

# A Simple Model of Wealth Inequality

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# Disclaimer

## Economic Background

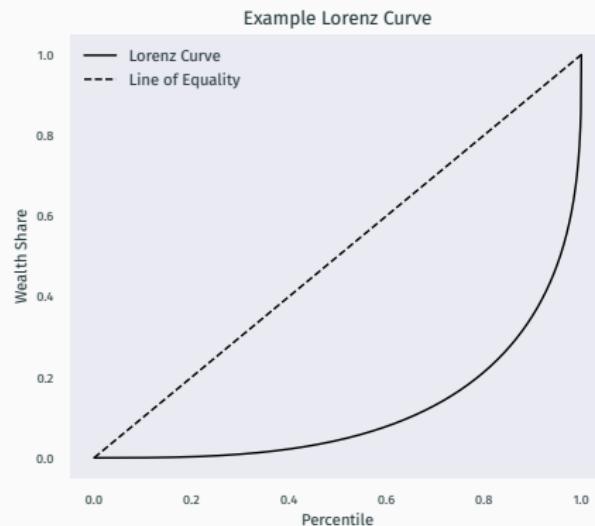
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# Lorenz Curve

A Lorenz Curve maps each percentile to the share of wealth held below that percentile

Ex: The bottom 50% to the right hold ~ 5% of the wealth

The Line of Equality shows a perfectly equal wealth distribution

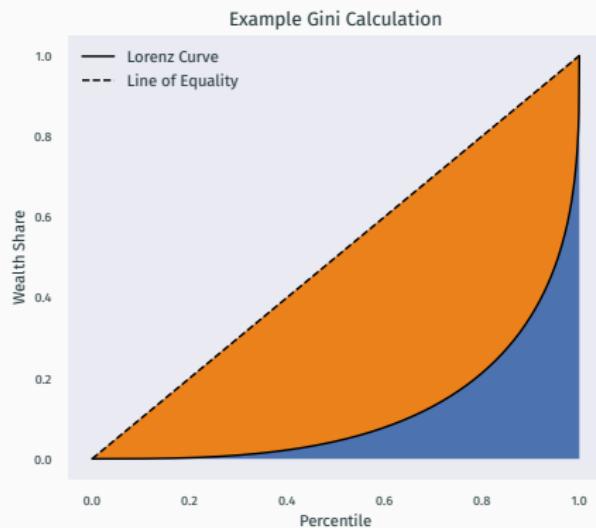


# Gini Coefficient

The **Gini Coefficient** is the ratio of the area between the Lorenz Curve and the Line of Equality to the area under the Line of Equality

It ranges from 0-1 where

- 0 is perfect equality
- 1 is perfect inequality



## Example Gini Values

Country	Gini	Region	Gini
United States	0.850	Africa	0.879
China	0.701	Asia-Pacific	0.885
Uruguay	0.774	Europe	0.816
Argentina	0.809	Latin America	0.858
United Kingdom	0.706	North America	0.842
Germany	0.788	World	0.889

Gini coefficients shown for wealth in each region. Suisse 2022

## The (Simple) Model

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## The Model

There are many agents which each hold wealth

Each period we

1. Pair each agent up with another
2. In each pair, randomly pick one agent to receive a transfer

The probability of  $i$  receiving the transfer from  $j$  is

$$p(w_i, w_j) = \begin{cases} 0.5 + \frac{\alpha}{2} & \text{if } w_1 > w_j \\ 0.5 & \text{if } w_1 = w_j \\ 0.5 - \frac{\alpha}{2} & \text{if } w_1 < w_j \end{cases}$$

3. Transfer wealth from the losing agents to the winning agents

# Lorenz Curve



# Lorenz Curve (With Real Data)

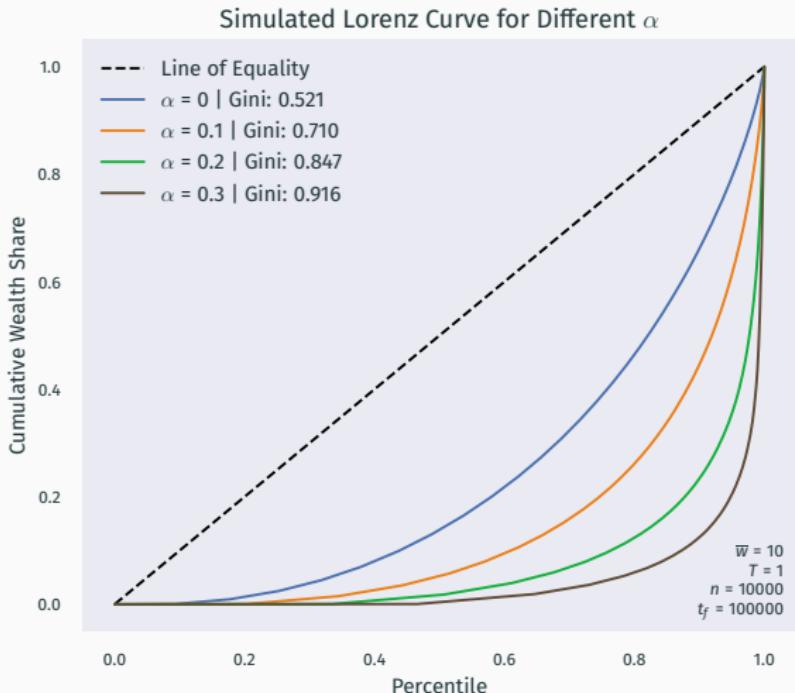


Date Source: Aladangady and Forde 2021

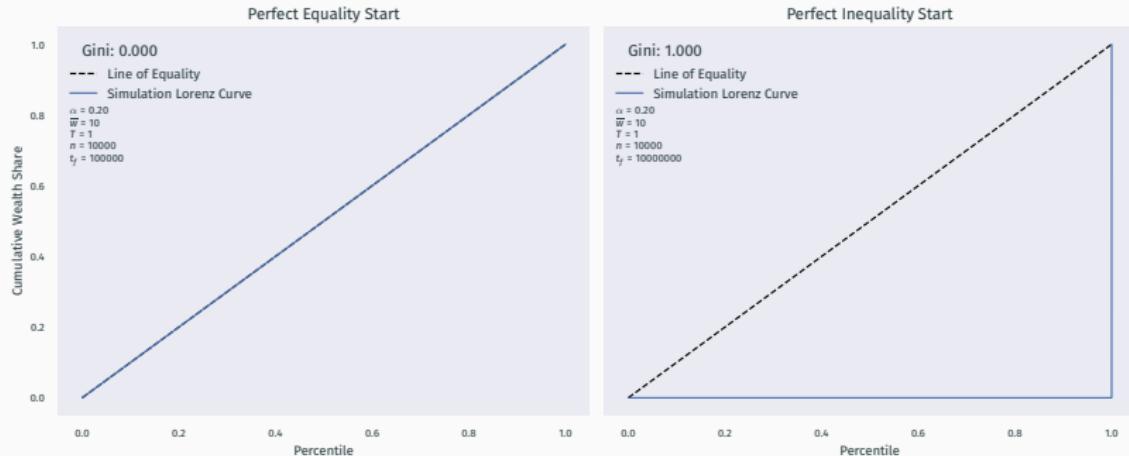
## Deeper Exploration

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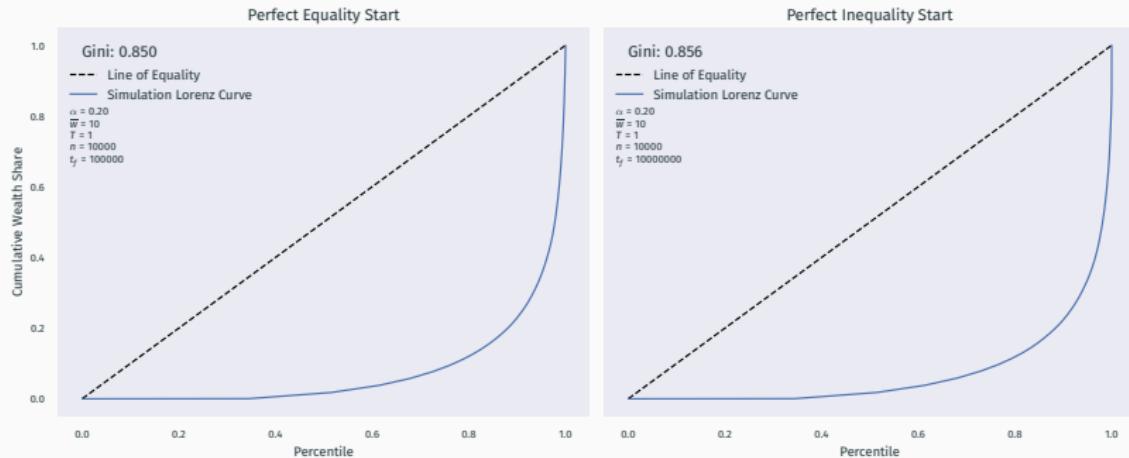
# Changing Parameters



# Initial Conditions



# Initial Conditions



# Agent Wealth



## Agent Wealth Cont.



## Agent Wealth Cont.



## Agent Wealth Cont.



## Agent Wealth Cont.



## Agent Wealth Cont.



## Groups

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## The (Expanded) Model

Each agent  $i$  is now assigned a group where  $W_i$  represents the average per-capita wealth of the group

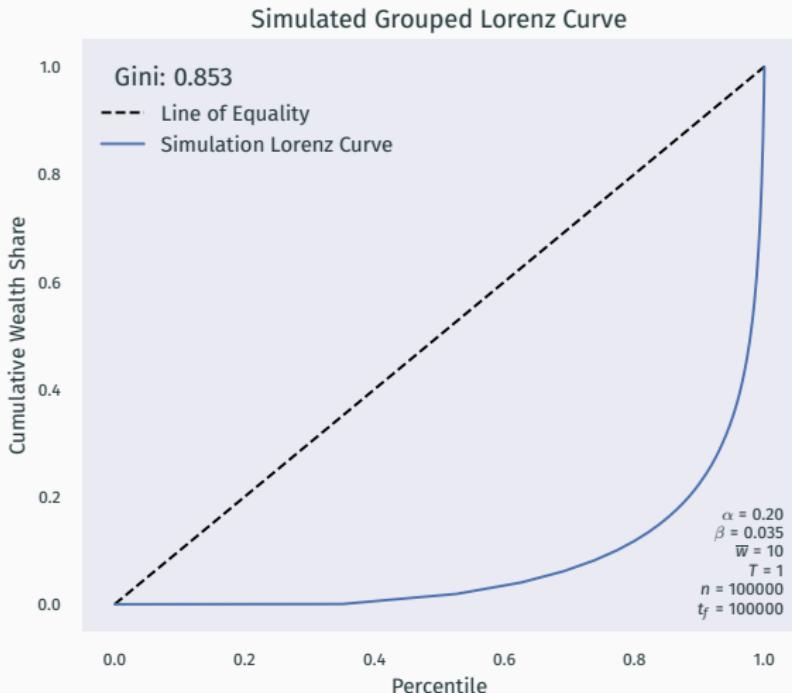
Let

$$w_{ij} = \begin{cases} 1 & \text{if } w_i > w_j \\ 0 & \text{if } w_i = w_j \\ -1 & \text{if } w_i < w_j \end{cases} \quad W_{ij} = \begin{cases} 1 & \text{if } W_i > W_j \\ 0 & \text{if } W_i = W_j \\ -1 & \text{if } W_i < W_j \end{cases}$$

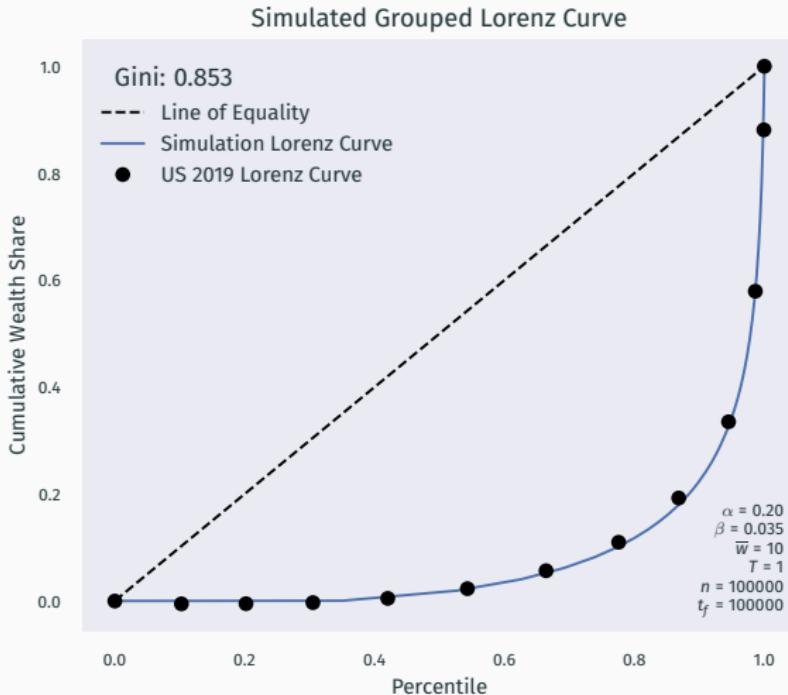
Then, the updated probability of a transfer from  $i$  to  $j$  is

$$p(i,j) = 0.5 + \frac{\alpha}{2} w_{ij} + \frac{\beta}{2} W_{ij}$$

# Lorenz Curve



# Lorenz Curve (With Real Data)



Date Source: Aladangady and Forde 2021

# Wealth Share



Date Source: Aladangady and Forde 2021

# Wealth Share (With Real Data)

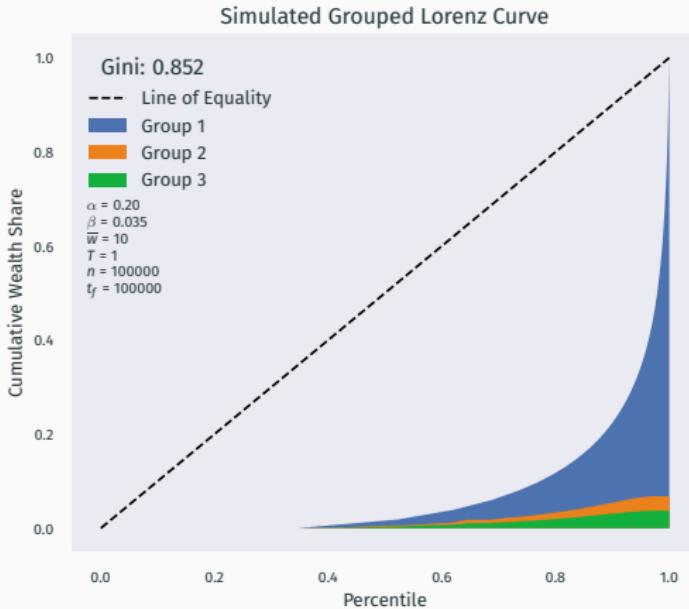


Date Source: Aladangady and Forde 2021

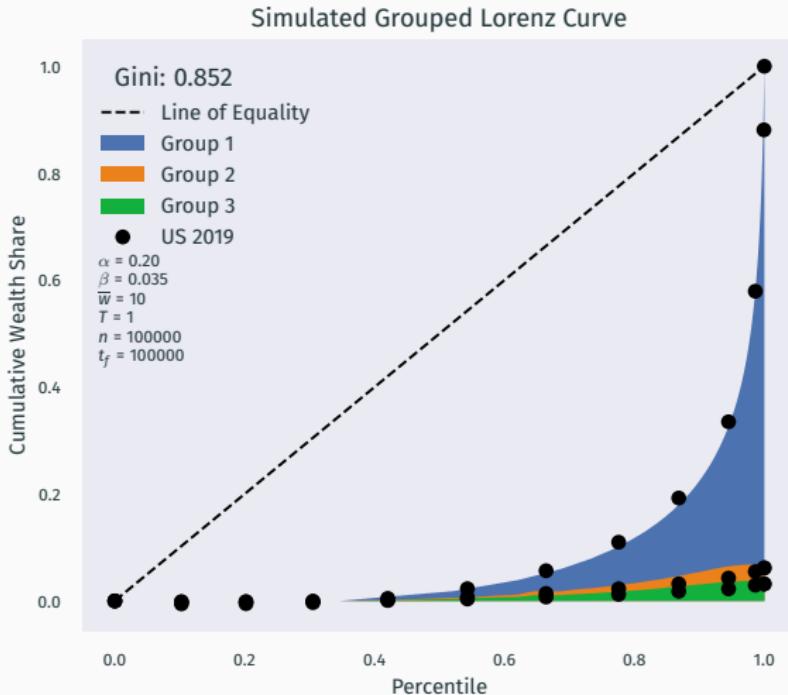
# Wealth Share with Different Parameters



# Lorenz Curves by Group



# Lorenz Curves by Group (With Real Data)



Date Source: Aladangady and Forde 2021

## Conclusion

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# Conclusion

This very simple model is able to successfully

- Simulate wealth inequality
- Simulate the racial wealth divide (More or less)

To expand on it, I'd like to

- Explore the grouped model more
- Fit to more countries
- Get better data
- Create a diffeq model

Questions?

## References i

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- Aladangady, Aditya and Akila Forde (2021). **“Wealth Inequality and the Racial Wealth Gap”**. In: *FEDS Notes*. Washington: Board of Governors of the Federal Reserve System.
- Suisse, Credit (2022). **“Global Wealth Databook 2022”**. In: *Credit Suisse Research Institute*.