

# Nudging to Freedom: A comparison of mechanisms for social accountability in supporting a system of voluntary tax

D. E. Jensen (201609870)

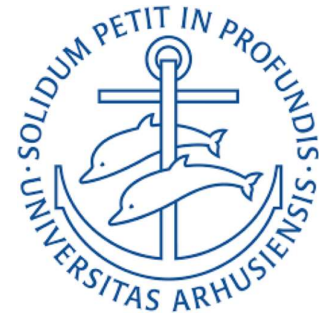
December 20, 2018

Supervisor: Joshua C. Skewes

Bachelor thesis, Cognitive Science

School of Communication and Culture, University of Aarhus

Jens Chr. Skous Vej 2, 8000 Aarhus, Denmark



Github repository: [https://github.com/au558796/Meritocracy\\_Emergence](https://github.com/au558796/Meritocracy_Emergence)

---

**Keywords:** *Wealth distribution, inequality, social accountability, welfare, agent-based modelling, behavioural economics, capitalism*

## Summary

The aim of the present study is to examine assumptions of political economics in light of the views of Thomas Piketty to investigate what economic conditions and psychological factors are necessary to enable the emergence of a meritocratic society. This investigation employs simulations of rational agents within frameworks of wealth distribution and public tax funding, where different tax mechanisms are created and their meritocracy indices recorded and compared to allow an empirical measure of how relatively effective each modification to the taxation mechanism is. Each simulation builds first upon a baseline of wealth distribution in absence of any tax system, then consecutively layers assumptions from the discussed economic and psychological schools of thought. Agents eventually choose individual tax rates based on a rational function of capital growth and the implementation of the cognitive bias of the identifiable victim effect. These different assumptions will be analysed to identify whether cognitive attributes can be employed to encourage voluntary tax contribution and the emergence of meritocracy within society, as

defined as the ranking of wealth of the agents being constituted in majority by agent income, sufficing a non-coercive and liberty-enabling environment for the agents. Specifically, the ideas of economists such as Piketty, which are in favour of the expansion of government and centralization of taxes, are contrasted with those which believe that the best results come from the localization of responsibility and the downsizing of government power and interventions. The results seem to indicate that the condition which surmounts a guaranteed and stable meritocracy over time is a no tax system, whereas the voluntary tax model has similar performance outcomes with the proposed induced voluntary tax model.

## **1.0 Introduction**

There is a familiar saying that there are only two things in life that are for certain: death and taxes. Whether this statement is emphasizing that society would crumble if there was not a tax mechanism in place or whether it is a jab at the love affair between government and money can be left to the interpreter. However, it does raise an important question: do taxes necessarily have to be certain? It is no doubt difficult to imagine how society could survive in its modern form in the absence of a tax scheme. How would everyday citizens account for this responsibility vacuum that was once filled by the state? Is it possible for people in a society to cooperate undirected in order to ensure these public-funded institutions receive sufficient funding? Ostrom notes that “individuals systematically engage in collective action to provide local public goods or manage common pool resources without an external authority to offer inducements or impose sanctions” (1998, p. 2). This topic has been subject to debate for centuries the fields of philosophy and economics, as in Locke’s ideas “of the extent of the legislative power” (1764) and Smith’s description of the “invisible hand” (Smith, 1776). Indeed, one is hard-pressed looking through history to find a point in time in which this issue has not been a key factor in economy and society as

a whole. For instance, the Boston Tea Party in 1773, or the famous post-Second World War rebound of leading industrial countries (Kaldor, 1976).

### *1.1 Ideas: Thomas Piketty and his Critics*

Today we face a dilemma of deciding how to approach the drastic magnitude of wealth inequality that we are witnessing. One comment on this is that it is not necessarily the fact that there is any degree of inequality that is the problem per se, but the fact that the distribution of wealth is so exceedingly skewed to the point where the top one to ten percent of the population has 60-90% of capital, while at the same time the poorest half of the population on the wealth spectrum has close to 5% (Piketty, 2014; Boas & Judge, 2018). This is controversial to those who believe that the top percent have accumulated these vast amounts of wealth through means which are not attributable to their natural talents or efforts and are therefore undeserving and undermine meritocracy, as Rawls exclaims, ...[one] is not downcast by the knowledge or perception that others have a larger index of primary social goods, or at least this is true as long as the differences between himself and others do not exceed certain limits, and he does not believe that the existing inequalities are founded on injustice or are the result of letting chance work itself out for no compensating social purpose (2000, p. 124).

Alesina and Angeletos (2005) were of the opinion that societies are less redistributive (however, more efficient) when the population believes that effort and talent are greater contributors to income than luck. Jiménez, Molis, and García tested this in an experimental environment where subjects received a high or low wage and obtained by either their talent in a tournament or being randomly assigned, and provided evidence to Alesina and Angeletos' hypothesis that a society which believes individual effort determines income will choose low redistribution and low taxes, and the opposite if it believes instead that factors such as luck, birth, connections etc. are the main determinants of wealth (2018).

And although common for Western countries to incorporate a progressive tax system (Ortiz-Ospina, & Roser, 2018) the argument is still made that this is not effective enough to counterbalance the large capital gains made through investments that are passed down through generations (Piketty, 2014). A proponent of this opinion is economist Thomas Piketty of the London school of economics. His answer to this inequality is more exertion of central power and the expansion of the governing state to implement a global tax on capital (Piketty, 2014). His analysis of the history of wealth distribution of the eighteenth through to the twenty-first century leads him to conclude that the cause of this hyper-inequality resides with the top percent of the wealthy who are able to accumulate and hide their wealth through capital and assets (Piketty, 2014). This can take the form of investments, real-estate or other property, corporations etc. One could then make the argument that this is the result of what is broadly known as the Matthew Effect (Merton, 1968). Originally this term was used to describe how scientific discoveries are often credited to scientists of higher esteem than those who are less known, even if they did the majority of the work. This concept can be extracted to also account for concentration of opportunities and talents. Those whose parents do well for themselves are often given opportunities in aspects of life such as education, finance, etc. that are not reachable to those whose parents are worse off, or at least they will have to work harder to achieve these same opportunities.

Piketty reasons this as unmeritocratic and uses this to justify the implementation of a tax on capital on a global scale. On such a grand scale, however, it is possible that this policy implementation would cause a boomerang effect as such that instead of tax contributions increasing, from the passing of legislation we might see less cooperation by the public and a rise in tax evasion (see Rizzo, 2017). Although Piketty does say in his book that this implementation cannot be done overnight, and it is a slow process that needs the cooperation of all nation's governments (Piketty, 2014), which may allow for the ease of

this system and to be accepted by society. However, an agent-based model ran by Ilzetszki suggests that a ‘significant overhaul’ when making changes in tax systems may be easier to accommodate rather than gradual reforms (2018), as sectors can be more easily balanced.

Piketty’s concern with the concentration of wealth is understandable; it is difficult to reason with ones’ self that it is moral to allow a small fraction of the population to gain such an out-of-proportion upper hand in wealth when there are many who are struggling with basic needs. However, people who are against the centralization of power will be against his proposition. Foucault mentions, “the idea of an economic-juridical science is strictly impossible and what is more it has never in fact been constituted” (2008, p.282). Those who carry the sentiment above wish to limit high concentrations of state power, as it poses a threat to individual rights and freedoms that are grounded in man (Foucault, 2008). Hence, the more localised and therefore limited power structures are, the less they intrude on the population. Piketty (2014) notes that today, the government is more involved in the everyday lives of individuals than ever before, so perhaps the answer is not larger government intervention as Piketty suggests, but rather less. If we are more inclined to visualize morality and political economy with a laissez-faire perspective, we can explore alternatives to Piketty’s proposal of a global tax on capital that are non-coercive and possibly produce similar results.

Piketty mentions that in the twentieth century, Europe saw a decrease in wealth inequality due to the devastation of the world wars. When the European economy was bad, everyone suffered. This was not a lasting effect, however, and concentrated capital has now gained new heights (2014). Contrarily, Thomas Sowell suggests that inequality is embedded in more than just differences in wealth, but also differences in people. Since popu-

lations differ in terms of demographics, geography, age, culture, etc., there is almost guaranteed to be inequalities that reflect these differences (Sowell, 2007). Thus, the solution to inequality may be particular to “local circumstances and the cultural repertoire of acceptable and known rules used generally in a region” Ostrom (1998), and not a tax on capital.

## *1.2 Homo Economicus*

Free-market economic theories generally assume that agents interacting in an economic ecosystem are self-interested and possess a natural rationality, hereby assuming humans to be homo economicus (Berggren, 2012). This idea of homo economicus, that humans are rational and integrate information with logic to come to reasonable decisions, is then followed by the obligation of humanity to take care of one and to honour individual freedom and morality (Younkins, 2017). However, the orthodox concept of homo economicus is increasingly losing friction in terms of remaining resilient against the complexities the world throws at it. One extreme claim is that it is not all humans that are homo economicus, but that it is only some that are rational, and therefore justifies the power to control these irrationals to be given to the select few who are (Cofnas, 2018). One critique of this kratocratic position is said through the words of Von Mises, who said “people tend to forget that the director is always a human being, not an abstract notion or a mythical collective entity” (Action, 1966), a more eloquent way of stating “no-one is perfect”. In addition, a study conducted by Berggren (2012) outlines the absurdity and flaw of this proposition, as it was found that of the articles which propose paternalist policies (as would be desired by Cofnas), 95.5% do not contain any analysis of the cognitive ability of the policymakers.

Piketty makes quite the stoic remark in his book that taxation is neither good nor bad in itself (Piketty, 2014). Those who subscribe to libertarian values, however, suggest that taxation in itself is immoral because it violates the non-aggression principle (Murray,

Friedman, Boaz & Bradford, 2005). This political philosophy promotes personal responsibility, and holds that people are autonomous and rational and therefore are capable of self-governance and moral insight without the interjection of authority. To them, taxation is exerting force on the population to deliver money to the state, classifying the welfare system as immoral (Murray, Friedman, Boaz & Bradford, 2005).

Why might people voluntarily contribute to state tax in the first place? If one is to look for an answer outside of the explanation of altruism and morality, it can be found by example of a public goods game. In this experimental set up, players have a number of tokens which they can choose to anonymously keep or give to a public pool which is then multiplied by some factor and distributed amongst the players, and they keep what they do not choose to contribute. The optimal circumstance to gain the most amount of coins would be if every player contributed all their coins. It's found that the number of contributors increases along with the size of the multiplication of the public pool, but also with the number of free-riders who never contribute and reap the benefits of gaining the multiplicative of what everyone else has contributed (Furusawa, & Konishi, 2011). In other words, the more people see a potential benefit, the more likely they are to contribute. If state pools and public institutions are well funded, the more the benefits of these institutions increase, and would therefore incentivize contribution. The acknowledgement of free-riders is discussed in the limitations section (section 5). Ayn Rand contested that it is kind of self-interest that makes economies efficient and improves society (Younkins, 2017).

### *1.3 Nudging*

The idea of using subtle changes in the environment to elicit these systematic errors was brought into popularity by Sunstein and Thaler's book *Nudge* (2008). In being human, we have embedded cognitive biases that restrain us from making rational choices for ourselves. The confounding factor of nudging is that it promotes as much freedom of choice

as possible while still attempting to facilitate a desired outcome. This concept is referred to as libertarian paternalism. In their own words, “we argue for self-conscious efforts, by institutions in the private sector and also by government, to steer people’s choices in directions that will improve their lives” (2008, p. 5). Unlimited choices can be a hinderance to rationality, however, as when individuals experience what is termed ‘information overload’ it can hinder their judgment and information search be supplemented by simple heuristics instead (Agnew, & Szykman, 2010, p. 25).

While libertarian paternalism at first might sound oxymoronic, it is a marriage between the two seemingly incompatible concepts of liberty and paternity. Should one think of the state as the authoritative parent that gives strict laws for its citizens to follow, libertarian paternalism attempts to reduce the overbearing authority of that parent, enabling a possibly healthier relationship while still maintaining order. But it is observed that this is not always the case, and crimes still occur. For instance, deviance can be the result of the issues and tensions within society (Erikson, 1962), constituting in-part to encourage the government to re-adjust policy. Rizzi (2017) also notes that with regards to tax evasion, deviance is a product of one or more of what is termed the three I’s: incidence, intensity, and inequality, which he borrows from factors contributing to poverty (Jenkins & Lambert, 1997).

The call for a scientific approach to policy making is not a new one. The divergence between successful policy and scientific exploration occurs with the complexity of the human psyche comes into play. Whereas molecules behave according to laws which prevents them from changing their behaviour, humans can be unpredictable. In 1979, Kahneman and Tversky bring forth the idea that humans, although intelligent, are not always rational in the traditional sense, and contributed to what is generally known as behavioural economics, which takes into account the psychological dimensions of economic decision



making to reveal how humans make systematic errors in judgment. Hence, there are psychological mechanisms that can be taken advantage of to yield behavioural results. For instance, many studies have shown the effectiveness of social pressure on yielding desired behaviour. An example of this is making transparent individual contributions for the benefit of the wider community increases contributions overall, since people become aware of others observing their behaviour (Burtch, Ghose, & Wattal, 2013). In a similar vein, when people find themselves in a situation in which they are unsure of how to proceed, they look at others' behaviour for information as a heuristic on how to react (Cialdini, 2007). By changing the way individuals perceive themselves through the lens of others can subsequently change their behaviour.

Thus, it seems that through a reconstruction of the environment or with the implementation of non-coercive mechanisms it is possible to guide the population's behaviour towards a desired outcome of behaviour. The proposed alternative reconstruction that accounts for this stems from the identifiable victim effect. This is common to see when being shown an advertisement for sponsoring a child in poverty, for example. Essentially, when an individual is singled out and identified to be in need of help, people are more likely to respond to this than if there was a plea to help a 'statistic' (Jenni & Loewenstein, 1997). These authors describe a situation where a girl was trapped in a well for 58 hours. The family received a generous amount in donations, and even had a television production based on her story. The authors explain that this could be for reasons such as the vividness of an individual story, certainty about the victim, belief in the amount of people that can benefit (for identified groups), and whether the plea is being asked pre- or post- occurrence (Jenni & Loewenstein, 1997). Another explanation for this effect could be that the respondent identifies the individual victim as a member of their group, which can be comprised from culture, language, race, religion, etc. Inter-group bias applied in this context

means that people are more likely to help others who they are familiar with and who they identify as in their group, since they share common values, attitudes, and norms (Lee, 2003, as cited in Chung, & Jin, 2011). Using this as a leverage to encourage voluntary tax is one way to account for an absence of a state-run redistribution system, as group members will help each other when they are in need.

## **2.0 Materials and Methods**

The following investigation seeks to identify if it is possible to achieve meritocracy in a social welfare framework with the implementation of these psychological traits in a system of voluntary tax. The following simulations employ a rational agent-based modeling method, where conditions are compared to a baseline which models wealth distribution in absence of any tax regime.

### *2.1 Agents*

Experiments whose results are derived from outputs of a model where the activities of individual agents respond to events within their knowledge are referred to as agent-based models (Lansing, 2005). In the current study, agents are equipped with responses which are formulated from cognitive and economic assumptions. For instance, the assumption that agents are rational is epitomal, and for the aims of this study this is justifiable. This is actualized in simulation three, where agents choose their own voluntary tax. Their tax rate is based off of a ruling system that their tax rates will increase only when their personal wealth grows. Although these agents naturally do not have motivations of their own, verified cognitive models can be taken and translated into these mathematical constraints, as explained in the following section.

### *2.2 Models*

All simulations were run in R studio (RStudio Team, 2015) and can be accessed from the website supplied on page 1. An initial base-line model is constructed to establish the foundation of how wealth circulates through the population without any implemented redistribution mechanisms. In order to empirically explore the parameters, basic assumptions are modelled which are then built upon when testing the mechanisms described above. Included in each simulation are 100 iterations, which utilize 100 agents and 500 trials for each mechanism. For the purpose of clarity: iteration refers to an iteration of the simulation (out of 100), and trial refers to a trial (out of 500) within one of these iterations. The initial parameters are sampled from a gamma distribution for the agent population to allow for some noise to enter the simulation to be parsimonious, while still maintaining values that are reflective of the real world. The gamma distribution was chosen, as exponential distributions have been used in the past to measure income inequality and reflect the nature of the distribution of income. Calderín-Ojeda, Azpitarte, & Gómez-Déniz propose distributions such as the gamma for investigating wealth, as they are shown to have good fit to income data (2016).

Each agent is assigned a value of what we call endowment, which is granted only once in the beginning of each simulation and is for the purpose of representing non-merit-based wealth akin to receiving an inheritance in the real world, since the inheritors presumably did not exchange it for their own goods or services. By the same principles of definition, agent tax revenue is also not meritocratic, but this discussion is beyond the scope of this paper. This endowment value is sampled from a gamma distribution, because it ensures entropy while setting a limit on zero. Agents are also assigned a value associated with income sampled from a gamma distribution. This is to represent the distribution and differences in income, interpreted here as meritocratic wealth. For the sake of simplicity, income will remain stable throughout the simulation.

In the simulation, wealth is defined as only endowment + income for the first trial, and from each consecutive trial afterwards is defined as wealth of trial  $t - 1$  + capital growth, which is a parameter of sampled from a beta distribution, as it allows for negative growth. Modelling with beta distributions have been used by Boas and Judge (2017) when recovering data from micro household incomes. This capital wealth is re-sampled every trial. This is important as to implement a level of noise in the simulation which is an element in a real economy, which contributes to why it is nearly impossible to consistently predict accurately (Mandelbrot & Hudson, 2004).

Agents are ranked based on their total wealth for each trial, thus making income and endowment both factors in the wealth ranking of each agent. The agent's wealth rank is measured in comparison to their rank of endowment and income. In this way, it is possible to see how the relationships between endowment, income, and wealth rank changes throughout the simulation. In other words, what an agent lacks in endowment contributing to how they rank in wealth can be compensated for with a large income or large capital gains achieved through growth, and vice versa.

At some point during the simulation, a junction is reached at which point income becomes a more dominant determinant of wealth rank than endowment. In other words, wealth rankings for each agent are dependent more on their income than on their endowment. This represents the point at which the society is defined as meritocratic, because it is based off of what is defined as merit-based wealth. Therefore, the earlier merit overcomes endowment for the determinations of wealth rank, the more meritocratic the societal system is. This is what we are interested in for all our simulations, to see which conditions elicit a meritocracy society comparatively fast.

The first simulation is run only with the parameters mentioned above, in absence of any redistribution scheme to serve as a base-line. In the second simulation, a variable of

taxation is added which includes different tax rates between 0.01 and 0.50 in intervals of 0.01 (total of 50) to be applied in each simulation. The tax is then added to the state pool and divided evenly amongst the agents. With this, it is possible to model the function of how quickly a meritocratic society will emerge under different tax rates. Intuitively, the higher the tax rate, the faster the emergence of meritocracy, because wealth status will be based rather on income (taxes will start eating away at endowments).

Next, the simulation is run with the added modification of the tax rate being calculated individually by each agent. This calculation is a function of the agents' capital growth, namely: 1) voluntary tax rate is reduced whenever there is negative personal growth, 2) voluntary tax rate is increased whenever there is positive personal growth and negative collective growth, and 3) voluntary tax rate stays the same if both personal and collective growth are positive.

These rules are an attempt to mathematically express cognitive processes that factor in when determining contribution. For one, Burtch, Ghose, & Wattal found evidence in crowd-funding that supports that contributors' marginal utility decreases when the perception of contribution is seen as having decreasing importance to the recipient (rule 3) (2013). Put more plainly, when contribution to the public pool matters less to the agents (because growth is positive), the utility of the contribution decreases, and agents will therefore not increase tax rates. They still retain, however, personal growth, which is why rates are not reduced in this circumstance.

More importantly, however, is the framework for utility. According to Bernoulli's proposal (1954), utility is what determines risk aversion, or rather, it is not the face-value of an item that determines worth in terms of loss, but its utility potential. Expanding on this idea, Pratt notes, "... it will be shown that one decision maker has greater local risk aversion  $r(x)$  than another at all  $x$  if and only if he is globally more risk-averse in the sense

that, for every risk, his cash equivalent (the amount for which he would exchange the risk) is smaller than for the other decision maker” (1964, p.122). Translated to the rules above, an agent is less likely to contribute in tax when his personal wealth is low (rule 1).

Granted, the rule in its true sense was not modelled, i.e. voluntary tax stays the same if there is negative personal growth, if this personal growth remains higher than negative collective growth, and voluntary tax is reduced if personal growth is more negative than collective growth, which is also an abstraction of rule 2, where instead of absolute values of growth are used, contribution rate depends on relative growth between agent and society. This would also be in-line with Bernoulli’s above-mentioned theory that it is the relative value of an item that is a factor for risk aversion. For the sake of simplicity in this preliminary study, the above cognitive framework is simplified to the stated rules. However, contribution rate as a function of relative growth can be an interesting extension for future researchers.

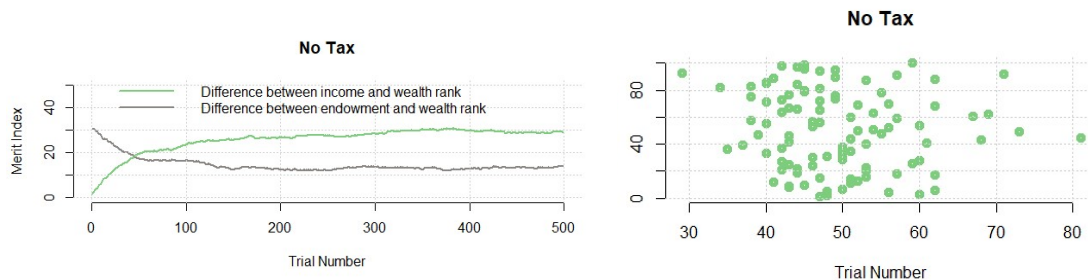
After this, the psychological mechanism to be investigated is incorporated into the simulation, which is the cognitive bias of the identifiable victim effect. This is modelled by pseudo-random assignment of agents to groups (see image in appendices for example of group distribution) at the beginning of each simulation and setting a wealth rank of 20 as an arbitrary poverty threshold. If there is an agent  $q$  with a wealth rank above 20 in the same group as agent  $i$  that has a wealth rank of 20 or below on trial  $t-1$ , then the tax rate for trial  $t$  for agent  $q$  will increase. This increase is defined as tax rate delta, which is set to 0.01.

## 3.0 Analysis and Results

### *Simulation One: No Tax*

The below graph shows an example of one simulation (of 500 trials). As the graph illustrates, at the beginning wealth ranking was mostly comprised of agents’ wealth (grey

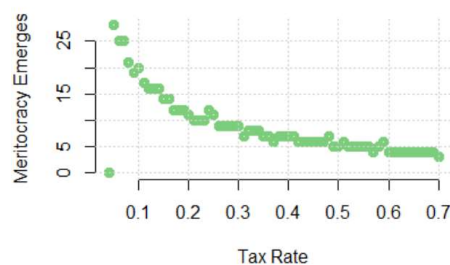
line). It can be seen that as time goes on and agents accumulate income, wealth rank increasingly is comprised by income, until the merit index is reached where the two lines



cross. From then on, income is the sole contributor of wealth rank. The noise that is seen is from the sampling from the growth distribution mentioned in the previous section. The next graph shows a scatter plot of the merit indexes from all 100 simulations. It is clear that there is no apparent pattern besides the indices being mostly clustered between trials 40 and 60, and diffusing in volume past these values.

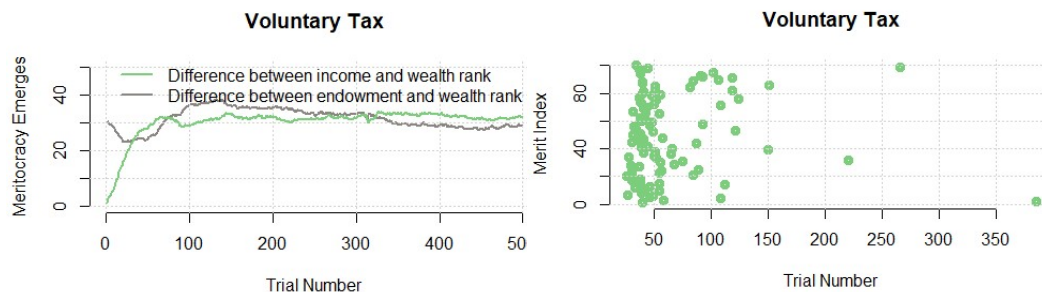
### *Simulation Two: Various Tax Rates*

The appendices supply examples of a selection of the tax rates for this simulation. The first noticeable feature of all these graphs is that they do not reach an equilibrium of a meritocratic society as the previous condition had. It can be seen that as the tax rate increases, so does the overlapping of the income and endowment differences in wealth. Note the volatility of these values, whereas with a tax rate of 0.05 the lines fluctuate with the normal noise of growth, with some slight volatility in the later trials, income and endowment differences with a tax rate of 0.7 shows staggering volatility. Secondly, meritocracy is achieved almost



instantaneously for high tax rates, although this is not maintained as mentioned. The scatter plot above shows the merit indices for each of the tax rates, showing a clear pattern that the higher the tax the faster meritocracy emerges, the highest merit index being intuitively for the low tax rate (with an outlier for the rate of 0.01).

### *Simulation Three: Voluntary Tax*

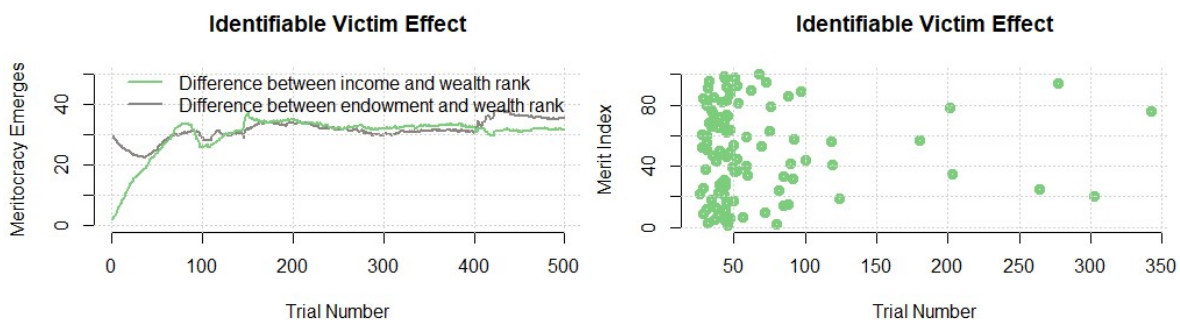


The left plot shows one simulation of voluntary tax, and to the right is a scatter plot showing the merit indices of all 100 simulations. It can be seen from the graph of an individual simulation that the income and endowment differences in wealth do not display the same volatility as did with the various tax rate condition just previously mentioned, though it should be duly noted that it does not maintain stable meritocracy as a no tax scheme (lines can be seen to cross multiple times after the initial takeover of income as a determinant of wealth rank). Additionally, meritocracy emerges slower than in the mandatory tax condition, with a minimum index of 25 and maximum of 253. Unlike the respective plot for the no tax condition, this plot clearly shows a strong clustering of merit indices in the first 50 trials of the simulation, with the volume decreasing as trials increase.



### *Simulation Four: Induced Voluntary Tax*

The below graphs display the results from the induced voluntary tax contribution condition. The reader will note that these look nearly identical to the respective graphs above for the pure voluntary tax contribution condition. Again, it is seen that meritocracy is achievable in this condition, but does not remain stable throughout. Additionally, the meritocracy index is achieved in early stages of the simulation, with the highest concentration of merit indices surrounding the fiftieth trial. The minimum index for this condition was 25, with the maximum being 311.



## 4.0 Discussion

The above results seem to imply that if meritocracy for a society is the main goal by any means, then a no tax scheme achieves this with the most efficacy, since it is able to stabilize income as the main factor contributing to wealth ranking. One may reason that this meritocracy is at the expense of wealth distribution being concentrated as Piketty says it is, and they would be partially right. When plotting the end result of wealth, it can be seen that it is dispersed exponentially. This has less impact, however, when one considers the initial distribution of income and endowment, which were both additionally exponentially distributed. This means that the distribution of wealth has not changed in society with no tax, although meritocracy has been achieved and stabilized. This is not meant as evidence to support tearing down the tax system - though this would be to the joy of the

libertarian-minded. More research is needed into these mechanisms. One thing future researchers can do is track individual agents' evolution of endowment and wealth, to see if the capital is indeed being concentrated with the few individual agents at the top of the scale throughout the simulation.

A graphic in the appendices is provided to show the merit indices for each condition. It can be seen that the identifiable victim condition has the largest range of merit values, extending over 300, whereas the various tax rates did not exceed a merit index over 28. The no tax condition has all merit values below 100, which would be expected from looking at the graph of one simulation in this condition (very stable with early emergence of meritocracy). Finally, the voluntary tax system has a large spread of merit indices, which is interesting in comparison to the identifiable victim condition, which has a larger range, but more lower merit indices.

## **5.0 Limitations and Future Directions**

The current study carries with it the same burdens that other agent-based modeling studies do. John Maynard Smith holds the opinion that a complex systems approach as an investigative tool is “fact-free” science, and that the outcome of a computer simulation it is rarely a fact about the world (1995). Although this critique was intended for evolutionary biology, the sentiment can extend to econometrics and behavioural science as well. The purpose of these agent-based simulations is to better understand the relationship between endowment, income, wealth, and inequality when compared with different tax systems of accountability. These unknowns can be cured with further research and robust sensitivity analyses.

For instance, it would be possible and perhaps more intuitive to have income fluctuate over time, as Langsing (2005) remarks that simulation models have experienced a movement from linear to dynamical models with the realization that economies may never

settle into an equilibrium. However, this is beyond the scope of this preliminary study and not the core aim of the simulation, but is a gateway for future research.

A study can, and has been (see Delsol, Lecaussin, Martin, & Miron, 2017) dedicated to only modelling the proposals Piketty outlines in his book, or perhaps only a few of his main arguments. In addition, one common aspect of taxation that was not implemented in the current study is a progressive tax system. It could be worth-while to have different levels of tax severity for which agents with lower wealth rankings will pay a lower tax than agents with higher wealth rankings.

The current study sampled growth on capital from a beta distribution. Although a justifiable method for the purpose of this simulation, people whose wealth is comprised of growth on capital would not allow this amount uncertainty of their investment. Investors take good care and effort to make sure their investments are continually profitable. If we wanted to model Piketty's assumption specifically, we could change the probability of capital growth being positive more often than negative, along with other parameters that more accurately reflect how investments perform in the real world. Another way would be to model more rationality agents, who could perhaps interact with variables such as growth. Thus, the function for capital gains would be an outcome of a) economic growth, but also b) spectrum of agent rationality.

One way the study can be improved is with the use of more agents, as only 100 were presently used. A simple intuition will tell that this may not be a large enough population when modelling a society. This can also generalise to an argument for why it is difficult to contrast different countries' tax schemes with each other. The tax system that works for Denmark for example, a population of approximately 6 million, may not yield the same outcome on the population of the United States, which has almost 326 million people. Further investigation into the sensitivity of  $n$  agents is recommended.

There are a few things that can be approved upon from the current mechanisms. For instance, the groups were made by a pseudo-random number generator function ‘sample’ in the R base package. Therefore, the distribution of the number of members in each group is undetermined. A more systematic way of creating groups of particular sizes may aid in identifying the relationship between tax rates and group size.

With regards to voluntary tax, there were some trials in the simulation where the highest amount of tax being paid was over 70 percent, which is an unheard-of number for tax in the first place, let alone for it to be voluntary. This can be overcome by setting an upper limit to voluntary tax to ensure that there are no agents paying 70 percent of their total wealth while others are gaining from the state pool. It would be interesting to see if the same outcome would result with this additional constraint. Although it is still technically in line with the libertarian philosophy of non-aggression, one is hard-pressed to generalize this outcome to the real world and say that a person would be completely self-satisfied with contributing 70% of their wealth to public funding.

Additionally, the tax collected in these simulations was on the total of the agents’ wealth, which again was the sum of endowment, income, and capital gains, although Piketty’s thesis was only concerning a tax on capital (which here would be endowment + capital gain). Therefore, further study can be done on the wealth distribution of tax schemes incorporating these differences of tax on income and assets, versus only tax on assets, only on income, etc., and perhaps also add a measurement for the relationship between capital growth and wealth rank. We could also add a variable of spending to the model, in order to allow agents to go into debt, as Braido (2013) implemented in his study of ergodic Marvok equilibriums and explore how this influences meritocracy index.

There was also the missing aspect of deviation in the current study. For instance, as mentioned in the introduction, there are individuals who will still not contribute to public

funding no matter the circumstances and remain as free riders. This is also a part of public goods games as mentioned in the introduction (section 1.2).

Concerning statistics, although in some cases researchers have used a gamma distribution for modelling income, Calderín-Ojeda, Azpitarte, & Gómez-Déniz note that in reality the bottom part of the income distribution can contain many values of zero, and this is important to consider when studying poverty, inequality and the concentration of wealth (2016). Future studies might consider these authors' proposed solution, by using their extension of the exponential distribution while still being able to account for zeros in data. In addition, it can be questioned whether a beta distribution is appropriate for growth, especially if what was discussed above about the probability of growth being positive is kept in mind. Refer to appendices for a graph of the differences between samplings from a beta versus a gamma distribution. Depending on the research question, experimenters should consider which of these (or other) distributions they wish to use in their models of growth and income, and so on.

## **6.0 Conclusion**

The implications of the present study are intriguing and conclude the apparent superiority of a no-tax system for supporting consistent and stable emergence of meritocracy. A normal tax system tested with varying rates fast-tracks meritocracy with the downfall of high volatility. Voluntary and induced voluntary tax perform similarly, with voluntary tax having a smaller range and more spread of merit indices. However, a variety of potential consideration for future studies have suggested, which leaves plenty of room for researchers to elaborate and modify (or replicate) this study as mentioned in the limitations section. The results suggest that the method of maintaining stable meritocracy is with no tax system at all, whereas the

method to fastest meritocracy is with a mandatory tax system - although meritocracy becomes increasingly volatile as taxation rate increases. As for voluntary tax, the simplistic model it had a smaller range of merit values than the identifiable victim effect condition, however, with more spread of the values. Whereas the latter had a larger range but more merit indices concentrated lower in lower values. As would be expected of topics branching from disciplines such as econometrics and cognitive science, the answer is complicated, and future research is encouraged.

## 7.0 References

- Action, H. (1966). A Treatise on Economics. *Scholar's Edition published by Ludwig von Mises*.
- Agnew, . R., & Szykman, L. R. (2005). Asset allocation and information overload: The influence of information display, asset choice, and investor experience. In Bruce, Brian. (2010). *Handbook of Behavioral Finance*. Edward Elgar Publishing Ltd. Cheltenham, United Kingdom.
- Alesina, Alberto, and George-Marios Angeletos. 2005. "Fairness and Redistribution." *American Economic Review*, 95 (4): 960-980. DOI: 10.1257/0002828054825655
- Berggren, N. (2012). Time for behavioral political economy? An analysis of articles in behavioral economics. *The Review of Austrian Economics*, 25(3), 199-221.
- Braido, L. H. (2013). Ergodic Markov equilibrium with incomplete markets and short sales. *Theoretical Economics*. 8, 41-57.
- Burtch, G., Ghose, A., & Wattal, Sunil. (2013). An empirical examination of the antecedents and consequences of contribution patterns in crowd-funded markets. *Information Systems Research*. 24(3), 499-519. DOI: dx.doi.org/10.1287/isre.1120.0468
- Calderín-Ojeda, E., Azpitarte, F., & Gómez-Déniz, E. (2016). Modelling income data using two extensions of the exponential distribution. *Physica A: Statistical Mechanics and its Applications*. 461(1), 756-766 <https://doi.org/10.1016/j.physa.2016.06.047>
- Cialdini, R. (2007). The secret impact of social norms. *Royal Society for the Encouragement of Arts, Manufactures and Commerce. RSA Journal*. (154)5528, 60
- Cofnas, N. (2018). Coercive paternalism and the intelligence continuum. *Behavioural Public Policy*. Cambridge University Press. 1-20. doi:10.1017/bpp.2018.4
- Erikson, K. T. Notes on the sociology of deviance. *Social Problems*. 9(4), 307-314.
- Foucault, M., Davidson, A. I., & Graham, B. (2008). The birth of biopolitics: Lectures at the Collège de France, 1978-1979. Basingstoke: Palgrave.
- Furusawa, T., & Konishi, H. (2011). Contributing or free-riding? Voluntary participation in a public good game. 6, 219-256
- Jenkins, S. P. & Lambert, P. J. (2018). Three 'i's of poverty curves, with an analysis of uk poverty trends. Oxford Economic Papers. *Journal of Public Economics*, 49(3), 317–327. DOI: <https://doi.org/10.1093/oxfordjournals.oep.a028611>
- Jenni, K. E., & Loewenstein, G. (1997). Explaining the "Identifiable Victim Effect". *Journal of Risk and Uncertainty*. 14, 235-257.
- Jiménez-Jiménez, E.et al., The effect of initial inequality on meritocracy: A voting experiment on tax redistribution, *Journal of Economic Behavior and Organization* (2018), <https://doi.org/10.1016/j.jebo.2018.09.019>
- Kaldor, N. (1976). Inflation and recession in the world economy. *The Economic Journal*. 86(344), 703-714
- Lansing, J. S. (2005) *Encyclopedia of Social Measurement: Reference Work*. University of Arizona.
- Lee, H.K. (2003), Bubmunsa, Seoul (in Korean) in Chung, J., & Jin, B. (2011). In-group preference as opportunism governance in a collectivist culture: Evidence from korean retail buyer-supplier relationships. *The Journal of Business & Industrial Marketing*, 26(4), 237-249. doi:http://dx.doi.org.ez.statsbiblioteket.dk:2048/10.1108/08858621111126983

- Locke, J., Madison, J., Hoover, H., & Lyceum, L. (1764). Two treatises of government. London.\
- Maynard Smith, J. (1995). Life at the edge of chaos. *New York Review of Books*, March 2, 28\_30.
- Mandelbrot, B., & Hudson, R. L. (2004). The misbehavior of markets. New York, NY: *Basic Books*.
- Merton, R. K. (1938). Social structure and Anomie. *American Sociological Association*. 3(5), 672-682.
- Merton, R. K. (1968). The Matthew effect in science. *Science*. 159(3810), 56-63.
- Murray, C., Friedman, D., Boaz, D., & Bradford, R. W. (2005) *Liberty*. 19(1), 31 – 39.
- Ortiz-Ospina, E & Roser, M. (2018). Taxation. *OurWorldInData*. Retrieved from: <https://our-worldindata.org/taxation> on Dec. 19, 2018.
- Piketty, T. (2014). Capital in the twenty-first century. *The Belknap Press of Harvard University Press*. Cambridge, Massachsetts.
- Pratt, J. W. (1964) Risk aversion in the small and Large. *The Econometric Society*. *Econometrica*. 32(1/2), 122-136
- Rawls, J. (1971). A theory of Justice. *Oxford University Press*. Oxford, England.
- Rizzi, D. (2017). Tax Evasion Indices. *Public Finance Review*, 45(6), 771-791.
- RStudio Team (2015). RStudio: Integrated Development for R. RStudio, Inc., Boston, MA URL <http://www.rstudio.com/>.
- Smith, A. (1950). *An Inquiry into the Nature and Causes of the Wealth of Nations*, (1776). Methuen.
- Sowell, T. (2007). Basic Economics: a common sense guide to the economy, 3rd ed. Basic Books, New York
- Thaler, R., Sunstein, C. (2008). Nudge: Improving decisions about health, wealth, and happiness. *Yale University Press*.
- Villas-Boas, S. B., Fu, Q., Judge, G. (2018). Entropy based European income distributions and inequality measures. *Physica A*. 514 686–698
- Younkins, E. W. (2017) Ayn Rand and Friederich A. Hayek: A comparison. *Libertarian Papers*. 9(1), 84-113.



## 8.0 Appendices

Figure 1-3 Example Simulations for Various Taxes

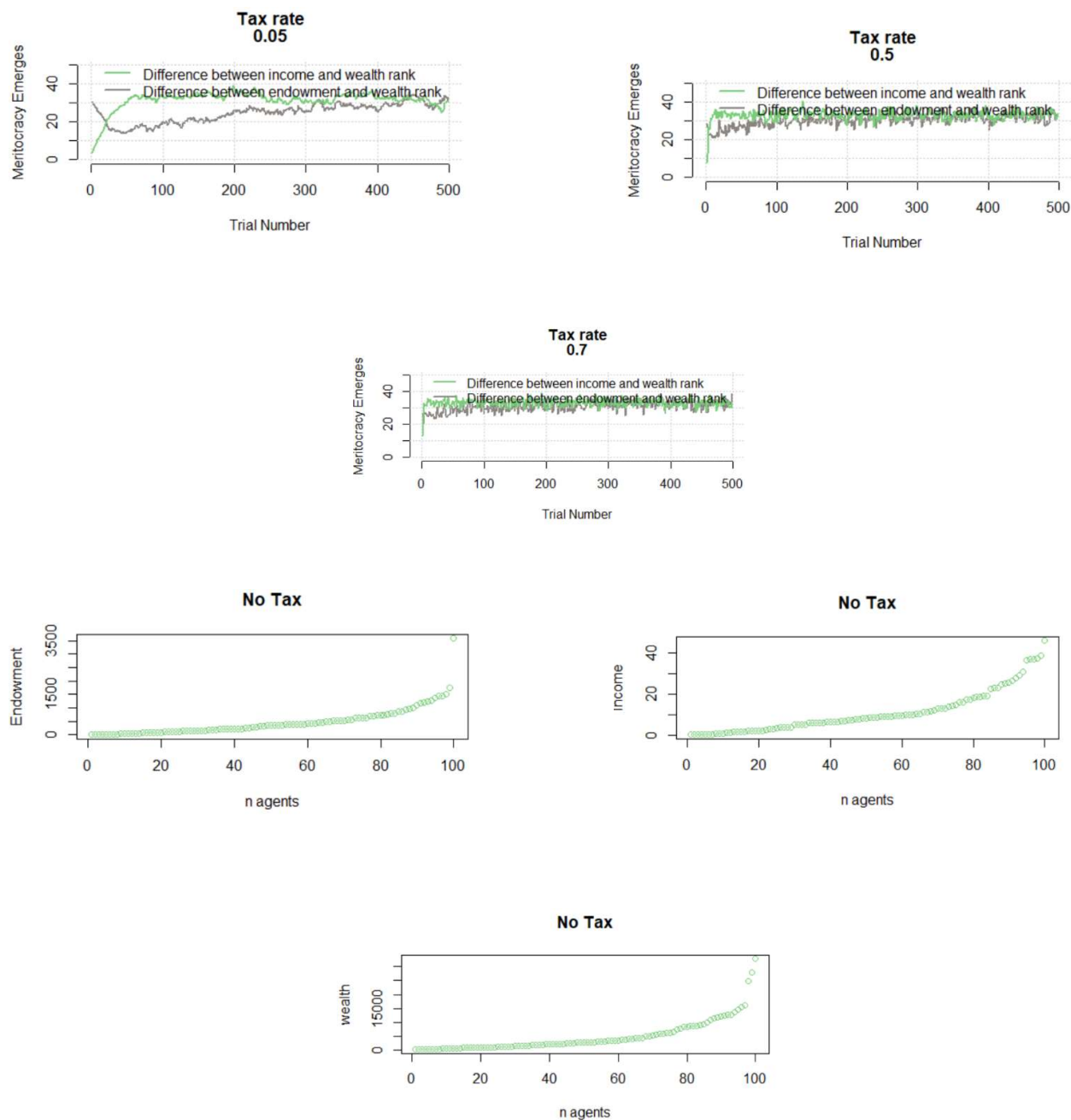


Figure 4-6 Example distributions of income, endowment, and final wealth.

Figure 7 Example placement of agents in groups

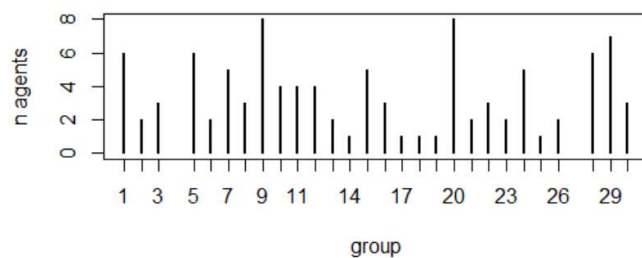


Figure 8 Example merit indices for different conditions (from left to right: no tax, induced voluntary tax, various tax rates, voluntary tax). Note that the condition labelled nt is equivalent to the no tax condition, is equivalent to the various tax condition, vt is equivalent to the voluntary tax condition and n1 is for the identifiable victim effect condition.

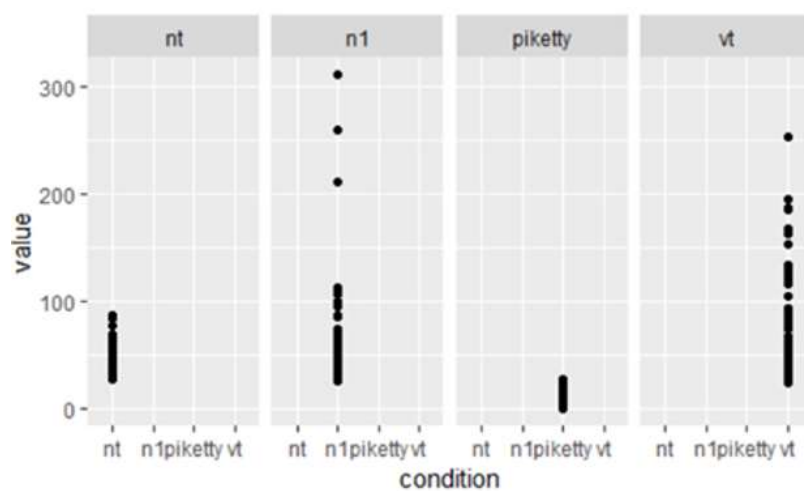


Figure 9-10 Example Sampling of beta and gamma distributions

