Introduction to Macroeconomics

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Useful information
Useful information

- **Lecturers:**
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- **Office:** Room 237 (Building II)

- **Note:** Until the mid November, VM may be more easily found at "ISCTE President’s Office" (Building I)

- **Phone numbers:** 773271 for room 327; 217903046/47 for the ISCTE President’s Office; 218426100 for INE

- **Classes:** Tuesdays, 18.00h — C407 or on a Computer Lab (to be announced)

- **Course homepage:** there will be one operational soon, with news and materials online
  - address: [http://cm.de.iscte.pt/](http://cm.de.iscte.pt/)
The grading process includes three major items:

- **Midterm Exam (30%)**: There will be one midterm examination extra class on a date to arrange.
- **Final Exam (40%)**: The final exam will be on January 2010.
- **A group essay (30%)** over a subject discussed in the course.

Active participation in classes will be welcome, it’s very useful for learning and grading.

The group essay should not be developed under "self–management".
Teaching approach

- The teaching material requires 10 weeks
- Some topics will be covered in just one week
- Some topics require two weeks
- The core theoretical parts (the last two topics) will be covered in five weeks
- The teaching follows a step ladder approach
  - So if you miss one step, it’s more difficult to put your feet on the next...
- Oriented towards "how to do"
  - Students are expected to finish their Master thesis
  - So, they need to master practical tools...
  - Not just descriptive general knowledge
Teaching approach (cont.)

- We will make use of the computer as much as possible (Matlab)
- Good knowledge of mathematics: it helps, however it is not enough
- Lack of good knowledge of mathematics: do not worry, you will not be left behind ... 
  - ... if you pay careful attention when the crucial maths concepts are introduced in classes 
  - ... if you are willing to do some extra study
- The course is intended to be "self–contained"
- The only maths that matters are basic knowledge of:
  - Derivatives
  - Difference equations
  - Optimization (Lagrangean)
  - Matrices
The textbook

- There is no adopted textbook
- A set of publicly available lecture notes will be provided (topic by topic)
- Main reasons:
  - Students save time
  - Lecture notes are "tailored" to each topic
  - Major available textbooks require a much lengthier course (not just 20 hours course)
- Some major postgraduate macro textbooks available:
A quick guided tour

1. Introduction to macroeconomics (1 week)
2. Introduction to Matlab (1 week)
3. Major stylized facts about business cycles (1 week)
4. Solving models with rational expectations (2 weeks)
5. The Real Business Cycle model (2 weeks)
6. Commitment and credibility in monetary policy (1 week)
7. The New Keynesian model (2 weeks)
What is macroeconomics?
What is macroeconomics?

- Analyses the interactions among **4 aggregate markets**:
  - Market for goods & services
  - Money and financial market
  - Exchange or FX market
  - Labor market

- ... to explain how **prices and quantities** are determined in each market in interaction

- ... considering different **time periods** for the analysis:
  - Short term: business cycles
  - Long term: economic growth, sustainability of social security and of public debt, among others

*Please, don’t mix up short term and long term phenomena*
... considering different crucial assumptions:
- Markets work perfectly well: Classical macroeconomics
- Markets show large imperfections: Keynesian macroeconomics

To give answers about economic policy: how and whether the government should intervene in the functioning of the economy in order to increase social welfare:
- Classical: Active economic policy is undesirable ... reduces social welfare
- Keynesians: Market failures are pervasive and require active public intervention ... to boost social welfare

Try to get this clear opposition between the two schools in your mind
Microeconomics vs Macroeconomics

- **Microeconomics**
  - The study of how individual agents behave (a household, a firm)
  - Addresses partial equilibria: how prices and quantities are determined in individual markets
  - There are no agents with political power to determine outcomes

- **Macroeconomics**
  - The study of how aggregate economies behave (all households and all firms, and their interactions in all markets).
  - Addresses general equilibria: how prices and quantities are simultaneously determined in all markets.
  - It includes the possibility of considering the political context of economics: Trade unions, Employers associations, etc...
What is macroeconomics?

Major agents in macroeconomics

- Private agents
  - Households
  - Firms
  - Banks (money) and financial institutions (financial assets)

- Agents with a political power
  - Government
  - Central Bank (in all OECD countries, this bank is totally independent from the Government)
  - Trade Unions and Employers Associations

- Foreign agents (agents living in foreign economies)
The current state of macro
The current state of macro

- Over the last 30 years, macroeconomics was in big turmoil
- However, a **new consensus** in macroeconomics has emerged ... developed over the last 10 years or so ...

”The field of macroeconomics has witnessed in recent years the development of a new generation of small-scale monetary business cycle models, generally referred to as New Keynesian (NK) models or New Neoclassical Synthesis models ... [integrating] Keynesian elements (imperfect competition, and nominal rigidities) into a dynamic general equilibrium framework that until recently was largely associated with the Real Business Cycle (RBC) paradigm. They can be used (and are being used) to analyze the connection between money, inflation, and the business cycle, and to assess the desirability of alternative monetary policies”. (page 1)
The First (Old) Neoclassical Synthesis

"Macroeconomics" is a relatively young subject: "born" in the mid 1940’s

1946: the first time the term "macroeconomics" were used in one title (vide Fig 1)

Macroeconomics were dominated by Keynesian ideas up to the early 1070’s

The first Neoclassical Synthesis: Keynesian/Classical dichotomy

- The economy "is" Keynesian in the short term: there is a permanent trade-off between inflation and unemployment that can be exploited by policy makers
- The economy "is" Classical in the long term: no such permanent trade-off exists

In the late 1960’s, serious problems with the Synthesis became evident: empirically and conceptually
MACROECONOMICS AND THE THEORY OF RATIONAL BEHAVIOR

By LAWRENCE R. KLEIN

1. THE PROBLEM

Many of the newly constructed mathematical models of economic systems, especially the business-cycle theories, are very loosely related to the behavior of individual households or firms which must form the basis of all theories of economic behavior. In these mathematical models, the demand equations for factors of production in the economy as a whole are derived from the assumption that entrepreneurs collectively attempt to maximize some aggregate profit; whereas the usually accepted assumption is that the individual firm attempts to maximize its own profit. For example, Evans, Keynes, Hicks, and Pigou all have in their systems marginal-productivity (i.e., profit-maximizing) equations for the total economy or for some very large subsections such as the consumer-goods or producer-goods industries. These marginal-productivity equations are written, without justification, for the economy as a whole, in exactly the same form as the marginal-productivity equations for a single firm producing a single commodity. These aggregative theories have often been criticized on the grounds that they mislead us by taking attention away from basic individual behavior. The problem of bridging the gap between the traditional theories based on individual behavior and the theories based on community or class behavior is, to a large extent, a problem of proper measurement. This paper attempts to make a very modest contribution toward the formulation and solution of the problem.

We have a body of theory which develops the economic behavior of

1 Cowles Commission Papers, New Series, No. 14. Part of the work on this paper was done under a fellowship of the Social Science Research Council. The author is indebted to other members of the Cowles Commission staff for constructive criticism.


Conceptual problems with the Old Synthesis

- No **microeconomic foundations**: most functions in the model were totally ad-hoc
- The model had an intrinsically **linear structure**, which led to many interesting issues to be aside from the model-economy (multiple equilibria, self-fulfilling prophecies, etc.)
- **Backward looking expectations**: private agents produce systematic mistakes in their forecasting exercises
- **Irrationality**: policy makers were fully-rational agents and knew how the economy works; private agents were "irrational" with little knowledge of how the economy works
- Total nonsense to admit that the Central Bank could manage monetary policy to **permanently** exploit the trade-off between inflation and unemployment
- Vulnerable to the **Lucas critique**: if policy makers intervene in the economy, private agents react by changing their choices, so the structure of the economy changes and the public intervention has
Empirical problems with the Old Synthesis

1. Real wages are countercyclical in the model, but procyclical in the economy.

2. The early 1970’s put in evidence a very unpleasant reality to which the model could provide no remedy: higher and higher unemployment and inflation rates (stagflation).

3. Public debt increased permanently in almost all OECD countries, with little evidence of a decline in unemployment.

4. Central Banks lost the control of monetary aggregates.

5. The model could hardly reproduce the basic stylized facts from the business cycles (variances, covariances, etc.)

(Vivaldo M. Mendes)
The Old Synthesis stand for the 1950’s and the golden 1960’s

Sargent and Lucas: launched the New-Classical model in the early 1970’s

- Macro with microeconomic foundations

Problems with New-Classical model ... led to the Real Business Cycles (RBC) model in the early 1980’s

- Finn Kydland and Edward Prescott (1982), Time to Build and Aggregate Fluctuations, Econometrica, 50, 1345–1370

Problems with the RBC led to the development of the New Keynesian Model (or the New Synthesis) in the mid 1990’s:

Main ingredients of the New Synthesis

- It is largely built upon the Old Keynesian framework
- ... with the usual nominal and real rigidities in price setting
- ... but without the problems that pushed the model to serious problems in the early 70s
- It has the same functions (IS, LM, Aggregate Supply) ...
- With some new arguments, like "forward looking or rational expectations" instead of "adaptive expectations", "Calvo pricing", maximization of utility, and so on ...
- Built upon a general equilibrium framework, based on sound microeconomic principles,
- Relies a lot on quantitative simulations like the Real Business Cycle literature
- But contrary to RBC, it ends up having a key role to monetary policy and a significant role for fiscal policy
Major predictions of the New Synthesis

- Four basic predictions:
  - the instrument of monetary policy ought to be the short term interest rate,
  - policy should be focused on the control of inflation
  - inflation can be reduced by aggressively increasing short term interest rates
  - the central bank should conduct monetary policy adopting a strategy of commitment in a forward-looking environment, instead of discretion

- The Old model’s predictions up-side-down!!!

- See Figure 2.
Active interest rate policy by central banks

The FED now reacts much more aggressively to inflation than in the "old times"
A picture of the success of the receipt (I)
A picture of the success of the receipt (II)
Macroeconomic models
vs
economic reality
The current state of macro.

The need for simplicity

- A modern market economy is a hugely **complex structure**
- There are thousands of firms, millions of households, thousands of goods and prices, there is a government, a central bank, trade unions and employers associations, a foreign sector
- All this occurs in 4 major markets in permanent interaction
- Moreover, agents are rational and try to anticipate the future (they formulate expectations)
  - Self-fulfilling expectations (in the good and the bad sense)
  - Herding behavior (euphoria and panic)
- It is totally impossible to include all this complexity in a single economic model
- So, any macroeconomic model is necessarily an **abstract simplification** of economic reality
The need for simplicity (cont.)

- Despite being necessarily an **abstract simplification** of economic reality
- However, models should not omit **defining features** of that reality ... for the sake of simplicity, e.g.:
  - *if prices are sticky, it looks questionable to assume that they are perfectly flexible in the model*
  - *if agents make mistakes when forecasting the future, it’s no good to assume in the model that expectations are always fulfilled*
  - *if there are agents which have market power, it looks bad if the model ignores that important feature*
- What makes a good model? Good assumptions and good predictions ... and simplicity
The main ingredients of a macroeconomic model

- The **agents** that are crucial players in the aggregate economy
- The **behavioral assumptions** about the macro agents: they try to optimize their objectives given the information they have and the constraints they face:
  - Consumers: max utility based on their preferences over goods
  - Firms: max profits
  - Government: max social utility (or votes in the next election??)
  - Central Bank: min inflation; min unemployment
  - Trade Unions: max real wages
- The **constraints** that the crucial players face
- An assumption about the **information set** available to the agents
- The set of **markets and assets** produced in the economy
- The **technology** that is available for producing goods and services
- A definition of **equilibrium** in order to close the model
Two notions of equilibrium

- **A competitive or Walrasian equilibrium** occurs when:
  - Firms and consumers take all prices as given (no market power)
  - There is perfect information concerning all relevant issues in the market
  - There are no externalities
  - Therefore, prices convey all relevant information, are fully flexible, such that supply = demand in all markets (*market clearing*).

- **An imperfectly competitive or Non–Walrasian equilibrium** occurs when:
  - Firms are price makers (they have market power)
  - Information is imperfectly disseminated throughout the markets
  - There may be externalities
  - Therefore, prices may not convey all relevant information, adjust slowly, and thus supply may be different from demand in all markets (*non–market clearing*).

- Classical: the economy tends to work under competitive conditions
- Keynesians: the economy tends to work under imperfectly competitive conditions
Perfect Markets: example

An increase in demand in a perfectly competitive market (prices are fully flexible to clear the market)
Imperfect Markets: example

An increase in demand in an imperfectly competitive market (prices are rigid and the market is not cleared without the intervention of Government)
Some useful concepts: a review
The Phillips Curve in the short term

- In the 1950’s, Almarin Phillips discovered a major stylized fact, widely widespread over all OECD economies
- This fact (known as the **Phillips Curve**) may be put like this:
  - *There is a short term negative trade-off between unemployment and inflation*
  - *If a government wants to reduce unemployment, has to accept higher rates of inflation*
- However, this relationship seems questionable over the long term. **Why**?
- If the government intervention leads to higher inflation, the next period workers will ask for higher wages:
  - costs will move up for firms, and prices will move up again
- So, the higher are the expectations about inflation, the higher will be the level of inflation for a given level of unemployment
The short term Phillips Curve

Phillips Curve: short term shifts
The long term Phillips Curve

- The reasoning that we applied to the short term cannot be applied to the long term.
- In the long term:
  - even if the government tries to exploit the trade-off between unemployment and inflation,
  - unemployment cannot go lower than its natural or full employment level ($u^*$).
- Therefore, the curve becomes vertical.
- Major message:
  - even if in the short term there is a trade-off between unemployment and inflation,
  - and governments may try to exploit this trade-off for economic or political reasons,
  - in the long term, no such trade-off exists.

See next figure.
The long term Phillips Curve

Phillips Curve: short term shifts

Phillips Curve in the long term
The "Steady State" or Long Term Equilibrium (LTE)

Dynamics and how to model it

- In modern macroeconomics ... everything is discussed using dynamic frameworks
- Dynamics can be modelled under three major ways:
  - Difference equations
  - Differential equations
  - Partial differential equations
- **Examples** (following the previous order)

\[
\Delta k_t = a \cdot k_{t-1} - c \cdot k_t^\alpha, \quad a, c, \alpha \text{ as parameters} \tag{1}
\]

\[
\frac{\partial k_t}{\partial t} = a \cdot k_t - c \cdot k_t^\alpha \tag{2}
\]

\[
\Delta k_t = a - c \cdot \frac{\partial k_t}{\partial u_t} \tag{3}
\]
Major ingredients of a dynamic model

- The **initial condition**
- The **transitional dynamics** process
- The steady state, or the **long term equilibrium** (or the fixed point)

**Definition**

**Long term equilibrium (LTE).** Este equilíbrio é definido como um estado em que as variáveis endógenas crescem a uma taxa constante, a qual pode ser positiva, nula, ou negativa, e em que o período temporal considerado é o longo prazo (tempo pode variar entre 0 e ∞).

**Definition**

**Transitional dynamics.** Representa o ajustamento das variáveis endógenas entre a condição inicial e o equilíbrio de longo prazo — ou entre dois equilíbrios de longo prazo, se houver uma alteração numa (ou várias) das variáveis exógenas —. Neste processo de transição, as variáveis econômicas endógenas podem crescer a taxas crescentes ou decrescentes.
Major ingredients of a dynamic model: graphically

- Situação inicial (vôo)
- Processo de transição dinâmica
- Equilíbrio de longo prazo (vôo)
The three major questions about the LTE

- In the analyses of any kind of dynamic process there are three crucial questions:
  - Does the process has a LTE?
  - If the LTE exists, is it stable or unstable?
  - If the LTE exists, it is unique or there are many equilibria?

- To answer the first question, we have just to impose the following condition to our previous equations

\[ \Delta k = 0 \]

- For our difference equation (\( x^* \) is the LTE level of \( x_t \)) we have

\[ x_{t+1} = x_t = x^* \]

- Intuition:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x_{t+1} &gt; x_t )</td>
<td>( x_t ) ↑</td>
</tr>
<tr>
<td>( x_{t+1} &lt; x_t )</td>
<td>( x_t ) ↓</td>
</tr>
<tr>
<td>( x_{t+1} = x_t )</td>
<td>( x_t = x^* ) (constant)</td>
</tr>
</tbody>
</table>
... three crucial questions:

- ..........................................................?
- *If the LTE exists, is it stable or unstable?*
- *If the LTE exists, is it unique or there are many equilibria?*

To provide formal answers to the second and third questions would take us a long time

So we will provide examples which will give intuition about the major points

As you will see no major maths is required to understand the following points
The steady state or the LTE

- Assume that our system can be represented by a rather simple equation

\[ x_{t+1} = 10 + 0.5 \cdot x_t \]

- The answer to the three questions depend on parameter \( a \):

\[
|a| < 1 \\
|a| > 1 \\
|a| = 1
\]

- First case: \( a = 0.5 \).
- Second case: \( a = 1.5 \).
- Third case: \( a = 1 \).
Our first case: $a=0.5$

- If we have

\[ x_{t+1} = 10 + 0.5 \cdot x_t \]  \hspace{1cm} (4)

- The LTE can be easily calculated

\[
\begin{align*}
    x_{t+1} &= x_t = x^* \\
    x^* &= 10 + 0.5 \cdot x^* \\
    x^* &= 20
\end{align*}
\]

- Answers:
  - The LTE exists: $x^* = 20$
  - It is unique (see next figure)
  - It is stable: no matter what the initial conditions may be, it tends towards the LTE
LTE: exists, unique and stable
Our second case: $a=1.5$

- Now, our system can be represented by

\[ x_{t+1} = 10 + 1.5 \cdot x_t \]  \hspace{1cm} (5)

- The LTE can be easily calculated

\[
\begin{align*}
  x_{t+1} &= x_t = x^* \\
  x^* &= 10 + 1.5 \cdot x^* \\
  x^* &= -20
\end{align*}
\]

- Answers:

  - The LTE exists: $x^* = -20$
  - It is unique \textbf{(see next figure)}
  - It is unstable: the LTE only exists if the initial condition equals exactly the value of $x^* = -20$. If there is a minor shock that forces the process to move away (even if only infinitesimally) from the LTE, the process diverges further and further away from the LTE.
LTE: exists, unique but unstable
Our third case: a=1

• Now, our system can be represented by

\[ x_{t+1} = 10 + 1 \cdot x_t \]  

(6)

• The LTE can be easily calculated

\[
\begin{align*}
  x_{t+1} &= x_t = x^* \\
  x^* &= 10 + 1 \cdot x^* \\
  0 \cdot x^* &\neq -20
\end{align*}
\]

• Answers:
  - The LTE does not exist: no value of \( x^* \) satisfies \( 0 \cdot x^* = -20 \)
  - Is it unique? Redundant answer (see next figure)
  - Is it stable? Redundant answer
LTE: it does not exist

Não existe equilíbrio neste processo dinâmico

Condicion inicial A
Condicion inicial B

45º
A fourth case: multiple equilibria

- Consider that a process can be modelled by the nonlinear difference equation

\[ y_t = \frac{a_1 y_{t-1}^3 - a_2 y_{t-1}^2}{2} \]  \hspace{1cm} (7)

- Assume that the parameters are: \( a_1 = -1, a_2 = 3 \). The LTE is calculated as

\[ y_t = y_{t-1} = y^* \]

- Answers:
  - The LTE exists? YES! The three roots from that equation are:
    \( y_A^* = 0, y_B^* = 1, y_C^* = 2 \)
  - Is it unique? NO!! We have three values that satisfy the LTE condition (see next figure)
  - Is it unstable: we get two stabe LTE and one unstable (\( y_B^* = 1 \))
LTE: exists, it is not unique, some stable and some unstable
A recipe for tragedy: mixing up short term with long term

- Please, never mix up short term (transitional dynamics) with long term phenomena (LTE)
- This is probably the most common and dangerous mistake in macroeconomics
- A simple example. The evolution of the public debt as a percentage of real GDP ($z_t$)

$$
z_t = \psi + \tau \cdot z_{t-1}, \quad t = 0, 1, 2, ... \tag{8}
$$

- $\psi$ is the primary deficit as a percentage of real GDP; $\tau = \frac{1+r}{1+g}$, with $g$ as the growth rate of real GDP, and $r$ as the real interest rate
- Assume $g = 3.5\%, r = 3\%$, and two scenarios: $\psi_A = 0.01, \psi_B = 0.02$. (see next figure)
- Assume also that between $t = 600$ and $t = 620$ the government increases the primary deficit: what happens to the LTE?
- Looking at panel (1) we will get a different answer to that of panel (2), which applies also to (3) and (4).
Don not mix up short term with long term
The importance of sustainable long term growth
Growth rates: basics

Assume the following problem:
- I have 10€ today
- I receive an interest of 4% per year on them
- How much are they worth off in \( t \) years time?

Mathematically speaking:

\[
\begin{align*}
y_1 &= y_0 (1 + g) \\
y_2 &= y_1 (1 + g) = y_0 (1 + g) (1 + g) = y_0 (1 + g)^2 \\
&\quad \vdots \\
y_t &= y_0 (1 + g)^t
\end{align*}
\]
Exponential growth and its log face: \( g = 4\% \), \( y(0) = 10 \)

\[ y(t) = y(0)*(1+r)^t, \quad y(0)= 10, \quad r = 4\% \]
Exponential growth and its log face (cont.)

- When we have exponential growth, this can be **linearized** just by applying natural logs.
- Logs are applied everywhere in macro ... makes live a lot easier.
- Apply logs to equation (9), and get
  \[
  \ln y_1 = \ln y_0 + 1 \times \ln(1 + g)
  \]
- As \( \ln(1 + g) \approx g \) for small values of \( g \) (try it with your calculator for \(-1 < g < 1\)), then
  \[
  \ln y_1 - \ln y_0 \approx g
  \]
- What about **average** growth rates? Apply logs to equation (10) and
  \[
  \ln y_t = \ln y_0 + t \times \ln(1 + g)
  \]
  or
  \[
  \frac{\ln y_t - \ln y_0}{t} \approx g
  \]
The importance of long term growth

The importance of sustainable growth

Assume 3 economies (A,B,C) all starting at \( t(0) \) with an income per capita of 10€

What happens to their income per capita in 60 years, if the annual growth rates of their income per capita are as follows:

\[ g(A) = 2\%, \quad g(B) = 4\%, \quad g(C) = 6\% \]

Do the calculations, and look at the next figure

Growth miracles and growth disasters: no mere rhetoric ... look at a figure and compare

- Argentina with Japan
- Botswana and Benin
The importance of long term growth

The importance of sustainable growth (cont.)

(Vivaldo M. Mendes)
Growth miracles and growth disasters

Real Output per capita, 1960-2004

Source: Penn-World Tables, chain-weighted data.