Sovereign Debt Markets in Turbulent Times: Creditor Discrimination and Crowding-Out Effects

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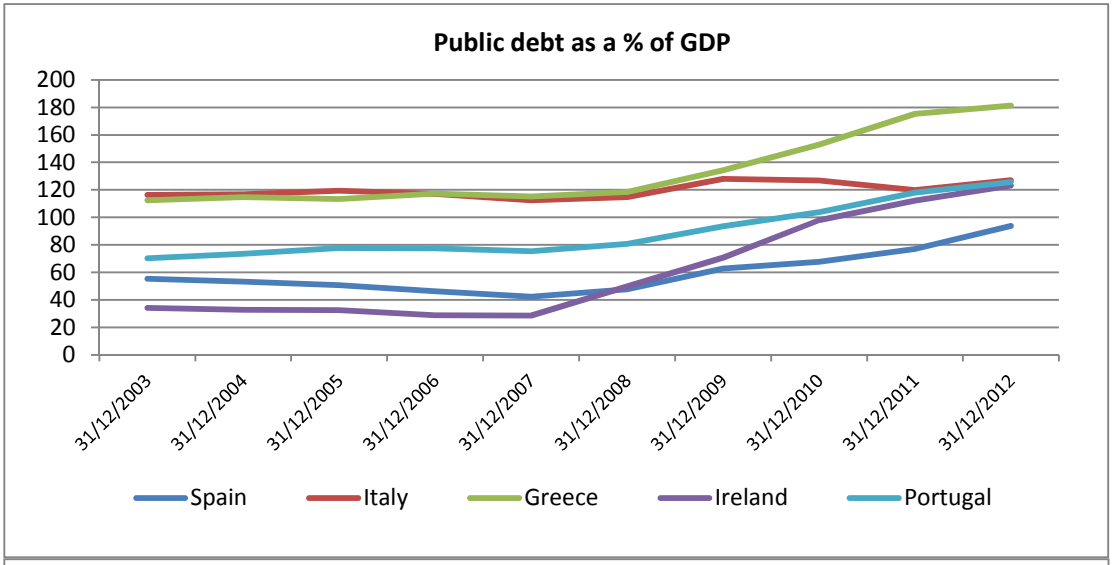
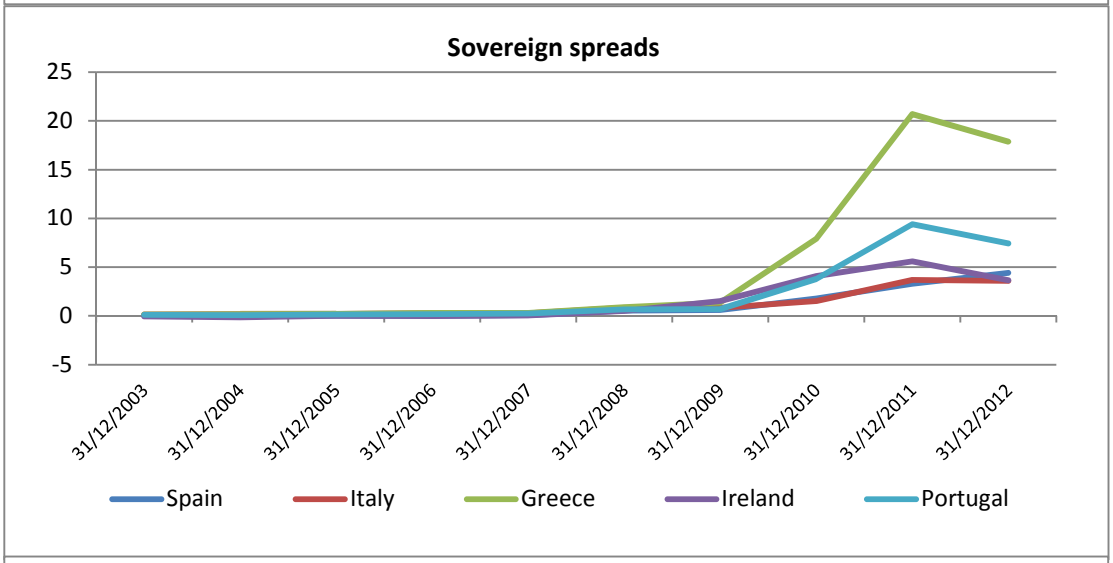
Background

- In 2006, Portugal, Ireland, Italy, Greece, and Spain looked very solid
  - growth: 3.7% (Germany and France 2.8%)
  - fiscal deficit/GDP: 1.8% (Germany and France 2.0%)
  - sovereign spreads: 0.15%
  - public debt/GDP: 77% (Germany and France 71%)
  - maturity: 6.4 years (Germany and France 6.6 years)

- By 2010, GIIPS were facing
  - major sovereign debt problems
  - deep recessions

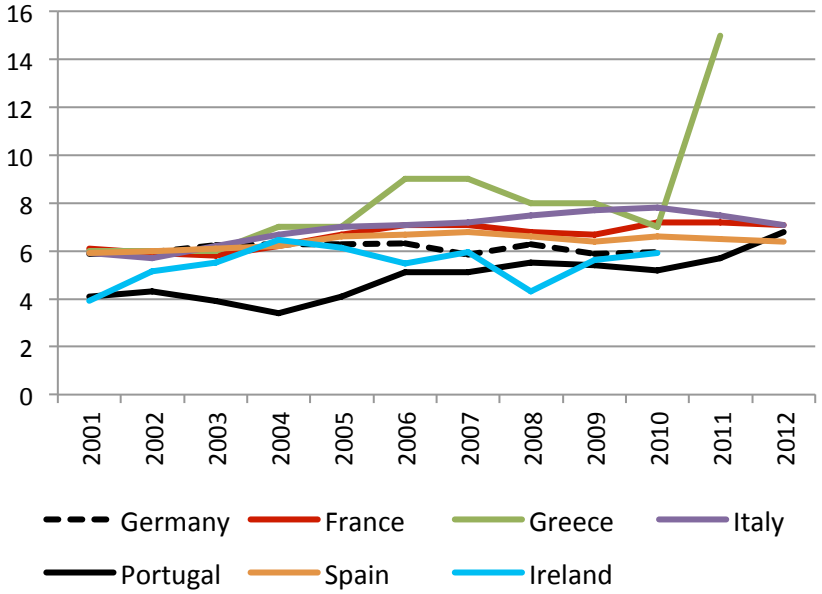
Figure 1. A bird's eye view of the Euro periphery



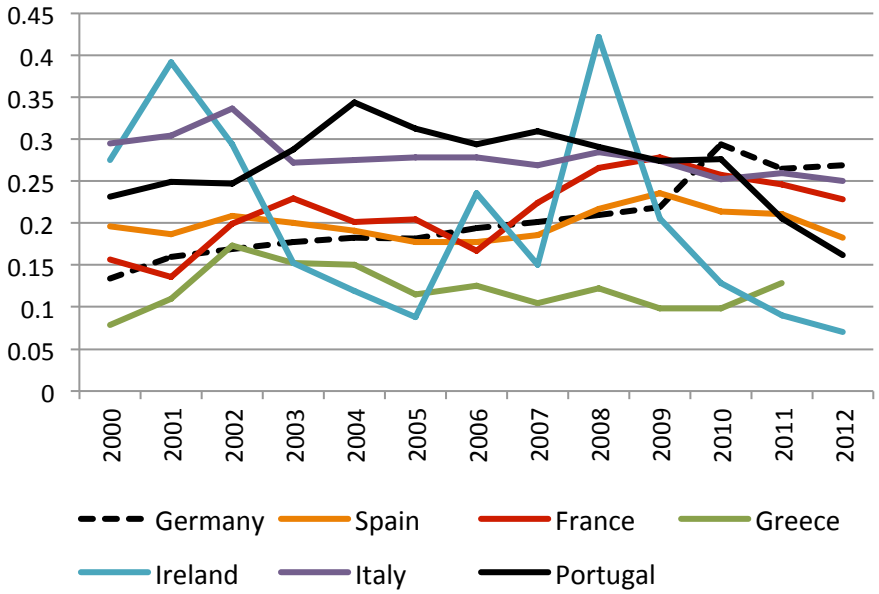


Sovereign debt maturity structure

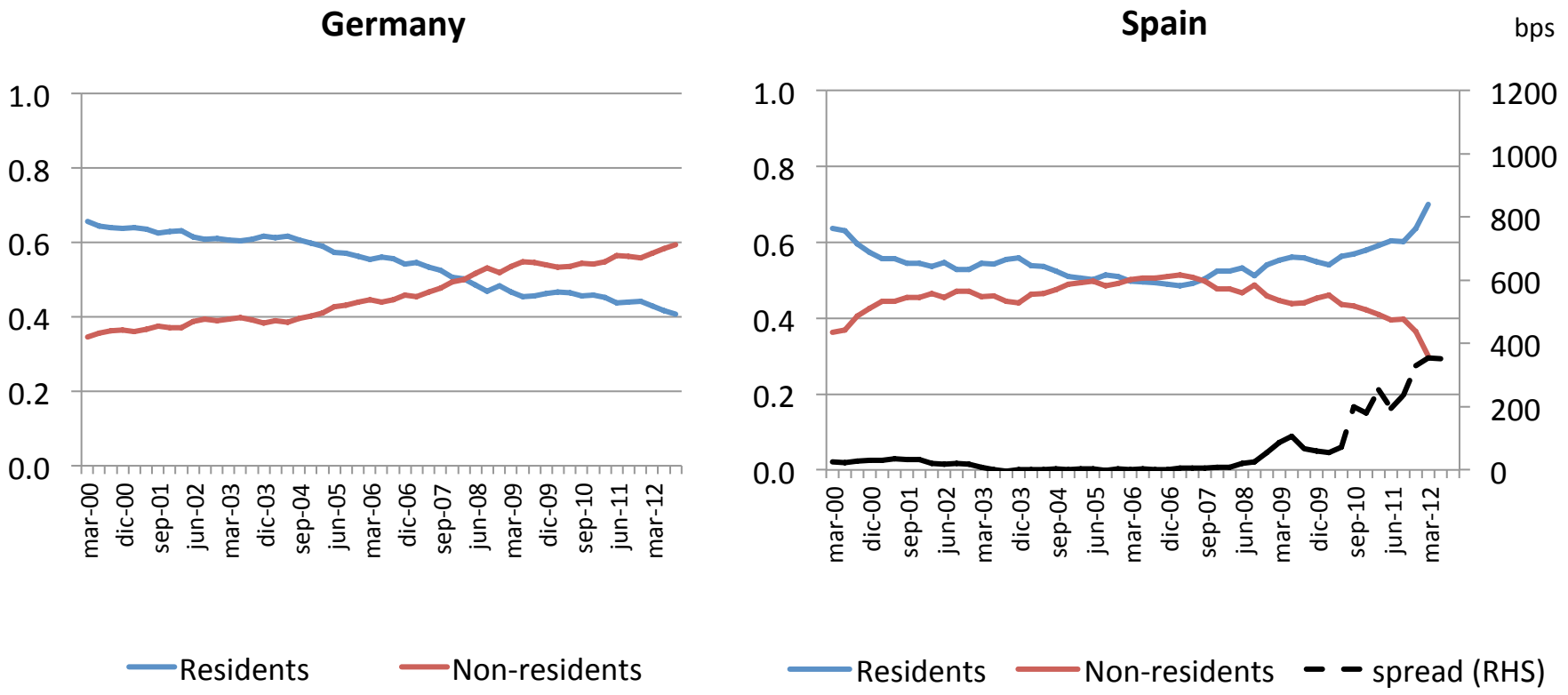
Average term to maturity

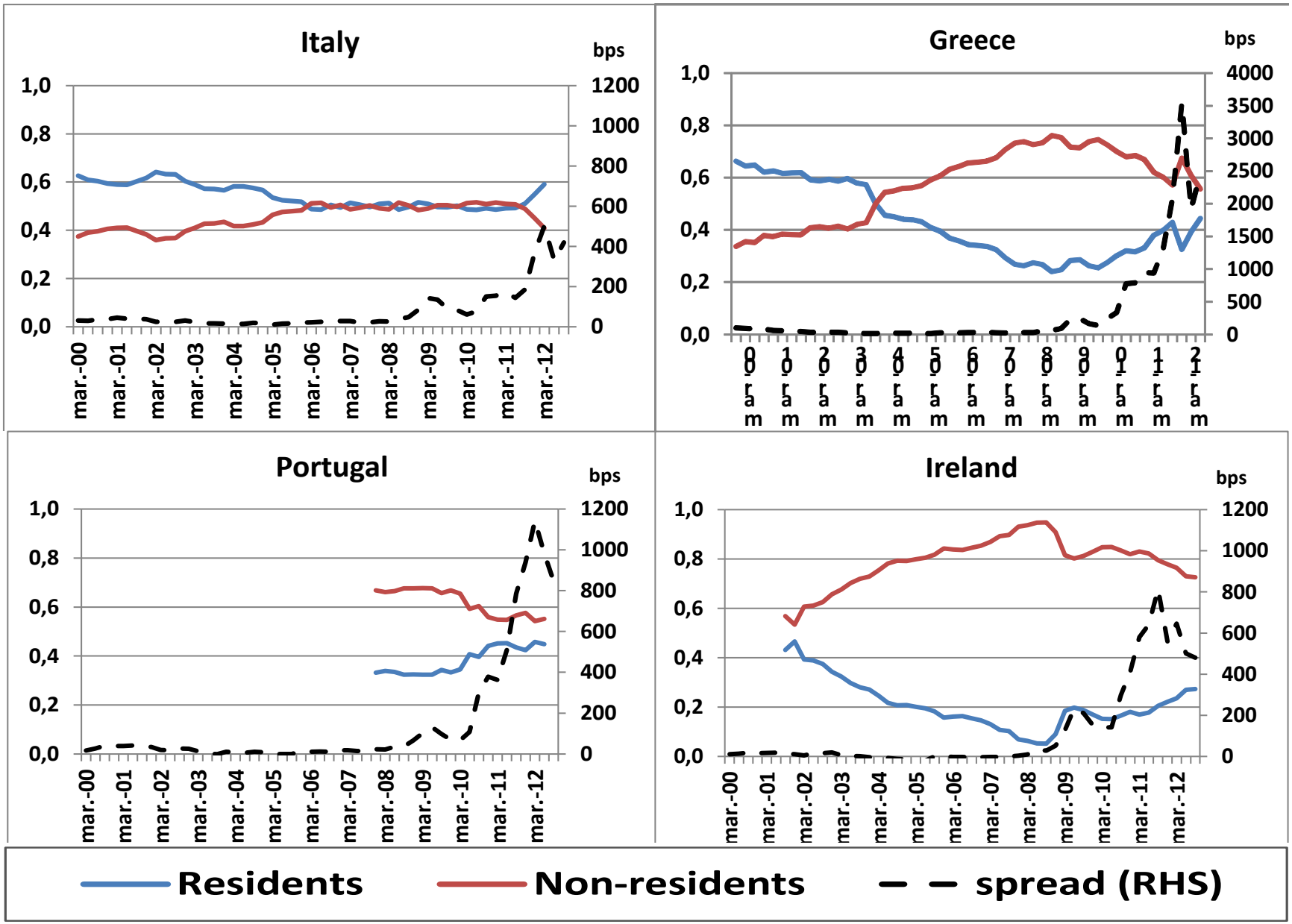


Short term debt over total debt

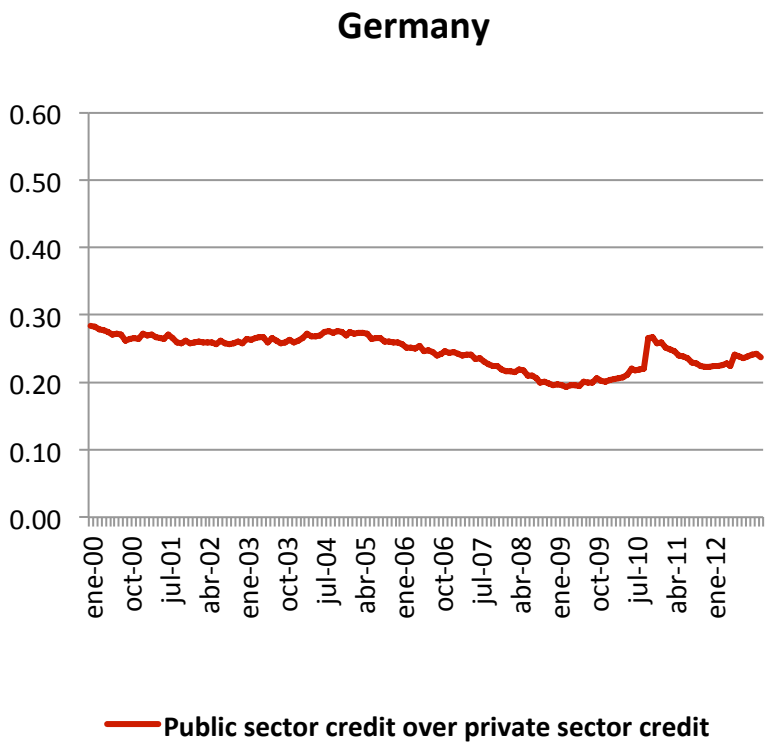


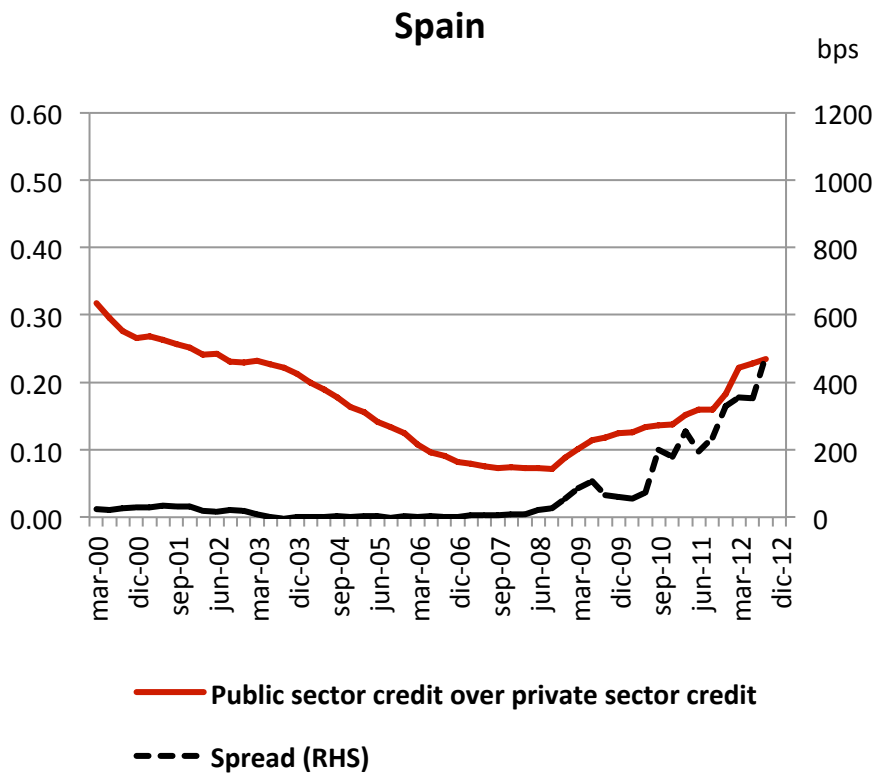
Sovereign debt holders: Germany vs. Spain

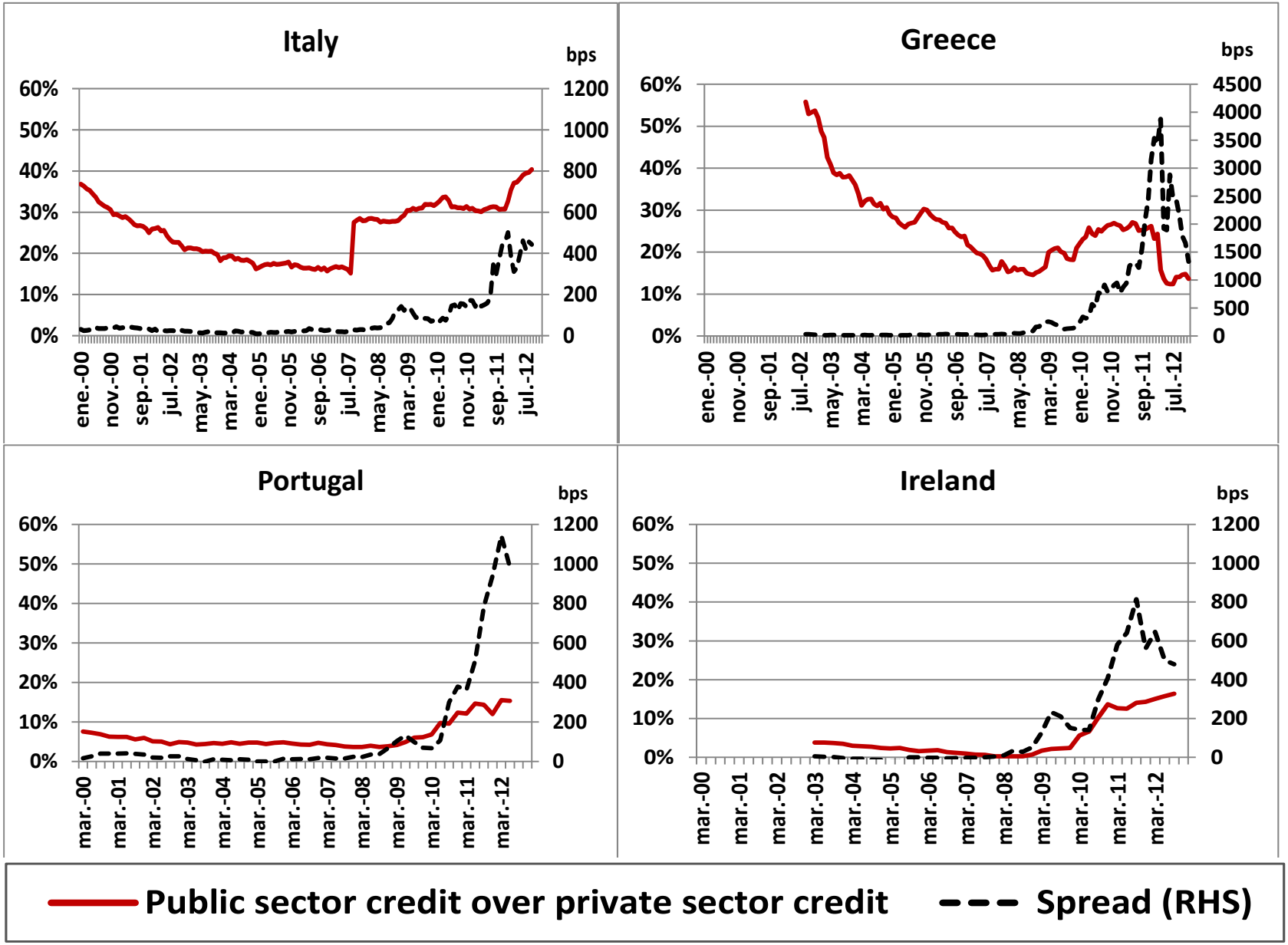



Italy
bps
1,0
0,8
0,6
0,4
0,2
0,0
1200
1000
800
600
400
200
0
mar.-00
mar.-01
mar.-02
mar.-03
mar.-04
mar.-05
mar.-06
mar.-07
mar.-08
mar.-09
mar.-10
mar.-11
mar.-12
Greece
bps
4000
3500
3000
2500
2000
1500
1000
500
0
Portugal
bps
Ireland
bps
Residents
Non-residents
spread (RHS)

Public credit, private credit & sovereign spreads






Italy
bps
60%
50%
40%
30%
20%
10%
0%
1200
1000
800
600
400
200
0
ene.-00
nov.-00
sep.-01
jul.-02
may.-03
mar.-04
ene.-05
nov.-05
sep.-06
jul.-07
may.-08
mar.-09
ene.-10
nov.-10
sep.-11
jul.-12
Greece
bps
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Portugal
mar.-00
mar.-01
mar.-02
mar.-03
mar.-04
mar.-05
mar.-06
mar.-07
mar.-08
mar.-09
mar.-10
mar.-11
mar.-12
Ireland
Public sector credit over private sector credit
Spread (RHS)

Questions

1. Why have sovereign spreads increased so much?
2. Why have the private sectors of GIIPS purchased the debts of their sovereigns?
3. What are the economic consequences of these domestic purchases of debt?
4. What are the key inefficiencies that these purchases generate?
5. What is the right set of policies to address them?
6. What difference does it make that GIIPS belong to the Eurozone?
7. Is there a role for Europe-wide policy?

Plan

- A model of sovereign debt, investment and growth
- Two crucial ingredients
  - governments (sometimes) discriminate in favor of domestic residents
  - sovereign debt is traded in secondary markets
- Emphasize crowding-out effects
  - various inefficiencies
  - multiple steady states and poverty traps
  - multiple equilibria and self-fulfilling crises
- Spillovers across an economic union
  - exporting crowding-out effects
  - role for transfers and broken unions

Related literature

- Self-fulfilling debt crises
  - Calvo (1988), Cole-Kehoe (2000), Conesa-Kehoe (2012), Aguiar-Amador-Farhi-Gopinath (2013)
- Secondary markets and sovereign risk
  - Broner-Martin-Ventura (2008, 2010), Broner-Ventura (2010, 2011), Lanau (2011), Bai-Zhang (2012), Pitchford-Wright (forth.)
- Sovereign defaults and economic activity
  - Aguiar-Amador-Gopinath (2009), Aguiar-Amador (2011), Brutti (2011), Erce (2012), Mendoza-Yue (2012), Mengus (2012), Gennaioli-Martin-Rossi (forth.)
- Gross capital flows during crises
  - Broner-Didier-Erce-Schmukler (2013), Brutti-Saure (2013)
- Sovereign debt and growth
  - Reinhart-Rogoff (2010, 2012)

Model without sovereign debt - Setup

- OLG: young and old, measure one
- Preferences: $1-\mu$ consume when young and μ maximizes expected consumption when old

$$U_t = E_t \{c_{t+1}\}$$

- Labor: young supplies one unit of labor inelastically
- Technology: Cobb-Douglas production function

$$f(k_t) = k_t^{\alpha}$$

- Factor markets

$$w_t = (1-\alpha) \cdot k_t^{\alpha} \quad \text{and} \quad r_t = \alpha \cdot k_t^{\alpha-1} + 1 - \delta$$

- Small open economy
  - international financial market (IFM) willing to borrow and lend at expected rate ρ
  - domestic residents save in capital and borrow from or lend to IFM
- Financial markets: domestic residents can pledge fraction $\phi \in (0, \rho)$ of capital stock

$$f_t \leq \frac{\phi \cdot k_{t+1}}{\rho}$$

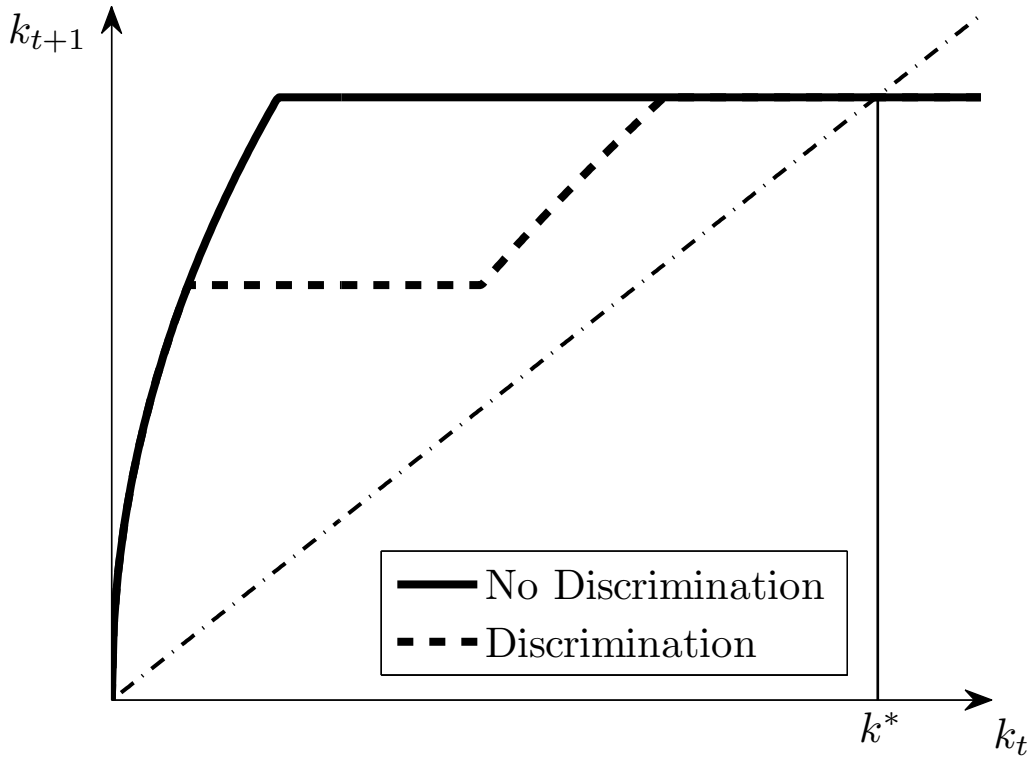
Model without sovereign debt - Equilibrium

- Young save fraction $s \equiv \mu \cdot (1 - \alpha)$ of output
- Borrowing constraint binds for low levels of capital, wages, and savings
- Law of motion of capital stock

$$k_{t+1} = \min \left\{ \frac{\rho}{\rho - \phi} \cdot s \cdot k_t^{\alpha}, \left(\frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \right\}$$

  - old receive return on capital, repay their foreign debts, and consume

Figure 9: The law of motion with and without discrimination



The solid line shows the law of motion of the capital stock when there is no discrimination between foreign and domestic creditors. It is defined by Equation (5). The dashed line shows the law of motion of the capital stock when default affects only foreign creditors, and is defined by Equations (9) and (10). The dash-dot line is the 45° line.

Model with sovereign debt - Setup

- Government
  - inherits amount of debt d_t
  - taxes lump-sum the old x_t
  - defaults with probability $1 - p_t$
  - permanent exclusion after default

- Thus

$$d_{t+1} = \begin{cases} R_t \cdot d_t - x_t & \text{with prob. } p_t \\ 0 & \text{with prob. } 1 - p_t \end{cases}$$

- For this presentation, I will usually assume

$$d_t \equiv d \text{ and } p_t \equiv p$$

- Sovereign debt is traded in secondary markets
  - no segmentation between domestic and foreign creditors!

- Key question for evolution of economy: Who buys this debt?
  - depends on probability of default and who is affected by it

Model with sovereign debt - Equilibrium

- Assume first foreigners and domestics are both defaulted with probability $1 - p$
- Contractual interest rate

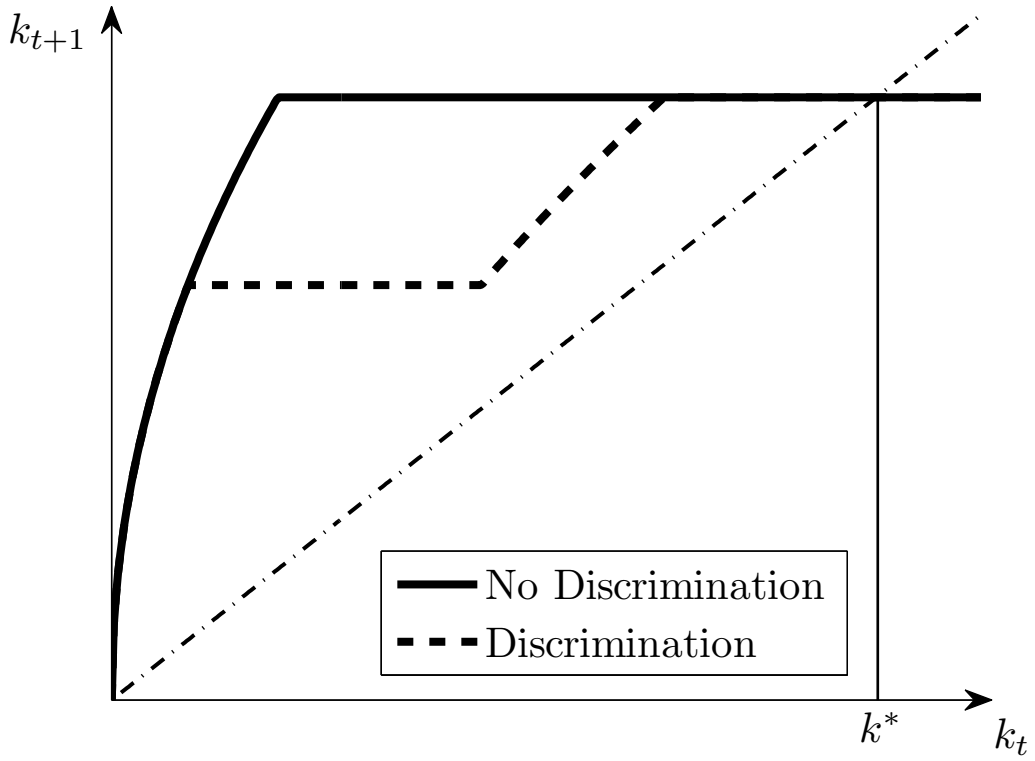
$$R_{t+1} = \frac{\rho}{p}$$

- Foreigners buy all government debt and young invest solely in domestic capital (if constraint binds)
- Law of motion of capital stock is not affected

$$k_{t+1} = \min \left\{ \frac{\rho}{\rho - \phi} \cdot s \cdot k_t^{\alpha}, \left(\frac{\alpha}{\rho + \delta - 1} \right)^{\frac{1}{1-\alpha}} \right\}$$

- Old receive return on capital, are taxed to pay government debt, repay their foreign debts, and consume
- Sovereign debt reduces consumption of old, but does not affect law of motion

Figure 9: The law of motion with and without discrimination



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Model with sovereign debt - Equilibrium

- Assume foreigners are defaulted with probability $1 - p$ but domestics are never defaulted on
- This creates a wedge between return to domestics R_{t+1} and return to foreigners $R_{t+1} \cdot p$
- Contractual interest rate depends on identity of marginal buyer
  - foreigners hold government debt if compensated for risk of default

$$R_{t+1} \geq \frac{\rho}{p}$$

  - domestics hold government debt if compensated for foregone investment

$$R_{t+1} \geq \left(\alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta - \phi\right) \cdot \frac{\rho}{\rho - \phi}$$

- For low (high) levels of capital stock foreigners (domestics) buy sovereign debt

Model with sovereign debt - Equilibrium

- Equilibrium contractual interest rate depends on the marginal buyer

$$R_{t+1} = \min\left\{\frac{\rho}{p}, \left(\alpha \cdot k_{t+1}^{\alpha-1} + 1 - \delta - \phi\right) \cdot \frac{\rho}{\rho - \phi}\right\}$$

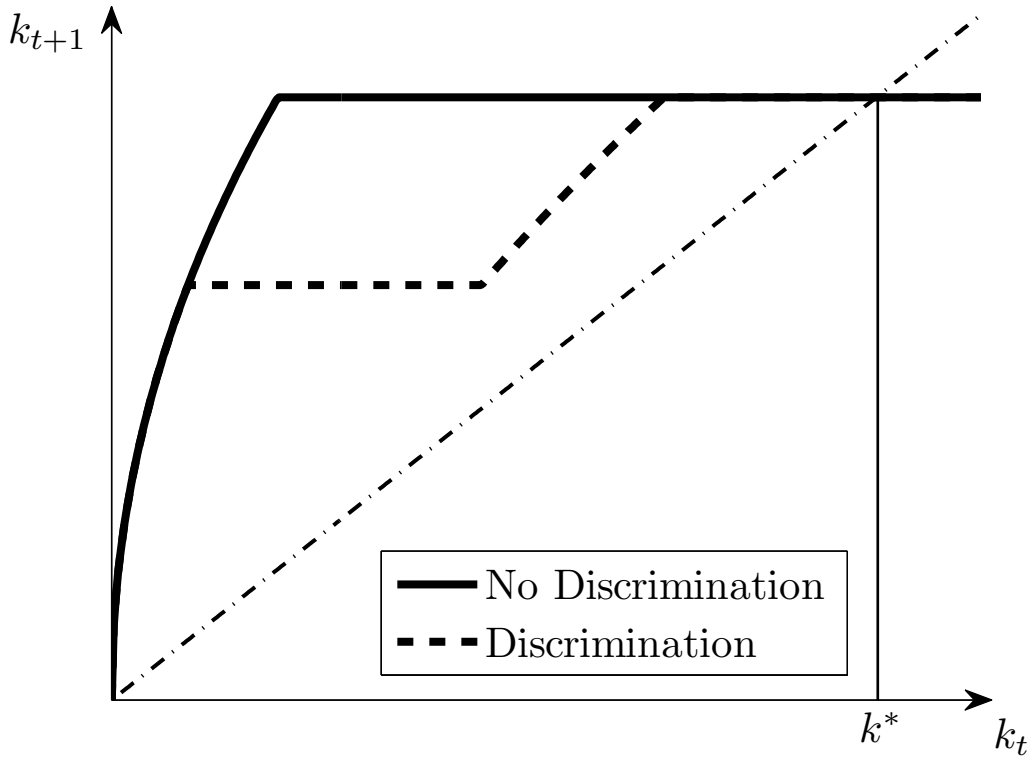
- Law of motion of capital stock

$$k_{t+1} = \begin{cases} \min\left\{\dfrac{\rho}{\rho-\phi} \cdot s \cdot k_t^{\alpha}, \left(\dfrac{\alpha}{(\rho-\phi)/p + \phi + \delta - 1}\right)^{\frac{1}{1-\alpha}}\right\} & \text{if } k_t \leq \bar{k} \\ \min\left\{\dfrac{\rho}{\rho-\phi} \cdot \left(s \cdot k_t^{\alpha} - d\right), \left(\dfrac{\alpha}{\rho + \delta - 1}\right)^{\frac{1}{1-\alpha}}\right\} & \text{if } k_t > \bar{k} \end{cases}$$

- Old receive return on capital, are taxed to pay government debt, repay their foreign debts, and consume

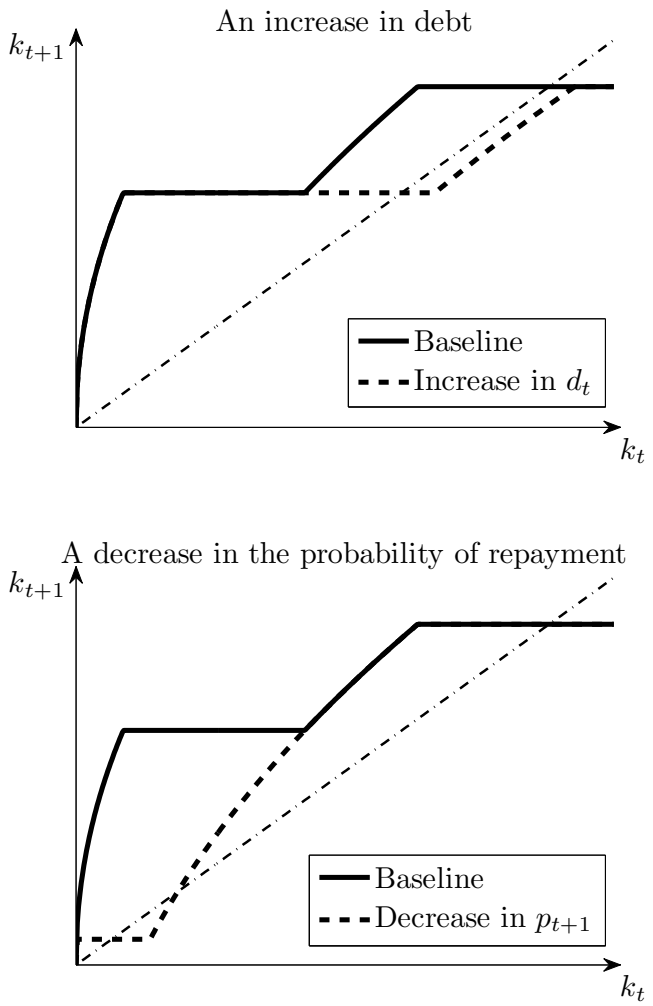
- Sovereign debt reduces consumption of the old, and it does affects the law of motion

Figure 9: The law of motion with and without discrimination



The solid line shows the law of motion of the capital stock when there is no discrimination between foreign and domestic creditors. It is defined by Equation (5). The dashed line shows the law of motion of the capital stock when default affects only foreign creditors, and is defined by Equations (9) and (10). The dash-dot line is the 45° line.

Figure 10: The effects of changes in debt and repayment probability

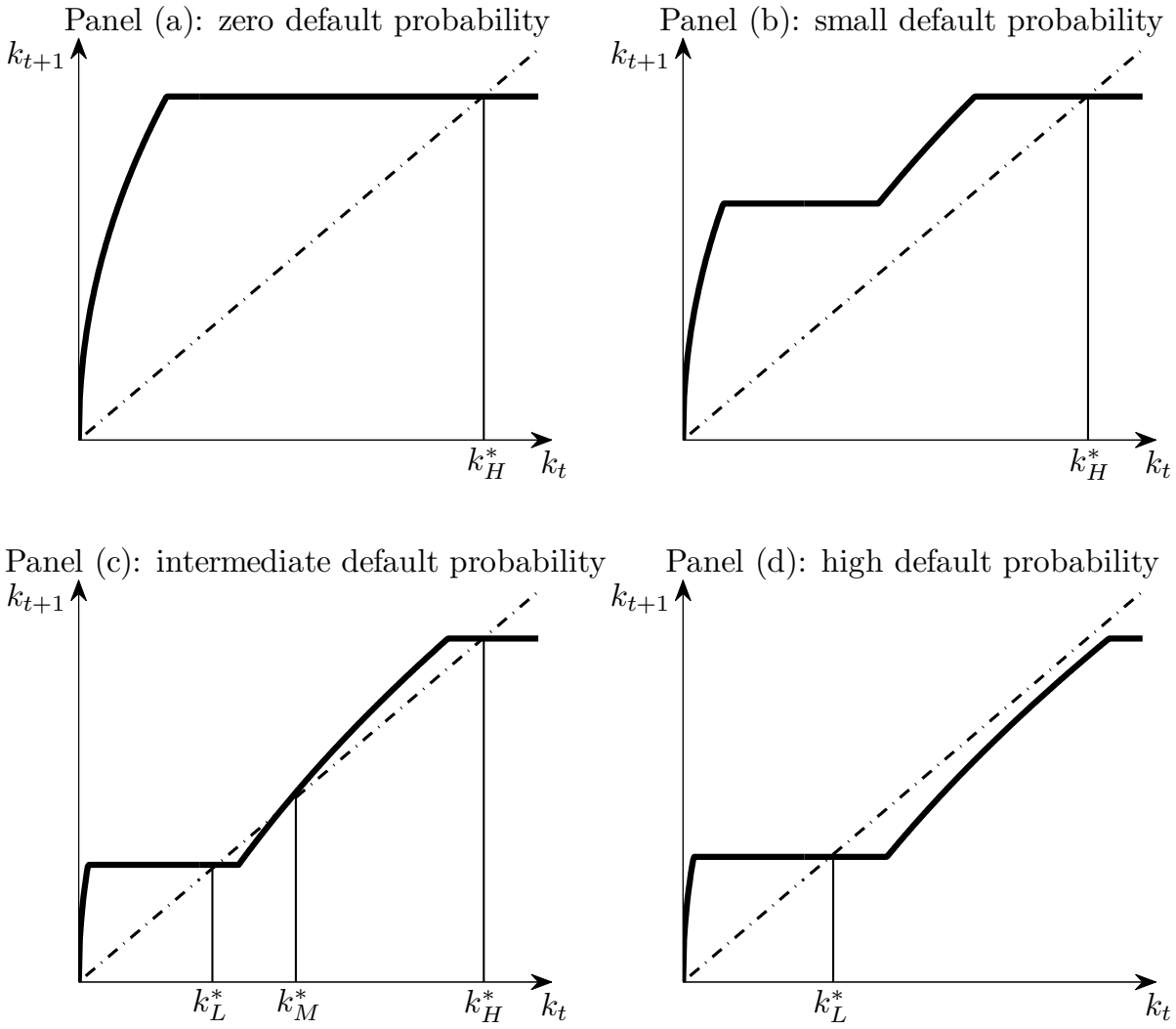


In both panels, the solid line shows the law of motion of the capital stock when default affects only foreign creditors, as defined by Equations (9) and (10). The dashed line shows the same law of motion when changing one parameter value: in the top panel, d_t increases and in the bottom panel, p_{t+1} decreases. The dash-dot line in both panels is the 45° line.

Model with sovereign debt - Dynamics and efficiency

- Crowding-out region can generate non-standard dynamics and multiple steady states

Figure 11: Crowding-out effects and dynamics



The solid line in the four panels shows the law of motion of the capital stock as defined by Equations (9) and (10), modified by taking into account Equation (14). Moving from Panel (a) to Panel (d), the probability of default p_{t+1} is gradually increased. In Panels (c) and (d), the debt level d is also slightly higher than in Panels (a) and (b). The dash-dot line in all panels is the 45° line.

Model with sovereign debt - Dynamics and efficiency

- Crowding-out region generates non-standard dynamics and multiple steady states
- Crowding-out region generates inefficiencies
  - substitute domestic investment for foreign borrowing
  - return to investment exceeds interest rate

Model with sovereign debt - Discrimination

- Secondary markets can fail to prevent discrimination ex post
  - capital controls, default before maturity, compensate losers
- Discrimination can also happen before default
  - tax treatment, regulations, financial repression
- For our mechanism
  - source of discrimination is not important
  - robust to discrimination taking place only sometimes

Model with cost of default - Setup

- Until now there was no cost of default
  - in reality: loss of reputation, sanctions, disruption of financial markets
- We now introduce cost of default
  - if government defaults on foreigners, old generation suffers a loss
- Deadweight loss
  - increases with capital stock: disruptions are more costly in absolute terms in a larger economy
  - increases with size of default: more effort undertaken to impose penalty
- In particular, we assume

$$\text{cost of default} = \lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1}$$

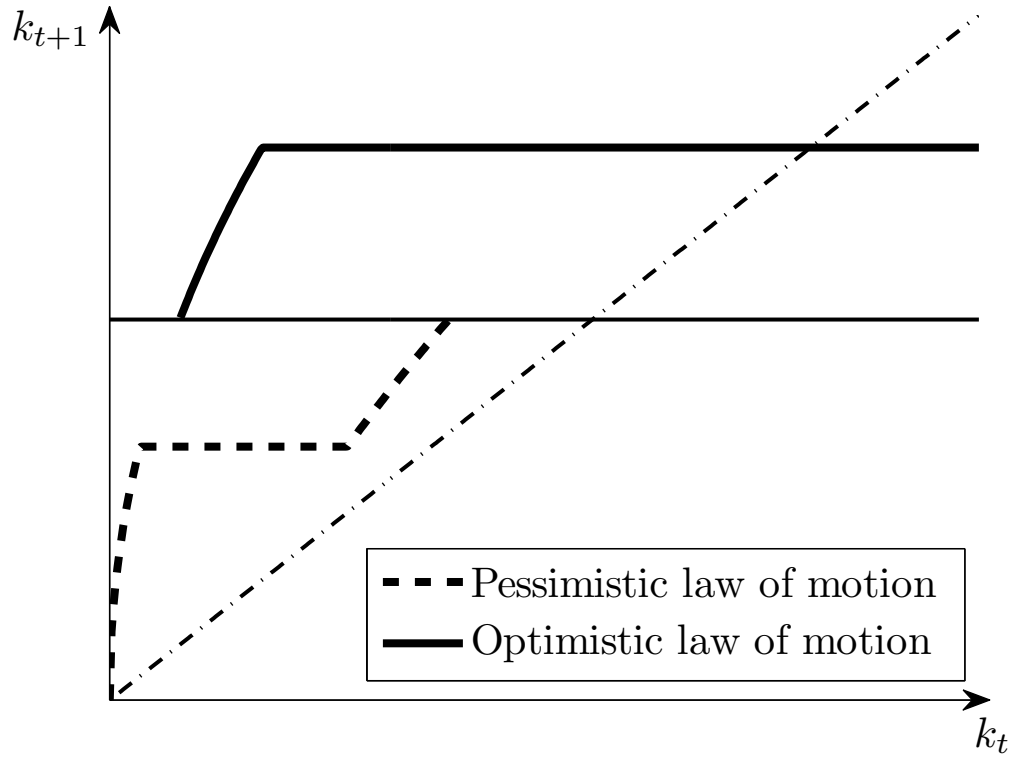
Model with cost of default - Equilibrium

- Cost of default may sustain "optimistic equilibrium"
  - if $\lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1} \geq R_{t+1} \cdot d^F_{t+1} \Leftrightarrow k_{t+1} \geq 1/\lambda$ government repays foreigners
- In this equilibrium
  - expect repayment $\longrightarrow$ debt not attractive to domestic residents $\longrightarrow$ high investment $\longrightarrow$ $\longrightarrow$ high capital stock $\longrightarrow$ repayment takes place

Model with cost of default - Equilibrium

- Cost of default may sustain "optimistic equilibrium"
  - if $\lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1} \geq R_{t+1} \cdot d^F_{t+1} \Leftrightarrow k_{t+1} \geq 1/\lambda$ government repays foreigners
- In this equilibrium
  - expect repayment $\longrightarrow$ debt not attractive to domestic residents $\longrightarrow$ high investment $\longrightarrow$
    $\longrightarrow$ high capital stock $\longrightarrow$ repayment takes place
- Despite cost of default there may be a "pessimistic equilibrium"
  - if $\lambda \cdot R_{t+1} \cdot d^F_{t+1} \cdot k_{t+1} \leq R_{t+1} \cdot d^F_{t+1} \Leftrightarrow k_{t+1} \leq 1/\lambda$ government defaults on foreigners
- In this equilibrium
  - expect default $\longrightarrow$ debt attractive to domestic residents $\longrightarrow$ low investment $\longrightarrow$
    $\longrightarrow$ low capital stock $\longrightarrow$ default takes place

Figure 12: The law of motion with multiple equilibria



The solid line represents the optimistic law of motion as defined by Equation (17). The dotted line represents the pessimistic law of motion as defined by Equation (19). The dash-dot line is the 45° line.

Model with cost of default - Equilibrium

- Since $k^{pes}(k) \leq k^{opt}(k)$ for all k, it follows that there the equilibrium thresholds

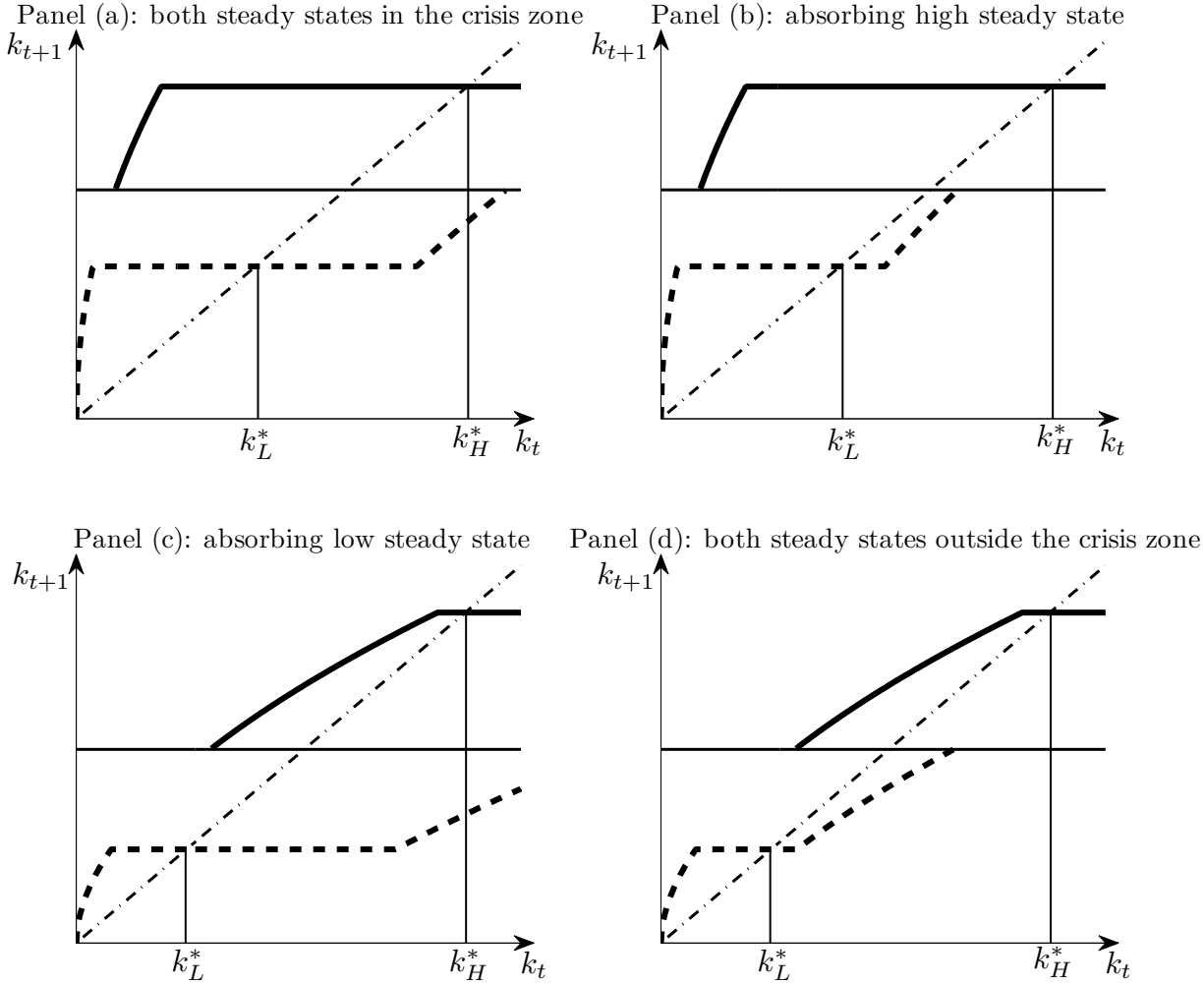
$$\bar{k}^P \geq \bar{k}^O$$

- Both optimistic and pessimistic equilibria exist if

$$k_t \in \left[\bar{k}^O, \bar{k}^P\right]$$

- A self-fulfilling crisis leads to
  - higher sovereign spreads
  - fraction of debt held domestically increases
  - domestic resources shift from investment to government debt
  - lower investment and growth
- Crisis zones, dynamics and exit

Figure 13: Dynamics with crisis zones



In all panels, the solid line represents the optimistic law of motion as defined by Equation (17), and the dotted line represents the pessimistic law of motion as defined by Equation (19). In panels (a) and (c), the debt level is high, so that both the optimistic and the pessimistic equilibrium exist at the high steady state. In panels (b) and (d), the debt level is lower, so that only the optimistic equilibrium exists at the high steady state. Furthermore, in panels (b) and (d), the curvature of the law of motion (governed by the parameters α and ϕ) is higher. In all panels, the dash-dot line is the 45° line.

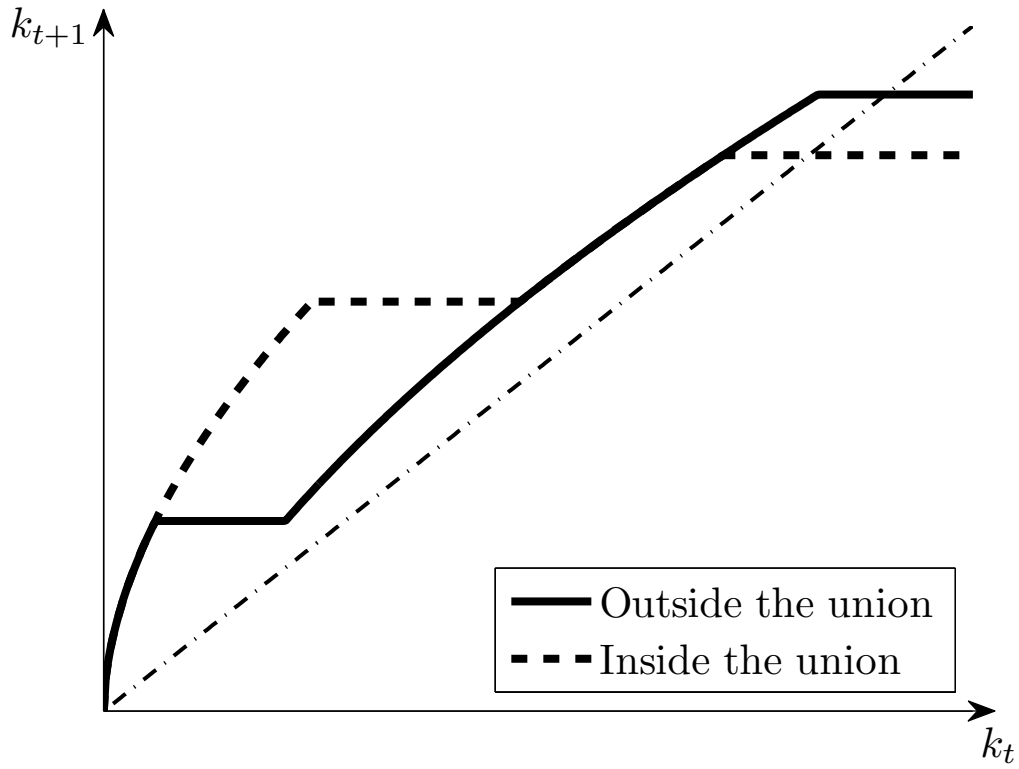
Model with economic union - Setup

- Probability of repayment to
  - domestic creditors: 1
  - creditors in the rest of the union: $p_{U,t+1}$
  - creditors outside the union: p_{t+1}

$$1 \geq p_{U,t+1} \geq p_{t+1} \geq 0$$

- Then
  - $1 - p_{U,t+1}$ is probability that there is a default and country exits the union
  - $p_{U,t+1} - p_{t+1}$ is probability that there is a default and country stays in the union
- Poor countries with high sovereign debt "export" crowding-out effects to rich countries with low debts

Figure 14: The effects of joining an economic union

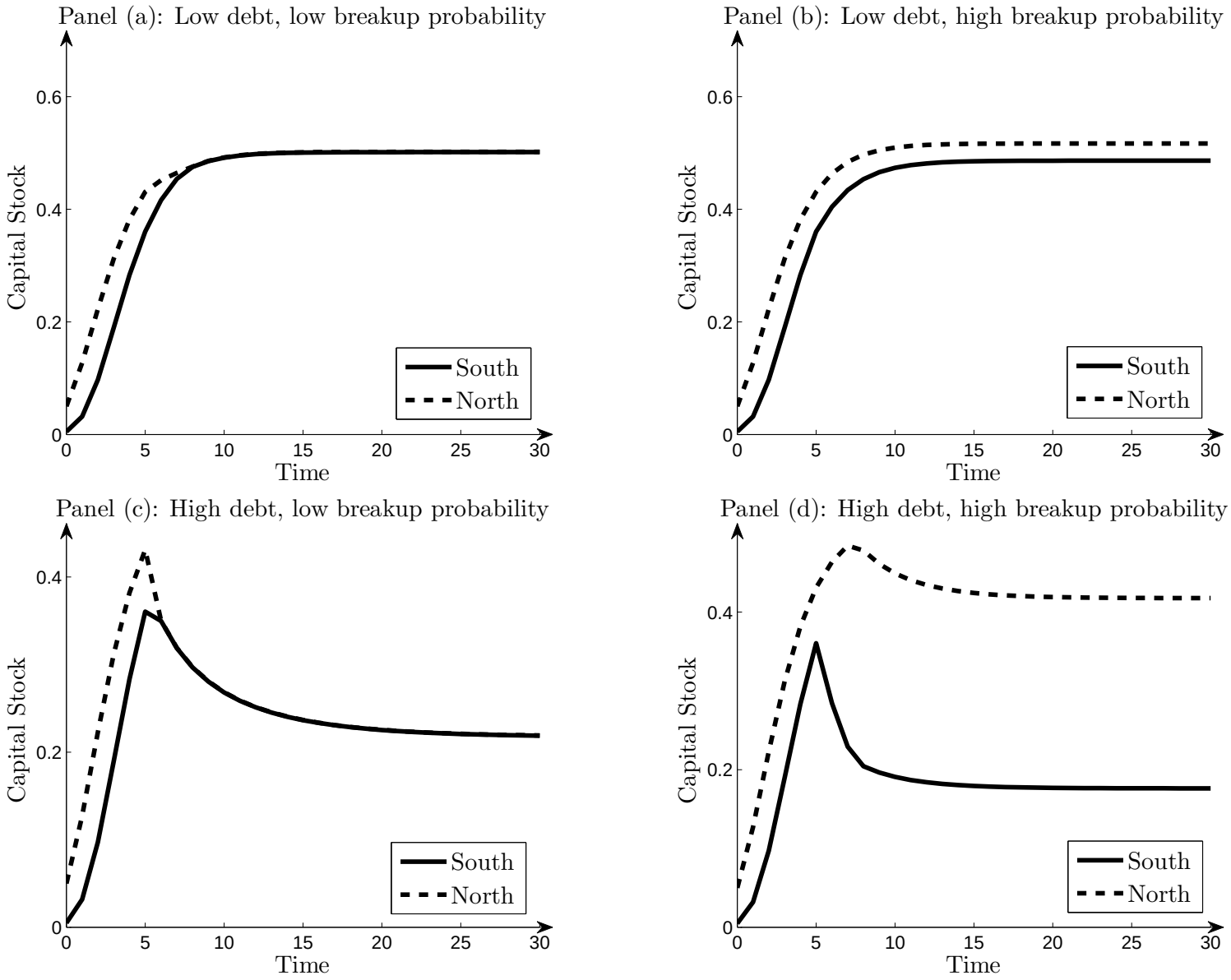


The solid line represents the low of motion of the capital stock outside the economic union, as defined by Equations (9) and (10). The dotted line represents the law of motion of the capital stock inside the economic union, as defined by Equations (22) and (23). The dash-dot line is the 45° line.

Model with economic union - Example

- Growth and convergence within union with North-South example

Figure 15: Dynamics of an economic union



This figure shows the evolution of the capital stock for two countries (South and North) belonging to an economic union, under the assumption that South issues an amount of debt d in period $t = 6$. The solid line indicates the evolution of South's capital stock and the dotted line the evolution of North's capital stock. The different panels consider different parameter values for the breakup probability of the union and for the amount of debt issued by South.

Model with economic union - Example

- Growth and convergence within union with North-South example
- Debt in union slows down growth and fosters/hampers convergence depending on breakup probability
- If p_{t+1} varies across members of union, there are gains from intermediation
  - members with high p_{t+1}
    - issue debt to IFM at low cost
    - purchase debt from members with low p_{t+1} at a premium
    - Eurobonds? ESM?
- This policy minimizes crowding-out effect and raises income of the union

Conclusions

We have presented a framework to think about these questions

1. Why have sovereign spreads increased so much?
2. Why have the private sectors of GIIPS purchased the debts of their sovereigns?
3. What are the economic consequences of these domestic purchases of debt?
4. What are the key inefficiencies that these purchases generate?
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