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

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

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
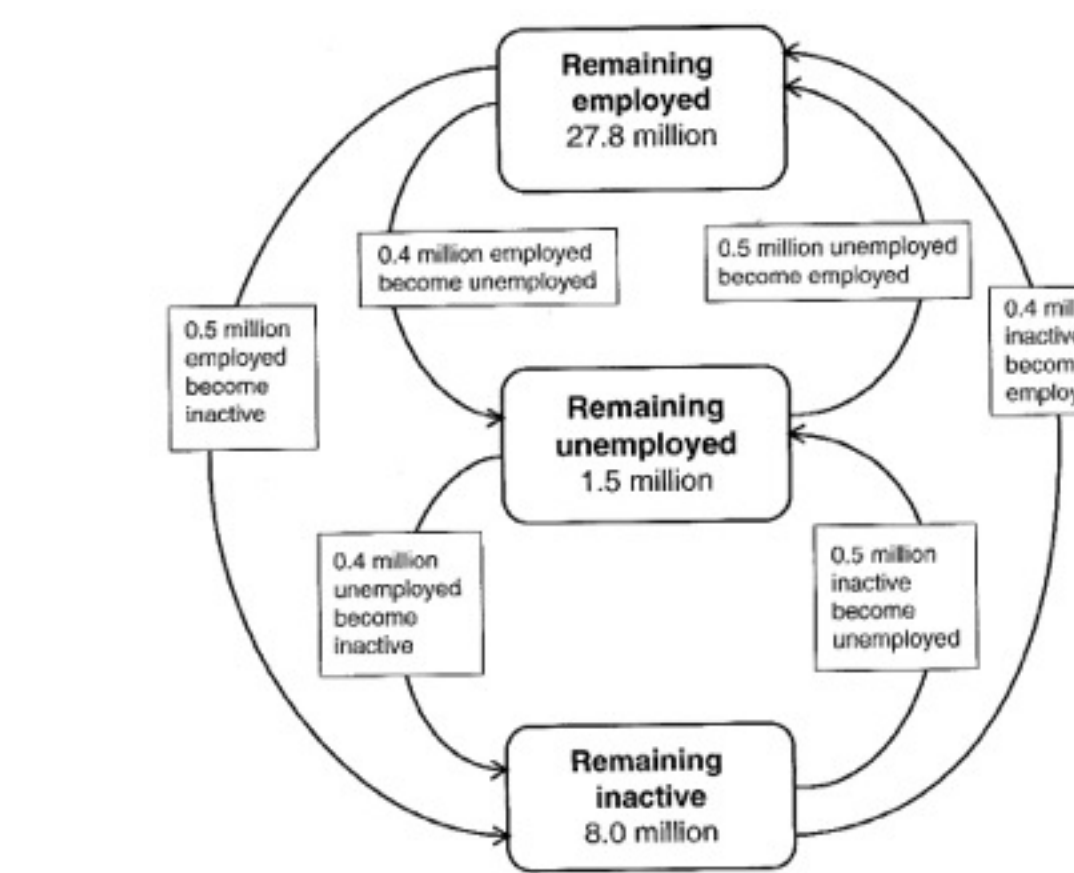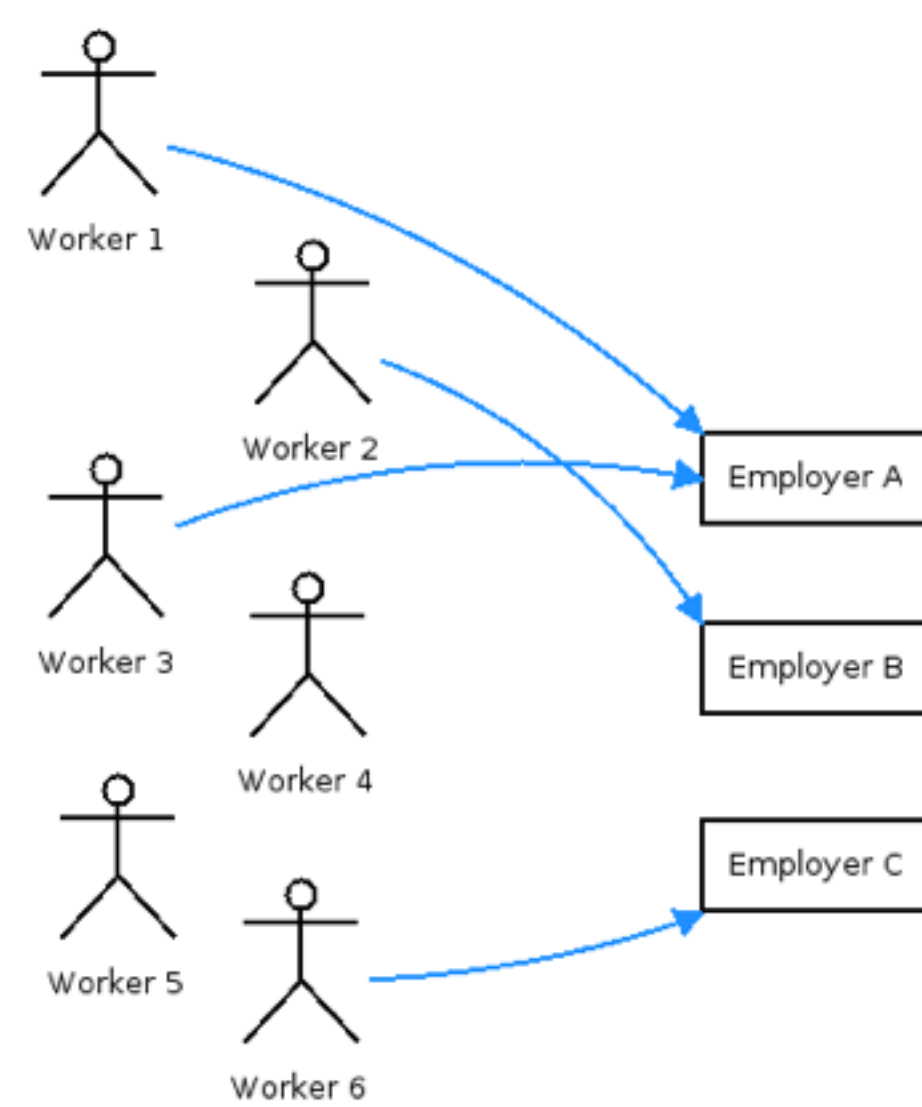5. Tax Rate > 0

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

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
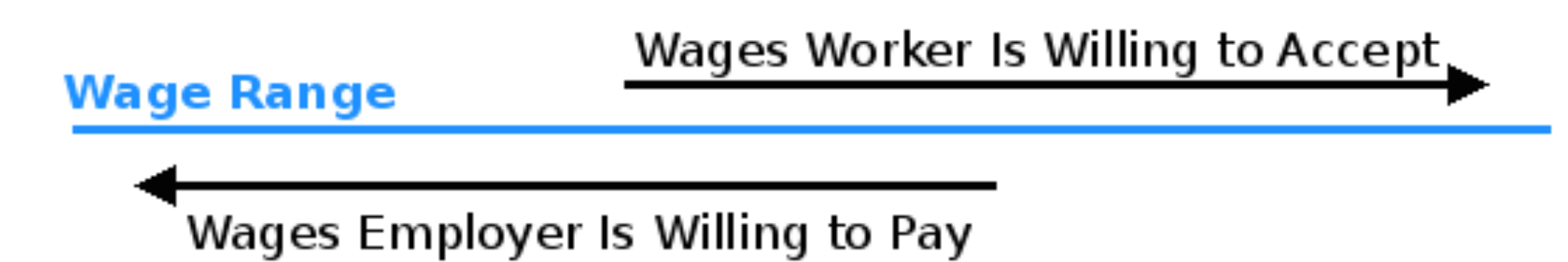- Increase in Unemployment Insurance Duration

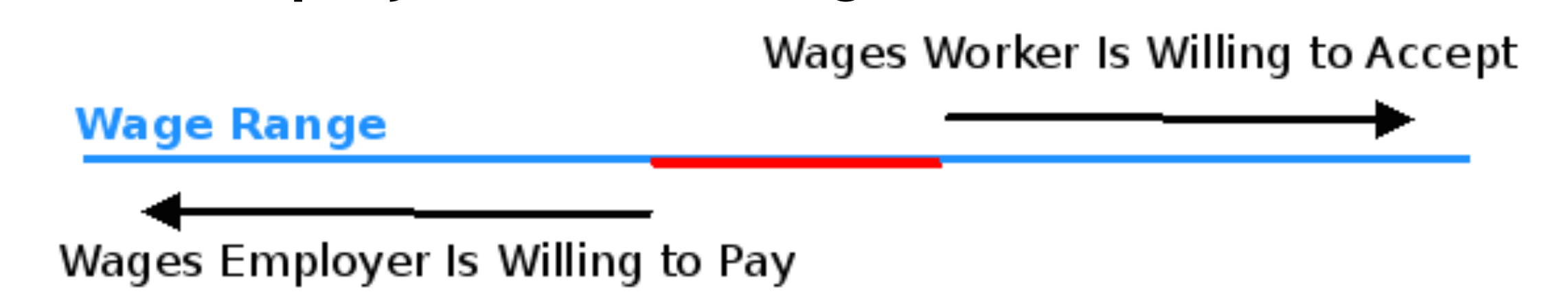Fig. 4. The Wage Negotiation Function: worker and employer reach an agreement

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

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)

Figures 6-8: Labor Market dynamics during recession as a result of an application of individual stimulus package components. Recession occurs at week 250; the Stimulus package component is introduced at week 306. Individual representative simulations are shown, therefore, the graphs should not be compared by their absolute values. Instead, the trends in the unemployment rate, as a result of the introduced measure, should be analyzed

Fig. 6: Isolated tax cut of 0% (red), 5% (blue) and 25% (green).
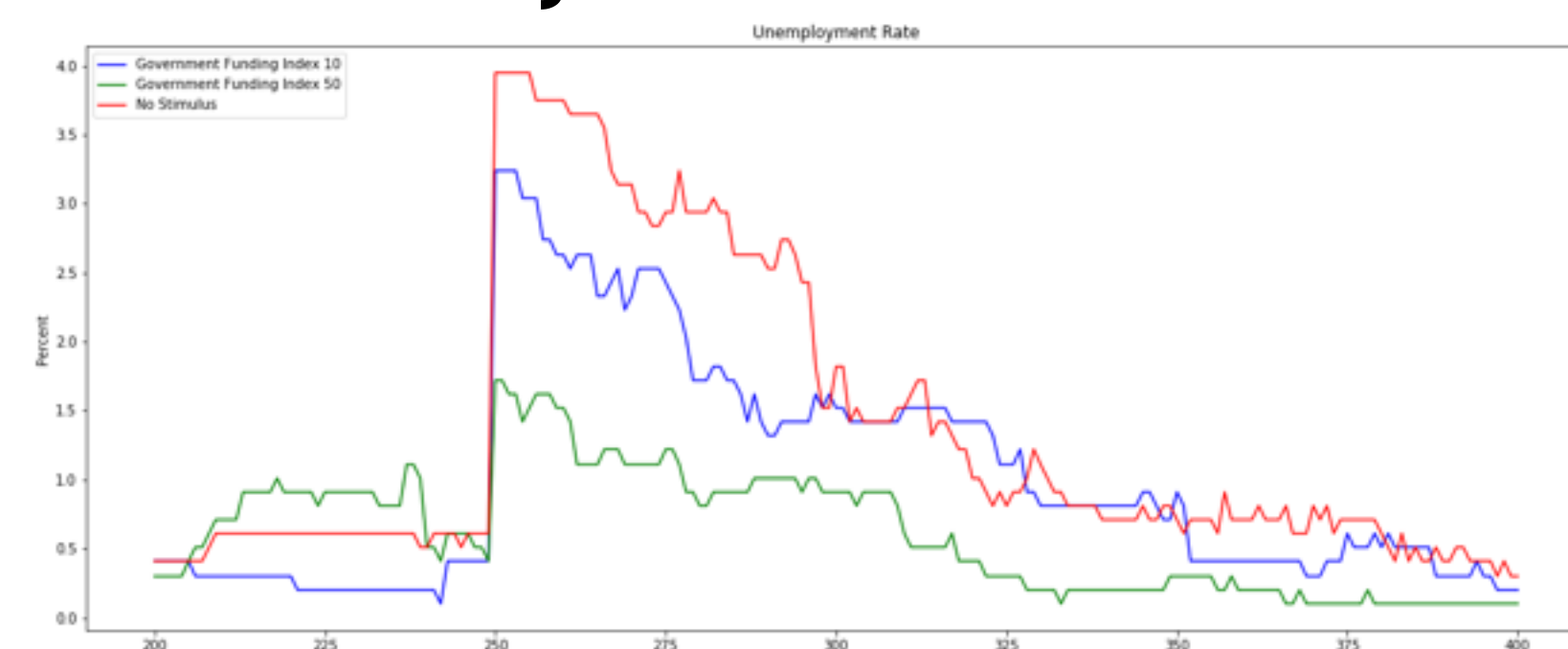
Fig. 7: Isolated government-funded projects with index of 0 (red), 10 (blue) and 50 (green).
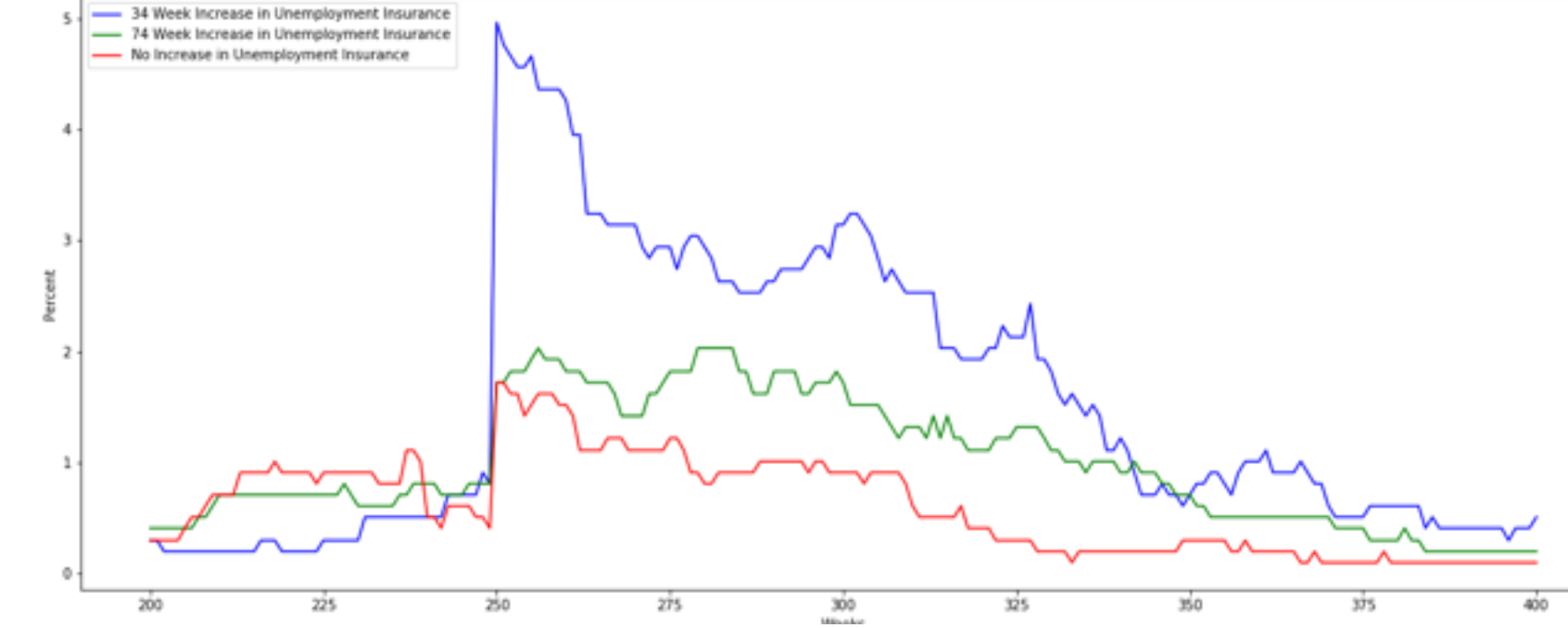
Fig. 8: stimulus without increasing duration of insurance (red) and increase of 34 weeks (blue) and increase of 74 weeks (green).

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.

References
[1] *US Business Cycle Expansions and Contractions*. Accessed: 15/02/2018. The National Bureau of Economic Research. URL: http://www.nber.org/cycles.html.

[2] Lynne Hamill and Nigel Gilbert. Agent-Based Modelling in Economics. The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom: John Wiley & Sons, Ltd., 2016. ISBN: 9781118456071.

[3] Uri Wilensky. NetLogo. Version 5.2.0. Oct. 1, 2015. URL: http : / / ccl . northwestern . edu / netlogo/.