and the number of students equals (m), the general number of these combinations (N) is equal to nm.

(2) $N=n*m$

For example, if it is given the standing of a absolute monopoly, then the number N, regardless of the number of students, always equals. It is fixed that N is maximal for a GHEM with perfect competition where both n and m are very broad. This numerical expression does not mean that a absolute monopoly market is a structure with the minimum level of entropy or, if it is so, that zero entropy is optative, but, in the same mode as for a market with perfect competition, this is checked by Boltzmann's probabilistic formula of entropy, because the maximum of the entropy function is the logarithm of the number of possible events, and come when all the events are equally supposable.

b) A homogeneous structure. The GHEM with perfect competition is a type of homogeneous ecosystem. But according to the Second Law of Thermodynamics, the maximal entropy characterizes the organization that consists of plurality of homogeneous elements.

c) An information point of view. As a homogeneous structure a GHEM with perfect competition should be distinguish by zero information. According to information theory, the equilibrium set of homogeneous elements in a state of chaos , we speak about absolute equilibrium, can not have the information (Melnik, 2003, p. 206). A market with perfect competition is also a market with perfect information in as much as information here is absent and has no value. Its lack is due to the circumstance that since the universities offer thoroughly identical educational services, they have nothing to hide from each other (Vozna L., 2016).

The absolute absence of barriers to entry in this market also means a lack of information barriers. But minimum (zero) information corresponds to maximum entropy. In modern educational ecosystems, such a market, defined as perfect competition, is a rather theoretical construction and practically does not exist. In addition, it is also called ,the competition without competition' (Yudanov, 1997.) In such a construction it cannot find here any value competition since no one university is able to influence a „value", as well as modify it without contrary consequences for themselves as well as non-price one as educational services here are standardized (Vozna 2016). It is distinguished that ,what the theory of perfect competition discusses has little claim to be called competition at all; advertising, undercutting, and improving differentiating (the educational services) or services produced are all excluded by definition, according to Friedrich August Hayek, expressed in his critique of the theory of perfect competition, wrote- perfect competition means indeed the absence of all competitive activities (Hayek, 2009). However, considering a educational market with perfect competition as the structure with maximum entropy, we highlight to the same.

Conclusion

- Educational market with perfect competition is characterized by maximum entropy but we have the conclusions about the impossibility of its practical implementation. Since entropy is a measure of disorder, a educational market with perfect competition is totally chaotic, unsystematic unstructured. That is why it is limited with a minimum densesess of evolution during time formation.

- Similarly, in a market with perfect competition, the macro-state parameters are indifferent to the individual behavior of the market agents, for example, in relation to their output decisions or location. Whereas the market with perfect competition is one type of homogeneous structure, the proposed situations give a real example of useing the entropy concept for the analysis of other social and economic systems. For example, the entropic invariance (indifference) of a macro-state in relation to changes at the level of the micro-elements, described above, can also be observed in the case of a homogeneous

social system such as a crowd, whose general behavior does not depend (or depends only weakly) on the characteristics of the individuals comprising the crowd" (Vozna L., 2016).

- Such an educational market exists outside of any educational ecosystem, both formal and informal, whereas, this based on general assesions of Douglass North (1991, p. 97), ‚institutions are the humanly devised constraints that structure political, economic and social interaction'. Thus, paradoxically, a perfectly competitive educational market cannot represent a market system that. It cannot work on the principles of the market economy since it excludes, in accordance with logic, the property institutions too. Being completely chaotic and unstructured, such a educational market should not be considered as a system. This means that in achieving the maximum level of entropy, a system ceases to exist. Thus, a perfectly competitive educational market characterized by the maximum level entropy cannot exist, basically.

- If the increase of entropy means the reduction of the system's ability to do useful work, a market with the maximum level of entropy should be characterized by minimum functionality. In particular this means that every other educaţional structure characterized by a higher level of services concentration can create a larger volume of utility than the structure with perfect competition. As a structure with a maximum level of entropy, a perfectly competitive educational market should be characterized by a lack of energy, that is, movement capacity. In our case it is not a mechanical motion, but processes of modification and/or development of a system. Thus, the educational market with perfect competition is incompatible with the processes of innovative changes. These conclusions are not statements, but only assumptions; they are, rather, questions designed to embolden further construction.

- Let's regard this very actually issue, which it's up to us, Global High Educational Market and its sustainability correlated with work market and technical evolution, from a new, and even unexpected, point of view. As for the market with perfect competition, it is sure, we can have doubts about the transfer of a principle of thermodynamics into global educational market analysis and about the analogy between economic actors and gas molecules moving randomly in space. „Nevertheless, in a similar way to a thermodynamic system (a state) with a maximum level of entropy, in a market with perfect competition we observe the same invariance of the macro-state in relation to changes at the level of the micro-elements. For instance, if we consider a thermodynamic homogeneous system (with maximal entropy in the state of equilibrium), the mutual swapping of particles ‚A' and ‚B' does not change the macro-state parameters, for example, the temperature (Vozna L., 2016)". Returning to reality, which doesn't means for sure a market with perfect competition we confront with the pace of scientific and technological development, all the while, continues unabated.

So, „multinational universities are set to dominate the future in the world of higher education. The educational service policy adapted to the requirements of time as well as cost / price and distribution of HE communitiesis a subject of nowadays.

Velocity of transmission and expansion of the information, due to digitization of all fields of our life are hastening both job creation and ravage. Exist assess that have evaluated the risk of informatization as high as half of current jobs. Cando the academic world keep up with these changes? Can the academic world be changed inside of it so to overtake job market? Because in the end all comes to students and value, High Education must be ready to equip them with proper theoretical and practical skills, but to make so that to know about entrepreneur request, in real time. If not, the knowledge gained by students will be useless and, because reshaping academic borders, many study programs will be jeopardized, and student will become nomadic, looking for the best HE syllabus and rewarding jobs! Arguably, academic field has accountability to dare upheaval enthroned tenets" (Zeca D.E., 2017) and all of these will happen not in a perfectly competitive educational market!

List of Symbols (Opţional)

k	Boltzman" constant
	k = 1,38 • 10-23 J/K
W	Number of distinct microscopic states consistent
E	Fixed total energy
U	University
m	The number of students
n	The number of university
N	Number of combinations of students distributions between GHEM

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