

Critical Analysis of Increasingly Mathematical Economics in the Modern Society

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This paper critically examines the escalating trend of mathematization in economics, highlighting its implications and controversies in contemporary economic research. While the application of sophisticated mathematical models and statistical techniques has enhanced the precision, rigor, and status of economics within academia and practical application, concerns arise regarding the potential oversimplification and detachment from real-world complexities. The adoption of mathematical tools has arguably led to a focus on theoretically tractable problems at the expense of those more relevant to practical economic and social issues. This paper explores both the benefits and limitations of this trend, discussing how the reliance on quantitative methods affects the innovation, comprehensibility, and application of economic theories. We argue for a balanced approach that fosters innovation by integrating qualitative insights and embracing interdisciplinary methods to ensure economics remains both rigorous and relevant to societal needs.

Keywords: mathematization of economics, quantitative methods, economic models, interdisciplinary integration

Introduction

The tendency of mathematization in current researches on economics has notably increased, making it the mainstream (Hoy et al., 2022). As the complex mathematical models and statistical methods are widely applied, economists rely more on these tools to explain and predict economic phenomena. From the perspective of macroeconomics, the use of mathematization enhances the accuracy and logical rigor of economic theories, and raises the status of economics in academic research and actual practice (Mokhov, Aliukov, Alabugin, & Osintsev, 2023). However, excessively relying on mathematization has also sparked controversies and concerns. Economists focus too much on the formalization and techniques of mathematical models, so as to neglect the complexity of economic phenomena and the diversity of problems in practice. This will not merely refrain the innovation and transformation of economics, but make economics too technical for the public to understand and even participate, which hinders the widespread application and social influence of economics.

The Trend of Mathematicalization in Economics

The emergence and development of mathematization in economics can be traced back to the late 19th century, when mathematical tools began to be widely applied in economics with the rise of the marginal revolution (Obregon, 2023). Economists in early times have introduced calculus and other mathematical methods, which provides a more rigorous and systematic analytical framework for economic theories. By the mid-20th

century, the trend towards mathematization has been further intensified as the rise of mathematical economics and econometrics, which continuously expanded the application scope of mathematical tools in economics. The role of mathematization, from the initial simple models to complex dynamic stochastic general equilibrium models, has become increasingly prominent in economics. Macroeconomic theory posits that mathematical tools improve the accuracy and rigor of economic analysis, as well as the predictive and explanatory power of economic theory (Banerjee, 2021).

Economic theories can be expressed and validated in a more precise and rigorous manner under the framework of mathematicalization (Moosa, 2021). Economists can use mathematical tools to establish a theoretical framework with logical system, reducing the ambiguity and subjectivity in qualitative analysis, while enhancing the credibility and scientific nature of economic analysis. Meanwhile, mathematization can strengthen the predictive ability of economic models (Angeli, 2021). Economists construct and analyze mathematical models to quantitatively describe and predict economic phenomena, which can provide scientific basis for policy-making and economic management. According to macroeconomic theory, the application of tools and methods from disciplines such as mathematics, statistics, and computer science not merely promotes the development of economic theories, but expands the perspective and methods of economic researches (Morgan, Syropoulos, & Yotov, 2023).

The Promoting Effect of Mathematicalization on Economic Innovation

As the mathematical models are used in macroeconomics, the economic theories can be expressed and validated more precisely and systematically (Goodwin et al., 2022). The use of big data technology allows economists to collect and process data in unprecedented amounts of scales, which provides a rich source of information for economic research and analysis. Researchers can offer new empirical evidence for economic theory based on microeconomic behaviors and macroeconomic trends that is difficult to capture under the traditional economic models. As a powerful tool of data analysis tool, machine algorithms can identify complex patterns and relationships in massive amounts of data, automatically adjust model parameters, and optimize the results of prediction, so as to discover new economic laws through data-driven approaches without relying on pre-set theories. This lays a more scientific foundation for the development of economic theories, injecting new vitality into economic research, and finally enhancing the ability of economics to explain and predict complex economic phenomena.

The mathematization has driven the integration of economics with other disciplines, thereby accelerating the innovation in economic research. As an interdisciplinary field of economics and statistics, econometrics have introduced statistical analysis and regression methods, which allows economists to conduct more accurate and systematic empirical analysis of economic phenomena (Astério & Hall, 2021). Mathematicalization enables more precise empirical verification of economic theories, thereby strengthening their reliability, and propelling the application of economics in reality. This integration of interdisciplinary methods not only enhances the scientific nature of economic research, but boosts the innovation and development of new theories and methods.

The Inhibitory Effect of Mathematization on Economic Reform

The extensive use of mathematization in economy can lead to the rigidity of research thinking (Schabas, 2014). Economists tend to focus on problems that are easy to mathematize. They use mathematical models and quantitative analysis tools when facing economic issues, while ignoring ones that are difficult to handle

mathematically but have important practical meaning, and thus reducing the comprehensibility and practicality of economic research. Economic phenomena are not merely influenced by economic variables, but constrained by various factors such as society, culture, and psychology. These factors belong to non-quantitative aspects and are often difficult to accurately describe using mathematical models, leading researchers to neglect or simplify their mathematical research, and causing one sidedness and limitations in economic theory and policy recommendations.

The mathematization will constrain the innovation of research directions in economics (Hoy et al., 2022). As the application of mathematical tools in economics expands, researchers tend to conduct research within existing mathematical frameworks rather than exploring new theories and methods, thereby limiting the innovation and development of economics. The direction of economic research has become narrow, its content tends to be singular and superficial, and economic theories and methods are inclined to be homogeneous and rigid, making it difficult to discuss the multidimensionality of economic phenomena in depth.

Although mathematization has improved the rigor and accuracy of economic theories, excessive digitization has also led to neglecting the complexity of reality. Some mathematical models rely on a series of simplified hypothesis, which, although logically convenient in theoretical analysis, cannot be justified in actual economic phenomena (Arthur, 2021). Some macroeconomic models assume perfect market competition and complete information symmetry, which are difficult to meet in reality.

Overly relying on mathematical models has led researchers to overlook the diversity and complexity of actual economic problems, thereby hindering the application of economic theories and methods.

Conclusion

While mathematizing, it is crucial to maintain the innovative thought about economics, and encourage the interdisciplinary integration. The theories and methods within other fields can bring new perspectives and ideas to economic research, providing new theoretical frameworks and analytical tools. Moreover, combining the qualitative and quantitative research can compensate the limitations of applying mathematical research in economics. Based on the in-depth analysis of the specific background and dynamic processes of economic phenomena, qualitative research can assist to reveal the complex and underlying factors that are difficult to be captured in quantitative research, thus providing more comprehensive and richer explanations for economic theories.

Enhancing the flexibility of methods in economic researches is also important in the way of pursuing mathematization. The practicality and explanatory power of economic theories can be strengthened by combining mathematization with economic reality. During the construction of mathematical models, the complexity and diversity of actual economic phenomena should be paid attention to avoid the excessive reliance on the simplified hypotheses and abstract models. Researchers can explore new analytical tools and methods to provide new data processing for economic research, which drives the emergence and formation of new economic rules and phenomena. Based on the enhanced flexibility of methods, economic research can better respond to the complicated and ever-changing economic realities, and thus strike a balance between mathematization and economic innovation.

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