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ORIGINS AND FRONTIERS OF BEHAVIORAL MACROECONOMICS – FROM (IR)RATIONALITY TO EXPECTATIONS

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Abstract

This paper examines the origins and current frontiers of behavioural macroeconomics, using expectation formation as a conceptual framework linking early psychological insights to modern formal models. The review traces developments from animal spirits, bounded rationality and adaptive expectations to heterogeneous heuristics, sticky information, rational inattention and behavioural New Keynesian models. Its main contribution is a comparative assessment of these approaches in terms of their underlying mechanisms, empirical predictions, identification challenges and implications for monetary and fiscal policy. Particular attention is given to heterogeneity stemming from different economic circumstances and to behavioural departures from rational expectations. The analysis shows that competing approaches can explain similar macroeconomic patterns yet imply different causal mechanisms and policy responses. Future progress depends on direct model comparisons, causal identification, out-of-sample validation and the integration of survey, experimental, administrative and high-frequency data into theoretically disciplined models.

Keywords: behavioral macroeconomics, expectation formation, bounded rationality, economic policy

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1. INTRODUCTION

Behavioral macroeconomics is a relatively new field in economic research that seeks to integrate the psychology of human behavior through decision-making into macroeconomic models and policies. In contrast to the macroeconomic level, behavioral economics has made significant progress at the micro level since the 1970s, largely due to the pioneering works of Daniel Kahneman and Amos Tversky, who initiated research from the then-current assumptions of *perfect rationality*. On the other hand, in the sphere and field of macroeconomics, acceptance of these ideas has only recently come to the fore. Traditional macroeconomic thought has been built for decades on the assumption of *rational expectations*, in a way that complex economic concepts have been simplified for the purpose of easier explanation and observation of the influence of various factors, but often neglecting bounded rationality, heterogeneity in expectations, as well as the influence of various psychological factors on aggregate outcomes. The arrival of the Great Recession, which began with the global financial crisis of 2007, and its aftermath, further highlighted the limitations of the previously dominant macroeconomic models, which were based on rationality and various simplifications. These factors have led to increased interest in alternative approaches that can explain phenomena such as the emergence of bubbles and shocks, the collapse of confidence, and perhaps most importantly, the unstable expectations of consumers and investors.

In this context, behavioral macroeconomics developed, which combined segments that were previously considered difficult to combine, namely different insights from behavioral economics, which was itself "microeconomic and individual", and macroeconomic models. It is precisely because of the topicality of this field of research that a "fresh" way of understanding macroeconomic fluctuations, politics, and labor markets has emerged at a time when standard theories are no longer able to provide answers to the questions raised. This paper aims to present the development of behavioral macroeconomics from its intellectual beginnings to the latest research, with a critical analysis of the aforementioned key contributions. Through a chronologically structured presentation, the paper will cover the early ideas that determined the behavioral approach, then the emergence and influence of behavioral economics at the microeconomic level, and the gradual, perhaps unconscious, but increasingly intensive integration of these ideas into macroeconomic models over the past decades. Special emphasis will be placed on the evolution of how we understand expectations, from the seemingly irrational or adaptive expectations in early theories, through the dominant paradigm of rational expectations, all the way to contemporary models of bounded rationality and heterogeneous expectations that, at least currently, are at the center of the behavioral macroeconomic approach.

Although existing reviews could provide extensive accounts of behavioral economics, adaptive learning, heterogeneous expectations, and experimental macroeconomics, these strands are not always examined within a single comparative framework that is centered specifically on expectation formation. This

paper contributes to the literature by using expectation formation as a common conceptual framework for comparing these approaches. More specifically, it distinguishes heterogeneity arising from different economic circumstances and information sets from specifically behavioral departures from rational expectations. It also compares the principal approaches according to their underlying mechanisms, empirical predictions, identification challenges, and implications for monetary and fiscal policy. The paper therefore moves beyond a purely chronological account and provides a critical synthesis of when and why behavioral models may offer additional explanatory and policy-relevant value.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The way in which expectations are formed in this paper represents the basic conceptual channel through which individual behavior and aggregated macroeconomic outcomes are linked. The existence of cognitive constraints and the availability of information affect the way in which economic agents interpret all available information and shape beliefs about the future. When expectations are formed in this way, then this determines the direction in which they make decisions about consumption, savings, investments, prices and wages, while the aggregation of these decisions affects the movement of production, employment, inflation and financial stability. At the same time, monetary and fiscal policy measures also change the way in which economic agents perceive them. Such a conceptual framework allows historically different approaches to be compared according to the same basic question, which is how economic agents use available information, form their own expectations and transfer them into decisions that produce macroeconomic consequences?

The idea that psychological factors have a significant impact on the economy is not new. Almost 100 years ago, Keynes introduced the concept of "animal spirits", with the aim of showing how feelings, emotions and perceptions of the present and the future, and especially optimism and pessimism among investors, can influence economic cycles. In this way, Keynes tried to explain that due to the uncertainty that otherwise prevails in the economy, emotions and subjective expectations can play a key role in determining the level of investment and consumption. Therefore, although Keynes's intention was not to formally establish a model that would include psychological factors, it is quite clear that his contribution will remain as the basis of the behavioral approach in macroeconomics (Akerlof & Shiller, 2009).

After Keynes, in the mid-20th century, other attempts to include more realistic behavior of various economic entities in macroeconomic theories emerged. In this sense, James Duesenberry (1949) developed the relative income hypothesis in 1949, trying to explain consumption patterns that standard economic theory could not explain. According to his model, consumers do not make decisions

solely on the basis of their own absolute income, but their relative position in society is also important to them. He believed through his model that they tend to compare their income with the incomes of others. It is important to emphasize that this theory implicitly introduced psychological elements such as social norms and the status effect into the macroeconomic analysis of saving and consumption. Duesenberry also anticipated concepts that would later become the basis of behavioral economics by assuming that consumers show loss aversion, because they do not want to reduce their standard of living once they have raised it, and the reference point effect, which means that they spend in relation to the previously highest level of income achieved. Although Friedman's permanent income hypothesis subsequently became dominant, the renewed interpretation of Duesenberry's work shows that the relative income hypothesis anticipated several later behavioral concepts, particularly social comparison, reference dependence and resistance to reductions in previously achieved consumption levels (McCormick, 2018).

In parallel, ideas of bounded rationality were developing in the broader economic discourse. Herbert Simon (1955) criticized the assumption that people are perfectly rational and have unlimited cognitive capacity to perform optimization processes. In his work "A Behavioral Model of Rational Choice", he laid the foundations for the concept of bounded rationality, which can be explained by the fact that people make decisions using satisfactory, but not necessarily optimal, strategies, due to the limitations of the information they have at their disposal, the time constraints in which they make decisions, and their own cognitive abilities. Although his work focused more on the microeconomic level, this idea was intended to pave the way for deviations from perfect rationality to be applied at the macroeconomic level.

Until the late 1960s, macroeconomics remained largely within the framework of the so-called neoclassical synthesis and Keynesian models with some ad-hoc assumptions. Expectations were often included in these earlier models in a very simplified way, for example through adaptive expectations, where it was assumed that people correct their inflation predictions based on previous errors. Such an approach was embedded in the early Phillips curve and inflation models, for example. These assumptions that expectations are not entirely rational can be seen as a kind of behavioral element in macroeconomic theories, although it is important to emphasize that they were not motivated by psychology but rather by the practical need to align models with empirical data. An example is Milton Friedman (1968), who introduces adaptive expectations of workers in his theory of inflation.

The following period, which included the late 1960s and early 1970s, brought about a new way of thinking through the rational expectations revolution. The work of economists such as John Muth (1961) and Robert Lucas (1972) laid the foundation for a completely new way of thinking, which was that economic agents were assumed to make optimal use of all available information in making their own decisions and to use it consistently in forming their own expectations

about the future. The rational expectations hypothesis soon became the standard in macroeconomic models, from business cycle theory to aggregate supply models, supplanting earlier, less rational specifications of expectations. Lucas's critique (Lucas, 1976) argued that only models based on microeconomic foundations with rational agents could reliably analyze the effects of policies, which strongly influenced macroeconomic methodology at the time. This development, although it represented a methodological advance, also temporarily distanced macroeconomics from the inclusion of psychological factors, because any deviation from the assumption of full rationality was treated as a potentially dangerous compromise of analytical consistency.

2.1. The emergence of behavioral economics and implications for macroeconomics

While macroeconomics was undergoing a "hardening" phase in the form of rational expectations and dynamic stochastic general equilibrium models, a quiet revolution was taking place at the microeconomic level. Behavioral economics emerged as a separate and new discipline led by empirical research that documented systematic deviations of actual human behavior from the assumptions of classical theory. Key moments were the work of Kahneman and Tversky (1974, 1979) on heuristics and decision biases, which included the development of prospect theory, which showed that people value gains and losses differently and often make decisions under risk that are contrary to the expected utility they might achieve. During the same period, Thaler and other economists began to identify so called "anomalies", or rather phenomena in economic practice that do not conform to the assumption that people are rational. An example of such an early anomaly is the equity premium puzzle. It is worth to mention that they saw the difference in returns between stocks and bonds was greater than would be justified by rational expectations and standard risk aversion. Benartzi and Thaler (1995) were able to explain this by using the concept of exchange loss aversion, as investors frequently check the value of their portfolio and due to loss aversion, overreact to short-term declines, which makes them more conservative and leads to demand a high premium on equity investments.

Although these early findings and papers focused more on individual decisions and explanations of market anomalies, especially in the domain of financial markets, they nevertheless indicated that aggregate outcomes, such as savings, investment, or market volatility, may be different if real, behavioral behavior is taken into account. In this context, one of the first links between behavioral microeconomic and macroeconomics was research in the field of behavioral finance. Shiller (1981) showed that stock prices are much more volatile than rational expectations of future dividends could explain, which indicated the existence of collective irrationality, or at least unstable expectations, in the stock market. Later, Shiller was the one to coin the term "irrational exuberance" in order to explain the over-enthusiasm of investors that leads to market bubbles.

Recent research has shown patterns that behavioral finance theory seeks to explain, and which are not limited exclusively to large and developed markets. Marić, Šagovac and Šikić (2024), analyzing the Croatian capital market in the period from 2000 to 2022, found that momentum and contrarian effects exist, with their size and statistical significance depending on the investment period and the way the market functions. It is important to emphasize that they determined that the fact that the contrarian effect was confirmed in a larger number of observed cases, which on the other hand indicates the existence of a certain type of market memory. In general, such findings support the assumption that investors' expectations and reactions are not always instantaneous and fully aligned with all the available information they have. However, they also show that the predictability of returns alone is not sufficient to reliably determine whether its cause is an overreaction or an underreaction, the use of simple heuristics or a change in risk perception.

Another research that brought microeconomics and macroeconomics closer together was the analysis of consumption and saving, published by Laibson (1997) by introducing hyperbolic discounting into the intertemporal consumption model. Instead of constant discount rates, hyperbolic discounting reflects the empirically observed tendency for people to value the present disproportionately more than the future. The consequence of this is a tendency that leads to insufficient saving or, on the other hand, excessive borrowing. These economic phenomena are also macroeconomically relevant, because they affect aggregate saving, investment, and even financial stability itself. It is important to note that Laibson's work showed that including assumptions about real self-control and preferences in intertemporal models can explain why many people do not save enough for retirement, which standard models failed to do without introducing certain ad-hoc factors. It is also important to emphasize that precisely these results opened the door to the idea that macroeconomic models should also take into account limitations of will and cognitive bias, such as a greater preference for the present in comparison to the future.

By the end of the 1990s, there was a wealth of evidence at the microeconomic level that the behavior of economic subjects and agents deviates from perfect rationality, because expectations can be overly optimistic or pessimistic, and decisions are often influenced by habits, social comparisons, emotions, or even cognitive constraints. However, macroeconomic theory was very slow to integrate this evidence, if at all. The reason lay partly in the inertia of the discipline itself, since the leading macroeconomic models were mathematically elegant and seemed to explain many aggregate movements well, at least in times when there were no crises, so there was no strong motivation to disrupt this elegance by introducing psychological complexities.

2.2. The beginning of integration - Early behavioral elements in macroeconomic models

Although slowly, the foundations for integrating behavioral ideas into macroeconomics began to be laid during the 1980s and 1990s. One of the pioneering contributions was the idea of "near-rational" behavior, first presented by Akerlof and Yellen (1985). In it, they showed that if there is even a small fraction of firms or workers that do not behave completely rationally, such as ignoring the very small cost of changing prices or wages, aggregate macroeconomic outcomes can change significantly. More specifically, even minimal deviations from perfect optimization could explain the existence of nominal rigidities, that is, slow adjustment of prices and wages, which in turn leads to monetary policy having real effects, contrary to the classical theory of the neutrality of money. The key contribution of this paper and these ideas is that they showed that even small irrationalities at the microeconomic level can lead to large consequences at the macroeconomic level. An additional contribution is that they gave credibility in this way to the idea that realism is an assumption, such as that people may not calculate every decision down to the last cent, which helped explain why markets don't solve problems immediately, and why we have recessions and unemployment.

Similarly, Akerlof emphasized the role of social norms and rules of conduct in economics in several of his research papers (Akerlof, 1982). He emphasized that employers sometimes pay higher than the equilibrium wage level because they expect greater loyalty and effort from workers, and workers reciprocate with greater effort if they feel that they are being paid fairly. It can be noted here that this concept of the efficiency wage represented a departure from the classical model of wages that are determined solely by productivity and market equilibrium, thus introducing a psychological motive into the explanation of why wages can be rigid and why unemployment can exist even in equilibrium. If these findings and conclusions were translated to the macroeconomic level, such a behavioral basis of wage rigidity meant that the labor market would not be able to automatically balance the supply and demand for labor.

In the following years, Akerlof (2007) continued to advocate the ideas of behavioral macroeconomics, especially through the reintroduction of psychology into macroeconomic models. He identified the so-called "missing motivation" in previous macroeconomic theories, arguing that many phenomena, such as why people hold money, why prices do not change immediately, or why nominal wages are negotiated in advance, are difficult to explain without factors such as habits, normative beliefs, or feelings of fairness. Akerlof emphasized that macroeconomic models must recognize the existence of multiple motivations, not just narrow self-interest, and that perceptions and expectations shape reality. For example, if people believe that prices will rise, they will raise their own prices in advance and demand higher wages, thereby ultimately confirming expectations, suggesting that expectation formation should be modeled outside the framework of perfect rationality.

At the same time, two important trends have emerged in the field of expectations theory that deviate from complete rationality, although this does not necessarily mean that it is for psychological reasons, but in this way a space has been opened for a later synthesis with behavioral ideas. Here we primarily refer to:

- Learning and adaptive expectations models were developed through several related contributions, including the analysis of the convergence of learning mechanisms by Marcet and Sargent (1989) and the systematic framework developed by Evans and Honkapohja (2001). In these models, economic agents do not know the complete structure of the economy but estimate its parameters and relationships over time on the basis of available information and previous forecasting errors. Their idea was to approximate the model to reality in which people have to learn the true structure of the economic system, which economists usually take for granted. This Adaptive Learning approach showed that the economy will not always converge to rational expectations if the environment is complex, since expectations may remain systematically biased or heterogeneous. Although this is not "behavioral" in the narrow sense of psychology, it nevertheless opened the door to the concept of imperfect knowledge and adaptive expectations in macroeconomics.
- The information inefficiency and limited attention models proposed by Ricardo Reis and Gregory Mankiw (2002) are the "sticky information" model, where agents are assumed not to update their expectations continuously in each period due to the costs of gathering and processing information. Instead, they do so intermittently and infrequently. The end result is differences in expectations between those who have updated their information and those who are late. Another related concept is rational inattention introduced by Christopher Sims (2003), inspired by information theory, where he considers that agents have a limited capacity to process information, and then filter and pay attention only to the most important information, ignoring the rest that is available. Ultimately, this leads to their expectations not perfectly reflecting every change in policy or the state of the economy, which in turn may explain why reactions are not immediately "perfect." These models are significant because they incorporate realistic cognitive constraints, primarily attention and frequency of information, into the framework of macroeconomic expectations, which is in the spirit of the behavioral approach.

However, when there are different expectations among economic subjects, this does not mean that this must automatically represent a behavioral deviation from rationality. Their expectations may differ because they do not all have equal access to key information, or are differently exposed to economic ones, even when each subject acts rationally within its own constraints. In that case, it is possible that there is a specific behavioral deviation, when different subjects simplify the available information in their subjective way, choose which ones to process or even misinterpret them, which ultimately leads, through the use of

heuristics, to prognostic errors. This distinction is important because heterogeneity alone does not explain why expectations deviate from the rational model or whether such deviations require a different economic policy response.

2.3. The rise of behavioral macroeconomics after 2008

The onset of the global financial crisis, that started in 2007, acted as a catalyst for a critical reexamination of previous macroeconomic assumptions. The dominant models, such as the representative agent DSGE model and rational expectations, mentioned above, largely failed to predict the crisis, nor could they simply explain how, for example, the collapse of the real estate market, panic reactions in financial markets, or why there is a prolonged weak recovery despite aggressively managed monetary expansion, came about. It was precisely because of the lack of these answers led to the flourishing of behavioral macroeconomics.

A major contribution in this direction was work by Akerlof and Shiller. They relied on Keynes's term animal spirits, and argued that without factors such as trust, honesty, corruption, investor misconceptions and narratives circulating in the public, we cannot fully understand economic developments. In addition, they particularly emphasized the role of narratives, simple stories that people tell about the economy, such as that real estate prices can never fall at the level of the entire country, which is exactly the story that preceded the bursting of the real estate bubble in the USA. Shiller later continued this line of research in his concept of narrative economics, arguing in his work (Shiller, 2017) that economic fluctuations sometimes have more to do with the spread and "contagion" of popular stories than with changes in the so-called fundamentals. As an example, excessive optimism in the narrative "real estate prices always rise" can lead to massive speculative construction and buying, which pushes the economy into a boom, while a change in the narrative to pessimism can cause a sharp decline in investment and the onset of a recession.

On the other hand, in the early 2010s, models were developed that are now grouped under the name “behavioral DSGE” or behavioral New Keynesian models. One of the pioneers in this field was Paul De Grauwe, who published a series of papers during this period showing how the standard NK model, as used by central banks for monetary policy analysis, can be “enriched” by introducing heterogeneous expectations and heuristic decision-making. In his work, De Grauwe assumed that instead of a single representative agent who knows the entire model, there are multiple types of agents who use simple rules for forecasting. For example, for one of them, they believe that if GDP is growing, it will continue to grow in the future, while others are opponents, expecting the indicator to return to its long-term trend. It is important to emphasize that these agents change their rules heuristically, i.e. switch to the strategy that has recently given better results. This seemingly simple and realistic setup resulted in a model that generates endogenous business cycles driven by changes in optimism and pessimism, which is precisely what could be called a formalization of Keynes's "animal spirits". A key

implication of De Grauwe's model was that monetary policy can stabilize the economy not only through traditional channels, such as interest rates, but also by influencing expectations. An example is a policy that calms excessive optimism or pessimism, in a way that, through communication and credibility, moderates the amplitudes of the current cycle. De Grauwe and Ji (2018) explicitly emphasize that "behavioral economics also uses the role of animal spirits in macroeconomics", emphasizing that standard models miss the mechanisms that arise from changing market sentiment.

A similar heterogeneous expectations approach was developed simultaneously by other authors. Hommes, for example, incorporated heuristic learning into macroeconomic models. For example, Branch and McGough (2009) examined a New Keynesian model with heterogeneous expectations, where some agents believe in one form of the Phillips curve and some in another, and switch between these expected models depending on the outcome. Such assumptions have shown that the stability of the economy and the outcomes of monetary policy can deviate significantly from the rational expectations case, because in some circumstances the economy can be more volatile due to the central bank's attempts to control inflation, and the main reason for this is that agents misunderstand or overreact to its actions.

Another significant step forward was the formalization of the concept of bounded rationality in the optimization of agents themselves in a macroeconomic model. Gabaix (2020) developed sparse rationality and constructed a behavioral New Keynesian model. In Gabaix's framework, agents do not perfectly monitor all future news and implications, but simplify their decision-making process by ignoring small or complex effects, given that they have limited depth of thought. The consequence is that, for example, consumers and businesses react less strongly to very distant or complex future events than the rational model predicts. This bounded rational NK model performed better in replicating some empirical puzzles of standard models, such as the so-called forward-guidance puzzle, i.e. the excessively large effect of promises of future interest rate cuts in rational models. In Gabaix's model, forward guidance has a moderate effect, quite close to empirical estimates, because agents simply do not pay full attention to events far in the future (Gabaix, 2020). This demonstrated and confirmed that behavioral elements do not only serve narrative explanation, but can also solve specific quantitative problems of standard macroeconomic models.

Alongside the aforementioned theoretical innovations, there has been the development of experimental macroeconomics, laboratory and field experiments that study how people form expectations and make decisions in environments that simulate macroeconomic conditions. The pioneer here is again Hommes, who organized experiments in which people play the roles of "inflation forecasters" or investors in an environment that can be mapped to a particular macroeconomic structure. Interestingly, the experiments confirmed that heterogeneous and adaptive expectations better describe the behavior of participants than the rational expectations model. When participants had to predict, say, inflation or interest rates

in a simulated economy, most would use trend-following heuristics or lag behind changes, rather than immediately factoring in all publicly available information. These findings have provided experimental support for behavioral macroeconomic theories, showing that assumptions such as bounded rationality and heuristic learning are psychologically and empirically grounded (Hommes, 2021).

Other recent empirical research further confirms the importance of cognitive limitations in the economic decision-making process. Birknerova and Zbihlejova (2025), analyzing metacognitive errors that occur in the assessment of managerial competencies, show that self-assessments can be systematically related to the level of actual competencies that managers have, as well as to the Dunning–Kruger effect. Although their research relates to the individual and organizational levels, their results confirm the broader significance of the limited abilities of economic agents to objectively assess their own knowledge and the quality of the decisions they make every day. However, for behavioral macroeconomics, the existence of such biases is only a starting point, because for an individual cognitive error to become macroeconomically significant, it is first necessary to explain the way in which it aggregates and has an impact on investment, employment, pricing, or the formation of expectations.

An additional aspect of the impact of irrationality on macroeconomics was presented by Ariely (2009) through reflections on the global financial crisis of 2008, in particular showing how wrong the assumptions about market rationality were. He particularly emphasizes his own experiences with economists who claimed that "all irrationality" is erased when it comes to big decisions and markets, because then rationality supposedly prevails. However, it was precisely the market crash and the domino effect on the financial sector that showed that human errors can be systemic, predictable, and can multiply to a level that threatens the stability of entire economies. Ariely concludes that relying solely on standard economic theory and self-correcting market forces can be dangerous because it ignores behavioral biases.

This spectrum of presented theories and topics shows that behavioral macroeconomics has reached a stage of maturity in which it is no longer a question of one or two theories, but of a broad set of models and approaches that share a common spirit, which is to bring the realism of human behavior to the core of macroeconomic analysis. It should be emphasized that the goal is not to abandon formalism or reject all old concepts, but to expand them and "relax" them where empiricism and psychology suggest that they are excessively rigid.

When all these approaches are considered together, they show that contemporary behavioral macroeconomics represents, in addition to an alternative to rational expectations, a set of different explanations of how expectations are formed and changed. Adaptive learning emphasizes the gradual acquisition of knowledge about the economic system, sticky information and rational constraints in obtaining and processing information, heuristic models emphasize the selection of simple forecasting rules, while models of bounded rationality emphasize the

simplification of complex and long-term consequences. All of these mechanisms can produce similar phenomena, which may include the constant presence of forecasting errors, heterogeneous expectations and delayed adjustment. Therefore, their theoretical separation and empirical comparison is a crucial step in order to assess their real contribution to macroeconomic analysis and economic policy.

3. COMPARATIVE DISCUSSION AND CRITICAL EVALUATION

A review of the development of behavioral macroeconomics shows that its current research boundaries are no longer determined by the question of whether economic agents deviate from the assumption of complete rationality. The existence of various cognitive limitations, unavailability of information, heterogeneous expectations and errors in estimates has been confirmed by various theoretical, empirical and experimental studies. However, the key question today is what are the mechanisms that lead to the emergence of such deviations, how they can be distinguished from each other and to what extent their inclusion can lead to improvements in the way macroeconomic developments are explained and economic policies are shaped. This is precisely why a critical assessment of behavioral macroeconomics cannot be based solely on a comparison of its psychological dimension with standard economic models. In this sense, it is necessary to compare different behavioral approaches according to their assumptions, empirical predictions, the possibilities they have and how they affect monetary and fiscal policy.

3.1. Conceptual frontiers of behavioral macroeconomics

The assumption of rational expectations has enabled the construction of such models in which economic agents use all available information and understand how the economic system works. Such an approach does not imply that every individual can perfectly predict the future, because their errors and expectations, on average, are aligned with the economic model. The advantage of this framework is reflected in the methodological ways to conduct a clear analysis of economic policy. The main disadvantage of such a model is that the process of forming expectations remains almost invisible, since the model assumes the end result of this process, but does not explain how economic agents collect information, how they interpret it and why they may react differently to the same economic change.

Introducing additional types of agents, rules for working on forecasts, psychological biases and nonlinear interactions can help the model make better use of historical data, but at the same time increase its complexity. For example, a model that can subsequently explain almost every recorded movement does not necessarily have a greater ability to predict future changes. Therefore, the value of

a behavioral model should be assessed according to whether it produces precise and empirical predictions that can be tested, and that differ from the predictions of simpler models. It is especially important to distinguish heterogeneity from behavioral deviation from rational expectations. Economic entities may have different expectations because they have different types of information, have different incomes and assets, face different liquidity constraints or are unequally exposed to economic shocks. Just such a heterogeneity can be present when each subject acts rationally within the framework of the information and limitations at his disposal. Contemporary models of heterogeneous agents, for example, can incorporate different marginal propensities to consume or different channels of monetary policy without abandoning their assumption of rational expectations.

It is also important to emphasize that specific behavioral deviations exist when economic agents systematically simplify or selectively process information, rely excessively on recent experience, follow different trends, succumb to dominant narratives, or use rules that produce predictable errors. Partly because of this, the boundary of behavioral macroeconomics cannot be determined solely by the existence of different agents, especially since its specific contribution arises when the way expectations are formed is an independent mechanism that changes aggregate economic trends. Another important distinction concerns deviations from rational expectations and outright irrationality. In this sense, adaptive learning, rational inattention, and occasional information updating do not necessarily imply that economic agents are irrational, since they can act rationally in circumstances where they do not have complete knowledge of the economic system or in which obtaining and processing information is costly. Behavioral macroeconomics should therefore be seen as an attempt to view rationality within real cognitive, informational, and institutional constraints.

3.2. Competing approaches to expectation formation

Contemporary behavioral macroeconomics does not offer a single, universally accepted alternative to rational expectations. Instead, multiple approaches have been developed that start from different ways of explaining the emergence of forecast errors and heterogeneous beliefs. Although they may produce similar macroeconomic phenomena, their underlying mechanisms and implications are not the same.

The first of the explanations are adaptive learning models, through which it is assumed that economic subjects do not know the real structure of the economic system and then, partly because of this, they gradually evaluate the available data, as well as based on previous mistakes. Subjects in these models can use statistical rules similar to those applied by economists, but their expectations during the learning process do not have to be aligned with the balance of rational expectations. Precisely such models can explain the gradual adjustment after the change of the economic regime, the constant presence of forecasting errors and the possibility

that expectations temporarily or permanently move the economy away from the equilibrium state (Evans & Honkapohja, 2001).

The second explanation refers to sticky information models, which offer somewhat different explanations. The main problem with them is that they do not update information in every period. According to this model, expectations differ because some agents have new information, while others are still using previously available data, resulting in a gradual and uneven reaction of expectations to economic news and policy measures (Mankiw & Reis, 2002). In contrast, rational inattention is based on a limited information processing capacity. In this sense, subjects do not ignore information randomly, since they direct their attention to the signals they consider to be most important (Sims, 2003). This difference is significant, because sticky information emphasizes the frequency of updates, while rational inattention emphasizes the selection of information to be processed.

Heuristic models assume that economic agents use simple rules, such as following an existing trend or expecting economic indicators to return to a defined long-term average. Agents can change the rule they use depending on its recent performance. Such a change in strategy can produce waves of optimism and pessimism, as well as endogenous business cycles that do not have to be triggered by large external shocks (Brock & Hommes, 1997; De Grauwe, 2012). In this approach, expectations can become an independent source of instability.

Bounded rationality models further differ from heuristic approaches. In them, economic agents do not have to choose between predetermined forecasting rules, but rather simplify complex decisions by assigning less weight to certain information. Such an approach may explain why a central bank's promise to change interest rates in the distant future has a smaller immediate effect than predicted by the standard rational expectations model (Gabaix, 2020).

The narrative approach emphasizes the way in which beliefs spread among economic subjects. Expectations are not formed exclusively by accepting simple, social stories about the economy that are easily transmitted. Narratives such as the belief that real estate prices are always rising or that a certain crisis is temporary can influence investment and consumption before there is a change in the underlying economic indicators (Shiller, 2017). This approach provides a plausible explanation for the spread of optimism and fear, but faces the challenge of how to accurately measure the narratives and how to disentangle their causal influence from the change in economic circumstances itself.

These approaches can simultaneously explain recurring errors, delayed adjustment, and excessive volatility. This creates a problem of empirical identification. For example, a slow response of inflation expectations may be due to infrequent information updates, limited attention, adaptive learning, or reliance on previous experience, and therefore, observing slow adjustment alone is not sufficient to determine which mechanism is dominant.

3.3. Empirical and experimental evidence

The development of behavioral macroeconomics has depended largely on the ability to test expectations assumptions outside of theoretical models. Experimental research has shown that participants under controlled conditions often use simple rules, follow past trends, change strategies based on their recent performance, and gradually learn about the structure of the economic environment. When such results are obtained, they can provide support for models of heuristic and adaptive expectations, because participants' behavior often deviates from the current alignment with the equilibrium of rational expectations (Hommes, 2021). However, experimental confirmation of the existence of heuristics is not in itself sufficient to establish their macroeconomic significance. Controlled experiments can allow for a more precise determination of the causal mechanism, but their participants, incentives, and time frame may differ from the actual decisions of households, investors, and firms, because behavior in a laboratory task of forming inflation expectations may not fully correspond to behavior during a real period when inflation occurs, or when it comes to income, savings, and living standards. Therefore, it is necessary to connect what is done through research with survey, market and administrative data.

Surveys of expectations allow for direct observation of the beliefs and attitudes of households and businesses. It is through surveys that one can see that these groups differ in the information available, how often they update the information, and how accurate and precise their forecasts are. Households often rely more on personal experience and the prices of products they regularly buy, while professional analysts are more likely to incorporate new macroeconomic information (Carroll, 2003; Malmendier & Nagel, 2016). Such heterogeneity supports the abandonment of the assumption of a single representative expectation, but does not yet show whether the differences arise from limited attention, information costs, different experiences, or some other psychological bias. On the other hand, market data provide a different type of evidence. Shiller (1981) showed that frequent changes in stock prices are greater than can be explained by changes in expected dividends. Research conducted for the Croatian market also confirms the existence of momentum and contrarian effects, the significance of which depends on the time horizon and market regime (Marić, Šagovac & Šikić, 2024). Such behaviors may be related to market memory, overreactions, or heterogeneous investor strategies. However, the same result may be explained by changes in risk premiums or structural characteristics of a less liquid market. In part, therefore, market predictability provides evidence that the standard model must explain, but does not automatically confirm a specific behavioral mechanism.

A similar problem arises when linking individual biases and macroeconomic outcomes. Birknerova and Zbihlejova (2025) confirm the importance of metacognitive errors in assessing managerial competence. Such results show that economic agents can systematically misestimate their own knowledge. However, a behavioral macroeconomic model in this sense must go the extra mile and explain how such individual errors aggregate and affect

investment, employment, pricing, or the business cycle. Microeconomic confirmation of behavioral biases is a necessary but not sufficient condition for its inclusion in a macroeconomic model. In this sense, the growing availability of large databases, Internet searches, social networks, and financial data allows for more precise monitoring of attention, mood, and the spread of economic narratives. These data can bring the measurement of "animal spirit," or rather collective psychology, closer to real time and help institutions recognize changes in collective optimism or fear earlier. However, even when there is a larger amount of data, it does not automatically solve the problem of theoretical identification. The correlation between negative sentiment that may arise and a decline in consumption may mean that sentiment causes a decrease in consumption, but also that worsening economic conditions simultaneously reduce consumption and produce negative narratives. The role of theory is therefore not diminished by the development of large databases. On the contrary, a theoretical model should specify the mechanism, time sequence and heterogeneous response through which information influences expectations and decision-making. Therefore, the goal of behavioral macroeconomics should be to distinguish between competing causal explanations and to assess behavioral models against simpler alternatives along several dimensions. A behavioral model may provide additional value if it identifies an economically relevant mechanism, generates empirically distinguishable implications, improves out-of-sample performance, or materially changes the evaluation of a particular policy. This broader assessment is important because simple autoregressive or adaptive rules can often produce good short-term forecasts, and a more complex behavioral model is therefore not justified merely because it fits historical data more closely. Its additional complexity should produce at least one clear explanatory or predictive advantage relative to a simpler benchmark. Without such a comparison, there is a risk that additional psychological realism increases the flexibility of the model without materially improving its contribution to macroeconomic analysis.

3.4. Implications for monetary and fiscal policy

The way expectations are formed may significantly affect the transmission of monetary policy. In the standard rational expectations model, a credible announcement of future changes in interest rates is expected to be incorporated relatively quickly into the current decisions of households and firms. If information is updated only occasionally, attention is limited, or agents rely on simple heuristics, the same announcement may produce weaker and more heterogeneous effects. These mechanisms suggest that different models of expectation formation may have different implications for central-bank communication. Sticky-information models may imply that communication is more effective when relevant information reaches a broader audience and is updated more frequently. Rational inattention models instead suggest that effectiveness may depend on its simplicity, salience, and accessibility to agents with limited information-processing capacity. Heuristic models suggest that the

credibility and past performance of policy may influence the forecasting rules selected by agents, while narrative approaches emphasize how policy messages are interpreted and socially transmitted. These implications should nevertheless be understood as conditional on the validity of the underlying mechanism and the institutional and economic context in which communication takes place.

Gabaix's (2020) bounded-rationality model assumes that agents assign less weight to distant and complex consequences, thereby moderating the strong immediate effects of forward guidance generated by standard models. This mechanism suggests that nearer-term, clearer, and more accessible announcements may exert a stronger influence than technically complex commitments concerning the distant future. However, the corresponding communication implications depend on whether this mechanism accurately describes expectation formation in the relevant institutional and economic setting. In this context, it is worth mentioning the work of Levaj and Viljevac (2025), who conclude that the increase in interest rates contributed to the reduction of inflation, but that this contribution was modest and accompanied by high costs of monetary contraction. Their findings indicate the need to distinguish the mechanical channel of interest rates from the expectations channel. A change in interest rates can affect demand through the price of credit, but its overall effect also depends on how households and businesses interpret the duration of inflation, the credibility of the central bank and their own future financial position.

Behavioral expectations are also very important for fiscal policy. In the standard framework, households' reactions to a fiscal policy measure depend on expected income and taxes. However, households may overvalue the present, undervalue future fiscal obligations, or interpret the temporary and permanent nature of the measure differently. Therefore, the same fiscal measure may produce different effects on consumption, depending on the way it is presented, the credibility of the institution, and expectations about the future economic situation. Here, heterogeneity must again be distinguished from behaviorality. A low-income household may spend a transfer immediately because it faces liquidity constraints, not because it is biased toward the present. On the other hand, a household may spend a temporary transfer because it misjudges its permanence or ignores future tax consequences. These mechanisms may produce similar observed results, but imply different explanations of the fiscal multiplier and different policy designs.

Similarly, firms' expectations also link their future beliefs and the decisions they make in the present. Dula and Krasniqi (2025) show that expectations regarding growth and development ambitions of firms are associated with employment difficulties in manufacturing SMEs. Although their research does not model the process of expectation formation, it shows that beliefs about future growth affect current needs for workers and investment in training. This confirms the practical relevance of including expectations in the analysis of labor markets and development policies. Behavioral macroeconomics also raises the normative question of the justification of intervention. If agents systematically undersave, overestimate the value of assets, or misunderstand central bank information, public

policy can attempt to improve their decisions. However, the macroeconomic application of the nudge approach is much more complex than changing the individual choice architecture. The central bank or government cannot reliably assume that they understand the collective psychology of the market better. If one tries to act on excessive expectations management, then this can lead to a loss of credibility, especially if the policy messages do not match subsequent economic outcomes.

3.5. Analytical limitations and research priorities

The greatest strength of behavioral macroeconomics is also one of its fundamental limitations. The diversity of human behavior has allowed the development of models of learning, attention, heuristics, narratives, social norms, and bounded rationality. However, without theoretical consolidation of these approaches, behavioral macroeconomics risks remaining a collection of disparate models, each tailored to explain a particular anomaly.

It is not necessary to integrate all behavioral approaches into a single model. Such a model could become too complex to understand and apply in practice. However, it is necessary to determine whether different forms of behavior can be derived from a smaller number of general principles, such as information costs, limited information processing capacity, learning from experience, or the selection of more successful strategies. This would reduce the arbitrariness in the choice of behavioral assumptions. Another challenge is the estimation of parameters. Behavioral models require measurements of the frequency of updates, the degree of trend following, sensitivity to past experience, changes in forecasting rules, or the strength of social diffusion of narratives. If these parameters are chosen only to ensure that the model reproduces historical data as well as possible, there is a danger of overfitting. Parameters should therefore, wherever possible, be based on independent survey, experimental, or microeconomic evidence. Finally, behavioral macroeconomics needs to maintain a connection with other schools of economic thought. Post-Keynesian approaches have long emphasized fundamental uncertainty and animal drives, as well as collective psychology, while institutional economics emphasizes the importance of norms, rules, and social context. The difference is that contemporary behavioral macroeconomics tends to formalize such elements within models that allow for quantitative analysis. Future development does not require a complete erasure of the boundaries between these approaches, but may use parts of them that are significant for it.

Based on all of the above, the research frontier of behavioral macroeconomics does not lie in constantly adding new biases to standard models. Its future progress depends on the development of relatively simple and theoretically disciplined mechanisms that can be empirically distinguished, quantitatively estimated, and used in economic policy analysis. Behavioral models will demonstrate a meaningful macroeconomic advantage when, relative to simpler

alternatives, they provide a clear explanatory, predictive, or policy-evaluation benefit that justifies their additional complexity.

4. FUTURE RESEARCH DIRECTIONS AND CONCLUSION

4.1. Future research directions

The development of behavioral macroeconomics shows that economic science has made a significant shift from the question of whether economic agents deviate from complete rationality to the question of how these deviations should be theoretically modeled, empirically identified, and incorporated into economic policy analysis. Previous research has developed various models of adaptive learning, limited attention, information availability, heuristic expectations, and bounded rationality. However, it has not yet been determined which of these mechanisms is most important in explaining specific macroeconomic phenomena, nor under what circumstances does the behavioral approach, in general, have a clear advantage over some other simpler models.

The first direction for future research is to directly empirically compare competing models of expectations formation. The same pattern, such as persistent forecast errors or delayed adjustment of inflation expectations, may be consistent with adaptive learning, periodic information updates, rational inattention, or reliance on past experience. Future research should therefore test these models on the same data sets and compare their results with simple autoregressive and adaptive rules. These comparisons should assess not only out-of-sample performance and model behavior after a change in the economic regime, but also whether a model identifies a relevant mechanism or materially changes the evaluation of policy effects and heterogeneous household and business responses.

The second direction is to better connect different data sources. Surveys of expectations allow direct observation of the beliefs of economic agents, while administrative and transactional data show their actual decisions. Laboratory and survey experiments can help in this area to better determine causal mechanisms, and market data allow monitoring of reactions in almost real time. By connecting them, it is possible to examine not only what households and businesses expect, but also whether changes in their expectations actually lead to changes in consumption, savings, employment, investment and pricing. Big data and machine learning can further improve the way we measure attention, sentiment, and economic narratives. Analysis of Internet searches, news, social networks, and communications from economic institutions can help track the spread of optimism, fear, and dominant economic narratives. However, these data alone cannot explain causal mechanisms. Future research needs to combine new empirical methods with theoretically derived assumptions about how information influences expectations and how these expectations are transmitted to economic decisions. Otherwise, there

is a risk that behavioral macroeconomics will be limited to documenting new correlations without reliably explaining their origin.

The third important direction represents the connection of behavioral expectations with heterogeneity and economic inequality. At the same time, heterogeneity should not be automatically equated with behavioral deviation. Households differ according to several factors, namely according to income, assets, liquidity constraints, access to information and exposure to economic shocks. The behavioral mechanism becomes further relevant when these differences affect the way households process information, assess risk, and form expectations. Future models should therefore connect the distribution of economic resources with the distribution of attention, knowledge, experiences and forecasting rules. Such an approach could advance how to better understand different reactions to inflation, interest rates, fiscal transfers and changes in the labor market.

The fourth direction is institutional application. The real progress of behavioral macroeconomics will be reflected in its ability to improve the way in which central banks, finance ministries, and other institutions forecast and evaluate policies. This requires models that retain enough realism to capture heterogeneous expectations, but also enough simplicity to make their mechanisms and results understandable to decision makers. Institutional acceptance of such an approach will therefore depend on whether behavioral models can demonstrate robust explanatory, predictive, or policy-evaluation advantages relative to simpler alternatives.

4.2. Conclusion

This paper analyzes the development of behavioral macroeconomics using expectation formation as a conceptual link between early psychological and modern formal models. A historical review shows that ideas about the importance of trust, optimism, social norms, and bounded rationality were present well before the institutional formation of behavioral economics. The dominance of rational expectations enabled the construction of a methodologically consistent macroeconomic framework, but at the same time suppressed the question of how economic agents actually collect, process, and interpret information.

Contemporary behavioral macroeconomics attempts to answer this question through several competing approaches. Adaptive learning emphasizes the gradual learning of the structure of the economy, sticky information the occasional updating of information, rational inattention the limited capacity for its processing, heuristic models the selection of simple forecasting rules, and bounded rationality the reduced weight of complex and temporally distant consequences. Narrative economics further demonstrates that beliefs can spread socially and change the way economic agents interpret the same objective information.

The main finding of the critical analysis is that these approaches do not represent a unique alternative to rational expectations. They can explain similar

empirical phenomena, but they differ in the cause of forecast errors, the way expectations are adjusted, and the recommendations for economic policy. Therefore, simply establishing that expectations are heterogeneous or systematically biased is not enough, as it is necessary to identify the mechanism that produces such deviations and show that its inclusion improves the explanation, prediction, or evaluation of a particular policy.

This review contributes to the existing literature by using expectation formation as a unique framework for connecting historical developments and contemporary research approaches. Its contribution is reflected in the distinction between heterogeneity of economic circumstances and specifically behavioral deviations, as well as in the comparative assessment of models according to their mechanisms, empirical predictions, identification capabilities, and implications for monetary and fiscal policy. This shifts the discussion from the general opposition between rationality and psychological realism to the more precise question of which expectation model provides the most added value in a given economic environment?

Behavioral macroeconomics has therefore moved from a phase of proving its legitimacy to a phase of theoretical consolidation, empirical differentiation, and practical application of its methods. Its future does not depend primarily on the inclusion of an increasing number of psychological biases in macroeconomic models.

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PODRIJETLO I GRANICE BIHEVIORALNE MAKROEKONOMIJE – OD (IR)RACIONALNOSTI DO OČEKIVANJA

Sažetak

Rad istražuje podrijetlo i suvremene granice bihevioralne makroekonomije, pri čemu se formiranje očekivanja koristi kao konceptualni okvir koji povezuje rane psihološke spoznaje sa suvremenim formalnim modelima. Prikazuje razvoj od životinjskih nagona, ograničene racionalnosti i adaptivnih očekivanja do heterogenih heuristika, neelastičnih informacija, racionalne nepažnje i bihevioralnih novokejnezijanskih modela. Glavni doprinos rada jest komparativna ocjena tih pristupa s obzirom na njihove temeljne mehanizme, empirijska predviđanja, probleme identifikacije te implikacije za monetarnu i fiskalnu politiku. Posebna se pozornost posvećuje razlikovanju heterogenosti koja proizlazi iz različitih ekonomskih okolnosti od specifično bihevioralnih odstupanja od racionalnih očekivanja. Analiza pokazuje da konkurentski pristupi mogu objasniti slične makroekonomske pojave, ali pritom pretpostavljati različite uzročne mehanizme i različite reakcije ekonomske politike. Budući napredak ovisit će o izravnoj usporedbi modela, uzročnoj identifikaciji, provjeri predviđanja izvan uzorka i povezivanju novih podataka s teorijski utemeljenim modelima.

Ključne riječi: bihevioralna makroekonomija, formiranje očekivanja, ograničena racionalnost, ekonomska politika.

JEL klasifikacija: E03, E71, B22.