4TH INTERNATIONAL CONFERENCE OF ZAKAT PROCEEDINGS
ISSN: 2655-6251

Can Zakat Charity Help Reduce Economic Inequality? An Agent Based Simulation

Muhammad Asif Jaffer
Institute of Business Administration, Pakistan

Paper to be presented at the 4th International Conference of Zakat (ICONZ)
7-8 October 2020, Surabaya, Indonesia

ABSTRACT

Purpose – This paper suggests an agent based model of economic behavior based on which it argues that the Islamic charity of Zakat can be rationalized as it significantly reduces wealth inequalities.

Design/methodology/approach – An Agent Based Model (ABM) of wealth distribution (Wilensky, 1998) is configured to introduce Zakat in the model. Simulations were run in the model with ordered and random distribution of Zakat charity and wealth distribution pattern compared with the standard simulation without Zakat.

Findings – The impact of this very small charity on the part of the rich (2.5% of net wealth) showed significant impact on wealth distribution pattern as it changed the power law distribution into normal distribution of wealth.

Practical implications – The results emphasize non-conventional handling of the economic problem of poverty and wealth signifying the importance of faith based policing

Originality/value – The paper contributes an agent based simulation which is a relatively newer technique to study human behavior and is commensurate to complexity theory. Its use is relatively rare in Islamic Economics and the paper is the first to propose a model simulation of Islamic charity of Zakat.

Keywords: Agent Based Simulation, Wealth Distribution, Zakat, Wealth Inequalities

JEL Classification: C63, D31, D63, D64, Z12

INTRODUCTION

Background

One of the major economic issues facing today's world is poverty. Economies suffering from poverty are identified with unequal distribution of wealth. As Davies & Shorrocks (2000) puts it, the distribution of wealth holdings across individuals, households, and population subgroups is capable of revealing something about both the type of economy people work in and the type of society they live in. In capitalist economics, power law distribution of wealth is common which means fewer people are found with large proportion of wealth condensed in their hands, and more people are on the lower end of the wealth concentration. Rich have a propensity for getting richer and poor tend to suffer more as a capitalist economy grow, and this is all that we witness around us.

To address this problem of inequality, capitalist economies use monetary and fiscal policies (especially direct taxation and public expenditure). Yet the global indicators on wealth inequalities confirm that the goal of reducing inequalities in wealth is hard to achieve. Devine teaching on the other hand tackle this problem differently, by creating a sense of social and economic responsibility on the part of rich towards the poor. One of the divine financial policing measure in Islam is Zakat. Zakat is an annual charity levy on rich on his net wealth (savings). The levy is equivalent to 2.5 percent of net wealth to be computed annually and paid to one or more poor individuals. There is a monitory threshold in savings and an individual whose savings increase that limit is obliged to pay Zakat[1]. Though the traditional mechanism of Zakat collection and disbursement was through State in the early Islamic history, the obligation is personal and needs to be met in the absence of the State mechanism; by paying it to one or more poor individuals (whose net wealth is less than the threshold).

Zakat as a charity is different from other tax levies under the capitalist structure in variety of ways. First, though it is still controlled by the Government in some Islamic countries, it does not necessarily need the centralized mechanism of state to collect it. Subjects of the economy can directly disburse it to those eligible under the Islamic jurisprudence. Second, it is fixed at 2.5% of net surplus wealth annually (savings or investments) and the state is not authorized to enhance or reduce it. Third, it must be transferred to the ownership of deserving individuals and cannot be spent as public expenditure like infrastructure development. Fourth, unless there is strict state control and compliance, the payment though obligatory under the Sharia (Islamic jurisprudence) is voluntary in practice. Under the Islamic jurisprudence, paying Zakat is a personal obligation on the part of rich, the underlying motivation for paying it is not that of regulatory compliance or threat of penalties, but the reward which the subjects are promised to get in this world and hereafter.

Impact of Zakat on material wellbeing and reducing wealth inequalities have been empirically studied in Muslim denominations like Pakistan (Geoffrey A Jehle, 1994), Bangladesh (Anis & Kassim, 2016) and Indonesia (Beik & Arsyianti, 2016). The philosophy of divine teachings or the Zakat itself are not discussed at length here which can be seen in Zayas (1960) and Qardawi (2000). However, this paper shows empirically using data generated through an agent-based simulation, as to how this levy, though very minimal i.e. 2.5% of net wealth per annum, could result in powerful change in the pattern of wealth distribution.

Objective

The objective of this study is to study the impact of Zakat on wealth distribution pattern in a model economy through simulation in an agent-based modeling environment.

LITERATURE REVIEW

Background Theory

Computational simulation based studies derive their foundations from complexity theory. Human systems including economics are viewed as Complex Adaptive Systems (CAS). In its very basic form, this theory asserts that macro level phenomenon emerges from micro level complex interactions of heterogeneous agents. CAS as such are nonlinear systems where sum of individual entities or behaviors is not equal to the whole (Epstein & Axtell, 1996; Tesfatsion, 2002).

On the contrary, Neoclassical economics that had a hold on mainstream economic theory has been criticized for its unrealistic assumptions like fixed and a priori knowledge of the choice set (indifference curves), convexity (choice of

[1] The fixed threshold is equivalent to the monetary value of savings of 87.5 grams of gold or 612 grams of silver, whichever is less, according to Hanafi Jurisprudence

factor combinations are always linear) and absence of uncertainty (Debreu, 1987; Geoffrey Alexander Jehle, 2001). The emergence of complexity theory counters many of the unrealistic assumptions of neoclassical economic theory. It holds that macro level behavior is not the linear combination of its micro level constituents rather emerge from complex interactions of heterogeneous agents. Uncertainty and novelty are therefore held as the inherent features of real world phenomena. As it suggests to model the real world more realistically, complexity theory is paving its way in mainstream economics literature. Agent-based computational economics (ACE) is now a recognized area of the computational study of economies modeled as evolving systems of autonomous interacting agents (Tesfatsion, 2002).

Complexity theory necessitate non-conventional techniques to study human systems. The interaction of different units, each with its own neighbors and to different independent variables, cannot be handled using representative agent models, nor with aggregate equations (Al-Suwailem, 2008). Modeling heterogeneous agents, their adaptive behavior and emergent macro level phenomenon necessitate new tools that were not possible until the advancement in computational technology. Agent based modelling or simulation has emerged as a tool to simulate complex adaptive social systems and is now widely recognized as research tool in studying social systems in sociology, economics, finance, political sciences, education and variety of other disciplines (Al-Suwailem, 2008).

Specially in the context of research in Islamic economics (which is a growing research domain in last forty years or so), agent based modelling seems more promising. This is so because of some fundamental inconsistencies between the neoclassical view and the Islamic worldview. These are not peculiar to Islam but other divine religions like Christianity and Judaism share almost the same worldview. Few of these principles maintain that

- Material interest are to be balanced with spiritual and social interests.
- Time horizon is extended beyond this world to include the Hereafter.
- Zakat or obligatory charity is an essential duty
- Interest on loans is strictly prohibited
- Gambling and wagering is also prohibited

Previous Studies

Models of wealth distribution and inequalities started back in mid twentieth century when life cycle models were first proposed (Modigliani & Brumberg, 1954). Wealth distribution was modeled as a function of aging (so life cycle accumulation of wealth). A number of subsequent developments were proposed in the basic model accommodating other variables like inheritance and other intergenerational transfers (Atkinson, 1971; Huggett, 1996), uncertainties in earnings and rate of returns (Sandmo, 1970), the type of assets in the savings (King & Leape, 1984; Reardon & Vosti, 1995), social security institution and retirement funds (Wolff & Marley, 1989), consumption (Davies, 1982), return on investments (Meade, 1964), and fertility, mortality and other family formation dimensions (Rosenzweig & Stark, 1997).

Charity and its impact on wealth distribution patterns in the society is relatively a fertile area. We did not find literature on the impact of charity and philanthropy on wealth distribution except an attempt by Dasgupta & Kanbur (2011) which also mainly deals with provision of public goods by rich and the resulting impact on welfare inequalities suggesting fiscal policy orientations for taxing or subsidizing such charities. Empirical studies in this domain are rare because it is generally difficult to observe the cause and effect relationship between private charity and wealth distribution mainly because it requires a well-managed field experiment extended over years and related time series data. It is this context where computational models and simulations come into play.

Computational agent based models in wealth distribution are relatively fewer. Damaceanu (2008) presented a model of wealth distribution as a function of resource growth interval stressing the importance of renewable resources. Later, a model was presented that simulates the impact of agents' preferences on wealth distribution in choosing other agents for interaction (Goswami & Sen, 2014). Impullitti & Rebmann (2002) studied agents' and environment's general attributes like initial wealth, agents' vision and spatial concentration of agents for their impact on wealth distribution patterns.

In Islamic economics and finance, agent based modelling is almost absent. In 2008, there was probably the first attempt made by Al-Suwailem (Al-Suwailem, 2008) who proposed a comprehensive model of Islamic economics in general, modelling concepts like riba, markup financing and charity (without reference to wealth distribution). Later on charity has been modeled for its impact on wealth distribution (Sabzian, Aliahmadi, Azar, & Mirzaee, 2018) that showed that one of the Islamic concept of charity (Sadqah) served the purpose of reducing inequalities in wealth distribution. Their model, however does not cater for charity in proportion to the net wealth, (the concept of Zakat in Islamic Finance) nor caters for random distribution of charity which is more close to reality. A recent study in Persian (Narges Javidi Abdollahzadeh Aval, 2019) explored Zakat through agent based modelling in rather complex environment of savers and investment but relatively more organized distribution of Zakat. This study further assumes a state mechanism to collect and disburse Zakat. These limitations call for a study that assumes a relatively simple economy and decentralized agent to agent mechanism to Zakat distribution to study its impact on economic indicators.

We present an agent based model of wealth distribution adopted from Epstein & Axtell (1996). Their model (herein after referred as original model) produces typical representative power law distribution of wealth evidenced in real world economies. We customize their model to include Zakat and show the impact of this small specific charity on wealth distribution. Our findings are interesting as well as suggestive of a different viewpoint of addressing the problem of economic inequalities.

Conceptual Framework: The Model

It is logical to expect that any transfer of wealth from the rich to the poor will reduce the wealth inequalities. The question is however that of the mechanism and the magnitude of such transfer. Taxing is one way of achieving this purpose which usually is carried out through a centralized mechanism (state to collect and utilize the tax amount) and progressive rates. Zakat on the other hand is different in both of these perspectives. Though state can collect and disburse zakat to the poor, it is not a prerequisite under the Islamic jurisprudence. The rate is also fixed and flat at 2.5% of net surplus wealth (savings and investments) under Hanafiah Fiqh, and is not subject to any regulatory approval or disapproval.

We posit that Zakat, when paid by all rich agents in an artificial society, will reduce the wealth distribution inequalities significantly such that it will change the wealth distribution pattern closer to normal distribution.

METHODOLOGY

Data

Data was generated through agent based simulations.

a) *Simulation Method:* This study used the simulation that was carried out through a modelling technique known as agent based modelling (ABM) (or agent based simulation). ABM is inherently a computational modelling tool, meaning that it encompasses complex interactions that cannot be modelled through mathematical equations or aggregative or representative models. Agent based modelling is different from multi agent systems in that its objective is not to solve a problem but to gain explanatory insight into the collective behavior of agents who follow simple rules (Niazi & Hussain, 2011). There are plenty of research areas and disciplines in which ABM is used, that include Biology, Ecology and Health Sciences, Physical Sciences, Computer Science, Economics and other Social Sciences.

   The advantage of ABM over mathematical models is obvious. Mathematical models are based on the assumption of representative agents where sum of individual attributes is equal to the whole. ABM on the other hand take into account heterogeneous agents and their interactions (random or otherwise), includes self-adapting mechanisms (therefore complex adaptive systems) and embodied learning, all which is only possible through the use of computational technology. ABM has facilitated study of human behavior which is not simply modelled on simple rules and aggregative sums of micro attributes of agents but accommodates concepts like complex interaction, adaptation and learning. This simulation method is therefore highly associated with the complexity theory which explains many of the human systems.

b) *Simulation Platform:* The simulation was modeled in NetLogo (Wilensky, 1999). It is a programming language and integrated development environment for modeling. NetLogo was first developed by Uri Wilensky, director of Northwestern University's Center for Connected Learning and Computer-Based Modeling. It introduces software principles through agents in the form of turtles, patches, links and observers. NetLogo has been designed specifically for educational community and subject experts with no programming experience. It is a simple, yet widely used simulation platform with more than 20,000 hits with its name search on Google Scholar.

Model Development

Economic theory is highly associated and supplemented with models. These models range from simple visual graphs like indifference and demand supply curves to mathematical and empirical models that incorporate multiple variables, their interdependencies and test empirical data with mathematical equations. Agent based models are relatively new but are more robust as these models ate free from the rigid and simplistic assumptions of neo classical economics. A whole body of literature is developed under Agent Based Computational Economics that not only include simulations and models in conventional areas of economics (like market processes, economic networks, etc.) but also newer areas like learning and embodied mind, computational agents, automated markets and many more (Tesfatsion, 2002).

The model used in the current study is adapted from Epstein & Axtell's "Sugarscape" model (Epstein & Axtell, 1996). This model is included in the standard library of models in NetLogo (Wilensky, 1998). The model simulates the distribution of wealth in a hunter-gatherer society ignoring work, production, and productive relations. As Robert Axelrod (Axelrod, 1997) emphasizes that the goal of agent-based modeling is to develop and enhance our understanding of fundamental processes that may appear in a variety of situations, requiring adhering to the KISS (keep it simple stupid) principle. Ignoring some dimensions of economic activity is therefore helpful in understanding the impact of changing one variable on others. The model, therefore, focuses on distributive interactions of the agents with the environment and other agents. This model is representative of the wealth distribution in Capitalist economics because it produces a power law distribution of wealth which is the real phenomena in the capitalist economies. To study the impact of Zakat, the original model was customized to include some new code. We first outline the attributes of original model and then describe the customizing made by us to study the impact of Zakat on wealth distribution.

1. The Original Model

    a) *The Environment*: The environment consists of patches that grow grain with an assigned maximum capacity. There is some land (collection of patches) that grow maximum grain and as such is best land, whereas some other patches grow lesser grain. At each time tick, grains on the patches are refreshed. The environmental space has periodic patterns as to condensation of grain with higher and lower concertation of grain, as such giving it a spatial dimension.

    b) *The Agents:* Agents (proxy for individuals in an artificial society) have certain attributes. For each agent a location on the grain space is specified. In the model, agents are randomly distributed in the grain space, meaning that some agents find more grain around them and some others do not. Each agent has an initial endowment as to grain metabolism (consumption of grain to survive), a level of vision (to look for grain in the proximity), and the agent's initial position in the landscape. The agents are as such heterogeneous. Agents also have life expectancy which again is a random number between 1 and maximum limit set in the model. Agents die when their lifespan runs out or they run out of grain. An offspring is produced that has a random metabolism and a random amount of grain as there is no inheritance of wealth in the original model.

    c) *The Interactions:* Agents collect grain from the patches, and eat the grain to survive. The model begins with a roughly equal wealth distribution. The agents then look for gathering more grain by attempting to move in the direction where the most grain lies. Each time tick (modeled to be equivalent of a year), each person eats a certain amount of grain. How much grain each person accumulates over and above consumed, is the agent's wealth. Agents are divided in three classes based on their wealth as compared to the wealth of the richest agent at any given point in time. Agents are classified as poor (and colored red in the model) if they have less than a third the wealth of the richest agent. Agents that have more than two third of the richest agent's wealth are classified as rich (colored blue). Rest of the agents are classified as middle class (colored green).

    d) *Model Output and Measures:* The original model is programmed to facilitate visibility of agent's movement, agents' wealth and grain in the environment. Size of each class (number of agents in each of the three classes i.e. poor, middle and rich) and average wealth of agents in each class are plotted. As a measure of wealth distribution, the model employs Lorenz curve and Gini Index. Gini Coefficient assumes a value between zero and one where a lesser value signifies a more equitable distribution of wealth.

2. The Zakat Model

a) *Zakat Procedure:* To observe the impact of Zakat, a Zakat procedure was inserted in the original model whereby in each cycle, each rich (blue) agent donates Zakat (2.5% of his unused wealth) to a poor agent. Two different variants of this charity were modeled. In one simulation, the recipients of charity (Zakat) were prioritized on the basis of amount of wealth, that is, the poorest agent gets the first charity and then the next one (Ordered Distribution). In the second simulation, the distribution was made on random basis, that is, a rich agent gives charity to one of the random poor agent (Random Distribution). In all, three simulations were conducted; that are, one without Zakat (original model), and two with Zakat, the ordered distribution and random distribution.

3. Method

Ten instances each of three independent scenarios were simulated. The parameters have been summarized below:

Number or agents	=	100
Agent's vision	=	Random between 1 and 5
Agent's metabolism	=	Random between 1 and 15
Agent's life expectancy	=	Random between 1 and 83
Best Land with maximum grain	=	10%
Maximum grain a patch	=	150
Number of cycles the model was run	=	400

Model flowchart is given in Figure 1

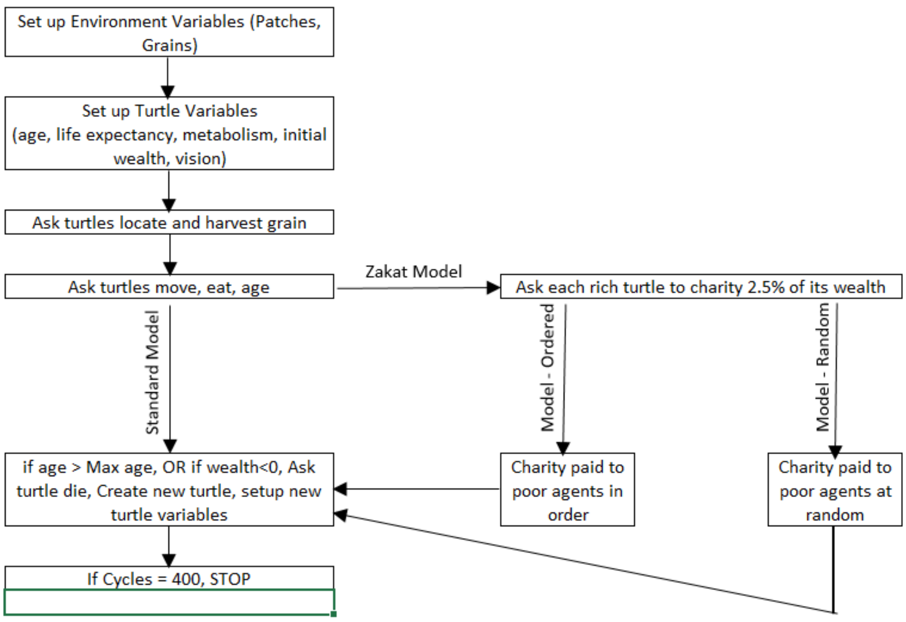

Figure 1. Steps in the Model / Simulation

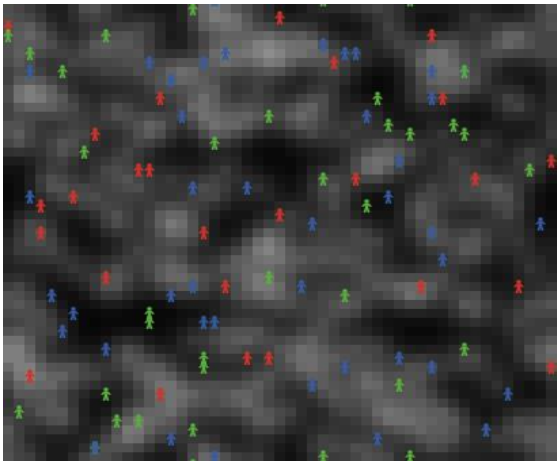

Figure 2. Agent Space in the NetLogo Model Showing three agent classes

RESULTS AND ANALYSIS

Results

Table 1 shows the class frequency of 100 agents in three classes as to poor, middle and rich class, across the ten runs of the three simulations. The numbers have a very apparent pattern across all the runs, that is, class frequencies become closer in Zakat models compared to the original model. Overall measure of variance among these class frequencies highlights the relative differences; the standard deviation across the three classes decrease from 27 in the original model to around 12 in the Zakat models.

Table 1. Average Class Frequencies in the Three Simulations (400 cycles)

Run	Original Model (Total = 100)			Zakat Model – Ordered (Total = 100)			Zakat Model – Random (Total = 100)		
	Poor	**Middle**	**Rich**	**Poor**	**Middle**	**Rich**	**Poor**	**Middle**	**Rich**
1	71	22	7	31	45	24	28	47	25
2	70	23	7	26	48	26	24	50	26
3	69	24	7	22	49	29	21	51	28
4	69	24	7	35	42	23	23	50	27
5	72	21	7	29	46	25	23	49	28
6	69	24	8	24	47	29	24	50	26
7	66	26	8	25	47	28	14	52	33
8	69	24	7	28	48	25	21	51	29
9	67	25	8	14	54	32	21	51	28
10	70	23	7	29	46	25	28	47	25
Mean	69	24	7	26	47	27	23	50	27
Maximum	72	26	8	35	54	32	28	52	33
Minimum	66	21	7	14	42	23	14	47	25
SD	2	1	0	6	3	3	4	2	2
Class SD		27			11			12	

Table 2 shows the total wealth condensed in the hands of each of the three classes in the ten runs of the three simulations. Table 3 is derived from the earlier two tables which shows average wealth per agent in the three classes in all the ten runs in the three simulations. Again, the variance across the three classes outwardly discriminates the Zakat models from the original model, decreasing from 436 units of wealth in the original model to 218 in the ordered Zakat model and 249 in the random Zakat model. The ordered zakat model has lesser variance because it addresses the wealth inequality in the poor in the order of their deserving (poorest get the Zakat distribution first)

Table 2. Average Total Wealth in the three simulations (400 cycles)

Run	Original Model			Zakat Model – Ordered			Zakat Model - Random		
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich
1	17060	17102	8721	7085	21864	18075	4796	23371	18675
2	17293	16620	8495	6511	23731	18995	4253	25088	19384
3	17339	19137	9170	5929	26180	23028	3542	26320	21596
4	18487	19828	9846	9254	22755	19047	4198	26913	21814
5	16163	15294	8559	6707	21833	17852	3751	23563	20176
6	18281	19366	9885	6473	24707	22839	4639	26830	20449
7	17234	20913	10805	6768	25448	22431	2556	29096	27782
8	15759	16558	8987	6427	22822	18234	3340	23753	20421
9	16093	19836	10289	3794	27962	25490	3909	27396	22192
10	16793	18058	9551	6834	23015	19584	4760	22937	19256
Average	17050	18271	9431	6578	24032	20558	3974	25527	21175
Maximum	18487	20913	10805	9254	27962	25490	4796	29096	27782
Minimum	15759	15294	8495	3794	21833	17852	2556	22937	18675
SD	894	1818	776	1323	2008	2660	708	2083	2593

Table 3. Average / Per Agent Wealth in the three simulations (400 cycles)

Run	Original Model			Zakat Model–Ordered			Zakat Model-Random		
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich
1	240	777	1,246	229	486	753	171	497	747
2	247	723	1,214	250	494	731	177	502	746
3	251	797	1,310	270	534	794	169	516	771
4	268	826	1,407	264	542	828	183	538	808
5	224	728	1,223	231	475	714	163	481	721
6	265	807	1,236	270	526	788	193	537	787
7	261	804	1,351	271	541	801	183	560	842
8	228	690	1,284	230	475	729	159	466	704
9	240	793	1,286	271	518	797	186	537	793
10	240	785	1,364	236	500	783	170	488	770
Average	247	773	1,292	252	509	772	175	512	769
Maximum	268	826	1,407	271	542	828	193	560	842
Minimum	224	690	1,214	229	475	714	159	466	704
SD	15	44	65	19	26	38	11	30	41
Class SD		436			218			249	

Analysis

The change in pattern of wealth distribution is apparent. As for class size, the strength of poor class reduces from around 66% in the original model to 14% in the Zakat models. Similarly, strength of rich and middle class increases, thus reducing the relative differences of the three classes. Original model yields a power law distribution, whereas Zakat models gives a fairly normal distribution in terms of the relative frequencies of the three classes. Figure 3 illustrates this difference.

Zakat model reduced income inequalities in terms of per capita wealth of turtles. Average net wealth of rich decreases with some decrease in middle class also, yet bringing the three classes closer in terms of wealth distribution. Though average wealth of poor class increases only marginally in ordered model and reduced in random model, this is substantiated by the fact that relative frequency of the agents in poor class is much lower in Zakat model than in the original model (Figure 4). These results are in line with the empirical studies like Geoffrey A Jehle (1994), Anis & Kassim (2016) and Beik & Arsyianti (2016) who found a positive impact of Zakat in reducing wealth inequality.

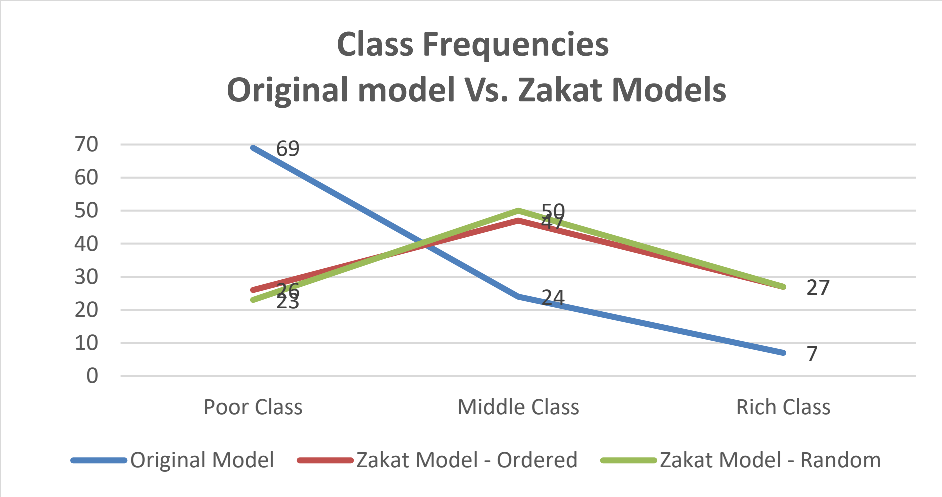

Figure 3. Class Frequencies Across the thee Models

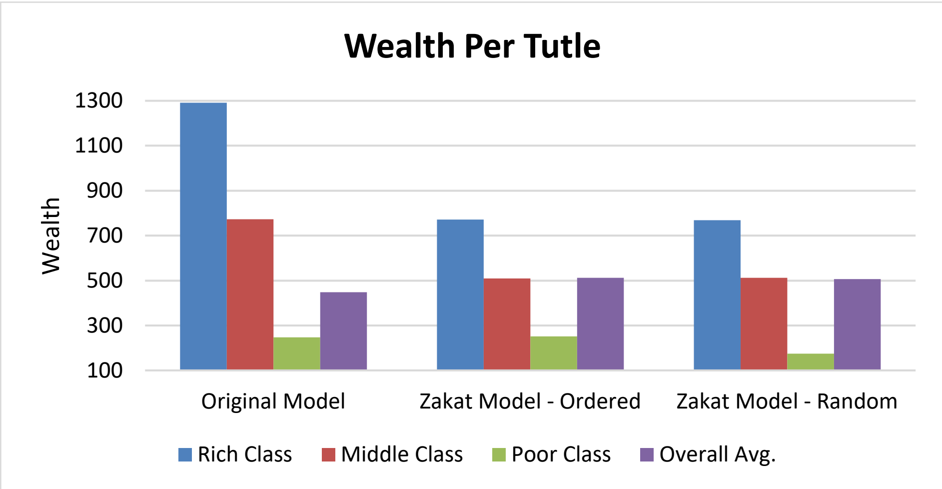

Figure 4. Average Wealth (per agent Wealth) in the three simulations

A more precise measure of the inequality (or equality) in wealth distribution is Gini Coefficient. The value of Gini coefficient ranges from 0 to 1, with 0 representing perfect equality and 1 representing perfect inequality. The Gini indices calculated under the original model are very much closer to world bank statistics of such indices of big capitalist economies. For example, the estimates were 0.42 (2016) for US and 0.47 (2017) for China. Average Gini index emerged under the original model's simulation was 0.46 which confirms the proximity of the model to the real world.

The Gini coefficients of the representative runs of the three simulations are plotted in Figure 5. Since initial wealth endowments are random, all the three models start with almost the same Gini Coefficient of around 0.2 and 0.25. However, the original model approaches 0.4 within first 30 to 40 cycles, whereas both Zakat models revolve around 0.15 and 0.35.

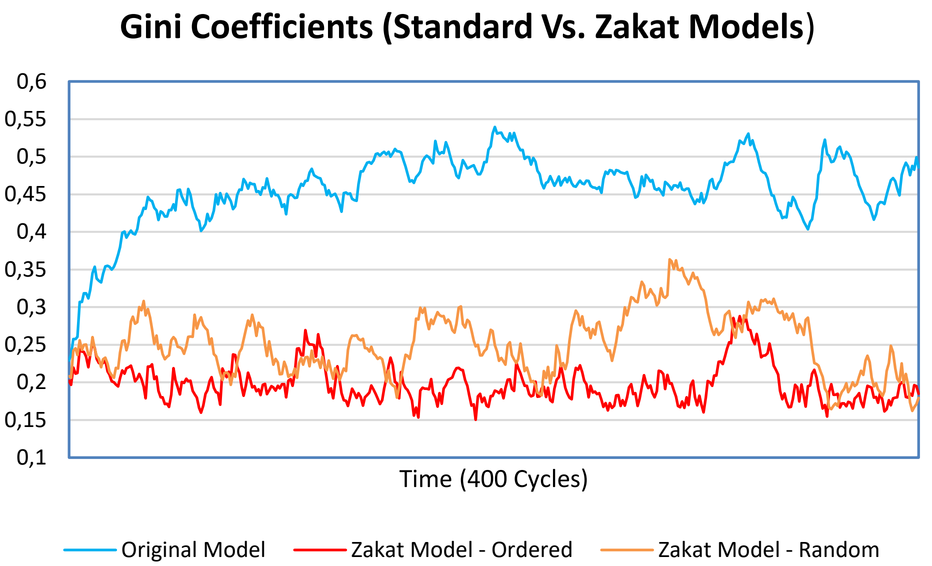

Figure 5. Gini Coefficients of a representative run of the three simulations

Average, highest and lowest Gini Coefficient values across all the ten runs have been shown in figure 6. It is noted that minimum values across all the runs of original model are initialized values, which means that the original model never falls back to this value again. On the other hand, both the Zakat models assumes much lower values than the initialized ones. This reflects the potential of Zakat models of correcting imbalances in wealth distribution at the start of an economy.

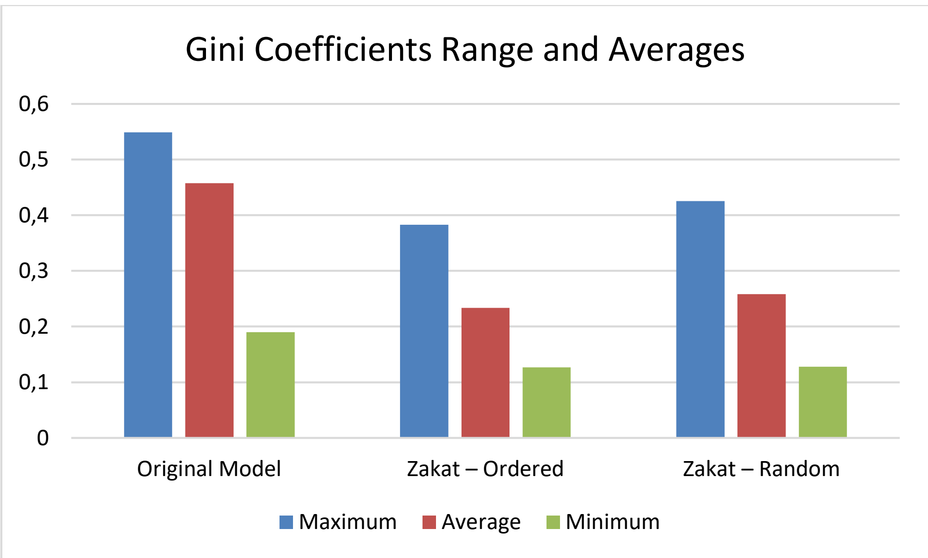

Figure 6. Gini Coefficients Limits and Averages

We conducted an independent sample t-test for comparison of these Gini means across all the runs of the simulations. The results confirm that the data series are significantly different further implying that the samples are representing two different populations.

1. Between Original model and Zakat Ordered Model:
   Original model (M=.4576, SD=.0496) and Zakat model – ordered, (M=.2337, SD=.0398); t = -222.31, p <.001,

2. Between Original model and Zakat Random Model:
   Original model (M=.4576, SD=.0496) and Zakat model – random, (M=.2583, SD=.0511); t=176, p <.001,

Another important measure of the inequality (or equality) in wealth distribution is Lorenz Curve. Lorenz curves of the representative run each of standard and the two Zakat models have been plotted in Figure 7 and Figure 8. The two figures have been drawn separately because the two Zakat Model curves almost overlap after that first 20% on both Axis. These curves clearly show the reduction in the area between the equality line and the Lorenz curve under the Zakat model (effectively the measure of Gini coefficients) when compared to the original model.

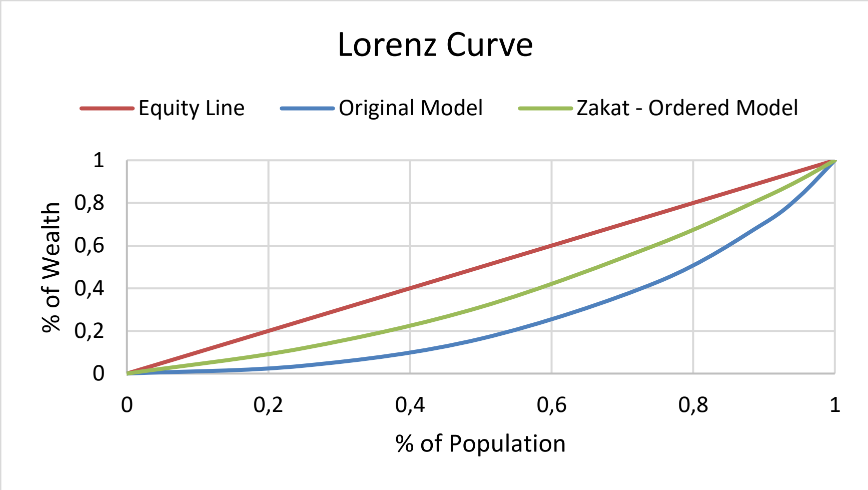

Figure 7. Lorenz Curve Original model and Zakat Ordered Model

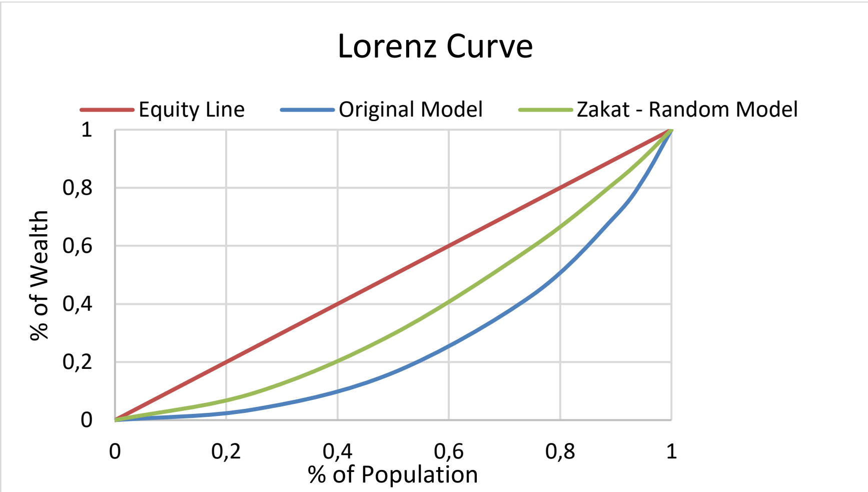

Figure 8. Lorenz Curve: Original Model and Zakat - Random Model

Apart from reducing inequalities in wealth distribution, the Zakat model improved the model economy in one novel way. In all the ten runs, it increased the total wealth of the economy as a whole as compared to the original model. Figure 9 summarize this phenomenon. Since resource parameters were kept constant in the three simulations, the higher wealth in the Zakat models are an indicator of efficiency and effectiveness in the collection of grains. According to the programming logic of the model (Wilensky, 1998), agents with wealth zero or less die in each run (people die due to hunger). After introducing the Zakat procedure in the model, this phenomenon is highly reduced keeping the agents live and collect more grain (wealth). This resulted in the higher wealth under the Zakat models and as evident in figure 8, this phenomenon is consistent across all the runs in both the Zakat models, though Ordered Zakat Model is on the higher side as logically expected. This phenomenon is reflected in Figure 10 wherein plot of number of agents died in each simulation is shown, which is again radically different in these models across all the runs. Note that deaths due to poverty were absent in Zakat-ordered model as the poorest agents got the Zakat to survive.

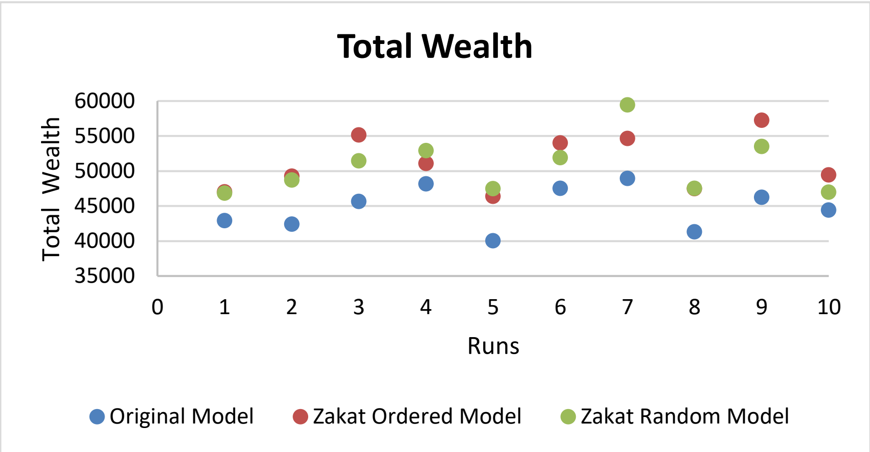

Figure 9. Total Wealth in the three simulations

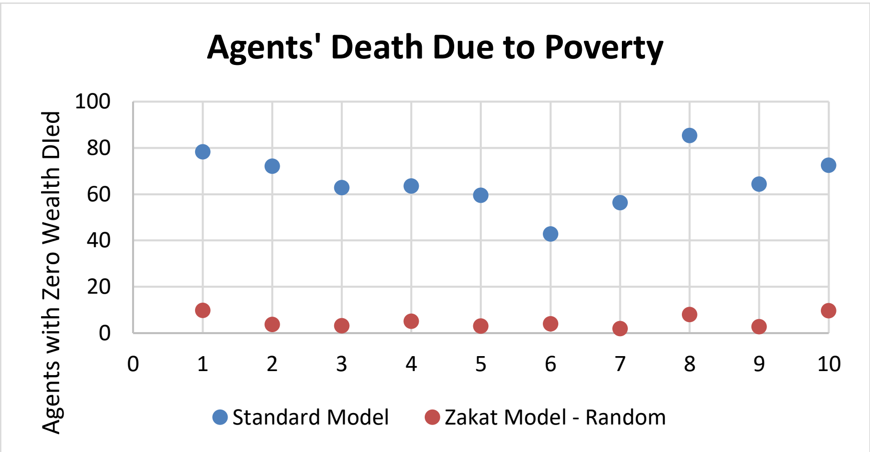

Figure 10. Agents Died for Zero Wealth

CONCLUSION AND RECOMMENDATION

Conclusion

Our simulations with insertion of Zakat in the model have shown the impact of Zakat on the pattern of wealth distribution. Zakat normalized the power law distribution of wealth thereby reducing wealth inequalities. The ordered Zakat model is an ideal scenario wherein charity is given to the poor in the order of their poverty (poorest first) and this model, as logically expected, has shown the highest potential to reduce wealth inequalities. However, random Zakat model, giving Zakat charity to a random poor agent which is more realistic, also showed significant impact on wealth distribution.

The simulations also shown a net increase in total wealth under the two Zakat models. These results indicate that such a redistribution also serves the purpose of marginal growth without even increasing the total available resources. Another very interesting finding is the drastic reduction in the number of agents dying under the Zakat model. This is reflective of the deaths due to poverty, hunger and lack of access to necessary health remedies in the real life.

Recommendations

The results stress the importance of non-conventional handling of the issue of wealth inequalities and poverty. Religious assertions can still offer a solution for some of the economic problems, as the charity of Zakat is guided by the spiritual landscape and not by any government or taxing authority. The results of the experiments support the notion that fiscal policy measures are not the only measures available to address wealth inequalities, and reinforce the notion of faith based policing. Spiritual ideologies when followed in true sense can serve economic purposes even without state intervention. State and regulators should consider novel ways for motivating people to discharge religious obligations which could result in addressing economic problems as well.

Limitations and Future Research

Simulations are rather simplistic representations of real word phenomena and as such are limited in scope. However, such simplistic models bring forward the impact of study variables more prominently than complex models (KISS principle) (Axelrod, 1997), thereby helping understand the impact of some selected variables on real life phenomenon, which are otherwise practically not possible to isolate in real world data. Simulations enable as if analysis and therefore help in developing theoretical insights.

We could not find real world data on wealth distributions with Zakat. If such a data is available, the model can be calibrated and become made more robust. Also in real world, not all subjects in an economy are expected to comply the Zakat requirements. There are other injunctions of charity even within Islamic Finance, known as Sadqa, the magnitude of which is not fixed but is over and above Zakat. A probabilistic model could be more realistic study in this context. Further, more insights can be developed when the model is tested changing other variables like population size, available resources, and inheritance.

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Muhammad Asif Jaffer
Institute of Business Administration,
Karachi, Pakistan
masif@iba.edu.pk