

# Inequality in the Economy: Testing Piketty's Theory through Simulation

## Goals

Argued by the economist Thomas Piketty in his book *Capital in the Twenty-first Century*, the growth of income from capital (i.e. investments, property, etc.)<sup>1</sup> has been outpacing economic growth, leading to increased inequality. This report gather, simulate, and analyse data to test the validity of Piketty's theory and to understand the causes and implications of increasing inequality.

## Methodology

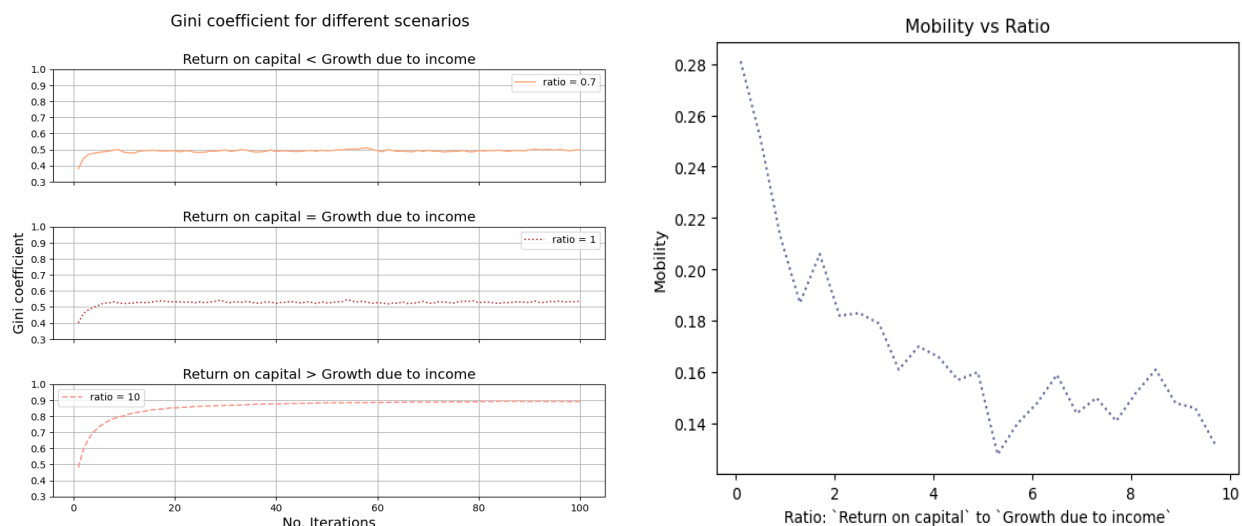
To test Thomas Piketty's theory, this study will simulate the economy by assigning each individual a random, normally-distributed, per-timestep income and calculating the return on capital by multiplying wealth  $w_i$  by a growth factor  $g_i$  every timestep ( $g_i$  is calculated such that it positively correlates with  $w_i$ , and the total return to capital would approximately match the ratio). The simulator will normalize wealth every timestep, by limiting total with to 1000, to prevent numerical instability. It will also incorporate value transfer model to simulate real-life random economic exchanges between individuals. The results of the simulation will be measured by the Gini coefficient, which will indicate the level of inequality in the distribution of wealth, and by a mobility measure, which will calculate the proportion of individuals who moved more than one quintile. By comparing the results of simulations with different ratios of return on capital to growth due to income, the report will seek to understand the relationship between the two and the validity of Piketty's theory.<sup>2</sup>

The simulation was run on population of size 1000. On each ratio of return on capital to growth due to income, 100 timesteps were run. This time was chosen to be large enough for Gini coefficient to stabilize. For mobility measurement, 25 different ratios were evenly sampled from 0.1 to 10.

## Result

Our plot on the left shows that as the ratio of return on capital to growth due to income increases, the Gini coefficient also increases as iteration goes through, indicating higher levels of inequality.

Our plot on the right shows that there exists an inverse relationship between mobility and the ratio of return on capital to growth due to income increases, despite some fluctuations.



## Conclusion

The conclusion of this report supports Thomas Piketty's theory that increased inequality in the economy is due to a higher return on capital than income growth. The results of the simulations indicate that this leads to decreased mobility and increased concentration of wealth in a few individuals. It is interesting to see that the gradient of the curve decreases and will eventually reach a limit as a horizontal asymptote. The findings of this report suggest the need for policies to address the issue of increasing inequality in the economy.

<sup>1</sup>This study simplifies the simulation by assuming capital to be the current wealth

<sup>2</sup>Source code is made available on [https://github.com/Haoran-Jie/EconomicInequality\\_Simulator\\_Investigation](https://github.com/Haoran-Jie/EconomicInequality_Simulator_Investigation)