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# The Simonian bounded rationality hypothesis and the expectation formation mechanism

**Abstract.** In the 1980s and at beginning of the 1990s the debate on expectation formation mechanism was dominated by the rational expectation hypothesis. Later on, more interest was directed towards alternative approaches to expectations analysis, mainly based on the bounded rationality paradigm introduced earlier by Herbert A. Simon. The bounded rationality approach is used here to describe the way expectations might be formed by different agents. Furthermore, three main hypotheses, namely adaptive, rational and bounded ones are being compared and used to indicate why time lags in economic policy prevail and are variable.

**Keywords:** bounded rationality, substantive and procedural rationality, expectation formation, adaptive and rational expectations, time lags.

**JEL Codes:** D78, D84, H30, E00.

## 1. The theoretical and methodological context

The main focus in mainstream economic theories is not as much on the behavior of individual agents as on the outcomes of behaviors and the performance of markets and global institutions. Such theories are based on the classical model of rational choice built on the assumption that agents are aware of all available alternatives and have the ability to assess the outcomes of each possible course of action to be taken, Simon (1982a).

Under the standard economic approach, decisions made by agents are always objectively rational. Thus rational agents select scenarios that will serve them best to achieve a specific utility goal. Under this common approach, rationality is an instrumental concept that associates ends and means on the implicit assumption that actions aimed at achieving goals are consistent and effective. Notably, agents in economics are very seldom differentiated. Rather, they are seen as pursuing the uniform goal of maximizing utility or profit.

In cognitive psychology, rational business entities (equipped with specific experience, information and methods of processing information) are expected to reach decisions that are orderly and consistent in terms of the applied procedures, Simon (1986, p. 210). Thus, contrary to the theory of economics, cognitive psychology takes an interest in both rational and irrational behaviors.

Under the standard economic approach, neither individual agents and undertakings nor such hierarchical structures as governments (subjects) that formulate economic policies satisfy the criteria of the rationality of agents. According to Herbert A. Simon, economic theories are deprived of realistic depth and psychological insights. The deficiencies have become even more pronounced with the evolution of quantitative studies and the associated practice of relying on largely simplified behavioral assumptions, Czerwinski (1996, p. 66-67).

Experimental economics and economic psychology studies suggest that uniform treatment of business entities (in terms of their management and decision-making in the social sphere) leads to oversimplifications and even distorted conclusions<sup>1</sup>. One of the pioneers of integrating economic and psychological research is Herbert A. Simon<sup>2</sup>. An integrated microeconomic theory of behavior forms an excellent methodological platform for studying interrelations between the political institutions of society and its economic policies, including the mechanism of time lag formation<sup>3</sup>.

What integrates economic and psychological studies is the recognition that in the process of decision-making, individuals rely on limited and somewhat inaccurate information that does not readily lend itself to processing. This approach rejects the assumption that individuals make perfect decisions to maximize the utility function. The assumption is an economic precept of mainstream economics and, chiefly, of new classical macroeconomics. A particular implication of this limitation is that information on the future may be unavailable, actions are undertaken under a certain degree of uncertainty and agents are unaware of the plans of their competitors. Recognition of the effects of limited access to information and the objective and subjective problems with processing such information has led to the formulation of the satisficing approach and the bounded rationality hypothesis, Koziellecki (1977), Simon (1978a).

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<sup>1</sup> The purpose of economic psychology is to explain human behavior while accounting for such personality factors as motivation, learning, perception and preferences.

<sup>2</sup> In 1978, Herbert A. Simon was awarded the Noble Prize for pioneering research on decision-making processes.

<sup>3</sup> The microeconomic approach focused on psychological factors was developed also by Harvey Leibenstein, see e.g. H. Leibenstein, *Teoria selektywnej racjonalności...*, op. cit. and H. Leibenstein, *Poza schematem homo oeconomicus. Nowe podstawy mikroekonomii*, PWN, Warszawa 1988, (*Beyond Economic Man. A New Foundation for Microeconomics*. Harvard University Press, Cambridge, Mass., London 1976). Note also that the work of H. Leibenstein is rarely cited in literature pertaining to expectations and economic policy analyses.

The satisficing approach describes the decision-making process as a search for ways of satisfying a specified cutoff level of aspirations, Mosley (1976). Any failure to achieve satisfaction of such aspirations triggers adjustive responses i.e., according to this methodological approach, the simultaneous launch of new actions aimed at reaching solutions and a downward correction of aspirations to the previous unachieved level. Gradual adjustments of targets (levels of aspiration) and actions continue until the subject is assured that a reasonably attainable target level (given specific internal and external constraints) has been achieved. Seen in this way, the decision-making mechanism also seems to be well-suited to describing the performance of hierarchical institutions and the mechanism of formulating macroeconomic policies.

Precepts of the above research program correspond to those of the institutional school. The main research postulate of the institutional school is to replace the prevailing approach based on the notion of homo oeconomicus with a model of behaviors that recognizes changes in preferences under the influence of institutions, the environment and changing motivations. Such factors are interrelated and subject to adjustments over time.

The key distinguishing features of the institutional school are its focus on regulatory mechanisms and state interference and the recognition, in its research work, of the significance of a number of other factors. The focus on institutions of all types, including governments and their actions, also leads to recognizing the state's impact on the economy. The impact is manifested by the regulatory role of the state on the one hand and by its allocative and redistributive functions on the other<sup>4</sup>.

An important feature of the institutional approach, particularly evident in the works of W. Mitchell and J.R. Commons, is the recognition that the standard assumption of global rationality leads to overestimating the effects of rationality on economies, Rutherford (1994, p. 58). According to Mitchell and Commons, rationality should not be viewed as a process of repeated calculation and deliberation. Rationality in economics and, in fact, in human nature, has resulted from the emergence and rise of financial institutions. Once value has been translated into money, actions and, thanks to the uniformity of this unit of measure, the process of assessing the available options to be acted upon, had to become rational. Note that under this approach, rationality is an acquired feature that gradually changes on a spectrum. Seen in this way, the ability to differentiate grades of rationality depends on the extent to which areas of human activity are governed by monetary relations.

Having adopted this view, one may postulate that, in certain fields (including elections), decisions of agents may be permanently inconsistent with the rationality standard applied in mainstream economics. In fact, decisions are affected by

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<sup>4</sup> It is worth noting that in mainstream economics, the state (the government) is either seen as neutral for economic phenomena and mechanisms or as a source of disruptions of market mechanisms and X inefficiency.

such difficult-to-quantify factors as conventions, routines, norms and customs<sup>5</sup>. It should also be noted that in addition to the degree of economic coercion (risk level), the factors that keep agents from reaching deliberate decisions each time also include:

- long time lags between decisions and their effects (e.g. potential changes in the economy),
- long intervals between election rounds – low frequency of election events,
- limited direct impact of individual decisions on the global outcome,
- difficulties with quantifying the potential effects of selecting specific options available to individuals.

A study of the legacy of the institutional school (the new institutional school) to date provides additional proof in support of the postulate that rather than deliberately analyzing individual choices, subjects tend to be governed by rules and schemes<sup>6</sup>. In today's institutional economics, rules or rather decision-making schemes are adopted as a result of, Rutherford (1994, p. 68):

- the cost of information and decision-making,
- constraints on cognition and information processing,
- the risk of errors occurring in attempts to adjust actions in response to particular changes,
- the perceived benefits to be derived by subjects from applying a rule.

The above observations suggest that research programs carried out in accordance with the institutional approach and the choice of the main factors taken into account in this approach are designed to describe mechanisms rather than find ways of predicting them. This is because accounting for a large number of factors (particularly the qualitative ones) hinders the qualitative analyses of their impact on the economy. Note, however, that accurate quantifications are not what this approach (that sees reality as incoherent and largely disorderly) aims to accomplish<sup>7</sup>. It should also be noted that a particularly important link between the institutional approach and H. Simon's hypothesis is the recognition that the rationality of subjects is bounded in nature, Jensen (1987).

This analysis shows that the research program of the institutional school is aimed at analyzing decision-making mechanisms and rules adopted by individual agents and hierarchical institutions. The school emphasizes the complexity of decision-

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<sup>5</sup> See e.g. W. Brian Arthur, *Inductive reasoning and bounded rationality (the El Farol Problem)*, American Economic Review (Papers and Proceedings) 84, 406, 1994 and Paul A. David, *Path dependence, its critics and quest for historical economics*, in: *Evolution and Path Dependence in Economic Ideas: Past and Present*, edited by P. Garrouste and p. Ioannides, Edward Elgar 200.

<sup>6</sup> The emergence of the new institutional school in the 1980s and 1990s should be associated mainly with the work of Olivier Williamson and Ronald Coase. The significance of this school of economic thought was recognized by awarding the Nobel Prize in Economics to R. Coase (1991).

<sup>7</sup> The views are shared by representatives of other schools in economics. An example is G.L.S. Shackle associated with the Neo-Austrian school.

making and provides reasons for which differentiation should be seen as the main feature of agents. Under such an approach, agents, in their specific economic and social roles, differ not only in terms of the capital they hold and the degree to which they are governed by the market but also in terms of their perceptive capacities and preferences and, consequently, the ways in which they form expectations. The approach provides a method for studying responses to political changes on the part of individual types of agents and on the part of the economy as a whole and may well be one of the most important tools for explaining the absence of unambiguous empirical verifications of quantitative models, including the models of political business cycles<sup>8</sup>.

## **2. The nature of rationality according to Herbert A. Simon**

Herbert A. Simon has worked with John Muth, Charles Holt and Franco Modigliani in a team formed to develop a general theory of the business ventures and methods of describing and analyzing inventory management. The outcome of their work was a book and, most of all, hypotheses that had a tremendous impact on the development of the theory of economics in the years that followed, Holt et al (1960).

The most important assumptions adopted by this team of four authors, other than the square criterion function, included the recognition that the distribution of the future events probabilities may be expressed in terms of their expected values. This approach was subsequently used and developed by J.F. Muth who put forth the hypothesis that business entities act rationally in circumstances of economic uncertainty and, most importantly, postulated the hypothesis of rational expectations. While describing the nature of differences between both authors' views of rationality, H.A. Simon observed that what the team saw as a working simplification of the complexity of the real world became a very important argument for global (unbounded) rationality for the original postulator of the hypotheses of rational expectations (and for his successors), Simon (1982a, p. 486). H.A. Simon noted that instead of focusing on uncertainty and developing a decision-making model, J.F. Muth assessed the process as insignificant for and negligible in formulating a model of expectations.

H.A. Simon also noted that the only reason why the four authors chose the particular form of the criterion function for dynamic programming was to simplify calculations. The adopted form of the function was not supported by any studies that would provide theoretical grounds for the adoption of the square function of choice. The square function of choice was additionally used in the studies of economic

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<sup>8</sup> The factor is often referred to in literature as Goodhart's law.

policy decisions. The first applications in this field are related to the works by Ch. Holt and H. Theil, Holt (1962), and Theil (1964). This trend in research based on the implicit substantive rationality hypothesis was also used in applying the optimal control theory to studying economic stabilization policies, Pindyck (1983).

As mentioned earlier, in mainstream economics, unbounded (objective) rationality is an attribute of the effects of actions and, by the same token, of the resulting choices. The process of reaching such choices itself falls beyond the scope of interest of mainstream economics. The practical implication of this fact is that, in the concept of rationality, the conditions and limitations are factors of the external environment in which agents operate. There is also another particularly significant feature. The application of unbounded rationality to describe economic processes requires additional decisions to fine-tune the adopted precepts, Simon (1985). Thus, the assumption made in analyzing the performance of a business undertaking is that the function of utility should be recognized as a function of profit. Similarly, in the case of analyzing the influence of a government on an economy, the criterion function of a governmental economic policy is the maximization of economic welfare. Another effect of the use of the unbounded rationality hypothesis in economics is that the theories of cycles and disequilibria call for additional precepts which, in effect, impose bounds on the rationality of agents, Simon (1985). The result is that most conclusions drawn with the use of economic models are not made on the assumption that subjects act rationally but rather by applying the bounding auxiliary assumptions. It is difficult to disagree with H.A. Simon's postulate that such auxiliary assumptions describing specific bounds of rationality differentiate individual schools of economic thought. What is more, the bounds are rarely adopted as a result of empirical studies. Rather, they constitute more or less original constructs developed by authors of theories and hypotheses.

H.A. Simon was the first to postulate (in his work published in 1955) that the concept of global rationality that prevailed in mainstream economics be replaced with another paradigm, Simon (1955). Simon's approach followed from the need to depart from the belief in the universal rationality of homo oeconomicus and to recognize that an agent's rationality must be established in the context of both the availability of information and the agent's ability to process and take advantage of the available set of information. According to H.A. Simon, general rationality is a behavior pattern adopted to achieve a given goal in the circumstances of limitations and restrictions imposed by the environment, Simon (1978b, p. 405). Such a general definition of rationality provided by H.A. Simon is a first step towards distinguishing between its two forms: the substantive and the procedural rationality<sup>9</sup>. The parallel concepts of substantive and procedural rationality have been proposed by Tadeusz Kotarbiński independently of H.A. Simon. The concepts were then fur-

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<sup>9</sup> In his publications, H.A. Simon uses the terms procedural and bounded rationality interchangeably.

ther developed and applied by, among others, Oskar Lange<sup>10</sup>.

H.A. Simon observed that agents may pursue maximization (of a preference function) as well as they might seek to rank the available options. Simon also noted that, in the most general sense, limitations might take the forms of, Simon (1978b):

- objective descriptions of the environment,
- subjective characteristics of the environment (as perceived by the agent),
- descriptions of the agent itself.

In light of prior observations, it should be noted that H.A. Simon's theory stresses a microeconomic view and the diversity of decision-making agents. Seen in this way, the theory is in strong opposition to reductionism.

The approach developed by H.A. Simon in subsequent years and known as the bounded rationality hypothesis has not been applied directly in economic policy research despite the fact that the focus on decision-making and the resulting option of diversified agents provided a wealth of methodological and cognitive possibilities. Gradually, however, in the 1990s views changed, giving rise to an interest in the notion of rationality based on the psychological precepts of cognition to be used in the economic policy studies Conlisk (1996).

It should be noted that theoretical approach, as used by H. Simon, implies the existence of various rational choice models that vary depending on presumptions as to which variables are to be treated as given and as bounds within which agents make their rational choices. Such standard bounds, which themselves may constitute subjects of rational deliberations, include, Simon (1955, p. 100):

- sets of open-ended alternatives,
- relations describing effects (degrees of effectiveness) as a function of open-ended alternatives,
- the rating and order of effects of actions.

Having identified the limitations and variables that remain beyond an agent's control, it is possible to identify the variables that an agent controls and therefore optimizes. Seen in this way, optimization is a rational adaptive response of an agent.

## ***2.1. Substantive rationality***

H.A. Simon defines rational behavior described in the sense of substantive rationality as behavior aimed at achieving a specific goal within the limitations and barriers imposed by an agent's external environment, Simon (1976, p. 130), and Simon (1985, p. 294). An important characteristic of such an approach to rationality is the emphasis on end outcomes and the fact that features of the decision-making agent itself and the psychological theory of behaviors are ignored. As mentioned earlier,

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<sup>10</sup> See T. Kotarbiński, *Traktat o dobrej robocie*, Łódzkie Towarzystwo Naukowe. Zakład im. Ossolińskich of Wrocław, Łódź 1955 and O. Lange, *Ekonomia polityczna*, PWE, Warszawa 1975.

substantive rationality, an approach concerned with types of decisions reached by agents, is a fundamental notion in the mainstream economics.

Substantive rationality is a key element of the hypotheses of rational expectations and the new classical macroeconomics. Defined in this way, rationality is an intellectual strength and an attribute of the effects of actions rather than of the decision-making process. Substantive rationality, as applied in economics, is reflected in the assumptions as to the function of utility used by business entities, Simon (1985, p. 296). The utility function may take any form as long as it helps consistently sort out all choices available to an agent. The other supplementary assumption is that an agent always selects the option that provides the best utility<sup>11</sup>. The dominance of substantive rationality in economic sciences has an impact on methodologies which, as a consequence, are dominated by reductionism. In particular, from the point of view of economic psychology, the main weaknesses of economic methodology are that, Simon (1978b):

- economics has failed to develop a methodology for analyzing ways in which agents account for individual aspects of reality in their decision-making,
- the ways in which agents define the situations of choice are not sufficiently known.

Agents operating in circumstances of uncertainty make use of the subjective expected utility. It is not possible to verify directly the hypotheses formulated in this way in real life, Kowalski (2001). It has also been found in experimental settings that agents not only fail to determine in a consistent manner the probability of occurrence of events but also have no consistent utility functions, Simon (1985, p. 296), and Kahneman and Tversky (1973), (2000)<sup>12</sup>. Failures in empirical tests of models that ignore agents' characteristics and the learning and decision-making processes have led to the rise of procedural rationality studies.

## ***2.2. Procedural rationality***

The concept of procedural rationality has been originally developed in psychology and subsequently applied in economic research by H.A. Simon. The concept may be applied to individual and collective (hierarchically structured) entities. According to Simon, behavior can be generally described as procedurally rational if supported with proper deliberation, Simon (1976, p. 133). Defined in this way, the notion of rationality can be scaled and implies an emphasis on choices and decision making.

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<sup>11</sup> In effect, although no direct assumptions are made of (the need for) knowledge on the detailed objectives of an entity, one should presume that the main purpose is to maximize utility. H. Leibenstein questions the need for using the concept of utility in reference to entities other than human persons. See *Poza schematem* by the same author, op. cit., p. 23-24.

<sup>12</sup> See also A. Tversky, and P. Slovic, *The causes of preference reversal*, American Economic Review, 1990 (March), vol. 80.

The concept of procedural rationality is built on the assumption of limited knowledge and limited abilities to acquire and process information<sup>13</sup>. Such assumptions imply that agents are incapable of making objectively optimal choices, Simon (1985, p. 294). Thus, procedurally rational behavior involves learning to adapt actions to constraints imposed by the environment and to an agent's internal limitations and qualities. The hypothesis allows for more realistic descriptions and analyses of the expectation formation and decision-making processes.

The structure of the bounded rationality hypothesis is not easily expressed in a formal manner. The hypothesis' postulate of incomplete information and, even more importantly, of agents' limited ability to obtain and process information, can be operationalized by accounting for the cost of deliberation in a model rested on the assumption of bounded rationality. Generally speaking, the cost of deliberation is the time and inputs required to form expectations and ultimately use them in decision making.

The recognition of the bounded rationality hypothesis and its application also to such hierarchical entities as governments (bodies formulating and implementing economic policies) helps also to understand the source of time lags, Kowalski (2001, chap. 4). This is particularly important in non-standard circumstances in which individual choices are either unknown or insufficiently known and uncertain and cause the prolongation of the internal time lag. It should also be noted that, in real-life conditions, decision makers operating in hierarchical structures commonly rely on incongruent utility functions. Such complex decision-making problems are better described with the use of an approach based on the bounded rationality hypothesis.

Today's processes shaping procedural rationality are significantly affected by quantitative and qualitative advances in information technology manifested by increases in both the computing power, the availability of information and the efficiency of data transfers<sup>14</sup>. While such advances promote globalization by dramatically increasing the amount of available information, they also tend to increase greatly the complexity of economic phenomena and processes. This can be seen in rapid changes occurring in behavioral relations in economies and in increases in the level of uncertainty. Thus, agents become more widely diversified in terms of their ability to use and interpret information. One might postulate, therefore, that the processes support R. Lucas' arguments with respect to barriers to and difficulties in modeling and interpreting macroeconomic phenomena, Kowalski (2001, chap. 2).

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<sup>13</sup> It is due to the recognition of limited access to information and limited knowledge of entities that the terms procedural and bounded rationality are used interchangeably.

<sup>14</sup> The computing power of computers doubles every 18 months (Moor's Law); the global network of data transmission centers has increased its capacities 1 million times in the last 20 years. Also, the cost of computer information processing has been falling at the rate of 30% a year. Cf. *The Economist*, Sept. 28th, 1996.

The scope of H.A. Simon's approach allows for the recognition of a number of factors treated as constant in the concept of substantive rationality (as described earlier). Such variable factors include motives, the degree of economic coercion, the level of risk and the effects of emotions. In addition to the main characteristics of procedural rationality, such factors will result in pronounced differences in expectation formation and the decisions made in their consequence.

According to H.A. Simon, in order to describe procedurally rational actions, account needs to be taken of the goals of agents acquiring information from the environment, Simon (1985, p. 294). The approach relies on examining the extent to which agents develop the concepts of their goals, gain information and acquire their ability to draw conclusions. Such programs of research draw directly on cognitive psychology. They involve the study of the heuristics used by individuals equipped with limited cognitive abilities. According to cognitive psychology, heuristics is rational in the sense of relying on intuition to avoid costly deliberation, yet, it also involves bounded rationality (as defined by H.A. Simon) as they often lead to repeated errors, Conlisk (1996, p. 678). Evidence of similarities between H.A. Simon's approach and those of cognitive psychology lies in the fact that, in the problem solving models proposed by the latter, individuals are described as, Simon (1985, p. 295):

- having a limited ability to process information,
- conducting selected and erratic (due to ignorance) searches for information and solutions which typically lead only to the identification of a satisfying solution,
- seeking to define the effects of their actions.

The adoption of the bounded rationality hypothesis need not necessarily spell a complete rejection of the substantive rationality paradigm and the resulting optimal behavior postulate. One might claim that in standard recurring situations, agents relying on their experience, etc. may be relatively fast and accurate in predicting the approximate outcome of applying an optimization procedure. The accuracy of predicting such outcomes will be best when market pressures are strong, products are uniform, data is easily accessible and decisions are made professionally. The above best describes the financial sector, especially in a free market.

A summary of the precepts and features of substantive and procedural rationalities is provided in Table 1. Table 1 shows that procedural rationality helps recognize significant distinguishing attributes of agents and, in effect, may constitute a basis for classifying different agents in terms of their actual ability to adopt behaviors expected within the framework of substantive rationality.

The notion of procedural rationality is particularly well suited to dealing with highly complex real-life situations faced by increasingly complex business entities, Simon (1982b). As a consequence of such complexity, conceptualizations of the environment and competing agents are far from accurate. The approach resting

on assumptions developed on the basis of procedural rationality is especially appropriate with respect to choices made in parliamentary elections. Such choices reflect complex sets of factors that are difficult to measure. The most important factors include the state of the economy, election programs, habits, the degree of loyalty and conventions. As a result of long intervals between elections, long time lags between elections and their outcomes and limited effects of individual election decisions on the end result, agents (voters) operate under limited market coercion and reach decisions that could hardly be described as rational in terms of the rational expectations hypothesis.

**Table 1. Comparison of precepts and features of substantive and procedural rationality**

Form of rationality	Knowledge of agent's objectives	Objective description of a situation	Knowledge of agent's characteristics	Subjective concept of information on the environment	Ability to draw conclusions based on information
Substantive	+	+	(-)	-	(-)
Procedural	+	-	+	+	+

+ Recognized feature / precept, (-) Feature / precept not recognized explicitly, - not recognized.

Source: Author's work.

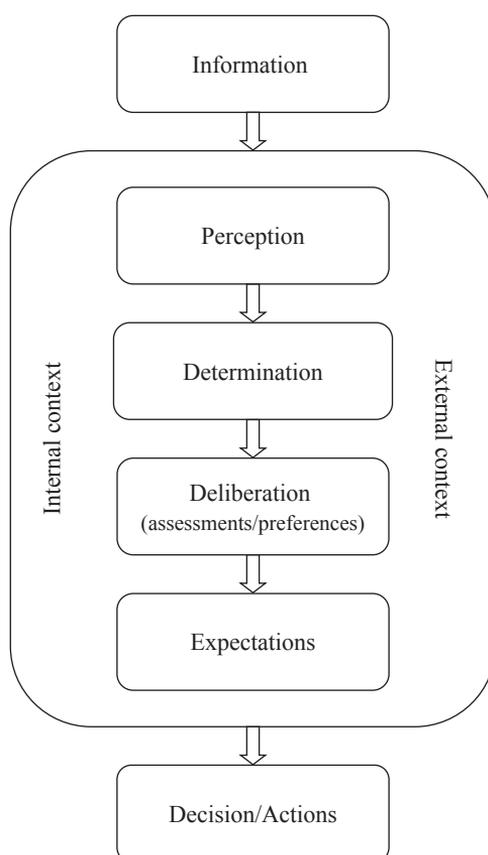
A key characteristic of the notion of procedural rationality is that it can only be analyzed on a case-by-case basis, Simon (1976, p. 133). In other words, every case is different and requires a specific process of cognition and a specific level of information processing effectiveness. One possible way to overcome such diversity is to apply normative concepts of the statistical decision theory in circumstances of risk and uncertainty. The approach works well (in experimental conditions) only if experiments are kept very simple, Simon (1976)<sup>15</sup>.

### **3. Expectation formation in the conditions of the bounded rationality hypothesis**

The adoption of the bounded rationality hypothesis, as proposed by H.A. Simon, can have a strong impact on the way of analyzing and modeling the expectation formation process. In light of the above observations, it may be postulated that the

<sup>15</sup> Ibid. This normative approach was used, among others, by Alberto Alesina in studying the effects of political developments, and particularly elections, on economic policies. See also Kowalski (2001, ch. 5 and 6).

process of expectation formation is diversified and affected not only by external factors but also by the internal attributes of an agent. It is therefore necessary to differentiate agents in terms of the forms of rationality they have adopted and to recognize the parallel existence of different but equally viable expectation models. Most generally, the sources of such differentiation can be presented, as in Figure 1, on the basis of notions described earlier. Economies associated with the same periods or fragments of reality may be described with the use of diverse contemporaneously existing models of expectation formation and states of expectation. The postulate of the existence of parallel and equally viable expectation models is vital for evaluating and methodologically verifying detailed models of economies, including models of correlations between election mechanisms and macroeconomic decisions on the one hand and the performance of the economy on the other.



**Fig. 1. Context of and factors affecting expectation formation according to the bounded (procedural) rationality hypothesis**

Source: Author's work

A key to describing the impact of agents' decisions is to recognize that they are not simply an outcome (function) of expectations. Decisions are also functions of factors inherent in the agents, particularly their views on and approach to risk taking, the level of determination and coercion on the part of the market. The lack of simple correlations between a formed expectation and the decisions based thereon makes the model of an economy even more complex. The recognition of the importance of limitations for the ability to obtain and process information may suggest that expectation formation should be treated as a particularly complex learning process in which an important role is played by the cost of deliberation.

To conceptualize the process, one might adopt a method proposed by J. Conlisk (1996, p. 685). The method relies on the need, emphasized and postulated herein, to recognize the model of broadly defined deliberation costs. In particular, such costs include the inputs needed to obtain information, the cost of processing information, and – in hierarchical organizations – personnel costs as a function of information needs and – additionally in households – the alternative cost of leisure and/or lost income. Furthermore, the subjective aspect of deliberation may include mood, fatigue and any perceived consequences of departing from a convention. Such a broad view of deliberation and its costs suggests the existence of different classes of agents for different degrees of market coercion bearing upon such agents, different abilities of the agents to search for and process information and different levels of incentives they receive to do so. It should also be noted that, for the most part, deliberation attributes may not take on a money form. Further, the circumstances faced by individual subjects and, in particular, voters assessing the competencies of a government in rounds of election widely distributed over time, are not conducive to forming expectations and making decisions in line with unbounded rationality as postulated in mainstream economics.

The addition of deliberation costs to those of expectation formation further increases the cost of solving a particular problem. A next logical question is how should deliberation be dispensed in various situations requiring expectation formation and how does deliberation change depending on agent type. The general task faced by an expectation forming agent can be described in the following manner.

Let us assume that a subject is forming its expectations as to the variable  $X^e$  and that  $\Pi(X)$  is the set of possible states of variable  $X$ . The assumption is that  $\Pi(X)$  has only one optimal value  $X^{e*}$  that corresponds to the accuracy of expectation formation postulated in the hypothesis of rational expectations. If, given the available information, the agent forms such expectations for a variable  $X^e$  equal to  $X^{e*}$ , its expectations, from the point of view of the end result (substantive rationality), will meet the conditions imposed by the rational expectations hypothesis. The deliberation cost can be included directly in the problem defined in such a way in the following manner, Conlisk (1996). One may modify input parameters by recognizing that finding an  $X^e$  equal to  $X^{e*}$  will be extremely costly. This is because of fac-

tors in the environment (the actual high complexity of the phenomenon for which expectations are being formed) or the absence of sufficiently strong and clear incentives to form an expectation in an organized and careful manner. In the latter case, expectations are formed by entities with respect to circumstances in which the degree of the agent's determination is relatively low and in which the effects of any decisions based on such expectations do not clearly translate into material benefits or losses<sup>16</sup>.

Having recognized that the formation of optimal i.e. accurate expectations (as defined in the rational expectations hypothesis) is extremely costly, one can distinguish various deliberation technologies and, in effect, establish a spectrum of rationality for the formed expectations. Let  $T$  denote the cost of deliberations incurred in searching for  $X^{e*}$  and let<sup>17</sup>:

$X_0^e$  denote expectations formed on the basis of experience and custom (without resorting to deliberation ( $T=0$ ),

$X_T^e$  denote expectations formed on the basis of deliberation,  $T \geq 0$ ,

$C$  denote the cost (extent) of deliberation per agent,

$u$  denote random disturbances of the expectation formation process.

Given the above denotations, the deliberation process that accompanies expectation formation can be expressed in the form of function (1):

$$X_T^e = G(T, X^{e*}, X_0^e, u). \quad (1)$$

Assuming that the properties of function  $G(T, X^{e*}, X_0^e, u)$  are such that  $X^e(T)$  changes stochastically from  $X_0^e$  to  $X^{e*}$  as  $T$  increases from 0 to  $\infty$ , two extreme cases may be distinguished, Conlisk (1996). If, in the process of forming expectations, an agent does not engage in deliberations (i.e. if  $C$  assumes a high value and  $T=0$ ), then the process of expectations formation proceeds on the basis of experience (custom) and can be expressed as  $X^e = X_0^e$ <sup>18</sup>. Hence, either the status quo is accepted or expectations are formed by a simple rule. A formal expression of such a rule is the model of adaptive expectations. If an agent functions in circumstances that stimulate high determination, its willingness to invest in deliberation will grow ( $T > 0$ ). If, however, in an extreme case scenario, the cost of deliberation per agent is zero ( $C=0$ ), then the total investment will approach infinity ( $T=\infty$ ). In such a case, according to the above assumptions,  $X^e$  will equal  $X^{e*}$  and, with respect to the end result, function (1) will describe circumstances postulated in the rational expectations hypothesis.

<sup>16</sup> The class includes election choices. A key factor here is that such choices are made on the assumption that individual decisions have little significance on the final outcome of an election (and on the resulting level of prosperity).

<sup>17</sup> For simplicity, subscripts designating time have been omitted.

<sup>18</sup> The lack of deliberation may result from extremely high costs or little incentive to increase inputs on deliberation.

The case that best reflects reality is the intermediate case in which the cost of deliberation is greater than zero but smaller than infinity ( $0 < T < \infty$ ). In such a case, agents set their deliberation efforts depending on external and internal factors. Thus, at the minimum level of rationality in expectations formation, agents secure net benefits on the formed expectations after deliberation costs. The assumption that deliberation may be an expression of procedural rationality allows us better to support the above-mentioned postulate of the gradual nature of rationality and, by the same token, of the gradual nature and variability of the expectation models adopted by various agents. The following classification of agents is proposed in terms of competitive pressures and the related ability and willingness to obtain and process information:

1. Agents operating in unrestricted and unified markets (in particular central banks, financial sector companies and undertakings operating on mass markets),
2. Businesses operating on national and local markets,
3. Central governments and their agencies,
4. Individuals acting as:
  - a) hired labor,
  - b) consumers,
  - c) voters.

In the case of expectations formed by professional agents (groups 1, 2 and 3), the frames of reference are different and the theoretical bases more consistent than in the case of expectations formed by households and individual agents. The professionalization of expectations on the part of agents classified in group 1 is manifested by, among other things, the division of work, specialization, reliance on a single standard of knowledge, uniform evaluation criteria and access to integrated sources of information. A common theoretical and methodological background is particularly characteristic of the financial sector.

In light of the above observations, the above classification (with items arranged in descending order in terms of their willingness and ability to obtain and process information) can be used to assign the most likely and suitable expectation formation models to the distinguished agents (table 2). As implied in table 2, subjects use a variety of expectation models. The choice of such models (the likelihood of model selection) is a function of the above-mentioned factors, which include procedural rationality and market pressures applied to the agent in question<sup>19</sup>. Subjects distinguished for the purposes of the analysis build their expectations primarily on the basis of experience and rules. Such experience and rules of thumb are supplemented with higher degree models according to external factors. In this context,

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<sup>19</sup> The recognition of differences between expectation formation models in cases where their end results converge is in line with the notion of paramorphism. For information on paramorphism, see P.J. Hoffman, *The paramorphic representation of clinical judgment*, Psychological Bulletin, 1960, vol. 67: after J. Koziellecki, *Psychologiczna teoria*, ..., op. cit.

**Table 2. Agent type and likelihood of selecting particular expectation formation model**

Model \ Agent type	Hierarchical			Individual		
	1	2	3	4a	4b	4c
Rational expectation model	(+)					
Adaptive expectation model	+	+	(+)	(+)		
Bounded rationality model	+	+	+	+	+	(+)
Experience/habit	(+)	(+)	(+)	+	+	+

+ Prevalent use, (+) Likely provisional use.

Source: Author's work.

one may postulate that the predictability of economic behaviors of agents is largely dependent on the common features of the expectation formation process, including the role of experience and rules, comp. Heiner (1983).

An important effect of differentiated expectation formation processes is time lags in agents' reactions to new information and phenomena. Time lags are of critical importance for both normative analyses and, especially studies of the effects of economic policies on the economy. As a result of expectations, time lags change both in terms of their length and their interim characteristics. In the light of the models and hypotheses discussed in this paper, it should be noted that in the case of circumstances described in the rational expectations hypothesis, the length of time lags will approach zero. In the case of the bounded rationality hypothesis, time lags will differ from zero. Their lengths will depend on the above-described factors and particularly on how recent the received information is and how dominant the specific distinguished types of agents are in transmission channels. The recognition of the importance of behavioral factors for describing the process of expectation formation should prompt more studies on agents' behavior in circumstances of limited access to information. The adoption of a methodological view based on the bounded rationality hypothesis implies that subjects use diverse and equally viable expectation models (table 3).

One may assume that in formulating expectations for a variable characterized by high frequency data, professional agents will be in a position to define probabilities and adaptive models and models containing weak forms of the rational expectation hypothesis will be the most likely expectation models (cf. table 2). In the case of events that are totally unprecedented or very rare, agents will make use of heuristics based on the bounded rationality hypothesis. A viable option may be to employ the satisficing approach or a method based on a neural network. In the light of the above observations, it is worth noting that the process of expectation formation is non-continuous and subject to differentiation both in terms of the nature of phenomena (that are subjects of expectation formation) and in terms of the type of the expectation forming agent.

**Table 3. Principal expectation formation hypotheses – key assumptions and features**

Assumptions and features	Adaptive expectations hypothesis	Rational expectation hypothesis	Expectations acc. to bounded rationality hypothesis
Assumptions of Rationality	Implicit assumption of substantive rationality	Explicit assumption of substantive rationality	Assumption of bounded rationality
Model's role in expectation hypothesis	Simple decision-making rule	"True" model	No uniform model
Information processing cost	Unaccounted for	Ignored or not significant for task	Significant
Significance of retrospection	Key factor	One of many factors	One of many factors
Role of forecasting	No reference	Key factor	One of many factors
Context, type of agent	No reference	Uniform treatment of agents	Significant differentiating factor
Access to information	No reference	Optimized	Limited
Relation of expectations to decisions	No reference	Identity (implicit)	Possible gap between expectations and decisions
Time lag implications	Integral part of economy descriptions	Approaching zero	Integral part of economy descriptions
Psychological profile	No reference	No reference (homo oeconomicus)	Significant part of hypothesis

Source: Author's work.

The adoption of the bounded rationality hypothesis implies two basic and mutually interrelated strategies for the analysis of expectation formation and the performance of economies. One may involve an eclectic approach that would integrate multiple expectation models with the use of, for instance, neural nets. Such a view of the expectation formation process may be based on prior education and the knowledge acquired in the process of such education. Much of the knowledge acquired in the course of pursuing studies by individuals forming expectations is not properly integrated. Thus, the rule is that either lectures are given on specific schools of economic thought or the eclectic approach is dominant starting at the stage of education. All this has a tremendous impact on standards and rules that shape the behaviors of business agents.

Another expectation formation strategy may be to adopt expectation models specific for a given group of agents. Subsequent adjustments may be made as, having gained new information and having come under changed competitive pressures, agents switch from models based on simple rules and standards to their more complex equivalents. Under this approach, an important cause of such switches (changes) of expectation models may be the creativity and industriousness of agents and

fluctuations resulting from change cycles affecting the phenomena for which expectations are formed, including the agents' general business activities. Expectation models adopted by agents in given periods and the expectations themselves may be subject to sudden switches and adjustments triggered by the acquisition of unforeseen information that considerably contradicts previous trends.

## 4. Conclusions

The research approach subscribed to by H.A. Simon relies on microeconomic analyses. With its emphasis on psychological factors, the approach focuses on examining outcomes and, in particular, on processes behind outcomes. It attempts to describe the insides of the "black box" of the homo oeconomicus hypothesis in mainstream economics.

Economic psychology studies show that agents are frequently motivated to survive and/or avoid failure rather than to maximize the expected utility. The actual conditions under which agents operate are far more complex than assumed in standard economic models and studies. The extent of simplifications, especially those made with respect to rationality and the process of expectation formation, results not only from the need to reduce the inherent complexity of the research subject to a level manageable in terms of formal analysis. In some cases where simplifications lead to ignoring the question of procedural rationality, broadly defined calculation costs are included in the total costs causing tasks to be subjected to the classical procedure of economic choice based solely on the concept of substantive rationality. Such a solution may be sufficient only as an approximation of very simple standard problems but will not allow for an effective analysis of a decision-making problem<sup>20</sup>.

The bounded rationality hypothesis as defined by H.A. Simon and the unbounded rationality hypothesis (of which the rational expectation hypothesis is a form) are two coherent and separate theoretical systems. The rational expectation hypothesis is an extension of the classical economic theory and relies on specialized techniques and methods of formalizing theoretical analysis. Studies based on the bounded rationality hypothesis are still in their development stages and have no specific apparatus of their own for formalizing analyses.

A key factor affecting economic processes and decisions is expectations. H.A. Simon's hypothesis implies that, objectively speaking, there is no uniformly prevalent expectation formation model. Under the bounded rationality hypothesis, the rational expectation model, as defined by J.Muth, certainly is not such a representative model. A recognition of the diversity of agents in one's research approach

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<sup>20</sup> See e.g. H.A. Simon, *Rationality as process and as product of thought*, and by the same author: *Rationality*, in: *Models of Bounded...*, op. cit.

allows one to grasp better the mechanisms of expectation formation and reveal important sources of time lags in economies' responses to economic policy stimuli and internal as well as external shocks.

The methodological perspective built around the bounded rationality hypothesis points to the need for research on microeconomic behavior, including the economic mechanisms behind the agents' election decisions. Furthermore, the bounded rationality hypothesis indicates that an important factor preventing simple modeling of processes spread widely over time is the incomparability of external conditions. Another significant obstacle is the changeability of external factors that, as demonstrated in this paper, has a strong impact on changes in the way reality is conceptualized in the expectation formation process. In the case of elections, a particularly significant factor is the specific nature of each election event. Differences in the nature of such events can also be seen in the natural demographic processes that considerably change the compositions of electorates.

In addition to expectations, an important role in economic behavior is played by preferences. Their significance can be seen in the case of election decisions. Preferences are not constant. Rather, they are a function of institutional, personal and material constraints. However, the actual changeability of preferences is stabilized by selective perceptions and limited abilities to absorb new information.

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