Macroeconomic Theory

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T3 2026

Course Content

Three foundational models of modern macroeconomics

This course presents macroeconomic modeling at an intermediate level.

Model 1
Ramsey-Cass-Koopmans
Neoclassical Growth

Model 2
Samuelson-Diamond
Overlapping Generations

Model 3
New-Keynesian
Fischer-Blanchard-Yun-Taylor

Course Content

Mathematical methods

We learn the methods used to study the 3 models:

- Dynamic optimization / Optimal Control / Dynamic Programming
- Differential systems (continuous time) / Difference systems (discrete time)

Sometimes a model is more naturally cast in continuous time, sometimes in discrete time. The first two models are deterministic; stochastic elements in the third are kept elementary.

Everything is done **analytically** as opposed to a numerical macro course where models are solved computationally.

Mathematical Methods

Dynamic optimization framework

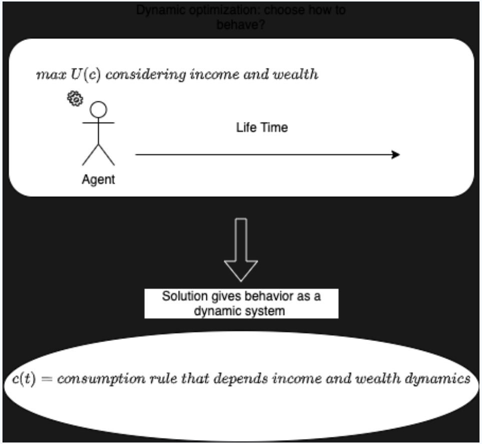
The dynamic optimization framework derives from microeconomic behavior of agents:

- ▷ They perform optimal choices by maximizing a utility function with few arguments:
    - Consumption (in all 3 models)
    - Leisure (only in the NK model)
- ▷ They consider the complete time horizon of their remaining life
- ▷ They consider their budget constraint(s)

The differential/difference system derives from the **solution** of the optimization problem — typically functions/rules describing variable behavior.

Mathematical Methods

From optimization to dynamics



Course Content

Microeconomic channels and macroeconomic questions

We learn the basic microeconomic channels at play, mostly **spending versus saving** under:

- Utilitarian behavior
- Perfect foresight / Rational Expectations

And the implications for benchmark questions on:

- Government debt and fiscal policy in the long run
- Social security
- Fluctuations and macroeconomic stabilization (monetary & fiscal)

Model 1 — Ramsey

Infinite horizon, continuous time

The social planner problem (simplest version) maximizes:

$$\boxed{U(0) = \int_0^{\infty} e^{-\rho t} u(c(t))\, dt}$$

subject to the resource constraint:

$$\boxed{f(k(t)) = c(t) + \dot{k}(t) + nk(t)}$$

with $k_0 > 0$ and $c(t), k(t) \geq 0$.

Model 1 — Ramsey

The objective function

$$\boxed{U(0) = \int_0^{\infty} e^{-\rho t} u(c(t))\, dt}$$

- $U(0)$ is the lifetime utility function
- ρ is the discount rate (impatience)
- $u(c(t))$ is the instantaneous felicity function depending on consumption c

Model 1 — Ramsey

The resource constraint

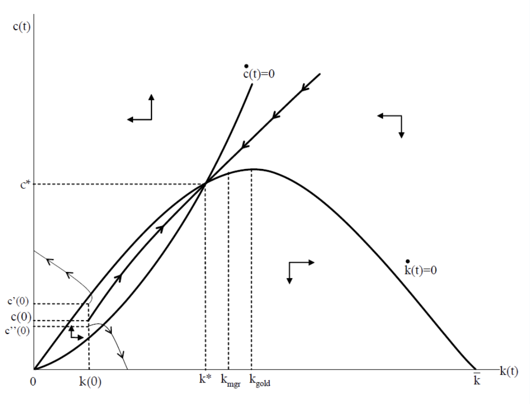
$$\boxed{f(k(t)) = c(t) + \dot{k}(t) + nk(t)}$$

- $f(k(t))$ is production using technology f with capital k (per capita)
- $\dot{k}(t)$ is the change in capital stock due to investment
- n is the population growth rate

Additional constraints: $k_0 > 0$ and $c(t), k(t) \geq 0$

Model 1 — Ramsey

Phase diagram



Model 1 — Ramsey

Key topics

- Economic aggregates dynamics determined by microeconomic decisions
- Centralized versus decentralized economy
- Real economy — nominal variables are decoupled
- How interest rates affect savings
- How tax vs. debt financing affects capital accumulation
- Extension to small open economy and investment decisions

Model 2 — OLG

Finite life, discrete time

Time represents the span of a generation; generations overlap. Population is N_t.

Household problem:

$$\boxed{\max \; u(c_{1t}) + (1+\rho)^{-1} u(c_{2t+1})}$$

Firm profits:

$$\boxed{\max \; F(K_t, N_t) - w_t N_t - r_t K_t}$$

Model 2 — OLG

Capital accumulation

Aggregate investment equals saving:

$$\boxed{K_{t+1} - K_t = N_t s(w_t, r_{t+1}) - K_t}$$

Model 2 — OLG

Household optimization

$$\boxed{\max \; u(c_{1t}) + (1+\rho)^{-1} u(c_{2t+1})}$$

subject to budget constraints, where:

- c_{1t} is consumption when **young** (period 1)
- c_{2t+1} is consumption when **old** (period 2)
- With more generations $\rightarrow$ more indices (aggregation issues)

Model 2 — OLG

Generational structure

Schéma de la succession des générations.

GÉNÉRATIONS	PÉRIODES.					
	----	T_{n-1}	T_n	T_{n+1}	T_{n+2}	----
G^{n-1}		Θ_0^{n-1}	Θ_1^{n-1}			
G^{n}			Θ_0^{n}	Θ_1^{n}		
G^{n+1}				Θ_0^{n+1}	Θ_1^{n+1}	
Population totale	----	$2n$	$2n$	$2n$	$2n$	----

Model 2 — OLG

Key topics

- Second basic model used in micro-founded macroeconomics
- Particularity: generations yet unborn whose preferences may not be registered in current market transactions
- Life-cycle saving
- Heterogeneity across cohorts
- Competitive equilibrium might **not** be Pareto optimal (over-accumulation of capital)

Model 3 — New Keynesian

Infinite horizon, discrete time

- Model that breaks the dichotomy between nominal and real
- Nominal and real rigidities
- Imperfect competition
- Labor supply decisions
- Real short-run effects of monetary policy and spending

Model 3 — New Keynesian

Key ingredients

We add to a discrete-time Ramsey model ingredients that allow us to talk about:

Imperfect competition (Dixit-Stiglitz):

$$\boxed{C = \left[\int_0^1 C(i)^{(\eta-1)/\eta}\, di\right]^{\eta/(\eta-1)}, \quad \eta > 1}$$

Nominal rigidities (Fisher, Taylor, Calvo, Rotemberg):
Prices cannot adjust instantaneously — time or state dependent

Shocks drive dynamics (technology, government, interest rate)

Model 3 — New Keynesian

The three-equation system

After solving for optimal decisions, the dynamical system is:

IS curve:

$$\tilde{y}_t = E_t \tilde{y}_{t+1} - \sigma \left[i_t - E_t\{\pi_{t+1}\} \right] + u_t^{IS}$$

NK Phillips Curve:

$$\pi_t = \beta E_t \pi_{t+1} + \lambda \tilde{y}_t + u_t^{PC}$$

Monetary Policy Rule:

$$i_t = MR(\pi_t, \tilde{y}_t, \ldots) + u_t^{MP}$$

Where $\tilde{y}$ is the output gap (resources not fully allocated), π is inflation, i is the policy rate.

Course Logistics

- ✓ We will have a lot of **fun** in this course
- ✓ Course based on **lecture notes** presented in class
- ✓ **Final exam**: 50% of grade
- ✓ **Homework**: 50% of grade (3 Problem Sets, each $\frac{1}{3}$)
- ✓ **Participation bonus**: up to 10%
- ✓ Work is **individual**