

BOUNDED RATIONALITY AND EXPECTATIONS IN ECONOMICS

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Introduction

In his contribution to the *Scandinavian Journal of Economics* on the occasion of Herbert Simon's Nobel Prize award in 1979, Albert Ando identified a consistent theme running through Simon's vast contribution to economics: his attempt "to construct a comprehensive framework for modelling and analysing the behaviour of man", acknowledging the implicit "limitations of his ability to comprehend, describe and analyse" the complex environment he inhabits.¹ In essence, this is a rich and, to a large extent, exhaustive description of Simon's work, and it provides the foundations for an operational definition of "bounded rationality", with a possible result, with the benefit of hindsight, even more far-reaching than was Ando's original intention.

At the time, bounded rationality in economics was generally meant to indicate the subject of Ando's companion paper in the same journal, in which William Baumol compared the "satisficing" criterion followed by Simon's economic agents in their attempts to reach the best decisions with the traditional microeconomic optimisation problem, which essentially consists in the constrained maximisation of a utility function of some sort. The crucial difference, Baumol noted, was that maximisation required a process of comparison of all the available alternatives, while Simon's satisficing criterion was aimed at pinning down "the first decision encountered which passes the acceptability test",² among those decisions which are subjectively considered to be feasible.³

In Simon's view, this satisficing criterion was not intended to contrast with rationality. On the contrary, this kind of behaviour was plausibly motivated at the very least by some significant informational deficiency and, more in general, by the natural constraints on the economic agents' ability to gain, store and process the information they receive. In a nutshell, Simon pointed out that since in most cases identifying and comparing all the possible alternatives is, in fact, a very costly option computationally, if at all feasible, it should generally be excluded by agents who are rational. Therefore, they will simplify the choice problem they face by only concentrating their efforts on a subset of all the possible choices,⁴ and on devising the best strategies to delimit such a subset.

With the passing of time, however, bounded rationality in economics came to be defined not only as the procedural rationality implicit in the satisficing criterion, but also as the broader "consistent theme" Ando had identified in Simon's work, the studying of the behaviour of man

when faced with economic choices. Moreover, the renewed attention that scholars and policy makers have progressively accorded to the limits of economic agents' knowledge, and to the recognition of their more common salient psychological traits, has even led some researchers to consider it as being the study of the deep consequences of including the actors' cognitive restrictions within a standard maximisation framework. The unifying theme of these two originally separate streams in Simon's thinking, as it was progressively received by the economics profession, is the recognition that economic agents have to devise behavioural strategies in a space where rationality (in the neo-classical utility-maximising sense) is itself a scarce resource, subject to the law of diminishing returns. Exercising rationality requires effort. This holds true for both the procedurally rational economic agents of theoretical models and those whose real-life decisions are the subject of empirical work. Consequences are pervasive, especially when studying organisations and institutions.⁵

When rationality is costly, then, there is scope to cut these costs along a number of dimensions (time, computational power, etc.). In his survey on the advances of behavioural economics, DellaVigna frames Simon's original contribution as one that was made to the "non-standard decision making" stream, as opposed to other lines of research dedicated to non-standard preferences and non-standard beliefs.⁶ Somewhat in line with, or stemming from, Simon's contribution are other works investigating the "limited attention" (or rational inattention, in macroeconomics parlance⁷) paid by agents to aspects of the choice problems they face that are not deemed salient, with saliency (a thoroughly subjective criterion) being, therefore, the constraint that determines the previously quoted "acceptability" region. The deviation from the choices that would be made under the same circumstances by neoclassical agents, measured by the welfare losses that they would incur if they had to identify all the alternatives that are possible in principle, could then be meaningfully used to measure the savings made thanks to the procedural rationality implemented by Simon's agents.

In this environment, heuristics (i.e. simple decision-making rules based on repeated experience, observation, intuition or common wisdom) are rational strategies and can be a very efficient tool for making choices when the cost for acquiring and processing information is high. According to some views,⁸ other perturbations of the choice process, such as framing (i.e., the impact of changes in the external context on the final outcome of a problem of choice), endowment effects (i.e., the influence of any given initial condition on preferences, even when these conditions could, in principle, be swapped at no cost) and sunk-cost fallacies (i.e., in a choice problem, non-zero weights given to sunk costs that, theoretically, should be deemed irrelevant) are disturbances of little or no importance, as they are scarcely able to modify the terms of the choice problem for procedurally rational agents.⁹

Bounded rationality and expectations

We will briefly consider the possible links between Simon's bounded rationality ideas and the different approaches adopted by economists in dealing with household and business expectations on the evolution of economic variables. By connecting the choices made in the present to possible future scenarios, expectations drive the evolution of the economy over time. How expectations are formed also changes through time, as economic systems evolve and adjust continuously. Fittingly with some procedural notions of rationality, households and businesses need to learn how best to make decisions in an environment of continuous change and adaptation.¹⁰

Adapting to new circumstances is indeed a common experience. It requires the selection of implicit or deliberate strategies, based both on free as well as on costly information and on the more or less sophisticated methods and tools needed to process this information. Lessons

learned in the past, for example, on how best to collect and treat the available information, may provide skills that could be applied valuably to decrypting the present and plan for the future. However, change is often itself a non-stationary process, in a statistical sense. Deep recessions, technological revolutions, institutional transformations and sudden changes in social habits can all make the set of abilities possessed by the economic subjects abruptly obsolete, including those related to the comprehension of the neighbouring environment. Crucially, they can also induce a rapid decay in the usefulness of routines followed by economic agents in the formation of their expectations, something that necessarily leaves them in need of re-learning and defining new routines.

Such a description does not appear to be controversial. Indeed, in the history of economics, the relevance of expectations for any intertemporal decisions (i.e., almost all relevant economic decisions, except for the simplest ones in static environments) has been repeatedly underlined.¹¹ However, the economists' degree of attention to how expectations are actually formed and to how they interact with the economic "observables" has followed high and low cycles.¹²

One "high" part of the cycle coincided with the prevalence of Keynesian theories, deeply informed by the recognition of the radical difference between risky and uncertain events¹³ and of the wide-ranging consequences that the latter could exert – mediated by their impact on expectations – on the functioning of the economy.¹⁴ On the contrary, a "low" cycle began when Bob Lucas famously criticised the way expectations were treated by macroeconomists at the time, rightly pointing out that they should not, in general, be invariant to changes in "the structure of series relevant to the decision maker", and in particular to changes in economic policy.¹⁵

In a few years, his critique had been fully taken on board by the discipline. However, Lucas did not suggest improving either the use of expectations in macroeconomic models, or the tools used to measure them, in order to identify the revision processes that businesses and individuals implement when the underlying reality changes. Rather, he ignored the early attempts of empirical research on expectations and instead introduced the powerful construct of the rational expectations hypothesis, based on Jack Muth's earlier work.¹⁶ Muth, who had previously shared ground-breaking empirical work on expectations with Simon,¹⁷ described the hypothesis of rational expectations as a situation in which the agents' average subjective probabilities on the distribution of the relevant variables coincide with the conditional probabilities in the "true" model of the economy, making "optimal" use of all the information available in the economy and deviating from perfect foresight only by some random noise.

Although Muth's contribution was originally intended for some specific and somewhat narrow circumstances, Lucas extended it by assuming it to be a necessary consistency condition in macroeconomic models, and the sheer theoretical power of the Muth-Lucas construct came to be seen as a revolution. In a few years the "rational" expectations hypothesis spread through the practice of the profession of macroeconomics, most of the time in conjunction with the notion of a "natural" level of unemployment, in a fundamentally stable environment.¹⁸ It is perhaps somewhat ironic that in the (general) equilibrium representation of the economy associated with the rational expectations hypothesis, there is no role for the state of (subjective) expectations.

Three complementary conditions coincided to make the success complete: (1) rational expectations allowed leading macroeconomic models to be closed in a straightforward way, spurring great waves of new research in macroeconomics; (2) rational expectations were seen as a natural benchmark for the comparison of the deviations posed by other formulations of expectations;¹⁹ and (3) the findings of models that included rational expectations did not appear to be obviously contradicted by the empirics of the economy, at least in advanced economies

(to which most of those models were applied) and chiefly in the US, in particular during the period of the so-called “Great Moderation”.

Indeed, in the relatively stable economic environment that prevailed during this period, it could also be argued that, in forming their expectations about the future paths of aggregate variables, the agents who populate the macroeconomic models did not have to be entirely rational in the fullest neo-classical sense of the word (i.e., able to consider all available possibilities, compare them at no cost and subsequently select the best one). The hypothesis of rational expectations could be unobtrusively introduced by assuming that economic agents lived in an environment that they had come to know sufficiently well over time, following a readily available learning procedure.²⁰

It should also be mentioned that a number of critiques were raised early on. Davidson pointed to the fact that if the economic processes move in time, so the data-generating processes are non-time invariant and the economic world these processes describe is not ergodic, Muth’s rational expectations hypothesis cannot hold, as “calculable probability statements may have no relation to future events”.²¹ Pesaran observed that rational expectations could be plausible only in contexts where all uncertainty was exogenous to the subjects formulating the expectations, meaning that, subjectively, the actions of those agents were not relevant in shaping the aggregate economic outcomes.²² Outside the realm of rational expectations, there were both non-stationary economic environments and also circumstances like the “beauty contest” famously described by Keynes (i.e. states of the world where the collective outcomes came from a general second-guessing of other agents’ behaviour).²³ The latter is a good description of the conditions of endogenous uncertainty.

A more nuanced view on expectations has started to prevail again only in the last decade or so. Dynamic stochastic general equilibrium (DSGE) models, which have been the workhorse of the new classical (and neo-Keynesian) macroeconomics originating from the rational expectations revolution, began increasingly to allow for the presence of rigidities and free parameters directly linked to intuitions on the actual workings of the economies that predated the rational expectation revolution.²⁴ Models retained their tendency to gravitate towards a long-run equilibrium, but they became much slower to converge, aiming to allow in their theoretical framework for the complexities of the economies that have challenged policy makers and academics alike in the wake of the so-called Great Recession.²⁵ In such more complex theoretic environments, expectations are re-gaining the central position that was attributed to them by the original Keynes’ contribution.

The cycle thus appears to have now turned towards the “high” region again, with new characteristics, in particular, a stronger focus on micro-data. Recent work has promoted a renewed interest in empirical inquiries on how expectations are actually formed. The larger and ever increasing availability of survey-based data on subjective expectations, collected from businesses and individuals, represents a crucial motivation of this current research.²⁶ The fact that the empirical expectations recovered in the surveys repeatedly deviate from implied rational expectations reinforces this motivation (and is not surprising at a time of great disruptions in the global economy).²⁷ It has also been suggested that the progressive marginalisation of empirical studies on expectations formation from the mainstream economic research has come to the great detriment of the discipline.²⁸ In monetary policy making, while ample use of survey data, especially on savings and income, has been made for a long time by central banks,²⁹ it is mostly in the last decade that special attention has been paid to measures of inflation expectations. In this respect, the risks of de-anchoring have been thoroughly assessed, making extensive reference to household, business and professional forecasters’ survey data.³⁰

The extent to which expectations collected directly from households and firms help to better forecast their future behaviour remains, of course, an open empirical question. However, careful extraction of the information they contain is undoubtedly useful in order to empirically discriminate among alternative hypotheses. Over time, both before as well as after Muth's proposal of the rational expectations hypothesis and its exponential adoption in macroeconomic literature following works by Lucas, Thomas Sargent, Edward Prescott and many other prominent economists not limited to the neoclassical camp, various suggestions on how economic agents may form their expectations have been advanced, following extrapolative, adaptive, regressive, error-learning or return-to-normality specifications.³¹ In a recent review by Manski about the increasingly relevant field of probabilistic expectations collection in micro data sets, the evolution of thinking about the formation of expectations in policy analysis is discussed in depth.³² Manski's conclusion is that the ongoing progressive demise in policy analyses of the rational expectation assumptions (a welcome development) should not be accompanied by a proliferation of alternative *ad-hoc* models of expectations formation (a confusing consequence). Careful empirical work would be needed in order to discriminate among these alternative models. In addition, while up to now most of the work on eliciting expectations from individual agents has been pursued by microeconomists, Manski advocates a more direct involvement of macroeconomists even at this early stage, given the crucial impact of expectations on the macroeconomic aggregates. Surveys can shed light not only on the state of expectations, but also on the main drivers of their revisions, when the economic reality changes.

These arguments had long been made by Herbert Simon himself, when he discussed objections to behavioural criticism of the rational expectation hypothesis, in particular those calling attention to its overall lack of coherence. He acknowledged these objections, accepting that simply highlighting the general shortcomings of a theory does not guarantee its demise, unless a newly formed alternative theory has been developed, which is also Mark Blaug's familiar argument that "you cannot beat something with nothing".³³ However, in Simon's words, Behaviouralism could be built only through extensive empirical research, and this had to be done even in times when it did not yet provide a fully-fledged alternative to mainstream theory. Consequently, the dispute around expectations could be settled only by "painstaking microeconomic empirical study of human decision making and problem solving".³⁴

Interestingly, this analysis had also to be done in order to pin down and estimate the particular deviation from full rationality that was needed to complement Lucas's rational expectations-based models in order to generate a meaningful business cycle theory: the inability of Lucas's agents to fully discriminate between shocks to own prices and shocks on the general level of prices. The failure of the Lucas islands model to confirm its results when the stochastic environment in which the agents act is not stationary was also pointed out by Albert Ando, Simon's former student and co-author, even if with a different focus.³⁵ Ando suggested that there was a lack of coherence between the professed general value of agents' expectations in Lucas's model and the strict (but not explicit) hypotheses under which they acted. As the fortune of Lucas's contribution was partly linked to his critique of previous models' *ad-hoc* assumptions, rather than to new empirical findings disproving such models, Ando's assessment was particularly sharp. Equilibrium cycle models, in the Lucas and Sargent formulations, were unable, in his view, to say anything significant about the origins of business cycles.³⁶ Adding to Ando's and Benjamin Friedman's view, Simon pointed out that Muth's expectations were more a special case than "a paradigm for rational behaviour under uncertainty"³⁷ and that their implied decision rule, rather than rational, should be labelled a "consistent expectations" rule.³⁸

Simon also addressed the fundamental non-stationarity of economic systems and the existence of states of the world where endogenous uncertainty is pervasive. For Simon's

rationally-satisficing agents, the “acceptability region”, in which the first satisficing choice must lie, is historically and institutionally determined. Inherently unstable economies will tend to gravitate towards the path set by institutions that have been devised to contrast such perceived instabilities.³⁹ This will produce conventions and habits as well as simple decision rules which individual agents will then be able to use in their choice-making, helping them to solve their particular beauty contest-like problems while saving on costly rationality. History is of the essence, and this renders any attempt to approximate the mechanisms of expectation formation without specific knowledge of the local circumstances driving the economy relatively useless.⁴⁰ Welcome discipline on theorising about expectations must therefore come from the empirical analysis and its detection of regularities.

Cognitive limitations and learning

The comparison between the economic agents’ theoretical cognitive abilities and the outcomes derived from empirically observed data is particularly relevant in policy making. A rich research agenda is associated with the need to understand how agents learn from past mistakes and from the availability of new information on the state of the world they are in. “Learning” as identified in the influential contribution by George Evans and Seppo Honkapohja, implies that a rational expectations equilibrium is only one of the possible outcomes when agents continuously update their expectations based on the comparison between past expectations and actual realisations.⁴¹

The roots of this stream of literature can be found in simpler models, such as the cobweb described by Nerlove, that showed how the extrapolation of specific adaptive expectations functions could lead either to equilibria (not necessarily unique) or to explosive outcomes.⁴² Error-learning mechanisms are, in fact, very general, and can rationalise sophisticated optimal forecasting rules.⁴³ Muth himself advanced his own rational expectations hypothesis in order to estimate the parameters of a model of adaptive expectations (where the change in the expected price level depends only on the forecast error just observed). Learning by boundedly rational agents is central also to Sargent’s successive research on expectations in macroeconomics,⁴⁴ where the limitations of the straightforward rational expectation hypotheses are contrasted with a more nuanced view of rationality, one that weakens the strong informational assumptions implicit in Lucas’s and Sargent’s original contributions.⁴⁵

The application of these tools in monetary policy has far-reaching policy implications. For example, Ferrero describes an environment where boundedly rational agents face the issue of formulating expectations on the future rate of inflation.⁴⁶ In this environment, economic agents learn from their past mistaken predictions by combining old and new information to form new beliefs; the policy maker (specifically in this case the monetary policy authority) can exert some influence on the agents’ learning process. The model is able to explain why policies that would be optimal under rational expectations could instead perform poorly when knowledge is imperfect. It also highlights that, under some conditions, converging to a rational expectations equilibrium could take an extremely long time, making it ill-suited to represent an anchor for rational agents. Welfare consequences are pervasive, especially when the policy maker is willing to influence the public learning rules.⁴⁷ In recent work, Busetti et al. investigate the effects of a sequence of deflationary shocks on expected and actual inflation and output in the context of a New Keynesian model where agents have incomplete information about the workings of the economy and form expectations through adaptive learning processes.⁴⁸ They show that the learning process could imply a de-anchoring of inflation expectations from the central bank’s target that is entirely data-driven, through the workings and feedback of the learning process.

More complex agent-based models have also been employed to explore the impact of heterogeneous expectations in environments where there could not exist any rational expectations equilibrium towards which agents can coordinate.⁴⁹ In line with Simon's (1955) seminal contribution, later developed with March, agents use expectations based on simple heuristics as a device to willingly ignore part of the available information in order to reach local optima which, in this particular setting, beat the outcomes of fully rational choices.⁵⁰ This strategy proves to be superior to more sophisticated ways of forming expectations, grounded, for example, in recursive least squares as in mainstream learning literature, due to the highly unstable and uncertain, in the Knightian sense, environment. Rather than making the case for a general superiority of simple versus sophisticated rules, this stream of works provides a counterexample to the opposite claim, even in the event that information is not costly *per se*. There are conditions under which less is clearly more.

Again, rules of thumb, traditions and common received wisdom can be somewhat effective tools in helping economic agents to efficiently reach their goals. It should be noted that also the results that come from the learning behaviour of boundedly rational (though not necessarily *à la* Simon) agents could and should be confronted with the "direct observation of human behaviour in the market and in the firm" available from survey-based data on expectations.⁵¹ Indeed, the strategy that Simon recommended to economists in the early 1980s was that of securing "new kinds of data at the micro level, data that will provide direct evidence about the behaviour of economic agents and the ways in which they go about making their decisions".⁵² The massive amount of empirical work at the level of individual decision makers, that was only imagined more than 30 years ago when Simon was advancing his criticism of rational expectations, has now been made possible by the availability of data and computational power.

Conclusion

Individual agents' expectations on the state and evolution of the economy have a great influence on macroeconomic variables. Macroeconomists have oscillated between giving prominent importance to survey-based expectations data (as in the first analyses of business cycles in the immediate aftermath of the Second World War) and ignoring empirical data on expectations altogether, relying instead on model-consistent rational expectations. In recent years, the increasing availability of individual survey data and the failings of models based on purely rational (representative) agents have prompted renewed interest in inquiries into the direct measurement of individual expectations and empirical studies of their formation. Herbert Simon's legacy provides a useful guide for both these activities.

Over the past decades, the success by policy makers in stabilising expectations could have generated the falsely reassuring conclusion that expectations are of limited consequence and can be assumed away. In fact, the unbiasedness that stems from Muth's original rational expectations hypothesis could hold both when agents behave as neo-classically rational agents as well as when they inhabit a sufficiently stable economic environment and follow a boundedly-rational learning procedure. Conclusions, however, differ when the economy is hit by sudden changes such as deep recessions, technological revolutions, institutional transformations, and rapid modifications in social habits. In such cases, which are by far the most common, possibly excluding only the 1960s and the couple of decades of the so-called Great Moderation around the turn of the last century, in a world populated by neoclassical agents, economies would be stabilised only by a quick, widespread agreement on the new general economic equilibrium (or its deep parameters), or if agents are closer to boundedly-rational ones, with the help of the actions of institutions and other focal actors. In the latter case, stories and narratives, as pointed

out by Akerlof and Shiller, as well as norms and conventions (in the spirit of Keynes and Simon) may become prominent macroeconomic forces.⁵³

Sound new research on expectations is warranted. It should be both empirical and theoretical. On the empirical side, better and larger data collecting is already ongoing. Big data techniques could possibly complement more traditional survey-based methods. With regard to theory, research on learning and information has been a promising avenue and should regain importance. Discipline in relation to a model internal consistency provided by the rational expectation hypothesis could be meaningfully substituted by strong, repeated empirical verification in order to avoid the proliferation of model-specific settings of expectations.

Finally, institutions should pay particular attention to current research on agents' cognitive limits. The reason is twofold. It would help, on the one hand, to perfect their policy tools, by relying on models better apt to gauge the reactions of businesses and households to policy interventions, and it would improve, on the other hand, their ability to drive the economy in times of great disruption, by better focusing on salient communication to the general public. In following Simon, economists and social scientists in general, not only those of strict behaviourist observance, could also benefit from this heightened institutional attention, as policy actions could provide the replicability they need in order to discriminate between model-specific local behavioural hypotheses and more general behavioural traits to be possibly included in macroeconomic models.

Notes

- 1 Ando (1979, p. 83).
- 2 Baumol (1979, p. 76).
- 3 That is, decisions that lie in a region of the space defined by a set of acceptability constraints.
- 4 Simon (1955).
- 5 Simon (1978).
- 6 DellaVigna (2009, p. 348).
- 7 Sims (2003).
- 8 See, among others, Gigerenzer (1996).
- 9 For an alternative view, that deems these perturbations as fundamental for modeling human choices, see Tversky and Kahneman (1974, 1981) and Kahneman, Knetsch and Thaler (1991).
- 10 See also Visco (2013).
- 11 The seminal works of Keynes (1936) and Hicks (1939) are well known examples.
- 12 The heterogeneous relevance of expectations in economic models that have been progressively considered mainstream has also made it difficult to develop a "theory of expectations", one that would form a basis for a well-defined field in the economic discipline dedicated to expectations. For an extensive analysis of this issue, see the Introduction to Visco (1985) and Visco (2009a).
- 13 Keynes (1921), Knight (1921).
- 14 Keynes (1936).
- 15 Lucas (1976, p. 41).
- 16 Muth (1961).
- 17 Holt, Modigliani, Muth and Simon (1960). In their contribution the authors derived a decision rule for firms that found the optimal level of production, given the state of inventories and the expectations on future sales. The cooperation, in Simon's words, of two Keynesian economists, one rational expectationist and a behaviouralist, gave origins to contributions that came to be prominent but opposing: the rational expectation hypothesis and the bounded rationality streams of research. An analysis is given in Egidi (2017).
- 18 As Simon (1984, p. 49) fittingly observed, the special virtue of these terms was largely due to their ability to "win instantly by taking the breath away from would-be disputants, whose very skepticism now accuses them of 'unnaturalness' or 'irrationality', as the case may be."
- 19 Woodford (2013, p. 304).

- 20 See Evans and Honkapohja (2001). In a stable environment a learning procedure based on a set comprising only the past realisations of the variable to be expected may lead to an unbiased though possibly inefficient expectation of its future path.
- 21 Davidson (1982, p. 190).
- 22 Pesaran (1988, Chapter 2).
- 23 Keynes (1936, p. 156).
- 24 Visco (2009a).
- 25 Visco (2009b).
- 26 For a survey on recent contributions see Coibion, Gorodnichenko and Kamdar (2018). See also Visco (1984) for an extensive discussion of results from early surveys of price expectations, as well as an empirical analysis of the formation of expectations in Italy from the early 1950s through the late 1970s.
- 27 Similar results hold for the years following the 1973–74 oil crisis, see Visco (1984, Chapters 4 and 5). See also Cukierman (1986).
- 28 Gennaioli, Ma and Shleifer (2016, p. 380).
- 29 For example, Banca d'Italia has carried out a Survey on Household Income and Wealth (SHIW) since the mid-1960s, complemented over the years by a number of surveys on firms' intentions and expectations. Similar information is gauged for instance by the Survey of Consumer Finances (SCF) and by several business surveys produced by the Federal Reserve System (e.g. the Empire State Manufacturing Survey by the New York Fed). In addition, both the Philadelphia Federal Reserve Bank (since 1968) and the European Central Bank (since 2002) release quarterly surveys on professional forecasters' expectations about real and nominal macroeconomic variables (SPF).
- 30 Recent work by Aruoba (2016) and Doh and Oksol (2018) use direct observations on agents' expectations to estimate the term structure of inflation expectations in the United States and evaluate the degree to which inflation expectations have been anchored over time. Buono and Formai (2018) use expectations recovered from the Consensus Economics survey to compare inflation anchoring in the euro area versus other major economies. Łyziak and Paloviita (2017) show some signs of deanchoring in the euro area inflation expectations in one analysis based on the ECB Survey of Professional Forecasters and on the European Commission Consumer survey.
- 31 See, for a succinct overview of some of the proposals advanced in the literature, Visco (1984, Chapter 6).
- 32 Manski (2018) reviews and extend a previous contribution on the same issue (Manski, 2004) where the use of survey-based expectations data in macroeconomic modelling was strongly suggested. Based on new empirical evidence, directly eliciting probabilistic expectations from households and businesses in surveys is found to be particularly effective.
- 33 Simon (1984, p. 52) summarising Blaug (1980, p. 186).
- 34 Simon (1984, p. 35).
- 35 Ando (1983).
- 36 See Lucas (1972, 1980) and Sargent (1976).
- 37 Simon (1979, p. 505).
- 38 Simon (1978, p. 10); see also Friedman (1979) and Ando (1981).
- 39 On this, see Simon (1958) and for similar arguments Keynes (1936, Chapter 12), even if it should be acknowledged that, according to Simon, "Keynes' modes of reasoning in the *General Theory* are only locally heretical. His general form of argumentation is the one that is standard in economics: what might be called 'what would I do if I were a rational man' argumentation" (Simon, 1984, p. 36).
- 40 A more radical approach addressing the interaction between historical evolutions, market and non-market behaviour and economic theorizing is found in Polanyi (1944).
- 41 Evans and Honkapohja (2001).
- 42 Nerlove (1958).
- 43 See, for a perceptive analysis, Rose (1972).
- 44 Sargent (1993).
- 45 According to Sent (1997), the link between Sargent's and Simon's bounded rationalities is still, after all, rather weak. This does not reduce the influence exerted by Simon, but while Sargent advanced in a world of adaptively learning (based on parallel computing) standard utility-maximising agents, Simon kept a clear distance from neoclassical theory, maintaining the prominence of "satisficing" behaviour and dismissing the adoption of parallel adaptive computing systems while continuing to prefer the recourse to more traditional serial symbol processing procedures.
- 46 Ferrero (2007).

- 47 “A policy-maker who considers his role in determining the dynamics of the agents’ learning process could choose a policy rule that induces agents to learn at a given speed, affecting the welfare of society along the transition.” (Ferrero 2007, p. 3034).
- 48 Busetti, Ferrero, Gerali and Locarno (2014) and Busetti, Delle Monache, Gerali and Locarno (2017).
- 49 See, for a recent contribution, Dosi, Napoletano, Roventini, Stiglitz and Treibich (2017).
- 50 See Simon (1955) and March and Simon (1993).
- 51 Simon (1984, p. 52).
- 52 Simon (1984, p. 40), where he also observes, somewhat surprised, that a similar suggestion had also been advanced by Lucas in his book on the business cycle (Lucas, 1980, pp. 288–289).
- 53 Akerlof and Shiller (2009).

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