Macroeconomics 1

Module 1, 2021-2022

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Course description

This is the first of a sequence of five required courses in macroeconomics. During the first module, we will discuss basic concepts of macroeconomics such as the determination of national income, employment, the price level, interest rates, and the exchange rate. We will review basic models that describe how these variables are determined in the long-run. The course starts with classical models and follows with growth theory and applications. Classical models address questions such as what determines the long-run level of output and inflation. Growth theory addresses questions as why do some economies grow faster than others, why are some countries rich and others poor? We will discuss some of the main empirical findings regarding the impact of institutions and open international trade on growth. This course will prepare you for Macro II in the second module, where you will learn more sophisticated models, including business cycle theory and short run macroeconomic policies, addressing unemployment, among others.

Course requirements, grading, and attendance policies

This course is intended for first year graduate students in the economics program. The requirements are active class participation, 3 homework assignments, and a final examination. The final examination will last 3 hours.

- Although I do not check attendance, attendance and participation in class are required. This said, some students could find the material covered in some lectures somewhat familiar, in which case they are allowed to miss up to 30% of the lectures. You are expected to have a mature and professional attitude, including coming on time (coming late to class disrupts the class and disturbs your colleagues) and not using the internet, including your cell phones.

- In addition, the class will be divided into 2 groups, each of which will be assigned to a weekly session (or recitation) held by teaching assistants. During the recitations, students will solve various problems, generally related to topics covered during the current week or the following week.

- The course assignments will consist in 2-4 questions and/or problems, and will be handed out to students a week before the due date. Students are required to hand in all assignments.

- The final is mandatory. Only under exceptional circumstances, students may find it impossible to attend the final, in which case they should contact me at least a week before the final (to the extent possible). The makeup exams will also be organized for students who receive a failing grade after the final. Students who would fail the course after the second makeup exam should carefully read the MAE course regulations to take the necessary next steps.
- Homework assignments carry equal weight and count towards 30%, and the final exam counts towards 70% of the final grade.

Course contents

1. Introduction and national income accounting
   Mankiw, Chapters 1, 2, and 3
   Macroeconomic aggregates, national income accounts, macroeconomics data, equilibrium, national income: where it comes from and where it goes.

2. Money, inflation, the financial system
   Mankiw, Chapters 4 and 5
   Economic definition of money, quantity theory of money, money supply, money demand, market for money, interest rates, and inflation.

3. The open economy: exchange rates, trade, and capital flows
   Mankiw, Chapter 6
   Balance of payments, saving and investment in a small open economy, net exports, exchange rate - real and nominal, purchasing power parity, exchange rate regimes.

4. Economic growth I
   Mankiw, Chapter 8
   Solow model, capital accumulation, Golden Rule level of capital, population growth.

5. Economic Growth II
   Mankiw, Chapter 9
   Technological progress in the Solow model, policies to promote growth, balanced growth path, convergence, endogenous growth theory, growth accounting.

Sample tasks for course evaluation

Problem 1. *Open market operations.*

Show the effect of a contractionary open market operation on the interest rate, both with algebra and with a graph. Explain.

Problem 2. ***Money market equilibrium.***

Suppose that the typical person in the economy has the following money demand function: $M^d = PY(0.5 - i)$, where M^d is money demand, Y is real income, P is the price of one unit of output, and i is the interest rate expressed so a five percent interest rate implies $i = 0.05$.

(a) Assume $P = 5$, $Y = 10000$, and $i = 0.05$. What is money demanded?

(b) Assume $M^s = 25000$, $P = 5$, and $Y = 10000$. What is the equilibrium interest rate?

(c) Starting from the equilibrium in part (b), assume the central bank carries out an open-market operation that reduces the money supply by 10 percent. What happens to the interest rate? Describe in words the adjustment process from one equilibrium to the other.

(d) Starting from the equilibrium in part (b), assume a recession reduces output by 10 percent. What happens to the interest rate? Describe in words the adjustment process from one equilibrium to the other.

Problem 3. ***True, false or uncertain.***

Please explain whether the following statements are True, False, or Partially True. You will be graded based on the quality of your explanation. If a statement is false, provide a counterexample.

(a) If the Russian CPI is currently at 150 and the U.S. CPI is at 85, then there is inflation in Russia but deflation in the United States.

(b) In the Solow model, the higher the saving rate, the higher per capita output in the steady state.

(c) If gross domestic product (GDP) in the economy is smaller than gross national product (GNP), than this economy will have a current account surplus.

(d) The production function $F(K, L) = \sqrt{K} + \sqrt{L}$ exhibits both constant returns to scale and diminishing returns to labour.

(e) According to purchasing power parity theory, a nominal depreciation of domestic currency results in real exchange rate depreciation.

(f) The unemployment rate is defined as the percentage of the adult population that does not work.

(g) Anticipated increase in inflation has no costs.

(h) Any production function with constant returns to scale implies a constant share of labour income in total income.

Problem 4. ***GDP and price indices.***

Consider an economy with three final goods: bread, apples and computers. Let their prices and quantities in 2015 and 2016 be given by the data in the table below.

	2015		2016	
	P	Q	P	Q
bread	\$1	5000	\$1.2	6000
apples	\$0.9	3000	\$0.8	4000
computers	\$300	5	\$400	6

(a) Assume that these three goods are produced and consumed within the domestic economy and calculate the nominal GDP and the real GDP using 2015 as the base year for both periods. Report the growth rates of nominal and real GDP in 2016.

(b) Calculate the GDP deflator in 2016, using 2015 as a base year. What is the inflation rate in 2016 measured by the GDP deflator.

(c) Calculate the consumer price index in 2016, using 2015 as a base year. What is the inflation rate in 2016 measured by CPI.

(d) How do your answers to (b) and (c) change if computers are not produced within the domestic economy but imported?

(e) How do your answers to (b) and (c) change if computers are not sold within the domestic economy but exported?

Problem 5. ***Factor mobility and long-run equilibrium in factor markets.***

Consider an economy which consists of two regions: North and South. Assume that both regions have the same Cobb-Douglas production function $Y = \sqrt{KL}$, where L and K are labour and capital, respectively. Supply of factors is fixed at $K^N = 16$ and $L^N = 25$ in the North and at $K^S = 9$ and $L^S = 25$ in the South, so the North is capital abundant.

Assume first that both regions are completely isolated and both capital and labour are immobile across regions.

(a) Compute output in both regions and global output. Which region has a larger per capita output? Why?

(b) Derive the demand functions on labour and capital in both regions.

(c) Compute the equilibrium prices and quantities of labour and capital in both regions. Illustrate an equilibrium in factor markets using graphs. Which region has a larger real wage and which one has a larger real return to capital? Why?

Assume now that capital is immobile but labour can move perfectly across regions, so migration will equate real wages in both regions.

(d) Compute the equilibrium factor prices and quantities of labour and capital in both regions. Does real wage increase in both regions comparing to the model with immobile labour? Why? Illustrate a new equilibrium in factor markets for both regions using graphs. Explain the results.

(e) Compute output in both regions and global output. Compare per capita output in both regions for the models with immobile and mobile labour? Explain.

Problem 6. ***Money and monetary policy.***

Consider an economy where the total reserves TR are equal to 1000, the currency in circulation CC is 2000, and deposits DD are equal to 10000. Also, the required reserve ratio rr is equal to 5%.

(a) Compute the money multiplier, m. What does this multiplier mean? Briefly explain (you may give a simple example of how it works).

(b) Calculate the monetary base and the money supply. Are there any excess reserves in this economy?

(c) Suppose the inflation rate has recently increased and the Federal Reserve wants to reduce it by contracting the money supply by 2000. What kind of open market operation must the Fed use and how large must this open market operation be to accomplish its goal? Calculate and explain.

(d) As a result of financial crisis deposits fall to 6000 whereas currency in circulation increases to 4000. What will happen with the money multiplier and money supply? What should the Federal Reserve do to keep money supply unchanged?

Problem 7. ***The Solow model with productive government spending***

Suppose that the production function is given by $Y = F(K, G, L) = K^{\alpha}G^{\beta}L^{1-\alpha-\beta}$, where $\alpha > 0$, $\beta > 0$ and $\alpha + \beta < 1$. Government spending G can be interpreted as infrastructure or other productive services. The resource constraint is:

$$C_t + G_t + I_t = Y_t = F(K_t, G_t, L_t)$$

Assume that government spending is financed with proportional income taxation at rate τ, and that private consumption and investment are fractions $1 - s$ and s of disposable household income:

$$G_t = \tau Y_t, \quad C_t = (1 - s)(Y_t - G_t), \quad I_t = s(Y_t - G_t)$$

Assume that the size of the population L_t is constant, and capital depreciates at rate δ.

(a) Derive the steady-state level of capital per worker in terms of the saving rate, s, the depreciation rate, δ, and the income tax rate, τ.

(b) Derive the equation for the steady-state output per worker and steady-state consumption per worker in terms of s, δ and τ.

(c) Calculate the income tax rate τ that would maximize steady-state level of capital per worker. Interpret the results. What is an optimal tax rate when government spending is non-productive, i.e. $\beta = 0$.

(d) Calculate the saving rate that would maximize consumption per worker. How to reach this golden rate of saving?

Problem 8. ***Real seigniorage maximization.***

Suppose that real money demand in the economy is given by $L(Y, i) = 0.4Y - 2000i$, where Y is real income and i is nominal interest rate. In equilibrium, real money demand L equals real money supply M/P. Suppose that Y equals 1000 and the real interest rate is 0.01. The government uses seigniorage to finance budget deficit and prices will adjust only after the moment when the government gets its seigniorage revenue.

(a) The real seigniorage in this economy is an increase in nominal money supply divided by the price level P (which is not changing immediately along with changes in M), i.e. $\frac{M_{t+1} - M_t}{P_t}$. Derive the formula for real seigniorage in terms of rate of growth of money supply and real money demand.

(b) Demonstrate that money supply growth rate is equal to inflation rate in steady state.

(c) Derive the formula for real seigniorage in terms of steady-state inflation rate.

(d) Find the maximum amount of real seigniorage revenue and the corresponding optimal rate of inflation. Interpret the result.

Problem 9. ***Long-run equilibrium in closed/open economy.***

Consider an economy with linear consumption function: $C(Y-T) = c_0 + c_1(Y-T)$, where c_0 and c_1 are constants. Investment demand function is given by $I(r) = i_0 - i_1 r$. Assume that this economy is closed and $c_0 = 200$, $c_1 = 0.75$, $i_0 = 500$, $i_1 = 50$, $Y = 5000$, $T = 1000$, $G = 1500$.

(a) In this economy, compute private and public saving, national saving, consumption, real interest rate and investment. Illustrate using graphs.

(b) Now suppose that government reduces government expenditures from 1500 to 1400. Compute private and public saving, national saving, consumption, real interest rate and investment in this new equilibrium. Explain and interpret the results. Illustrate using graphs.

Assume now a small open economy model with the same parameters ($G = 1500$). The world real interest rate is equal $r^* = 2$ and net export is given by the following function: $NX(\epsilon) = nx_0 - nx_1\epsilon$, where ϵ is a real exchange rate, $nx_0 = 200$ and $nx_1 = 40$.

(c) Compute private and public saving, national saving, consumption, real interest rate, investment, net export and real exchange rate in this small open economy. Illustrate using graphs.

(d) Suppose that government reduces government expenditures from 1500 to 1400. Compute private and public saving, national saving, consumption, real interest rate, investment, net export and real exchange rate in this new equilibrium. Explain the differences with respect to closed economy. Illustrate using graphs.

(e) Now suppose that government expenditures are equal to 1500 and higher oil price increases nx_0 from 200 to 300. Compute private and public saving, national saving, consumption, real interest rate, investment, net export and real exchange rate in this new equilibrium. Illustrate using graphs and explain.

Problem 10. ***Growth with natural resources.***

A commonly held view states that natural resources that are available in finite supply will eventually bring growth of per capita output to a halt.

Consider an economy with the following production function: $Y = K^{\alpha}(AL)^{\beta}T^{1-\alpha-\beta}$, where T is a land (natural resources), $\alpha > 0$, $\beta > 0$ and $\alpha + \beta < 1$. Capital accumulation follows $\dot{K} = sY - \delta K$, labour grows at rate $\dot{L}/L = n$, technology grows at rate $\dot{A}/A = g$ and land does not grow $\dot{T}/T = 0$. Depreciation rate is equal to δ and saving rate is given by s.

(a) Does this economy have a stable balanced growth path for capital, output and consumption, i.e. is it possible for capital, output and consumption all to grow at the same constant rate? If yes, derive the balanced growth rate, and explain its dependence on α, β, g and n. (*Hint:* Start by differentiating the production function as it is.)

(b) Derive the balanced growth rate of *per capita* capital, output and consumption. When is it positive? Explain the contribution of land for this result. Be clear and brief.

Course materials

Required textbooks and materials

The textbook for the first two modules is

- Mankiw, N. Gregory, *Macroeconomics*, 8th edition, Worth Publishers 2012.
  In the first module, we will cover chapters 1-9.

Additional materials

Reference books for rigorous treatment of economic growth and financial markets:

- Barro, Robert & Xavier Sala-i-Martin, *Economic Growth*, 2nd Edition, Cambridge MA: MIT Press 2003.
  Available in the NES library.

- Mishkin, Frederic S. & Eakins, Stanley G., *Financial Markets and Institutions*, 7th edition, Pearson 2012.

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.