

LLM-enhanced Agent-based Model of Markets: Development, Results, and Methodological Implications

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Agent-based models are a suitable tool to study different kinds of systems where a proper intuition regarding the underlying behavior of their components is possible, either intuitively or empirically based on data. Traditionally, agents modeled the behavior of the entities through a set of simple and explainable rules, leading to emergent behavior at the system level. However, for a long time, decision-making based on neural networks has also been integrated into agent-based models, allowing agents to learn in non-trivial situations. This approach comes at the cost of reduced explainability and increased computational demands, particularly when neural networks require pre-training or real-time adaptation.

Given the success of modern LLMs, multiple examples of agent-based models enhanced by generative AI systems have emerged, along with a broad discussion on if, when, and how to use them. In this work, we explore the possibility of employing LLMs as the “brain” of agents simulating companies competing in a market. In this way, the study focuses more on how LLMs behave in a specific environment and how they can be employed in a simulation setting rather than conducting research on an economic market.

The findings of this work highlight the relevance of the system prompt, the sensitivity of results to specific initial conditions, and the necessity of implementing strategies to manage the high computational costs of the simulation, such as parallelization. Additionally, different outcomes were observed when using different models, indicating challenges in achieving reproducible results in this context.