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Economic Models and Human Behavior: The Tension Between Mathematics and Reality

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The use of mathematical models in economics has long been a subject of debate, particularly regarding the tension between mathematical precision and the unpredictability of human behavior. This paper critically examines the limitations of over-relying on mathematical models to predict economic outcomes, arguing that such models often fail to account for the social, cultural, and psychological factors that drive economic activities. The analysis highlights how attempts to quantify complex economic behaviors may lead to oversimplifications and inaccurate forecasts, as illustrated by past financial crises and market disruptions. The paper concludes by advocating for a more balanced approach that combines mathematical rigor with an understanding of human behavior to enhance the accuracy and effectiveness of economic predictions.

Keywords: economic models, mathematical precision, human behavior

Part I. Mathematics in Economics: A Critical Analysis

Consider the following complex economic formula:

$$P = \frac{\alpha\big(C + 1 + G + (X - M)\big)}{\beta(W + L)}$$

The equation above attempts to forecast Economic Output (P) by indicators that include consumption (C), investment (I), government purchasing (G), exports (X), wages (W), and labour force (L). The above example shows how, in the mathematical approach, the economists try to have rather detailed predictions based on the formalisation of the descriptions. Nonetheless, economists are inherently tasked with the difficulty of approximating the pure technicality of mathematicians since the latter use mathematics to explain the social and behaviours of people that are intrinsically not purely technical.

The sketch of an economical affair or the business model emphasises the mathematical models more, which does not explain the understanding required for precise formulas of economic scenarios. To some extent, mathematics decides the outcome. It can be stated categorically that such an outcome is correct and unambiguous. In contrast, economic phenomena, to a significant extent, are individuals' inherently relative behaviours and can vary. This dualism of human behaviour produces a discipline such as economics, which, on one side, is anchored on mathematical formulas, while on the other side, is based on human activities that characterise the economy. According to Krugman (2009), using mathematics in economics fails to analyse human-led activities and social results. Another theory established by Kahneman and Tversky, known as the Prospect Theory, also

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argues that social members make decisions with risk and volatility. This illustrates that the over-dependence on mathematical techniques to explain economic activities is inherently unattainable.

This tension is made vivid by the formula mentioned above. The exact mathematical form attempts to replicate human behavioural response in the sphere of economics, which by itself is an individualistic endeavour. Economists apply this formulation in their models, bearing in mind that the results they arrive at are inconclusive because they are derived using subjective information. Mathematicians adhere to deriving the correct solution, proving their derivation, and disproving opponents' arguments, while economists use mathematical definitions but apply the "art" of their profession. Hayek (1945) sees a problem in using quantification techniques or mathematical models in the discipline, stating that the world cannot be measured in this manner because people behave in a way that cannot be modelled.

Economic systems evolve over time, posing risks to predictive models. Overestimating this evolutionary pattern can lead to inaccurate predictions due to future changes in human behavior and social structures. As claimed by Friedman (1953), in order to get the degree of precision from the equation necessary in the evaluation of facts and relationships that comprise the economy, its factors have to be oversimplified into mathematical variables—meaning that factors affecting the economy are just as similar to numbers in math as the models portray it.

Analysing the use of mathematical models in economics, one can conclude that this approach has advantages and drawbacks. These of such models, like the formula $P = \frac{\alpha(\boldsymbol{C}+\boldsymbol{1}+\boldsymbol{G}+(\boldsymbol{X}-\boldsymbol{M}))}{\beta(W+L)}$, showcase an attempt to bring objectivity and precision to the field. Economic activities rely on subjectivism, making sophisticated models impossible to replicate real-life situations. The challenge lies in incorporating mathematical modeling while addressing people's messy behavior. Speaking of the main assumptions of the neoclassical paradigm, Hayek (1945) stated that economics must be handled with care, primarily because predictions concerning human behaviour cannot be entirely accurate.

Part II. Potential Threat of Over-Mathematical Economics

Using certain mathematical models, one can quite objectively describe market relations, the formation of prices, and the distribution of resources. This is regarding quantitative analysis, which entails integrating, sorting, and consolidating large amounts of information. Economists rely on quantitative analysis to identify patterns of economic development, aiming for two main goals: predicting future economic trends and preventing potential economic issues (Smith, 2016). They try to anticipate the causality of the economic development by man and then influence it to produce the intended results. This is similar to having an experiment in which manipulation of variables leads to actual results that are required. However, the excessive use of mathematical quantification to predict and intervene in human economic activities poses a significant threat: It disregards people's behaviour within economics and cultural-social aspects of undertaking economic exercises, which causes wrong forecasts and, during interferences, may worsen economic problems (Jones & Foster, 2019).

For instance, during the current pandemic, there has been a lack of manufacturing plants, disruptions of transport means, and other disruptions in the delivery of automobile spare parts across the world. Models used to estimate market demand could not present these eventualities; most car manufacturers could not alter their production schedules effectively in response to short-supply situations, exponentially slowing production and leading to hefty losses (Lee, Kim, & Park, 2021). However, when economists employ these mathematical models, their approach by necessity does not consider all these factors, even if using such models presupposes that one can reduce economic activities to mathematical formulas as precisely as mathematicians do. This misconception leads economists away from the essence of economics: These advances depict that human-initiated economic dealings are characterised by risks and intricacies (Miller, 2020).

The excessive focus on mathematics in economic prognosis and remedy has extreme consequences, as seen with Archegos Capital Management, which exposed high-risk products and financial techniques, but failed to monitor risks systematically. It is the scenario where the big positions establish themselves, and when the market turns bearish, these positions significantly erode the value, making the margin calls huge. The Archegos crisis cost Credit Suisse and Nomura Holdings several multi-billion dollars; this shows that using complex financial products closely associated with high leverage poses significant risks to financial institutions (Johnson, 2022).

Mistakes in economic activities, such as anticipating market interventions and company collapses, and mathematical models' inability to calculate economic cycles, led to the 2008 financial crisis. These models endeavoured to rational behaviour and market equilibrium without paying attention to such aspects of financial innovation, risk-taking personalities, and regulatory lapses that formed the centre of the crisis (Green & Stark, 2010). The failure to implement these elements shows that there is a wide space between formally defined approaches and the reality of human behaviour in the sphere of the economy (Wilson & Clarke, 2015).

Mathematical models often overlook social and cultural factors that influence economic activities, making them challenging to measure and incorporate into equations. For instance, consumer expenditure trends depend not only on earnings and the price of goods and services but also on cultural beliefs about the appropriate or desirable saving and consumption propensities (Akerlof & Shiller, 2009). That is why many economic predictions become incomplete or inaccurate; models do not consider such factors.

The fourth issue is that relationships are treated as static in dynamic environments, ignoring the constant change and non-permanent interactions between variables in economic systems. Still, it is possible to make faulty forecasts when the previously identified relationships no longer exist in different contexts (Taylor, 2013). This limitation, therefore, calls for more pliable and versatile methods by economists to accommodate the rather more dynamic systems in the economy.

Formalisation and modelling improve economic phenomena analysis and forecasting, but potential weaknesses include errors when human actions, social environment, and evolving structures are not adequately captured. Economists should seek a symbiosis between, on the one hand, mathematical modelling and, on the other hand, considerations about the varied aspects of the economic processes to improve the predictiveness and effectiveness of the forecasts and the interventions based on them (Morris, 2021).

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