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Influence of AI in theoretical perspective of economics

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Abstract: *This paper provides an insightful analysis of the growing significance of artificial intelligence (AI) in reshaping economic theory. AI's role in refining demand and supply models through advanced forecasting and management was assessed, along with its impact on market pricing with the advent of dynamic and personalized pricing strategies. The study also addresses AI's influence of AI on asymmetric information, emphasizing improved decision-making and emergent ethical concerns. Finally, the paper discusses AI's enhancement of predictive models in the context of rational expectations, while highlighting the importance of incorporating behavioral biases into these models. The findings reveal both the transformative potential of AI in economics and the necessity of ethical guidelines to manage its disruptive effects on markets and society.*

Key Words: *Artificial Intelligence, Economic theory.*

1. INTRODUCTION :

Artificial intelligence (AI), which is a popular term, refers to the reproduction of human intellect in machines for making them suitable to carry out tasks which usually requires human intelligence. This encompasses a broad range of techniques, approaches, and applications aimed at creating systems that can perceive their environment and reason and take appropriate actions to achieve specific goals. Artificial Intelligence technologies have seen rapid advancement in recent years and are being applied in a wide range of domains, including healthcare, finance, transportation, entertainment, and more, with the potential to transform industries and societies in profound ways. The emergence of artificial intelligence has changed many disciplines like engineering, social science, and economics. From classical economics to the modern era, economic theories have been based on the assumption of rationality in human behavior. The application of economic theories in real life has been plagued by the irrational behavior and responses of mankind. However, machines and technologies are expected to be less effective. Hence, economics may be more applicable for artificial agents than for human agents, with a better response to the idealized assumptions of economic models.
The remainder of this paper is organized as follows. Section one introduces the paper, objectives and literature reviews are given in the subsequent sections. The concepts and research designs are presented in sections of the study. In the fifth section main findings are elaborately discussed. The final section concludes the paper.

Objective: The main objective of this study was to determine the relevance of economics in the age of artificial intelligence.

2. Review of Literature:

Currently, many studies are ongoing in this field. A few relevant studies are discussed in this section. Lu and Zhou et al (2019) attempted to identify approaches used to represent AI in economic models. Along with this, the study tries to determine how the impact of AI differs from the impacts of other technological innovations.

Aghion et al. (2022) considered two conflicting views when discussing the effects of automation on employment. Their first view recognizes that automation destroys job opportunities for human beings while the second view focuses on how automation has a positive productivity effect leading to higher demand and employment opportunities.
To support their second view the authors showed literature on automation and employment trends in France and in many other countries. Finally, the author accepted that automation can actually have a positive impact on the job market, as it increases competitiveness and enables them to win new markets.

By concentrating on the effects of automation on different skill groups differently, Hassel, Özkiziltan, and Weil (2022) did a meta analysis on the impact of it on employment generation and wages. It focuses only on OECD countries for the past two decades. Result of the study identifies that skillful workers reaped the benefit of automation with effective employment generations, while middle-skilled workers tend to have adverse results. For the low skilled workers this result is mixed. The impact of AI on the labor market has been analyzed by Webb (2019), Acemoglu et al. (2020), Tolan et al. (2021), Genz et al. (2021), Damioli et al. (2022), etc.

Dwivedi et al. (2021) attempted to find out the impact of AI on different sectors of the economy like finance, healthcare, manufacturing, logistics, supply chain, utilities and retail. Taking ideas from leading experts the paper focuses on the opportunities and challenges of rapid development of AI. It also considers future potential research agendas in the context of fast progression of AI. Considering the social influence on the expansion and advancement of AI, the study highlights a deep understanding of the impact of AI on the future of human society as well as industries. This paper identified the same transformative potential of AI as that of the industrial revolution. Moreover, the study concludes that new algorithmic machine learning and breakthroughs in the field of generative AI can create new opportunities for innovation. Few studies (Marwala and Hurwitz 2017, Tayal et. al 2023) which attempts to determine the influence of AI from a theoretical perspective of economics.

3. Conceptual Framework and Methodology

Artificial intelligence is basically a computational technique inspired by natural phenomena like the path-finding behavior of ants, the working of the brain, the swarming of birds etc.
In the field of economics individual actors make choices to maximize their personal and social welfare. This perception is based on the traditional Homo economicus model, which presumes that based on one's own self-interest, individuals make rational decisions. However, this model was criticized over the years from different economic schools of thought, leading to the innovation of a more flexible perspective.
However, the effect of this perception of neoclassical economics on economics has remained significant (Chowdhury and Begum, 2012). Accordingly, many economic theories are designed to put up the features of an economic agent with self-interest and rational decision-making capability. The advancement of artificial intelligence (AI) in recent years has included new dynamics to the characteristics of economic actors. AI agents are deliberately designed to act rationally, drawing inspiration from Homo economicus. As AI operates algorithmically not influenced by emotional factors and makes logical decisions based on available information, AI agents outperform human individuals in economic decision making.

Following Marwala and Hurwitz (2017), this study discusses different economic theories in the context of artificial intelligence. This study mainly discusses the theory of demand and supply, market pricing, asymmetric information, rational expectation, and game theory. This study discusses these theories in the context of AI.

4. Results and discussion

4.1 Artificial Intelligence (AI) and Demand and Supply

Artificial Intelligence (AI) plays a significant role in influencing and optimizing the demand and supply dynamics across various industries. The following are some ways in which AI intersects demand and supply.
Demand Forecasting: It is possible to create more accurate demand forecasts using AI by analyzing historical data, market trends, and a variety of external factors. This process helps businesses optimize their inventory, production, and distribution, preventing issues such as overstocking or understocking.

Supply Chain Management: The applications of artificial intelligence in supply chain management include demand forecasting, inventory management, and logistics. A better alignment of supply and demand can reduce costs and improve service levels for businesses.
Dynamic Pricing: A dynamic pricing algorithm driven by artificial intelligence adjusts prices based on fluctuations in demand and supply. As a result, businesses can maximize revenue by offering the right prices to customers at the right times.
Marketplace Platforms: Online marketplaces use AI algorithms to match supply and demand by recommending products to customers, suggesting service providers, or matching buyers with sellers more efficiently.
E-commerce: AI personalization systems analyze user behavior and preferences in order to recommend products or services that align with individual demands. This drives sales by presenting customers highly relevant offerings.
Manufacturing: AI can improve manufacturing processes by optimizing production schedules and managing inventory levels, thereby ensuring that goods are produced based on real-time demand.
Agriculture: AI technologies in agriculture help to optimize planting, harvesting, and distribution based on weather conditions, soil data, and market demand. This leads to more efficient use of resources and reduces waste.
Retail Inventory Management: AI systems help retailers manage inventory by predicting demand, identifying slow-moving products, and optimizing reordering. This minimizes inventory-carrying costs and ensures that the products are available when needed.
Healthcare: In healthcare, AI can be used for demand forecasting of medical supplies, ensuring that hospitals have the right medications, equipment, and staff to meet patient demands.
Transportation and Logistics: AI enhances route planning, fleet management, warehouse operations, and the alignment of supply and demand in the delivery of goods and services.
Energy Management: In the energy sector, AI optimizes energy supply and demand by forecasting energy usage, managing grid operations, and improving the efficiency of power generation and distribution.
Real Estate: AI is used in real estate to match property supply with demand, assist in property valuation, and optimize rental pricing.
Waste Management: AI helps manage waste collection by predicting when and where waste will be generated, optimizing collection truck routes, and reducing operational costs.
Public Services: AI is used in public services to forecast demand for services such as public transportation, allowing for better resource allocation and improved service quality.
While AI can significantly enhance demand and supply management, it is essential to address potential challenges such as data privacy, ethical considerations, and the potential for biases in AI models. Additionally, effectively integrating AI solutions into existing systems and processes is crucial for realizing the full benefits of AI in demand and supply management.

4.2 AI and market pricing

AI (Artificial Intelligence) has a significant impact on market pricing across various industries. AI influences market pricing in several ways.
Dynamic Pricing: AI is widely used in dynamic pricing strategies. Retailers, airlines, and other businesses use AI algorithms to adjust prices in real time based on various factors, such as demand, competition, and historical data. This allows businesses to optimize prices for maximum revenue.
Algorithmic Trading: In financial markets, AI-driven algorithmic trading systems use complex algorithms to make rapid trading decisions based on market data, news sentiment, and historical trends. These systems can influence the pricing of stocks, commodities, and other financial instruments by reacting to market conditions faster than human traders.
Personalized Pricing: E-commerce platforms and service providers use AI to offer personalized pricing to customers. AI analyzes customer data, browsing history, and purchase behavior to tailor prices, discounts, and promotions in order to maximize sales and customer retention.
Risk Assessment: In insurance and lending, AI helps to assess the risk associated with individual customers or policies. Pricing can be adjusted based on a more accurate evaluation of the likelihood of claims or defaults, leading to more precise pricing.
Real Estate: AI is used to determine property values and rental rates based on various factors, including location, property features, and market conditions. Real estate market pricing can be influenced by AI-driven valuation.
Energy Markets: In energy trading, AI models are employed to forecast energy demand, optimize the dispatch of power plants, and determine the pricing in electricity markets. This can lead to a more efficient use of energy resources and pricing.

Commodity Markets: AI is used in the analysis of commodity prices, including forecasting future prices based on factors, such as supply and demand trends, geopolitical events, and weather conditions. This information is crucial for businesses that rely on commodities for their operations.

Healthcare: AI can be used in the pharmaceutical industry to optimize drug pricing by considering factors such as R&D costs, market demand, and regulatory constraints. This can significantly impact the pricing of prescription medications.
Agriculture: AI and precision agriculture technologies help farmers optimize crop production, considering factors such as weather, soil conditions, and market prices. Efficient farming practices can also affect the supply and pricing of agricultural products.

It is important to note that the use of AI in market pricing raises questions regarding fairness, transparency, and ethics. Regulators and policymakers are increasingly examining the use of AI in pricing strategies to ensure that they comply with the existing laws and do not lead to discriminatory or predatory practices. Appropriate governance and transparency in AI-based pricing are essential for maintaining market integrity and fairness.

4.3 Asymmetrical information

The term 'asymmetric information' refers to a situation in which one party involved in a transaction has more or better information than the other. In the context of AI (Artificial Intelligence), asymmetrical information has various implications and applications. There are several ways in which AI intersects with asymmetrical information.
Enhanced decision making
Financial Markets: In the financial sector, AI algorithms can analyze vast amounts of data to make informed investment decisions. Traders or organizations with access to advanced AI tools may have a significant informational advantage over others.
Healthcare: AI can be used to analyze patient data, medical records, and research articles to support clinical decision making. This information advantage can lead to better diagnosis and treatment options.
Data Privacy and Security
Cybersecurity: AI systems are used to detect and respond to cybersecurity threats. Entities with more sophisticated AI-driven security systems may be better equipped to protect their information than those with less-advanced defenses.
Data Ownership: As AI processes and analyzes data, issues with data ownership and control arise. Organizations with more control over valuable datasets may have an informational advantage.
Market Competition:
Business Intelligence: Companies utilizing AI for market research, customer analytics, and competitive intelligence can gain insights that give them a competitive edge. This information advantage may impact decision making and strategic planning.
Fake news and information.
Social media: AI algorithms are used to spread and detect misinformation on social media platforms. Those who can manipulate or leverage these algorithms may influence public opinion, creating an asymmetry in information dissemination.
Government and Defense:
Military intelligence (AI) is increasingly used in defense for tasks such as threat detection, surveillance, and strategic planning. Nations with more advanced AI capabilities in their defense systems may have an advantage in information warfare.
Algorithmic Trading:
Stock Markets: AI-driven algorithms can execute trades at speeds and frequencies that human traders cannot. This can create information disparities in financial markets.
Personalization:
Recommendation Systems: Companies using AI for personalized recommendations (e.g., in e-commerce or content platforms) have the advantage of understanding user preferences and behavior, thereby creating a personalized user experience.
Although AI can contribute asymmetrical information, there are also concerns related to fairness, ethics, and the potential to create or exacerbate societal inequalities. Regulatory frameworks and ethical considerations are essential to address these challenges and ensure that AI is used responsibly and equitably.

4.4 AI and Rational expectation

Rational expectation is a concept in economics and finance that suggests that individuals make predictions about the future using all available information, and that these predictions are, on average, correct. Several key points can be made regarding the interaction between AI and rational expectations.

AI as a Tool for Better Predictions: AI, particularly machine learning algorithms, can be used to make predictions based on historical data and current information. When properly trained and deployed, AI systems can provide more accurate forecasts that align with the concept of rational expectations in economic models. AI can process vast amounts of data and recognize patterns that may be difficult for humans to discern.

Market Efficiency: Rational expectations theory is closely related to the Efficient Market Hypothesis (EMH). AI is often used in financial markets to detect and act on information more efficiently and quickly than human traders do. AI can contribute to market efficiency by incorporating a wide range of data into price movements as participants quickly adjust their expectations in response to new information.

Behavioral Considerations: While rational expectations assume that individuals make predictions based on all available information, they do not always hold true in practice. Behavioral biases and heuristics can cause individuals to deviate from their fully rational expectations. AI models can be designed to account for these deviations by analyzing both quantitative and qualitative data to capture market sentiment and investor behavior.

Forecasting Economic Variables: AI is frequently used to forecast economic variables such as GDP growth, inflation rates, and unemployment. These forecasts can be valuable for policymakers, businesses, and investors, who make decisions based on their rational expectations of future economic conditions.

Challenges in Model Assumptions: AI and machine learning models are data-driven and may not always adhere to the strict assumptions of the rational expectations theory. These models may identify patterns in data that do not perfectly align with rational behavior. This raises questions about how well AI can capture the nuances of human decision making and expectations.

Feedback Loops: AI can create feedback loops in financial markets. If many market participants rely on similar AI models for decision-making, their actions can influence market dynamics, causing deviations from rational expectations, especially in the short term.

Regulatory and Ethical Considerations: The use of AI in financial markets and economic forecasting raises regulatory and ethical questions. Concerns exist regarding the potential of AI-driven trading strategies to exacerbate market volatility and affect market stability.

In summary, while AI can enhance the quality of predictions and align with the concept of rational expectations in some contexts, it does not guarantee perfectly rational behavior or market efficiency. The interaction between AI and rational expectations is complex and subject to various factors, including the design of AI models, human behavioral biases, and broader economic and regulatory environments.

4.5 AI and Game theory

Artificial Intelligence (AI) and game theory are closely related fields, and AI has a significant impact on the study and application of game theory. Game theory is a branch of mathematics and economics that analyzes the interactions between rational agents or players in strategic situations, often referred to as "games." AI techniques have been used to model, simulate, and solve complex games, resulting in a wide range of applications. AI and game theory are interconnected.

Strategic Decision-Making: AI is used to model and simulate strategic interactions in various fields such as economics, politics, and biology. AI agents can make decisions based on game theory concepts, such as the Nash equilibrium, where each agent's strategy is optimal, given the strategies of others.

Game-Playing AI: AI has made significant advancements in playing complex games, such as chess, Go, and pokers. These games are often used as testbeds for the development and testing of artificial intelligence (AI) algorithms. Game-playing AI systems employ strategies and decision-making based on game theory.

Reinforcement Learning: Reinforcement learning, a subset of AI, uses game theory concepts to train agents to make decisions that maximize rewards. It is widely used in various applications including robotics and autonomous systems.

Auction Theory: AI is used in auction mechanisms to design and optimize auction formats such as second-price auctions or sealed-bid auctions. Auctions are fundamental in markets, advertising, and resource allocation.

Bargaining and negotiating: AI is employed to model bargaining and negotiation situations, thus allowing agents to find mutually beneficial agreements. These scenarios are common in business, conflict resolution and diplomacy.

Multi-Agent Systems: AI is used in multiagent systems in which multiple AI agents interact with each other. These systems are applied in areas such as robotics, traffic management, and supply chain optimization.
Game-Theoretic Approaches to Security: In cybersecurity, AI and game theory are combined to model and analyze the strategies of attackers and defenders. This will aid in the development of improved security measures.
Economic and Market Behavior: AI models are used to simulate and predict economic and market behaviors based on game theory. This has applications in financial modeling, pricing strategies, and investment decisions.
Social and Behavioral Sciences: AI can simulate and analyze social interactions and behavior in various scenarios, contributing to our understanding of human behavior and strategic decision making.
Environmental and Resource Management: Game theory and AI have been used to model and optimize resource allocation and environmental management, including water allocation, climate change negotiations, and wildlife conservation.
Machine Learning in Game Theory: Machine-learning algorithms can be applied to learn and adapt strategies in dynamic game environments. This is particularly relevant in scenarios in which the rules of the game or the behavior of other agents are not perfectly known.
Mechanism Design: AI is used in mechanism design to create systems and rules that incentivize the desired outcomes in multiagent settings. This is crucial when designing markets, voting systems, and online platforms.
Overall, AI and game theory share common principles related to strategic thinking and rational decision-making, and the combination of these fields leads to practical solutions in a wide range of domains, from economics to social sciences and technology applications.

5. CONCLUSION:

The integration of Artificial Intelligence into economic theory presents both significant opportunities and notable challenges. AI's capacity to process vast datasets and enhance forecasting contributes positively to the field of economics, particularly in areas such as market dynamics and decision-making. However, the impact of AI on economic models is not without complexity, as it may challenge traditional notions such as rational expectations and game theory equilibrium. Moving forward, careful consideration of AI's limitations, a focus on cross-disciplinary collaboration, and strong regulatory frameworks are essential to harness the full potential of AI in economics while safeguarding against ethical dilemmas and market instability. The dynamic interplay between AI advancements and economic theory warrants continuous research to strike a balance between innovation and responsible application.

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