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Fiscal Policy Simulator

Introduction

This prototype simulator allows the user to decide the fiscal policy of a country on an annual basis. Fiscal policy involves the annual allocation of government funds across different categories of public spending. This simulator computes how much the country's GDP per capita grows every year based on the user's input, and the objective is to achieve the highest possible GDP per capita at the end of the simulation period.

The simulation is based on data from Singapore during the period from 2011 to 2015, when the city-state was recovering from the global recession. During this period, Singapore's GDP per capita, adjusted for purchasing power parity (PPP)[1], grew from $80,052 in 2011 to $86,975 in 2015.

Using the Simulator

When the program is launched, it first shows the user a message stating the value of the GDP per capita at the start of the simulation period ($80,052 in 2011). The user then has to allocate available funds for 2012 across three categories:

I. Social development (education and healthcare)
II. Infrastructure and research
III. Security (police and military)

The user is instructed to assume that necessary spending in other categories, such as debt repayments and welfare programs, is being taken care of.

Based on the user's input, the simulator computes a value for 2012 GDP per capita, and the user is asked for allocations for 2013. This repeats until the user decides fiscal policy for the last year of the simulation period (2015).

If the user assigns less than 25% of spending to security in any year, the simulator displays a message stating that insufficient defense spending has left the city vulnerable to attack, and the simulator restarts from 2012. This reflects the reality that a certain level of defense spending (Singapore's was on average 31% in the simulated period) may be necessary for a nation's survival.

Computation of GDP

For the purpose of this simulation, we assume that the Singapore government's actual allocations are the optimal ones for maximizing GDP per capita growth. In reality, an effective government would allocate funds in a way that maximizes long-term socioeconomic welfare, not

[1] All GDP figures in this document are in current (2021) international dollars, adjusted for PPP

just GDP per capita growth. However, GDP per person is strongly tied to overall welfare, so this is a reasonable assumption for a prototype simulator.

Singapore's actual allocations in 2012-2015[2] are given below. Roughly 3.5% of the Singapore government's annual budget is dedicated towards administrative expenses, which we exclude for simplicity. We scale the remaining categories so that the allocations sum to 100% in each year:

	2012	**2013**	**2014**	**2015**
Social development (education and healthcare)	47	48	50	49
Infrastructure and research[3]	21	19	19	23
Security (police and military)	32	33	31	28

Let $\Delta_{actual} GDPPC_y$ be the actual increase in GDP per capita from year *y* to the next. For example, for year 2011, $\Delta_{actual} GDPPC_{2011} = \$82,065 - \$80,052 = \$2013$. We compute the simulated change in GDP per capita for year *y* as follows (*c* represents the three categories):

$$\Delta_{\text{simulated}}\text{GDPPC}_\text{y} = \frac{1}{100}\left(\sum_{\text{c}=1}^{3} \min\left(\text{UserAllocation}_\text{c}, \text{ActualAllocation}_\text{c}\right)\right)\Delta_{\text{actual}}\text{GDPPC}_\text{y}$$

According to this formula, every additional percentage point allocated to one of the three categories will contribute 1% more of the maximum possible increase in GDP, as long as the user's allocation for the chosen category is still below the Singapore government's actual allocation in that year. This ensures that the closer the user's allocations are to actual allocations, the higher the growth calculated by the simulator will be.

Possible Extensions

- Differentiation between education and healthcare spending by using more detailed datasets, and further splitting the existing categories into more specific areas of spending (e.g. K-12 vs. university education)
- A more realistic calculation of GDP based on the diminishing marginal utility of government spending in different categories
- Allowing the user to simulate government borrowing and debt repayments

The code can easily be adapted to simulate government spending in another country, using data from that country, and for longer periods than five years.

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[2] The Straits Times, https://graphics.straitstimes.com/STI/STIMEDIA/Interactives/2015/02/budget_singapore_2015/index.html

[3] Listed as "Economic Development" in the source above

Example 1

34%-33%-33% allocation in each year, leading to a final 2015 GDP per capita of $86559 ($416 away from the maximum possible value of $86975)

```
Welcome to the economic policy simulator!
You will steer the Singapore economy through the years from 2012
through 2016 by allocating budget funds across three categories:

I. Social development (education and healthcare)
II. Infrastructure and research
III. Security (including police and military)

For each year, enter the percentage of available funds that you wish
to allocate to each of these categories. For example, you may enter
"40 30 30" or "90 5 5". Please ensure that these percentages sum to
100.

Your objective is to maximize the GDP per capita (PPP) of the city in
2016.

You can assume that other necessary expenditures, such as welfare
programs and national debt repayments, are being taken care of.

Be careful not to spend too little on security. Doing so may leave
the city-state vulnerable to attack from a foreign power.

.....................................................
In 2011, the GDP per capita (PPP) was $80052.
.....................................................
The year is 2012.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 34 33 33


Nice work! GDP per capita (PPP) has risen by $1754.
GDP per capita (PPP) is now $81809.
The year is 2013.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 34 33 33
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```
Good choices! GDP per capita (PPP) has risen by $1023.
GDP per capita (PPP) is now $82835.
The year is 2014.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 34 33 33


Good choices! GDP per capita (PPP) has risen by $1334.
GDP per capita (PPP) is now $84172.
The year is 2015.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 34 33 33


Good choices! GDP per capita (PPP) has risen by $2384.
GDP per capita (PPP) is now $86559.
..........................................................
The city's final GDP per capita (PPP) is $86559, which is $416 away
from the maximum possible value of $86975.
```

Example 2

Optimal allocations in each year, leading to the maximum possible 2015 GDP per capita of $86975

```
Welcome to the economic policy simulator!
You will steer the Singapore economy through the years from 2011
through 2016 by allocating budget funds across three categories:

I. Social development (education and healthcare)
II. Infrastructure and research
III. Security (including police and military)

For each year, enter the percentage of available funds that you wish
to allocate to each of these categories. For example, you may enter
"40 30 30" or "90 5 5". Please ensure that these percentages sum to
100.

Your objective is to maximize the GDP per capita (PPP) of the city in
2016.

You can assume that other necessary expenditures, such as welfare
programs and national debt repayments, are being taken care of.

Be careful not to spend too little on security. Doing so may leave
the city-state vulnerable to attack from a foreign power.

.....................................................
In 2011, the GDP per capita (PPP) was $80052.
.....................................................
The year is 2012.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 47 21 32


Nice work! GDP per capita (PPP) has risen by $2007.
GDP per capita (PPP) is now $82062.
The year is 2013.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 48 19 33
```

```
Good choices! GDP per capita (PPP) has risen by $937.
GDP per capita (PPP) is now $83002.
The year is 2014.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 50 19 31


Nice work! GDP per capita (PPP) has risen by $1418.
GDP per capita (PPP) is now $84422.
The year is 2015.
Please enter your allocations towards 1) Social Development, 2)
Infrastructure & Research, and 3) Security, according to the format
described in the instructions above:
Enter spending here: 49 23 28


Congratulations! GDP per capita (PPP) has risen by $2549.
GDP per capita (PPP) is now $86975.
..........................................................
The city's final GDP per capita (PPP) is $86975, which is $0 away
from the maximum possible value of $86975.
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