

Analysing Wealth Redistribution in India using Matrix Multiplication

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Abstract: At present, the richest 1% of the population of India own over 40% of the entire nation's wealth, the highest since 1961. Meanwhile the bottom 50% of the country is struggling to obtain adequate food, healthcare and education- the most basic necessities of a human being's life. This gap is a result of various factors including discrimination, corruption, low minimum wages, unequal employment opportunities and disparities in quality of education. With previous efforts of wealth redistribution focusing on policy intervention, tax schemes and Land reforms. However, due to criticism and complications in logistical implementation wealth distribution is still skewed.

Introduction

Our paper focuses on utilising matrix multiplication to calculate how wealth can be redistributed taking into account India's economic circumstances in order to fund employment and educational opportunities for the underprivileged. This approach aims to ensure that equal opportunities are provided so that individuals have the chance to attain financial security on their own rather than being directly provided with money which can act as a disincentive to work.

Research Methodology

Previous research methodology used and its criticism

The robin hood effect is represented as a monetary resource redistribution model which takes away wealth from the economically advantaged and gives it to the economically disadvantaged. This effect aims to improve social cohesion and reduce poverty. However, the theory has a few limitations which can exponentially reduce economic growth for an economy like India. Due to the model aiming to hand money directly to the economically underprivileged, it will provide them with financial resources to survive without them having to work for it. Due to this, it creates a disincentive to receive education or train towards jobs because the government is already providing monetary security through the robin hood effect. Further, after the money runs out, the individuals will again return below the poverty line and will take the government for granted in order to receive financial resources. This will reduce their contribution to the Gross Domestic Product of India and decrease injections in the circular flow of income.

Our suggested methodology

We assume money can be redistributed with the aim to invest it in educational and employment opportunities for individuals. Through this method the government can create schemes and programmes that utilise the financial resources to create infrastructure, train individuals, create awareness about employment and encourage entrepreneurship in low-income and rural areas. Entrepreneurship encouragement especially can help skill development of the individuals and make them more desirable in the labour market. It also gives them the opportunity to innovate in industries other than agriculture and induce technological advancements.

Mathematics of Redistribution

Wealth redistribution can be represented using matrix multiplication.

Matrix multiplication in simple terms is the product of two or more matrices that results in a single final matrix.

To illustrate:

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \text{ and } B = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$$

The product of matrices A and B, denoted as AB, is:

$$AB = \begin{bmatrix} a * e + b * g & a * f + b * h \\ c * e + d * g & c * f + d * h \end{bmatrix}$$

So, the product of two 2x2 matrices results in another 2x2 matrix.

In our context, initial wealth can be represented as a 1 x n matrix *I* where n is the number of population groups being considered. The redistribution will be represented as a n x n matrix *R* where term *R_{ij}* represents the fraction of *ith* row wealth being given to *jth* column of wealth. So, the result of redistribution will be 1 x n matrix *I x R*.

I x R^m represents the wealth distribution after m years of redistribution

In the following we implement this redistribution using a visual simulation-based software, Vensim. (<https://vensim.com/>)

We propose that the wealth taken from the rich will be used to provide education, healthcare and other basic things for the bottom 50% of our population. However, in the following representations we have shown the increase in wealth of both categories as we are assuming that the money used to provide education etc will increase the wealth of the bottom 50% of the population

Since the ratio of average wealth of someone from the top 1% to average wealth of someone at the bottom 50% is 5*50 (since the population is 50 times more), we have taken the initial value of wealth of the top 1% as 100 and initial value of wealth of bottom 50% as 20 to maintain the 5:1 ratio given at (<https://wid.world/country/india/>)

Also, we assume that the wealth of the rich and poor increases at the constant rate of 8% each year. In this model we analyse the situation with and without redistribution of wealth. The below figure 1.0 indicates the implications of wealth redistribution not occurring.

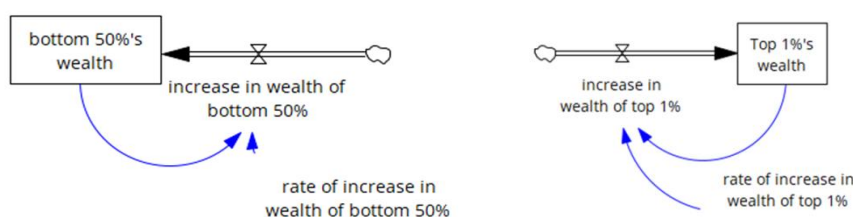
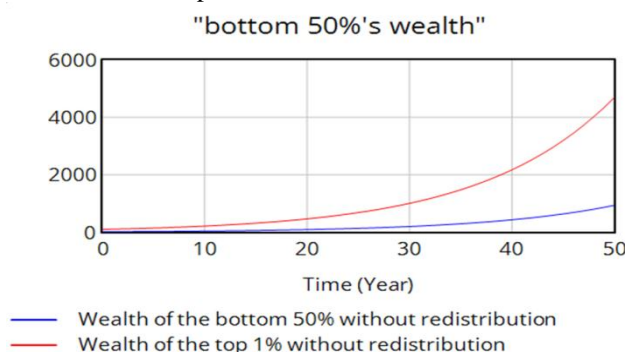


Figure 1.1 shows that if we don't redistribute income, the magnitude of difference increases exponentially but the ratio stays the same as we have assumed increase in wealth is constant and same for both categories. With redistribution of 1% the following occurs:

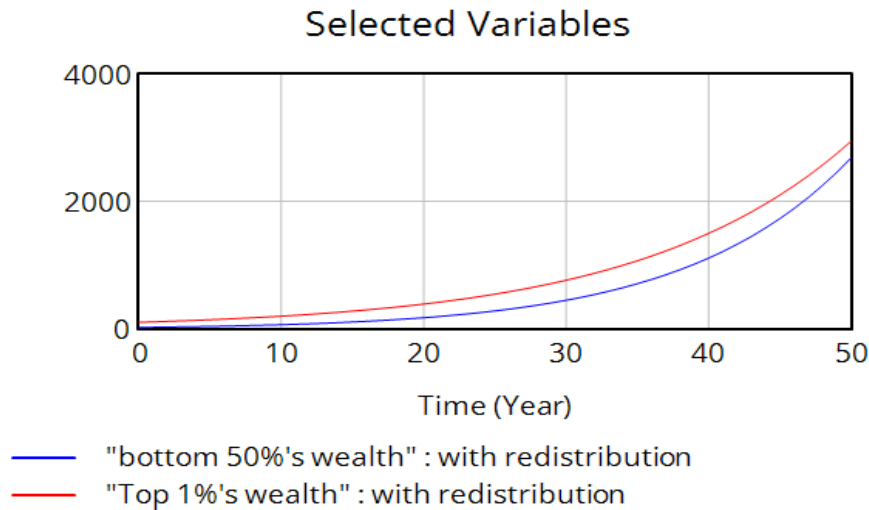


Figure 1.2

Clearly this has a huge impact.

Average adult from the top 1% has 5.4 crores. Taking 1% of their wealth has negligible impact on their total wealth.

However, for a person from the bottom 50%, in the next 50 years their wealth would more than triple and this would make a lot of difference as they were struggling to obtain basic necessities.

Also note that since 1% from the rich is being given to the poor, the wealth of the rich is increasing at a 7% rate but the wealth of the poor is increasing at a 9% rate and hence the graphs are getting closer.

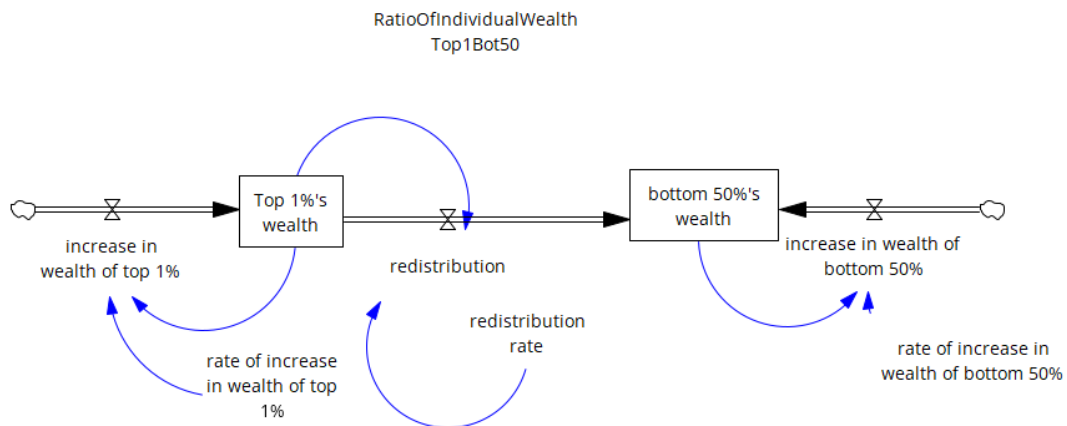


Figure 1.3

The code for the stock flow diagram illustrated in Figure 1.3 is:

```
{UTF-8}
"bottom 50%'s wealth"= INTEG (
    "increase in wealth of bottom 50%" + redistribution,
    20)
~
~
|

"increase in wealth of bottom 50%"=
    "bottom 50%'s wealth" * "rate of increase in wealth of bottom 50%"
~
~
|

"increase in wealth of top 1%"=
    "Top 1%'s wealth" * "rate of increase in wealth of top 1%"
~
~
|

"rate of increase in wealth of bottom 50%"=
    0.08
~
~
|

"rate of increase in wealth of top 1%"=
    0.08
~
~
|

redistribution=
    redistribution rate * "Top 1%'s wealth"
~
~
|

redistribution rate=
    0.02
~
~
|

"Top 1%'s wealth"= INTEG (
```

Figure 1.4

```
"Top 1%'s wealth"= INTEG (
    "increase in wealth of top 1%" - redistribution,
    100)
~
~
|

*****
.Control
*****~
Simulation Control Parameters
|
FINAL TIME = 50
~
~
Year
~
The final time for the simulation.
|
INITIAL TIME = 0
~
~
Year
~
The initial time for the simulation.
|
SAVEPER =
TIME STEP
~
~
Year [0,?]
~
The frequency with which output is stored.
|
TIME STEP = 1
~
~
Year [0,?]
~
The time step for the simulation.
|

\\--// Sketch information - do not modify anything except names|
V300 Do not put anything below this section - it will be ignored
*View 1
```

Figure 1.5

A more complex diagram that has not been made by us shows what happens to 4 sections (top 1%, 1%-10%, 10% -50%, 50%-100%) of the population. This model takes 1% of the income from all four categories and distributes it equally amongst the entire population. This means that groups with less population get less money. It sort of represents wealth tax with a constant rate of 1% across all classes. It considers data over 40 months.

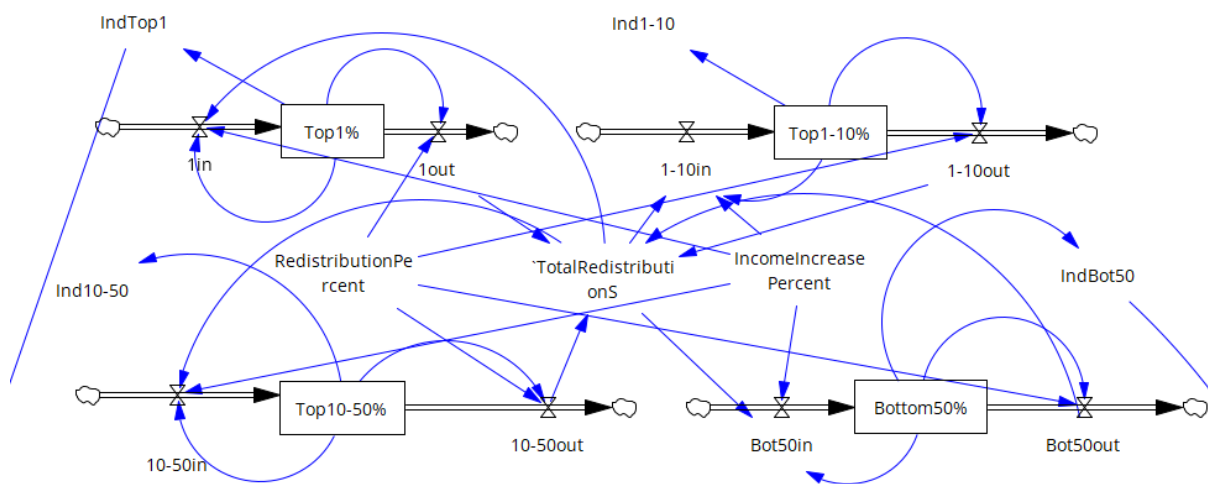


Figure 1.6

Source- private communication

The graphical representation of the same is:

Selected Variables

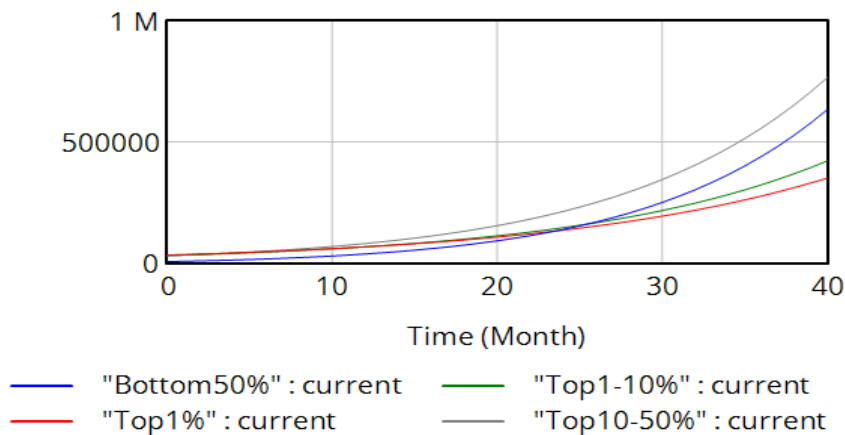


Figure 1.7

Evaluation

The calculations of the proposed solution assumes that the higher income population will be willing to give away a proportion of their income. Further, confounding variables like corruption in the Indian government can distort the accuracy of the results as high-income individuals can get government officials to make asset distribution unequal by bribing them. The percentage for income growth rate for the low as well as the high-income individuals was taken as the same, which may not be the case in real life.

In order to make sure individuals still get direct access to income, the minimum wages in India should be better implemented. Nudge theory can be utilised to provide incentives like lower corporate tax rates and higher subsidies to firms which adhere to minimum wage laws.

Conclusion

In our study, we found that if we take a mere 1% of the wealth of the top 1% in the country and invest in government schools, hospitals etc, it can greatly improve the standard of living for most people in the country. This model can further be utilised for other countries to analyse the wealth redistribution opportunities after a primary Gini coefficient and tax system analysis is conducted. A holistic approach to wealth redistribution which takes into consideration a move towards progressive taxes and an improvement in the implementation of minimum wages can act as a method of growth for the overall economy.

Citations

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