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Recursivity and Self-Referentiality of Economic Theories and Their Implications for Bounded Rational Actors

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in Economics*



**Recursivity and Self-Referentiality of Economic
Theories and Their Implications for Bounded
Rational Actors**

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Dresden Discussion Paper in Economics No. 03/07

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Recursivity and Self-Referentiality of Economic Theories and Their Implications for Bounded Rational Actors

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Abstract:

This study aims at the analysis of the possible self-referential effects of economic theories and models on its own subject and of the mechanisms through which bounded rational actors perceive the self-referential nature of economic theories and might absorb their prescriptions. Thus, the focus of the present study will be on the effects of economic theories on the behaviour of the analyzed economic actors. The analysis of the possible causal role of theories on bounded rational economic behaviour will be interpreted as a sort of validity test of economic theory.

JEL-Classification: D01, D7

Keywords: self-referentiality, recursivity, self-altering predictions, theory absorption, bounded rationality

1. Introduction

Bounded rational social actors are not just stimulus-response machines but more complex beings, whose actions are led by their own beliefs and mental representations. Such representations can shape mental models, i.e. subjective theoretical frameworks that predict the course of the social system the actors are involved in and that establish cause-effect relations that the individual uses in her decision-making. Individuals can also modify their mental models when they are not satisfied with the results of their application. Such learning operation requires that the individuals are able to reflect the theoretical statements on themselves and on the situation they are confronted with.

According to the result of this reflection process, they will then decide which theory they want to refer to, or in other words, which theory they want to absorb.

Economic theories aim at the description and prediction of economic behaviour and interactions, but at the same time interfere with the phenomena they aim to depict. Revealed theories, if accepted, may influence the behaviour of the agents they focus on, either in the sense of validation of the theoretical content, or in that of its rejection.

This analysis tries to discuss the implications of those recursive, or self-reflexive effects of economic theories on bounded rational economic behaving and interacting. In particular, a distinction will be made between the perception of the self-referentiality of a theory by bounded rational individuals (i.e. the perception of its applicability to a concrete setting) and its absorption (i.e. the compliance of the decision makers with the prescriptions of the theory).

A factor that makes the role of mainstream theories in influencing economic interactions and behaviour even more complicated to evaluate is the discrepancy between the neoclassical rationality standard and the observable cognitive limitations to the subjective rationality. The problem of how bounded rational actors process the content of theories of full rationality undoubtedly is worth of being explicitly analyzed, particularly for the aim of enhancing efficient economic advising. Normative prescriptions for economic advising could also be taken from theories of bounded rationality, if it could be proven that such theories enjoy a broader acceptance by the bounded rational actors and survive to their absorption.

The paper is organized as follows: After an introduction on the concept of “self-reference” (Section 2) and on its implications for social reality (Section 3) and social theorizing (Section 4), the absorption of economic theories will be discussed (Section 5). To deepen the mechanisms through which bounded rational individuals may process and absorb economic theories within the bounds of their subjective rationality, the rationality standard of the economic actors will be specified (Section 6) and their cognitive processes will be discussed from a constructivist perspective (Section 7). An approach to the experimental analysis of self-referentiality and absorption of economic theories will be proposed in Section 8, and final conclusions will be provided in Section 9.

2. The Concept of Self-Reference

“Without a wide range of abilities to refer, we would be bereft of thoughts, memories, and sensations.”

(Bartlett, 1987, p. 5)

„Self-reference [is] in the context of language, a statement that refers to itself or contains its own referent. [...] In the more general sense, self-reference is involved in a description which refers to something that affects, controls or has the power to modify the form or the validity of that description. [...] In this general sense, self-reference establishes a circularity that may involve not only referential but also causal, interpersonal or instrumental relations and thereby constitute a unity of its own.”
(Krippendorff, 1986)¹

Self-reference occurs whenever something refers to itself. Many studies on self-reference concern linguistic questions, where a self-referential sentence is a statement that refers to itself, or contains its own referent, i. e. falls into its own domain. Lots of elementary linguistic forms present a self-referential character, definite descriptions or proper names, for instance.² There are different degrees of semantical self-reference, depending on if the sentence refers exclusively to itself, or also to itself as a member of the whole class of reference. An example of a totally self-referring sentence is “This is a short statement”, while the sentence “All the sentences on this page are meaningful” is just partially self-referring. Furthermore, a statement can also be incidentally self-referring if it can be interpreted as a self-reference, only if the statement itself belongs to the sub-class to which it refers; for example, “Some sentences on this page are meaningful”.³ In set theoretical terms, a relation R can be said to be self-referential in a set S if it relates every element a of S to itself, i.e. aRa , for each a belonging to S .⁴

The phenomenon of referring is almost pervasive and might appear in thoughts, conceptualizations, and expressions.⁵ The human capability of referring creates the basis for ordering the subjective perception of the world, for interpreting events, interacting with others etc.; thus creates the basis for all activities which regard human cognition

¹ <http://pespmc1.vub.ac.be/Asc/SELF-REFERE.html>

² Cf. Bartlett (1987), p. 5. Going more into details, there is a vivid debate on the legitimacy of self-referential sentences, as well as on the relations between linguistic self-referential sentences and paradoxes. See for more information Bartlett (1987) and Whewell (1987).

³ Cf. Whewell (1987), p. 32-33.

⁴ Cf. Davis / Klaes (2003), p. 329.

⁵ Cf. Bartlett (1987), p. 5.

and which are essential for individual survival.⁶ The human capability to establish self-references is required even for self-change and behavioural adjustment. The reflexive capacity underlies basic problem-solving abilities and makes mental adaptiveness possible.⁷

Self-reference is strongly related to the concept of feedback and based on the mechanism of a feedback loop, whereas *“a positive [resp. negative] feedback loop [is] a chain of cause-and-effect relationships closes on itself, so that increasing any one element in the loop will start a sequence of changes that will result in the originally changed element being increased [resp. decreased] even more”*⁸. An example of a positive feedback loop is the increase of money in a savings account due to the interest rate.

Reflexivity has often been interpreted⁹ as a possible menace to logical reasoning and as potentially leading to paradoxes. Since there are different forms of self-references, it is not possible to draw general conclusions on the logical legitimacy of reflexive mechanisms. The famous Liar’s paradox “*p* is false” leads to a contradiction, whether *p* is false or true, and therefore it constitutes an example of misleading, malignant, self-reference. On the other side, the sentence “*q* is true” cannot be anything but true and valid, since the opposite (the Liar’s paradox) is contradictory per se. Thus, this is the case of a harmless, benign, self-reference. Generalizing those examples, self-references that present a self-reinforcing character - thus relying on a positive feedback loop - have a stabilizing effect on the phenomena they concern, while reflexivities acting in a self-refuting way - i.e. based on a negative feedback loop - have a destabilizing nature.¹⁰

It is possible to enumerate lots of different types of self-references, and several attempts at classifications of this concept have been proposed. Mainly, there are two possible approaches for classifying the types of reflexivity: either focusing on the object involved in the self-referential relation, or on the kind of relation itself. Because of the pervasiveness of reflexivities, the first method may not offer manageable taxonomies, while the second may suffer from a lack of comprehensiveness.

⁶ Cf. Bartlett (1987), p. 5.

⁷ Cf. Bartlett (1987), p. 6.

⁸ Cf. Bartlett (1987), pp. 21-22.

⁹ This relates particularly to the fields of philosophy, logic, and scientific methodology.

¹⁰ Cf. Davis / Klaes (2003), p. 333.

Self-referential relations can establish tautological, set-theoretical, pragmatical or meta-logical relations.¹¹ A tautological self-reference can be also defined as a static relation, a self-reference that does not add anything but redundant information to its predicate. A set-theoretical reflexive relation generates mostly paradoxes and it appears when set-memberships are used in a reflexive way. Graucho Marx's gag: "I don't want to belong to any club that will accept me as a member," is an example of such reflexivity. When the content of a sentence and the sentence itself refer to each other, i.e. when the sentence falls into its own domain, as in the sentence "there are no truths" for instance, it can be called a pragmatic, or performative self-reference. Finally, the relation "*between a truth-functional referring proposition and the set of conditions which are necessary in order for the proposition to be capable of referring at all*"¹² can be defined as meta-logical, since it occurs transcending the same logic it states. Meta-logical self-reference can represent a limitation, whenever it implies a self-falsifying, or self-refusing dynamics, while it can be interpreted constructively, if it involves self-validation.¹³ Scientific reasoning often involves meta-logical referring.

Another interesting taxonomy of self-references has been proposed by Davis and Klaes (2003). They distinguish between immanent, epistemic, and transcendent reflexivity, depending on which levels the reflexive relation involves. Immanent reflexivity means a reflection from an entity to itself, while epistemic reflexivity results from a conscious act of a subject referring to itself. Eventually, the transcendent reflexivity almost coincides with the meta-logical self-reference presented above.

As said, the present analysis focuses on the recursivity of economic theorizing and its effects for the economic actors. Since economic theories are social theories and necessarily embedded in social reality, a short digression on some well-known examples of recursive social phenomena will precede some considerations on the recursivity of social theorizing, which will then introduce some notes on the absorption of economic theories.

¹¹ This classification of self-references is freely based on Bartlett (1987).

¹² Cf. Bartlett (1987), p. 10.

¹³ For more on the constructive versus critical use of self-reference involving human understanding see e.g. Bartlett (1992), pp. 3 - 6.

3. Recursivity in Social Reality

Recursive relations play an important role for social phenomena and are almost pervasive, both of social reality and of the social sciences. Examples of recursive phenomena may regard almost all aspects of social reality and have always attracted the attention of social analysts. The individuals involved in a social system act intentionally – i.e. they try to reach a certain end state from a given initial state using (limited) own capacities and extraneous resources - and define in this way the system's course. So, the individual mental representations and expectations play a decisive role in shaping social reality. Reflexivity may also lead an erroneous statement to become true or invalidate a true one; thus it can act in a self-fulfilling, or self-destroying way.

The problem of reflexive predictions concerns all behavioural sciences. A published prediction may affect the predicted event, or process, and then, as a so-called “self-altering prediction”, either works toward the self-fulfillment, or the self-destruction of the prediction if it is not “neutral” in the sense that both tendencies compensate each other. Plenty of examples of self-fulfilling as well as of self-destroying dynamics can be mentioned. The disclosure of a public opinion survey can manipulate its results, by acting in a self-fulfilling way. Similarly, the German Federal High Court recently had to decide on the responsibility of the Deutsche Bank for the bankruptcy of Kirch's corporation; Kirch accused the bank of having caused its bankruptcy by publicly doubting its creditworthiness.

Additionally, ideologies may have a self-referential effect, since they tend to be self-validating systems of beliefs, thus self-reinforcing and self-isolating. Revolutions can be seen as recursive phenomena as well, where the internal dynamics of a political system may become self-destructive. The Pygmalion, or Rosenthal, effect refers to situations in which pupils, who are expected to perform better than others, will indeed perform better. This effect was first examined in a study by Rosenthal and Jacobson (1968, 1992), in which some teachers were misleadingly told that some children had a higher-than-average IQ. It was shown that the expectations of the teachers led the children to an actual enhancement of their performance.

That the patient's symptoms can be alleviated, just because of the belief in the efficacy of an otherwise ineffective treatment, is the well-known placebo effect. The opposite

effect - the so called “nocebo effect” - can occur as well, if a patient disbelieves an effective treatment.

The attention financial investors pay to what can be called the “market psychology” reveals that financial markets are also highly self-referential. Soros (1994) describes the dynamic of financial markets by means of a reflexivity theory, according to which the market process is determined by a two-way feedback loop between information and pricing.¹⁴

4. *Recursivity of Social Theorizing*

Social theorizing can be affected by recursivity in two different ways: first, a social scientist inevitably is part of the system she analyses and second, theories can affect the state and the evolution of the social system they aim to describe. Though the first sort of recursivity regards all forms of human theorizing, since the scientist can never be completely disentangled from the reality she examines,¹⁵ the fact that theories may “interfere” with the evolution of the system they aim to describe is a peculiarity of the social sciences. Obviously, it stems from the coincidence between subject and object of the analysis. The focus here will be on this latter sort of recursivity, which we will call reflexivity or self-referentiality, on its impact on social predicting as well as on the conditions under which a theory may actually imply recursive effects.

4.1. Explaining and Predicting the Social Reality

Natural sciences do not suffer from the second sort of reflexivity mentioned above (“*Nature does not care – so we assume – if we penetrate her secrets*”¹⁶), and therefore explaining and predicting the natural phenomena can be seen as symmetric processes. Explaining is the codification of a particular real situation, or event, by means of abstracting some conditions that apply and some theoretical laws, while predicting means proceeding in the opposite logical direction. Predicting starts from the observation that in the particular situation examined certain conditions take place. By

¹⁴ For more experimental evidence on reflexive predictions, see e.g. Marx (2006).

¹⁵ See for instance the indeterminism problem of quantum physics.

¹⁶ Cf. Morgenstern (1972), p. 707.

means of application of the theoretical laws, which suit the conditions, the development of the observed situation will then be described. The common methodological ground between explaining and predicting can be found in the explicating process; that is, the process which leads to a theoretical substitute for a pre-theoretical concept.¹⁷

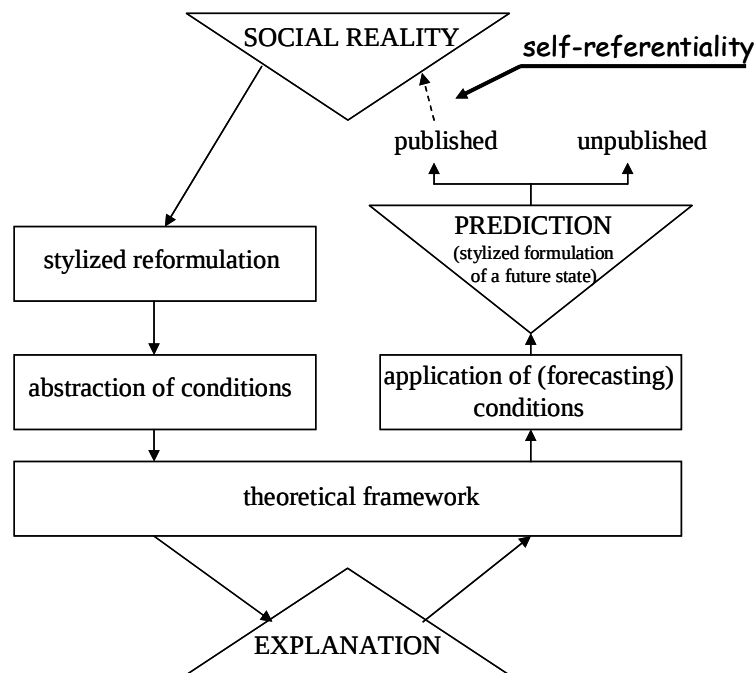


Fig. 1: Explaining and Predicting the Social Reality

As represented in the flow chart in Fig. 1, even if the social and natural sciences are both based on the scientific methodology of explaining and predicting, recursivity disturbs the symmetry of those processes for social theorizing.

On the left side of the flow chart, the process of scientific explaining of social reality is depicted, while the right side represents that of social predicting.

Explaining social reality means at first to observe a social phenomenon and then to codify it in a stylized way. This “stylized reformulation” („*This stylized reformulation is the actual common sense understanding of the scientific community of the real situation which gives the subject of the analysis*“)¹⁸ is the expression of the actual mainstream codification of the situation in question. Such reformulation gives evidence

¹⁷ Cf. Güth/Kliemt (2001), p. 1. For a definition of “explication”, cf. Carnap (1956)

¹⁸ Cf. Lehmann-Waffenschmidt (1996), p. 46.

of some “abstract conditions” that can properly depict the situation in a standardized and comparable manner, so that a suitable “theoretical framework” – a theory or a model - may be found or worked out and an “explanation” of the social phenomenon can be achieved.

Predicting social reality can be characterized as a successive step of the scientific procedure, and be interpreted as a first test of the validity of scientific explaining.¹⁹ For this reason, the process of social forecasting can be read as articulating in the opposite logical direction of that of explaining. Consequently, the forecasting process goes top-down on the flow chart and starts exactly from the “explanation.”

The first step in order to forecast a social phenomenon is to insert it (again) into the “theoretical framework” which suited the “explanation”. The “abstract conditions” that the phenomenon can be reduced to should be compared with those that led to the choice of the theoretical framework. If they are coherent to each other, a “stylized formulation of a future state” - in other words, a “prediction” – can be elaborated. As already stated, it makes a great difference if a social prediction is published, or not. A published social prediction may lead social actors to modify their behaviour, either in order to fulfil, or to destroy the prediction’s content. In this way, social predicting can influence its own object, i.e. the forecasted reality.

Every step of explaining and predicting the social reality can be affected by some distortions, which mainly stem from the cognitive and computational limitations of the individual. Going, as before, top-down, the theoretical framework can be affected by the problem of the validity of the theories or of the models chosen; they may be mis-specified or even ideologically distorted. Both the abstraction of conditions in the explaining process and their application in the predicting process can be of course affected by the application problem. Further, as every stylization is the reduction of the redundant aspects of a complex reality, such an operation is per se arbitrary, and scientific stylizations, even if they are based on strong codified and standardized methods, make no exception. Thus, both the stylized reformulation of a complex real phenomenon (on which the explanation relies) and the stylized formulation of a future state (the prediction) cannot be but selective and may be distorted and undermined by information deficiencies.

¹⁹ That will be discussed in more details later, cf. Section 5.

another prediction, P_3 , will be necessary. From a purely logical point of view, this infinite recursive process between prediction and reaction makes it impossible to deal correctly with social predictions, and also with the theme of the self-referentiality of social theory. About the question of whether the Morgenstern Paradox has also an empirical and not merely a logical validity, a vivid debate flourished in economic literature²¹. It can be demonstrated however (both in a mathematical and a pragmatic way) that the conclusions, to which the Morgenstern Paradox leads, are not sustained from the evidence.

As Grunberg and Modigliani (1954) demonstrate by a fixed-point argument, the Morgenstern Process may not occur at all in that there is (at least) one fixed-point of a suitable self-mapping which coincides with a correct, though self-altering, prediction. Another case is that of convergence of the Morgenstern process where the limit point represents a correct prediction of the phenomenon (see Lehmann-Waffenschmidt 1990, 1996). Thus, the infinitely evolving Morgenstern Process not admitting a finite solution regarding to correctly predicting refers to the non-convergent case of two conceivable cases.

A pragmatic solution of the Morgenstern Paradox can also be formulated, considering that in reality nobody can perform infinite reflection processes. Two sorts of limitations occur: the bounded rationality of the subjects and natural restrictions. Bounded rational subjects are not able to perform infinite steps of recursive reasoning, and in the meantime are aware that the other interacting subjects won't do it. This is proved, for instance, by the experimental evidence from beauty contest interactions: in those situations - where individuals have to guess what the others are going to choose - subjects usually perform only a few (two or three) reflection steps. Natural restrictions refer to time restrictions (the real choice-making process cannot take an infinite time horizon) as well as to cost restrictions (time has an opportunity cost). This explains why even fully rational subjects could not perform infinite reflection processes.

Another crucial point regarding the self-altering effect of revealed social predictions is whether they are believed, or not. The "compliance" with a prediction depends strictly on the perception the agents have of its validity. Even theoretically erroneous statements

²¹ Among others see Bosse (1957) and Grunberg/Modigliani (1954). For a reconsideration cf. Lehmann-Waffenschmidt (1990).

could become self-fulfilling only because believed by the individuals, or supposed to be believed by the majority of them. Similarly, the concept of “sunspots equilibrium”²² refers in economics to situations in which the market outcome and allocation of resources depend on variables that only matter because individuals believe they do.

4.2. Self-Referential Theories

There can be different notions of self-referential theories, at first because there is much hidden behind the concept of “theory” and then because of the polymorphism of recursive relations.

“Theory” can be meant as one, or several, statements that describe a property, a peculiarity, or more generally a certain aspect of a certain object. An economic theory will be conceived here as a conditional generalization, i.e. as a statement of the sort: “for every x , if P of x , then Q of x .”²³

It should first be stated that following a radical constructivist perspective,²⁴ every sort of theorizing would be but self-referential because of the interdependence between observer and observation. Similarly, the approach of the sociology of scientific knowledge asks whether the view of a scientist who stays in a disentangled relation to the world - which is, in the end, the object of her analysis - can be realistically sustainable.²⁵

However, in a strict sense, a theory should be said to be self-referential if it refers to itself - if it contains sentences or theorems related to the theory itself, e.g. meta-theoretical considerations. In other words, a self-referential theory applies to itself, i.e. the theory falls into its own domain and thus becomes an object of itself.

In a broader sense, a theory that deals with something that can modify, or affect, the validity of its content also implies a recursive relation and thus can be said to be self-referential. To this category of recursivity – which implicates a meta-logical referring - also belong all conceptualizations, where is sought to know the

²² Cf. Cass / Shell (1983).

²³ Cf. Dacey (1976), p. 249.

²⁴ For an introduction cf. Rusch (1999), or Schmidt (1987).

²⁵ Cf. Woolgar (1992), p. 334.

presuppositions involved in knowing. This occurs whenever observer and observation are part of the same system.

The social sciences are intrinsically exposed to this sort of recursivity, since they are the product of the reflection of individuals upon selected “facets” of the individual in her social system. Social sciences aim at the description of a system made by an observer, who inevitably is part of the system observed. Thus, considerations on meta-logical reflexivity suit undoubtedly the social sciences and indicate their self-referential nature. The kind of social theory which is known to the social actors who are interacting in a social system can affect the social system itself: “*There is thus a “back-coupling” or “feed-back” between the theory and the object of the theory.*”²⁶ Social theorizing can have both a self-supporting, or a self-refusing, impact on the social actors and on the social system it aims to analyze, since social actors can react opportunistically, or in opposite to the theorizing about themselves. That implies that every theoretical statement can be either invalidated, or reinforced, by the actors’ behaviour, as in a feedback loop.

5. Self-Referentiality of Economic Theories and Theory Absorption

“I believe that the study of the degree of ‘theory absorption’ by the members of the economy [...] will make all of us more modest in judging how far we penetrated into the economic problems.”
(Morgenstern, 1972, p. 707)

To depict the fact that a social theory which is known to the actors interacting in a social system analyzed by this theory may affect the course of the social system itself, Oskar Morgenstern (1972) introduced the concept of “theory absorption.” Although potentially any economic theory can be absorbed for the resolution of a concrete problem,²⁷ the exact way of absorption differs from case to case, depending on its formulation, its understanding, and its acceptance by the members of the economic system, as well as on its accessibility.²⁸ Furthermore, past experiences and learning may also matter when it comes to evaluating the absorption of a certain theory.

²⁶ Morgenstern (1972), p. 707.

²⁷ Cf. Dacey (1976), p. 248.

²⁸ Cf. Morgenstern (1972), p. 707.

A theory is said to be absorbed by an individual if that individual internalizes it in her own mental models and chooses to act according to its logical content. In interactive contexts, theory absorption will also be strongly related to the supposed mental models of the others. It can be distinguished among unilaterally-, partially-, and fully-absorbable theories, depending on the number of individuals - from one to all - who follow its prescriptions and are satisfied with the result.²⁹

Among the elements that determine, or influence, theory absorption, self-reference plays a preliminary role, in the sense that it can be characterized as a prerequisite for the absorption of a theory. Individuals self-refer a theoretical framework to support their decision-making and then choose whether to rely on it or not, in other words, whether to absorb that theory or not.

Thus, theory absorption is a consequence of the self-referentiality of the social theory. An individual self-refers a theoretical statement and, according to the results of such reflection, she will then choose either to rely on that theoretical framework, or on a different one. In an ideal setting - populated by unbounded rational social actors - a theory of rational choice will be absorbed universally, such theory being at the same time descriptive and prescriptive of the full rational behaviour. In a real setting, thus populated by bounded rational social actors, things are slightly different and more complicated. A requisite for a theory to be absorbed is that it can be understood by the individuals - i.e. it does not overstretch their bounded cognitive and computational capabilities - and that it can be integrated with the subjective beliefs and mental representations. In particular, a theory can be absorbed if its content does not violate the normative components of beliefs as well as the beliefs about the others.

Several attempts have been done to reduce the bounded rationality approach to the homo oeconomicus approach, mostly relying on the consideration that the social actors, though not fully rational, act “as if” they were. Among others, the generally accepted view that “*The aim of a good theory is prediction and in prediction lies the ultimate test of validity*”³⁰ has added some plausibility to the “as if” argument. But, in spite of that, the fact that in simple settings bounded rational best replies may coincide with optimal

²⁹ Cf. Güth/Kliemt (2004a), p. 523.

³⁰ Cf. Morgenstern (1972).

responses is far to endorse the “as if” approach. Moreover, there is no evidence that satisficing behaviour can be simply read as a step towards optimization.³¹

Furthermore, it can be argued whether the proof of a behavioural theory, or model, i. e. its empirical validation, can solely be based on its accuracy of prediction, instead of also trying to describe the way a decision emerged. In other words, the validity of a behavioural theory should be proved “from inside,” and in this sense the proof of the absorption of a certain theory could also be interpreted as an ultimate test of the validity of such a theory in a concrete setting. As stated, the prerequisite of theory absorption is a self-application of a theoretical framework, and its conditions are its coherency with the subjective mental representations. The fact that individuals absorb a theory implies that they accept they will rely on it - i.e. that they are first able to conceptualize it, so that they share the rationality standard underlying such an approach - and then that they adhere to its logic. A theory that passes such a test can be said to assume a real descriptive validity of the behaviour of “human beings” dealing with economic decisions and not just of stylized economic subjects.

6. A Model of Bounded Rational Behaviour

An essential tool in modelling economic behaviour is the representative agent framework which defines axiomatically the figure of the homo oeconomicus. Relying on the assumptions of fully rational behaviour and expectations, the homo oeconomicus approach interprets rational decision making as the result of optimization under constraints and it implies, for interactive situations, mutual rationality and consistency that guarantee an equilibrium outcome. Observations of reality, however, unequivocally lead to reject (except for some of the simplest cases) the assumptions of optimizing behaviour and of rational decision making. The concept of bounded rationality has been introduced³² to point out the differences in the behaviour of a stylized homo oeconomicus and a real economic agent, where the latter cannot be seen as “*a straightforward maximizer, but torn between the extremes of strategic calculation and*

³¹ For more cf. Güth/Kliemt (2004a), p. 522-3.

³² See e.g. Simon (1957).

blind rule following.”³³ Bounded rational behaviour can be seen as a “*sub-species of rational behaviour.*”³⁴ This is because the concept of bounded rationality does not deny deliberation, theorizing, or forward-looking strategic behaviour, but it allows those processes on the basis of the cognitive and computational limitations of concrete economic agents. In particular, bounded rational social actors are complex beings, who do not react in a deterministic way to the stimuli from the social system they are involved in, but whose actions are led by their own beliefs and mental representations.

Beliefs are the simplest form of mental representations, whereas mental representations can be defined as coordinated sets of beliefs. Beliefs are characterized by the coexistence of normative and positive aspects.³⁵ Normative aspects regard what “ought to be” in the individual’s mind and include preferences about ideal states of the world. Positive aspects concern subjective theoretical statements that predict the course of the social system, and that establish cause-effect relations that support the individual in her decision-making. Positive aspects also concern expectations about the others, as a counterpart of social interactions.

Mainstream game theory - as a theory of rational decision making (rational choice) - focuses exclusively on the interpretation of beliefs as (rational) expectations about the others’ behaviour and denies the role of different subjective beliefs in shaping individual decision making. The recent approach of behavioural game theory integrates strategic game theoretical considerations with contributions from the behavioural sciences. In interactive situations agents think strategically, in the sense that they form beliefs about how the others might behave and then (bounded) best respond according to such beliefs. In fully rational settings, mutual consistent and rational beliefs would lead to the same rational behavioural patterns, i.e. to a unique and stable equilibrium.³⁶ So, the rationality assumption can neither explain heterogeneous behaviour (since all individuals share the same rational beliefs), nor persistency of sub-optimal situations (since sub-optimal behaviour gets eliminated by optimal rational behaviour).

³³ Güth/Kliemt (2004b), p. 17.

³⁴ Güth/Kliemt (2004a), p. 523.

³⁵ Slembeck (2003) states that the distinction between normative and positive beliefs is somehow artificial, because both sorts of beliefs tend to influence each other; p. 131.

³⁶ The general mechanism through which beliefs are updated is learning, which takes place, according to Camerer (2003), p. 1, when a change in behaviour due to experience can be observed.

Beliefs may be non-homogeneous, because they stem from lots of different and highly subjective factors,³⁷ they can be mistaken and also modified³⁸ if agents are not satisfied with the result of their application. The factors that shape the subjective beliefs cannot be classified exhaustively, essentially because the individual as a social actor is a non-deterministic product of her social history.³⁹ The beliefs about the others, though also influenced by the individual social history, can be characterised much more as the product of introspection.

It seems reasonable to assume that individuals perceive themselves as not perfectly rational, but bounded rational, and that they suppose others possess the same cognitive and computational capabilities.⁴⁰ In other words, individuals use the tool of introspection to form beliefs about others. This is an important way of trying to predict the others' behaviour, since bounded rational behavioural pattern cannot be simply logically inferred. It must be here underlined that also introspection, as a product of bounded rational individuals, cannot be but bounded. Through introspection an individual will conceptualize just a finite number of iterations of strategic thinking, and she will then respond strategically to what she presumes is the last iteration of thinking performed by others. In this sense, each individual perceives herself as being the most sophisticated.

This can be illustrated by the parable of Sherlock Holmes taking a train from London to Dover and getting off at an intermediate stop, because he expects his adversary, Professor Moriarty, to take a direct, faster, train to Dover in order to await him there.⁴¹ This turns out to be a correct prediction for Moriarty's behaviour. However, the story could have also developed in a different way, if Moriarty, anticipating Holmes' decision of getting off the train before reaching Dover, would have done the same. This could have been again anticipated by Holmes, who would then stay in the train till Dover to

³⁷ Among them are past experience, knowledge, expertise, social norms and individual perception of them, risk propensity and its frame, etc.

³⁸ Cf. Camerer (2003), p. 265.

³⁹ More in Berg/Dickhaut/McCabe (1995), or Mistri (1997).

⁴⁰ There is also evidence showing a clear tendency of overestimating the coincidence between the own and others' motives ("consensus bias"), cf. e.g. Fields/Howard (1976-77). For more see Gilovich/Griffin/Kahneman (2002).

⁴¹ Cf. Lehmann-Waffenschmidt (1990), p. 150. Thus in Conan Doyle's novel Sherlock Holmes finally wins this „expectations-expectations“ game expecting that Moriarty will perform only the first step of the mutual reflection process.

get rid of his adversary. In deciding how to behave, both Holmes and Moriarty assume to be a step ahead of the other, thus to be the most sophisticated.

In many real situations, however, individuals with different cognitive abilities interact; some of them can be more experienced for instance, or cleverer, or simply have a better theoretic knowledge of the situation they are confronting.

It could seem obvious, and it would also be adopting the neoclassical homo oeconomicus paradigm that a superior endowment of capabilities (experience, expertise, cleverness...) constitutes an advantage. In spite of that, what really matters in interactive situations is to be able to predict with accuracy the choices of others, in order to be able to best respond to their actual (in the observed case of asymmetry, probably inferior) behaviour. In such situations “superiorly endowed” individuals could misunderstand what motivates their “less endowed” counterparts and so behave in a too clever, unsuccessful way. Among others, results from the ultimatum game in Güth (1982) as well as findings from the “less-is-more” effect⁴² corroborate this thesis.

For those reasons, individuals who possess superior knowledge, expertise or capabilities could paradoxically decide not to rely - or at least not exclusively - on them, but instead on their common sense, in order to predict what a “representative” bounded rational individual might do.

The influence of experience and of expertise on the behaviour of real economic actors has been deeply experimentally investigated, while systematic experimental evidence on the role of theoretic knowledge, particularly self-referential theoretical knowledge, not supported by experience is still missing.⁴³ Undoubtedly, it cannot be inferred in a purely logical way how bounded rational individuals understand and interpret theoretic statements, how they integrate their beliefs with such theoretic information, and what they make out of them in the interaction with other bounded rational individuals. Accordingly, experimental evidence is needed also in this case. But before developing an experimental approach to study this we have to think on a systematic base for this. In our eyes the constructivist approach qualifies for this.

⁴² Cf. Gigerenzer/Goldstein (2002).

⁴³ A contribution in this direction is Beckenkamp (2003).

7. The Constructivist Approach to the Analysis of Cognitive Processes

The framework of constructivism provides a philosophical basis for deepening the understanding of the general mechanism through which individuals form their beliefs as well as an explanation of its heterogeneity.⁴⁴ This approach, allowing for just partial subjective knowledge of the world, takes into account both *“the intrinsic limits of the human mind in terms of computation and prediction capabilities... [and] the heterogeneity of agents in their beliefs and information endowments.”*⁴⁵ Thus it is compatible with the bounded rationality approach, in particular for what concerns the assumption of satisficing instead of optimizing behaviour. Furthermore, relying on the constructivist approach, it seems possible to outline a framework in which the heterogeneity of knowledge and information and the subjective rationality of the individuals can be modelled in a mutually consistent way.

“Knowledge” should be distinguished from “information”; the first being a *“map from action to consequences... [which] is activated whenever the system changes its state”*,⁴⁶ the latter being the identification of a given state.⁴⁷ In a constructivist way⁴⁸, *“(i) knowledge is the output of active elaboration of the subject ranging from the selection of external inputs to the constructions of “models of the world”; (ii) the subject is continually engaged in the empirical control of such models, which thus act as a feedback mechanism in the construction process.”*⁴⁹ This implies, in particular, that the individual’s “models of the world” cannot be isomorphic (i. e. 1-1) with an external world.⁵⁰ Also according to the bounded rational approach, the cognitive activity produces stylized subjective mental models to support the individual in her decision-making; the individual will then evaluate the feedback such models receive from the external environment and, if satisfied, she will rely further on those models; if not, she will modify them.

⁴⁴ The radical constructivist approach can be applied to most various aspects of economics, as done e.g. by Lehmann-Waffenschmidt (2002 and 2006a), Meier / Slembeck (1998), Ötsch (1996).

⁴⁵ Tamborini (1997), p. 255.

⁴⁶ Tamborini (1997), p. 257.

⁴⁷ Idem.

⁴⁸ Here is meant the approach of Watzlawick (1981).

⁴⁹ Tamborini (1997), p. 257.

⁵⁰ The radical branch of constructivism (cf. footnotes 24 and 47) denies the ex-ante existence of an (ontologically given) external world, since we cannot decide from our “relative” sensual perceptions, whether there is an ontological external world, or not. We will, however, not adopt, or discuss, this radical view here (cf. e. g. Watzlawick 1981, Schmidt 1987, Rusch 1999, or Lehmann-Waffenschmidt 2006a).

The cognitive process can be depicted as an input-output process with a feedback mechanism (cf. Fig. 3):

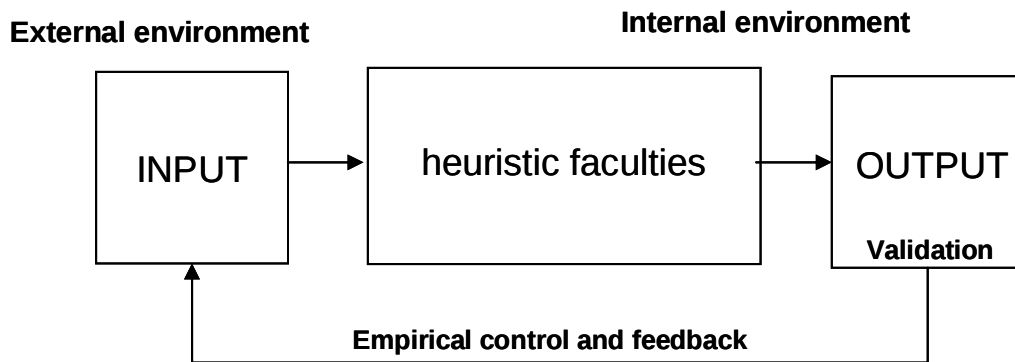


Fig. 3: The cognitive process in the constructivist approach (cf. Tamborini, 1997, p. 258)

Stimuli from the external environment, interpreted here in the form of physical signals and without any prior ontological assumption, are the inputs of the cognitive process and are elaborated in the internal environment. The internal environment, i.e. the “mind,” includes all thinking faculties. To represent its functioning, the computational approach⁵¹ will be followed, which focuses on the mapping from external to internal states, the latter being interpreted as logical ordering of syntactic elements (*“like steps in a computer programme”*⁵²). An alternative approach could have been the „neural approach,“ which focuses on the physical disposition of the internal environment, thus on the particular configuration of the neuronal networks⁵³. The neural approach seems to have a better explanatory power for the unconscious mental processes, whereas the computational approach suits the representation of conscious thinking and decision-making better.⁵⁴

According to the computational approach, the mapping from external to internal states is based on a series of heuristic faculties, among which abstraction and causation are essential for rational decision-making. The internal environment produces as output a

⁵¹ Cf. Newell/Simon (1972), Simon (1977) and (1981).

⁵² Cf. Tamborini (1997), p. 258.

⁵³ Cf. McClelland/Rumelhart, (1986).

⁵⁴ Cf. Tamborini (1997), p. 258.

representation, or a mental model, of the world, i.e. “*a set of causally ordered relationships [...] among selected objects or events, aimed at explanation and prediction.*”⁵⁵ Causal ordering, i.e. how the human mind creates an efficient order for action,⁵⁶ plays a central role in human explaining and predicting. Rational actions are based on causal models that forecast in the individual’s mind the consequences of her actions. The bounded rationality approach relies consistently on the notion of mental models. To elaborate her mental models, the individual selects the external signals and combines them according to pre-existing patterns of configuration; the combinations of signals have to match with such patterns in order to be recognized.⁵⁷ This process of selective perception can be called “abstraction” and regards both physiological (e.g. of an object) and conceptual perception (e.g. of an immaterial object, or of a social situation).

The last stage of the cognitive process is represented by the validation of the mental models. This does not require, in a constructivist perspective, that an internal (mental) representation should be an exact reproduction of the external reality, because this would be just a metaphysical ideal, deprived of any operational content. Rather, the individual simply needs a rule that establishes that a certain model is *provisionally “valid”*, or “*viable*”, for action. The constructivist approach introduces the notion of “cognitive equilibrium” as a sort of measure to which the viability of a mental representation can be related. An individual can be said to be in “cognitive equilibrium” if the actions generated by her internal environment are consistent with her objectives, given the responses from the external environment.⁵⁸ To make the concept of provisional viability more operative, the notion of cognitive equilibrium could be related to that of satisficing, since it allows that different mind constructions can coexist and meet the subjective aspiration levels. Viability is based on what the individual experiences, whereas experience here should not be interpreted as observation of events, but as action, because it is through action that the individual tests her mental models. The result of such testing operates as feedback on the construction of knowledge, which leads either to the validation of actual mental models, or to their modification. In this way, knowledge is not a direct representation of the world, but a representation of the

⁵⁵ Tamborini (1997), p. 259.

⁵⁶ Cf. Lorenz (1973).

⁵⁷ Idem.

⁵⁸ Idem.

experience of the world.⁵⁹ This feedback mechanism lets one characterize the cognitive process as self-referential, because every construct, once confronted with the subjective experience of the external environment, shall be reflected to the mind which originated it, i.e. it shall be self-reflected. Human cognition is recursively engaged in the elaboration of mental models out of external stimuli and in their evaluation according to the individual experience of the external world, either to consolidate a (subjective) viable construct or to modify a non-viable one.

Knowledge in the constructivist view thus can be characterised through the attributes of particularity and possibility, as opposed to the objectivist ideal features of completeness and necessity. This allows for heterogeneity and coexistence of mental models.⁶⁰ Particularity stems from the conception of the individual as purpose oriented and guided by “interest,” i.e. any purpose (in a broad sense) that can motivate (“cause”) the individual’s action. Thus interests “(i) elicit agents’ actions and (ii) direct agents’ heuristic procedures in construing an intendedly valid model of the external environment. In cognitive terms, interests provide the focus for ‘conscious devices’ aimed at reducing complexity through pattern creation and signal-pattern matching.”⁶¹ Interest not only provides a motivation for action, but can also direct the cognitive process on which rational action relies. An immediate consequence is that no one needs more knowledge than what she needs to manage the situations she is usually confronted with; another one is that, since no isomorphic representation of the external environment is possible, the selection of an absolutely valid rule can be excluded. So, partial knowledge is the intentional result of the cognitive activity of an interested individual and not just an exogenous constraint. As such, it explains the persistence of heterogeneous mental models and of the consequent behavioural patterns.

Since knowledge in the constructivist conceptualization is insolubly connected to a particular experience, it gives life to a constellation of different mental models. Their convergence to collective shared mental models may take place, or may not.⁶² If individuals interact for a sufficient time, their (heterogeneous) possible mental models may eventually converge to a common one (with common knowledge of this). However,

⁵⁹ Cf. Maturana/Varela (1985).

⁶⁰ Cf. Tamborini (1997), pp. 261 - 263.

⁶¹ Cf. Tamborini (1997), p. 261.

⁶² Cf. Denzau / North (1994).

there is also evidence⁶³ that, if the exchange of information is imperfect, the convergence of beliefs toward a common mental model may be excluded.

Though admitting the possible heterogeneity of beliefs and mental models, constructivism assumes isomorphism among human minds, that is, individuals do not differ in the way they know.⁶⁴ Also, the notion of an isomorphism can be integrated into the bounded rational approach: individuals assume isomorphism, or symmetry, between themselves and others and they use the tool of introspection to form beliefs about others.

8. A Possible Experimental Approach

In this section some speculations on a possible way of experimentally analysing the self-referentiality of economic theories and their absorption will be presented. A research program on this topic should comprehend a broad spectrum of experiments, which aim at the detailed analysis of specific faculties involved in different scenarios of economic problem solving. The following considerations will be presented as ideas for approaching the wide field of the recursivity of economic theory, and for exploring the possibility of testing the validity of economic theories by relying on their absorption by bounded rational economic actors.

The considerations presented in this Section partially rely on the indicative results of some pilot classroom experiments, dealing respectively with (1) the experimental attempt of debiasing the conjunction-effect bias through meta-information⁶⁵, with (2) a repeated guessing game with information feedback and meta-instructions and with (3) the role of the theory of integrative negotiation in promoting efficiency in multilateral negotiations. The experimental evidence, however, will not be explicitly illustrated here, however, since neither the size of the sample (which does not offer enough independent observations to corroborate any result), nor the experimental conditions (in a classroom perfect isolation of the subjects cannot be achieved) allow one to trust such results as definitive evidence.

⁶³ Cf. Geanakoplos (1989).

⁶⁴ The homogeneity of individual constructions (beliefs, expectations, and so on) is emphasized by the “universals approach”, cf. e.g. Hejl (2001a, 2001b).

⁶⁵ See e. g. Pombeni (2005).

This examination could focus on the testing of mainstream theories, which thus rely on the assumption of fully rational economic actors, or on that of bounded rationality. Plenty of experimental evidence reveals how theories of unbounded rationality are not always descriptive of the observed economic behaviour. Now, the proof of the absorption of such theories could work as a test of their “viable” normative validity. On the other hand, theories of bounded rationality have tried to interpret and stylize the systematic violations of theories of full rationality. So, theory absorption could be seen as an ultimate test of validity of the real descriptive power, as well as of the acceptance degree, of the bounded rationality approach.

The effects of the self-referentiality of economic theories and their absorption can be experimentally analyzed through the observation of how individuals deal with meta-theoretical information in different experimental contexts. Meta(-theoretical) information - i.e. theoretic information about the experimental situation the experimental subjects face, which aims at adding to the theoretical knowledge of the subjects and not simply to their information⁶⁶ - could be communicated to the experimental subjects in the form of “meta-instructions.” By “meta-instructions” instructions are meant that reveal the theory underlying the experimental situation and / or previous experimental findings. The information contained in the meta-instructions should not overwhelm the cognitive bounded capabilities of the individuals and that should be secured by some control questions on the application of the meta-instructions or supplemented by a questionnaire at the end of the experimental sessions.

The experiments could be conducted over two treatments, with and without meta-instructions, and the comparison between the two treatments would enhance some conclusions both on the perception of the self-referentiality of economic theories and on theory absorption. In particular, a significant difference between the behaviour of the test and of the control groups – respectively with or without meta-instructions – would reveal the perception of the self-referentiality of the theory presented in the meta-instructions, while theory absorption would require compliance with it. The experimental hypothesis would be that meta-theoretical information can support the bounded rational decision process and improve the outcome’s efficiency degree in

⁶⁶ The difference between “knowledge” and “information” is here meant as on p. 20.

various experimental settings. The experimental research should concern both situations of individual decision-making as well as interactive ones.

Meta-instructions can be also interpreted as an attempt to support the subjective rationality, in the sense that if non-optimizing behaviour would simply be a step of a discrete optimization process – as sustained by the “as if” approach - individuals would choose to optimize, if they could; i.e. they would comply with the theory presented in the meta-instructions. It can be argued whether that really happens. In many situations, as for instance in beauty contests, coordination or public good games, common knowledge of the equilibrium does not eliminate strategic uncertainty. In similar settings the outcome of the game cannot be foreseen and the players are mainly concerned in predicting the others’ behaviour. In economic interactions where bounded rationality of the others matters, meta-information could be expected to promote the emerging of a sort of meta-rationality, thou of a behavioural-rationality, which transcends full rationality and is superior to it in terms of success in concrete settings.

However, the absorption of meta-instructions is not a trivial question even for unilateral decision making. Supporting the subjective bounded rationality is far from leading to perfect rationality, as corroborated by the resistance of several cognitive biases to debiasing attempts as well as by the evidence on “less is more” heuristics. The absorption of meta-instructions requires their coherency with the subjective beliefs in order to be trusted as a valid support to the decision. So, even in situations where it has been experimentally shown that actual behaviour differs from the predictions of the rational choice theory, theory absorption could test its normative acceptance and validity.

The compliance with meta-instructions based on theory of bounded rationality could help in testing the real coherency between the assumptions underlying those theories and the mental models of the individuals. The proof of the survival of a theory of bounded rationality to its own acceptance could say more about its cognitive reliability.

9. Conclusions

Although reflexive phenomena have been widely observed in economics, the analysis of the mechanisms that lead bounded rational individuals to accept and eventually comply – in a bounded rational way of course - with the theoretical prescriptions is still at its beginning. It should be considered that bounded rational individuals cannot process the content of a theory but in a bounded rational way. A better understanding of the mechanisms on which theory absorption relies could help defining bounded rational expectations and in this way also lead to a better approximation of bounded rational best replies and economic forecasts. Practical implications of that could be then extended to the training of economic professionals or to policy advising in general.⁶⁷

Because of the self-referential character of social theorizing, its reflexive effects on the social actors can potentially never be excluded. To be sure they depend actually on different factors: its understanding, acceptance and coherence with the individual mental models on the one and with the rationality standard on the other hand. Therefore, it should be explained, first, how real economic actors perceive the recursive character of economic theorizing; second, if and under which conditions economic theories affect in a self-referential way the behaviour of the economic actors; and third, how the self-referentiality of economic theories can be empirically tested. In a last step one can infer conclusions for professional advisers for optimal advising when self-referential effects may occur. Lehmann-Waffenschmidt (2006b) presents an application of this idea to the case of underpinned advices which are confronted with delaying reaction behaviour of the addressees.

It should be stated once again that such a research program cannot just rely on theoretical speculations, but needs from the outset to be supported by empirical results. In this sense, the present analysis should be interpreted as a programme for approaching the wide and complicated field of the recursivity of social theories and economic theory in particular, and for exploring the possibility of testing the validity of economic theories relying on their absorption by real bounded rational economic actors.

⁶⁷ “Explaining to bounded rational policy makers on the basis of bounded rational behavioural assumptions why and how certain measures may (or may not) work will render policy advice more acceptable than conventional advice based on welfare maximization.” (Güth/Kliemt, 2004a, p. 538)

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