

ODD (Overview, Design concepts, Details) Protocol for the Agent Based Taxation and Almsgiving Model for Social Justice

Overview Section

Purpose: The purpose of Model 1 is to examine, assess and control the effect of taxation. In a theoretical simple economy in which the only economic activity is a fixed-amount money transfer between agents, taxation is levied on transactions to observe if it helps to build a more socially fair wealth distribution. The central idea in the model is that taxation of trade might decrease relative poverty of subordinate classes in a society, if a portion of profit (i.e. tax) from commerce is redistributed to the needy.

Like Model 1, the purpose of Model 2 is to examine and assess the effect of almsgiving. Islamic practice of alms (zakat) is a religious obligation which requires an individual to give 1/40 or more of their wealth. As ethically almsgiving's aim is social justice, transfer of a certain percentage of wealth to another agent in our simple economy is expected to lead to a fairer wealth distribution, but this should be empirically tested and shown.

Entities, State Variables, and Scales: Both Model 1 and Model 2 include only one type of entity: individuals. As the main economic agents they are characterised by one discrete state variable: Wealth. Every individual's wealth defines the amount of money they have at a certain point in time, represented in dollars. Bottom value of wealth is zero whereas it has no upper limit. One time step of the model represents the time in which all individuals have randomly chosen another individual and possibly interacted with it. Simulations run until the distribution of opinions becomes stationary.

Process Overview and Scheduling: In both models in each time step each individual chooses randomly one other individual to interact with, and transfers a fixed amount of dollar (ten dollars) to them to represent trade. Sender's (buyer) wealth is decreased immediately by that fixed value, whereas receiver's (seller) is increased by the same amount. Updating of state variables is thus asynchronous.

In Model 1, after transaction is complete (from buyer to seller), seller's profit is taxed by the government according to a specified tax rate. The government immediately passes this

income to lower classes of the population characterised by a specified percentage of individuals with bottom level wealth.

In Model 2, after transaction is complete, buyer gives a specified portion of their wealth to a different second receiver as alms (zakat). The buyer chooses this receiver randomly and freely.

Design Concepts

Basic Principles: Base model (control group) extends an earlier simple economy model of Wilensky and Rand (2015) in which a fixed money transfer between agents results in an exponential (Boltzmann) wealth distribution. Their model begins with an equal initial wealth for agents whereas in our model agents get a random amount of initial wealth. Model 1 examines taxation of trade via transfer of a certain ratio of income to lower classes of population. Model 2, on the other hand, examines transfer of a certain proportion of wealth personally to a random needy recipient, as an act of almsgiving.

Emergence: The distribution pattern of wealth in the population emerges from interactions among the individuals.

Interaction: Pairs of individuals interact for money transfer for trade, tax collection-redistribution (Model 1) and almsgiving (Model 2).

Stochasticity: The interaction between individuals is a stochastic process because interaction partners are chosen randomly.

Observation: Two plots are used for observation, the histogram of wealth distribution and wealth of top 10% and bottom 50% population. Resulting wealth distribution pattern of the population is assessed about normality (skewness and kurtosis) and proportion of highest ten per cent level wealth to lowest fifty per cent level wealth.

Adaptation, objectives, learning, prediction, sensing and collectives are excluded in this description, since they are not effective in any of our models.

Details

Initialisation: Simulations are run with 500 individuals, each beginning with a random amount of wealth between 0 and 200 dollars. This results in approximately 50000 dollars of total wealth for initialisation of each replication of each model.

Input Data: None of the models includes any input of external data.

Submodels: For Model 1, there are two parameters, namely T, taxation rate of transactions, and P, the proportion of population with bottom level wealth for whom taxes are spent or redistributed for. For Model 2, the only parameter is Z, the proportion of wealth given to a random other individual as alms (zakat). Values of these parameters in our experiments are given in Table 1

Parameter	Value
T: Taxation rate	10%, 20%, 30%
N: Proportion of population that gets the taxes	Bottom 10%, Bottom 50%
Z: Proportion of wealth given as alms	1/10, 1/40, 1/100

In the base model of simple economy, and in both Model 1 and Model 2, after initialisation, simulations run with trade process in each time step. In Model 1, taxation process follows every trade, creating trade with taxation process. In Model 2, almsgiving process follows every trade, creating trade with alms process.

Trade process: This process represents an instance of free trade between two individuals in a simple economy. In the models, we are only interested in money transfer resulting from the trade and we exclude goods or services provided in return. Trade process is exercised according to following pseudocode:

For every time step t {

For every individual i1 {

Select a random individual i_2

Decrease i_1 's wealth by ten dollars: $W_1 \beta W_1 - 10$

Increase i_2 's wealth by ten dollars: $W_2 \beta W_2 + 10$ } }

Trade with taxation: States levy tax on trade for various purposes such as military expenditures or education. In our Model 1, however, we assume that taxation income of the state is wholly redistributed to subordinate classes of the society as social assistance. Associated procedure is as follows:

For every time step t {

For every individual i_1 {

Select a random individual i_2

Decrease i_1 's wealth by ten dollars: $W_1 \beta W_1 - 10$

Increase i_2 's wealth by ten dollars minus tax: $W_2 \beta W_2 + 10*(1-T)$

Select a random individual i_3 from poorest N percent of the population

Increase i_3 's wealth by amount of tax: $W_3 \beta W_3 + T$ } }

Trade with alms: Islamic practise of almsgiving (zakat) is calculated and given as a proportion of wealth, rather than trade volume of profit. It is a free, personal and often undisclosed process with a hidden receiver. Because an almsgiver could choose any person they like, we assume a random selection process for every individual. Associated trade with almsgiving procedure is as follows:

For every time step t {

For every individual i_1 {

Select a random individual i_2

Decrease i_1 's wealth by ten dollars: $W_1 \beta W_1 - 10$

Increase i_2 's wealth by ten dollars: $W_2 \beta W_2 + 10$

Select a random individual i_3

Decrease i_1 's wealth by proportion of Z : $W_1 \beta W_1*(1-Z)$

Increase i_3 's wealth by the same amount: $W_3 \beta W_3 + W_1*Z$ } }