DEVELOPMENT OF MACROECONOMIC MODELS BASED ON BEHAVIORAL ECONOMICS: ISSUES AND FURTHER RESEARCH

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Abstract.

The article analyzes the formation, spread and development of behavioral economics in microeconomic research, as well as its development in macroeconomic research over the past two decades. The key shortcomings of neoclassical macroeconomic models and their critique based on existing research and practical application by central bankers are highlighted. The key stages in the formation of behavioral macroeconomics, elements of which began to appear in the works of neoclassical macroeconomists, have been identified. The main arguments in favor of replacing neoclassical macroeconomic models with new behavioral macroeconomic models are presented, as well as key issues of behavioral macroeconomics and prospects for its further adoption as a basic concept for decision-making for governments. Key studies of behavioral economists on behavioral macroeconomic models, most of which are agents-based (microfoundations-based), have been identified and systematized. Based on the results of testing various behavioral models by world-renowned scientists, as well as our analysis, it is proposed to focus further macroeconomic research on behavioral models based on the activities of agents (microfoundations).

Key words: *behavioral economics, behavioral macroeconomics, behavioral macromodels, agents-based models (microfoundations-based)*

Problem statement. The role of behavioral economics in the development of modern socio-economic theory is difficult to underestimate. The number of scientists conducting research in the field of behavioral economics is growing. All major US universities have added a course on behavioral economics and teach it alongside classical economic theory. In addition, some governments, such as the UK government, have formed groups of behavioral economists to gain new insights to manage decision-making and help shape public policy. Many corporations and private companies have also used the results of behavioral economics research and incorporated them into their marketing strategies, hired behavioral economists as consultants, or even set up special departments responsible for analyzing the behavior of their consumers based on behavioral economics theory [1]. In addition, there are six scientists who have been awarded the Nobel Prize in Economics for their research in behavioral economics. However, much of the research in behavioral economics is focused on the micro level, behavioral macroeconomics started evolving only 20 years ago, with major share of the research intensified only after the global financial crisis of 2008-2009 [2].

Analysis of recent research and publications. Over the last three decades, behavioral economics has finally become a separate branch of science. The first attempts to combine psychology with economics were the works of economists such as Francis Edgeworth, Wilfredo Pareto and Irving Fischer. Economic psychology, in turn, appeared in the 20th century in the works of George Catona, Gabriel Tard and Laszlo Garay [3]. The following researchers specialize in modern behavioral economics: D. Kahneman, A. Tversky, D. Cato, R. Schiller, D. Arieli, M. Alle and others. The issues of application of behavioral economics in such spheres as microeconomics, financial markets, investments are mainly researched. The following scientists studied the essence of behavioral finance: B. Barber, N. Barberis, T. Odean, Nobel Laureate R. Thaler and others. A. Tversky and D. Kahneman studied the essence of cognitive psychology. Behavioral macroeconomics has been studied by such scientists as Nobel Laureate D. Akerlof, R. Schiller, P. De Grauve, K. Gomez and others.

The aim of the article is to identify the links between behavioral economics and macroeconomics that have already been studied, and as a result to propose further directions of research.

Presenting main material. Behavioral economics gained widespread recognition after the Nobel Prize in Economics was awarded to George Akerlof in 2001 and Daniel Kahneman in 2002. And after its award to Richard Thaler in 2017, behavioral economics was finally established among scientists and began to be perceived as a full-fledged way of thinking about economic issues. In fact, there has been a change of views among economists, who are increasingly convinced that it is necessary to deviate from the paradigm of "Homo Economicus" (rational man) in the conduct of economic research [4]. Unfortunately, this all applies almost exclusively to the micro level. Most of the analysis in shaping the economic policy of the state is still based on models of rational expectations.

Behavioral economics combines economics and psychology to explore why people are sometimes irrational, and why and how their behavior does not conform to the assumptions of standard neoclassical economic models. In addition to psychology, neuroscience and microeconomic theories are also widely used in behavioral models. Behavioral economics studies the influence of psychological, cultural, emotional, cognitive and social factors on the decision-making process of people and institutions and the difference between these decisions and decisions provided by neoclassical economic theory. Decisions such as where to get a job, whether to go to the university, etc. are the decisions that most people make in their lifetime. Thus, behavioral economists seek to explain why an individual chose option A rather than option B, and to investigate whether there is any impact from such a choice, and what is the impact on his future economic life, and in recent studies - on the life of society as a whole [5].

The first studies that revealed a significant impact of microeconomic behavior (microfoundations) of economic agents on macroeconomic models were the works of neoclassical economists, written in the late 1960s [6]. The new version of macroeconomics they created in the late 1970s became the standard. Following in the footsteps of its predecessor, the new neoclassical macroeconomics was based on a

competitive model of general equilibrium. But it differed in that it insisted that all decisions — household consumption and supply, production, employment and producer pricing, and wage agreements between workers and firms — corresponded to maximizing and rational behavior. Therefore, the new classical macroeconomics abandoned the assumption of a stable wages. To explain unemployment and economic fluctuations, the neoclassicists relied first on imperfect information and then on technological shocks [7].

Although this new theory was a step forward, its behavioral assumptions were so primitive and meager that it is difficult to call it a pioneer in behavioral macroeconomics. A significant positive development was that the neoclassicists acknowledged that decisions about prices and wages were based on clear micro-foundations. However, as noted by scientist George Akerlof, this neoclassical macromodel has failed to explain at least 6 macroeconomic phenomena, including [7]:

1) The existence of involuntary unemployment: in the neoclassical model, the unemployed can simply agree to a slightly lower wage than the average market, and easily find a job; since no other factors are taken into account, there is no involuntary unemployment in the neoclassical understanding;

2) The impact of monetary policy on production and employment: in the neoclassical model, monetary policy is ineffective and does not affect changes in prices and wages. Since the change in the money supply is completely predictable, when it occurs, prices and wages simply change in the respectful proportions;

3) The failure of deflation to accelerate when unemployment is high: the neoclassical model is based on the Phillips curve, which establishes the natural rate of unemployment, and assumes that there is no other;

4) The prevalence of undersaving for retirement: in the neoclassical model, people themselves know how much they need to spend and how much to save for retirement, so there can be no shortage of funds at retirement. In practice this is not the case;

5) The excessive volatility of stock prices relative to their fundamentals: neoclassical theory assumes that stock prices reflect fundamental indicators, namely

the discounted value of future cash flows, i.e. excessive volatility, which in practice is constantly observed, can not exist;

6) The stubborn persistence of a self-destructive underclass: Neoclassical theory suggests that poverty is a reflection of the low initial inclinations of human and non-human capital. It does not include the impact on poverty of factors such as alcohol and drug addiction, family inferiority, crime, etc.

The existence of these and other macroeconomic phenomena has been noticed by more than a dozen scientists, but their scientific work in the 1980s and 1990s offered mainly a critique of neoclassical macroeconomic models but did not provide specific ways to improve them. The situation changed after the Nobel Prize was awarded to George Akerloff in 2001, including for his contribution to the development of behavioral macroeconomics. Since the beginning of the 21st century, many scientists have begun to propose their own behavioral macroeconomic models (see Table 1). Most of them are based on the activities of agents (microfoundations), and also include elements of behavioral finance, business cycle fluctuations and heuristics.

Table 1. Research of macroeconomic models based on behavioral economics over 2005-2021.

Date	*Authors*	*Short description*	*Field of research*
2005	Alfarano et al.	The authors have developed an agent-based model (microfoundation-based), in which widespread stylized facts (asymmetry, excesses, clustering of volatility) are the initial properties of interaction between traders	Behavioral finance
2006	Tesfatsion and Judd	The advantages and disadvantages of using the model of agent-oriented computing economy for the study of economic systems are studied	Behavioral macroeconomics

2008	Colander et al.	Critique of DSGE models and research of agent-based (microfoundation-based) heterogeneous models	Behavioral macroeconomics
2009	Farmer et al.	Research and advocation of agent-based (microfoundation-based) models	Behavioral macroeconomics
2012	Westerhoff and Franke	Two examples that illustrate the usefulness of agent-oriented models as a tool for economic policy development are outlined	Behavioral finance and macroeconomics
2014	Gabaix	Developed and proposed a model of finite rationality based on sparseness	Behavioral macroeconomics
2017	De Grauwe and Ji	Developed a macroeconomic model based on behavioral economics that examines endogenous fluctuations in business cycles	Behavioral macroeconomics and business cycles
2021	Kukacka and Sacht	This paper proposes a model-based method for estimating heuristic switching in nonlinear macroeconomic models	Behavioral macroeconomics and heuristics

Made by the authors based on: [4, 8-14]

We analyzed in detail the behavioral macroeconomic studies outlined in Table 1. Their authors proposed a number of behavioral macroeconomic models, which are mainly agent based (microfoundation-based). All these models have performed well in each of the studies and deserve attention and further research. Given that these studies have shown higher efficiency than neoclassical models, we believe that further behavioral macroeconomic research should be conducted on models based on the activities of agents (microfunds). We consider it expedient to conduct research using the example of Ukraine, as most research has been conducted in developed countries, so it does not show the fullness and possibility of generalized use of these models.

Despite the fact that the critical scientific literature on the applicability of neoclassical macroeconomic models in real life has more than a dozen works, there is still no generally accepted behavioral macroeconomic model. The models listed in the table above have not yet become universal and are not widely used in practice, only in some specific cases. However, even after the global financial crisis of 2007-2008 and the recession that really shook the world, politicians and scholars have become seriously concerned about the empirical relevance of using a standard representative structure of rational agents in macroeconomics. The then President of the European Central Bank (ECB), Jean-Claude Trichet, expressed these concerns as follows: “Macro models failed to predict the crisis and seemed incapable of explaining what was happening to the economy in a convincing manner. As a policy-maker during the crisis, I found the available models of limited help. In fact, I would go further: in the face of the crisis, we felt abandoned by conventional tools"[2]. The global Covid-19 pandemic, which began in late 2019 in China, has once again proven that neoclassical macroeconomic models are not ready for sudden "blows" from unforeseen events.

Among all the models proposed by behavioral economists that could potentially replace, and in some cases are already replacing, neoclassical macroeconomic models, are models based on the activities of agents (microfunds). These macroeconomic models are a valuable tool for economic policy analysis in addition to theoretical considerations, human experiments, and empirical research. These models have a number of advantages in assessing the effectiveness of certain economic policies, which have been proven in numerous studies, including: [13]

- They give policymakers a new idea of how economic systems work and, thus, how regulatory policy can dynamically shape and develop these systems. For example, the direct impact of regulatory policy on the economy is usually quite obvious, but the indirect one is not always noticeable at first glance;
- They can be used to pre-test the effectiveness of recently proposed policies;

- These models allow policymakers to control all exogenous shocks and simulate extreme events, which can not be done with neoclassical models;
- They allow policymakers to generate as much data as needed, in contrast to neoclassical models, where most of the data is not used, because they are considered unimportant;
- They make it possible to accurately measure all the necessary variables used in the process.

However, despite all the advantages of agent based (microfoundation-based) modeling, in macroeconomics it is Homo Economicus that continues to dominate in macroeconomic models of dynamic stochastic general equilibrium. In these models, individual agents (microfoundations) maximize the utility function in the long run, using rational forecasts based on all available information, including that built into the model. Nothing really can go wrong in models that include agents who perfectly optimize all processes and are endowed with excellent cognitive abilities that allow them to understand the complexity of the world. Only exogenous factors can throw these agents out of balance, forcing them to optimize [4]. As a result, these models suggest that business cycle fluctuations occur solely as a result of exogenous events (shocks) that force people to reconsider their optimal plans. Nothing in the model can cause endogenous business cycle movements. Ups and downs are the result of exogenous disorders [15,16].

All complex systems include many agents (consumers, producers, investors, etc.), the interaction between which at the individual (micro) level together forms a collective (macro) behavior. That is why it is necessary to develop a more unified behavioral macroeconomic model based on the activities of agents (microfoundations), which could finally displace and replace neoclassical models, which in the opinion of most practitioners and scientists do not work and can not be the basis for economic decisions [2]. In particular, the President of the ECB said: “The atomistic, optimising agents underlying existing models do not capture behaviour during a crisis period. We need to deal better with heterogeneity across agents and the interaction among those heterogeneous agents. We need to entertain alternative motivations for economic

choices. Behavioural economics draws on psychology to explain decisions made in crisis circumstances. Agent-based modelling dispenses with the optimisation assumption and allows for more complex interactions between agents." Unfortunately, there is still no such behavioral macromodel that is universally recognized and meets the needs of both scientists and practitioners. But given the complexity, diversity, and heterogeneity of agents, even within a single country, let alone the world, we are unlikely to see a single unified behavioral macromodel that will be applied equally by all countries.

Conclusions and prospects. It has been about 50 years since the first microeconomic behaviors were researched. Since then, behavioral microeconomics has taken a strong position and significantly supplanted the previously accepted assumption of homo economicus (rational man). Modern behavioral microeconomics is already the standard for study at most universities and is widely used in practice by both small companies and global corporations.

We have analyzed several key articles on behavioral macroeconomics that has been written over the past 20 years. There is an opinion in scientific circles that the next branch of the economy, which should be based on behavioral principles, should be macroeconomics. Unfortunately, its general acceptance has not yet taken place as such. Many scientists agree that neoclassical macroeconomic models are unsuitable for use in real life and have already proposed more than a dozen of their own behavioral models, which in general shown promising results in each particular study. But in most cases, neoclassical macroeconomic models are still used in practice, based on the assumption of a rational man. As George Akerlof notes, "Macroeconomics should be based on behavioral perceptions of the economy, not outdated models that are unsuitable for use in real life" [17].

We believe that further research in this area should be conducted in the field of modeling based on the activities of agents (microfoundations) on the example of one of the developing countries, in particular Ukraine. It is necessary to develop such a model so that it can be extrapolated at least within one region or industry. The very

essence of behavioral economics suggests that we are unlikely to see a single generally accepted model in the world, as was the case with neoclassical models. And this is hardly necessary, because in each country economic agents (consumers, producers, investors, etc.) have different specific customs, traditions, views and often religion.

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РОЗВИТОК МАКРОЕКОНОМІЧНИХ МОДЕЛЕЙ ЗАСНОВАНИХ НА ПОВЕДІНКОВІЙ ЕКОНОМІЦІ: ПРОБЛЕМИ ТА ПОДАЛЬШІ ДОСЛІДЖЕННЯ

У статті проаналізовано становлення, поширення та розвиток поведінкової економіки в мікроекономічних дослідженнях, а також її розвиток у макроекономічних дослідженнях протягом останніх двох десятиліть. Виділено ключові недоліки неокласичних макроекономічних моделей, та їх

критику на основі існуючих досліджень й практичного застосування головами центральних банків. Виявлено ключові етапи становлення поведінкової макроекономіки, елементи якої почали з'являтись саме у працях неокласичних макроекономістів. Наведено основні аргументи на користь заміни неокласичних макроекономічних моделей новими поведінковими макроекономічними моделями, а також проаналізовано ключові проблеми становлення поведінкової макроекономіки та перспективи її подальшого сприйняття, як базової концепції для прийняття рішень для урядів країн. Виокремлено та систематизовано ключові дослідження поведінкових економістів про поведінкові макроекономічні моделі, більшість з яких базується на діяльності агентів (мікрофундацій). На основі результатів тестування різноманітних поведінкових моделей всесвітньо відомими вченими, а також проведеного нами аналізу, запропоновано сконцентрувати подальші наукові макроекономічні дослідження саме на поведінкових моделях заснованих на діяльності агентів (мікрофундацій). Як базу для проведення досліджень, запропоновано взяти кейс України, як країни, що розвивається.

Ключові слова: *поведінкова економіка, поведінкова макроекономіка, поведінкові макромоделі, моделі засновані на діяльності агентів (мікрофундацій)*

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РАЗВИТИЕ МАКРОЭКОНОМИЧЕСКИХ МОДЕЛЕЙ ОСНОВАННЫХ НА ПОВЕДЕНЧЕСКОЙ ЭКОНОМИКЕ: ПРОБЛЕМЫ И ДАЛЬНЕЙШИЕ ИССЛЕДОВАНИЯ

В статье проанализированы становление, распространение и развитие поведенческой экономики в микроэкономических исследованиях, а также ее развитие в макроэкономических исследованиях за последние два десятилетия. Выделены ключевые недостатки неоклассических макроэкономических моделей и их критику на основе существующих исследований и практического применения председателями центральных банков. Выявлены ключевые этапы

становления поведенческой макроэкономики, элементы которой начали появляться в трудах неоклассических макроэкономистов. Приведены основные аргументы в пользу замены неоклассических макроэкономических моделей новыми макроэкономическими моделями, а также проанализированы ключевые проблемы становления поведенческой макроэкономики и перспективы ее дальнейшего восприятия, как базовой концепции для принятия решений для правительств стран. Выделены и систематизированы ключевые исследования поведенческих экономистов о поведенческих макроэкономических моделях, большинство из которых базируется на деятельности агентов (микрофундаций). На основе результатов тестирования различных поведенческих моделей всемирно известными учеными, а также проведенного нами анализа, предложено сконцентрировать дальнейшие научные макроэкономические исследования именно на поведенческих моделях, основанных на деятельности агентов (микрофундаций). Как базу для проведения исследований, предложено взять кейс Украины как развивающейся страны.

Ключевые слова: *поведенческая экономика, поведенческая макроэкономика, поведенческие макромодели, модели основанные на деятельности агентов (микрофундаций)*