Newtonian roots of Adam Smith's "Theorem"
Toward a systemic approach to market competition

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1. Introduction

Adam Smith states that the relation between the division of labour and the extent of the market is the crux of his Inquiry into the Nature and Causes of the Wealth of Nations(WN). Nevertheless, this relation has been treated by modern authors simply as a deterministic association between the increase in job fragmentation and the expansion in production volume. Moreover, this "theorem" is considered a final version of an already rich tradition of comments on the division of labour (1) to the extent that Schumpeter can affirm that Smith offers nothing new and is an ecletic,who moves around from astronomy to economics (2).

This approach, however, does not take into account the newtonian roots of Smith's research programme and undervalues the philosophical context in which the Scottish philosopher was working.

Neglecting the newtonian roots of Smith's Theorem leads to a distortion of the concept of "market" and a significant reduction of the "competiton" element.

This article seeks to show that the final aim of Adam Smith's scientific research programme was to identify a law of rational mechanics for human interaction, one which would have an internal consistency similar to that of Newton's law.

Smith had sketched out this "law" in the Early Draft (ED), explained it in the Lectures on Jurispudence (LJ) and gave it a precise formulation the WN.

"As it is the power of exchanging that gives occasion to the division of labour, so the extent of this division must always be limited by the extent of that power, or in other words, by the extent of the market" (3).

2. The relevance of Newton's discoveries

In the mid-XVIII Century, Scottish universities were, like all the European universities, attempting to rebuild the destabilised foundation of knowledge (4). On the one

hand, the connection between physics and metaphysics, that had governed scientific knowledge for centuries, had been definitively broken by Newton's discoveries. On the other, the connection between ethics and politics that had hitherto regulated human behaviour, had been destabilized by Hobbes and Locke's dispute over the conflictual interaction of subjects surviving together in a collective group. The two areas came together in the debate on the methodology of science and especially on the role to be attributed to empirical analysis as opposed to syllogistic deduction.

Smith was working within this context, beginning with an analysis of newtonian mechanics, and was working through all the philosophical disputes of his time, in order to arrive at an overall view of the nature and causes of motion and forces (that is, the mechanics) of human interaction.

The Principles which lead and direct Philosophical Enquiries, illustrated by the History of Astronomy (HA) was written during the first period of his teaching at Glasgow University. It is a sort of set of lecture notes, comparing the Cartesian Vortex Theory to the Newtonian Theory.

The Note by the Editors, who published these notes after the death of the author, is explicit:

"(This essay) must be viewed not as a History or Account of Sir Isaac Newton's Astronomy, but chiefly as an additional illustration of these Principles in the Human Mind, which Mr. Smith has pointed out to be the Universal Motives of Philosophical Researches" (5).

Newton's Astronomy had indeed changed the Universal motives of philosophical research (6).

Before Newton,the "normal science" in physics was the Cartesian Vortex Theory, according to which physical motion generateed by the Divinity was transmitted through an infinite universe of atomistic particles. This perpetual motion forces all particles into a linear movement, causing a continuous revolving friction between them and moulding them into bodies with different internal consistencies, forming earth, water, fire and air, created and maintained through this perpetual vortex (7).

Following the alternative tradition (that of Copernicus and Galileo) opposed to the "normal science", Newton inquired into celestial mechanics, identifying a type of motion based on the power of interactive forces expressed by various bodies on the basis of their specific masses.

Refusing to search for an original cause of the motion (hypothesis non fingo), Newton founded his theory of universal mechanics in the "competition" of forces. The word "competition" derives from Latin "cum-peto", meaning a conflictual, collective tension, motivated by the same reason.

In the second edition of Newton's Opticks , we find at the Questio 31:

"How this attraction may be performed I do not here consider. What I call attraction may be performed by some other means unknown to me. I use that word here to signify only in general any force by which Bodies tend towards one

other, whatsoever be the cause. For we must learn from the Phaenomena of Nature what bodies attract one other, and what are the Laws and Properties of the Attraction, before we inquire into the Cause by which Attraction is performed" (8).

In Newton's view, every single particle - as Koyré writes - participates in the construction of the universal system (sistema mundi), so that Atomism is not denied, but particles are considered only as forming bodies, having a power of attraction in terms of their internal organization of these specific particles (9).

The fundamental newtonian vision - writes Cassirer - extends our physical knowledge simply in terms of the relations between phenomena, not with regard to their unknown causes; this is clearly expressed in the concept of "force" present in the scientific literature of that time. The problem of attraction became both the focal point of the dispute on causality and the actual example used in its redefinition (10).

Smith, in his lecture notes, writes:
"But of all the attempts of the the Newtonian Philosophy, that which would appear to be the most above the reach of the human reason and experience, is the attempt to compute the weights and densities of the Sun, and of the Several Planets. An attempt, however, which was indispensably necessary to complete the coherence of the Newtonian system. The power of attraction which, according to the theory of

gravity, each body possesses, is in proportion to the quantity of matter contained in that body" (11).

Smith links the power of attraction to the internal structure of the bodies and explicitly identifies this point as the crucial focus of the newtonian view. The final aim of Smith, pupil and teacher of Moral Philosophy, is to formulate a general law of human interaction with the same "firmness and solidity" as that of Newtonian Astronomy.

3. The Methodology of the New Science

Smith's "The Universal Motives of Philosophical Researchs" was a search for a science of nature not founded on metaphysical deductionism and useful in explaining human behaviour as a part of a social universe in motion.

Scholastic heritage regarded the universe as a living organism, in which relations between individual subjects were determined (and therefore fixed) by their relative distance with respect to a centre, and it was this centre that was pre-determined rather than the universe itself. By extending this global vision to the sub-systems, every human grouping was depicted in terms of this universe: from family, to local courts, to the empire (12).

In this view, the recording of empirical date was considered of use only in connecting particular evidence to

the general explanations deduced by metaphysical principles.

Smith recalls these problems in the History of the Ancient Logics and Metaphysics and History of the Ancient Physics, notes published with the History of Astronomy in the Essay on Philosophical Subjects (EPS).

The newtonian revolution established a vision of the universe as a systemic machine, where the single parts were relevant not with respect to a centre, but to all the power relations among all the interactive subjects. Mechanics, emerged, the science inquiring into the nature and the causes of motion as a result of interacting forces, emerged and "experience of facts" became the way to prove evidence already forecast by rational conjecture (13).

Francis Bacon in his Novum Organon in 1621, had proposed the replacement of the traditional syllogistic deduction with an experimental logic. Inductive empirism had to lead the search into the nature of things by considering the forms of things as the essence of things themselves.

Hobbes replied reproposing the role of science as aimed at identifying universal notions, through "names", which were not derived by experiments but which recalled experiences. A considerable emphasis on language emerged as the relevant means to convert particular experiences into universal notions.

An example of these universal notions is Hobbes' concept of "motion" as consisting of opposing forces. The same principle - motion as a result of the composition

of opposing, conflicting forces – was being expressed by Galileo.

Hobbes argued that this principle of motion governs human beings; pleasure and pain, desire and aversion are equal, but opposite forces, moving individuals. Life is a result of these continuous forces and is based on individual self-interest,which acts as a law of self-identification and therefore of survival in the collective interaction expressed in civil society. The Social Universe is the effective result of the interaction of these individual particles, moved by contrasting original forces, each one identifiable by their particular self-interest. This is the real core of the idea of self-interest as "soul of modern economic man" (14).

Hobbes argued that this motion is potentially explosive, due to the tension between the individual particles, so that it is necessary to create a sovereignity, which defends collective self-interest against individual self-interest,which represents the whole against the parts.

Locke argued that ideas were original and considered them a result of experiences. They are based on sensation (on external senses) and reflection (on internal senses). Simple ideas are compounded into complex concepts and relations. Names and languages have the crucial function of transmitting ideas (Smith approached these problems in the various essays on external senses, arts, languages).

Moreover, Locke argued that nominal and real forms

coincided only in the mathematical and moral sciences. Therefore "justice", like "triangle" is not a mere nominal expression, but a model of scientific synthesis, used to give an order to individual things. In this sense, identifying the "moral sentiment of self-interest" entails finding the general rule of universal motion. That is, if individual self-interest is the survival principle (derived by opposing forces) for the single member of the group, the group as a whole has a collective self-interest, expressed in the collective motion.

From these principles, the success of Lockism merged into the general enthusiasm for newtonism. According to Koyrè's reasoning, a view of human interaction was derived from the secular union of lockism and newtonism, a view whose protype was the mechanical determinism of the celestial, physical order (15).

This view was one fashionable in Smith's time (and was to re-emerge as dominant after Smith), but Smith and the Scottish School received it through the teaching of Hume. It was therefore mediated by Hume's skepticism, one which refused to accept any form of determinism (16).

4. Smith's Philosophical Envirnement

For the Scottish academic circle, too, the problem of how to extend newtonism to the humanistic disciplines was considered the overriding aim of the generation (17).

Newton's Regolae Philosophandi with its emphasis on the interaction between rational deduction and experimental induction, was being accepted as the model of scientific discovery. The desire to give new foundations to science, present in British culture since Bacon, was being substantially satisfied and the "power of attraction" was being assumed as a sort of general rule in accounting for any opposing forces.

Since Hobbes, methodological attention had been paid to the perception of facts and, through the composition of simple ideas, the identifying of general laws. Smith approached these problems of method under the strong influence of David Hume (18).

Hume had considered ideas as images of perceptions. Between ideas and impression there is a sort of attraction similar to the physical power of attraction. Ideas are connected one to the other to form complex representations, but the tendency to recall past representations for present impressions establishes deterministic cause-effect relations that are not demonstrable by reason.

The supposition that the future resembles the past is unfounded, stated Hume, who would not accept any

deterministic extensions of newtonian mechanics to human interaction.

Smith studied these methodological problems, inquiring into the the formation of language in order to to obtain a theory which could be used as an intellectual tool of scientific discovery.

He had written in the HA:

"Systems in many respects resemble machines. A machine is a little system, created to perform, as well as to connect together, in reality, those different movements and effects which the artist has occasion for. A system is an imaginary machine invented to connect together in any fancy those different movements and effects which are already in reality performed ..... The first system, in the same manner, is always the most complex and a particular connecting chain, or principle, is generally thought necessary to unite every two seemingly disjointed appearances: but it often happens, that one great connecting principle is afterwards found to be sufficient to bind together all the discordant phaenomena that occur in a whole species of things" (19).

These concepts were reproposed in the Formation of Languages, where the process of theory formation is constitued by the contribution of an intellectual machinery which is at the beginning complicated and inefficient, but, through subseqent refining becomes, eventually, simple and efficient on the basis of a single principle, connecting opposing perceptions (20).

In Newton's system, the power of attraction is that connecting principle which is sufficient to bind together the discordant phenomena. Following the same line of reasoning, Hutcheson, Smith's master and predecessor in the chair of Moral philosophy at Glasgow, had written in A System of Moral Philosophy:

"Self-love is really as necessary to the Good of the Whole, as that Attraction which causes the Cohesion of the Parts, is as necessary to the regular State of the Whole, as Gravitation" (21).

Hutcheson established this "machine", by extending the power of attraction to the self-interest that he called self-love (22).

Smith uses this "machine" and in the Theory of Moral Sentiments (TMS) he recalls Hobbes' contrast between desire and aversion, in order to define the equal, but opposing forces determining motion.

In the TMS analysis, dated 1795, the concept of "sympathy" emerged. This would seem to be in contrast to the use of the term "self-interest" in the LJ of the 1762-3. However, this contrast, between "sympathy" and "self-interest" is not an analytical inconsistency. It is rather the actual motor of the social mechanism, according to this approach which considers social motion as a result of conflicting, but equal forces (23).

In Smith's Theory, the term "Sympathy", like "self-interest", was the fruit of the long philosophical

debate over newtonianism.

Writing on "sympathy", Smith certainly had in mind the dispute between the newtonian and the cartesian scholars, but also, more particularly, the English edition of the Physica of the cartesian Jacques Rohault, introduced by the newtonian Samuel Clark (first published in 1697, but reprinted several times). Rohault would not accept either term, Attraction or Sympathy, considering them as a synonymous, while on the other side Clark understood the two terms as indicating the same action, both governing collective motion (24).

Self-interest and sympathy can be considered in the same way as the centrifugal forces which are the expression of the same power of attraction, as a general rule which can explain the rational mechanics of the social universe. But the core of the newtonian principle clearly stated that power relations among bodies are related to the"quantity of matter contained in that body" (25).

Thus, at beginning of the 1760, Smith faced the crucial problem of what functions as quantity and density of matter, constituing those individual bodies which conflict in the social universe. Further, he had to establish which kind of social motion has to be considered in order to understand those complex tensions, identified by Hobbes and Locke as the engine of civil life.

5. The power of exchange and the division of labour

Starting from these positions, Smith proceeded to analyse the system of wealth production. Several authors had written impressive analyses of the increasing wealth of the British nation. Smith assumes the "wealth of nations" to be the motion of the human "universe" and proposes to inquire into the mechanics of that motion. In the TMS (IV.I.1.10) he had asserted that wealth serves to rouse and keep in "continual motion the industry of mankind". Thus, he aimed to inquire into its causes and nature and, especially into the working of the principle of the power of attractions, using a "newtonian" approach. Nevertheless, he followed Hume in being ready to admire and receive evident sensations, but firm in rejecting any mechanicistic determinism.

Smith developed the core of the theory in his Glasgow period. The intellectual debt to the French physiocrats, which he recognizes, is essentially the reconfirmation of the need for a simple intellectual machine to give a systemic order to the complex sensation of the social universe (26).

Smith opens his treatise with "admiration" that the greatest improvements in the productive powers of labour seem to be effects of the division of labour.

At that time, this was a widely-accepted argument, from the early Advantages of East India Trade to Mandeville's Fable of Bees.

In accordance with the empirical approach of British phylosophers, Smith affirms that "the effects of the division of labour in the general business of society will be more easily understood by considering in what manner it operates in some particular manufactures" (27).

Understanding is the principal aim and it is reached by moving from empirical evidence to the whole, because micro- and macro-systems are governed by the same rule.
In the WN, Smith offers a sketchy version of the production cycle scheme, attributing stages of production to single workers (28). However by comparing the various versions of this analysis from the two fragments of Glasgow notes, through the ED to the WN, it seems evident that he considers the production cycle as articulated in the stages of production and that these stages are organized internally in operations managed by one or more workers.

After admiration for the positive effects of division of labour, the second chapter examines the human attitude to exchanging, which is considered a necessary consequence of the faculties of reason and speech, and therefore not belonging to this enquiry and thus only postulated. In fact, the enquiry into the nature of these faculties of human reason and speech was the research program followed by the author from the HA to the Formation of Language; "reason" and "speech" are the foundations of perceptions and ideas which work together in that imaginary machine, the "system", which models reality to permit communication and interaction

among individuals inside a society (29).

In this second chapter, clearly following the Glasgow Lectures, the self-interest principle is highlighted by the aphorism of the butcher, who exchanges his production not out of benevolence but out of self-interest. In WN, I, II, 2, 27, Smith refers to self-interest, using the term "self-love", as Hutcheson did.

This assertion, recalling the view already expressed in the TMS, is not yet a law of social motion.

This law is finally stated at the beginning of the third chapter. These three chapters are the oldest and best-established part of the Smith's work. The arguments treated had already been presented in the E.D. and in the LJ (A) and LJ (B) and some sections remain almost unaltered apart from the statement on the relations between the division of labour and the extent of the market. Both the two terms had been mentioned but not fully eklaborated in the earlier works (30).

In the early text of E.D. Smith considers the advantages of the separation but does not link it to the extent of the market. In the LJ (A), dated 1762-3 he underlines that "the division of labour is greater or less according to the market". In the LJ (B) dated 1766, he refines this concept: "the division of labour must always be proportioned to the extent of commerce". The two fragments on the division of labour,identified as EA and EB present refined versions and EA introduces the concept of the power

of exchanging (31).

Smith's process of refinment implemented his idea of "theory as a system" given by an imaginary machine "created to connect together in the fancy those different movements and effects, which are already in reality performed". Thus he wrote in his early epistemological treatises on Astronomy and Languages, that he had created a very conceptually poor, but complicated machine, that, step by step, he enriched conceptually but simplified in terms of its formal relations. However, he needed a law of association operating the same "mechanism" role, as that performed by the power of attraction in the newtonian system.

Finally he formulated as in WN, I, II, 1, 31:
"As it is the power of exchanging, that gives occasion to the division of labour, so the extent of this division must always be limited by the extent of that power, or, in other words, by the extent of the market".

The power of exchanging is not a product of human wisdom, but is the law of association of self-interest, conceived of as self-love, that is, the seeing of one's own existence by the individual subject as a part of general ensemble. It is a power of attraction/repulsion acting in reality, but is also seen as key to the imaginary machine of the theoretical system, so that Smith, following the newtonian method, does not formulate any hypothesis about the original determinant.

The interaction of forces "gives occasion" to the

division of labour and, therefore there can be no analysis of the division of labour, outside of this scheme of interactive motion.

Smith considers division of labour at three levels: in the economy, in the production cycle and in operations.

The first level is illustrated by the well-known example of division of labour within a community: it is the case of the butcher of a small Scottish village who has to manage a bakery in order to maintain himself at full-capacity level (a constant occupation) (32).

The second level of division of labour is given by the various subsequent stages of production, making up a production cycle, such as bread production (mixing flour with water, kneading and baking in an oven), which has an articulation different from the economic activity of the butcher (killing animals, cutting up into parts, selling slices) (33).

In order to maintain a continuous production flow through the cycle, the subsequent stages have to be balanced, because they need different timing to be realized. Thus, the third level is the operational level inside the single stage of production, specifying how many workers have to be activated in the same single operation of a functionally interactive series of operations (e.g. the blower and the gatherer in the blowing stage of glass production).

This division of labour permits the development of a

capacity to invent, and, moreover, it also is possible to introduce innovation in the organization of operations inside a stage (a new way to dye clothes), inside the cycle (to dye finished fabric, instead of colouring yarn, in order to sell clothes which are always of the fashionable colour), or in the economy (by introducing new products) (34).

Adam Smith already notes that these kinds of innovation are conserved as "secrets" by the manufacturer, who "may, with a good management, enjoy the advantage of his discovery as he lives, and even leavae it as as a legacy to his posterity" (35).

Smith points out frequently in the WN that it is possible enter new markets and to try to maintain the advantage of a temporary monopoly, by imposing barriers to the potential rivals (36).

However, it is possible to influence the "organization" of production and this is not neutral in term of its effective interaction with the other subjects, competing (that is, having common, but conflictual tendencies) in the same "industry of mankind".

In this sense, division of labour in smithian systems plays the same role as that played by "mass" in a newtonian system (that is the quantity of matter, in term of its density, contained in a single body, interacting in the system). In this case, the "mass" can be assumed as the quantity of work (this was pointed out many times in various versions on the division of labour) in terms of its density,

that is the internal structuring of this quantity of matter.

The crucial difference of the newtonian "mass", and of course, the real focus of Smith's extension of physical mechanics to social mechanics, is that the competitive mass, given by a specific division of labour is a result itself of management decision, because of the possibility of innovating own particular division of labour and of obstructing the general diffusion of the innovation.

Following Smith from his early analysis and positioning him in his intellectual environment, it seems reasonable to offer a connection between the "power of exchanging" and the "division of labour" in terms of attempts at newtonian mechanism of social motion.

The Hume scholar had to avoid any mechanicistic, that is deterministic, assumption of this connection, and thus he linked the two terms, considering that "... it is the power of exchanging that gives occasion to the division of labour".

The power of exchanging is a general law of association, but Smith uses the term "to give occasion" to strengthen the particular nature of this connection, acknowledging his intellectual debt to Hume.

The subsequent problem was to reverse the relation, to explain the internal connection between quantity and density of work and power of exchanging.

6. "Extent of the market" and "Extent of that power"

The term "extent" is also derived from the cartesian-newtonian dispute. According to the tradition which runs from Aristotle to the Cartesian Physic, the entire universe was completely filled with matter, and the extent of this matter was considered the extent of the universe itself. The cartesian Rahoult stated that extent is the essence of matter: because of the non existence of vacuum space, spatial motion is derived from the continuous activity of atomistic matter, which he considered caused by exogenous Divinity (37).

The newtonian Clark replied that matter and space are not consubstantial: space is infinite (an attribute of the Divinity), matter is finite, that is limited, having an "extensio solida". For Clark, "vacuum" did not mean "nihil", nothing: vacuum space is the place of the extent of the forces, expressed by the "extensis solida" of the bodies.

Therefore, this extent of matter, that is not just particles, but organized particles, is limited (that is, restricted) by the power of attraction, expressed by the interaction of the bodies themselves.

Newton insisted on this connection between "extensio" and "attractio", that had generated doubts and misunderstanding among his friends as well: Cote's famous letter to Newton (18 March 1712/1713) shows that the reciprocal effects of attraction were not clear enough:

"Suppose two globes A & B placed at a distance from each other upon a table, & that whilst A remains at rest B is moved towards it by an Invisible Hand. A by-stander who observes this motion but not the cause of it, will say that B does certainly tend to the centre of A, & thereupon he may call the force of the invisible Hand and the centripetal force of B, or the Attraction of A since the effect appears the same as if it did truly proceed from a proper & real Attraction of A" (38).

This image of an "invisible hand" became a recurrent analogy to explain a motion, whose cause was out of experimental observation.

Newton answers recalling the third law of motion, formulated in his Principia (that is, to every action corresponds an equal, but contrary action) and referring to the Scholium, where he stressed that the actions were proportional to their motivating forces (as the second law formulated), but that these were directly linked to the quantity of matter and inversely linked to the distance (39).

Newton introduced in the forthcoming English edition of his Principles some remarks, stressing the reciprocal character of attraction.

To this example of the Invisible Hand, an exogenous force pushing one globe towards another, inducing its linear movement, Newton reacted by reaffirming that attraction is a real power, whose original cause is unknown, but whose

resulting motion (non-linear) can be empirically ascertained.

In other words, Newton stressed that the power of attraction was the law of association of a system governing bodies, whose movements are understandable only as an expression of the systemic motion constituted by the interaction of forces which are "competitive" but which have different powers according to their body masses.

Smith had stressed this aspect in his early notes on Newtonian Astronomy, underlining the crucial connection between the power of attraction and the quantity of matter and the indispensable necessity to compute the weights and the density of the quantity of matter contained in the body (40).

"That the extent of this division must always be limited by the extent of that power" was concordant with Newton's view, connecting a) the "structural" essence of matter considered as definitely limited, that is, restricted in its motion, to b) the power of attraction considered, that is, as the interaction of the competitive (equal, but opposite, therefore conflictual) forces, expressed by the other bodies constituting the system, according to their internal structure.

Smith concludes by defining the extent of "that" power as the "extent of the market". Nevertheless, Smith is not merely a follower, an epigone, of newtonian natural phylosophy: the extension of newtonian physics to social

organization, involved introducing the human qualities of reason and speech that - from the decline of the Scholastics to Hume - has been considered as the core of moral philosophy. Smith, a follower of Hume, asserted the possibility of acting on the "mass", by introducing secrets of manufacturing, changing the relative powers among competitors. Moreover, he proposed simulatory exercises on the relative reaction to an external event.

"A publik mourning raises the price of black cloth (with which the market is almost always under-stocked upon such occasions) and augments the profits of the merchants who possess any considerable quantity of it. It has no effect upon the wages of the weavers. The market is understocked with commodities, not with labour; with work done, not with work to be done. It raises the wages of journeymen taylors. The market is here under-stocked with labour. There is an effectual demand for "more" labour, for more work to be done than can be bad. It sinks the price of coloured silks and cloths, and thereby reduces the profits of the merchants who have any considerable quantity of them upon hand. It sinks too the wages of the workmen employed in preparing such commodities; for which all demand is stopped for six months, perhaps for a twelvemonth. The market is here over-stocked both with commodities and with labour" (41).

He considers that different reaction times exist, according to the internal organization of production and

suggests that different "work to be done" (that is different capabilities of work) can produce a differentiated quality of work done. In other words, he assumes the effectiveness of the extent of relative powers, derived by the decision to act on one's own division of labour, that is, the "managed" connection between the "organized" "work to be done" and the resulting "work done".

Moreover, he brings into the analysis another factor: that the universe of the exchanging of specific commodities is finite, because limited by an effectual demand. He writes:

" The market price of every particular commodity is regulated by the proportion between the quantity which is actually brought to market, and the demand of those who are willing to pay the natural price of the commodity, or the whole value of the rent, labour, and profit, which must be paid in order to bring it thither. Such people may be called the effectual demanders, and their demand the effectual demand; since it may be sufficient to effectuate the bringing of the commodity to market. It is different from the absolute demand. A very poor man may be said in some sense to have a demand for a coach and six; he might like to have it; but his demand is not an effectual demand, as the commodity can never be brought to market in order to satisfy it" (42).

Further, he points out that "natural causes" or "regulations of police" can "keep the market price a good

deal above the natural price" (43). We know also that by acting on the division of labour, to reduce the natural price, it is possible to enlarge the effectual demand; by changing industrial organization, it was possible to move from only a few pins to thousands per day per worker, to the sale of cheaper pins and therefore to increase the number of "effectual demanders".

As the pin manufacturers do not introduce the new methods at the same time, the innovator, by changing his own division of labour, puts pressure on the extent of the market, both extending the limits, and altering the relation of powers. The resulting motion has a "causality", but - according to Hume - this means an historic result of human systemic interaction, and not a predetermined atomistic neoclassicism.

In this sense, the Invisible Hand, that Smith introduces in TMS and in WN, can not be thought of as a metaphysical cause of human motion, but as the result of collective human interaction, not of a single or collective human project (44).

7. Market Interaction and the Newtonian Paradigm

Analysing the Newton influence of on scientific standards, Lakatos underlines that Newton undermined the

cartesian concept of 'proof' and proposed a method that moulded together -according to the scientific standards of his time- poor deductions and partial inductions. But the final result has been an extraordinarily powerful instrument of knowledge (45). In practice he used a strong scientific method but he offered a very weak methodology of science. The incredible success of Newton's scientific achievement generated a stream of confused and inconsistent theories of "newtonian" methodology, aimed at spreading the new scientific paradigm to all scientific fields (46).

According to Lakatos' reasoning: "One is tempted to say that Newton created two cultures; one which developed his method, another which developed his methodology" .

The newtonian paradigm superseded the cartesian paradigm, but it was based on the vulgarized and standardized methodology of science derived from Newton's method itself.

"The worst part of Newton's theory of method - wrote Lakatos - was set up as a rulebook for the underdeveloped disciplines and especially for the social sciences. Newtonianism, preached by semiliterates, like John Stuart Mill, who never read Newton, exerted a powerful influence in keeping underdeveloped disciplines underdeveloped" (47).

The Newtonian paradigm in the social sciences merged lockism into the vision of deterministic order derived from the standardization of Newton's discoveries.

The first result was the increasing success of a normal

science based on "empirical observation of sensible things", connected by simple laws of association/attraction.

The second result was an atomistic vision of society, where subjects are unweighted particles which in a perfect universe should be perpetually moving in harmony.

The final result has been a discipline, based on a poor empirism and on a strong ideology of social atomism, perfectly stable because of the uniformity of the attributes of subjects and the symmetry the possible movements of subject.

"Equilibrium" lost its character as the effective result of a continuous conflict among differentiated, competing forces, and has become an "a priori" condition to describe the social and economic universe.

Contrasting evidence such as the strengthening of monopolies and the emerging class struggle had to be swiftly denied or considered as temporary accidents to be rapidly inserted into the ordinary cause of the harmonic universe, presented by the current "normal science", the victorious paradigm.

Only a few authors tried to follow Newton' s actual method. Lakatos refers to Smith himself, Whewell and Leroy as the philosophers that have been substantially involved in this process of filling the gap between Newton's method of scientific discovery and the newtonian methodology of science.

Smith was working when this gap was not yet fully

apparent. He realized that systems are immaginary machines used to model reality, and he attempted to reach a model of human interaction and of the peculiarity of human nature. He identified this peculiarity both in the capacity to exchange and to produce in order to exchange and in the ability to invent, to learn and to organize this activity of production and exchange.

He did not formulate hypothesis on the unknown original cause of this social motion, but considered the actual motion and the infinite, relative and immediate states of equilibrium as the result of competing forces, that the single producer can alter,but not determine.

The core of the Smith's scientific program (which we can identify in the "motion theorem" and in the first three chapters of the WN corroborated by chapter VII on natural and market prices) was established according to Newton's method, in the light of certain misgivings derived from Hume.

Nevertherless, the protective belt - using a Lakatosian approach to the methodology of science - that had to strengthen the core, had often been influenced by the emerging "newtonian paradigm". The Wealth of Nations was written at the time of the emergence of this scientific paradigm, but, more importantly, it was read when "newtonianism" had become the the mechanistic orthodoxy of the social sciences until the "modernization" offered by John Stuart Mill. Thus, the massive diffusion of Smith's

research programme has been accomplished by vulgarizers – using Lakatos's expression –, who could not however follow his research programme, but could only scan his slogans.

The principal concepts, that suffered most by this standardization of Smith's programme into the emerging paradigm of science, were the basic ideas of "market", "competition" and "equilibrium", which have been sterilized and robbed of their systemic content of equal, but conflicting forces, of their essential nature as the conflict of powers.

Footnotes

(1) Although many authors argue that Smith's Theorem can not be considered a formal "theorem", we prefer to identify it as "Smith's Theorem", according to the long tradition, which lasted until Young (1928) and Stigler (1951).

(2) Schumpeter refers to the division of labour as "this eternal commonplace of economics" (1954,p.56) and he considers that Smith's masterpiece contained "no really novel ideas" (1954, p.185).

(3) The Wealth of Nations (1976), book I, chapter III, paragraph 1, p.31 (WN,I,III,1,31).

(4) Analyses of Scottish Enlightenment can be found in Lecaldano (1985), Olson (1975), Skinner (1965), Skinner (1974), Raphael (1969).

(5) HA,IV,76 published in the EPS,p.105.

(6) The impact of the newtonian methodology on scientific activity is described in I.B.Cohen (1980), Koyre' (1957),Koyre' (1965), Cassirer (1957), Lakatos (1978).

(7) See "Newton and Descartes" in Koyre' (1965), pp.53-200. Recent biographies of Newton are Westfall (1980) and Christianson (1984); an exhaustive bibliography on Newton and Newtonians can be found in Wellis (1977).

(8) Optice (1719), pp.380-381; Opticks (1717), p.351.

(9) Koyre' (1965), p.16

(10) Cassirer (1957), p.462

(11) HA,IV,75,103

(12) On the Scholastic vision see Grant (1977); on the Enlightenment as "a Rise of Modern Paganism", see Gay (1969),vol.II.

(13) Westfall (1977), I.B.Cohen (1985) are Histories of Mechanics.

(14) Myers (1983),pp.11-27.

(15) Koyre' (1965), pp. 24-25, see also Rogers (1978)

(16) The relationship between Smith and Hume analysed in W.P. Wightman (1977), pp. 44-67.

(17) Koyre'(1965), p. 261

(18) Dougal Stewart refers to the "acquaintance" existing from 1752 between Hume and Smith; Stewart (1793), in EPS, p. 272. On the cultural formation of Smith, see Raphael (1985), Foley(1976)

(19) HA, IV, 19, 66

(20) Formation of Language, 41, in Lectures on Rhetoric and Belles Lettres, p. 248.

(21) Hutcheson (1755) in Selby-Bigge (1965),p.164, also quoted in Myers (1983),p.69.

(22) Myers analyses in depth the authors who worked on the extension of newtonian ideas to moral sciences,pp.65-75.

(23) TMS,I,I,1,13; Wilson(1976), p.73 analyses this relationship between sympathy and self-interest.

(23) The Rohault-Clark dispute is analysed in Koyre' (1965),pp.170-172

(25) Lakatos (1978),p.211

(26) Dobb (1973) stress this point.

(27) WN,I,1,2,14

(28) The example was already familiar, occurring both in the French Enciclopedie and in the Chamber's Cyclopedia.

(29) See Cremaschi (1984), chapters 1 e 2.

(30) A survey of the various versions of Smith's analysis on the division of labour can be found in Meek-Skinner (1973).

(31) See LJ (A),VI,30,30 in LJ,p.342; LJ (B),214 in LJ,p.490; ED,7 in LJ,p.565; FA,1 in LJ,p.582.

(32) WN,I,III,2,3i

(33) WN,I,I,3,14-15

(34) On the innovation activity in relation to the division of labour, see Rosenberg (1965)

(35) WN,I,VII,22,27

(36) On monopoly, see especially WN,I,VII, 26-27, 78-79; WN,I,XI, 5,163-164

(37) Koyre' (1965),pp.164-184,

(38) Cote's letter can be found in Turnbull and Scott (1959-1977), V, p. 392; see also Edleston (1969);the letter analysed in Koyre'(1965), pp.273-281.

(39) See I.B. Cohen (1971); Worland (1976) considers the analogy with respect to the theory of value; nevertheless, the main subject of A. Smith's research activity was for many years focused on the division of labour and the extent of the market.

(40) HA,IV,75,103

(41) WN,I,VII,19,76-77; on this point see Bianchi (1984)

(42) WN,I,VII,8-9,73-74

(43) WN,I,VII,20,79

(44) Smith refers to the Invisible Hand in TMS, IV,I,1,10 and WN,IV,II,9,456.

(45) Lakatos (1978),p.220

(46) On the usage of the term "paradigm", see of course Kuhn (1970),and the dispute with "lakatosians", in Lakatos-Musgrave (1970), and Latsis (1976); see also Blaug (1980).

(47) Lakatos (1978), p.221

References

ADAM SMITH The Glasgow Edition of the Works and Correspondence of Adam Smith, Claredon Press, Oxford, 1976-1980; The theory of Moral Sentiments, (TMS), edited by A.L. Macfie and D:D: Raphael; An Inquiry into the Nature and Causes of the Wealth of Nations, edited by R.H. Campbell and A. Skinner, textual by W.B. Todd; Essays on Philosophical Subjects (EPS), edited by W.P.D. Wightman; Lectures on Rhetorie and Belles Lettres (LRBT), edited by J.C. Bryce; Lectures on Jurisprudence (LJ), edited by R.L. Meek, D.D. Raphael, P.G. Stein; Correspondence of Adam Smith, edited by B.C. Mossner, I.S. Ross.

P. BIANCHI (1984), Divisione del lavoro e ristrutturazione industriale, Il Mulino, Bologna.

M. BLAUG (1980), The methology of Economics, Cambridge U.P., Cambridge.

E. CASSIRER (1952), Das Erkenntnisproblem in dex Philosophie und Wissenschaft der neuren Zeit. W.Kohlammer,Berlin (1910).

E. CHISTIANSON (1984), In the Presence of the Creator, Isaac Newton and His Times, New York, The Free Press

I. BERNARD COHEN (1971), Introduction to Newton's 'Principia', Cambridge Mass., Harvard U.P.

I.B.COHEN (1980), The Newtonian Revolution, Cambridge, Cambridge U.P.

I.B.COHEH (1985), The Birth of a New Physics,W.W.Norton,New York

S. CREMASCHI (1984), Il sistema della ricchezza, F. Angeli, Milano.

H.M. DOBB (1973), Theories of Value and Distribution since Adam Smith - Ideology and Economic Theory, Cambridge U.P., Cambridge.

J. EDLESTON (editor) (1969), Correspondence of Sir Isaac Newton and Professor Cotes, Frank Cass, London (1850).

V. FOLEY (1976), The Social Physics of Adam Smith, Purdue University Press, West Lafayette, Indiana.

P. GAY (1977), The Enlightnment. An Interpretation. Vol. I, Vol.II, London Norton e Co., New York (1967)

E. GRANT (1977), Physical Science in the Middle Age, Cambridge U.P. ,Cambridge.

F. HUTCHESON (1755), A System of Moral Philosophy, in L.A.Selby-Bigge (ed.), British Moralist ,2 vols, Dover Publications,New York,1965

A. KOYRE' (1957), From the closed World To The Infinite Universe, The Johns Hopkins Press, Baltimore.

A. KOYRE'(1965), Newtonian Studies, Harvard U.P., Cambridge (Mass).

T.S. KUHN (1970), The Structure of Scientific Revolution, Chicago, University of Chicago Press, 2nd Ed.

I. LAKATOS, A. MUSGRAVE (editors) (1970), Criticism and the growth of knowledge, Cambridge University Press.

J. LAKATOS (1978), Newton's Effects on Scientific Standars, in The Methodology of Scientific Research Programmes, edited by J. Worrall and G. Currie, Cambridge U.P., Cambridge (U.K.).

S.J. LATSIS (editor) (1976), Method and Appraisal in Economics, Cambridge, Cambridge University Press.

E.LECALDANO (1985), L'ILLUMINISMO INGLESE, Loesher,Torino

B. de MANDEVILLE (1714), An Enquiry into the Origin of Moral Virtue, in The Fable of the Bees on Private Vices, Publick Benefits, edited by F.B. Kaye Oxford University Press, Oxford, 1924, 1966.

R.L. MEEK (1971), Smith, Turgot and the "Four Stages" Theory, in History of Political Economics, p. 9-27.

R.L. MEEK, and A.S. SKINNER (1973), The Development of Adam Smith's Ideas on Division of Labour, Economic Journal, LXXXIII, 34, p. 561.

M.L. MYERS (1983), The Soul of Modern Economic Man. Ideas of Self-Interest, Thomas Hobbes to Adam Smith, The University of Chicago Press, Chicago and London.

I. NEWTON (1687), Philosophia Naturalis Principia Naturalis, Londini, Jussu Societatis Regiae ac Typis Josephi Streater

I.NEWTON (1934),Mathematical Principles of Natural Philosophy, translated by A.Motte (1729), revised by F.Cajori,University of California U.P.,Berkeley.

I. NEWTON (1719), Optice sive de Reflexionibus, Refractionibus, Inflexionibus et Coloribus Lucis. Libres tres: Latine reddidit S.Clark. editio secunda, Londini, Gul. et Joh. Innys.

I. NEWTON (1952), Opticks or a Treatise of the Reflections, Refractions, Inflections and Colours of Light (1704; second edition 1717), reprinted with foreword by A.Einstein, introduction by E. Whittaker, preface by I.B.Cohen, analytical table of contents by D.H.D. Roller, Dover Publication, New York, revised printing, 1982.

D.P. O'BRIEN (1975), The Classical Economist, Claredon Press, Oxford.

R. OLSON (1975), Scottish Philosophy and British Physics, Princeton U.P., Princeton .

D.D. RAPHAEL, (editor) (1969), British Moralists (1650-1800), Oxford University Press, Oxford.

D.D. RAPHAEL (1985), Adam Smith, Oxford, Oxford U.P.

G.A.J. ROGERS (1978), Newton's "Principia" and Locke's "Essay", in Journal of the History of Ideas, XXXIX, pp. 217-32.

N. ROSENBERG (1965), Adam Smith on the Division of Labour Two View or One, in Economica, pp. 127-39.

J.A. SCHUMPETER (1954), History of Economic Analysis, edited by E.B. Schumpeter, Allen and Unwin, London

A.S. SKINNER (1965), Economics and History: The Scottish Enlightenment, in Scottish Journal of Political Economy, 12, pp. 1-22.

A.S. SKINNER (1974), Introduction to the Wealth of Nations, Book I-III, Pelican Classics-Penguin Books, Harmondsworth.

T. SOWELL (1974), Classical Economics Reconsidered, Princeton U.P., Princeton (N.J).

D. STEWART (1793), Account of the Life and Writings of Adam Smith, in EPS, pp. 268-351.

G.J. STIGLER (1951), The Division of Labour is limited by the extent of the Market, in Journal of Political Economy, June, pp. 185-193.

W.L. TAYLOR (1965), Francis Hutcheson and David Ricardo as Predecessor of Adam Smith, Durham.

H.W. TURNBULL, J.F. SCOTT (editors) (1959-77), The Correspondence of Isaac Newton, Cambridge University Press, Cambridge, 11 vol.

A.A. YOUNG (1928), Increasing Returns and Economic Progress, in Economic Journal, XXXVIII, Dec., pp. 527-54.

F.R.WELLIS (1977), Newton and Newtonians, 1672-1975. A Bibliography, Dowson, Folkestone (Kent)

R.S. WESTFALL, (1977), The construction of Modern Science. Mechanism and Mechanics, Cambridge, Cambridge U.P. (1971)

R.S. WESTFALL (1980), Never a Rest. A Bibliography of Isaac Newton, Cambridge, Cambridge U.P.

W.P. WIGHTMAN (1975), Adam Smith and the History of Ideas, in Essays on Adam Smith, edited by A.S. Skinner, T. Wilson, Claredon Press, Oxford, pp. 44-67.

T. WILSON, (1976), Sympathy and Self-Interest, in The Market and the State, Essays in Honour of Adam Smith, edited by T.Wilson and A.S.Skinner Claredon Press, Oxford, pp.73-98.

S.J. WORLAND (1976), Mechanistic Analogy and Smith on Exchange Value, in Review of Social Economy, 34, pp. 245-259.