Agent-Based Modeling to Analyze the Effect of the 2009 Government Stimulus Package on the Labor Market

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In 2009, in response to the economic recession of 2008, the U.S. government introduced a stimulus package that consisted of three primary components: tax cuts, government-funded projects and increased duration of the unemployment insurance [1].

RESEARCH QUESTION

How effective were the individual components of the 2009 stimulus package in improving the condition of the labor market and decreasing the unemployment?

METHOD

Agent-Based computer Modeling (ABM) of the labor market within the NetLogo multi-agent programmable environment [3]:
✓ Allows for numerical analysis of non-closed form problems
✓ Allows the user to create a set of heterogeneous agents and have them interact in a simulation

MODIFIED AGENT-BASED MODEL:
The Hamill-Gilbert Simple Labor Market Model was used as a base model with the following modifications to better represent the real-world economic situation [2]:
1. Heterogeneous agents (employers and workers)
2. Number of jobs is not equal to number of workers; Pre-existing unemployment.
3. Realistic business size distribution
4. Realistic wage standard deviation and mean
5. Tax Rate > 0

MODELING THE RECESSION & STIMULUS

During a Recession:
• More employers go out of business
• Decrease in Job Vacancies
• Increase in Unemployment

Stimulus introduces:
• Tax Rate Changes
• Government-Funded Projects
• Increase in Unemployment Insurance Duration

MAJOR RESULTS

1. EFFECT OF TAX RATE CUTS:
Decreasing tax rate decreases unemployment, as it makes workers more willing to accept a lower wage (Fig. 4) and makes it easier to match workers and employers (Fig. 6).

2. EFFECT OF GOVERNMENT-FUNDED PROJECTS:
Governmental funding is advantageous, because government-funded projects increase demand and create employment opportunities (Fig. 7).

3. EFFECT OF INCREASED DURATION OF UNEMPLOYMENT INSURANCE:
During a recession, increased duration of unemployment insurance decreases the workers’ willingness to agree to employment at a lower wage (Fig. 5) and therefore has a detrimental effect on labor market recovery (Fig. 8).

PROJECT SUMMARY

➢ The agent-based modeling is an effective method for stimulus package analysis; during recessions, such analysis can help maximize the positive effect of government stimulus by balancing various components of the stimulus package.
➢ During a recession, tax cuts and government-funded projects aid labor market recovery, but unemployment insurance is detrimental to the labor market recovery.
➢ The Developed Model successfully:
   • Reflects the heterogeneity of the labor market
   • Follows a recession
   • Demonstrates the effects of various components of the stimulus package
➢ The Model is limited, since it is simplified and only shows relative, not absolute effect.

Fig. 1. A three dimensional representation of an agent-based model [2]

Fig. 2 & 3. An Agent-Based Model of a Simple Labor Market

Fig. 4. The Wage Negotiation Function: worker and employer reach an agreement

Fig. 5. The Wage Negotiation Function: worker and employer cannot reach an agreement

Fig. 6: Isolated tax cut of 0% (red), 5% (blue) and 25% (green).

Fig. 7: Isolated government-funded projects with index of 0 (red), 10 (blue) and 50 (green).

Fig. 8: stimulus without increasing duration of insurance (red) and increase of 34 weeks (blue) and increase of 74 weeks (green).

References