Martin Luther University Halle-Wittenberg
Chair of Economics, especially Macroeconomics
Professor Dr Oliver Holtemöller

Advanced Macroeconomics

Exam Winter 2024/25

Problem Set No. 2 n:10

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********** Student Data **********
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********** January 9, 2025 **********

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Overview of Code Files

File Name	File Description	Reference Files
`Data_Cleaning.R`	Takes the raw data acquired from the World Bank Group and trims non-relevant information	N/A
`GDP_Plots.m`	Generates plots from cleaned data: GDP of Sri Lanka, Norway, and a combined plot for task 1	N/A
`Solow_Simulation.m`	Computes the capital stock of two economies specified in task 2 b)	Example_6_1.m

Table 1: Table of code files.

Data Section

Data ID	Data Description	Data Source
`GDP.csv`	Data is given as the GDPs of Sri Lanka and Norway, 1974 - 2023, compared to the value of USD in 2015	World Bank Group
`Cleaned_Data.csv`	File containing the GDP data for use in Octave after being cleaned in R	N/A

Table 2: Table of data.

1 Task 1

Data

The data for Sri Lanka and Norway's GDPs comes from the World Bank Group through their "World Development Indicators" database, where the last 50 years were selected. All numbers are adjusted for inflation and expressed in terms of 2015 US dollars. Prior to plotting the data, it was cleaned. Though possible to work with entirely within Octave, R was chosen due to simplicity of manipulating data. The goal of cleaning the data is to format it in a usable and standardized format, with one column corresponding to one variable of the data set.

The raw data file was first transposed as to have one variable per column. This is done out of convention for working with data. The data cleaning was continued by trimming any excess information about the dataset, and a column was added with the year information as to make a year axis simple to plot, without the need for parsing information within column labels.

Plotting GDP per Capita

In Figure 1 and 2 are plotted the real GDP per capita for Norway and Sri Lanka from 1970 to 2023. Looking at these figures we can compare the growths of these two economies, with Norway experiencing steady growth from 1974 until the 2010s, followed by slower but consistent growth. While Sri Lanka has had more of an exponential growth until the 2010s, followed by consistent lowering in GDP per capita in the last decade. Sri Lanka's GDP per capita ranges from 819 USD in 1974 to 3969 USD in 2023, while Norway's was at 31440 USD in 1974, and 78939 USD in 2023, with inflation of the US dollar being adjusted for.

It is difficult to draw further comparisons about difference in real world effect of growth in GDP per capita due to there being more factors, such as the exchange rate of the local currency, and the fact that these two economies operating on different scales.

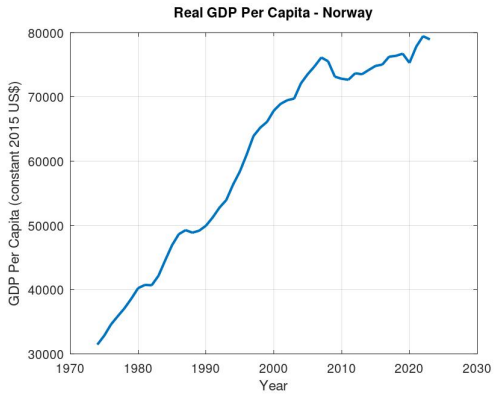

Figure 1: GDP per capita of Norway, 1974 - 2023 (compared to USD 2015)

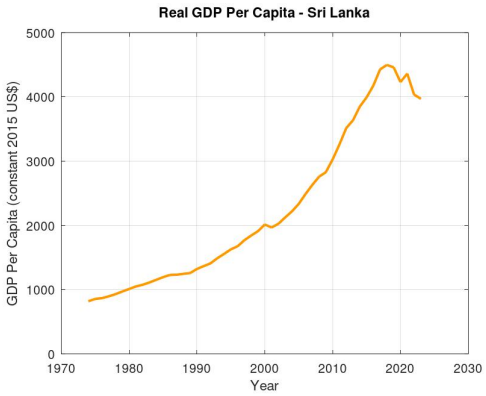

Figure 2: GDP per capita of Sri Lanka, 1974 - 2023 (compared to USD 2015)

In Figure 3, both economies are compared to scale, where Sri Lanka has a significantly lower GDP per capita for the whole observed time period. Norway exhibits more fluctuations, however with larger growth overall in this metric.

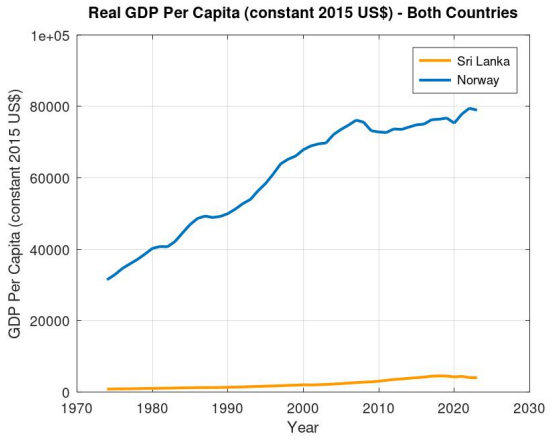

Figure 3: Comparison of GDP per capita between Norway and Sri Lanka, 1974 - 2023 (compared to USD 2015)

2 Task 2 b)

The two economies at hand have the same conditions, except for productivity.

$\alpha = 0.3$	output elasticity
$s = 0.3$	savings rate
$\delta = 0.1$	depreciation rate
$A_1 = 1$	productivity in economy 1
$A_2 = 1.1$	productivity in economy 2

The simulations for both these economies are generated by the equations as stated in the task,

$$y_t = A \cdot k_t^{\alpha}$$
$$k_{t+1} = s \cdot y_t + (1 - \delta) \cdot k_t$$

With both economies having an initial capital stock of $k_0 = 0.1$. Note that the model expresses values as per capita units. Figure 4 plots the evolution of capital stock of these economies over time.

Economy 1 has a slower growth of capital stock than economy 2. When looking at the model, we see capital stock being a function of y_t, which itself is a function of capital stock multiplied by productivity factor. This means that the productivity factors directly influences the growth rate of capital stock in the economies, which explains why economy 2, with a productivity of 1.1 has a steeper growth than economy 1 with a productivity of 1. Economy 1 converges to a capital stock of around 4.8, whereas economy 2 converges around 5.5.

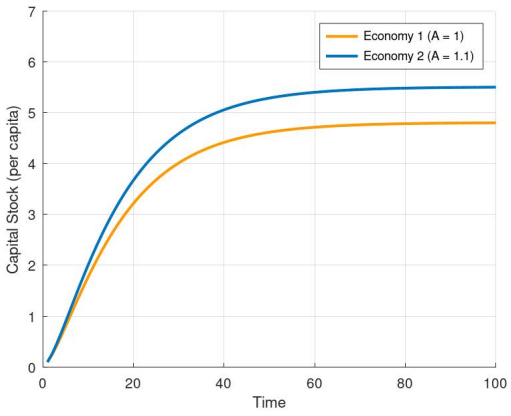

Figure 4: Comparison of capital stock per capita over time for two economies with different productivity levels (A = 1 for Economy 1 and A = 1.1 for Economy 2)

Both economies hold all variables equal, except for productivity. In the end, economy 1 with a lower productivity reaches a steady state with lower capital per capita compared to economy 2 with a higher productivity. This due to lower growth in capital stock, which can be explained by the equations constituting the model, as well as in Figure 4 where growth in capital stock can be seen as the slope of the plotted curves.

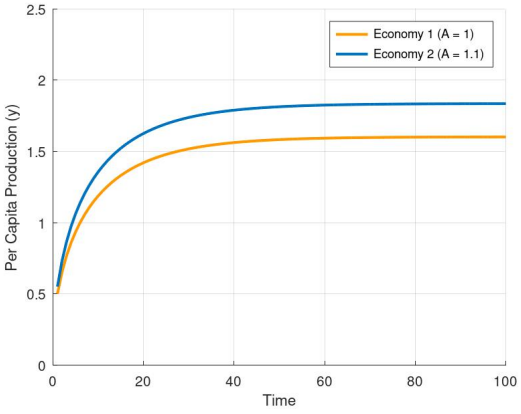

Figure 5: Comparison of production per capita over time for two economies with different productivity levels (A = 1 for Economy 1 and A = 1.1 for Economy 2)

In Figure 5 is plotted the evolution of production per capita. We see that the growth rate of this metric is similar to that of capital stock. Economy 2 with higher productivity has a higher growth rate than economy 1 at every point in time, expressed as the slope of the curves. The steady state is reached with higher productivity leading to higher production. Analytically, it also makes intuitive sense that the plots of Figure 4 and 5 are closely linked, seeing as the production per capita (y) is a function of, and proportional to capital per capita (k).

3 Sources

Software

Octave (9.3.0): `https://octave.org/index`
R (4.4.2): `https://posit.co/download/rstudio-desktop/`

Online Sources

`https://www.rug.nl/ggdc/productivity/pwt/?lang=en`
`https://databank.worldbank.org/source/world-development-indicators`

Lecture Material

Holtemöller, O., 2024. Advanced Macroeconomics. Chapter 6. Lecture Slides.
`Example_6_1.m`

AI Tools

ChatGPT was used to debug code, as well as help with syntax regarding Octave. All code was double checked and written by hand. AI tools only aided in providing example code as a guide to using Octave. The R code was fully produced without any sort of external help.

Declaration of Independence

I hereby declare that I have worked independently on this problem set. If I have received help, I have explicitly referred to it.

09/01/25, Anton Cronet