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# EXPLORING THE EFFECT OF ZAKAT ON WEALTH REDISTRIBUTION IN MOROCCO USING AGENT-BASED MODELING

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**Abstract:** *Zakat is one of the pillars of Islam, a mandatory financial obligation for Muslims who meet specific conditions. Its significance lies in its role in wealth redistribution and reducing economic disparities between the rich and the poor. This contribution, often referred to as an "Islamic tax," is intended to provide for the immediate needs of specific social groups, as defined in verse 60 of Surah At-Tawba in the Holy Quran. Globally, wealth distribution generally follows Pareto's law, which explains its concentration among a small percentage of individuals. One way to mitigate this inequality is through taxation. In Islamic finance, Zakat is presented as a mechanism for poverty alleviation and economic redistribution. This study proposes an agent-based modeling (ABM) approach using NetLogo software (version 6.4p), based on the framework developed by Wilensky. Within this model, we incorporate the concept of Zakat to analyze its impact on wealth distribution. The results of the simulation, assessed through various indicators, will then be presented and discussed.*

**Keywords:** *Zakat, Agent Based, Wealth Distribution, Netlogo, Islamic finance*

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## Introduction

Islamic finance has grown significantly since the 1970, reaching total assets of 3.38 trillion dollars (USD) in 2023 (IFSB, 2024). One of the tools for financing the social sector in the Islamic economy is Zakat, the main idea is to donate a small portion of personal wealth to a specific category of the poor. Zakat is obligatory alms and one of the main tools of Islamic finance that ensures the redistribution of wealth and is used for poverty alleviation in Islamic societies (Bouanani & Belhadj, 2020).

Nowadays, this mechanism is adopted in different ways by governments and the management of Zakat can be both voluntary or compulsory through specialized institutions, according to (Beik, 2015) the system known as "Zakataire" can be classified into four categories as below: regulated and voluntary as in Indonesia, regulated and compulsory as in Malaysia, unregulated and voluntary as in Morocco, and unregulated and compulsory, this last classification is an impossible one. The Moroccan government has created a special Zakat fund, published in the 1980 finance law n°38-79. However, this special fund has not yet been activated, due to a lack of implementing legislation (Ghaouri, Kassim, Abdullah Othman, & Zakariyah, 2023).

Indeed, inequality has increased in most countries over the last few decades, even in the developed world. In fact, the richest 10% of the population receives nearly 40% of the world's total income, while the poorest 10% earn between 2% and 7% of the world's total income (Idalfahim, Assouih, & Ouardirhi, 2023).

Morocco's income distribution by socio-professional category is characterized by highly concentrated to the benefit of only the richest quantile. In fact, the richest 20% monopolize 52.6% of the income pool, while the poorest 20% have a share of only 5.4% (Chtouki, 2021). This leaves us to wonder what effect Zakat could have on the distribution of wealth in Morocco? To try to answer to this question, this paper proposes to run a simulation of a small community to show the impact of Zakat on the wealth distribution based on the Moroccan wealth distribution state official data of using Netlogo software developed by Professor Uri Wilensky to build the Agent-Based Environment (ABM) (Wilensky & Rand, 2015).

This document is organized into four main parts: the first deals with the conceptual framework, the second describes the methodology, the third is devoted to a simulation and finally to the reporting of the results.

## Literature Review

Many published papers have focused on the topic of Zakat, however very few use software tools to simulate it, and fewer use agent-based modelling powered by Netlogo.
Each article analyzed and explained two different models: first, without Zakat, and second, including Zakat, with the goal to understand the influence of Zakat on the redistribution of wealth, on the emergence of social disparities, on the economic growth and on social equity.
The table below resumes the papers that have discussed the issue of zakat with an agent-based simulation built on the Netlogo software.

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**Table N° 01: Articles That Use ABM For Modeling Zakat**

| Year Published | Authors | Titles |
|---|---|---|
| 2018 | Hossein Sabzian, Alireza Aliahmadi, Adel Zar, Mdjid Mirzaee | Economic Inequality And Islamic Charity: An Exploratory Agent-Based Modeling Approach |
| 2020 | Diyah Putriani, Gairuzazmi Mat Ghani Et Mira Kartiwi | Exploration Of Agent-Based Simulation: The Multiplier Effect Of Zakah On Economic Growth |
| 2020 | Diyah Putriani, Gairuzazmi Mat Ghani Et Mira Kartiwi | Zakah In A Complex World |
| 2020 | Muhammad Asif Jaffer | Can Zakat Charity Help Reduce Economic Inequality? An Agent Based Simulation |
| 2020 | Yuqian Yang, Pingchao Chen, And Qixuan Jin | Impact Of Taxes And Subsidies On Social Wealth Distribution: By Agent-Based Modeling |
| 2021 | Younas, Hussain, Anam & Jaffry | Agent Based Model For Zakat Distribution |
| 2022 | Muhammad Asif Jaffer | Zakat Charity And Wealth Distribution An Agent-Based Computational Model |
| 2023 | Erşan Taşan, Bertan Badur | Towards Social Justice Via Giving: Agent-Based Econophysics Models Of Taxation And Zakat |
| 2024 | Abderrahim haddad, Fadma El Mosaid | The Effect Of Applied Zakat On Wealth Distribution Using Agent Based Modeling |

Source: Authors

In the paper of (Sabzian, Aliahmadi, Azar, & Mirzaee, 2018), Zakat is referred as Sadaqah as well as scenario-based assumptions. The authors were then able to simulate a system in a closed economy, with the goal of observing the emergence of economic inequality to explain the reasons for inequality. The simulation output without Zakat is a distribution of wealth in the form of a power law (Pareto). The study of (Putriani, Ghani, & Kartiwi, 2020) examined the way in which Zakah can reduce the Gini Index Level, and simulated Zakat in its impact on economic growth through the redistribution of wealth. In fact, two scenarios were used (with or without Zakat) with the design of Zakat as a decentralized distribution, the result of the simulation demonstrates that the Gini index remains stable once implemented and may be used as one tool to use in order to minimize negative impact of interest-bearing loans. While the two paper of Mr Jaffer (Jaffer, 2020) and (Jaffer, 2022) used a model that does not limit total wealth in the simulation of zakat as a decentralized distribution via two scenarios they used the ordered distribution and random distribution. Their simulation revealed that applied Zakat can decrease the number of poor people and increase the size of the middle category, as well as restructuring the power distribution (Pareto) to a normal one.

The papier of (Yang, Chen, & Jin, 2020) aim to study taxes and subsidies on the social distribution wealth through the development of Wilensy's simple economic program. In this study, it was found that taxation helps to minimize the gap separating the rich from the poor.
In other hand, the article of (Younas, Hussain, Anam, & Jaffry, 2021) studied the impact of the Zakat system through a centralized treasury via Netlogo simulation built on agent-based modeling. And the paper of (Erşan Taşan & Badur, 2023) examines the use of simulation through agent-based modeling (ABM) in order to study economic inequality while,

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simultaneously, considering the role that Islamic charity (sadaqah) or Zakat may have in alleviating this phenomenon. The authors conclude that taxation and zakat can together make an important positive contribution to a more equal redistribution of wealth and equality.

Our paper (Haddad & El Mosaid, 2024) studies the impact of Zakat on wealth redistribution using a multiagent simulation in NetLogo. It proposes a simple economic model with no redistribution and a model with Zakat, where the rich give 2.5% of their wealth to the poor after a specified period. The results show that the application of Zakat reduces inequality, thus lowering the Gini index and approaching the Lorenz line of perfect equality. The study thus confirms that Zakat can be an effective tool for reducing wealth disparities.

## Conceptual Framework

The story behind Islamic finance and its principles reaches as far as the history of Islam itself. Indeed, the fundamental principles of the Islamic economy are inspired by sources such as the Quran, the Sunna, and scholarly practices or jurisprudence relating to Muamalat (Adraoui, Rouggani, & Amine, 2016). The Islamic finance prohibits interest, promotes profit-and-loss sharing, and requires that transactions are asset-based.

Zakat is one of the most important instruments of Islamic finance, this is because Zakat is one of the five pillars of Islam, which combines a cultural and financial act (Attak, 2022). Zakat enables believers to purify their souls as well as their wealth. This concept is based on the principle of solidarity, and is both religiously obligatory and, in some countries, legally compulsory. Zakat fulfils a vital function by establishing a system of solidarity, helping to mobilize the funds needed to transfer wealth to the needy to achieve what is essential for living (health, education, food..etc) (Lakhyar & Fekkak, 2019). Its religious importance can be seen in the fact it is cited 32 times in the Koran, including 28 times at the same time as Salat (obligatory prayer) (Razak, 2022).

The mechanism that obliged the rich who has attained the “Nissab” (the minimum amount of Muslim's wealth that is obliged to pay Zakat) to allocate around 2.5 percent of their wealth to the poor is a good way to help alleviate the poor and improve equality (Pratama, 2023).

On the other hand, the concept of agent-based modeling was inspired by biology, in the last few years, many applications are used in the economic area like labor market, game behavior and financial market (Yang et al., 2020), and agent-based modeling is applied to simulate or model complex adaptive systems. Indeed economic systems are considered as complex systems (Al-Suwailem, 2011), and there are many computer simulation tools supported by agent-based modeling.

## Methodology

Based on the Simple Economy concept developed by Wilensky, and using Netlogo 6.4, the authors have developed a code capable to simulate the Impact of Zakat on a Social Wealth Distribution area, of course, since this is a computational model, a number of assumptions have been implemented. Initially, a wealth distribution respecting the latest official data on wealth distribution in Morocco in 2019 was used by the code on the sample of 400 agents.

The simulation program allows agents to carry out transactions between agents with given rules that essentially depend on wealth classes, and it applies a simple tax and the Islamic tax called

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Zakat. Subsequently, the results displayed will allow the user to observe the indicators that enable to explain the impact on wealth distribution.

The present study follows a quantitative approach which relies on secondary data from government sources and findings produced by computer simulation. With a view to analyzing the data, an exploratory descriptive research technique has been adopted, and observations made will be presented and commented and discussed.

**Design of the model**

The model illustrates a closed economy, for a period of five (5) years. It is also inspired by the work of (Yang et al., 2020), especially in the part relating to introducing the simple tax. The proposed simulation involves the deduction, monthly, of a fixed fraction of the taxable income of the agent with a specific index of total income; this fraction, known as the simple tax, will be directly allocated, according to a random approach, to another agent.

As previously explained, the Initial Wealth Distribution is identical to the Moroccan Wealth Distribution in 2019, whereby the model has been designed to allocate initial wealth to agents with the same quantile rates as the Moroccan Wealth Distribution.

Meanwhile, a taxation mechanism respecting the Islamic principles has been defined to check, for each day, if the agents' income has fulfilled the conditions to pay the Islamic tax (Zakat). In fact, both conditions must be fulfilled simultaneously, i.e. to reach the wealth threshold and to have a wealth that exceeds this threshold for a linear calendar year, then the agent should give 2,5% of his wealth to a poor one.

To ensure a more realistic model, the agents were allowed to engage directly on transactions to satisfy their own consumption needs, and in accordance with their respective categories of wealth.

**Initialization parameter**

- Simulation for 5 years (1825 ticks)
- One tick is one day
- 400 agents
- Each agent gets a random amount of wealth between 0 and 3000
- The Initial Wealth Distribution is identical to the Moroccan Wealth Distribution in 2019, so Q1 = 5.6% ; Q2 = 9.2% ; Q3 = 12.7% ; Q4 = 19.7% ; Q5 = 53.3%
- Zakat: Every agent who exceeds Nissab wealth (75) during one year (354 days) must donate 2.5% of their wealth to a poor agent with less than 40 wealth randomly.
- For transact, the agents are categorized on riches, medium and poor
- The poor categories' (Q1 and Q2) transact every week (7 days) by given 2 randomly to another agent
- The medium categories' ( Q3 and Q4) transact also every week by given 4 randomly to another agent
- The riches categories' Q5 transact every week by given 6 randomly to another agent
- Simple tax all agent whose exceeds 60 must pay 4 every month and give to another poor agent randomly

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### Simulation and Results

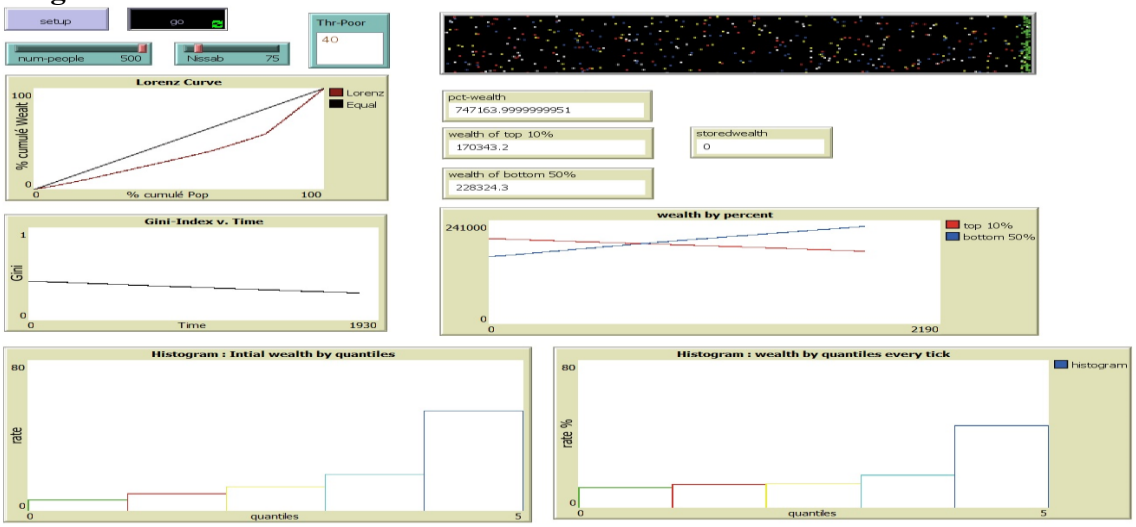
In this section, we present three possible scenarios:

- Scenario 1: Wealth distribution with no tax and no Zakat
- Scenario 2: Wealth distribution with simple tax and without Zakat
- Scenario 3: Wealth distribution with simple tax and Zakat

**Scenario 1: Wealth distribution with no tax and no Zakat**

The following figure show the result of simulation "after 1825 ticks (5 years)":

**Figure 1: Simulation Results Of Wealth Distribution With No Tax And No Zakat**




Source: By Authors

**Result:** We obtain this indicators:

- The quantiles after 5 years is Q1 = 11.4%; Q2 = 13.1% ; Q3 = 13.9% ; Q4 = 18.1% ; Q5 = 45.1%
- At 747 ticks the total wealth of top 10% the more rich population become equal to wealth of bottom 50% less rich population (the wealth is 188 000)
- The total wealth is 747 164
- The wealth of top 10% of the more rich population become less than the wealth of bottom 50% less rich population
- The index Gini change decrease from 0,44 to 0,30
- Lorenz curve show that the distribution become more equal than the started situation

Accordingly, it is reasonable for us at this stage to conclude that the transaction between agents has contributed to more equitable distribution. Indeed, within 747 days, the 10% of people who are the richest are no longer holding most of the wealth. In addition, there's an improvement in the Gini index, down from 0.4 to 0.3, and a better repartition: Q1 = 11.4%, Q2 = 13.1%, Q3 = 13.9%, Q4 = 18.1% and Q5 = 45.1%, compared with an initial distribution of Q1 = 5.6%, Q2 = 9.2%, Q3 = 12.7%, Q4 = 19.7% and Q5 = 53.3%. Thus, the simple action of moving cash around within a closed economy would be a factor favoring a better redistribution of wealth.

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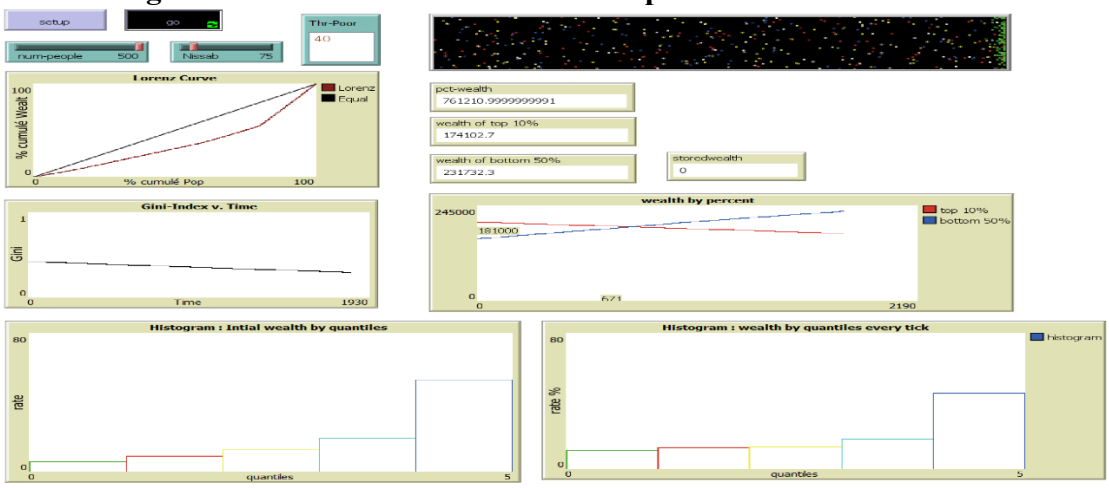
**Scenario 2: Wealth distribution with simple tax and without Zakat**

The following figure show the result of simulation, "after 1825 ticks (5 years)":

**Figure 2: Wealth distribution with simple tax and without Zakat**




Source: By Authors

**Result:** We obtain this indicators:

- The quantiles after 5 years is Q1 = 11.4% ; Q2 = 13.1% ; Q3 = 13.1% ; Q4 = 18.1% ; Q5 = 44.6%
- At 785 ticks The total wealth of top 10% the more rich population become equal to wealth of bottom 50% less rich population ( the wealth is 192 000 )
- The total wealth is 761 211
- The wealth of top 10% of the more rich population become less than the wealth of bottom 50% less rich population
- The index Gini change decrease from 0,42 to 0,31
- Lorenz curve show that the distribution become more equal than the started situation

Same thing at this point, it's reasonable to consider that the addition of a simple tax and transactions between agents has achieved a more uniform wealth distribution. In 785 days, the richest 10% no longer hold the majority of wealth. Furthermore, the Gini index was reduced from 0.42 to 0.31, and the global distribution became more balanced: Q1 = 11.4%, Q2 = 13.1%, Q3 = 13.1%, Q4 = 18.1% and Q5 = 44.6%, compared with the initial distribution of Q1 = 5.6%, Q2 = 9.2%, Q3 = 12.7%, Q4 = 19.7% and Q5 = 53.3%. Such results strongly suggest that integrating a simple tax into economic transactions could improve the distribution of wealth.

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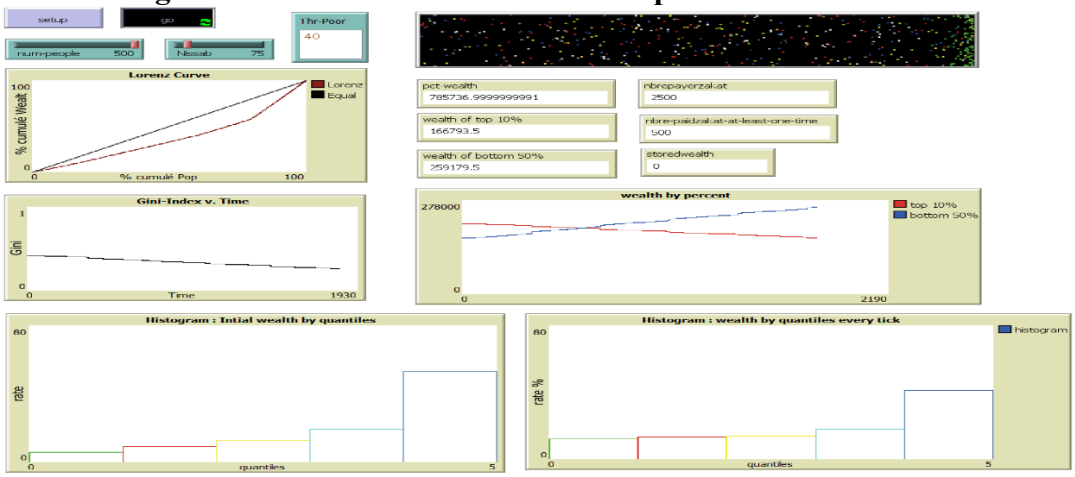
**Scenario 3: Wealth distribution with simple tax and with Zakat**

The following figure show the result of simulation, "after 1825 ticks (5 years)":

**Figure 3: Wealth distribution with simple tax and with Zakat**




Source: By Authors

**Result:** We obtain this indicators:

- The quantiles after 5 years is Q1 = 12.2% ; Q2 = 13.9% ; Q3 = 13.9% ; Q4 = 18.1% ; Q5 = 41.7%
- At 620 ticks The total wealth of top 10% the more rich population become equal to wealth of bottom 50% less rich population ( the wealth is 201 000 )
- The total wealth is 785 737
- The wealth of top 10% of the more rich population become less than the wealth of bottom 50% less rich population
- The index Gini change decrease from 0,41 to 0,26
- Lorenz curve show that the distribution become more equal than the started situation

At this stage, it's possible to conclude that the combination of Zakat, a simple tax, and transactions between agents has led to a more equitable wealth distribution. In the space of 620 days, the richest 10% no longer hold the majority of wealth. Meanwhile, the Gini index fell considerably, from 0.41 to 0.26, and the total distribution became more balanced: Q1 = 12.2%, Q2 = 13.9%, Q3 = 13.9%, Q4 = 18.1% and Q5 = 41.7%, compared with the initial distribution of Q1 = 5.6%, Q2 = 9.2%, Q3 = 12.7%, Q4 = 19.7% and Q5 = 53.3%. These results clearly illustrate that integrating zakat and a simple tax in a transactional economy can effectively reduce wealth inequalities in a closed economic system.

## Conclusion

The results of the simulations indicate a significant improvement in wealth distribution following the introduction of simple taxes, with an even greater enhancement when Zakat was incorporated into the taxation system. The wealth concentration in the fifth quintile decreased from 53.3% to 41.7%, while the shares of the lower quintiles (Q1 to Q4) also declined and became more evenly distributed, with only small differences between them. This reflects a more balanced allocation of wealth across the population. These findings provide clear evidence that both taxation and Zakat play a crucial role in wealth redistribution, particularly by transferring resources from the wealthiest segments of society to those with the least wealth. Nevertheless, the model's very primitive nature obviously limits the ability to generalize the results, and it will need to take other economic and social parameters in consideration to be able to generalize.

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