Assessing the Effects of AI on the Job Industry using Evolutionary Game Theory

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Abstract

Although AI can be a powerful force for good in our population and help make many people's jobs easier, there is ongoing rhetoric about the risk of AI "stealing" jobs. **Looking through the lens of evolutionary game theory, this paper investigates the impact of AI on the job industry, looking at a variety of different occupations.** Using the Kaggle dataset "From Data Entry to CEO: The AI Job Threat Index," we model the evolution of job roles and skill sets in response to AI-driven changes. Our findings suggest significant shifts in employment patterns, with implications for workers, employers, and policymakers. While we don't seek to fearmonger, we do hope to help employees across all industries think critically about how AI might affect the job pool of opportunities.

Introduction/Literature Review

The rapid rise of AI has **significantly transformed the tech job market**.

Recently, there has been a significant increase in the number of papers studying the subject of how AI will impact the job market, specifically **if AI is capable of replacing human jobs**. However, there was a notable **lack of papers utilizing evolutionary game theory to study this phenomenon**.

Many papers looked at the ethical considerations on if artificial intelligence *should* replace human jobs and provided useful background information on how artificial intelligence can be utilized as a supplementary tool rather than something that fully replaces human work. **However, while these theoretical models provide useful conceptual ethical ideas, they do not provide the mathematical models** that can help assuage the fear of many Americans on how safe they are from getting laid off.

Our ultimate aim is to make an easily accessible **AI threat index** that helps employees from all different industries use evolutionary game theory to assess their best next steps in their careers in the face of AI.

In our study, we model three key strategies that job roles can adopt in response to AI's impact:

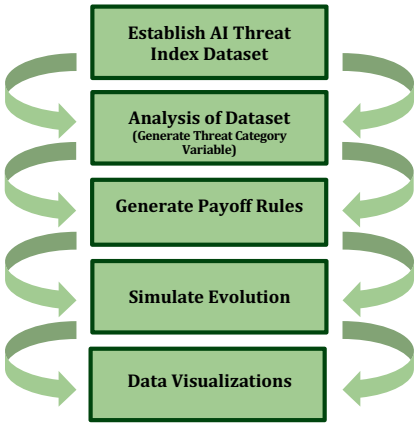
Upskill: This strategy involves acquiring new skills or improving existing ones to enhance job performance and adaptability. Upskilling can help workers stay relevant in their current roles or transition to more advanced positions that are less susceptible to automation.

Stay: Choosing to stay means maintaining the current job role without making significant changes or acquiring new skills. This strategy might be viable for roles with low AI threat levels but can be risky for positions highly susceptible to automation.

Switch: Switching involves transitioning to a new role, often one that is more aligned with AI technologies or less likely to be automated. This strategy can provide a safer and potentially more rewarding career path for those in high-threat job roles.

These strategies reflect different approaches workers might take to navigate the evolving job market influenced by AI advancements.

Methodology and Game Simulation



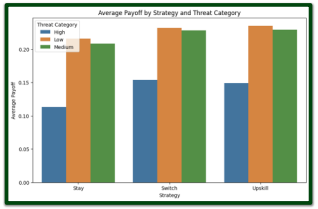


Figure 1. Average Payoff by Strategy and Threat category.

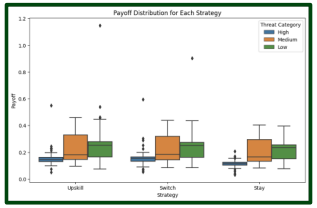


Figure 2. Payoff Distribution for Each Strategy.

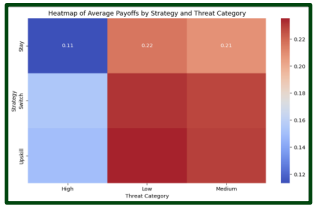


Figure 3. Heatmap of Average Payoffs by Strategy and Threat Category.

Main Contribution

The project applies evolutionary game theory to study the impact of AI on job roles, filling a gap in the existing literature where most studies focus on ethical considerations rather than quantitative models.

Our ultimate contribution finds that medium and high threat job roles should opt for the "upskill" or "switch" strategy, and that the "stay" strategy leads to lower payoffs.

Results

We assume a population of 4,706 job roles, performing 100 iterations, with each role having a random number of neighbors. There are three strategies, 'Upskill', 'Switch' and 'Stay'.

For Upskill payoff a, Switch payoff b, and Stay payoff c, we model the following scenarios:
$A \times D = \{(a,d) | a \in A := \{0.1, 0.15, 0.2\}$ and $d \in D := \{0.05, 0.1, 0.15\}\}$. We essentially artificially increase or decrease the efficiency of a worker based on the strategy and a random uniform number.

In the **Average Payoff by Strategy and Threat Category Figure** in Fig. 1, we observe that job roles with higher AI threat levels have lower payoffs across all strategies. We also see that strategy "Upskill" tends to be the most successful across all threat levels. This reflects a population's propensity for upskilling.

Next, we focus on the iterations required for a population to reach critical upskill probability. Many populations' average upskill probabilities remain low after 100 iterations, requiring thousands of iterations to increase significantly. Below, we show how iterations to reach critical upskill probability vary with AI threat payoffs.

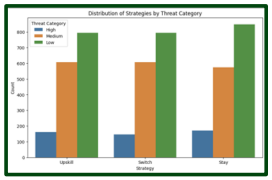


Figure 4. Distribution of Strategies by Threat Category.

In **Distribution of Strategies by Threat Category Figure** above, iterations to reach critical upskill probability increase with AI threat payoff and decrease with upskill payoff, the dynamic between low/medium/high threat jobs is consistent between all strategies.

In the **Payoff Distribution for Each Strategy Figure** (Fig. 2), we then vary the difference between upskill and AI threat payoffs, along with the job security coefficient. This yields the following plots.

In the **Heatmap of Average Payoffs by Strategy and Threat Category Figure** (Fig. 3), we can see in a more visual sense how the highest payoffs are clustered in the Upskill category for low and medium threat levels. For the high threat level job roles, we see that Switching is a slightly better strategy.

Implications and Further Research

Our findings indicate significant shifts in employment patterns due to AI, with job roles adapting differently based on their AI threat levels. These results have profound implications for workers, employers, and policymakers.

Workers in high-threat roles should consider **upskilling or transitioning to AI-related positions to enhance job security**. Understanding AI's impact can help workers **make informed career decisions and reduce anxiety about job displacement**. Employers can use these insights for strategic workforce planning, including developing targeted training programs to help employees adapt to AI-driven changes. Identifying roles most at risk of automation can aid companies in managing talent pipelines effectively. Policymakers can leverage this data to **craft policies that support workforce transitions, such as subsidies for training programs or incentives for companies to invest in employee development**. Ensuring the workforce adapts smoothly to AI can maintain economic stability and mitigate the social impact of job displacement.

For further research, it is crucial to **test our results against the evolving job market to ensure they accurately reflect AI's current role** in replacing jobs. This involves continuously updating models to capture the latest AI trends and their applications across various industries. Analyzing the impact of emerging AI technologies on different job sectors can provide real-time insights.

Leveraging **tools like the AI Threat Tool Advisor can guide ongoing research and offer actionable insights** for workers and employers. Enhancing these tools with more nuanced data and predictive analytics will improve their accuracy and utility. Studying the broader economic implications of AI-driven job displacement, including effects on income inequality and social mobility, can inform policy measures to promote inclusive economic growth.

By addressing these areas, future research can **ensure the workforce remains resilient and adaptable** in the face of rapid technological advancements, fostering a more **secure and prosperous** economic environment.

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Acknowledgements/References

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