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The unexplored influences of modern physics on John R. Commons' economic theory

As influências inexploradas da física moderna na teoria econômica de John R. Commons

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RESUMO: Trabalhos anteriores dos intérpretes de John R. Commons enfatizaram a influência de várias referências teórico-metodológicas (por exemplo, pragmatismo, evolucionismo, etc.) na formação de seu pensamento econômico. No entanto, quase nenhuma menção é feita à influência da física de partículas e da relatividade, que, conforme debatemos, fornecem fontes de insights para seu trabalho. Este artigo explora essas conexões, mostrando que John R. Commons não estava apenas interessado nos avanços dessa ciência, mas também foi inspirado por eles para produzir paralelos e analogias que permitiram que sua teoria escapasse das armadilhas do individualismo e do determinismo enquanto incorporava tempo e espaço de forma inovadora no discurso econômico.
PALAVRAS-CHAVE: Economia institucional; física moderna; John R. Commons economic theory.

ABSTRACT: Previous works of John R. Commons' interpreters have emphasized the influence of numerous theoretical-methodological references (e.g., pragmatism, evolutionism, etc.) in shaping his economic thought. However, almost no mention is made of the influence of particle and relativity physics, which, as we debate, provide sources of insights to his work. This paper explores these connections by showing that John R. Commons was not only interested in the advances of that science but was also inspired by them to produce parallels and analogies that allowed his theory to escape the pitfalls of individualism and determinism while incorporating time and space in an innovative way in the economic discourse.
KEYWORDS: Institutional economics; modern physics; John R. Commons economic theory.
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INTRODUCTION

The literature so far produced on John R. Commons' economic thought has sought to connect him to a myriad of more general approaches, theoretical and methodological in nature, ranging from evolutionism (Bazzoli, 2000), pragmatism (Bazzoli, 1999; KEMP, 2009) and methodological holism (Ramstad, 1986), among others. This diversity is positive, as it signals the complexity of Commons' theorizing, which had not refused to mobilize different sources of knowledge to construct his own economic theory. But the cast of influences, we believe, does not end with those mentioned earlier. In fact, there are still others to investigate and this is what this paper proposes.

We intend to explore the affinities between Commons' economic thought in connection with the developments of modern physics (quantum and relativity) in the period in which this theory and the author's ideas were developed. However, we do not make the strong claim that Commons proposed to operate the economic transformations in terms of the new physical science, which was not the case, since one cannot observe direct links between the theoretical instruments used by Commons and those of modern physics. Moreover, this economic theorist had always been conscientious in demarcating the different nature of the social and natural sciences, refusing any kind of methodological monism.

However – and this is the paper's contribution – it is argued that there are significant analogies between the two approaches in terms of general worldview and some aspects of methodological principles. Particularly as both present themselves as antiatomists and antimechanists, offering a new perspective for the discussion of space and time.

We argue that the conceptual framework of Commons' economic theory and its internal relations present great similarities with the content of modern physics and that it was intentionally sought. In Commons, these aspects appear especially in his concepts of transaction, in the principle of reasonableness and in the concept of futurity, with its theoretical developments. From this perspective, Commons appears as a case of the appropriation of metaphors and analytical resources from modern physics, thus highlighting one more of the intellectual sources of his thought.

We intend to explore the connections between Commons theorizing and the advances of modern physics (quantum and relativity physics of his time) mainly in the book *Institutional Economics*, whose first edition was published in 1934. This fact will not prevent references to other works by this author whenever they reinforce the main argument. The choice of the book *Institutional Economics* is justified for the following reasons: a) because it is his *Opus Magnum*, qualified by one of his most renowned commentators as his "most complete attempt to incorporate legal institution within economics" (Rutherford, 2003); b) because it is in this book that Commons' most explicit and systematic references to modern physics are found among all of his prolix theoretical work, c) because it is in this book that

concepts, conceptions and ideas are more robustly consolidated, such as those of futurity and reasonable value, which occupy most of the book.

In terms of formal distribution, the article is divided as follows. The second section presents evidence indicating Commons' interest in modern physics, as well as his perception of the possibilities and limits of its use in economic theory. Third section describes the main features of theoretical physics in Commons' days and their significance in terms of rejecting core aspects of atomism, as well as innovative treatment of questions involving space and time. It is necessary to draw the reader's attention to the fact that the presentation of modern physics made in this section is panoramic and explanatory, based on secondary literature of self-disclosure to non-specialists. But it does not result, we believe, in losses in the essential features of that discipline. Fourth and fifth sections focus on Commonsian theory, trying to interpret some of its core concepts in light of the analogy from modern physics as presented in the previous section. The last section summarizes the main results of this investigation.

WHAT ARE THE LINKS BETWEEN COMMONS AND MODERN PHYSICS?

Is there any evidence of a link between Commons and modern physics? How much did he know of that science? What aspects of modern physics are present in Commons' work?

Regarding the first question there are direct and indirect connections. Of an indirect nature is that made by Dewey and Bentley (1946) from the concept of transaction which is important to resume in more detail. For these two authors the origins of the concept of transaction go back to the reflections made in the second half of the nineteenth century by Scottish physicist Maxwell. A trained Newtonian, his convictions about aspects of classical physics were shaken and eventually abandoned when he had to deal with the problem of space. We can summarize the terms of the problem as follows: from the acceptance of the Wave Theory in 1815, it was believed that light was a wave motion that propagated in a space composed of ether and governed by Newton's laws. Thus, the displacement of any object, both in space and on earth, should cause the same displacement of ether "fractions", regardless of their size. From this "belief", research in theoretical physics was done to identify, through experimentation, the displacements of the ether, which proved unsuccessful (Kuhn, 1996, 101-102).

Maxwell's theory of the magnetic field, though intended to be within normal Newtonian science, apparently involuntarily (that is, unintentional falsification), established one of the pillars of the modern theory of relativity, since the electromagnetic field in which the body moved dispensed the ether. It stated roughly that electric charges and currents act as sources of time-varying electric and magnetic fields, and vice versa, which explains the existence of electromagnetic waves that propagate in empty space. Maxwell's calculated speed for electromagnetic waves

coincided with the speed of light, which allowed him to state that light is an electromagnetic waveform.

Dewey and Bentley (1946) interpreted Maxwell's contributions as the abandonment of the atomistic and relational perspective of the elements in spacetime in favor of the transactional approach, which they said was adequate to deal with situations

> Where systems of description and naming are employed to deal with aspects and phases of action, without final attribution to "elements" or other presumptively detachable or independent "entities", "essences", or "realities", and without isolation of presumptively detachable "relations" from such detachable elements (Dewey and Bentley, 1946, 509)

Both authors show that Maxwell used the concept of transaction, preferable to relationship, which still fit the mechanical and atomistic view of Newtonian physics. Both commentators hailed it as an appropriate approach to the analysis of social phenomena and, interestingly, cited some social scientists who successfully applied the concept of transaction, one of which was John Rogers Commons. This, then, is the first indirect "evidence" of the link between modern physics and the institutional economist.

In addition to that, there are other more direct connections. In Commons' own work there are explicit analogies to quantum physics, for example, in the book *Legal Foundations of Capitalism*, published in 1924, in which the transaction is compared to the dynamics of particles, as he observed:

> "While the economists start with a commodity or an individual's feelings toward it, the court starts with a transaction [...] The transaction is two or more wills giving, taking, persuading, coercing, defrauding, commanding, obeying, competing, governing, in a world of scarcity, mechanism and rules of conduct. The court deals with the will-in-action. Like the modern physicist or chemist, its ultimate unit is not an atom but an eléctron, always in motion – not an individual but two or more individuals in action. It never catches them except in motion. Their motion is a transaction. (Commons, 1995, 7-8)

More striking evidence appears, however, in the book Institutional Economics. In this book, in item X (From absolutism to Relativity) of the chapter entitled "Efficiency and Scarcity," in about four pages, Commons makes more direct comments on the relationship between his theory and modern physics. In this text he deals with the differences between his economic theory and that of his predecessors (particularly those of classical and neoclassical economics), pointing to the relativistic nature of the concepts of transaction, reasonable value, and futurity. It is also in this book that such links between modern physics and his economic theory become more apparent and, moreover, one can speculate about the sources, the type

and depth of knowledge that Commons had of the theoretical and experimental physics of his day.

Table I presents the bibliographical references of books and articles on theoretical physics present in the book *Institutional Economics*, as well as the page of that book where they are cited. From it can be taken some interesting observations. The first is that Commons seemed to be interested in knowing the scientific progress observed in the physics of his day as judged by the books related to this subject cited in *Institutional Economics*. The second is that this knowledge was obtained exclusively by secondary literature, in the form of commentators and disseminators. The complexity of the subject and the technical limitations with respect to mathematical and calculational mastery were certainly elements that explain a strategy of avoiding the source texts of theoretical physicists, but even if this were not the case, the use of secondary sources was sufficient for Commons' theoretical purposes: to produce process analogies between the two areas of knowledge in order to move away from a particular tradition of thought

Table 1: References on theoretical physics quoted in Commons' book *Institutional Economics*

Paper/Book	Author(s)	Publishing year	Page in *Institutional Economics*
Science and the modern world	Whitehead, A.N	1926	96;619
Wholes and prehensive unities for physics and philosophy (*Journal of Philosophy*, xxiv)	Akeley, L.E	1927	101; 619
Knowing something without knowing everything else, as a prerequisite in eletricity and heat (*Journal of Engennering Education,* XVIII)	Akeley,L.E	1928	619
The universe around us	Jean, James	1929	17
Flights from chaos: a survey of material systems from atoms to galaxies	Shapley, Harlow	1930	84
Reason and Nature	Cohen, Morris	1931	98; 388
Atoms and Cosmos: the world or modern physics	Reichenbach, Hans; Allen, E.S	1933	17;388
Adventures of ideas	Whitehead, A.N	1933	17

Source: The authors.

The third inference is that mentions of physics are not concentrated in just one part of the book, but spread throughout it, suggesting its use for different aspects of Commons' theoretical interests, especially in his discussion of the concepts of futurity and reasonable value, presented, respectively, in Chapters IX and X of *Institutional Economics*.

Finally, there is general evidence that is borrowed from Togati (2001), who noted the impact and influence of the scientific revolution – personalized in Einstein's figure – that was taking place in the physics of the first half of the twentieth century on the social sciences, arts, literature and culture in general. That author argued that this was inspiring for Keynes to subvert – through criticism – the structure of orthodox economics. Perhaps a similar effect might have happened for Commons: Society's enthusiastic reception of the achievements of physics must have influenced and induced him to seek to know them better, borrowing some analogies to produce parallels between the two sciences.

In any case, it seems unlikely that Commons derived from Maxwell's physics, which he cited in a marginal commentary in the book *Legal Foundations of Capitalism* (p.374), or from quantum physics his concept of transaction. It is also true that he did not make of Maxwell's physics, or modern particle physics, the unifying principle of his theory. It is worth remembering his reservations about any attempt to reduce the social sciences to those of nature, drawing attention to their transdisciplinary and volitional character, as they required the mobilization of various sources of knowledge and dealt with intentional men capable of acting on the world and – under certain conditions – change it (Commons, 1996a; Commons, 1996b). This fact made him hold reservations even about the possibilities offered by modern physics, which lacked both the volitional dimension and the meso approach, capable of surpass the gap between subatomic and relativity physics. As he observed:

> We have suggested that the foregoing sketch of the history of economic Science bears some resemblance to the history of physical science from Euclidean to non-Euclidean geometry. But there are important differences which make it mislead to speak of "Euclidean and non-Euclidean economics". The non-Euclidean physics is concerned, as shown by Reichenbach, with the "microscopic" and "macroscopic" relations of the universe, as affecting the basic concepts of space and time. But economics is concerned with the ordinary, everyday experiences of mankind in the world of "medium dimensions" Midway between these extremes of the problems of physics. Our analogy holds true only in so far as economic Science is passing from what we name the absolutistic to the relativistic point of view. The costumery ideas of space and time, employed in economics, are not dependent on microscopes or telescopes. (Commons, 2003, 388)

These facts seem to suggest that the development of Commons' economic theory (the concepts of transaction, futurity, reasonableness, etc.) was autonomous, but influenced by modern physics, which provided not only analogies and metaphors, but also ontological and epistemological subsidies.

THEORETICAL PHYSICS IN COMMONS' DAYS

In the late nineteenth and early twentieth centuries, theoretical and experimental physics reached an immense level of achievement that produced a "scientific revolution," establishing a new paradigm for the natural sciences (Kuhn, 1996). This was the moment of advances in understanding the nature of matter by confirming the existence of the atom, its irreducible unity, but also the moment in which subatomic particles were identified and their properties affirmed, leading to a kind of "dematerialization" of the matter. After all, protons, nuclei, photon electrons, and later, mesons, pions, etc. were still "smaller" than the atom. The atom was found to be always in motion, permanently agitated, and as a result produced thermal energy (Feynman, 2017, 34). The clash against each other in different substances produced random motions (Brownian motion) whose average (not individually) could be determined. From this it was possible to advance in determining the size and mass of atoms.

At the same time, significant advances were made in what came to be known as thermodynamics. From the identification of the relationship between temperature and motion (vibrating atoms produce heat that can be transmitted, and thus material bodies produce thermal radiation and cast it on other bodies, just as they receive such radiation from them), it was discovered that electromagnetic energy was the result of the frequency of the electromagnetic wave multiplied by the irreducible unit of energy called 'quantum'. This aspect allowed immense progress in understanding the nature of light. Since Maxwell it was known that it was electromagnetic energy that propagated through a medium in the form of waves. The discovery of the quantum made it possible to unify the thermodynamic theory with the quantum theory, because the dual nature of light was discovered: it was both wave and particle. Later, derived from advances in the structure of atoms offered by Rutherford, Bohr, and Broglie, this dual understanding of light extended to all forms of matter (Feynman, 2017, 64).

The implications of this led to what we mentioned earlier as "dematerialization" of the world, meaning the abandonment of the perspective that emphasized matter as inertial substance or mass. Throughout its permanent movement, matter will change its nature/substance, sometimes assuming the "nature" of particle, sometimes wave. Their "nature" was relative to the circumstances of the world (ontology) as well as the way they could be observed in scientific experiments (epistemology). In this last aspect, this also meant the adoption of a point of view in which it became impossible to start the explanation from these irreducible units, as well as to treat their movements as capable of precise determination. In fact, the claim of atom (matter) and quantum (energy) as irreducible units did not mean that the explanation of nature could be made from them individually. After all, what individual unity can exist in these constitutively dual phenomena? This fact led to indeterminacy, since the fact that each particle has an associated wave function means that it is completely impossible to accurately determine its location in space at any moment in time (BOHM, 2008).

When experiments are performed to determine the position of the particle, the wave function collapses: the particle location is known, but it no longer follows the wave-particle undulatory pattern. This led to considering nature as probabilistic (Feynman, 2017, 63). Heisenberg, in 1927, strengthened this probabilistic argument trough experiments which concluded that if one wishes to determine with absolute precision the position of a particle, one must give up the knowledge about its velocity. And the opposite. Both can be jointly determined, but at the price of higher precision for one and lower accuracy for the other. (Heisenberg, 1958, 49).

On the other hand, from Einstein's contributions on space and time, modern physics was able to transcend Newtonian physics, turning it into a special case, valid in realities where the speed of bodies is far below the speed of light. Again, Maxwell's contribution is important. By postulating the wave nature of light, he induced physicists into an intense research agenda, as it was necessary to identify in which medium the light wave propagates (after all, every wave propagates in some material medium). Then began the search for the luminiferous ether, the medium by which light was supposed to propagate. This line of research was perfectly compatible with the Newtonian paradigm – in which space and time were absolute, unchanging measures and served as a backdrop for the unfolding of events in the world, providing a secure framework for establishing the laws of physics – since the existence of a motionless luminous ether offered the absolute reference to the Newtonian coordinates of space and time.

Experimental observations attempting to demonstrate the existence of ether usually involved the emission of a divided beam of light: one part passing through a semi-transparent mirror, and the other part redirected at a 90-degree angle. The length of the two paths was equal, just as there were mirrors at the end of them, returning the light to its emitting point. The experiment hoped to obtain proof of the existence of ether by the difference between the speed of light in the two paths: as it passed through the ether, light would slow down slightly, thus manifesting its existence (Heisenberg, 1958, 120). The results of these experiments falsified the hypothesis of the existence of ether because they concluded that the speed of light was always the same regardless of the object emitting or detecting it.

Einstein drew important theoretical conclusions from these experimental results. If the speed of light is constant in any situation, regardless of the frame, whether in uniform motion or not (acceleration) is equivalent to saying that time "passes" under different conditions as the course is observed by who is moving or who is in rest. In motion, time passes more slowly. As one reaches very high speeds, the observer perceives time moving slowly, stopping at the limit if the speed of light could be reached.

This finding also affects the notion of space, because for the observer at rest, the object moving at the speed of light will be shorter to compensate the greater distance travelled in relation to the moving observer. Similarly, the simultaneity of an event is not the same whether it is perceived by an observer at rest or in motion: as they are moving relative to each other, the rhythm of time and distances in space are different for them. These findings challenged the conception of three-dimen-

sional space (width, height, length), as they required time to be incorporated as a fourth dimension, producing the idea of a continuum between space and time. With his reflections, Einstein challenged the Newtonian notions of absolute time and space (Feynman, 2017, 219).

From an ontological as well as methodological point of view, modern physics revealed that: a) the minimum units of matter cannot be apprehended in isolation, but in the permanent movement of their interactions; given this fact, the explanation of physical phenomena cannot be accomplished by taking them as the starting point of the explanation. This aspect represents the refusal of any form of atomism; b) by their dual nature (wave and particle) and their perpetual condition of motion and interaction, particles cannot be the object of any deterministic knowledge, because their situation in space and time is uncertain. Uncertainty is the condition of the movement of particles, hence all knowledge about them is inaccurate, partial, and at most probabilistic; c) in the more aggregate dimension, the discovery of the nature and properties of light has led to re-evaluating the importance of time and space and including them as variables, not parameters, by relativizing the notion of time and space, making them dependent – at least less at very high speeds – of the referential/observer.

These three main and decisive aspects of modern physics have received analogical treatment in the view that constitutes the theory of Commons from the following concepts: transaction, the principle of reasonableness and futurity, which will be discussed in the following topics.

THE TRANSACTION AS THE CRITIQUE OF MECHANISM AND INDIVIDUALISM

Commons sought to oppose those conceptions of economics of the past and those contemporary to him in his ideas. He used the term "mechanism theories" to characterize them and emphasized their main aspects as follows. They treated economics – inspired by Newtonian mechanics – as mechanisms that functioned according to objective laws and acted in a system in which the main coordinates of space (the economic space of competition) and time (succession of moments from the past to the present) were given to individuals (such as atoms) to interact and produce some result while preserving their substantive individual characteristics. The phenomena observed were precise and definite, unambiguous substances that regained their substantive property as soon as the interactions ceased.

It may be appropriate to concretely illustrate a "theory of mechanism" by using the example of the Classical Economists, who have identified in the amount of labor (contained and/or commanded) necessary to produce a commodity the objective and stable basis of its value (or relative price). The value (the amount of work contained/commanded) tended to decrease due to changes in the productive orbit of human activity, usually associated with technological and organizational changes. As the amount of labor declined, values and prices fell together, obviously re-

flecting productivity gains. Productive units that anticipated productivity gains have temporarily enjoyed excessive profits from the fact that they can sell their commodities produced at lower labor costs at current market prices.

Since the system operated in or near a "space" of perfect competition, the other productive units would seek to replicate the technology and organizational forms of the most efficient firms. In doing so, they led to widespread falling prices, the elimination of provisional monopolies, and the transfer of productivity gains to society as a whole. Thus, for the English classical economists, economics was a determined system, subject to autonomous laws of the socioeconomic context.

This mechanism produced an automatic and self-corrective order, in the sense that it was detached from the influence of institutions. In short, from the individual motivations and freedom, it was possible to explain the capitalist economic order. In it the price system – and the values they represented – played an essential role, as it was responsible for the functioning and balance of the economic system. Prices – and their fluctuations – coerced individuals into a certain pattern of behavior: when they rose, they better remunerated resource holders (capital, labor, and land), attracting new providers, and thereby increasing the supply of goods and services that promised to pay; as the new supply materialized, however, prices tended to fall, causing the opposite movement from that described earlier.

Despite their fluctuations, prices tended toward an equilibrium that Smith and Ricardo called price or natural value. Thus, in the classical system (which remained essentially intact despite the marginalist revolution) the price mechanism spontaneously produced – by simple motivation and exchange interaction – a balanced, harmonious and efficient economy.

From this individual, by the aggregation of other equals, "society" was obtained. The elemental social form of a society where exchange had become widespread was the commodity, whose value was determined in the productive space of isolated individuals before they entered the circuit of exchange. Objectively, the Classics understood that it was the transformative activity of labor that added value to things, which could be measured directly by working time. Free and guided by instrumental reason, individuals could produce without premeditating a spontaneous economic order whose only condition was economic freedom, hence the corollary of liberalism as a theory of action.

In Commons' transactional approach, everything is different. Neither the individual nor the commodity are the starting point of explanation, nor can it be reducible to the behavior of their individual units. Although the individual does not disappear from the analysis, it is not he, with his idiosyncrasies and his "nature", the starting point of the investigation. Rather, its basic, elementary unit of inquiry must be the transaction, understood as a unit of activity involving at the same time several individuals. Elevated as the basic unit of analysis by Commons, the transaction is the social form that incorporates the material relationship man-nature and the social man-man, the one inscribed in the physical dimension of the processes of transformation and distribution of material wealth, and this in the dimension of transfer of property rights over such wealth (and also over nature).

Transaction was generically defined as "actions between individuals" (Commons, 2003, 73), emphasizing the relational and dynamic aspects that link individuals. In the context of modern economic life, the institutions of capitalism took care of operating three types of transaction: bargaining, managerial and distributive, differentiated according to the function and socio-legal status of their participants. They exist simultaneously and individuals coexist with each other, moving from one to the other daily.

Bargaining transaction is characterized by a type of social relationship that involves at least five actors: two who sell and two who buy more sovereignty (Commons, 1995 [1924], 68, 88). Its main feature is the formal equality between the parties using the resources of persuasion and, alternatively, of coercion. Its essential function is to transfer property rights between those involved in the transaction. When two people "trade" their products, what they are doing is transferring ownership, or right of possession and use, from one to another. Despite being a kind of social relationship among "equals" (only under the law), Commons has no illusions about the nature of the bargaining deal, which involves real power differences between its participants and mechanisms of coercion. In short, the bargaining transaction performs the social function of transferring property rights of goods between individuals and social groups.

The managerial transaction typically occurs between two people whose relationship is unequal. The managerial transaction is hierarchical, materialized between superior and inferior, employer and employee. The task of this transaction is to produce wealth, and its most obvious (but not exclusive) dimension in modern capitalism is the great corporation. This is the quintessential space of efficiency, achieved through the submission the inferior to the superior's command. For their realization, therefore, the working rules must establish the usual reasonable conditions of obedience and command.

In the "managerial transaction", the 'freedom' of the inferior is constrained, subordinate to the freedom to command of the superior. Clearly, the managerial transaction is a space of power of an essentially coercive, arbitrary, and enforcing nature. In it, the freedom of the superior can organize the productive process giving to the inferiors a condition of 'resource', instrument for the increment and qualification of the physical production of goods. This is the crudest and most visible dimension of labor relations. In the managerial transaction, the efficiency objective – understood as the production of use values with the least expenditure of resources – is a goal that is confused with the corporation's own profit objective (Mitchell, 1950; Hodgson, 2003).

The third form of transaction, the distributive, also occurs between two persons (or organs), is hierarchized and carried out by authorized "going concerns", that is, imbued with legality and legitimacy. It is in charge of deciding on resource allocation and distribution, setting the burdens of that decision (Commons, 1996, 448-449).

Bargaining, managerial and distributive transactions conceptually bring together the central elements of any economic system: production, distribution and

exchange (Kemp, 2009, 64), which characterizes the Commons' approach as systemic. They are means of conflict resolution and, in addition, function as regulatory elements of capitalism, replacing the explanation offered by the price system (Hartes Jr, 1962).

In addition to these three types of transactions, Commons alluded to two others, which he called routine transaction and strategic transaction. Both are transverse to the other types, i.e., they are contained therein. Routine transactions were recurrent actions that, appropriate to the unchanged environment, took past and habit as references. Strategic, on the other hand, anticipated changes or were caused by these, requiring the mobilization of broad cognitive instruments, from rational calculation, specific heuristics, etc. (Commons, 2003, 630).

The types of transactions previously analyzed were present to varying degrees and measures in all "going concerns", understood as "[...] the institutional perimeter within which transactions take place" (Fiorito, 2010, 284) and which are as diverse as the family, the company, the union, the church, etc. The internal welding of a going concern was given by the working rules that set "[...] behavioral patterns which govern the actions of each participant to a transaction, defining, at the same time, expectations about what the participants can, must, or may do as controlled, liberated, or expanded by collective action" (Fiorito, 2010, 284).

Every "going concern" concentrates more than one individual, and has some instance of deliberation, direction, and rule enforcement. It also has goals, so that by acting and interaction within it, individuals produce the meaning and materialize the goals of the "going concern", which are distinct and often divergent from those of their individual members.

The going concerns are thus like governments with their hierarchies, rules and objectives; and individuals are their citizens, for they act within and among themselves as subjects who owe obedience and duties, but also holders of rights. All of us are born, grow, and die in "concerns" that organize the work and collective action of isolated individuals.

The socialization of individuals happens within and between going concerns. In them they submit to the working rules in force, adjusting their behavior and evaluating that of others. They therefore constitute the social fabric in which social relations (transactions) take shape. They are various, independent, but connected by the social ties that individuals "sew" in their daily life as they move from one to the other. The same person lives at a given moment and throughout his or her life in various going concerns. One thus undergoes different working rules, different patterns of behavior, representation and cognition.

The "going concern" is a collective that determines and is determined by individuals. It determines in the sense that they exist before the individual and the individual is confronted in his social life with those previous structures with which and often within which they must deal with daily. "Going concerns" offer individuals who deal with them the living force of actions of other individuals in the past, who remain and perpetuate themselves through customs, habitual practices,

precedents, working methods, e.g., working rules that constrain the discretion of the present.

At the same time, however, people in the present animate with their daily practices and behavior the very existence of a "going concern". Although conditioned by habits and customs, people preserve varying degrees of autonomy and discretion. In this sense, the working rules are a source not only of restrictions and conditioning (its negative aspect), but of protection and stimulation of autonomous and discretionary behavior present in the individual sphere (Lawson, 1996; Guedes, 2013). Thanks to them they can exercise discretion and choose alternatives. In this sense, the going concern's "will" is nothing more than the working rules (Commons, 1995, 147), that is, the actions and transactions of those who obey them.

As can be seen, with the concepts of transaction, institution, and going concern Commons produced results compatible with those obtained by modern physics: first, it transcends the conception of economic "space" as a given, fixed and unchanging parameter in favor of another where it is dynamic, composed of an institutional territory that contracts or expands according to the position of the individual within a going concern. Commons (1996, 525) gave an example of this kind of "contraction" of the economic space promoted by institutions as they expand individual action. "far beyond what he can do by his own puny acts. The head of a great Corporation give orders whose obedience, enforced by collective action, executes his will at the ends of the Earth"; second, he transcends individualism (atomism of premodern physics) without falling into holism by recognizing that the individual exists but is not a given and permanent instance. Like a particle, it builds its identity (its thinking habits, etc.) as it moves through and relates to institutions. Through institutions he receives the elements and conditions with which he constructs his identity/individuality. This process is all the more intense and broader the larger and more complex is the group to which the individual belongs; third, he prescind the notion of equilibrium, as there is no specific tendency for the interaction of individuals in the system to move. There is, however, a "provisional" stabilization achieved by the intentional management of individuals within the transaction itself: a synthesis of conflict, cooperation, and order (Commons, 2003 [1934], 58).

FUTURITY AND REASONABILITY AS A CONTINUOUS FIELD OF TIME AND SPACE

The economic theory of Commons – contrary to the atomist tradition – incorporates the notion of space and time in its analysis. Instead of taking them as given, parameters, they become this author's constitutive elements of the investigation itself. It is as if time had been incorporated as another dimension into the space in which transactions take place in order to alter/modify their perimeter. This is how the concept of futurity pushes the conception of time to the limit as a succession of moments marked by the present, according to the tradition in economics. According to Com-

mons, the reason economists of the past disregarded time, and especially future time, was that their minds operated on the usual understanding that the cause precedes the effect. Therefore, work precedes the product, sensation, action, scarcity and desire precede effort and satisfaction (Commons, 1970 [1950], 105).

On the contrary, for him past-present and future constitute a continuous and one field, which cannot therefore be separated and maintained without connection. In that concept, past and future – aspects that no longer or exist or not yet – have effects on action in the present, determining it in a sense. The past lives in the present through habits and customs that perpetuate practices and "mentalities", offering some security to individuals deriving out of "experience." The future is the storehouse of "expectations" that present behavior and commitments will be maintained and perpetuated. Because the future is uncertain, individuals resort to every kind of resource to match their expectations. Laws are one of them, and the State, the legitimate violence mobilized to implement it, another.

As a continuous temporal field, the past is alive in the present because it has transmitted to these customs and habits, as well as "models" of how the actions of the past unfolded in their effects. Thanks to pragmatism and the concepts of habit and futurity, time is incorporated into Commons' analysis as an endogenous ingredient of economic analysis. The future, in turn, by carrying the ingredient of uncertainty, can only be treated as expectation: a hope that behavioral commitments made by individuals in the present will be retained later. The economic implication of this idea is that greater or lesser uncertainty affects the "expected" value of commodities "for value is only an expectation of future income and outgo" (Commons, 2003 [1934], 408).

An example can help us clarifying this statement and articulating the facets of reasonableness and futurity in transactions. Commons treated debt (an incorporeal asset) as futurity because its transaction involved two stages in time. The first concerned the closing of the negotiation, held at a point of time (present), which created rights and duties. The second stage of closing the transaction, took place in the future time flow, and concerned the behavioral performance between the parties in relation to the obligations/rights created after the close of the negotiations. In the future time flow, two commitments are created: the performance duty (for example, the seller commits to deliver the product in the future) and the payment duty (where the buyer commits to deliver the money in the future). In the future time flow, debts are negotiable (they are solvable) and this gives them exchange value. However, its current exchange value depends on the expected future exchange value, on which a discount rate applies. In this way, the temporal vector is inverted, and the present value becomes a consequence of the expectation of future value. The effect determines the cause. The future determines the present (Commons, 2003 [1934], 407).

Similarly, space and its traditional notion as physical demarcation of "territory" was questioned by Commons through the concepts of transaction and "going concern". The institutional "space", the territory of norms, laws, habits and customs that were outside the analysis, taken as given, parameters of social life, were

then introduced in the analysis as active elements, participants in the narrative of economic activity played by volitional actors. Nothing more eloquent about this than the term "going concern", which preserves, as we have seen, both the dynamic effect and the blurring of the limits and frontiers of the spatial boundaries of human action, which develops simultaneously in various and different going concerns.

Therefore, human action does not fit within the limits of a priori-attributed rationality, according to the various economic models founded on methodological individualism. Given the characteristics of economic space and time, human conduct is anchored in a multitude of habitual and customary behaviors as well as strategic actions when those heuristic solutions fail. In neither case, however, can rationality produce maximization. It is for this reason that Commons preferred to use the term reasonability, which caught both the cognitive and linguistic limitations of human reason, as well as those derived from uncertainty, that is, the nature of time.

A characterization of what we have analyzed allows us to understand human interactions as a "transactional field". In capitalism, men live in society, condemned by the division of labor and the need for cooperation to interact permanently. This interaction happens within and through the mediation of "going concerns", which calibrate individual behavior. Daily and throughout their lives, individuals are socialized by the "going concerns", deriving from it the different behaviors and actions that they manifest in their daily life. There is no unique behavior (e.g., that of substantive rationality) by which they adapt or change their conditions.

Rather, the movement of individuals through different "going concerns" produces strong constraints, but at the same time open possibilities for different perspectives and perceptions. The transactional field is the dynamic institutional territory in which individuals live, reproduce (and their economic relations) and permanently (re)construct their individuality, for the individual is a different person according to the "going concern" in which he participates or transits. As Commons observed (1970 [1950], 117) "the individual is a system of relations, and changes with the collective action of which he is part and product".

Constitutive and complementary to this view of space and time as futurity is the principle of reasonability. It is one of the most important in Commons' theoretical framework and, although it seems to have derived from observing court procedures, its nature and characteristics are like those required to determine the position value (or speed) of atomic particles. With this statement we want to point to new analogies, beyond those presented in previous works, such as Ramstad (2001), who drew attention to the affinities of its content with the concept of "just price" of St. Thomas Aquinas.

Commons himself had noticed the "relativistic" nature of the concept of reasonableness (Commons, 2003 [1934], 388) since it

> Rejects the earlier methods of elimination of factors as assumptions, or axioms, or things 'taken for granted', and finds its economic concrete

> case in the concept of reasonable value, in a scheme where all things are continually changing by their own forces and relatively to each other.

What aspects of the concept of reasonability are related to those of modern physics?

The first has already been anticipated in a previous item and affirms the absence of any substance or quality present in the goods that can "anchor" objectively and precisely its value. It will lead its interest to the more characteristic forms of wealth of banking capitalism, which increasingly tended to dematerialize, that is, to adopt non-tangible forms. For him, capitalist wealth found at least three forms of expression: as tangible, as incorporeal and as intangible assets. Of the first kind are the forms of wealth that interested classical and neoclassical economists, for by the time this school flourished the most notorious expression of wealth was the accumulation of goods and equipment. The transfer of ownership of such assets occurred at the time the exchange took place, thereby obscuring the problem of property rights. That's why exchange and transactions are distinct things, one subsuming the other. Such assets are tangible, and can be materially identified to machinery, equipment, land/field, commodity inventories and other equivalents

The incorporeal assets are distinguished because their material form is essentially expressed in papers, bonds, stocks, promissory notes. They fundamentally materialize credit and debit relations, rights and duties of the "going concerns" or their physical members. In other words, they express promises of future behavior, of which the fulfilment will crystallize in the future the expectations deposited on the present.

The third type of asset, called intangible, is the most abstract because its existence prescinds event the papers. Intangible are reputation, market and customer access, brand, patents and, most importantly, "goodwill".

The nature of these assets – unanchored in material base – led him to question the valuation process, which could not be objective or dependent on individual preference/utility. It is not the individual reason that establishes the value of things. This is the second important aspect of reasonableness because the valuation process is collective and contains, as its result, the more or less consensual acceptance of its outcome. In fact, in his principle of reasonableness, Commons is stating that valuation of a commodity (its value) is not independent of the conditions under which valuation can be performed, making objectification of value only a practical possibility. This is equivalent to the problem identified by quantum physicists when they began to observe particles: the very activity of observation (of assigning value) interferes with the object of observation (value), making the evaluative relationship an approximate and uncertain process. As it has been said, for him the value of things is not in things as an objective substance or in the individual mind which establishes its value from things. But in the evaluation process conducted by actors involved in the transactions.

The third aspect concerns the valuation process itself, which is mutable and relative because property has dual character (tangible and intangible) that has

value because it is actually the process of transferring (alienating and acquiring), by legal means, the ownership of material, physical or not, from one hand to another. It is not exchange, but transaction, and it is highly variable and independent, though inseparable from the exchange of materials or services.

CONCLUSIONS

This paper has explored the connection between modern physics and Commons' economic theory, which, in our view, has been unexplored by specialized literature. The relations between physics and Commons' work are not simple and straightforward. He was a critic of the economics of the past, which he called "mechanism economics", among other reasons for his claim to establish a science along the lines of Newtonian mechanics. Averse to the monistic pretensions in the methodology of science, he sought to reaffirm the specificity of economics as a social science and its interdisciplinary nature, drawing attention to its volitional character.

Nevertheless, he knew that modern physics was distinct in several and substantial respects from its preceding theory. Admittedly, Commons did not intend to construct his economic theory on the foundations of modern physics, but the progresses in that science did not, however, pass him unnoticed nor indifferent. Far from it, the paper showed that Commons – mainly in his book *Institutional Economics* – was interested in knowing these progresses, mobilizing them to produce analogies and parallels with the worldview and concepts he elaborated for economic science. These features served a twofold purpose: firstly, by demarcating a new view of economics confronting the dominant approach, just as modern physics had done in relation to Newtonian physics, and secondly, by inspiring his approach to economics, now understood as a dynamic field of transactions in the world within which economic time and space are relativized by institutions

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