Economic Policy Simulation and Optimization

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Abstract

There are several variations on gubernatorial economic policy around the world. Given different populations and demographics, economic policy changes. How can we best predict the ramifications of a given policy? Can we produce an optimal policy? Computer simulations and optimization using genetic algorithms may be able to provide policy makers with the data to answer these questions. An iterative model of the relationship between the government, economic policy, and the governed and optimization processes involving genetic algorithms were tested in an attempt to further this research.

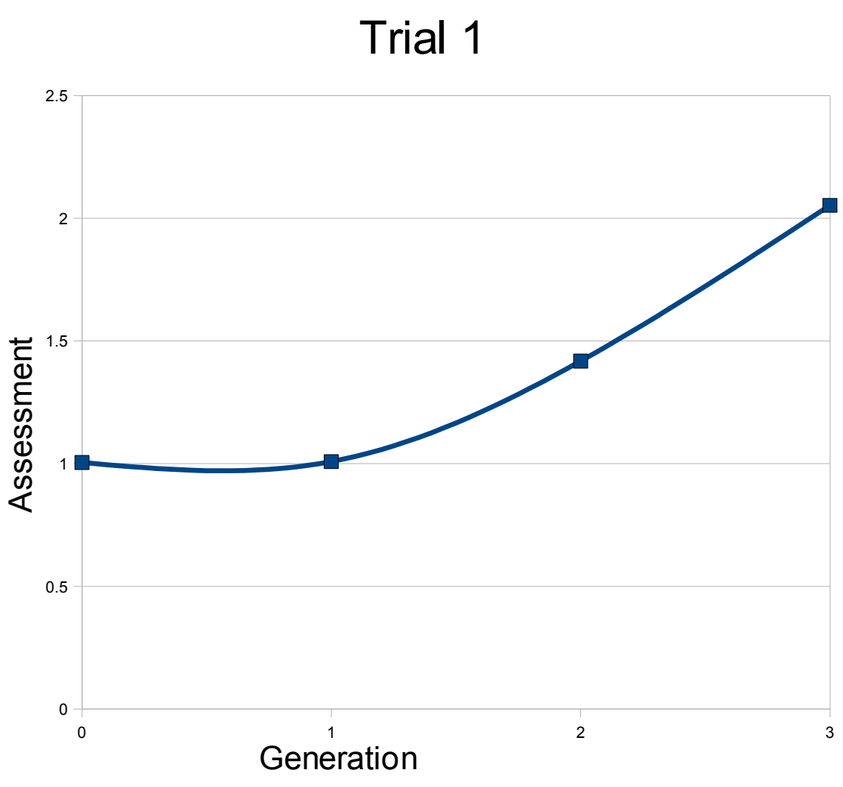
Purpose and Methodology

The core of this project is an agent based model system to provide data of government and population economic and subjective satisfaction over time. Changing demographics and complicated economic systems may obstruct desired outcomes in certain economic policy, disrupting social order. Computer models can provide prediction data quickly and at a low cost to economists, businessmen, and policy makers. Data from the model and perhaps from the genetic algorithm based optimization can guide those involved in economics.

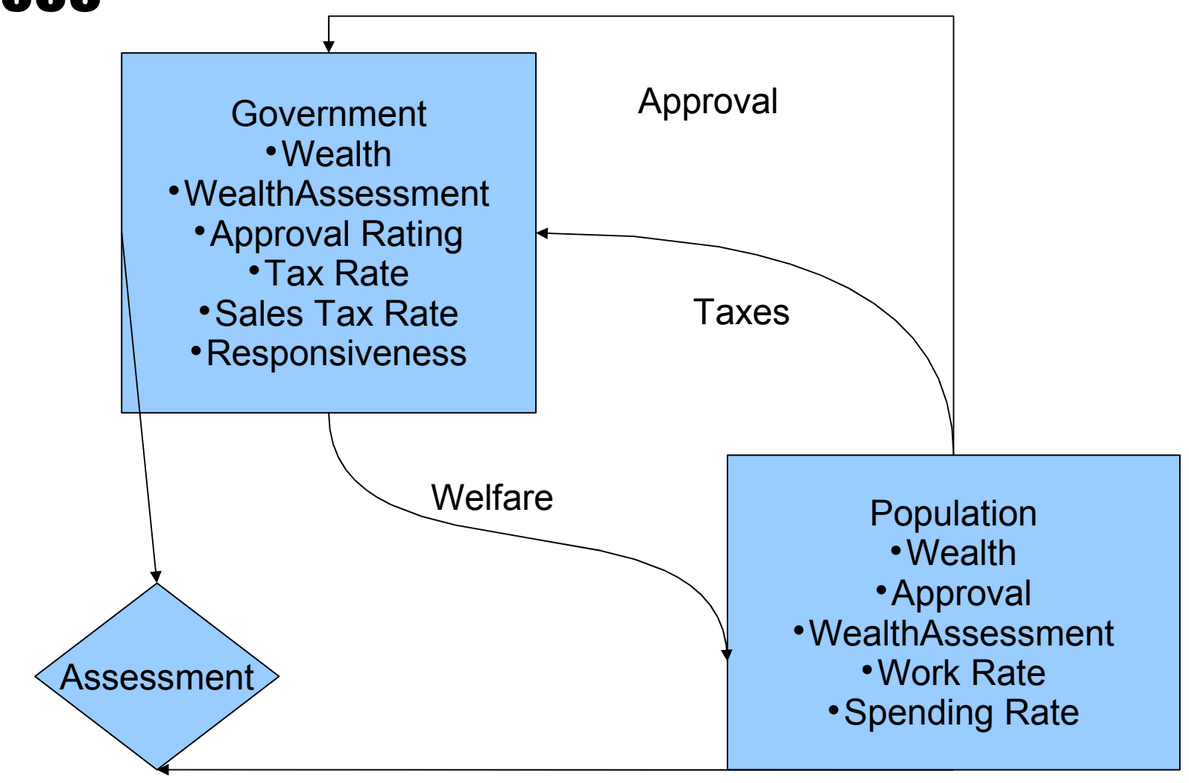
The project, coded in Java models a 12 year economic cycle, a population will consume and produce, and an authority ("government") will tax and implement welfare programs. The economics and relative health of the population and governing body will be assessed by instantaneous change in wealth. Data from the model was analyzed and run through a genetic algorithm. The genetic algorithm mixes attributes of government policy, namely tax rates, willingness to give welfare, and welfare rate. to create new policy. New policies are tested and analyzed, and the process is repeated for 10 generations.

Data and Results

Currently, using varied data, there is an overwhelming trend of the total civilian wealth plummeting and leveling out, while the total government wealth continues to go up. The assessment, which is defined as the current wealth divided by the previous month's wealth for the total civilian population averaged with the same assessment for the government wealth, is mostly erratic. The genetic algorithm is successful – the assessments for each generation improve, getting as much as 50% improvement in less than 10 generations. However, it is clear that while the citizenry's approval of the policies rises, the governments often plunge into debt, even causing computational problems from extremely negative numbers.



Genetic Algorithm Improving the Assessment



Model Flow Diagram

Background

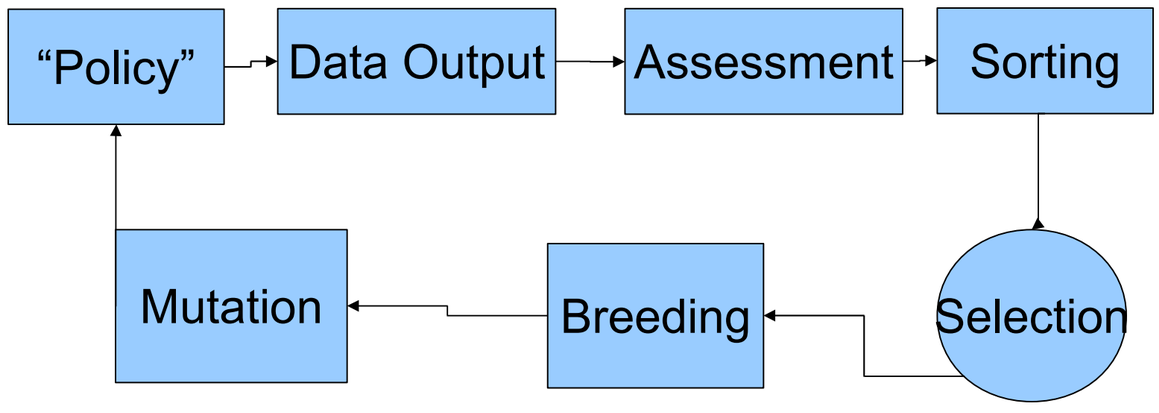
Tax burden and sudden changes in tax policy are detrimental to approval ratings according to Vermeir's model in Taxation and Presidential Approval: Separate Effects from Tax Burden and Tax Structure Turbulence?. My project sought out to test such theories.

As for optimization, there are several approaches to attain the "best" policy. The assessment determined in the model and other data will be put under optimization algorithms. One possible algorithm is the genetic algorithm. In Optimization in a Distributed Processing Environment using Genetic Algorithms with Multivariate Crossover, a genetic algorithm is employed to find the best result of a multi-faceted problem. By "breeding" data, one may find the best result, similar to the process of natural selection in biology. Data sets are paired, and elements from sets make up the new generation. Simply said, the best elements of a generation are passed on. In On the Application of Hierarchical Coevolutionary Genetic Algorithms: Recombination and Evaluation Partners, researchers concluded partnering strategies all had strengths depending on the type of problem. Possible strategies are pairing based on attraction, fitness, or randomized partnering. This project is using pairing based on fitness, or the "best" data.

Analysis

Results indicate the society simulated in the model gets more satisfied with each generation. The genetic algorithm itself is successful.

However, there are problems in the data. The assessment itself is heavily based on relative change and reacts strongly to sudden changes. The government wealth plunges into debt, but the degree of change is not as much as the citizenry's profit. The debt accumulated isn't recovered because it seems like it's not as "important" as the citizenry in the model. A government deficit isn't optimal. But, this indicates that governments can spend themselves into debt and the general public can remain content. This phenomena in the model is possible as shown by the fiscal and monetary policy of the United States government in recent years.



Genetic Algorithm Process

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