Macroeconomics 1 (6/7)

Fiscal policy in the representative-agent model (Cass-Koopmans-Ramsey)

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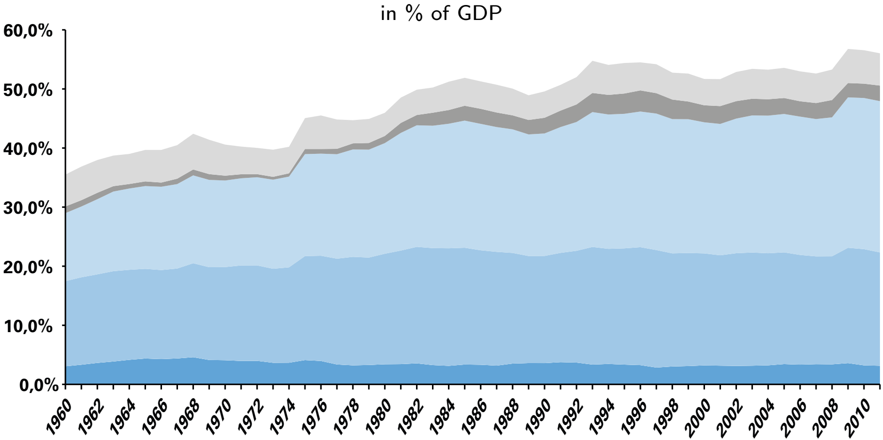
Goal of the chapter

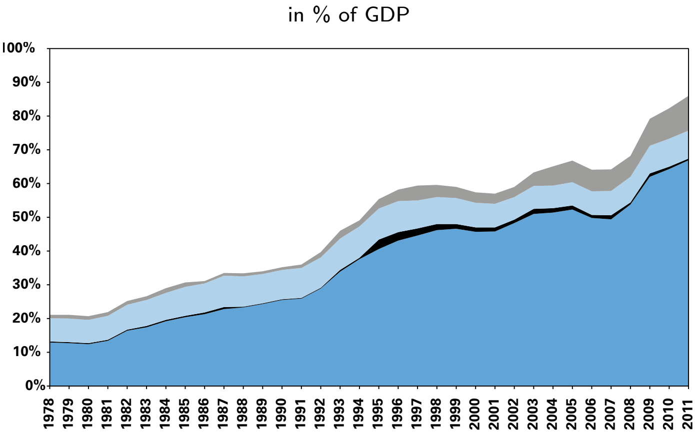
- This chapter introduces fiscal policy and studies its effects in the Cass-Koopmans-Ramsey model.
- **Fiscal policy** $\equiv$ government expenditures financed by taxes or public-debt emission.
- In many countries, fiscal policy can play an important role given the large amount of government expenditures and public debt.

Government expenditures in France, 1960-2010



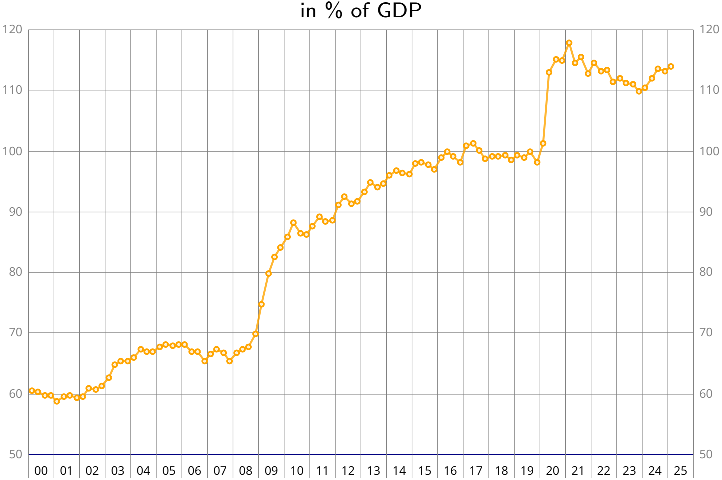
Source: INSEE, computations DG Trésor. In dark blue: investment. In light blue: functioning. In very light blue: social benefits. In dark grey: interest payments. In light grey: others.

Public debt in France, 1978-2011



Source: INSEE. In dark blue: state government. In light blue: local governments. In black: various state-government institutions. In light grey: social-security administration.

Public debt in France, 2000-2025



Source: INSEE.

Some limitations of Chapters 6-7's analysis

- We restrict the analysis to public expenditures that
  - do not affect the production function,
  - do not affect the private-consumption-utility function,
  - are financed with lump-sum taxes or debt emission.
- **Lump-sum (resp. distortionary) tax** $\equiv$ tax such that the amount that an individual has to pay does not depend (resp. depends) on their actions.
- In practice, all taxes are distortionary nowadays. Part 6 of the tutorials studies the case of a distortionary tax.
- We focus on the positive $-$ not normative $-$ analysis of the effects of fiscal policy (as a matter of fact, there will be no role for discontinuous variations in public expenditures over time).
- We assume that the risk of sovereign default is zero.

General overview of the model I *

- Firms rent capital (owned by households) and employ labor (supplied by households) to produce goods.

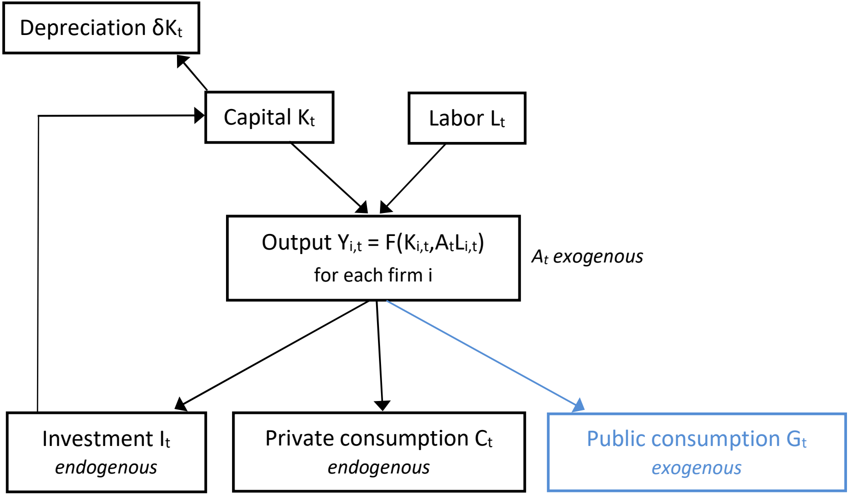
- The goods produced by firms are used for
  - households' consumption,
  - the government's consumption,
  - investment in new capital.

- The saving rate (quantity of goods saved−invested by households / quantity of goods consumed or saved−invested by households) is endogenous, optimally chosen by households.

- Capital evolves over time due to investment and capital depreciation.

(In the pages whose title is followed by an asterisk, compared to Chapter 2, in blue: additions; in red: replacements.)

General overview of the model II *



Good, private agents *

- **Only one type of good**, used for
  - private consumption,
  - public consumption,
  - investment.

- **Two types of private agents**:
  - households,
  - firms.

Markets *

- **Five markets**:
  - goods markets,
  - labor market,
  - capital market,
  - loans market,
  - public-debt market.

- On the public-debt market,
  - *supply* comes from the government,
  - *demand* comes from households.

Exogenous variables *

- **Neither flows nor stocks**:
  - continuous time, indexed by t,
  - price of goods $\equiv$ numéraire $= 1$,
  - (large) number of firms I.

- **Flows**:
  - labor supply $= 1$ per person,
  - real public expenditures G_t,
  - real lump-sum taxes T_t.

- **Stocks**:
  - agregate initial capital $K_0 > 0$,
  - population $L_t = L_0 e^{nt}$, where $L_0 > 0$ and $n \geq 0$,
  - productivity parameter $A_t = A_0 e^{gt}$, where $A_0 > 0$ and $g \geq 0$,
  - real initial public debt D_0.

Endogenous variables *

- **Prices**:
  - real usage cost of capital z_t,
  - real wage w_t,
  - real interest rate r_t.

- **Quantities – flows**:
  - aggregate output Y_t,
  - aggregate labor demand N_t,
  - aggregate consumption C_t.

- **Quantities – stocks**:
  - aggregate capital K_t (except at $t = 0$),
  - real aggregate amount of private assets B_t,
  - real public debt D_t (except at $t = 0$).

Chapter outline

Equilibrium conditions

Households' intertemporal utility *

- At time 0, the representative household's **intertemporal utility** is

$$U_0 \equiv \int_0^{+\infty} e^{-\rho t} \frac{L_t}{L_0} [u(c_t) + v(g_t)] dt = L_0 \int_0^{+\infty} e^{-(\rho - n)t} [u(c_t) + v(g_t)] dt$$

  where

  - $c_t \equiv \frac{C_t}{L_t}$ and $g_t \equiv \frac{G_t}{L_t}$,
  - ρ is the rate of time preference ($\rho > n > 0$),
  - u is the instantaneous-utility function for private consumption,
  - v is the instantaneous-utility function for public expenditures.

- As in the second part of Chapter 2, we assume that u is such that the elasticity of intertemporal substitution is constant, equal to $\frac{1}{\theta}$.

Households' assets *

- Each household can hold three types of assets:
    - loans to other households (zero in equilibrium),
    - capital ownership titles,
    - public debt.

- In equilibrium, households must be indifferent between these three asset types, so

$$\begin{aligned} r_t &\equiv \text{real interest rate on loans to households} \\ &= \text{real rate of return on ownership titles} \\ &= \text{real interest rate on public debt}. \end{aligned}$$

- We can therefore sum up these three types of assets, and denote by E_t the total amount of assets in units of goods.

- We denote by $b_t \equiv \frac{B_t}{L_t}$, $d_t \equiv \frac{D_t}{L_t}$ and $e_t \equiv \frac{E_t}{L_t}$ respectively the private assets, the public assets and the total assets in units of goods per person.

Households' budget constraint I *

- The **instantaneous budget constraint** of the representative household is

$$\dot{E}_t = w_t L_t - T_t + r_t E_t - C_t.$$

- Defining $t_t \equiv \frac{T_t}{L_t}$, we can rewrite it, in per-capita terms, as

$$\dot{e}_t = w_t - t_t + (r_t - n) e_t - c_t.$$

- Re-arranging the terms and multiplying by the exponential, we get

$$\left[\dot{e}_t - (r_t - n) e_t\right] e^{-\int_0^t (r_\tau - n) d\tau} = (w_t - t_t - c_t) e^{-\int_0^t (r_\tau - n) d\tau}.$$

Households' budget constraint II *

- Then, integrating from 0 to T,

$$e_T e^{-\int_0^T (r_\tau - n)d\tau} - e_0 = \int_0^T (w_t - t_t - c_t) e^{-\int_0^t (r_\tau - n)d\tau} dt.$$

- Going to the limit $T \to +\infty$, we get households' **intertemporal budget constraint**

$$\underbrace{\int_0^{+\infty} c_t e^{-\int_0^t (r_\tau - n)d\tau} dt}_{\substack{\text{what should be saved at time 0} \\ \text{to finance future consumption}}} \leq \underbrace{e_0}_{\substack{\text{wealth} \\ \text{at time 0}}} + \underbrace{\int_0^{+\infty} (w_t - t_t) e^{-\int_0^t (r_\tau - n)d\tau} dt}_{\substack{\text{what could be borrowed at time 0 and reim-} \\ \text{bursed with future after-tax wage incomes}}}$$

$$\text{if and only if} \qquad \lim_{T \to +\infty} \left[e_T e^{-\int_0^T (r_\tau - n)d\tau} \right] \geq 0.$$

- This last inequality is households' **solvency constraint**.

Households' optimization problem *

- Households' optimization problem is thus the following:

  at time 0, for some given $(r_t, w_t, g_t, t_t)_{t\geq 0}$ and e_0,

$$\max_{(c_t)_{t\geq 0},(e_t)_{t>0}} \int_0^{+\infty} e^{-(\rho-n)t}[u(c_t)+v(g_t)]dt$$

  subject to the constraints

  1. $\forall t \geq 0,\ c_t \geq 0$ (constraint of consumption non-negativity),
  2. $\forall t \geq 0,\ \dot{e}_t = w_t - t_t + (r_t - n)e_t - c_t$ (instantaneous budget constraint),
  3. $\lim_{t\to+\infty}\left[e_t e^{-\int_0^t (r_\tau - n)d\tau}\right] \geq 0$ (solvency constraint).

Solving households' optimization problem *

- The resolution of this optimization problem leads, with the same kind of computations as in Chapter 2, to the following conditions on $(c_t)_{t\geq 0}$ and $(e_t)_{t>0}$:

  1. $\frac{\dot{c}_t}{c_t} = \frac{r_t - \rho}{\theta}$ (**Euler equation**),
  2. $\dot{e}_t = w_t - t_t + (r_t - n)e_t - c_t$ (instantaneous budget constraint),
  3. $\lim\limits_{t\to+\infty} \left[e_t e^{-\int_0^t (r_\tau - n)d\tau} \right] = 0$ (**transversality condition**).

- Condition 1 (Euler equation) involves neither g_t nor t_t because
  - instantaneous utility is separable,
  - taxes are lump-sum.

Government's budget constraint I

- The government's **instantaneous budget constraint** is

$$\dot{D}_t = r_t D_t + G_t - T_t.$$

- It can be rewritten, in per-capita terms, as

$$\dot{d}_t = (r_t - n) d_t + g_t - t_t.$$

- Re-arranging the terms and multiplying by the exponential, we get

$$\left[\dot{d}_t - (r_t - n)\, d_t\right] e^{-\int_0^t (r_\tau - n) d\tau} = (g_t - t_t)\, e^{-\int_0^t (r_\tau - n) d\tau}.$$

Government's budget constraint II

- Then, integrating from 0 to T,

$$d_T e^{-\int_0^T (r_\tau - n)d\tau} - d_0 = \int_0^T (g_t - t_t)\, e^{-\int_0^t (r_\tau - n)d\tau} dt.$$

- Going to the limit $T \to +\infty$, we get the government's **intertemporal budget constraint**

$$\underbrace{d_0}_{\substack{\text{debt} \\ \text{at time 0}}} \leq \underbrace{\int_0^{+\infty} (t_t - g_t) e^{-\int_0^t (r_\tau - n)d\tau} dt}_{\substack{\text{actualized value at time 0} \\ \text{of future primary surpluses}}}$$

if and only if $$\lim_{T \to +\infty} \left[d_T e^{-\int_0^T (r_\tau - n)d\tau} \right] \leq 0.$$

Government's solvency constraint

- The condition
$$\lim_{t\to+\infty}\left[d_t e^{-\int_0^t (r_\tau - n)d\tau}\right] \leq 0$$
is the government's **solvency constraint**.

- It imposes that the actualized value at time 0 of public debt in the long term must be non-positive.

- It implies that in the long term, public debt D_t cannot increase at a rate higher than the interest rate (r_t).

- It rules out the possibility of financial scheme in which each borrowing would be reimbursed with a new borrowing ("Ponzi scheme").

Other equilibrium conditions *

- All the other equilibrium conditions obtained in Chapter 2, about
  - firms' behavior,
  - market clearing,

  remain the same, except one.

- The exception is the goods-market-clearing condition, which becomes

$$\underbrace{Y_t}_{\text{output}} = \underbrace{C_t}_{\substack{\text{private}\\ \text{consumption}}} + \underbrace{G_t}_{\substack{\text{public}\\ \text{consumption}}} + \underbrace{\dot{K}_t + \delta K_t}_{\text{investment}}.$$

- Finally, the public-debt-market-clearing condition is

$$E_t = B_t + D_t.$$

Equilibrium determination

1. Introduction
2. Equilibrium conditions
3. Equilibrium determination
   - Equilibrium conditions on κ_t and γ_t
   - Steady state for $\chi_t \equiv \frac{g_t}{A_t}$ constant
   - Equilibrium path for χ_t constant
4. Effects of fiscal policy
5. Conclusion

Equilibrium conditions on κ_t and γ_t I *

- For the sake of simplicity, we focus on values of d_0, $(g_t)_{t\geq 0}$ and $(t_t)_{t\geq 0}$ such that the government's intertemporal budget constraint is binding:

$$d_0 = \int_0^{+\infty} (t_t - g_t) e^{-\int_0^t (r_\tau - n) d\tau} dt.$$

- The government's solvency constraint then becomes

$$\lim_{t \to +\infty} \left[d_t e^{-\int_0^t (r_\tau - n) d\tau} \right] = 0.$$

- Using $e_t = b_t + d_t$, we can then rewrite the transversality condition

$$\lim_{t \to +\infty} \left[e_t e^{-\int_0^t (r_\tau - n) d\tau} \right] = 0 \quad \text{as} \quad \lim_{t \to +\infty} \left[b_t e^{-\int_0^t (r_\tau - n) d\tau} \right] = 0.$$

Equilibrium conditions on κ_t and γ_t II *

- We then get, in the same way as in Chapter 2,

$$\lim_{t \to +\infty} \left\{ \kappa_t e^{-\int_0^t [f'(\kappa_\tau) - (n+g+\delta)] d\tau} \right\} = 0,$$

where $\kappa_t \equiv \frac{k_t}{A_t}$ (with $k_t \equiv \frac{K_t}{L_t}$), δ is the capital-depreciation rate and $f(x) \equiv F(x, 1)$ for any $x \geq 0$, F being the production function.

- "Subtracting" the government's instantaneous budget constraint $\dot{d}_t = (r_t - n) d_t + g_t - t_t$ from households' instantaneous budget constraint $\dot{e}_t = (r_t - n) e_t + w_t - t_t - c_t$ (where $\dot{e}_t = \dot{b}_t + \dot{d}_t$ and $e_t = b_t + d_t$) gives

$$\dot{b}_t = (r_t - n) b_t + w_t - g_t - c_t.$$

Equilibrium conditions on κ_t and γ_t III *

- We then get, in the same way as in Chapter 2,

$$\dot{\kappa}_t = f(\kappa_t) - \gamma_t - \chi_t - (n + g + \delta)\,\kappa_t$$

where $\gamma_t \equiv \frac{c_t}{A_t} = \frac{C_t}{A_t L_t}$ and $\chi_t \equiv \frac{g_t}{A_t} = \frac{G_t}{A_t L_t}$.

- This differential equation implies the goods-market-clearing condition: $\dot{K}_t = Y_t - C_t - G_t - \delta K_t$ (consequence of Walras' law).

- Finally, as in Chapter 2, the Euler equation can be rewritten as

$$\frac{\dot{\gamma}_t}{\gamma_t} = \frac{1}{\theta}\left[f'(\kappa_t) - \delta - \rho - \theta g\right].$$

Equilibrium conditions on κ_t and γ_t IV *

- $(\kappa_t)_{t\geq 0}$ and $(\gamma_t)_{t\geq 0}$ are therefore determined by two differential equations, one initial condition and one terminal condition:

$$\dot{\kappa}_t = f(\kappa_t) - \gamma_t - \chi_t - (n+g+\delta)\,\kappa_t,$$

$$\frac{\dot{\gamma}_t}{\gamma_t} = \frac{1}{\theta}\left[f'(\kappa_t) - \delta - \rho - \theta g\right],$$

$$\kappa_0 = \frac{K_0}{A_0 L_0},$$

$$\lim_{t\to+\infty}\left\{\kappa_t e^{-\int_0^t [f'(\kappa_\tau)-(n+g+\delta)]d\tau}\right\} = 0.$$

- The other endogenous variables are residually determined, from $(\kappa_t)_{t\geq 0}$ and $(\gamma_t)_{t\geq 0}$, using the other equilibrium conditions.

Steady state for χ_t constant I *

- We assume temporarily that $\forall t \geq 0$, (i) $\chi_t = \chi > 0$ and (ii) households expect that $\forall \tau \geq t$, $\chi_\tau = \chi$.

- We then show, in the same way as in Chapter 2, that κ_t and γ_t are constant at the **steady state** ($\equiv$ situation in which κ_0 is such that, in equilibrium, all quantities are non-zero and grow at constant rates).

- Replacing $\dot{\kappa}_t$ with 0 in the differential equation in $\dot{\kappa}_t$, we get

$$\gamma_t = f(\kappa_t) - (n + g + \delta)\kappa_t - \chi,$$

which corresponds to a **bell-shaped curve** in the plane (κ_t, γ_t).

Steady state for χ_t constant II *

- Replacing $\dot{\gamma}_t$ with 0 in the differential equation in $\dot{\gamma}_t$, we get

$$f'(\kappa_t) = \delta + \rho + \theta g,$$

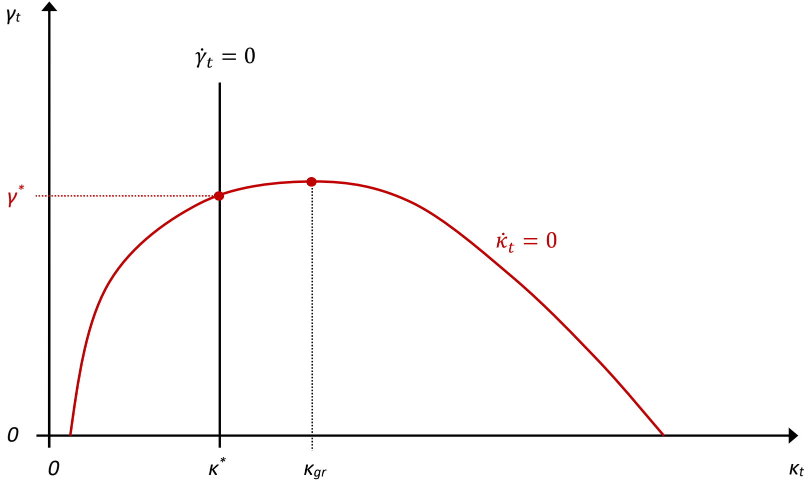
which corresponds to a **vertical straight line** in the plane (κ_t, γ_t).

- The **intersection point** of this curve and this straight line corresponds to the steady-state value of (κ_t, γ_t), denoted by (κ^*, γ^*).

- Compared to the figure in Chapter 2, the only difference is that the bell-shaped curve is translated downwards.

- So, as in Chapter 2, at the steady state, there is **no dynamic inefficiency due to capital over-accumulation**: $\kappa^* < \kappa_{or}$.

Steady state for χ_t constant III *

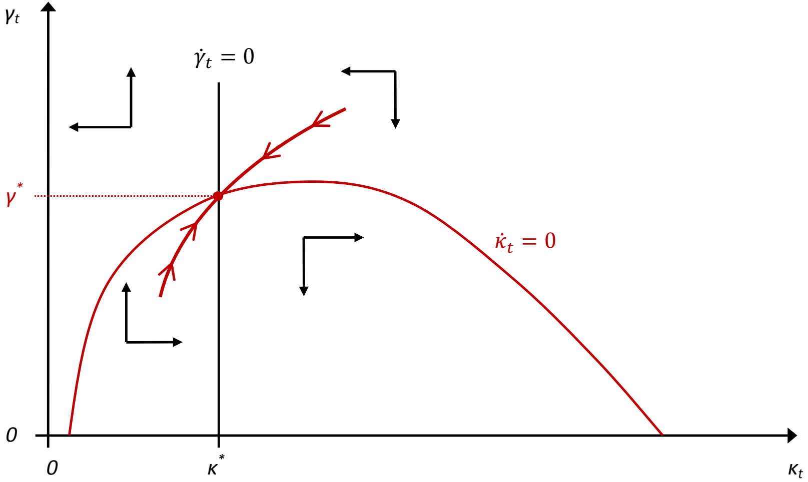


Equilibrium path for χ_t constant I *

- As in Chapter 2, there exists a unique path, called "**saddle path**", along which (κ_t, γ_t) can converge to (κ^*, γ^*).

- We show, in the same way as in Chapter 2, that the unique equilibrium path of (κ_t, γ_t) for a given κ_0 is the saddle path.

Equilibrium path for χ_t constant II *



Effects of fiscal policy

Ricardian equivalence I

- The lump-sum taxes do not appear in any of the four equilibrium conditions on κ_t and γ_t.

- So, in equilibrium, no endogenous variable (except public debt) depends on the lump-sum taxes.

- In other words, **the effect of public expenditures on the economy does not depend on the way they are financed** (current lump-sum tax or current borrowing reimbursed with a future lump-sum tax).

- This result is called "**Ricardian equivalence**".

Ricardian equivalence II

- This result was first
  - stated by Ricardo (1817),
  - formalized by Barro (1974).

- **David Ricardo**: English economist, born in 1772 in London, deceased in 1823 in Gatcombe Park.

- **Robert J. Barro**: American economist, born in 1944 in New York, professor at Harvard University since 1987.

- This result is due to the fact that the way public expenditures are financed does not affect households' intertemporal budget constraint, as we show on the next page.

Ricardian equivalence III *

- Using the intertemporal budget constraint of the government

$$d_0 = \int_0^{+\infty} (t_t - g_t) e^{-\int_0^t (r_\tau - n) d\tau} dt,$$

we can rewrite households' intertemporal budget constraint

$$\int_0^{+\infty} c_t e^{-\int_0^t (r_\tau - n) d\tau} dt \leq e_0 + \int_0^{+\infty} (w_t - t_t) e^{-\int_0^t (r_\tau - n) d\tau} dt$$

as

$$\int_0^{+\infty} c_t e^{-\int_0^t (r_\tau - n) d\tau} dt \leq b_0 + \int_0^{+\infty} (w_t - g_t) e^{-\int_0^t (r_\tau - n) d\tau} dt.$$

- Thus, the way public expenditures are financed (current or future tax) does not affect households' choices because it does not affect the actualized value of their future after-tax incomes. Put differently: **public bonds are not "net wealth" for households**.

Ricardian equivalence IV

- Consider a given amount of public expenditures at a given time.
- In the case (denoted by A) in which the government finances these expenditures with current taxes, households reduce their current consumption to pay this tax.
- In the alternative case (denoted by B) in which the government borrows to finance these expenditures, households also reduce their current consumption, in order to save in anticipation of the future taxes.
- Because the rate of return of households' savings is equal to the interest rate at which the government borrows, households save in Case B an amount equal to the tax that they pay in Case A.
- As a consequence, households' current consumption is the same in the two cases.

Ricardian equivalence V

- The literature is not very conclusive about the empirical validity of the Ricardian equivalence (Seater, 1993).
- Several issues could explain a lack of empirical validity:
  1. different generations and no bequest or altruism between generations (case studied in Chapter 7),
  2. distortive taxes (case studied in Part 6 of the tutorials),
  3. households' non-optimizing behavior,
  4. households' liquidity constraints.
- The Ricardian equivalence nonetheless remains a useful benchmark to analyze the effects of the way public expenditures are financed.

Ricardian equivalence VI

- In the context of fiscal consolidation in the euro area after the 2008-2009 crisis, the empirical validity of the Ricardian equivalence was an important issue in the debates – for instance, in Trichet (2010):

  "*The concern is, however, that in the short run the deficit reductions – although unavoidable in the long run – have negative effects on aggregate demand. The economy, it is sometimes argued, is at present too fragile and thus consolidation efforts should be postponed or even new fiscal stimulus measures added.*

  As I pointed out recently, I am sceptical about this line of argument. Indeed, the strict Ricardian view may provide a more reasonable central estimate of the likely effects of consolidation. For a given expenditure, a shift from borrowing to taxation should have no real demand effects as it simply replaces future tax burden with current one."

Variations in χ_t over time

- We assume, in the rest of this chapter, that
  - χ_t can vary over time,
  - these variations can be expected, or not expected, by households,
  - at each time, households are unaware that they may be surprised, at a later time, by the value of χ_t or by the announcement of its future path,
  - at each time at which they are surprised by the current value of χ_t or by the announcement of its future path, households solve their new optimization problem and change their current and expected future behavior accordingly,
  - the path of taxes over time adjusts to variations in χ_t in such a way that the government's intertemporal budget constraint always remains binding.

Continuity or discontinuity of κ_t, γ_t and $\dot{\gamma}_t$ as χ_t varies

- κ_t is a **stock**, and hence a **continuous** function of time (except following "earthquake shocks", destroying part of the capital stock).

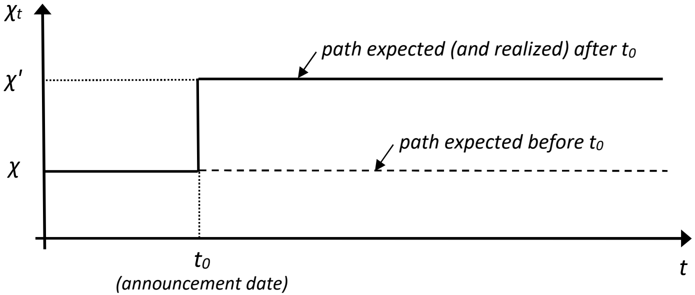
- γ_t and $\dot{\gamma}_t$ are **flows**, and hence potentially **discontinuous** functions of time.

- γ_t and $\dot{\gamma}_t$ can be discontinuous only at the times at which households are surprised by the current value of χ_t or by the announcement of its future path.

- The reason is that when there is no surprise about the path of χ_t (even when this path is discontinuous), it is optimal for households to smooth γ_t and $\dot{\gamma}_t$ over time, as the differential equation in $\dot{\gamma}_t$ implies.

Effect of an unexpected permanent increase in χ_t I

- We first consider an **unexpected permanent** increase in χ_t: we assume that there exists a time t_0 such that
  - $\forall t < t_0$, (i) $\chi_t = \chi$, (ii) households expect that $\forall \tau \geq t$, $\chi_\tau = \chi$, and (iii) the economy is at the corresponding steady state,
  - the government credibly announces at t_0 that $\forall t \geq t_0$, $\chi_t = \chi' > \chi$,
  - the government conducts, from t_0, the fiscal policy announced at t_0.



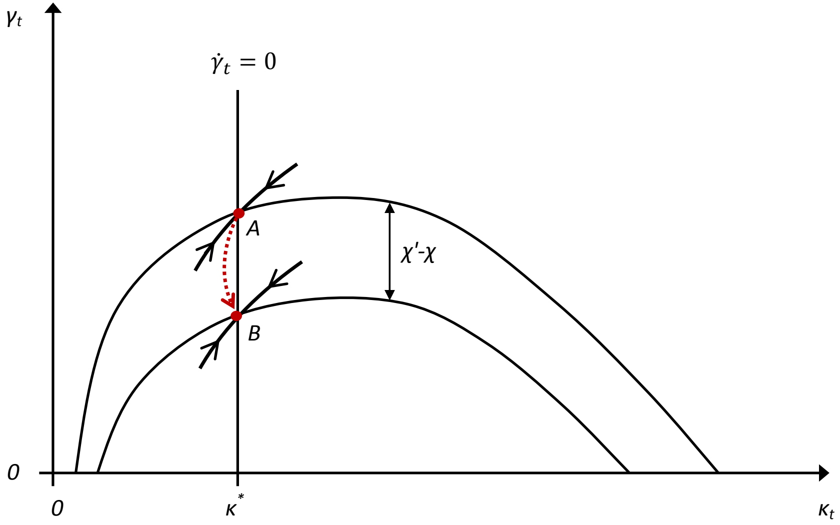
Effect of an unexpected permanent increase in χ_t II

- From t_0, χ_t is constant over time and there are no more surprises, so the economy is on its new saddle path (lower than the old saddle path).

- So, the economy jumps at t_0 from the old steady state (Point A) to the new one (Point B) and remains at the new one thereafter.

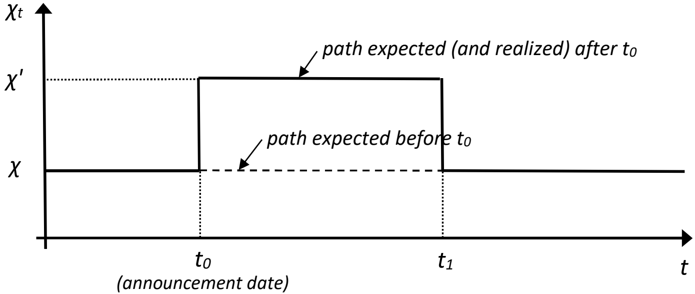
- Consumption γ_t falls at t_0 by $\chi' - \chi$ because the permanent increase in χ_t reduces at t_0 the actualized value of households' future after-tax incomes by $(\chi' - \chi) \int_{t_0}^{+\infty} e^{-\int_{t_0}^{t} (r_\tau - n) d\tau} dt$.

Effect of an unexpected permanent increase in χ_t III



Effect of an unexpected temporary increase in χ_t I

- We now turn to an **unexpected temporary** increase in χ_t: we assume that there exist t_0 and t_1 such that $t_0 < t_1$ and
  - $\forall t < t_0$, (i) $\chi_t = \chi$, (ii) households expect that $\forall \tau \geq t$, $\chi_\tau = \chi$, and (iii) the economy is at the corresponding steady state,
  - the government credibly announces at t_0 that (i) $\forall t \in [t_0; t_1[$, $\chi_t = \chi' > \chi$, and (ii) $\forall t \geq t_1$, $\chi_t = \chi$,
  - the government conducts, from t_0, the fiscal policy announced at t_0.



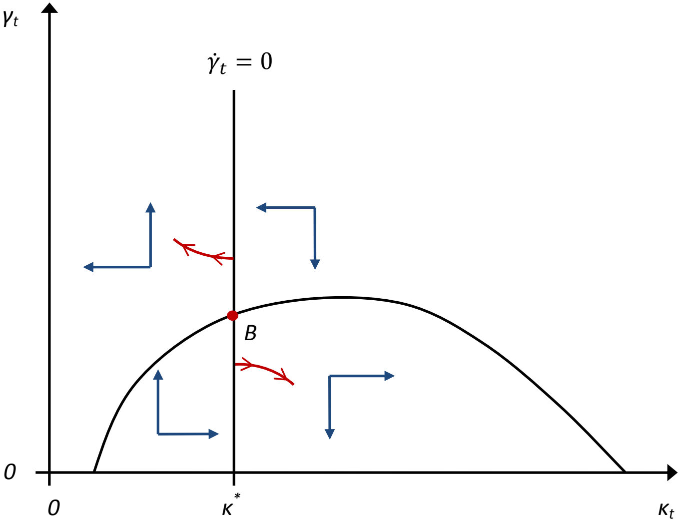
Effect of an unexpected temporary increase in χ_t II

- From t_1, χ_t is constant over time, equal to its old value, and there are no more surprises, so the economy is on its old saddle path.

- From t_0 to t_1, the possible paths are those that
    - start from a point C on the vertical straight line,
    - go northwestwards if C is above B,
    - remain at B if C coincides with B,
    - go southeastwards if C is below B.

- For the economy to be on its old saddle path at t_1, C must lie between A and B.

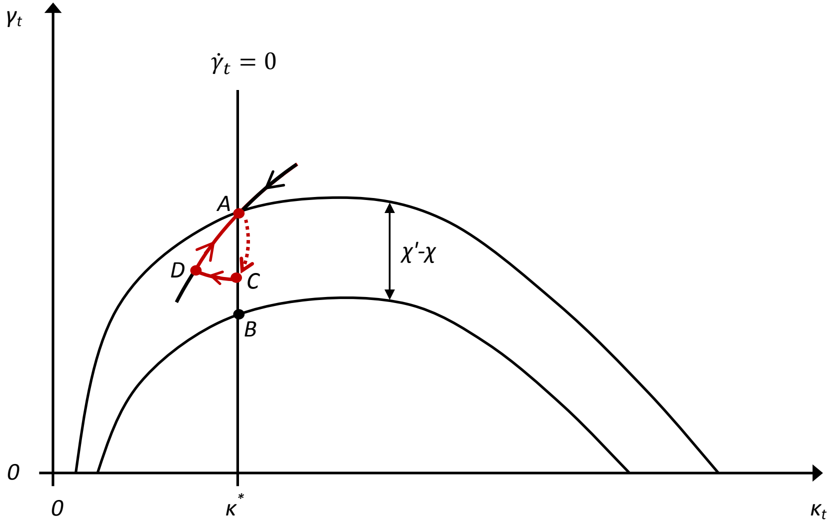
Effect of an unexpected temporary increase in χ_t III



Effect of an unexpected temporary increase in χ_t IV

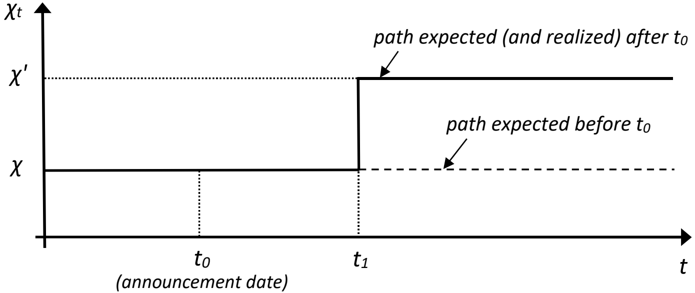
- So, the economy jumps from A to C at t_0, then moves from C to D between t_0 and t_1, then moves from D to A between t_1 and $+\infty$.
- Consumption γ_t falls at t_0 by less than $\chi' - \chi$ because the temporary increase in χ_t reduces at t_0 the actualized value of households' future after-tax incomes by less than $(\chi' - \chi) \int_{t_0}^{+\infty} e^{-\int_{t_0}^{t}(r_\tau - n)d\tau} dt$.
- From t_0 to t_1, γ_t increases, despite the high level of χ_t, thanks to a larger and larger decrease in κ_t ($\ddot{\kappa}_t < 0$).
- From t_1, γ_t increases as κ_t recovers.
- This path is preferable to the path that jumps from A to B at t_0, remains at B between t_0 and t_1, and then jumps back from B to A at t_1, because it smooths γ_t and $\dot{\gamma}_t$ over time from t_0.

Effect of an unexpected temporary increase in χ_t V



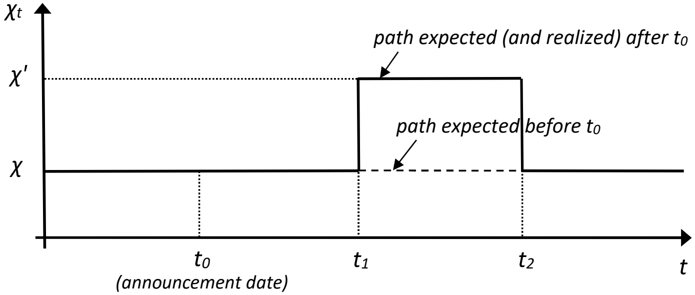
Effect of an expected permanent increase in χ_t

- Part 6 of the tutorials studies the effect of an **expected permanent** increase in χ_t: there exist two times t_0 and t_1 such that $t_0 < t_1$ and
  - $\forall t < t_0$, (i) $\chi_t = \chi$, (ii) households expect that $\forall \tau \geq t$, $\chi_\tau = \chi$, and (iii) the economy is at the corresponding steady state,
  - the government credibly announces at t_0 that (i) $\forall t \in [t_0; t_1[$, $\chi_t = \chi$, and (ii) $\forall t \geq t_1$, $\chi_t = \chi' > \chi$,
  - the government conducts, from t_0, the fiscal policy announced at t_0,



Effect of an expected temporary increase in χ_t

- Part 6 of the tutorials also studies the effect of an **expected temporary** increase in χ_t: there exist three times t_0, t_1, t_2 such that $t_0 < t_1 < t_2$ and
  - $\forall t < t_0$, (i) $\chi_t = \chi$, (ii) households expect that $\forall \tau \geq t$, $\chi_\tau = \chi$, and (iii) the economy is at the corresponding steady state,
  - the government credibly announces at t_0 that (i) $\forall t \in [t_0; t_1[$, $\chi_t = \chi$, (ii) $\forall t \in [t_1; t_2[$, $\chi_t = \chi' > \chi$, and (iii) $\forall t \geq t_2$, $\chi_t = \chi$,
  - the government conducts, from t_0, the fiscal policy announced at t_0.



Conclusion

Main predictions of the model

- The effect of public expenditures on the economy does not depend on the way these expenditures are financed (Ricardian equivalence).
- An unexpected and permanent increase in public expenditures reduces consumption permanently and leaves the capital stock unchanged.
- An unexpected and temporary increase in public expenditures reduces consumption and the capital stock temporarily.

One limitation of the model

- The model implies the Ricardian equivalence, whose empirical validity is uncertain.

- If the model were modified so as not to imply the Ricardian equivalence anymore, what would be the effect of public expenditures depending on the way they are financed?

  $\hookrightarrow$ Chapter 7 studies the effects of fiscal policy in the overlapping-generations model, which does not imply the Ricardian equivalence (even when taxes are lump-sum).