The dynamics of sovereign debt crises in a monetary union.

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Outline

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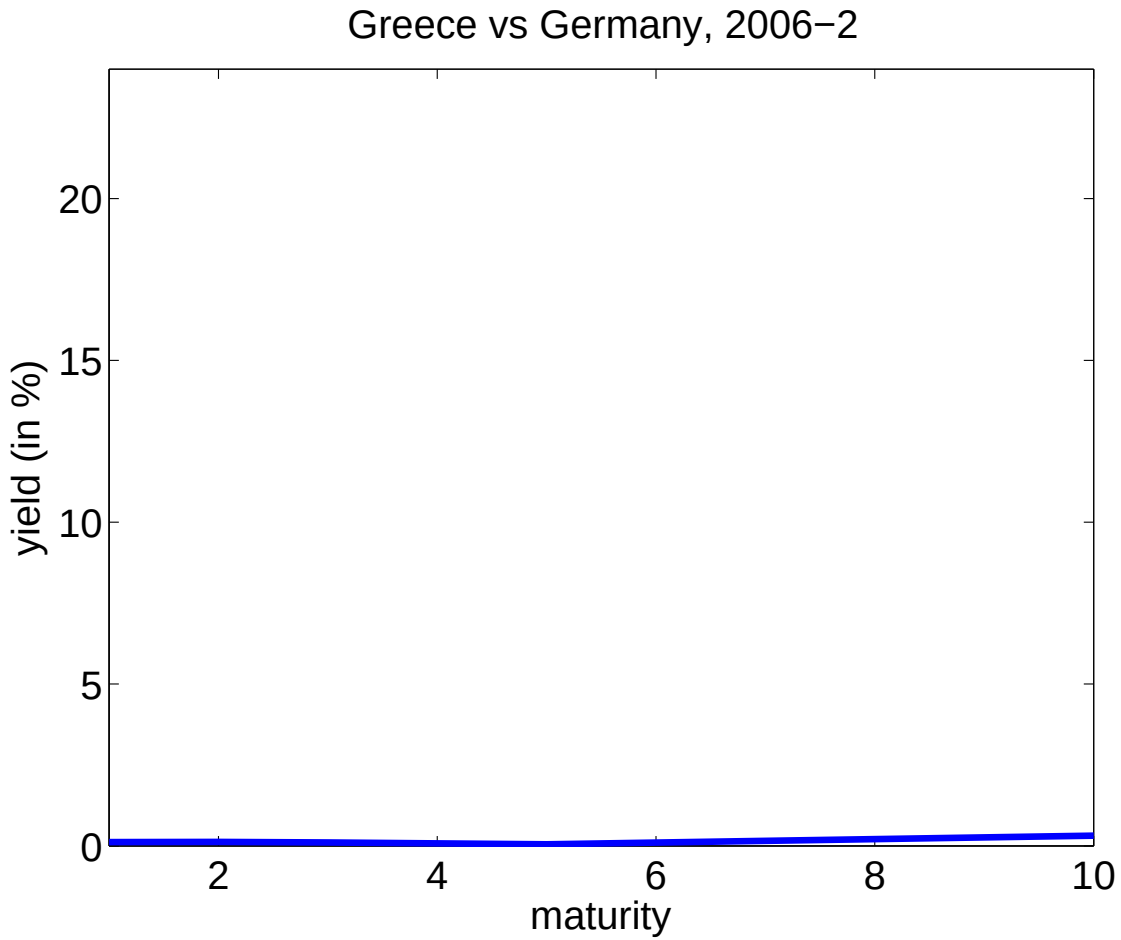
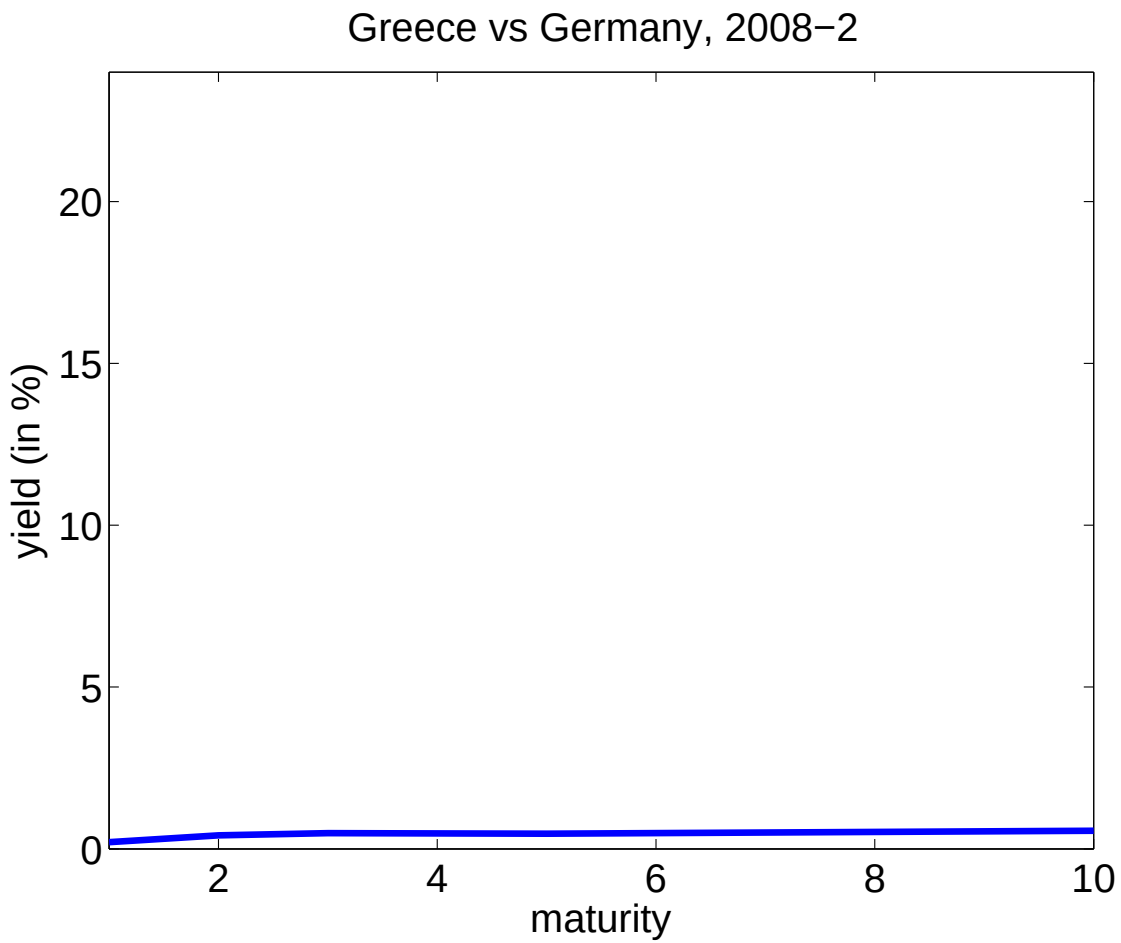
Motivation

- 2010: fears of a Greek default.
- Contagion? Euro crisis? European banking crisis?
- May 2010: EMU-IMF rescue package.
- European Financial Stability Facility (EFSF)
- Nonetheless, spreads remain high and fears persist.

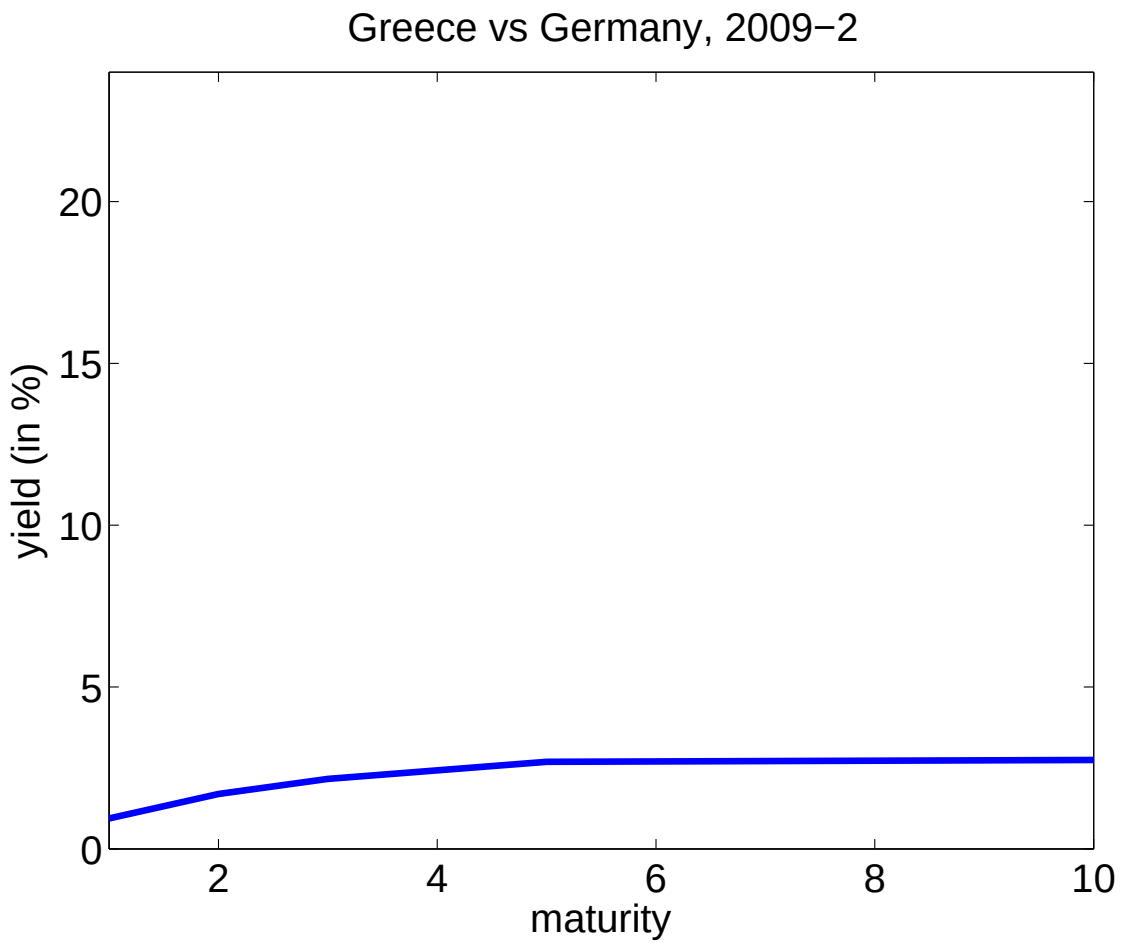
Greek-German Yield Spreads: Feb 2006



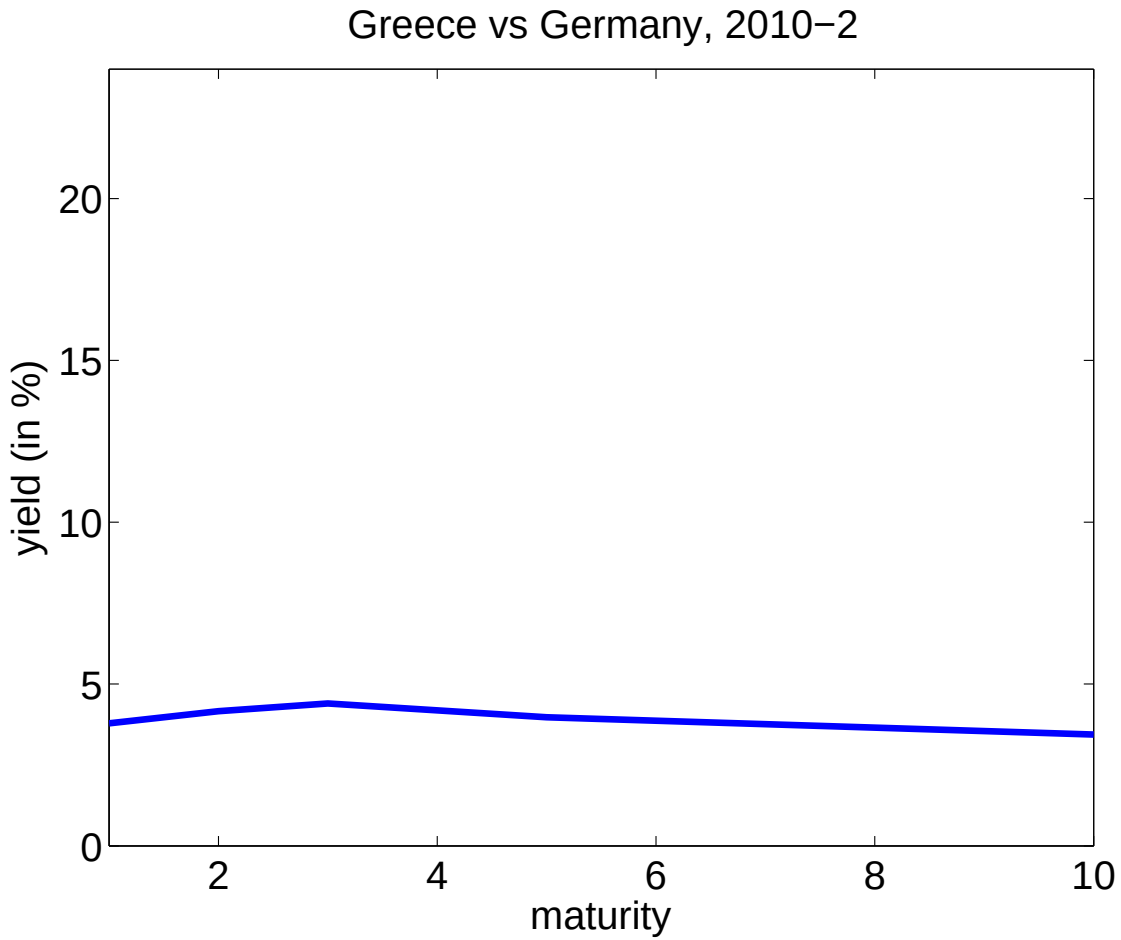
Greek-German Yield Spreads: Feb 2008



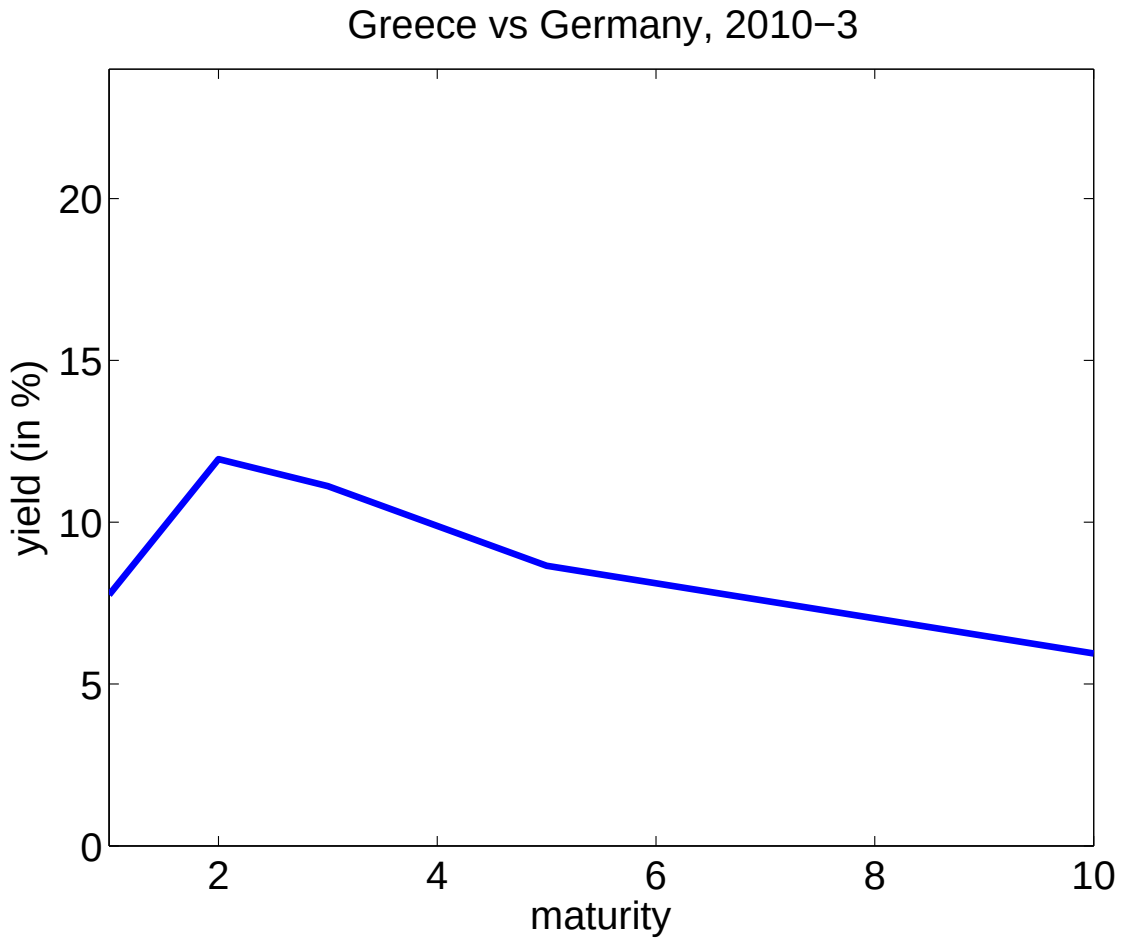
Greek-German Yield Spreads: Feb 2009



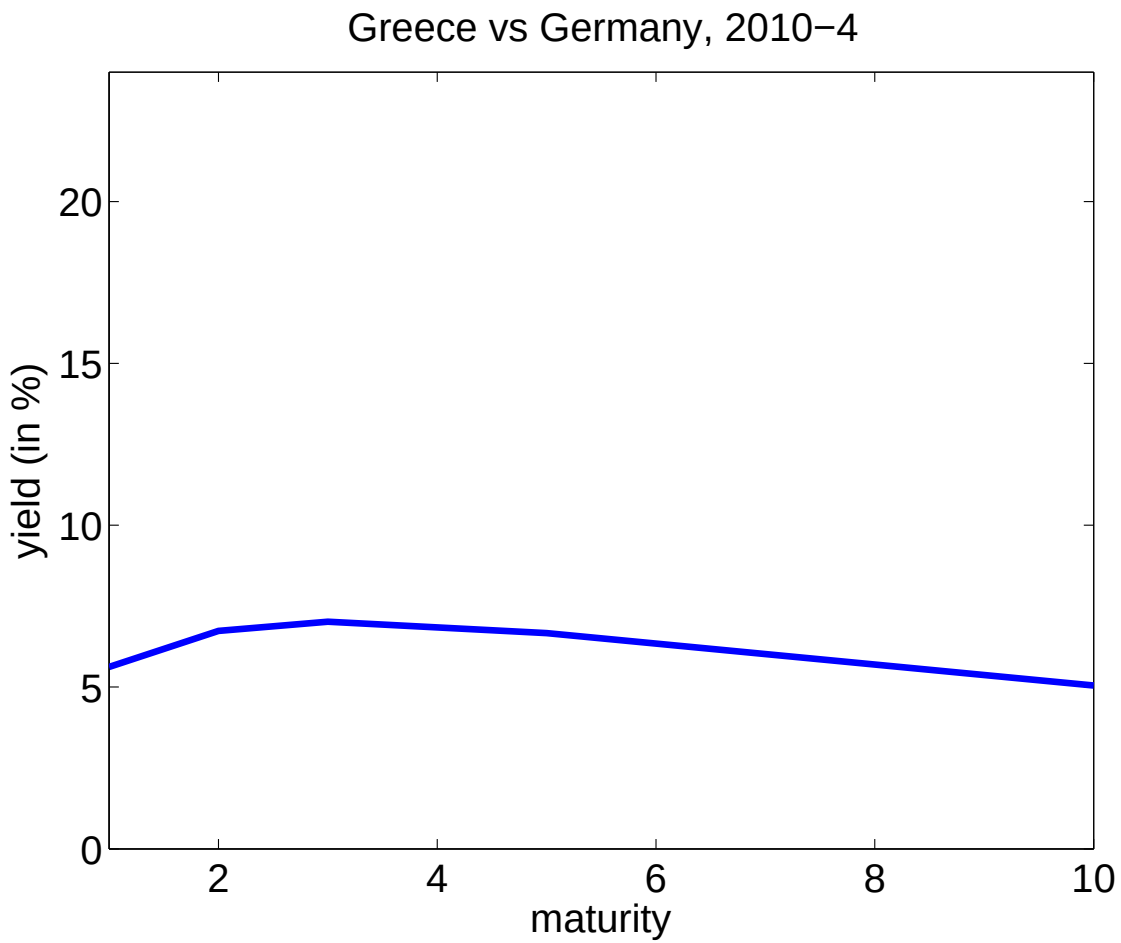
Greek-German Yield Spreads: Feb 2010



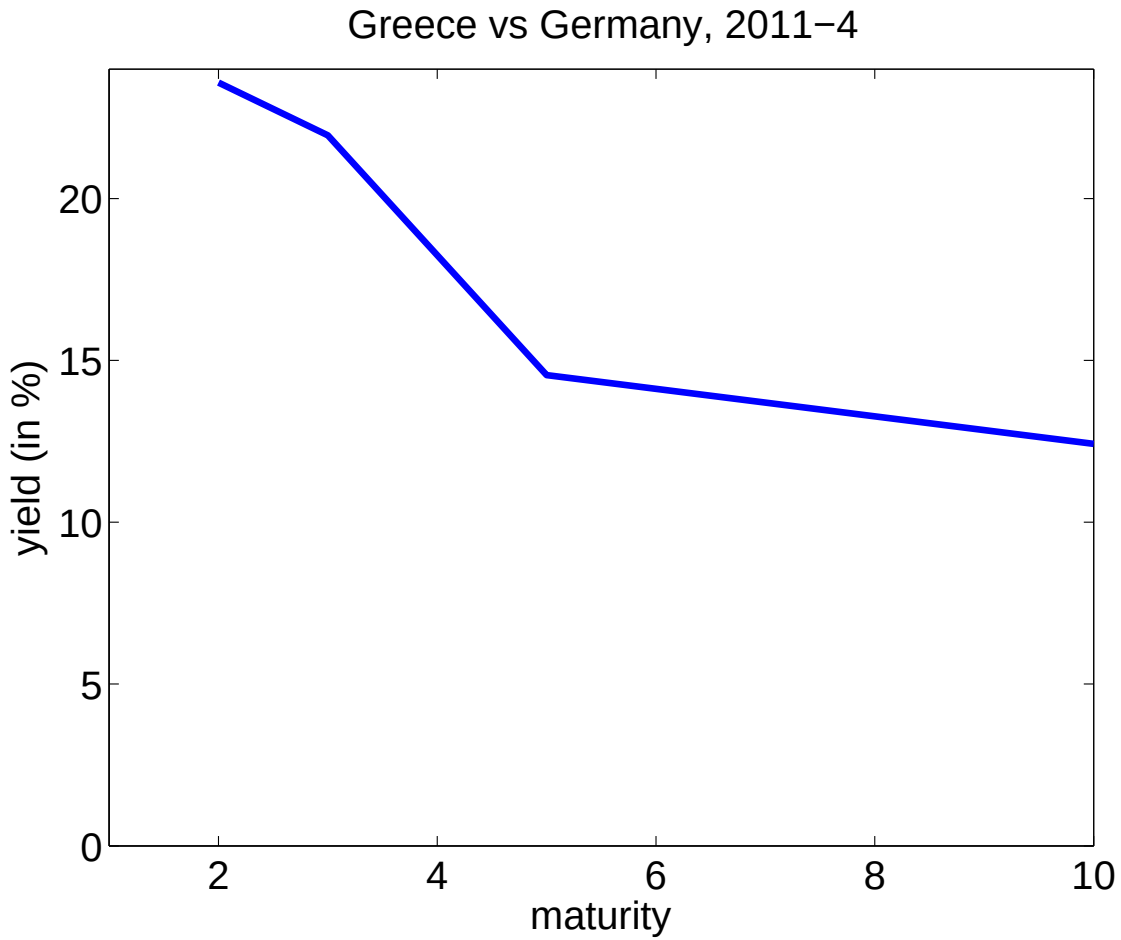
Greek-German Yield Spreads: Mar 2010



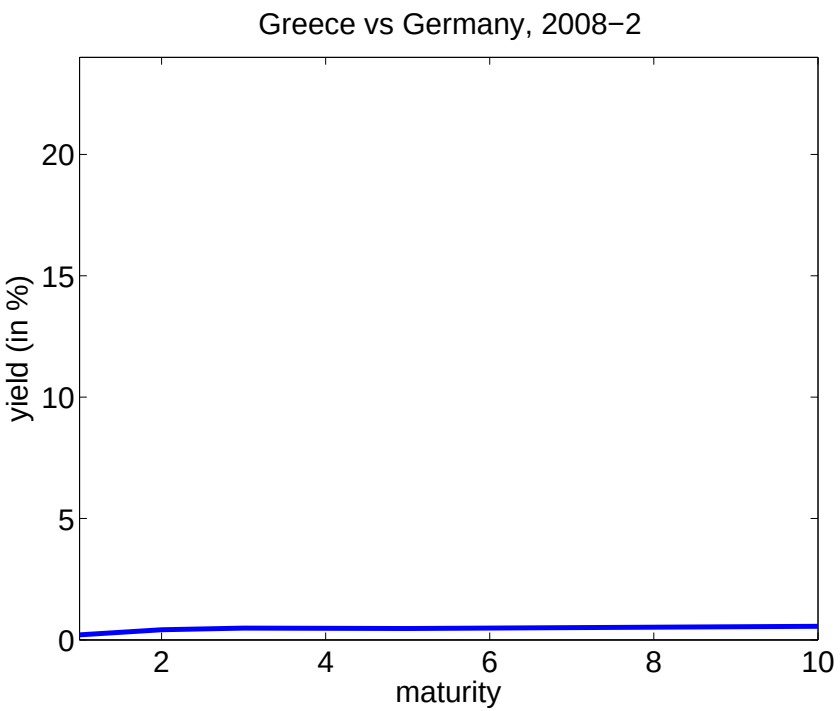
Greek-German Yield Spreads: Apr 2010

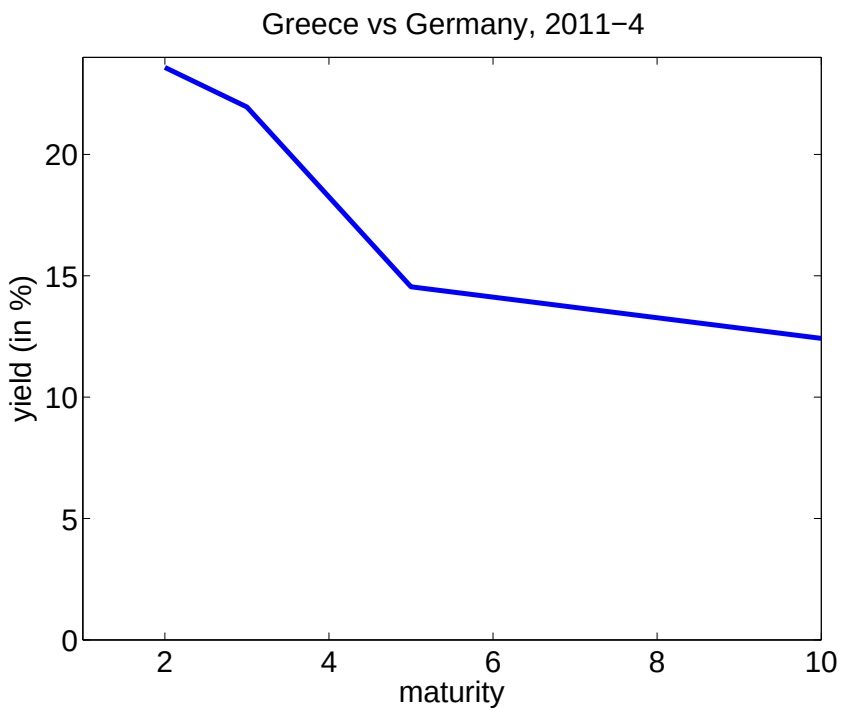


Greek-German Yield Spreads: Apr 2011

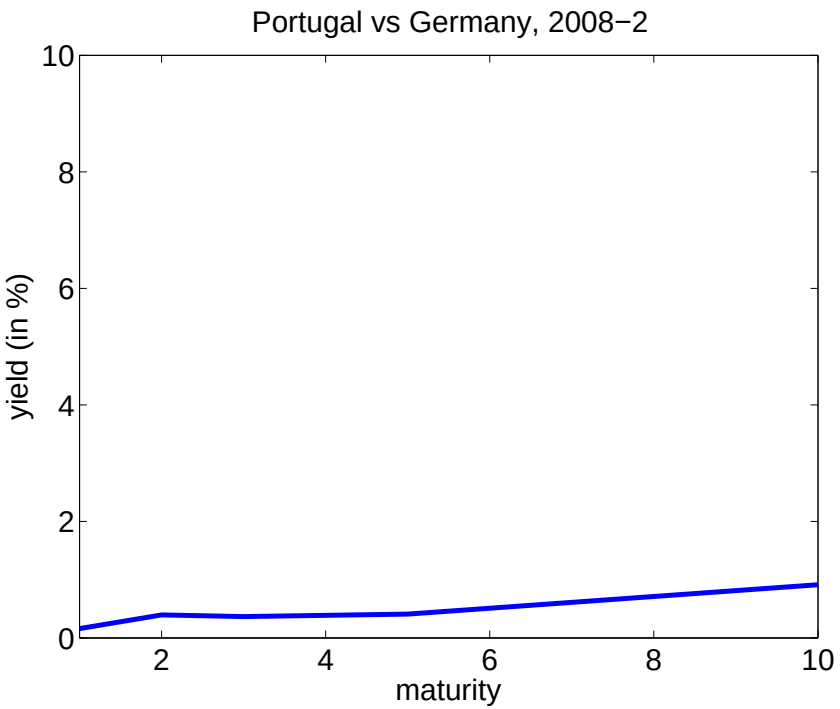


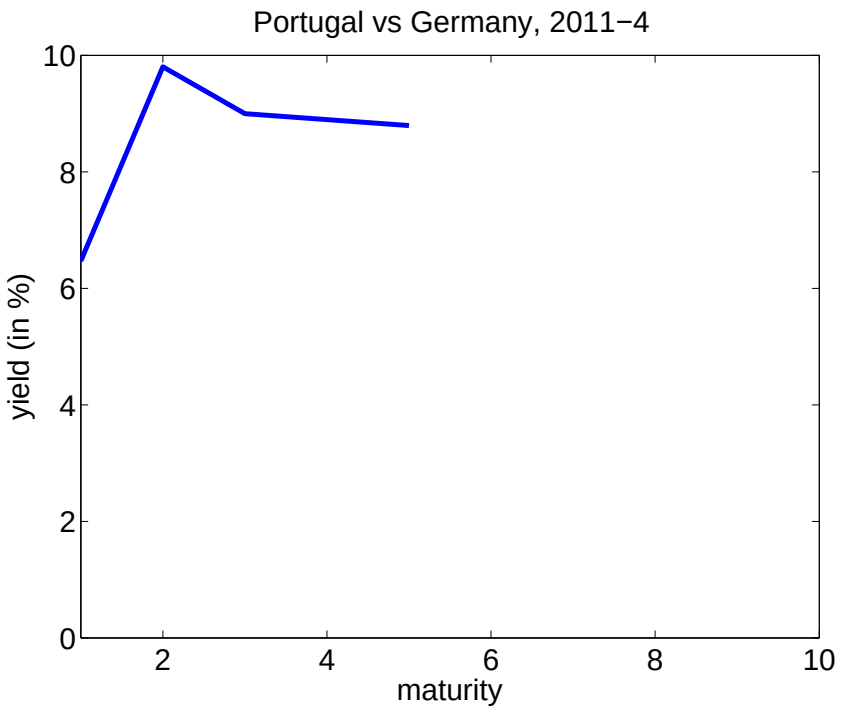
Greek-German Yield Spreads: Feb 2008 vs Apr 2011



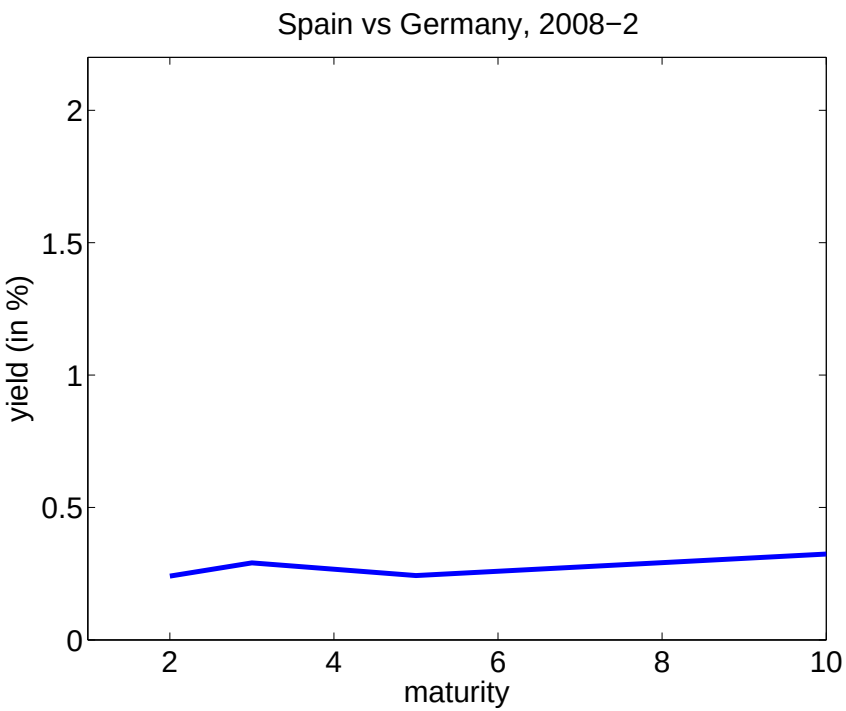


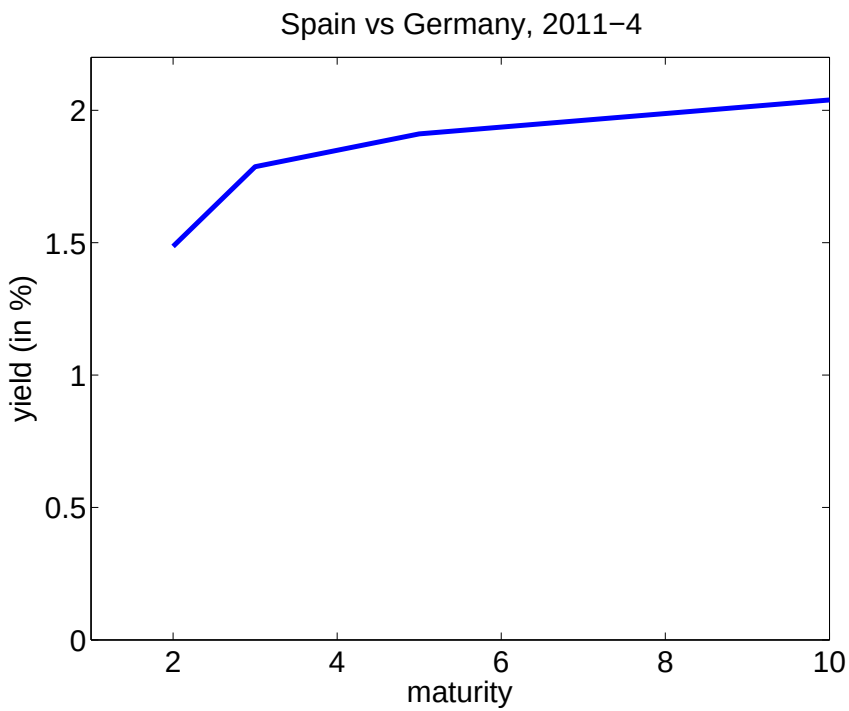
Portugal-Ger. Yield Spreads: Feb 2008 vs Apr 2011



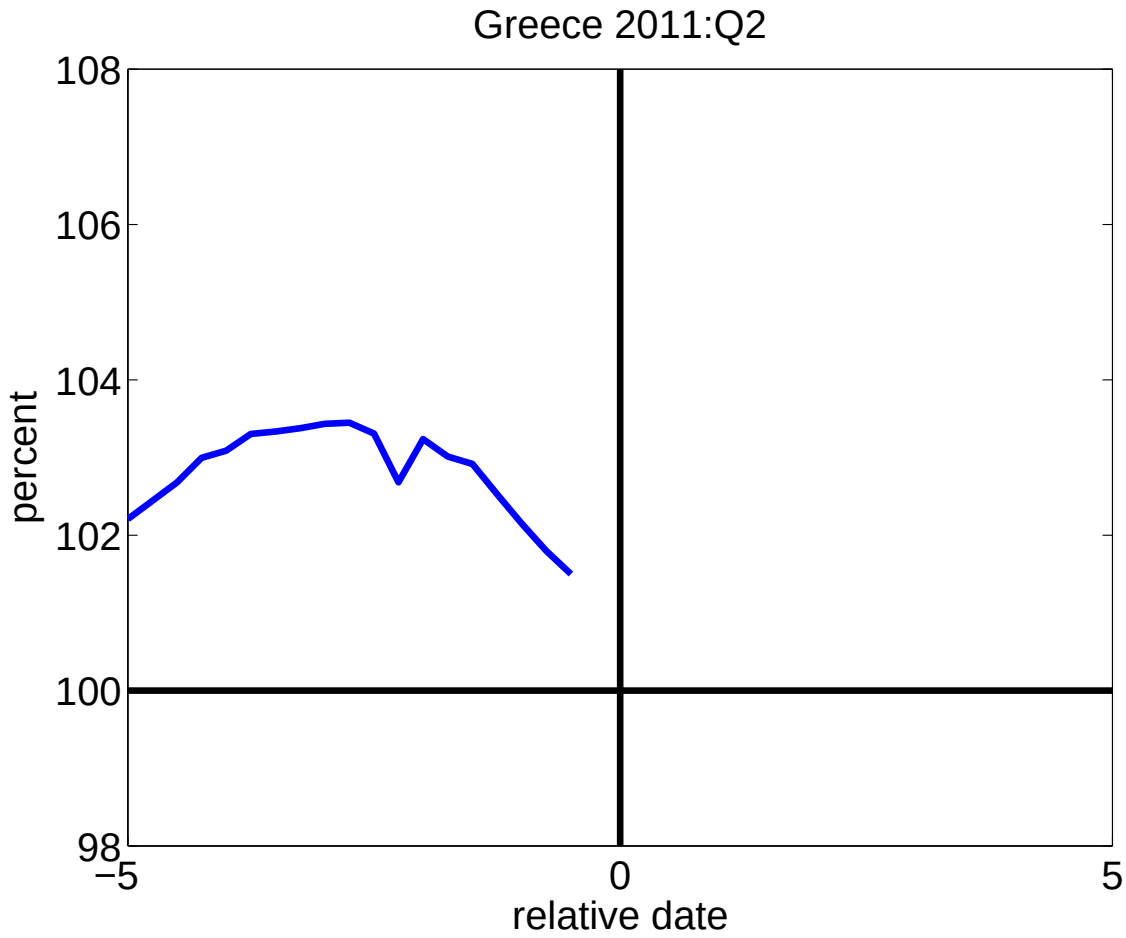


Spain-German Yield Spreads: Feb 2008 vs Apr 2011

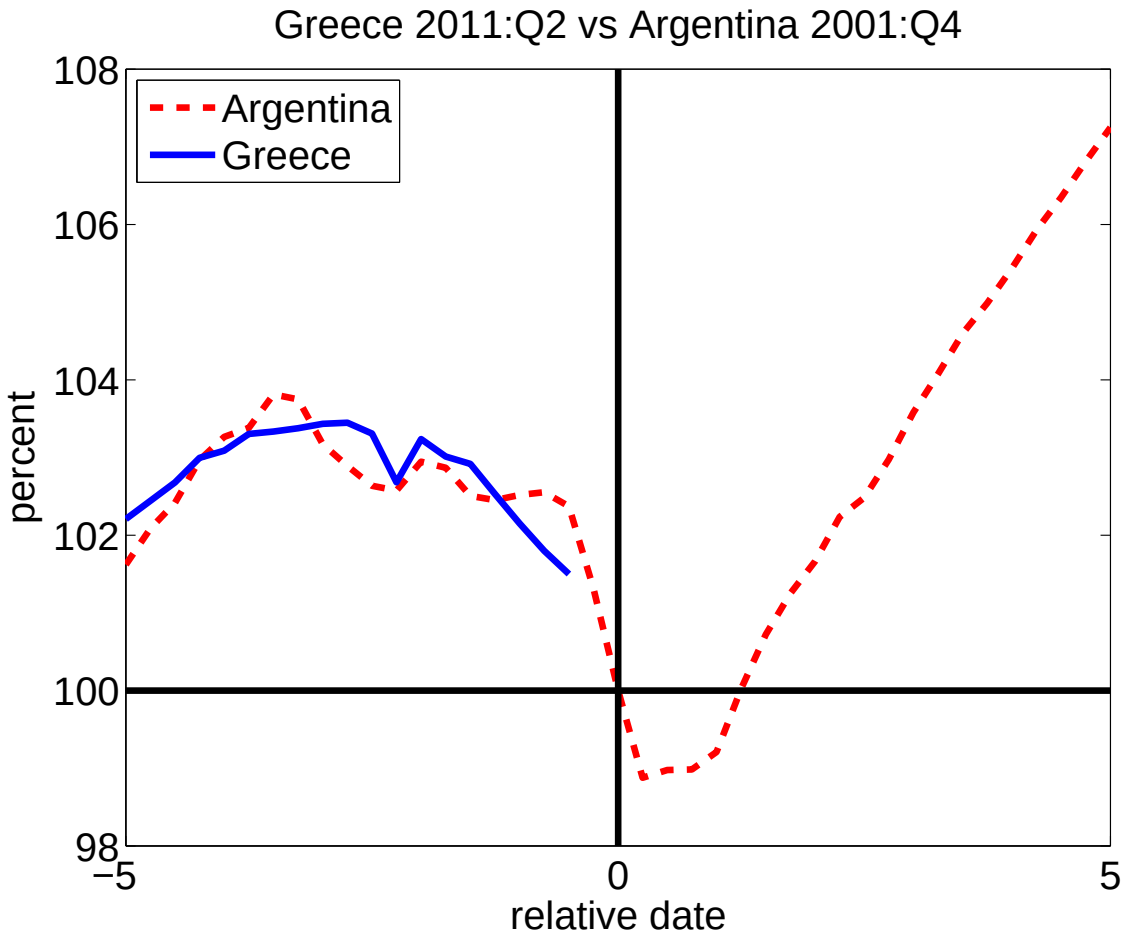




Greece GDP vs 2011:Q2



Greece GDP vs Argentine GDP



Goal

- Modelling financial crises ...
  - self-fulfilling default possibility, Cole-Kehoe (2000)
  - random income shocks, Arellano (2008)
  - short-sighted politicians, Beetsma-Uhlig (1999)
- ... and the role of bailouts.
- Contagion and amplification in a monetary union.

Fiscal policy in a monetary union

- Cooper-Kempf (2004) / Cooper-Kempf-Peled (2009, 2010): fiscal policy in a monetary union is crucial. Spillovers will be there. Incentives for excessive deficits.
- Beetsma-Uhlig (1999): a growth-and-stability pact is needed.
- Uhlig (2003): “what if” a sovereign defaults in EMU?

Outline

The government

Arellano (2008).

- Government objective:

$$U = \sum_{t=0}^{\infty} \beta^t (u(c_t) - \chi_t \delta_t)$$

  - c_t: gov. spending.
  - y_t: tax receipts.
  - $\delta_t = 1$: default in t. χ_t: loss in "face".

- Budget constraint:

$$c_t + (1-\theta)B_t = y_t + q_t(B_{t+1})(B_{t+1} - \theta B_t)$$

- $0 < \theta \leq 1$: maturity.
- Once defaulted, forever excluded. Then, $c_t = y_t$.

Debt pricing

- Risk neutral traders. Discount future with R.
- Debt pricing schedule: $q_{m,t}(B_{t+1})$.
- International assistance ("bailout"): $q_{a,t}(B_{t+1}) \geq 0$.
- (Future version: conditionality...)
- $$q_t(B_{t+1}) = \max\{q_{m,t}(B_{t+1}), q_{a,t}(B_{t+1})\}$$

Timing

1. Shocks are realized.
2. Pricing schedule established.
3. Government decides:
   - Default or
   - pay and issue new debt.
4. government consumes.

Outline

State space representation

Cole-Kehoe (2000)

- State is

$$s = (B, d, z)$$

where B: debt, d: default status, z: exogenous random variables,

$$z = (y, \zeta, \psi)$$

- $y \in [y_L, y_H]$, $0 < y_L \leq y_H$, with strictly positive and continuous density iid.
- $\zeta \in [0, 1]$ uniform, iid: "crisis" sunspot.
- $\psi \in [0, 1]$ uniform, iid: "bailout" sunspot.

Budget, if not defaulted:

$$c + (1 - \theta)B(s) = y(s) + q(B'; s)(B' - \theta B(s))$$

Value functions

- Default:

$$v_D(z) = u(y(z)) + \beta E\left[v_D(z') \mid z\right]$$

- No default:

$$v_{ND}(s) = \max_{c,B'}\{u(c) + \beta E\left[v(s') \mid z\right] \mid$$
$$c + (1-\theta)B(s) = y(s) + q(B';s)(B' - \theta B(s))$$
$$s' = (B', d(s), z')\}$$

- Overall:

$$v(s) = \max_{\delta\in\{0,1\}} (1-\delta)v_{ND}(s) + \delta(v_D(z(s)) - \chi(s))$$

Equilibrium

1. Given $q(B';s)$, the government maximizes its utility with the choices $c(s), \delta(s)$ and $B'(s)$, s.t. the budget constraint.
2. The market pricing function $q_m(B';s)$ is consistent with risk-neutral pricing of government debt.
3. The pricing function satisfies

$$q(B';s) = \max\{q_m(B';s), q_a(B';s)\}$$

Outline

Continuation probabilities

- Given B, let $A(B)$ be the set of no-default z:

$$A(B) = \{z \mid \delta(s) = 0 \text{ for } s = (B, 0, z)\}$$

- Continuation probability:

$$P(B'; s) = \text{Prob}(z' \in A(B') \mid s) = E\left[1_{\delta(s')=0} \mid s\right]$$

- $q(B'; s) = \bar{q}(B'; s)$: if no default today.
- If $\theta = 0$, i.e one-period debt: market price is

$$\bar{q}_m(B'; s) = \frac{1}{R} P(B'; s)$$

Sunspots

- Suppose, $q(B';s) = \bar{q}(B';s)$ is consistent with debt repayment now. Let

$$\bar{v}_{ND}(s) = \max_{c,B'}\{u(c) + \beta E\left[v(s') \mid z\right] \mid$$
$$c + (1-\theta)B(s) = y(s) + \bar{q}(B';s)(B' - \theta B(s))\}$$

  Maximal debt level:

$$\bar{B}(z) = \inf\{B \mid \bar{v}_{ND}(s = (B,0,z)) \leq v_D(z(s)) - \chi(s = (B,0,z))\}$$

- Suppose, $q(B';s) = q_a(B';s)$ is consistent with default now. Let

$$\underline{v}_{ND}(s) = \max_{c,B'}\{u(c) + \beta E\left[v(s') \mid z\right] \mid$$
$$c + (1-\theta)B(s) = y(s) + q_a(B';s)(B' - \theta B(s))\}$$

  Maximal debt level:

$$\underline{B}(z) = inf\{B \mid \underline{v}_{ND}(s = (B,0,z)) \leq v_D(z(s)) - \chi(s = (B,0,z))\}$$

Sunspot assumption

Assumption A.

For some parameter $\pi \in [0,1]$*, and all* s *with* $\underline{B}(z) \leq B(s) \leq \bar{B}(z)$*, we have* $q_m(B';s) = \bar{q}_m(B';s)$*, if* $\zeta(s) \geq \pi$ *and* $q_m(B';s) = 0$*, if* $\zeta < \pi$*.*

Sunspot equilibrium

Cole-Kehoe (2000): assume constant probability π of sunspot default.

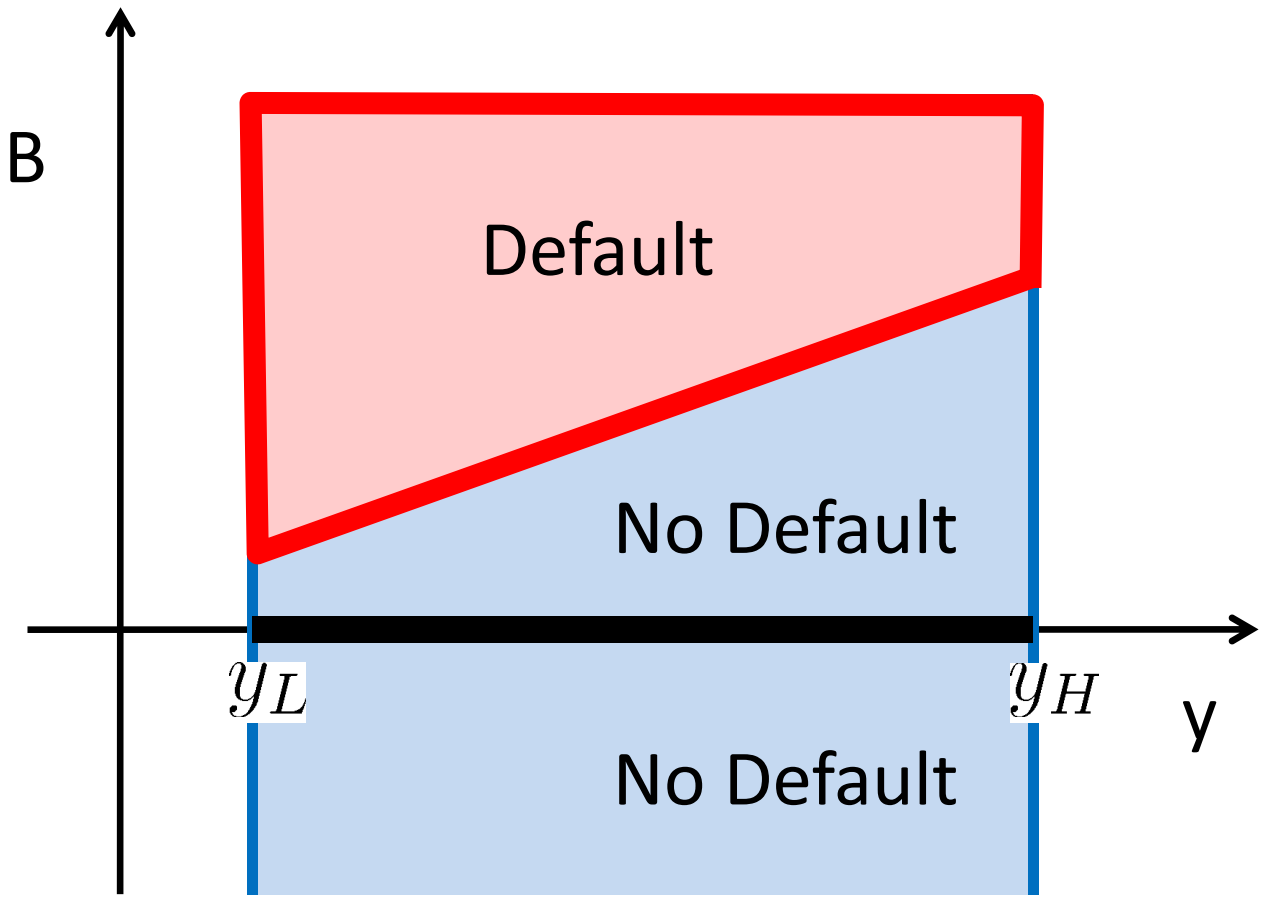
1. If $B > \bar{B}(z)$, default now. Market price for new debt is zero.
2. If $\underline{B}(z) \leq B \leq \bar{B}(z)$,
   1. default with probability π (i.e. $\zeta(z) < \pi$).
      Market price for new debt is zero.
   2. continue with probability $1 - \pi$ (i.e. $\zeta(z) \geq \pi$).
      Market price for new debt is $\bar{q}_m(B'; s)$.
3. If $B < \underline{B}(z)$, no default. Market price for new debt is $\bar{q}_m(B'; s)$.

Crisis zone

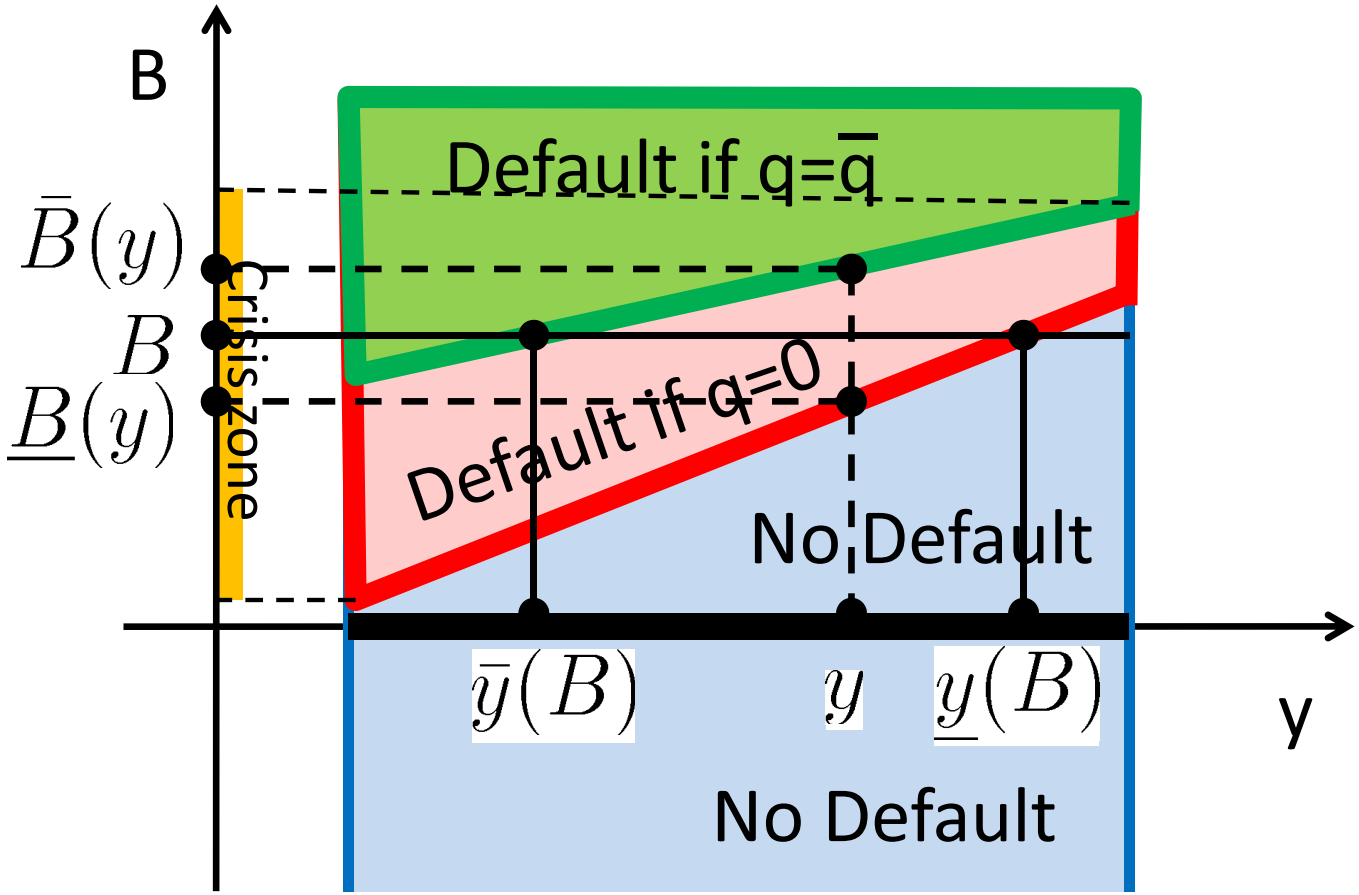
$$B' \in \mathcal{B} = \left[\min \underline{B}(z), \max \bar{B}(z)\right]$$

Outline

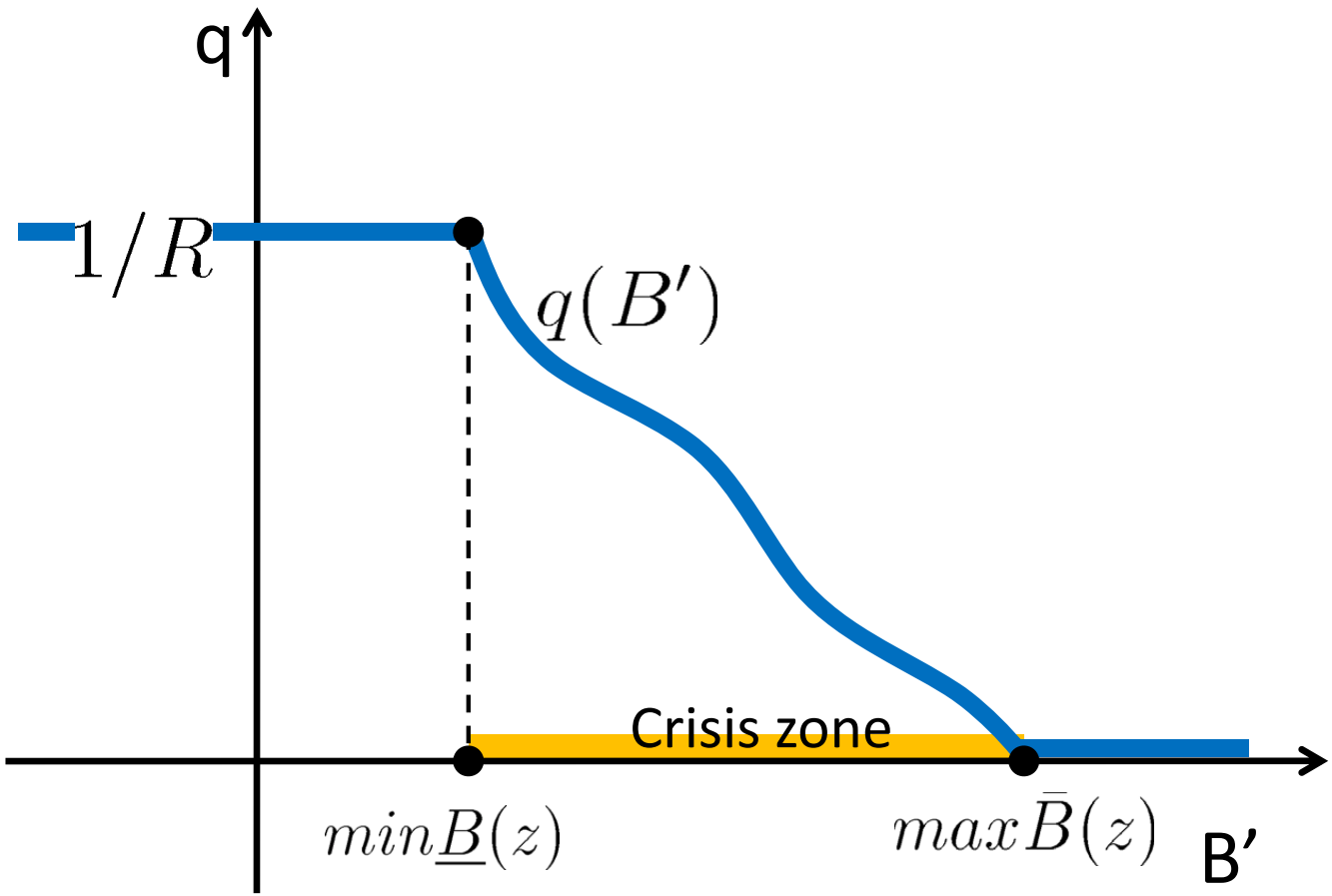
Default decision



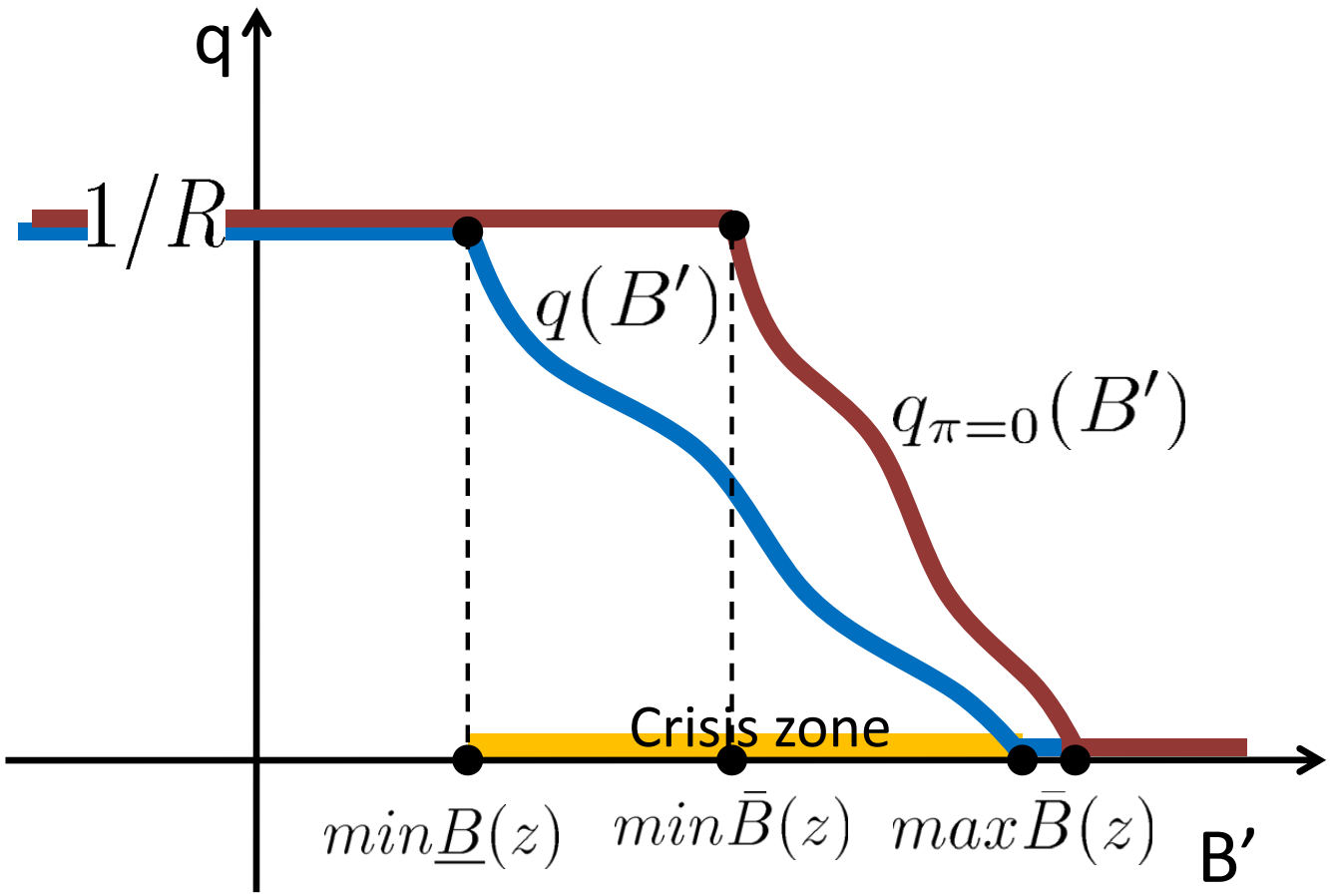
Sunspot


B
$\bar{B}(y)$
B
$\underline{B}(y)$
crisis zone
Default if q=$\bar{q}$
Default if q=0
No Default
$\bar{y}(B)$
y
$\underline{y}(B)$
y
No Default

Debt pricing



Debt pricing with and without sunspots



A first order condition

Proposition

If optimum = first-order condition, then

$$q(B';s) + q_1(B';s)B' = \beta E\left[\frac{u'(c(s'))}{u'(c(s))}(1-\theta+\theta q(B''(s');s'))1_{\delta(s')=0}\right]$$

If $\theta = 0$ *(only short-term debt), then* **FOC**

$$q(B';s) + q_1(B';s)B' = \beta E\left[\frac{u'(c(s'))}{u'(c(s))}1_{\delta(s')=0}\right]$$

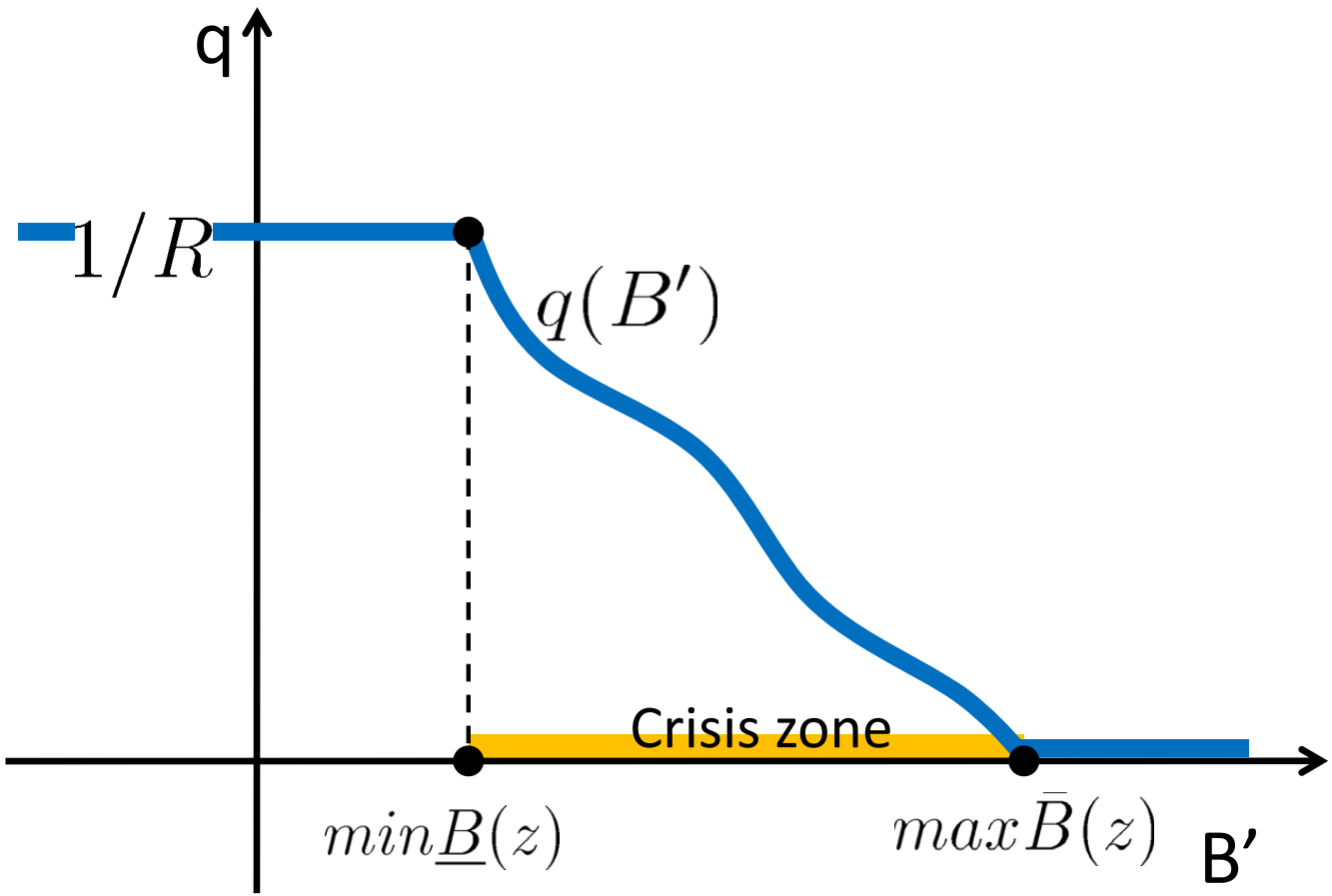
or

$$1 - h(B';s)B' = \beta R E\left[\frac{u'(c(s'))}{u'(c(s)} \mid \delta(s') = 0\right]$$

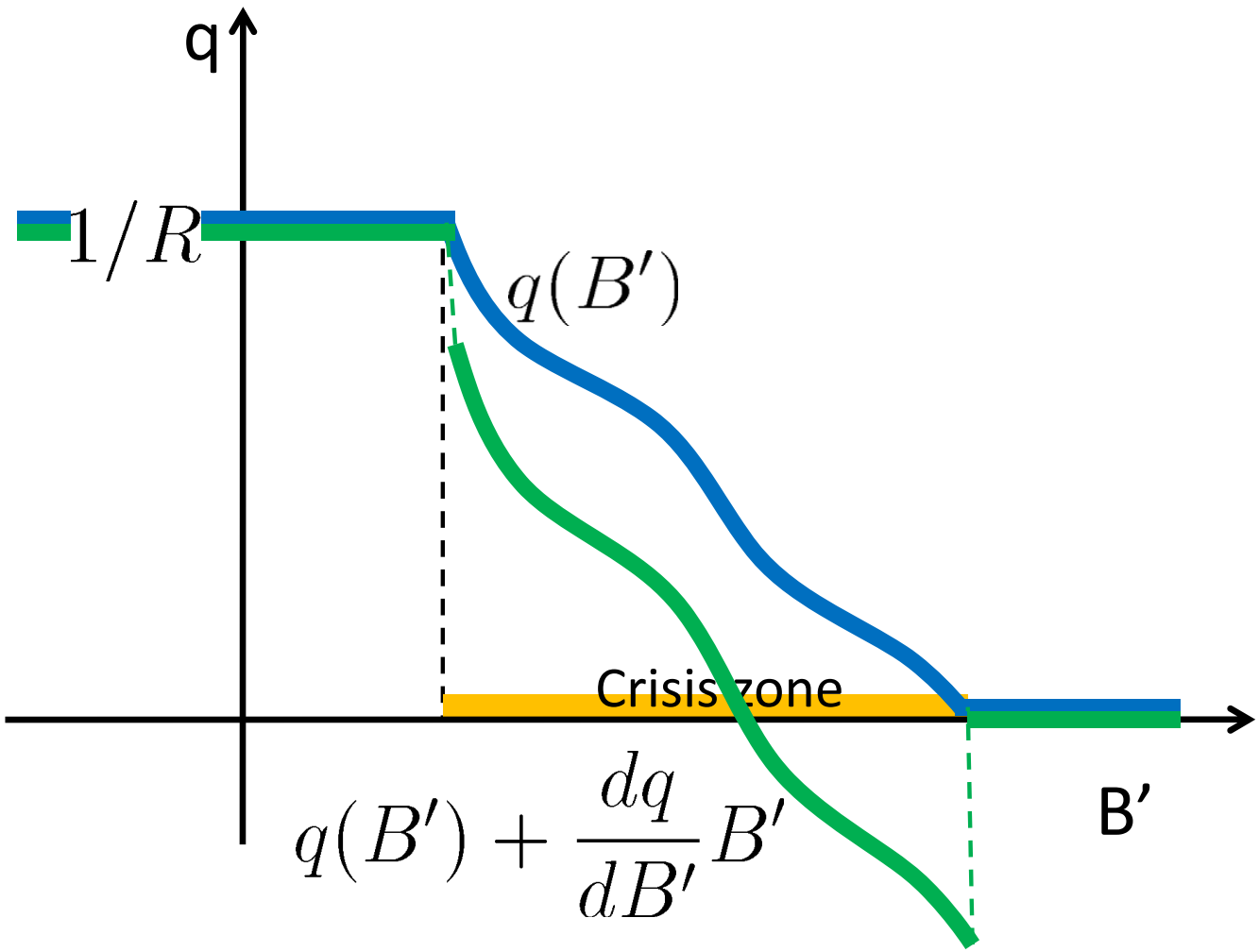
where

$$h(B';s) = -\frac{\partial E\left[\delta(s') = 0\right]/\partial B'}{E\left[\delta(s') = 0\right]}$$

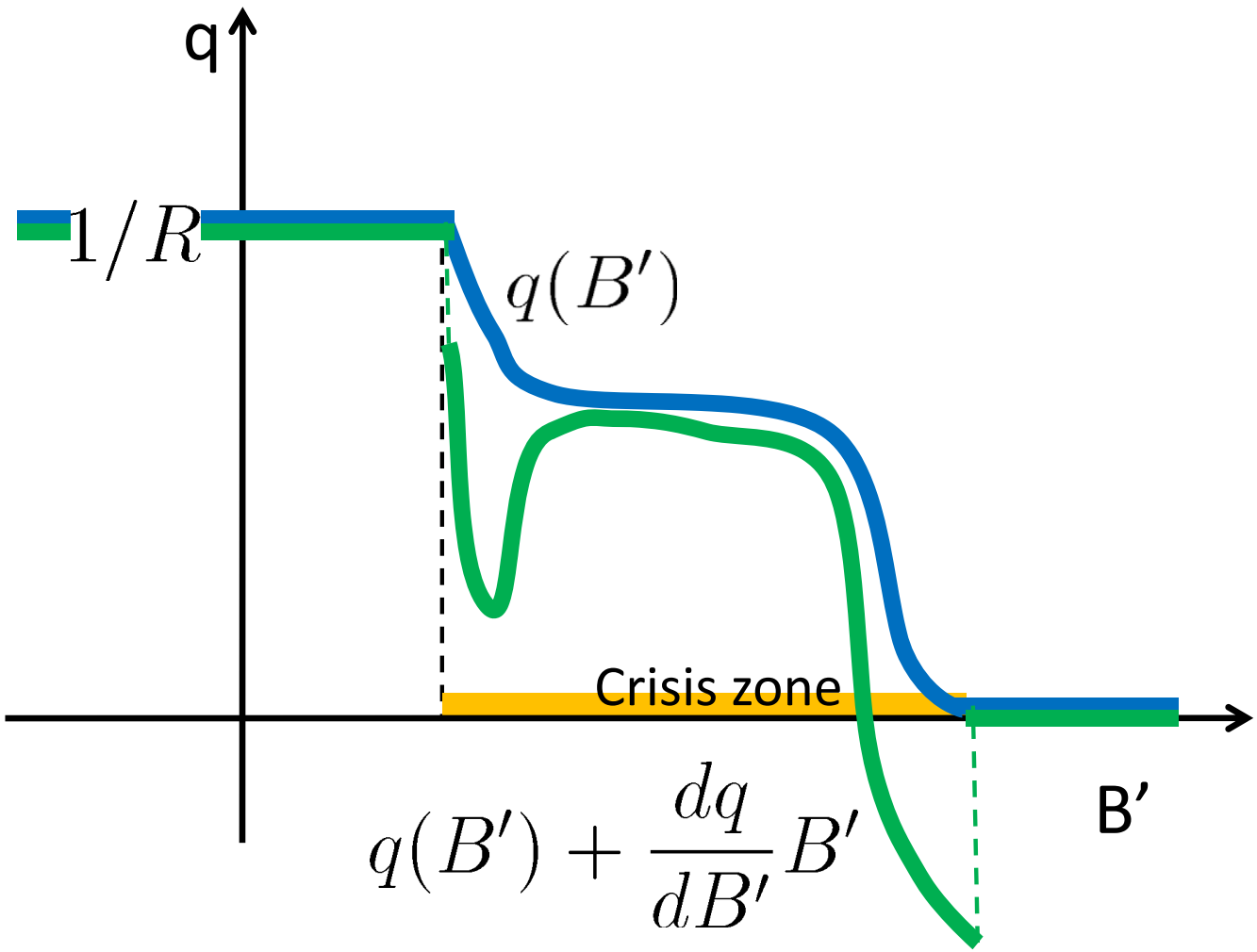
The market price $q(B')$



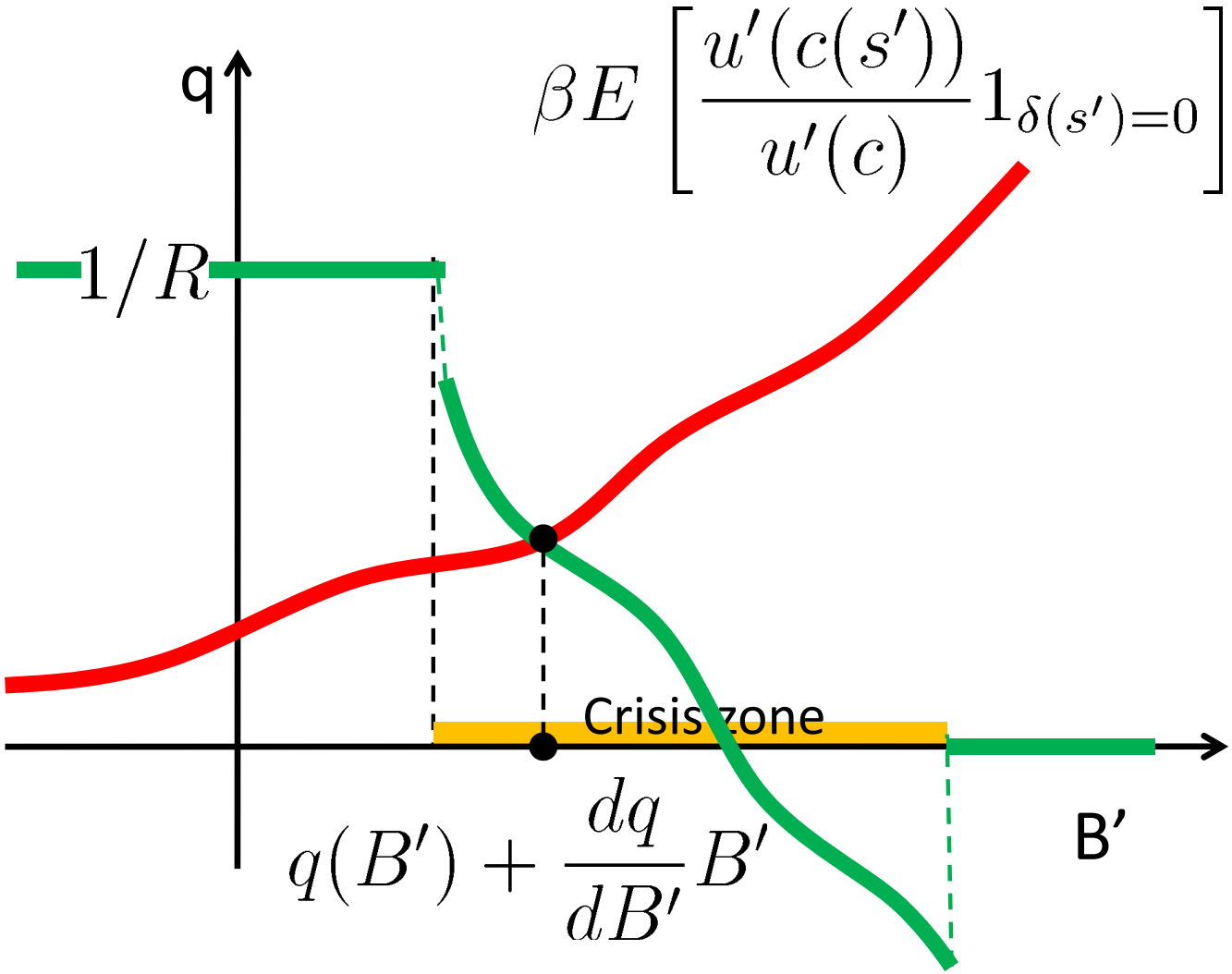
The market price $q(B')$ vs the lhs of **FOC**



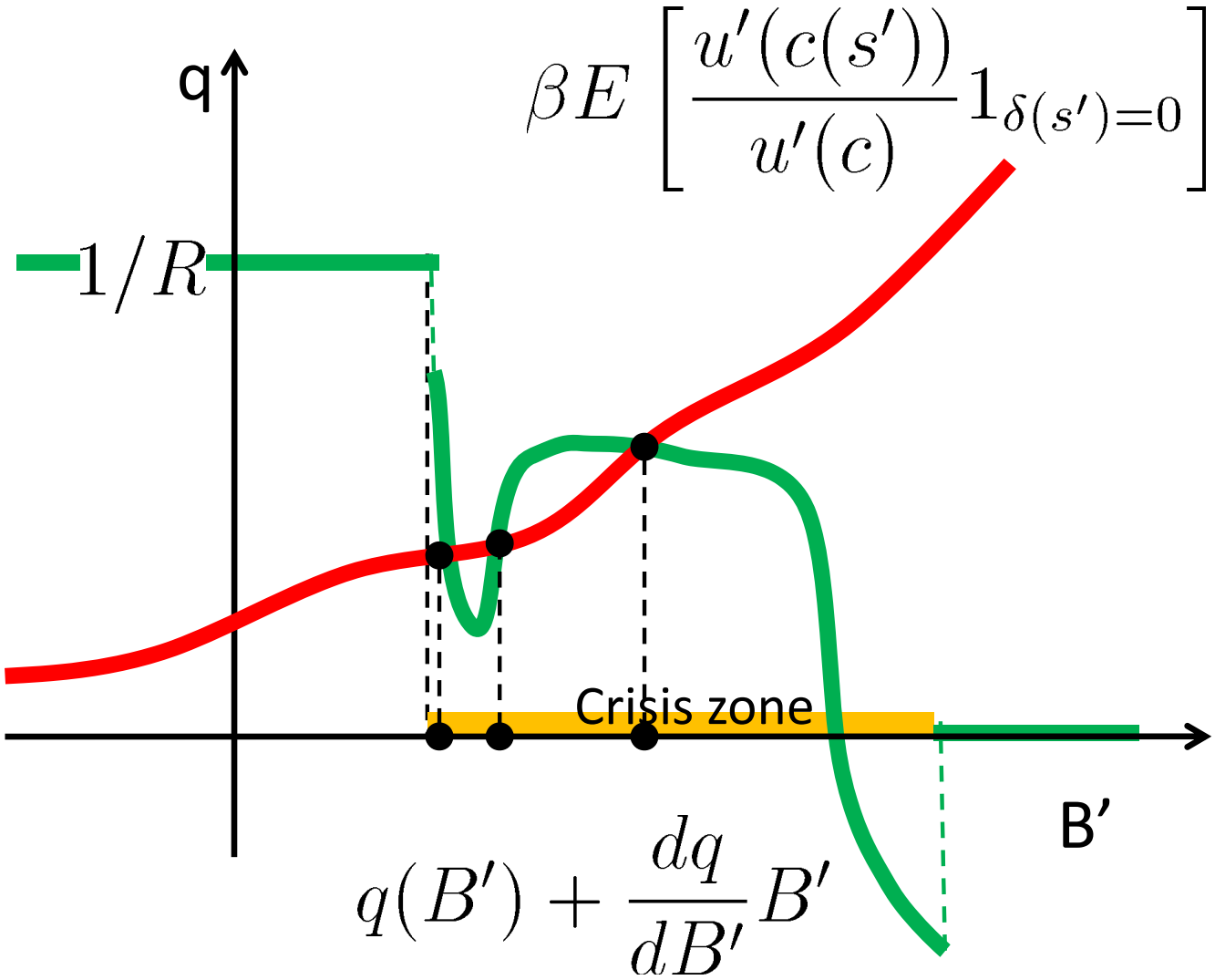
The market price $q(B')$ vs the lhs of **FOC**



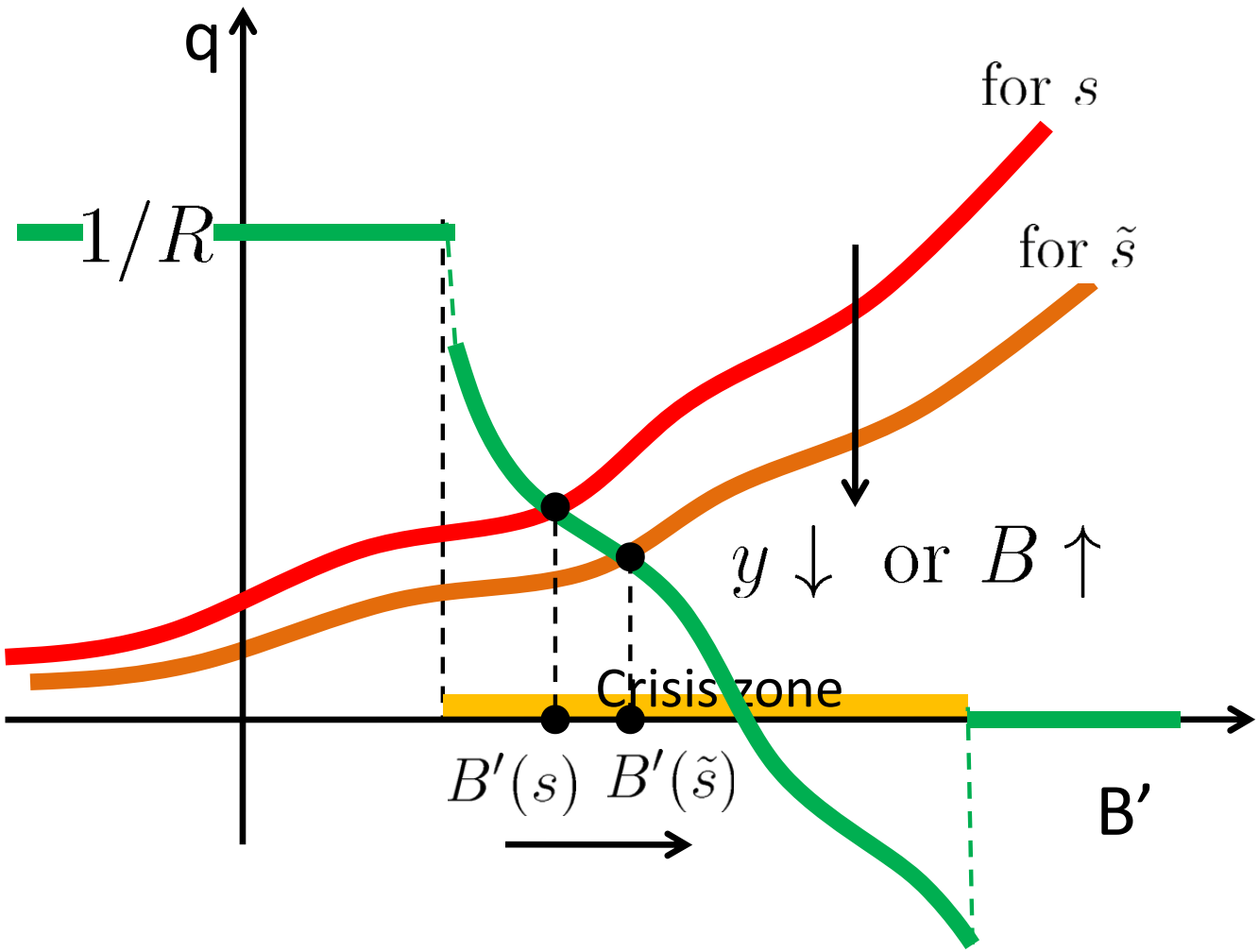
The two sides of **FOC**



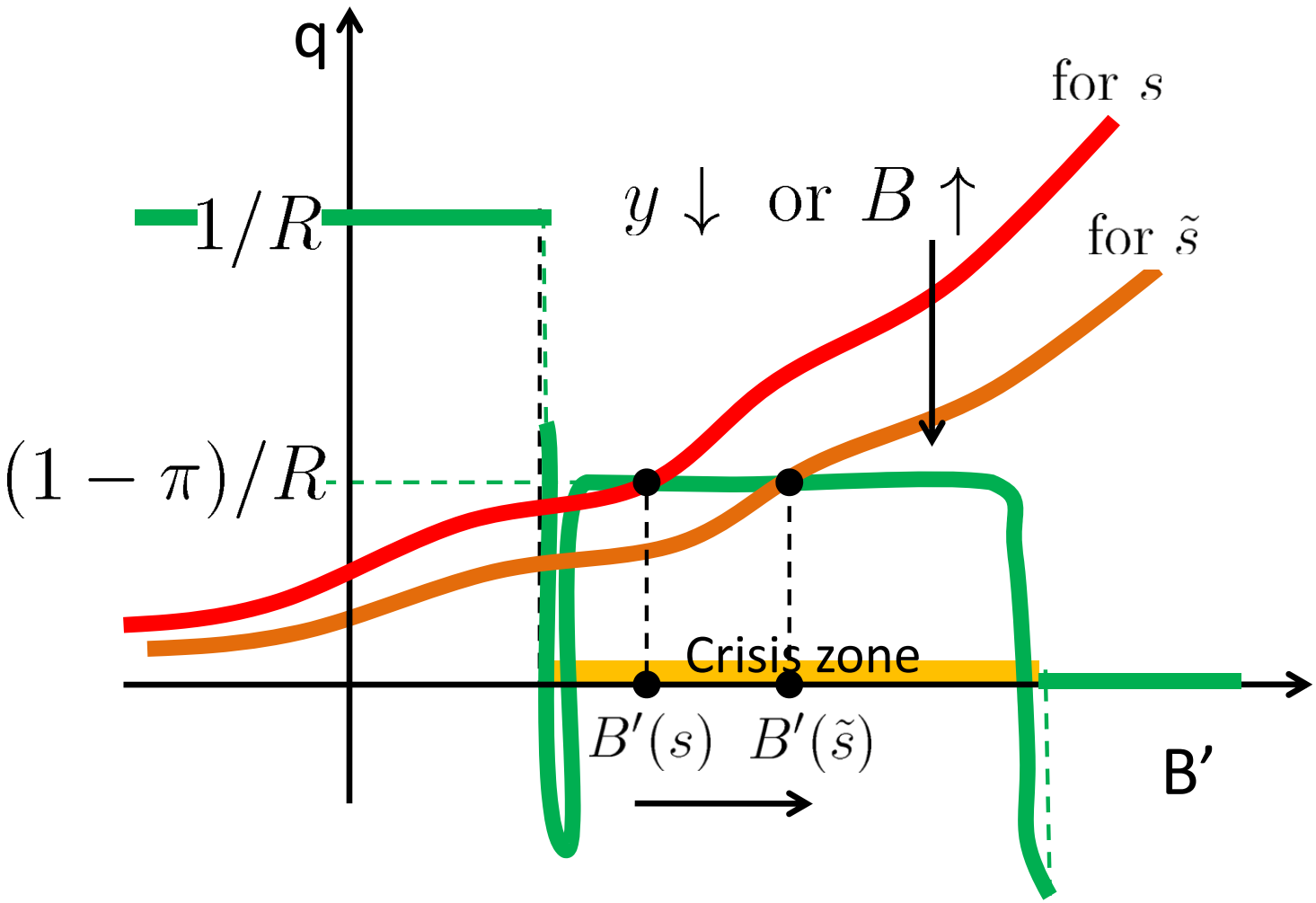
The two sides of **FOC**



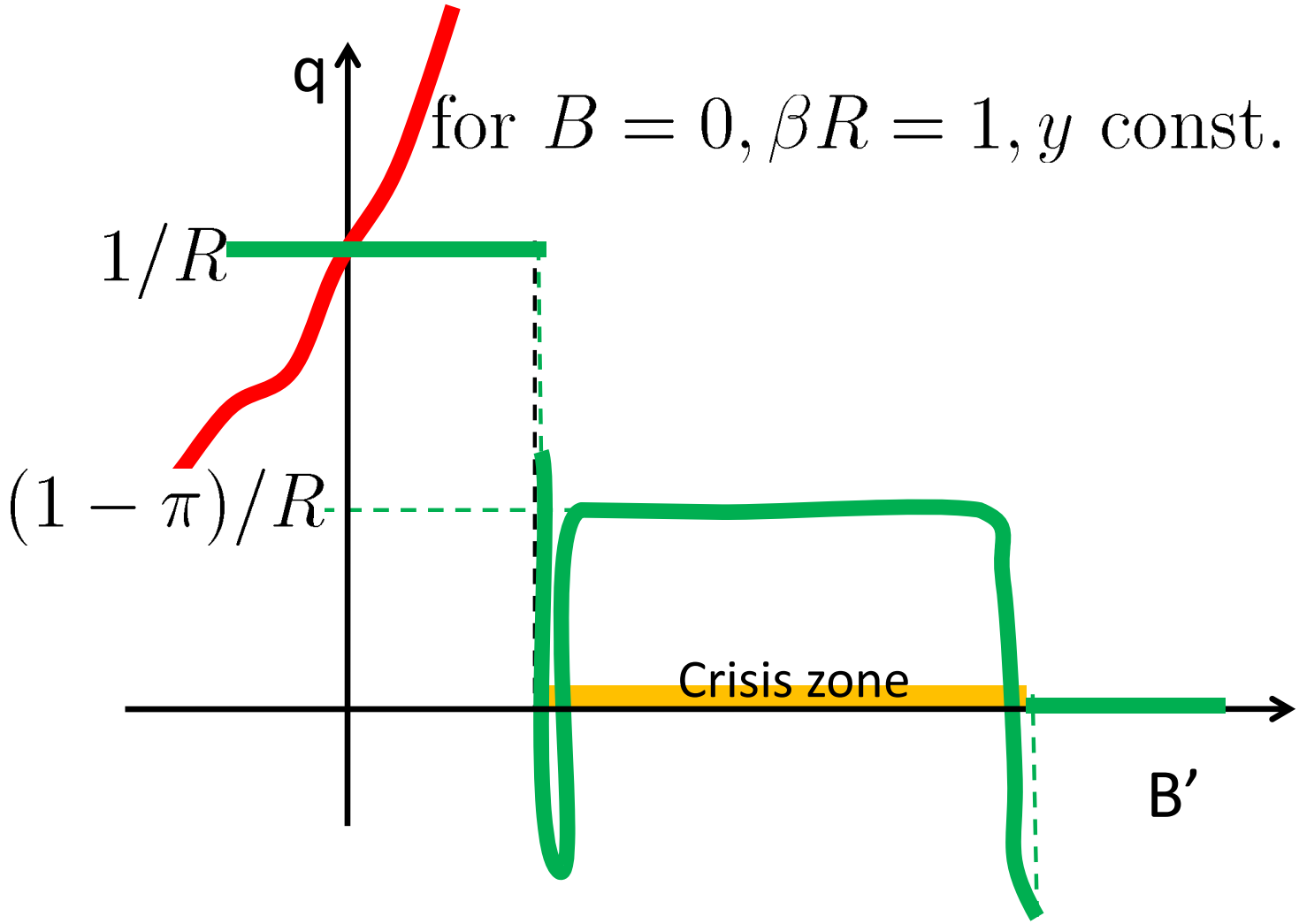
Current income, future debt



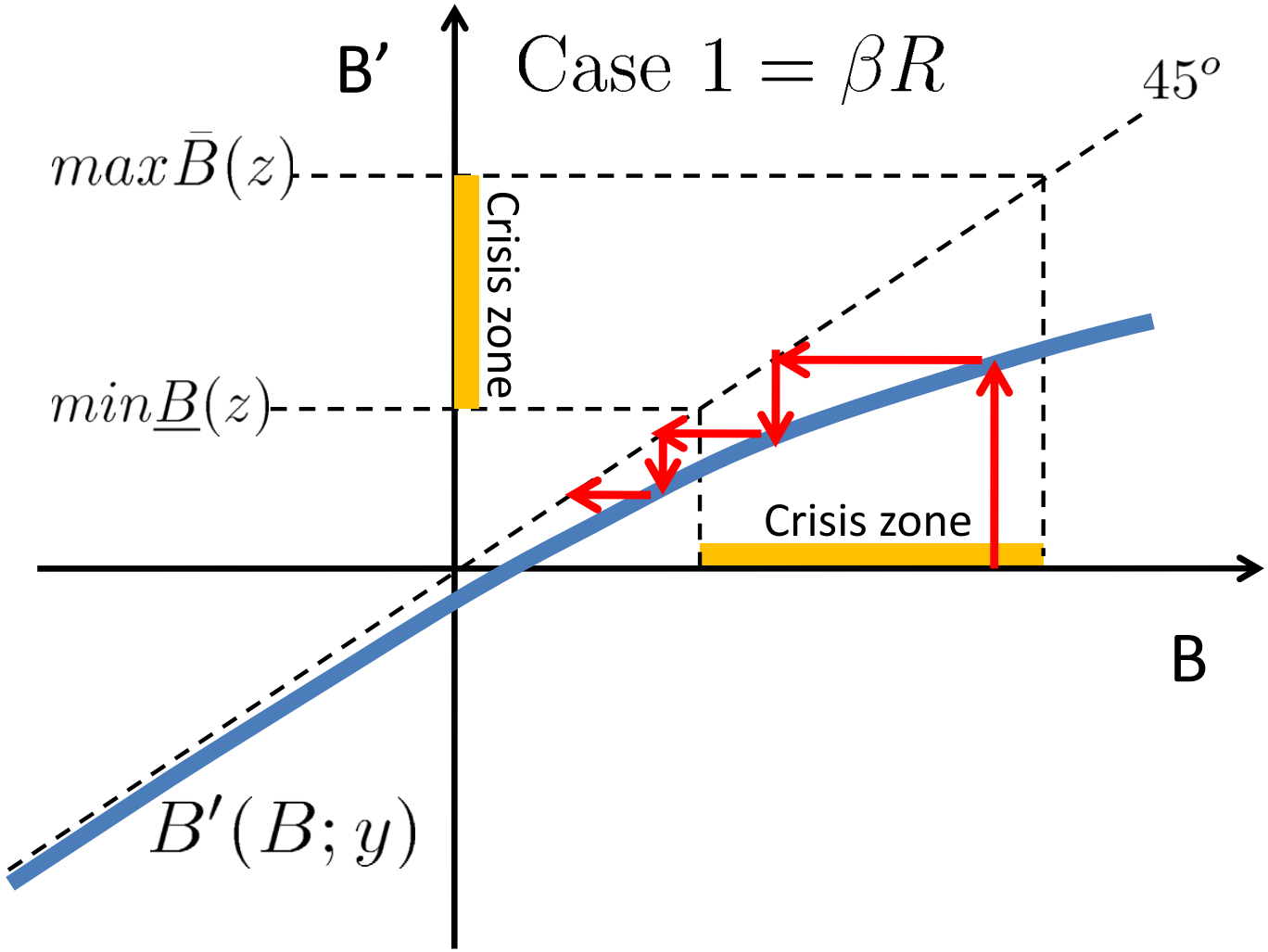
FOC, when income fluct. are small.



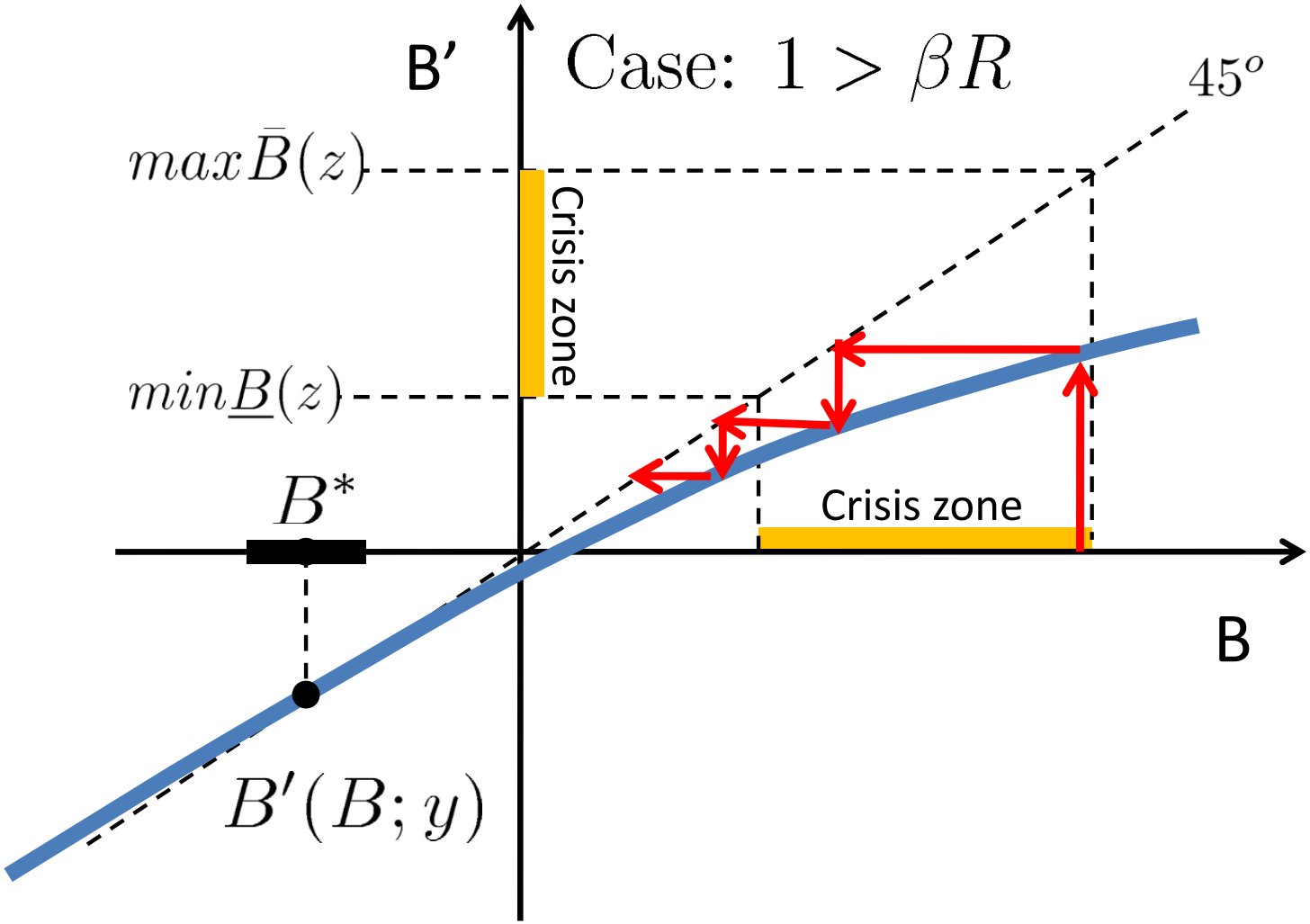
FOC, when $B = 0$ and income fluct. are small.



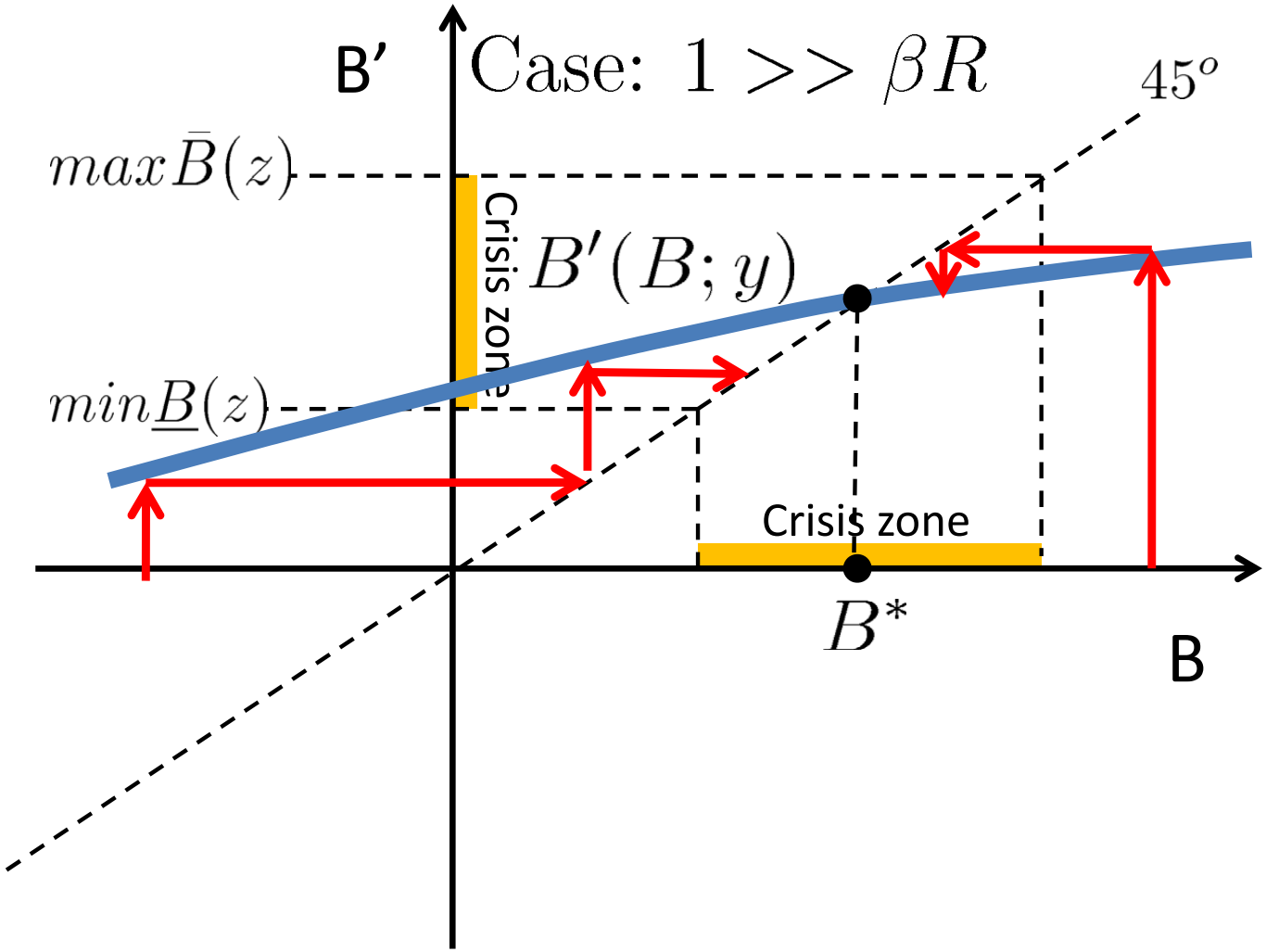
Debt dynamics, $\beta R = 1$, small income fluct.



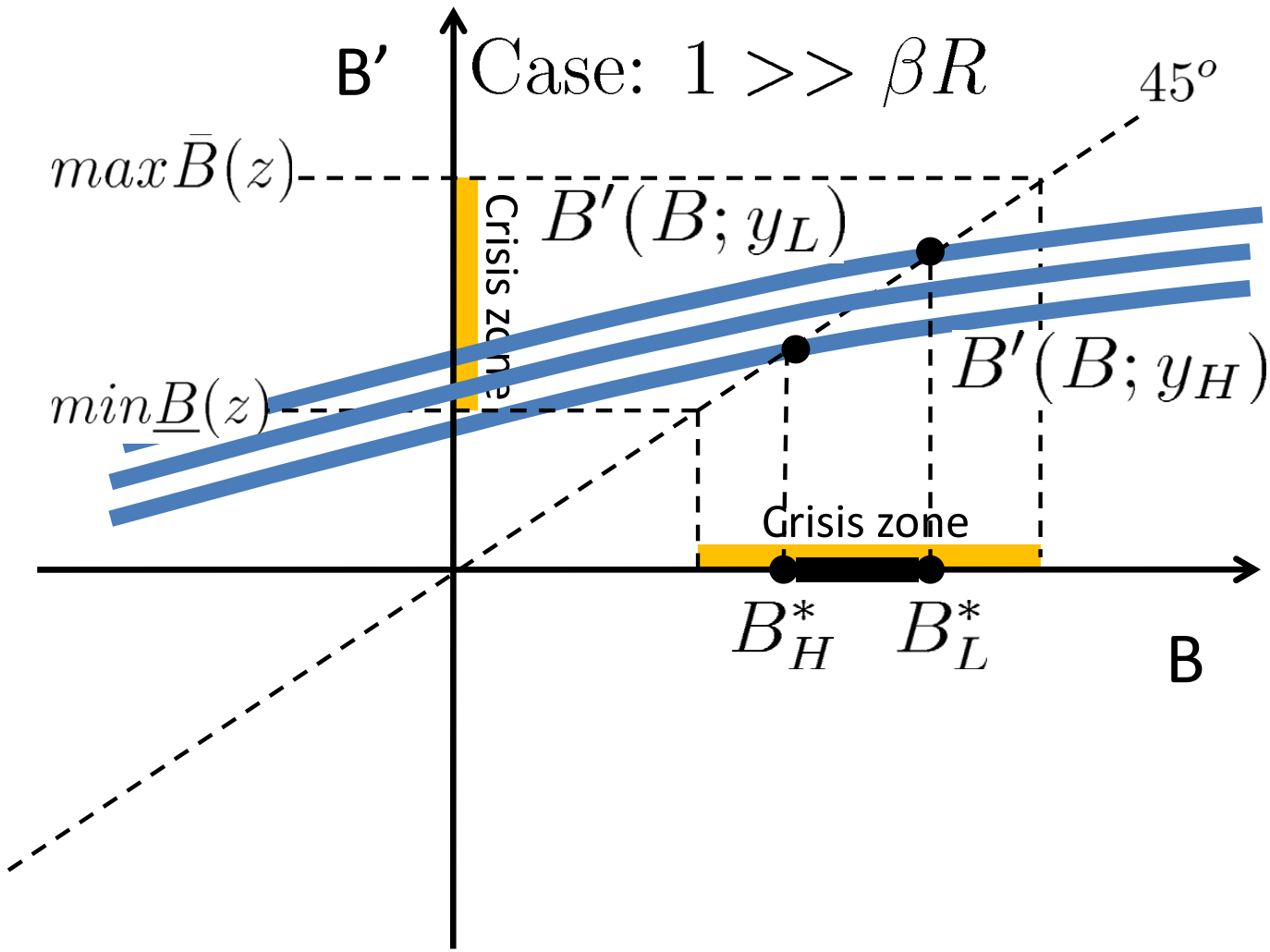
Debt dynamics, $\beta R < 1$, small income fluct.



Debt dynamics, $\beta R << 1$, small income fluct.



Stationary debt dynamics, $\beta R << 1$

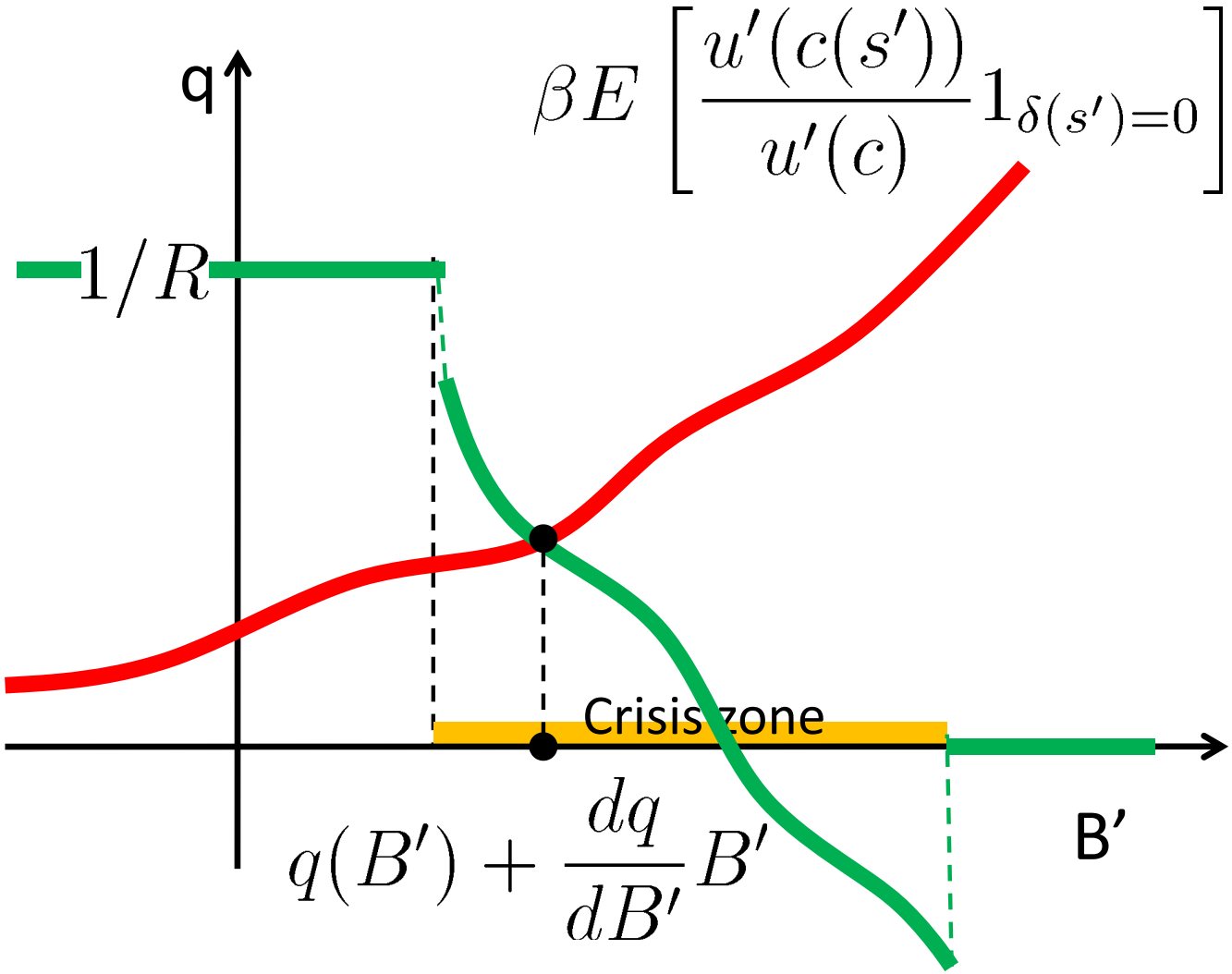


Outline

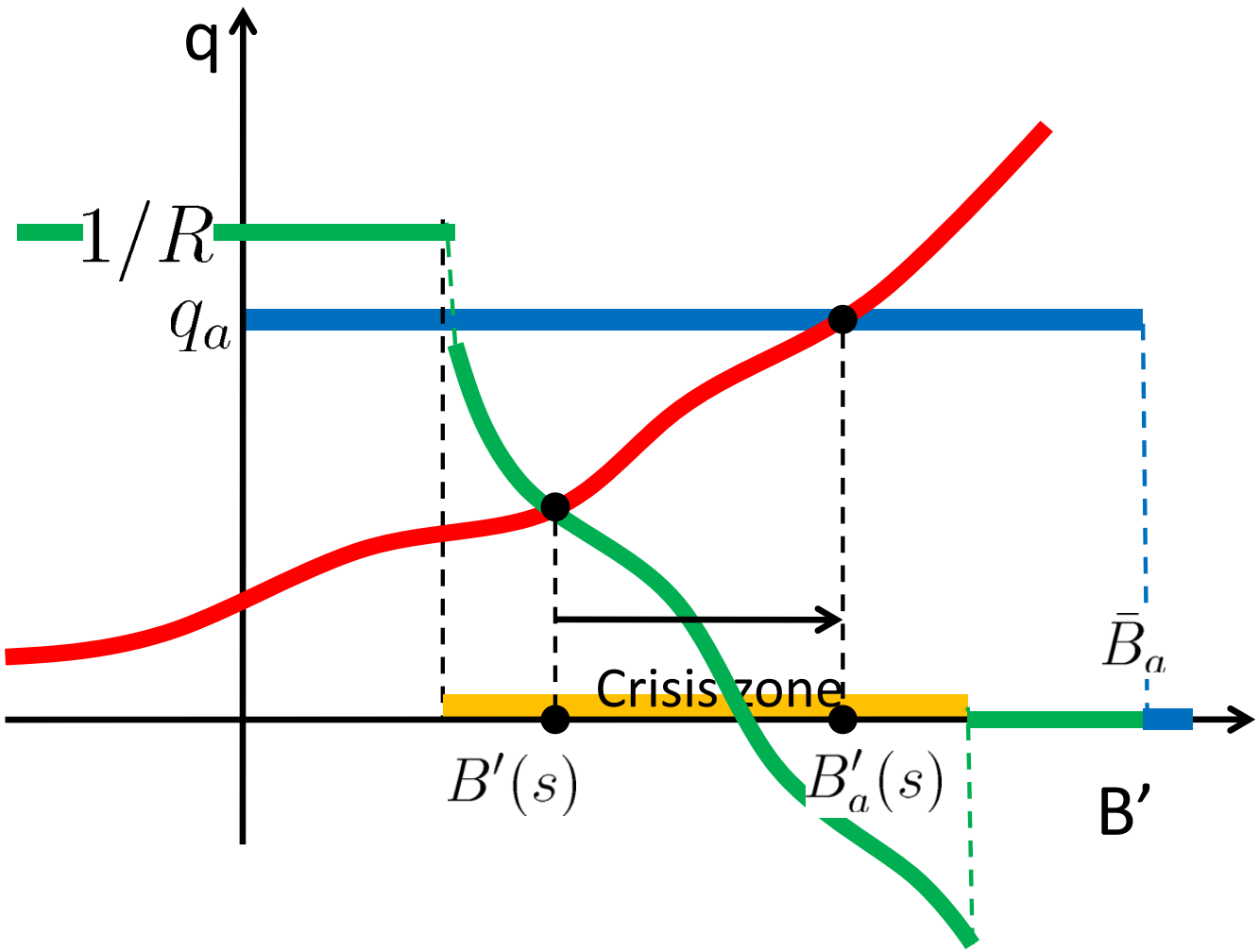
Bailouts

- Country can sell debt at some "assisted" price $0 < q_a < 1/R$ to some outside facility, provided the total amount B' of debt does not exceed some upper limit $\bar{B}_a$.
- $q_a(B'; s) \equiv q_a$ for $B' \leq \bar{B}_a$.
- Probabilistic bailout: with exog. probability ω.
  1. $q_a(B'; s) \equiv 0$ for $B' \leq \bar{B}_a$, if $\psi(s) < \omega$.
  2. $q_a(B'; s) \equiv q_a$ for $B' \leq \bar{B}_a$, if $\psi(s) > \omega$.
- Conditionality ...

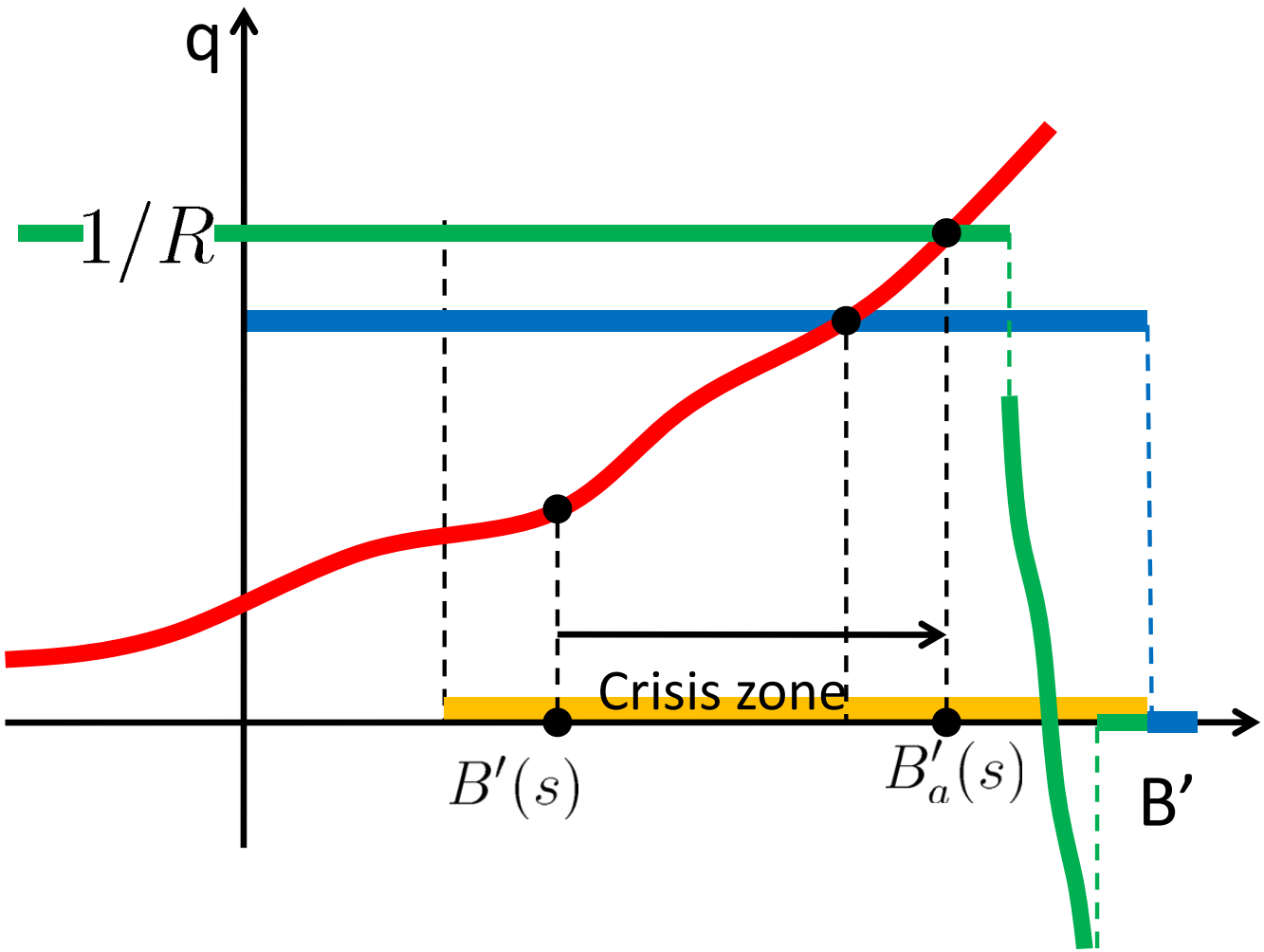
FOC, no assistance



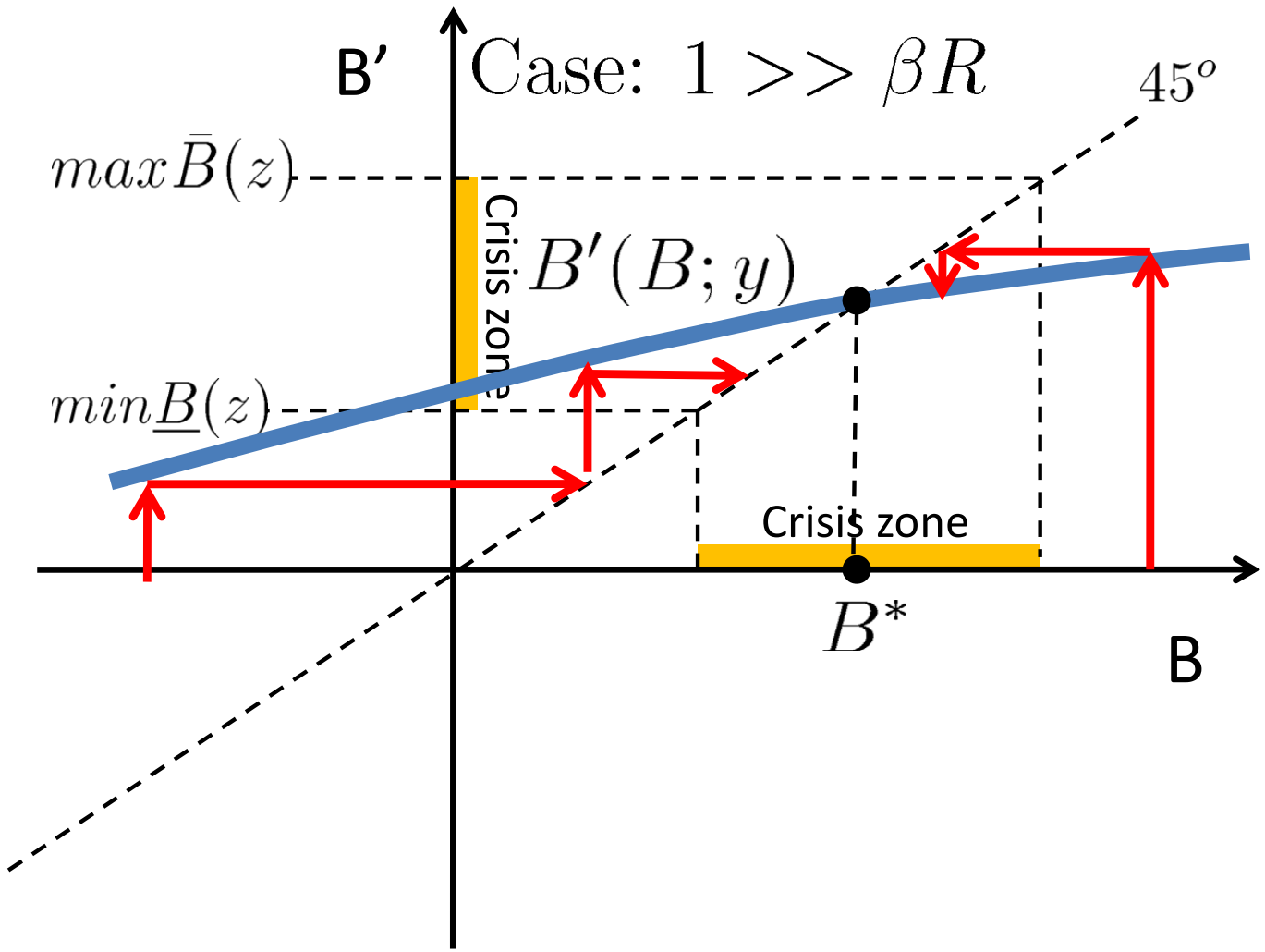
FOC, with one-time assistance



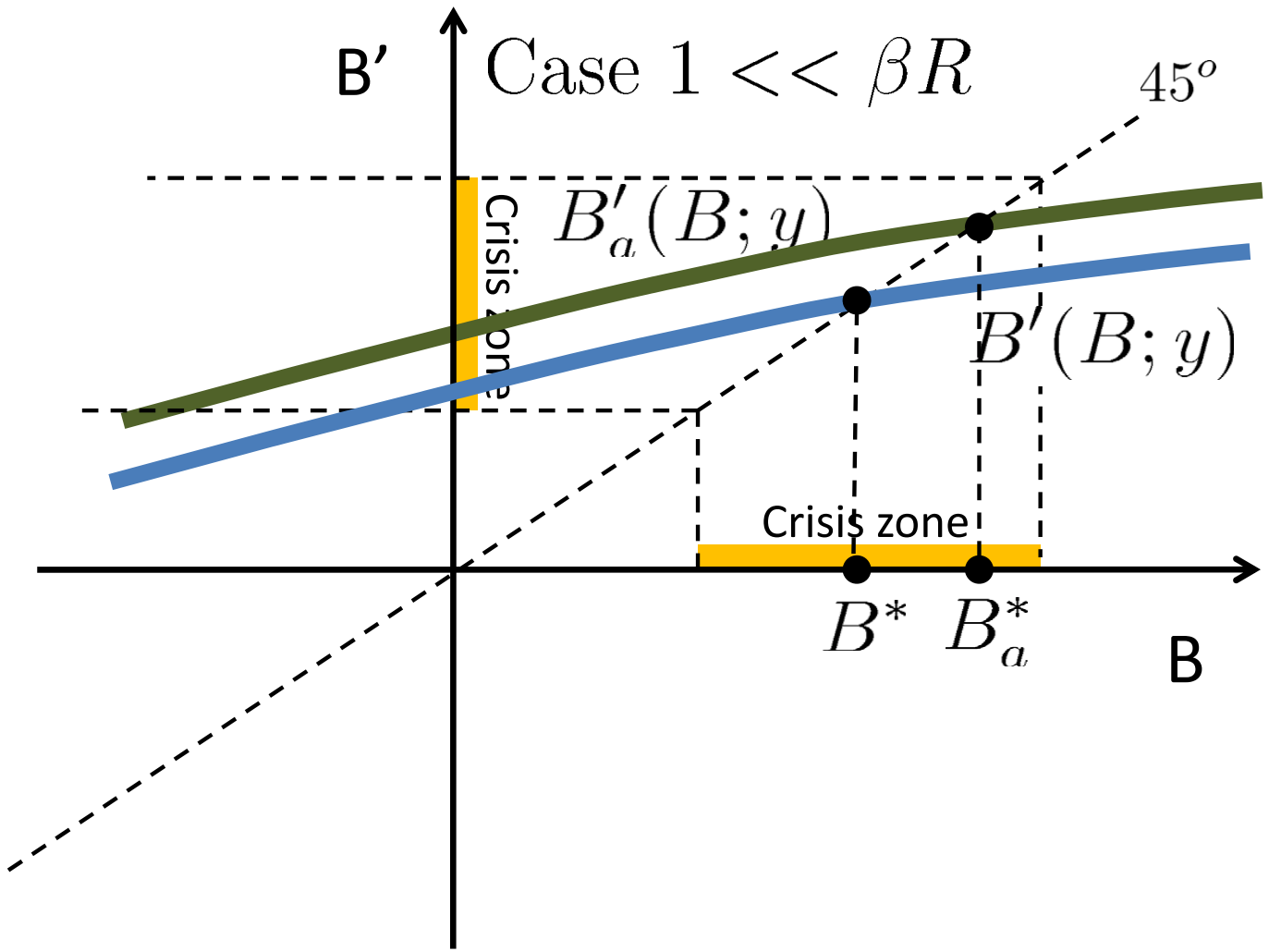
FOC, with permanent assistance



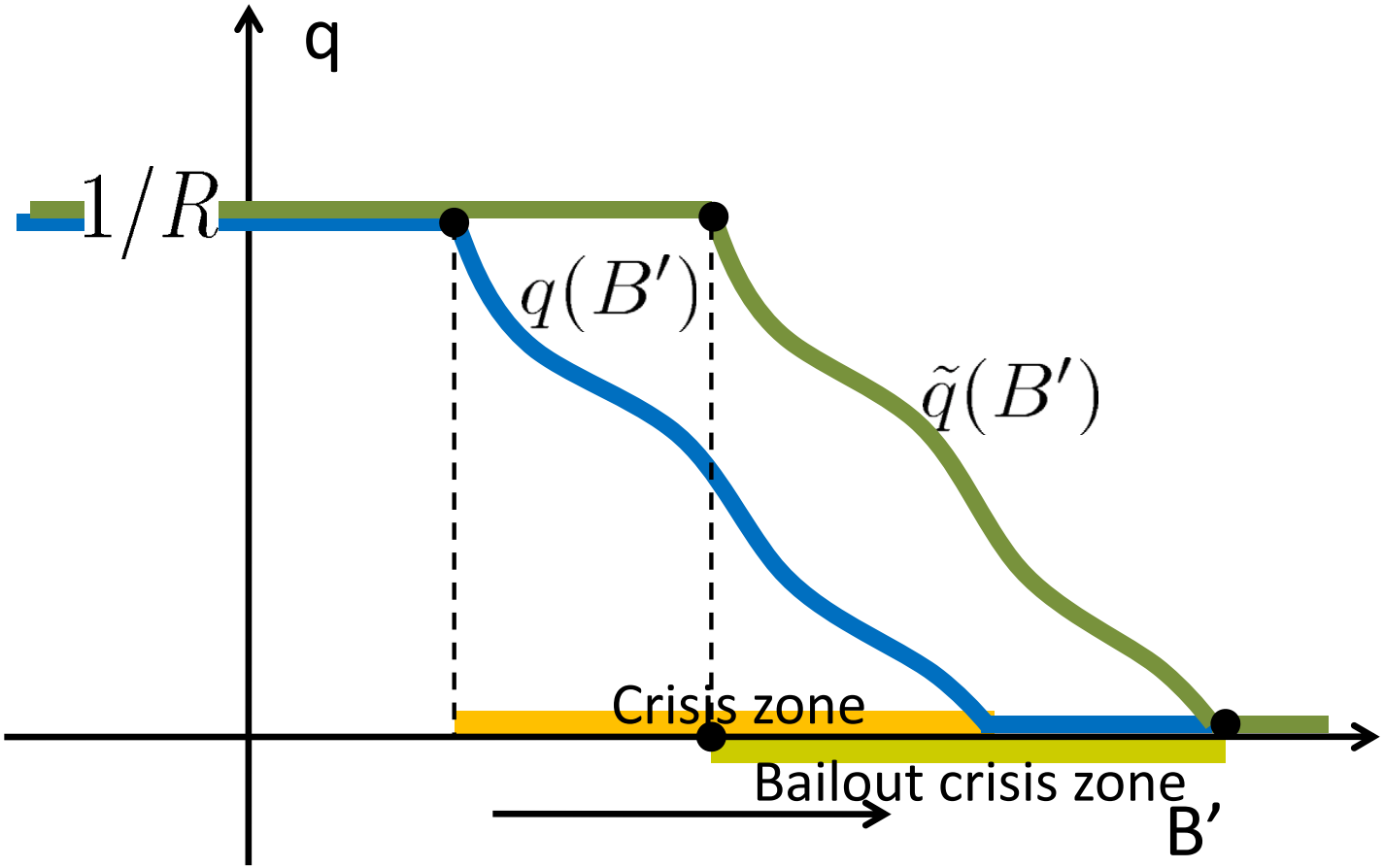
Stationary debt dynamics, one-time assistance



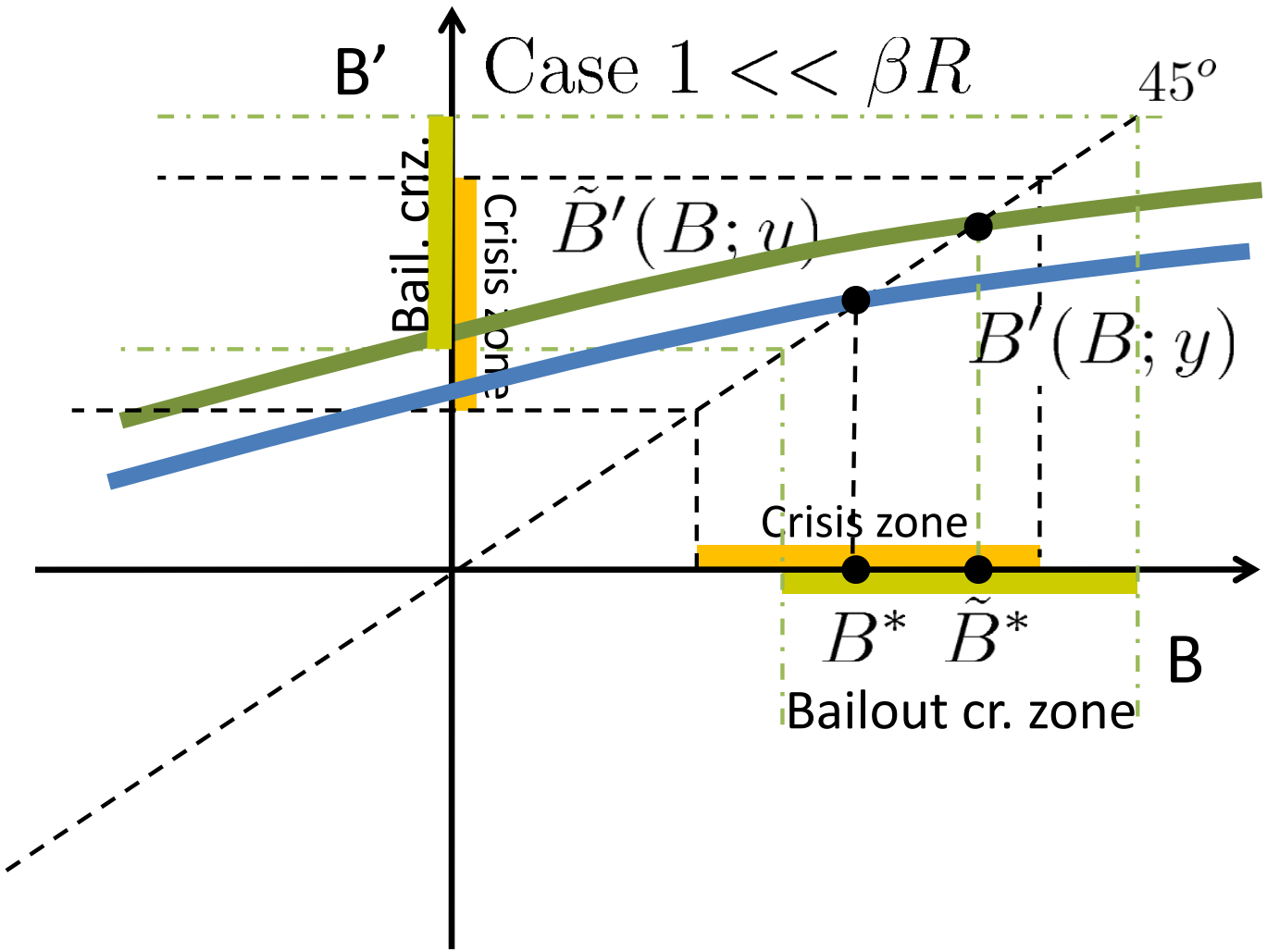
Stationary debt dynamics, permanent assistance



Debt pricing: no vs probabilistic assistance



Stationary debt dynamics, probabilistic assistance



Conditionality

- So far, two alternatives: default, don't default. Assisted pricing.
- Better: three alternatives:
  1. Default.
  2. Don't default.
  3. Accept outsider plan: assisted pricing, **but** reduced consumption.
- Incentive compatibility.
- Future versions.

Outline

Contagion

- Several countries.
- State

$$s = (s_1, \ldots, s_J)$$

where

$$s_j = (B_j, d_j, z_j)$$

and where

$$z_j = (y_j, \chi_j, \zeta_j, \psi_j, \pi_j, \omega_j)$$

- Suppose $\chi_j \equiv \chi$ iid. Or suppose $\pi_j \equiv \pi$ iid.
- Suppose $\omega_j \equiv \omega$ iid? Or should it be negatively correlated?

Amplification

- Debt pricing so far: risk neutral traders.
- Instead: debt is held by outside banks.
- When some banks need to sell: cash-in-market by other banks determines debt.
- Contagion:
  1. Falling debt price in country 1 ...
  2. ... means closure of fragile banks ...
  3. ... debt gets dumped, all debt prices fall ...
  4. ... increasing default probability in country 2.
- Why not also in Germany? Answer: outside crisis zone.
- Cash-in-market? Why not private purchasers of debt?

Outline

Conclusions

- Dynamics of debt default:
  1. Arellano (2008) [income fluct.] meets
  2. Cole-Kehoe (2000) [sunspot defaults] meets
  3. Beetsma-Uhlig (1999) [short-sighted politicians]
- Stationary debt dynamics: precarious.
- Assisted pricing: debt level increases, still precarious or assured default. Postpones the “day of reckoning”.
- Conditionality, contagion, amplification, banking system: future versions / future work.