Martin Luther University Halle-Wittenberg
Chair of Economics, especially Macroeconomics
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Advanced Macroeconomics

Exam Winter 2024/25

Problem Set No. 3 n:10

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************ Student Data ************
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************ January 23, 2025 ***********

Contents

List of Figures

List of Tables

Overview of Code Files

File Name	File Description	Reference Files
`Data_Cleaning.R`	Cleans data for use in Octave	N/A
`Task_1.m`	Takes French GDP data applies hpfilter plots cyclical component	N/A
`hpfilter.m`	takes time series data applies hp filter, returns: trend and cyclical parts	hpfilter.m
`Task_2.m`	Applies Ramsey Model plots saving rate vs. time pref. rate plots endog. variables after time pref. shock	Example_9_1.m
`ramseygrowth_perm.mod`	Dynare file for Ramsey Model with time preference rate shock	ramseygrowth_perm.mod

Table 1: Table of code files.

Data Section

Data ID	Data Description	Data Source
`FR.gz`	Raw file from Eurostat Specifications detailed in Task 1: Data	Eurostat
`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 was acquired from Eurostat. The data set covers the GDP at market prices of France spanning from Q1 2000 to Q3 of 2024. The values are quarterly and expressed in millions of Euros, these are seasonally as well as calendar adjusted. The GDP values are adjusted with inflation in comparison to values of 2010.

To clean the data, the raw file was imported into R. The data was trimmed of excess information, and the data of the dataframe was set as "double" to avoid issues of data for being parsed correctly in Octave, The data was also transposed out of convention, keeping 1 column to 1 variable.

Plotting the Cyclical Component of GDP

Applying the HP filter to the data returns both the trend and the cyclical components. The smoothing parameter was set to 1600, and was chosen as it is typically used with quarterly data, like in this case.

For analysis, the cyclical component holds more insight into deviations in the GDP of France, as it accounts for and removes the positive trend in the data. What is left are the ups and downs, which can show shocks within the French economy, using GDP as a metric.

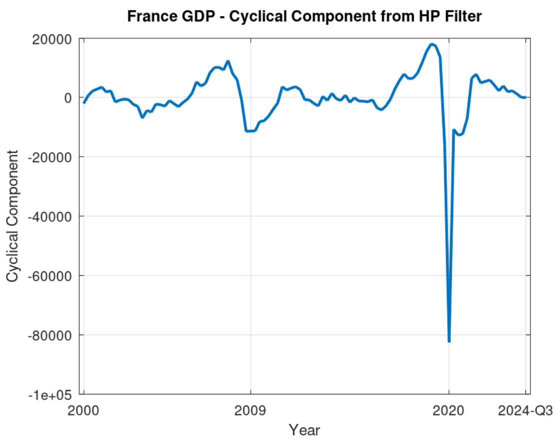


Figure 1: Quarterly GDP at Market Prices for France (Q1 2000 – Q3 2024), Chain-Linked to 2010 Prices

Figure 1 is this plot of the cyclical component of France's GDP. Most of the time it stays around the 0 mark. There are however some notable shocks, these being a sharp decrease in the end of 2008, as well as a major downward spike in the start of 2020. Both of these events are explained by major events that impacted global economies, with the 2008 financial crisis, and well as the start of the corona pandemic in 2020. The fact that the cyclical component of GDP stays most of the time around 0 shows the impact of having policies to guide the economy, with the goal to keep it steady.

2 Task 2

Model Parameters:

$\alpha = 0.3$	Output elasticity of capital
$\rho_p = 0.01$	Base time preference rate
$\delta = 0.02$	Depreciation rate
$\theta = 1$	Elasticity of intertemporal substitution
$a = 0.01$	Adjustment parameter
$n = 0$	Population growth rate
$Z = 1$	Total factor productivity

Endogenous Variables:

$k =$ Capital stock	$i =$ Investment
$c =$ Consumption	$s =$ Savings rate
$y =$ Output	$\rho_v =$ Time preference rate

Model Equations: The Ramsey model is defined by the following equations:

1. $\frac{c_{t+1}}{c_t} = \left(\frac{1 + \alpha Z k_t^{\alpha-1} - \delta}{1 + \rho_v}\right)^{\frac{1}{\theta}} \frac{1}{1+a}$ — Euler equation for consumption
2. $k_t = \frac{Z k_{t-1}^{\alpha} + (1-\delta) k_{t-1} - c_t}{(1+n)(1+a)}$ — Capital accumulation
3. $y_t = Z k_{t-1}^{\alpha}$ — Output equation
4. $i_t = y_t - c_t$ — Investment equation
5. $s_t = \frac{i_t}{y_t}$ — Savings rate
6. $\rho_v = \epsilon \rho_p$ — Time preference rate adjusted by shock

Initial Conditions:

$k_0 = 10$	Initial capital stock
$c_0 = 2$	Initial consumption
$y_0 = 5$	Initial output
$i_0 = 1$	Initial investment
$\epsilon = 1$	Initial shock factor (no shock)

Permanent Shock: A permanent shock is introduced by setting $\epsilon = 2$ which doubles the time preference rate ($\rho_v = 2\rho_p$). This affects the economy by increasing the value of money for the present, having an effect on the other variables' steady states in the model. The model is then solved using perfect foresight simulation to analyze the other variables' dynamics after the shock.

Effect on Savings Rate by Varying Time Preference Rate

Using the Ramsey Model, and varying the time preference rate (ρ_p), the steady state for the savings rate can be calculated at each iteration to see the relationship between these two variables.

Figure 2 is such a plot, showing the time preference rate varying from 0.01 to 0.05 by increments of 0.005, and the respective savings rate reached in the steady state. The plotted curve has a negative trend. This is in accordance with the theory, where the time preference rate indicates the value that costumers have for money at the current time period. The more value money has at the current time period, the less value a consumer will receive by saving this money for later time periods, that being the savings rate.

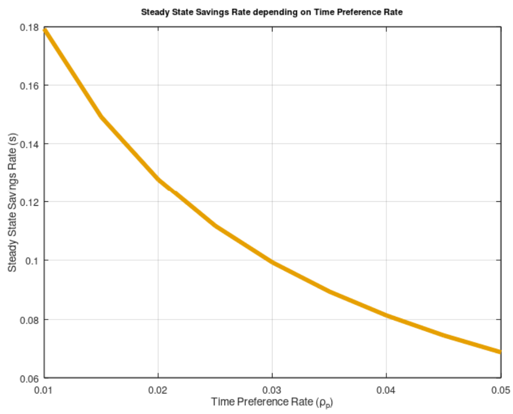


Figure 2: Impact of Time Preference Rate on Steady-State Savings Rate (Shock Model)

Note that Figure 2 uses the model as specified above, including the permanent shock to the time preference rate. In order to remove any effect that the shock may have on the savings rate, Figure 3 sets epsilon to 1 in the endval. This removes the effect of the shock, keeping ρ_v constantly equal to ρ_p. The plot below follows a very similar trend, therefor the reasoning for the relationship between time preference rate and savings rate still holds, regardless of using the model with a permanent shock or not.

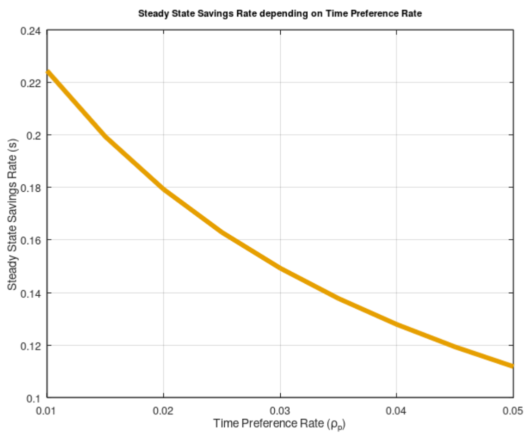
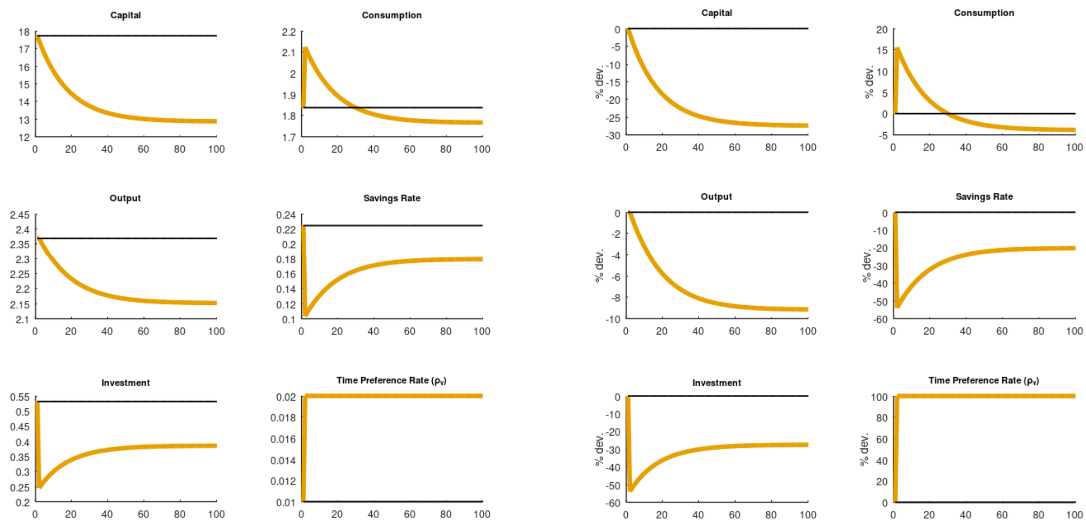


Figure 3: Impact of Time Preference Rate on Steady-State Savings Rate (Without Shock)

Permanent Shock's Effect on Endogenous Variables

The Ramsey model is extended with a permanent shock that affects the time preference rate (ρ_v). This increase in time preference rate makes consumers value money more at the current time period. In Figure 3 the plots display the changes of the endogenous variables over time after the shock. Of the 300 time periods simulated, 100 of these are plotted. In Figure 4 (a) are plotted the actual value changes, while these are useful for real world interpretations, Figure 4 (b) plots percentage changes which illustrate the impact of the shock in a more intuitive way.



(a) Actual change

(b) Percentage Change

Figure 4: Comparison of Savings Rate in Level and Percentage Change

As the time preference rate is doubled from 0.01 to 0.02, plot (a) reflects this increase, as well as plot (b) showing a 100% increase. In the initial periods, consumption increases sharply, as indicated by plot (b) for consumption, which peaks at around a 15% increase. This behavior reflects the preference for immediate consumption when future utility is discounted more heavily.

As consumption spikes upwards, investments spike down. This can be seen by Equation 4 where i = y - c. Intuitively, it also makes sense seeing as the more money is spent on consumption, due to it being valued more in the current time period, the less money is left for investments. The same reasoning goes for the savings rate, where Equation 5: s = i / y. As investments decrease, the savings rate necessarily does too.

Output follows a similar trajectory to capital, decreasing by nearly 10% in the initial periods and stabilizing over time, as seen in plot (b). This is expected, as reduced capital stock lowers productive capacity. Looking at Equation 3, y and k are directly proportional.

As capital decreases due to lower consumption as seen in Equation 2, so does the marginal productivity of capital $\alpha k_t^{\alpha-1}$, which induces a decrease in consumption, as dictated by Equation 1. This feedback stabilizes the economy.

As a steady state is reached, the variables that spiked get smoothened out in the opposite direction. In the steady state after the shock, capital and output settle at 25% and 9% lower than the initial state of the economy. The savings rate and investment which go hand in hand settle at -30% compared to what they were. Consumption is the only variable which spikes upwards, which settles to less than it was in the steady state, at around a 5% decrease.

In summary, the permanent shock to the time preference rate introduces a short term shock to allocation of resources, favoring short-term consumption at the expense of long-term capital, output, investments and therefor savings rate. As the economy balances and reaches a steady state, it can be conclude that the shock increase to the time preference rate has had a negative effect. The economy is left with lower production, capital stock, output, savings and investments.

This model illustrates the importance of policy guiding consumer behavior. Having an uncertain future, which can lead to money having more value in the present, leaves an economy worse off than balancing consumption with investments into the future. The importance of institutions with the power to set policies creates a net gain for society.

3 Sources

Software and Versions

Octave (9.2.0): `https://octave.org/index`
Dynare (6.2): `https://dynare.org/`
R (4.2.3): `https://posit.co/download/rstudio-desktop/`

Online Sources

`https://ec.europa.eu/eurostat/databrowser/view/namq_10_gdp__custom_14701021`

Lecture Material

Holtemöller, O., 2024. Advanced Macroeconomics. Chapter 9. Lecture Slides.
`Example_9_1.m`
`hpfilter.m`
Holtemöller, O., 2024. Advanced Macroeconomics. Chapter 10. Lecture Slides.

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.

23/01/25, Anton Cronet