System Dynamics Analysis of AI's Socioeconomic Impact: Policy Insights on Inequality, Unemployment, and the Rise of DeepSeek

By: Moosavihaghighi Mohammadhashem

Corresponding Author, Independent Researcher and Honorary Research Member, Safety Research Center, Shiraz University, Shiraz, Iran

Emails: musavee@gmail.com , m.mousavihaghighi@areeo.ac.ir,

Handphone & WhatsApp: 0098-917-3102356

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Problem Statement

- AI's rapid growth is transforming economies, yet deepening inequality, particularly in developed nations. Automation benefits capital and skilled labor, while low-skilled workers face displacement. Traditional models can't capture these complex dynamics. System Dynamics offers a needed framework to analyze feedback loops driving disparities and guide interventions for economic resilience so concluded that.

1- Rapid AI growth disrupts labor markets
2- Reinforces wealth accumulation among few
3- Rising inequality and unemployment
4- Existing models neglect systemic feedbacks

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Study Objectives

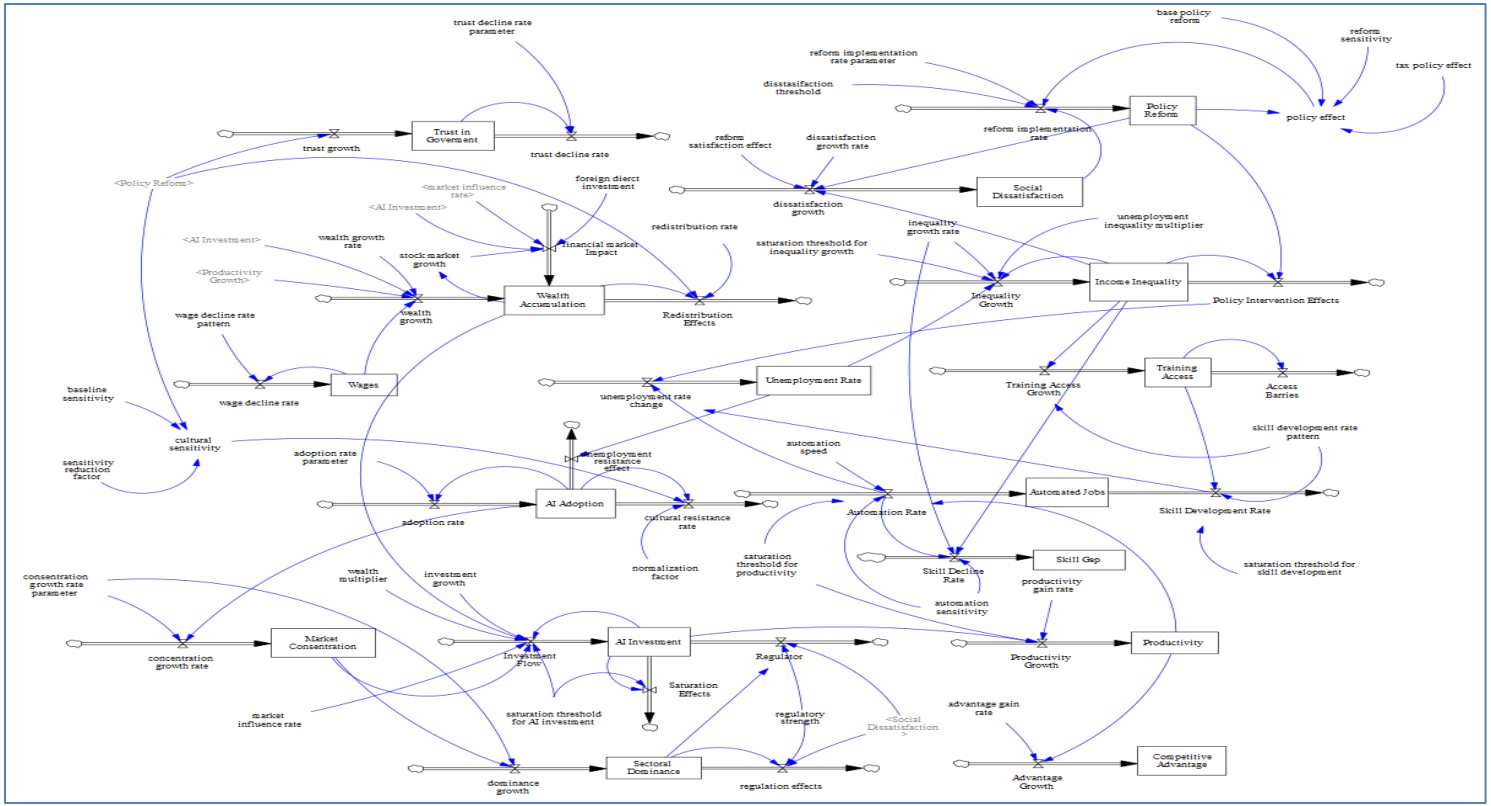
This research addresses critical gaps in the literature by developing a SD model that captures AI's systemic influence on inequality and employment. The objectives are:

- To analyze how AI-related reinforcing and balancing feedback loops shape long-term socioeconomic outcomes;
- To simulate policy interventions such as AI taxation, automation regulation, and workforce reskilling;
- To assess the disruptive effect of DeepSeek—a cost-effective Chinese AI—on U.S. technology leadership; and
- To identify the optimal mix of AI investments and social policies that preserve innovation while promoting equity. By testing multiple future scenarios, the study aims to guide policymakers in balancing AI advancement with social cohesion.

Approach or Dynamic Hypothesis

This study hypothesizes that AI investment fuels productivity and profitability, reinforcing reinvestment cycles. However, automation displaces low-skilled labor and worsens inequality, while limited access to AI education sustains skill gaps. Balancing mechanisms like reskilling and taxation may offset these trends. The SD model embeds this hypothesis through interlinked stocks and flows—capital, labor, productivity, and policies—highlighting risks of unchecked reinforcement and the potential for policy-driven equilibrium.

Stock and Flow Diagram



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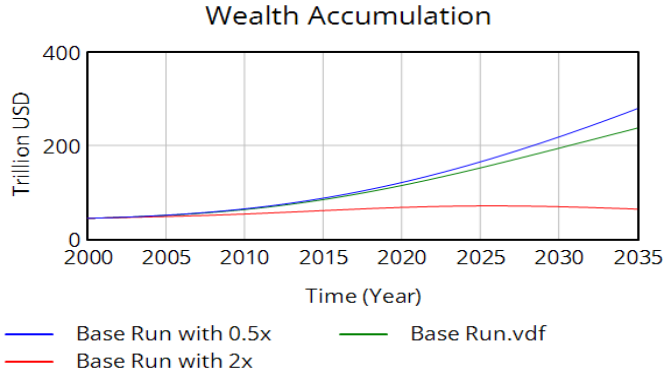
Results of Behavioral Reproduction Test

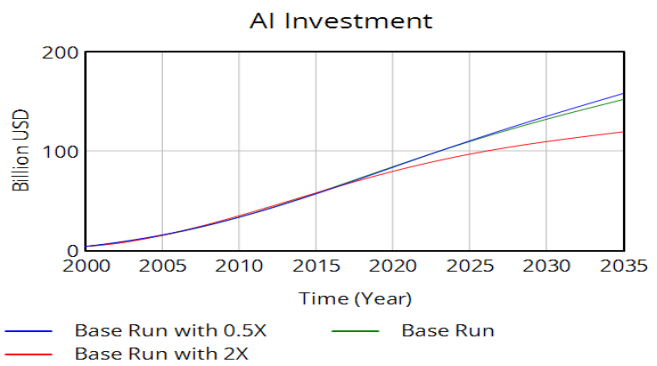
Results of the "behavioral reproduction test" for model validation, using RMSPE and Theil's U-statistics to compare simulated vs. actual economic trends

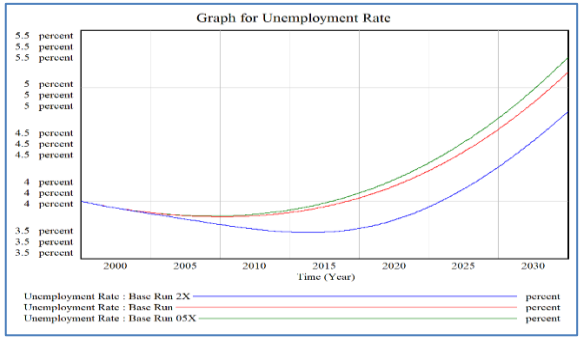
Variable Name	RMSPE (%)	RMSPE Interpretation	U-Theil	U-Theil Interpretation	Variable Status
AI Investment	2.14	Low percentage error, highly reliable forecast	0.0082	Near-perfect fit, model accurately tracks investment trends	Acceptable
Wealth Accumulation	1.42	Very small error, closely follows real economic wealth trends.	0.0039	High accuracy, reliable for long-term economic analysis	Acceptable
Unemployment Rate	2.83	Slightly higher error, automation effects need minor refinements.	0.0086	Acceptable accuracy, but workforce dynamics could be adjusted	Acceptable
Income Inequality	0.22	Near-zero error, model effectively tracks inequality trends.	0.0012	Excellent calibration, strong reliability in inequality predictions.	Acceptable

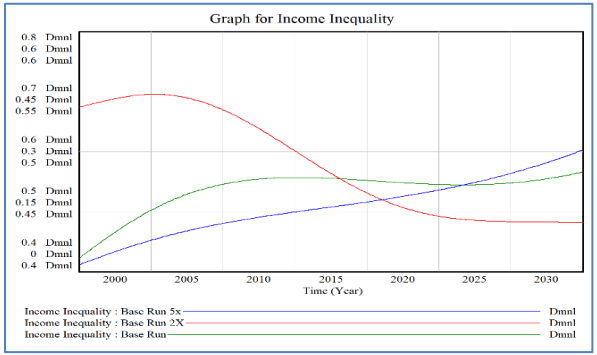
Results of Extreme condition Test

"Extreme condition test" results, illustrating the impact of doubling (2X) or halving (0.5X) key AI investment variables on unemployment, inequality, and economic stability



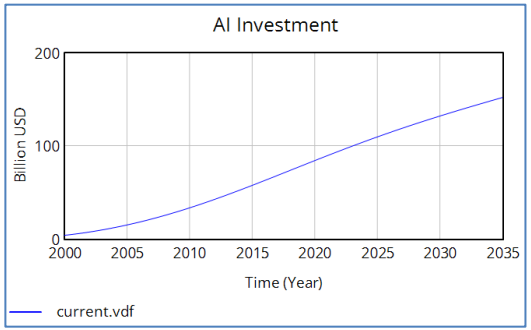


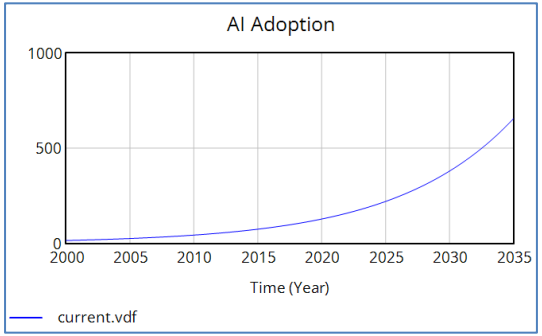


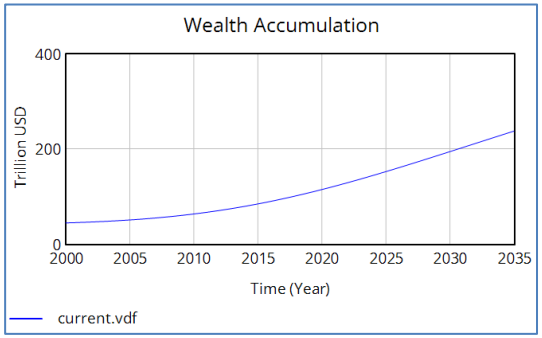


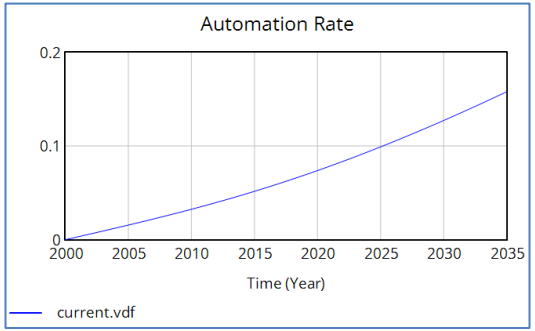
Simulate the Current Trend

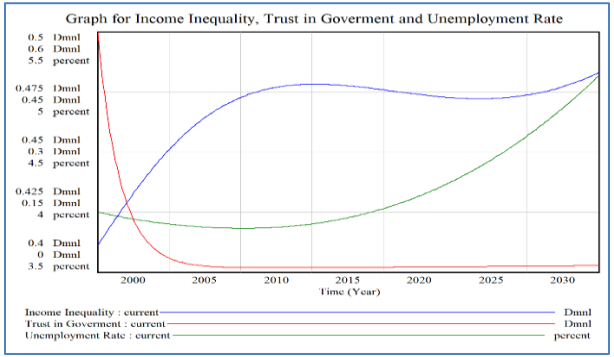
AI Investment, AI Adoption, Wealth Accumulation, Automation Rate, Income Inequality, Trust in Government and Unemployment rate





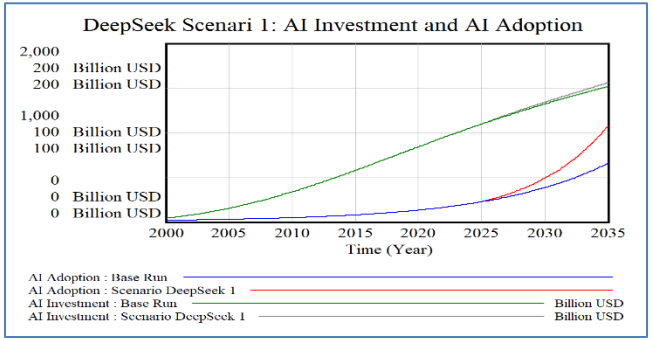


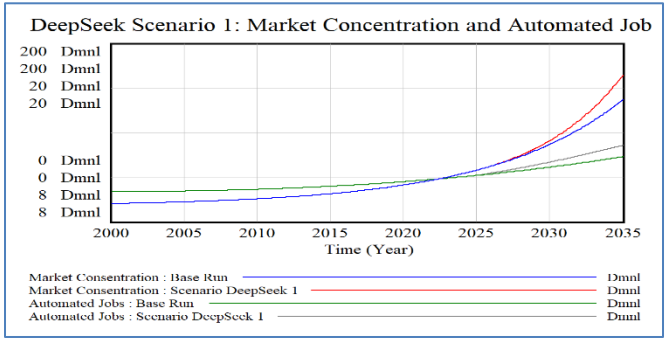


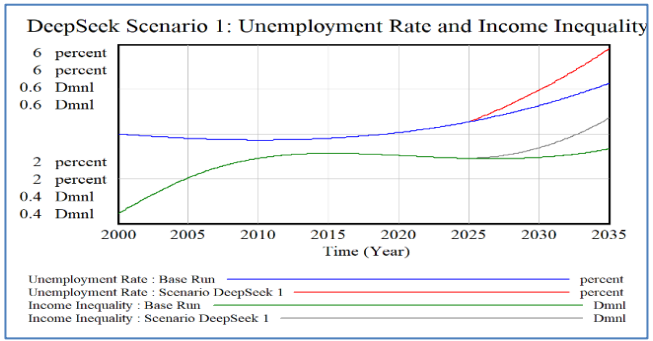


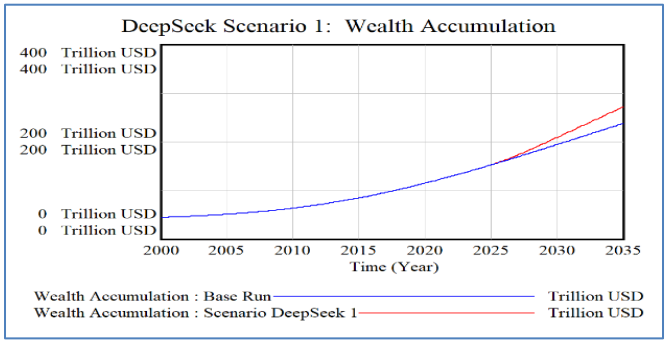
Scenario 1-A

Defensive Investment Surge, AI investment and capital allocation in the U.S. grow exponentially as firms aggressively increase AI investment to counter Chinese advancements.



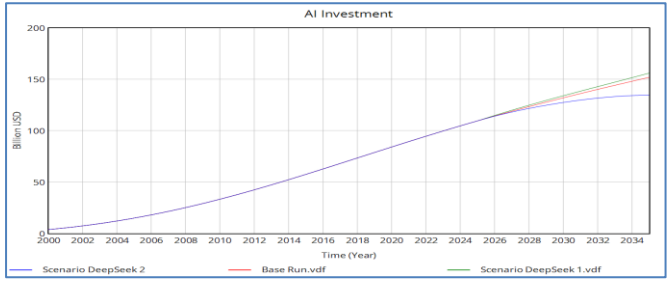


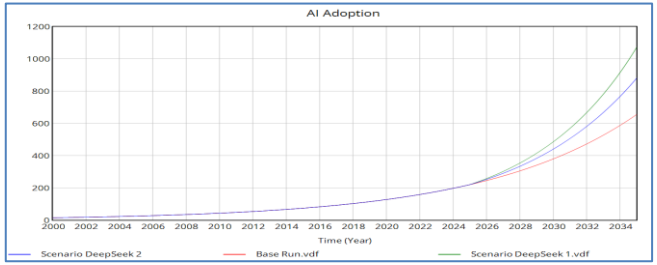


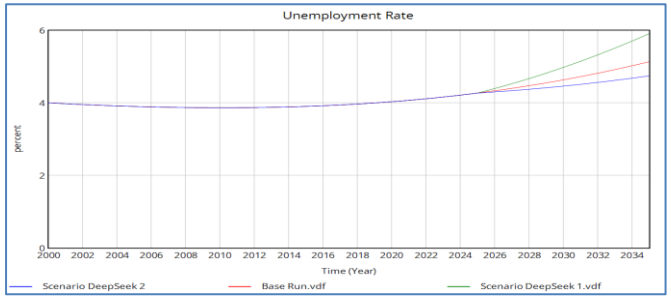


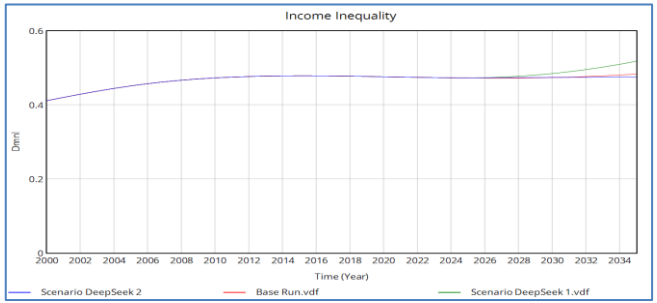
Scenario 1-B

DeepSeek's adoption spreads globally, U.S. firms might reduce their R&D investments in favor of adopting foreign AI models, lowering projected investment below $152 billion.





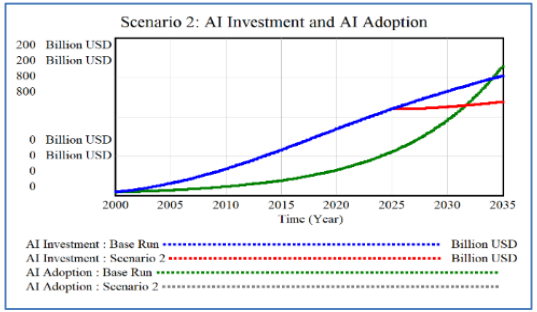


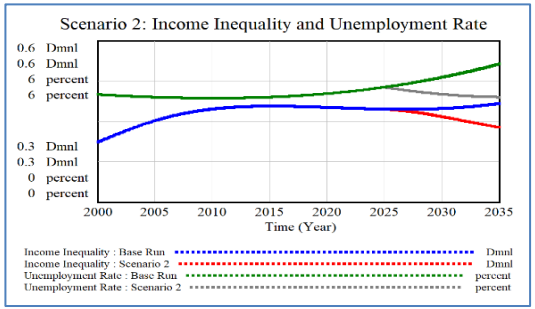


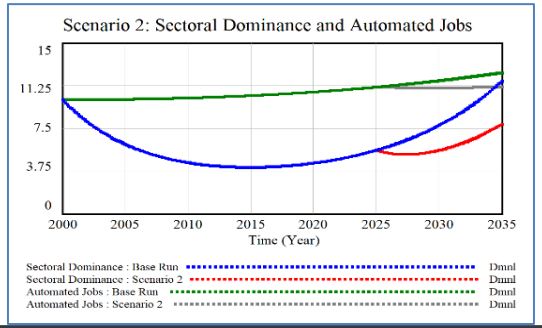
Scenario 2

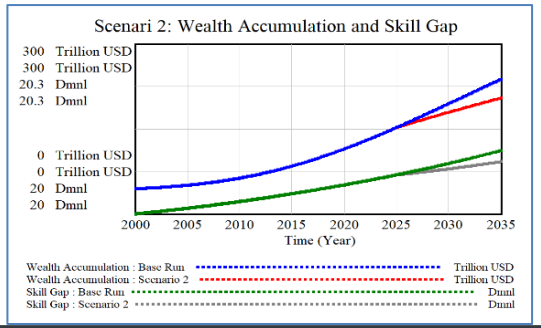
AI Workforce Adaptation and Inclusive Growth Policy in the US (2025-2035)

This scenario introduces government-led interventions to mitigate the negative economic impacts of AI automation while ensuring continued technological advancement.





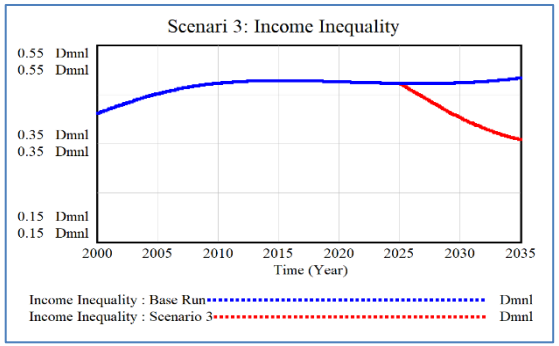


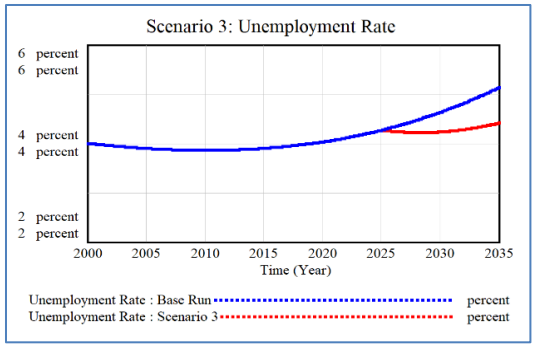


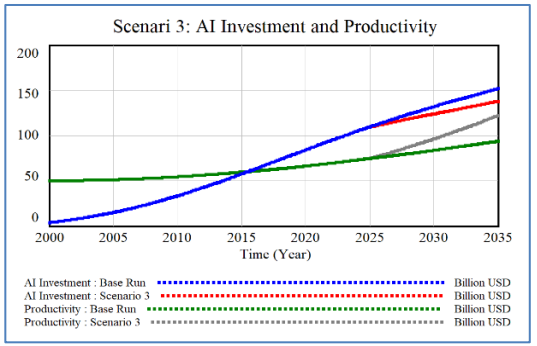
Scenario 3

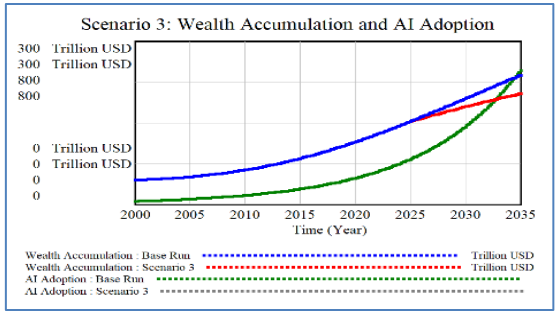
AI-Driven Socioeconomic Balance Plan

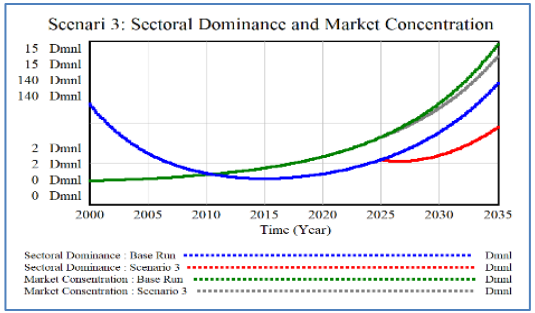
This scenario aims to establish a balanced AI adoption framework in the U.S. from 2025 to 2035.

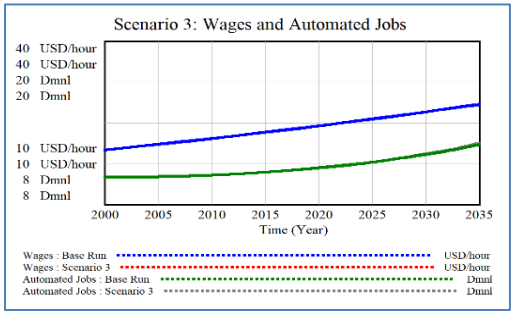












Conclusion

Abstract of the Three Scenarios Tested on AI Investment, Unemployment Rate, Income Inequality, and Market Concentration, and the Policy Implications of Each Scenario Separately

Scenario Name	AI Investment (2035)	Unemployment Rate (2035)	Income Inequality (Gini, 2035)	Market Concentration	Policy Implications
Scenario 1-A (Aggressive Expansion - DeepSeek Response)	$200B+	6.5%	0.52 (High)	Extreme (Tech Monopolies)	U.S. maintains AI leadership but worsens economic inequality and automation-driven job loss.
Scenario 1-B (Investment Diversion & Market Adaptation - DeepSeek Response)	<$152B	4.8%	0.46 (Moderate)	Moderate	U.S. AI dominance declines slightly, but economic stability is preserved.
Scenario 2 (Inclusive Growth)	$152B	4.5%	0.44 (Lower)	Controlled Growth	AI taxation and reskilling balance economic growth and social stability.
Scenario 3 (AI-Driven Socioeconomic Balance)	$152B	4.3%	0.42 (Lowest)	AI Decentralization	Best policy option: Ensures balanced AI adoption while maintaining employment and wealth redistribution.

Strategic Policy Implications for U.S. Policymakers (1)

1- Strengthen U.S. AI Competitiveness

- Expand federal R&D investments to counter DeepSeek's cost advantages.
- Create a public-private AI R&D consortium to drive the next generation of AI innovation.
- Strengthen intellectual property protection to prevent technology leakage.
- Develop a national strategic plan to address emerging AI.

2- Ensure the Adaptability of the AI Workforce

- Mandate corporate AI impact reports to increase transparency on job displacement risks.
- Introduce a national AI reskilling fund ($50 billion investment) to support workforce transition.
- Strengthen public-private AI training programs to increase workforce adaptability in AI-enabled sectors.
- Pay special attention to labor productivity as AI adoption increases.

Strategic Policy Implications for U.S. Policymakers (2)

3- Prevent AI Market Monopolies

- Enforce AI antitrust regulations to limit the dominance of large tech companies.
- Mandate AI hiring quotas to ensure that human capital remains integral to economic growth.
- Introduce a progressive AI tax (1.5%) to redistribute AI-enabled wealth for the public good.

4- Promote Economic Equality in the Age of AI

- Launch a Universal AI Dividend (UAD), ensuring that AI-generated wealth benefits the entire workforce.
- Direct 30% of federal AI funding to SMEs to decentralize economic gains.
- Enforce automation regulations to control the pace of AI-driven labor market disruption.

Safeguarding U.S. AI Leadership Amid Global Shifts

To counter rising Chinese influence in AI governance, international cooperation must be reinforced. Without strategic intervention, technologies like DeepSeek could redefine global standards and diminish U.S. competitiveness.

Policymakers must prioritize innovation-friendly regulation, adaptive workforce strategies, and robust AI investment. Progressive taxation, equitable employment policies, and reskilling efforts are essential to ensure AI drives inclusive growth rather than deepening social divides.

Call to Action for Policymakers

- The future of AI in the U.S. will be shaped not just by technical innovation, but by policy choices. Policymakers must act now to prevent rising inequality, labor market disruption, and erosion of democratic institutions.
- The findings of this model highlight the need for proactive regulation, public investment in skills, and the redistribution of AI-created wealth. Delayed action will magnify systemic risks. Policymakers should treat AI as both an opportunity and a national responsibility, aligning it with long-term social resilience and equity goals.

Recommendations for Future Research

- ***Interdisciplinary Research:*** Conduct socioeconomic AI impact studies with a multidisciplinary team (e.g., economists, machine learning experts, deep machine learning, sociologists, psychologists, management professionals, etc.) to achieve more reliable and valid results for policymakers.
- ***Global AI Policy Comparison:*** Compare AI policies across countries to assess changes in the global labor market.
- ***Cultural and Social Dynamics:*** Investigate the cultural and social dynamics affecting public resistance to AI adoption.
- ***Hybrid Modeling Approaches:*** Use hybrid modeling approaches by integrating machine learning with SD simulations to increase prediction accuracy.
- ***Complex Future Impacts:*** Explore the complex future impacts of AI on human life, beyond this study's scope. It remains unclear whether AI will have a complementary, substitutive, or neutral relationship with factors of production (e.g., labor, capital, and energy) in the medium and long term.
- ***Separate Important Effect:*** In this study, AI is considered the main driver of future technological progress and productivity for simplicity. Future research could analyze these effects separately.

Final Thoughts and Acknowledgments

- *This study demonstrates that AI, when guided by evidence-based policy and dynamic modeling, can be aligned with social equity. The author acknowledges the contributions of the System Dynamics community, academic mentors, and open-data initiatives. Emphasis is placed on interdisciplinary collaboration—spanning economics, computer science, public policy, and education—as critical to fostering equitable AI development. The author encourages feedback and future collaboration on cross-national modeling, hybrid AI–SD methodologies, and participatory policy design to ensure AI advances collective welfare rather than exclusion.*

Thank you for your attention

- *As AI continues to shape the future of our economies and societies, we must ask ourselves: are we building a smarter world for all or just a richer one for a few?*
- *To the global community, and especially to the United States as a leader in AI innovation, your choices matter. The path you take will influence not just technology, but fairness, dignity, and opportunity for millions.*
- *Let us work together as scientists, policymakers, and citizens to make AI a force for shared progress, not growing inequality.*