

A Simple Mathematical Model of the Inequity of Income and Wealth Distribution: A hypothetical country and society

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1 Abstract

In this paper we will observe the extent of the inequity of income and wealth distribution in a hypothetical country and society among different classes of people with the flow of time by constructing a simple mathematical model.

2 Introduction

Poverty is a one of the major problem on the path of civilization. Many evidences have found from the archaeological expedition and literature which were written thousand of years ago, where social scientists are surprised about even the depth of ancient human knowledges and feelings on the multidimensional nature of the poverty. One of the dimension is inequity of income and wealth distribution.

A mathematical model is not strong enough to explain the full extent of the income and wealth distribution in a society. There are millions of latent variables in a society, human life and behavior. It is very difficult to combine all of them together in a dynamic mechanism of a mathematical model. Perhaps, yet it is impossible with our limited knowledges. The scientific research is conducting across the world to compute the accurate and precise numbers, which will help us not only to understand the core of this problem but also will help the policy makers to take the proper action and steps.

3 Structure of The Model

In this simple mathematical model some restrictions have imposed on coefficients under the social, economic and political history of the world. For simulation, programming language of Octave is used. Readers can check the result by changing the value of coefficients according their own interest.

Let us consider, a country with three classes: the upper, middle and the lower, under the consideration of their income and wealth.

1. The number of people in upper class is less than those in the middle and in the lower class.
2. The number of people in middle class is lower than those in the lower class.
3. The total amount of the income and wealth in upper class is more than those in the middle and in the lower class.
4. The total amount of the income and wealth in the middle class is more than that in the lower class.

5. The percentage of expenditure in the upper class is less than those in the middle and in the lower class.
6. The percentage of expenditure in the middle class is less than that in the lower class.

4 Model

The number of people :

Upper class = r

Middle class = d

Lower class = p

Social restriction: $r < d < p$

On average the amount of income and wealth of each person :

Upper class = x

Middle class = y

Lower class = z

Social restriction: $x > y > z$

The percentage of each person's expenditure :

Upper class = k

Middle class = m

Lower class = n

Social restriction: $0 < k < m < n < 1$

Total Years = N

Total population = $r + d + p$

After N years the Income and Wealth of the Upper class will be
 $= r*x*N$

After N years the Income and Wealth of the Middle class will be
 $= d*y*N$

After N years the Income and Wealth of the Lower class will be
 $= p*z*N$

After N years total expenditure of $(r + d + p)$ people will be
 $= (r*k*x + d*m*y + p*n*z)*N$

After N years, the people of the upper class, middle class and the lower class will get back α , β and μ percent from the total income accordingly.

After N years,

Savings of the Upper class = $r*x*N - r*k*x*N$

Savings of the Middle class = $d*y*N - d*m*y*N$

Savings of the Lower class = $p*z*N - p*n*z*N$

Social restriction: $1 \geq \alpha \geq \beta \geq \mu \geq 0$

For each person in upper class, after N years the income and wealth will be
 $= x*N - k*x*N + \frac{\alpha}{r}*(r*k*x + d*m*y + p*n*z)*N$

For each person in middle class, after N years the income and wealth will be
 $= z*N - m*z*N + \frac{\beta}{d}*(r*k*x + d*m*y + p*n*z)*N$

For each person in lower class after N years the income and wealth will be
 $= y*N - n*y*N + \frac{\mu}{p}*(r*k*x + d*m*y + p*n*z)*N$

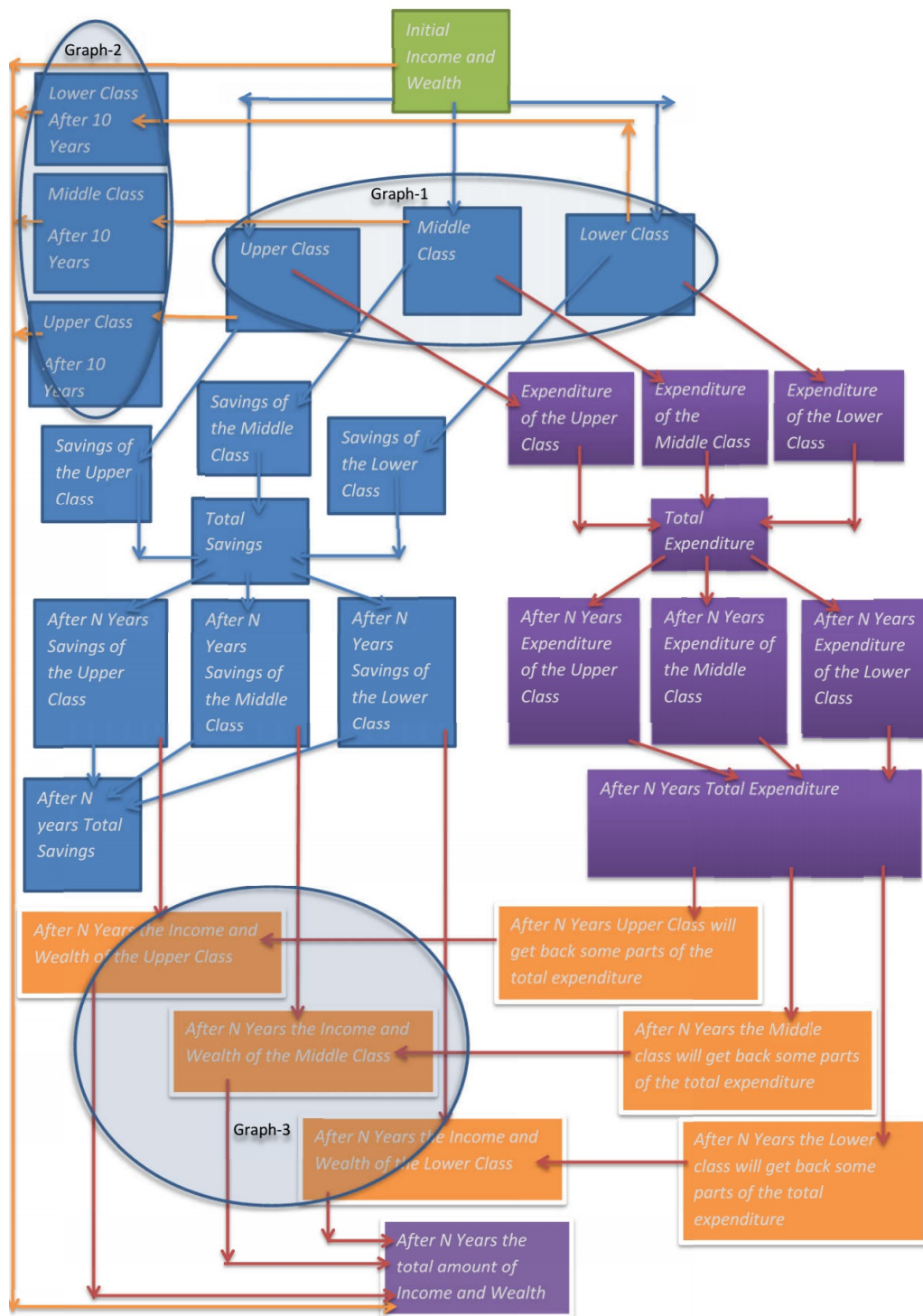


Figure 1: Diagram

5 Code

```
clear all
% simulation: Example-1
%The number of people : Upper class = NumU , Middle class = NumM,
%Lower class = NumL
NumU = 2
NumM = 30
NumL = 500

%On average the amount of income and wealth of each person :
%Upper class = IncomeWealthU , Middle class = IncomeWealthM,
%Lower class =IncomeWealthL
%IncomeWealthU > IncomeWealthM > IncomeWealthL

IncomeWealthU= 10000
IncomeWealthM= 500
IncomeWealthL= 100

TotalWealthIncome= IncomeWealthU*NumU + IncomeWealthM*NumM +
IncomeWealthL*NumL

%Number of the years
N= 10
%After 10 years the income and wealth of the:
IncomeWealthUNI=IncomeWealthU*NumU*N
IncomeWealthMNI=IncomeWealthM*NumM*N
IncomeWealthLNI=IncomeWealthL*NumL*N
%The percentage of each person's expenditure : Upper class =
%PercentExpU , Middle class = PercentExpM , Lower class = PercentExpL
%PercentExpU > PercentExpM > PercentExpL

PercentExpU= 5/100
PercentExpM= 60/100
PercentExpL= 95/100

%Total expenditure:
TotalExp = NumU*IncomeWealthU*PercentExpU + NumM*IncomeWealthM*PercentExpM
+ NumL*IncomeWealthL*PercentExpL

%After N years the total expenditure of the all of the people will be
N= 10
TotalExp= TotalExp*N

%After N years the fraction of the total expenditure that The people of
```

```

%the upper class, the middle class and the lower class will get back:
%Upper class = GetBU , Middle class = GetBM, Lower class = GetBL
%GetBU>GetBM>GetBL
%GetBU+GetBM+GetBL=1

GetBU= 60/100
GetBM= 30/100
GetBL= 10/100

if GetBU+GetBM+GetBL >= 1
    disp 'error: The sum of GetBU, GetBM and GetBL should be 1'
end

%After N years the Income and Wealth of the every one in the upper, middle
and the lower class

NU= IncomeWealthU*N - PercentExpU*IncomeWealthU*N+ GetBU*TotalExpN/NumU
NM= IncomeWealthM*N - PercentExpM*IncomeWealthM*N+ GetBM*TotalExpN/NumM
NL= IncomeWealthL*N - PercentExpL*IncomeWealthL*N+ GetBL*TotalExpN/NumL

SavingsUpperClassN = (NumU*IncomeWealthU*N - NumU*IncomeWealthU*PercentExpU*N)
SavingMiddleClassN = (NumM*IncomeWealthM*N - NumM*IncomeWealthM*PercentExpM*N)
SavingLowerClassN = (NumL*IncomeWealthL*N - NumL*IncomeWealthL*PercentExpL*N)

TotalSavingsN = SavingsUpperClassN + SavingMiddleClassN + SavingLowerClassN

TotalIncomeWealthN= IncomeWealthU*N*NumU + GetBU*TotalExpN -
NumU*PercentExpU*IncomeWealthU*N +IncomeWealthM*N*NumM + GetBM*TotalExpN
- NumM*PercentExpM*IncomeWealthM*N + IncomeWealthL*N*NumL +
GetBL*TotalExpN - NumL*PercentExpL*IncomeWealthL*N

TotalSavingsAndExpenditureN=TotalSavingsN +(PercentExpU*IncomeWealthU*N*NumU+
PercentExpM*IncomeWealthM*N*NumM +PercentExpL*IncomeWealthL*N*NumL)

subplot(3,0.5,1)
m =[IncomeWealthU,IncomeWealthM,IncomeWealthL];
bar(1:3,m,'m')
legend('Graph-1')
xlabel('1: Upper Class, 2: Middle Class, 3: Lower Class')
ylabel('Income and Wealth')
title('Comparison of the Income and Wealth Distribution at Present Period')
grid on

```



```

subplot(3,0.5,2)
k=[IncomeWealthUNI,IncomeWealthMNI,IncomeWealthLNI];
bar(1:3,k,'b')
legend('Graph-2')
xlabel('1: Upper Class, 2: Middle Class, 3: Lower Class')
ylabel('Income and Wealth')
title('Comparison of the Income and Wealth Distribution after 10 years with-
out Inequality')
grid on
subplot(3,0.5,3)
y=[NU,NM,NL];
bar(1:3,y,'r')
legend('Graph-3')
xlabel('1: Upper Class, 2: Middle Class, 3: Lower Class')
ylabel('Income and Wealth')
title('Comparison of the Income and Wealth Distribution after 10 Years with
Inequality')
grid on

```

6 Result

<i>Number of The People</i>	<i>NP</i>	(1)
<i>Percentage of Expenditure</i>	<i>PE</i>	(2)
<i>Duration of Time</i>	<i>DT</i>	(3)
<i>Percentage of Get Back</i>	<i>PGB</i>	(4)
<i>Present Income and Wealth</i>	<i>PIW</i>	(5)
<i>Future Income and Wealth Without Inequality</i>	<i>FIW</i>	(6)
<i>Future Income and Wealth With Inequality</i>	<i>FIWI</i>	(7)

Class	NP	PE	DT	PGB	PIW	FIW	FIWI
Upper	2	5	10	60	1000	20000	170300
Middle	30	60	10	30	500	150000	3160
Lower	500	95	10	10	100	500000	-736.80

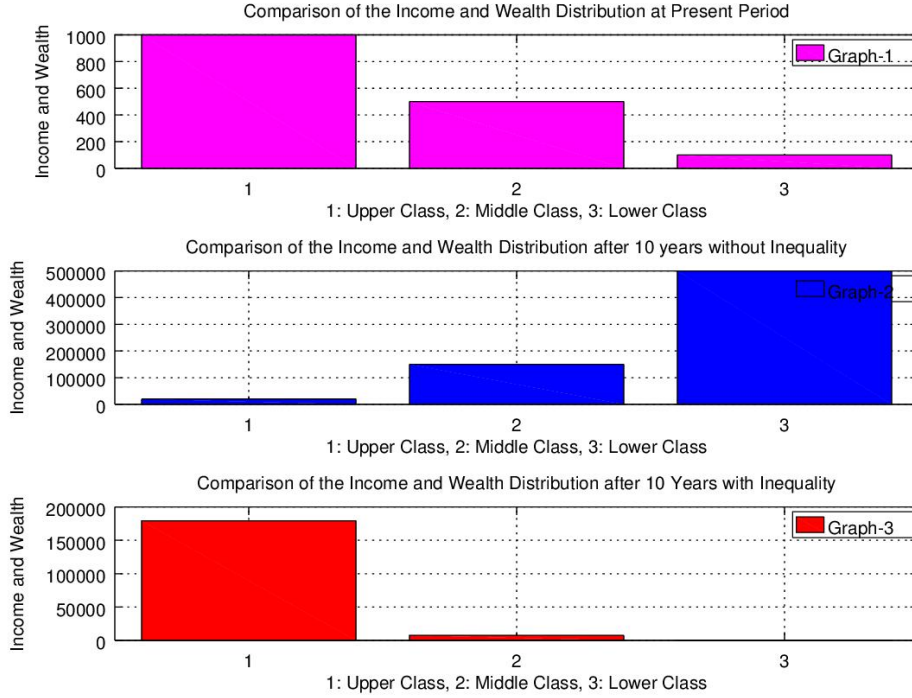


Figure 2: Comparison of The Income and Wealth Distribution

7 Conclusion

No doubt that this model has limitation. Though for the simplicity of model different aspects of the economic activities (taxation for example) has not included, in future much more complex model will be restructured.

8 References

1. Zaman, Md Shahrear. 2011 . *Bohumatrik Daridrer Porimap: Manusher Jibon Jatonar Sarup Udghataner Ekti Prayogik Ebong Ganitik Prochesta* (Written in Bangla). Thesis Paper. Bangladesh: Department of Economics, University of Chittagong.
2. User Manual. Octave.