Is Inflation Default? The Role of Information in Debt Crises

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Sovereign Debt and Local-Currency Debt

- Countries that borrow in their own currency more resilient to debt crises
  - High-debt countries: Japan vs. Italy
  - High-deficit countries: UK vs. Spain
- Local-currency government bond prices react less to bad news

A Puzzle

- The ability to print money avoids default risk...

  $\Longrightarrow$ Interest rates do not jump in anticipation of default

- ...but printing money will cause inflation

  $\Longrightarrow$ Interest rates should jump in anticipation of inflation

However

- Inflation adjusts more slowly (at least in developed economies)
- Sovereign spreads move very fast, onset of rollover crises is sudden

Our Story

- Debt crises require a certain amount of coordination

- With foreign-currency debt, anticipate spike in default spreads
  $\Longrightarrow$ coordination among **bondholders**
- With domestic-currency debt, anticipate escalation of inflation expectations
  $\Longrightarrow$ coordination among **price setters**

- Price setters less precisely informed about gov't finances

  $\Longrightarrow$ **Information frictions** underlie differential response of bond prices to shocks

Model, Timing and Actions

$t = 1$

- Govt sells 1 unit of debt at price q_1
- to bond traders, prior + private signal on s (precision β_1)

$t = 2$

- bond traders re-sell bonds at price q_2
- to new bond traders (€), or to workers through cash (¥)
  - prior + private signal on s (precision $\beta_2 > \beta_2$)

$t = 1, 2 \rightarrow$ additional, random noise-agents demand ϵ_t

$t = 3$

- If $s \geq \hat{s}$, govt repays
- If $s < \hat{s}$, govt defaults/ inflates by $1 - \theta$

Equilibrium Prices

State variable $z_t = s + \epsilon_t$

$t = 2$

- equilibrium price of debt/money

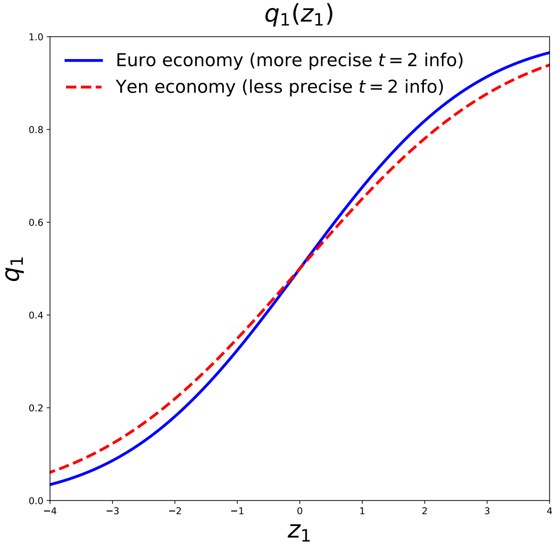
$$q_2(z_2) = \theta + (1-\theta)\Phi\left(\frac{(1-w_S)\mu_0 + w_S z_2 - \hat{s}}{\sigma_S}\right)$$

$t = 1$

- equilibrium price of debt

$$q_1(z_1) = \theta + (1-\theta)\Phi\left[\frac{\mu_0 - \hat{s}}{\sqrt{w_S^2\sigma_{S|B}^2 + \sigma_S^2}} + \frac{w_S w_B}{\sqrt{w_S^2\sigma_{S|B}^2 + \sigma_S^2}}(z_1 - \mu_0)\right]$$

Comparative Statics (more precise info = higher β_2)



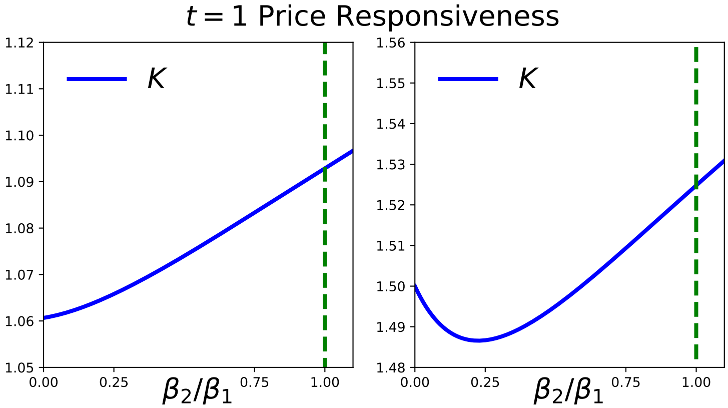
What if there is Recall of the First-Period Price?

Same payoffs, but different information set for $t = 2$ agents

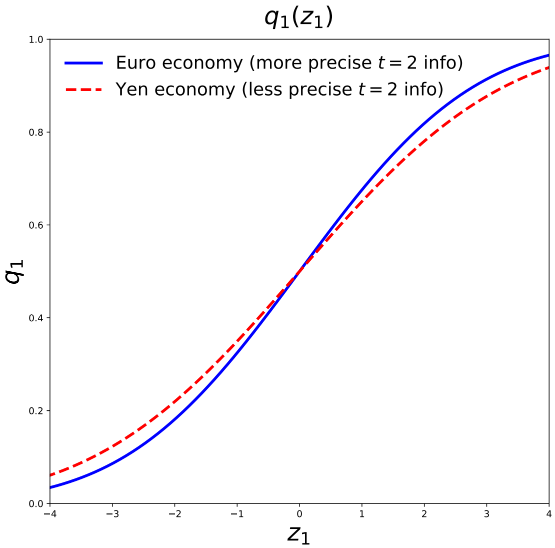
- z_1 new source of common knowledge with $t = 1$ traders

Comparative Statics

$$q_1(z_1) = \theta + (1-\theta)\Phi\left[\frac{\mu_0 - \hat{s}}{\sqrt{w_{2,S}^2\sigma_{S|B}^2 + \sigma_S^2}} + \underbrace{\left(\frac{w_{1,S} + w_{2,S}w_B}{\sqrt{w_{2,S}^2\sigma_{S|B}^2 + \sigma_S^2}}\right)}_{K}(z_1 - \hat{s})\right]$$



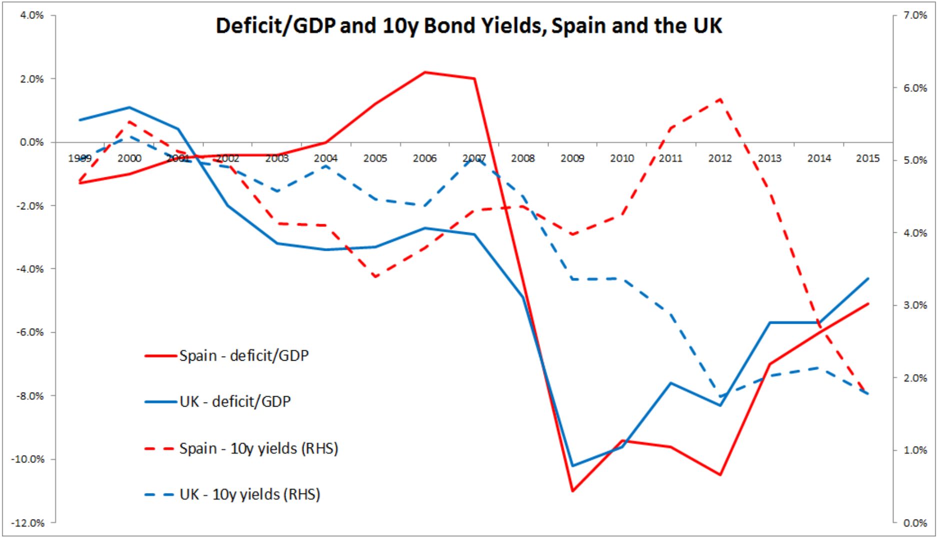
Single Crossing Again



Conclusion

- Heterogeneity of information has important implications for debt management
- We have shown insurance role of domestic-currency debt
- Next step: optimal theory of currency denomination (study of effects on ex ante price)

Thank You!


Deficit/GDP and 10y Bond Yields, Spain and the UK
4.0%
2.0%
0.0%
-2.0%
-4.0%
-6.0%
-8.0%
-10.0%
-12.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
1999
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2007
2008
2009
2010
2011
2012
2013
2014
2015
Spain - deficit/GDP
UK - deficit/GDP
Spain - 10y yields (RHS)
UK - 10y yields (RHS)

Back

Macro Model: Setup and actors

- Three periods
- Bond traders: strategic and noise
- Workers: strategic and noise
- Government (described by a mechanical rule)

back to setup

Workers: Preferences and Technology

- Only alive in periods 2 and 3
- Strategic workers
  - One unit of endowment in period 2
  - Wish to consume in period 3, risk neutral
  - Can store good (zero return) or sell it
- Noise workers
  - (Unobserved) relative mass $\Phi(\epsilon_2^w)$, $\epsilon_2^w \sim N(0, 1/\psi_2^w)$
  - Can produce in period 3
  - Demand 1 unit of consumption in period 2

Bond Traders: Preferences and Technology

- 2 OLGs living for two periods
- Endowed with goods when young
- Want to consume when old, risk neutral

- Strategic traders:
  - Can store
  - Can buy one unit of government bonds

- Noise traders:
  - Demand an (unobserved) fraction $\Phi(\epsilon_t^b)$, $\epsilon_t^b \sim N(0, 1/\psi_t^b)$, of gov't debt

- Mass of bond traders negligible compared to workers

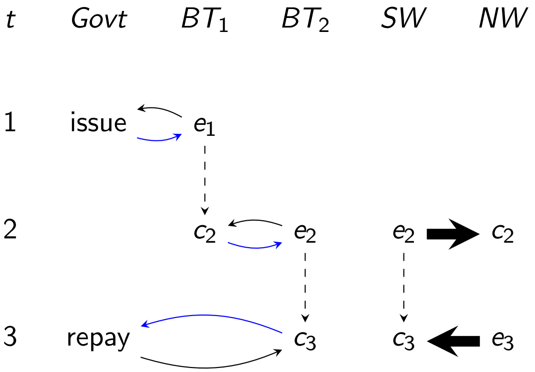
Government - "Euro" scenario

- Auctions one unit of debt in period 1 (per capita per young strategic trader), price q_1

- Debt is a promise to pay $\hat{s}(q_1)$ Euros (goods) in period 3. Examples:
  - $\hat{s}(q_1) \equiv 1$ (Eaton and Gersovitz)
  - $\hat{s}(q_1) \equiv 1/q_1$ (Calvo)

- In period 3, gov't collects taxes, depending on the realization of $s \sim N(\mu_0, 1/\alpha_0)$:
  - If $s \geq \hat{s}(q_1)$, full repayment
  - Otherwise, haircut $1-\theta$, gov't pays back $\theta\hat{s}(q_1)$

Euro Markets



Price

$$q_1 = \mathbb{E}_{BT_1}[q_2]$$

$$q_2 = \mathbb{E}_{BT_2}[q_3]$$

$$q_3 = \delta\theta + (1-\delta)$$

goods; bonds; storage (dashed)

Yen Markets

Government - "Yen" scenario

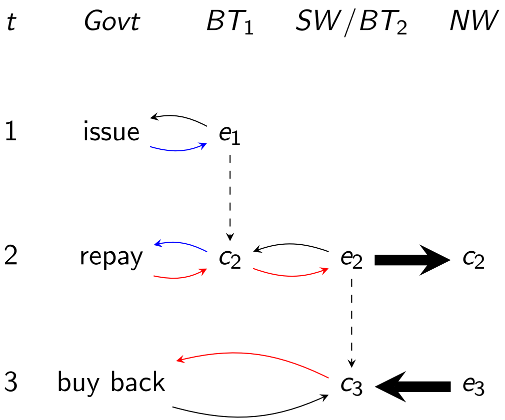
- Auctions one unit of debt in period 1 (per capita per young strategic trader), price q_1
- Debt is a promise to pay $\hat{s}(q_1)$ Yen.
- In period 2, gov't prints Yen, pays debt back.
- In period 3, gov't collects taxes, depending on the realization of $s \sim N(\mu_0, 1/\alpha_0)$:

  $$\left.\begin{array}{l}\text{- If } s \geq \hat{s}(q_1)\text{, collects } \hat{s}(q_1) \\ \text{- Otherwise, collects } \theta\hat{s}(q_1)\end{array}\right\}\text{(same as Euro scenario)}$$

- Period-3 taxes used to buy Yen back. Price level is either 1 or $1/\theta$.

  Price Level Determination

Yen Markets



Price

$$q_1 = \mathbb{E}_{BT_1}\left[\frac{1}{P_2}\right]$$

$$\frac{1}{P_2} = \mathbb{E}_{SW}\left[\frac{1}{P_3}\right]$$

$$\frac{\hat{s}(q_1)}{P_3} = [\delta\theta + (1-\delta)]\hat{s}(q_1)$$

goods; bonds; cash; storage (dashed)

Euro Markets

Euro vs. Yen: the Key Difference

- Eventual default/inflation is the same at the end ($t = 3$)
- Identity of primary-market participants is the same at the start ($t = 1$)

- Period 2 Identity of secondary-market participants different:
  - Under Euro, bonds offloaded to **new bond traders**
  - Under Yen, bonds offloaded to **workers (through cash)**

- With same information, same prices/payoffs in the 2 scenarios:
  - collapse them into a single problem: $q_2 := 1/P_2$ in the Yen case
  - index scenarios with period-2 agents' information precision

Price Level Determination, Yen Economy

Government money valuation equation

$$\frac{M}{P_3} = \text{real tax revenues}$$

and since $M = \hat{s}(q_1)$ (govt repays debt with money at $t = 2$)

$$\frac{M}{P_3} = \frac{\hat{s}(q_1)}{P_3} = \delta \cdot \theta \hat{s}(q_1) + (1 - \delta) \cdot \hat{s}(q_1)$$

so that

$$\begin{cases} \delta = 1 & P_3 = 1/\theta \\ \delta = 0 & P_3 = 1 \end{cases}$$

Back

Equilibrium Definition

Definition

A Perfect Bayesian Equilibrium consists of bidding strategies $d(x_{i,t}, q_t)$ for strategic players, a price function $q(s, \epsilon_t)$ and posterior beliefs $p(x_{i,t}, q_t)$ such that

(i) $d(x_{i,t}, q_t)$ is optimal given beliefs $p(x_{i,t}, q_t)$,

(ii) $q(s, \epsilon_t)$ clears the market for all (s, ϵ_t), and

(iii) $p(x_{i,t}, q_t)$ satisfies Bayes' Law for all market clearing prices q_t.

More Definitions

- Precision of first-period posterior beliefs

$$\frac{1}{\gamma_1} := \frac{1}{\alpha_0 + \beta_1(1+\psi_1)}$$

Case 1: $t = 1$ beliefs | Case 1: comparative statics

- Second-period Bayesian weights (case with recall)

$$w_{1,S} := \frac{\beta_1\psi_1}{\alpha_0 + \beta_1\psi_1 + \beta_2(1+\psi_2)} \quad w_{2,S} := \frac{\beta_2(1+\psi_2)}{\alpha_0 + \beta_1\psi_1 + \beta_2(1+\psi_2)}$$

Case 2: q_1

- Aggregate noise term of first-period price (case with recall)

$$S := \sqrt{w_{2,S}^2\left(\frac{1}{\gamma_1} + \frac{1}{\beta_2\psi_2}\right) + \sigma_S^2}$$

Case 2: q_1 | Case 2: comparative statics

Simplest Case

Proposition (1)

There exists a cutoff level $\hat{z}_1^{\beta} \in \mathbb{R}$ *such that when* $z_1 < \hat{z}_1^{\beta}$*, a decrease in* β_2 *improves the issuance price* q_1*, whereas the reverse occurs for* $z_1 > \hat{z}_1^{\beta}$*.*

Proposition (2)

There exists a cutoff level $\hat{z}_1^{\psi} \in \mathbb{R}$ *such that when* $z_1 < \hat{z}_1^{\psi}$*, a decrease in* ψ_2 *improves the issuance price* q_1*, whereas the reverse occurs for* $z_1 > \hat{z}_1^{\psi}$*.*

Back

With Recall, Exogenous Threshold

Proposition (3)

There exists a cutoff level $\hat{z}_1^{\psi} \in \mathbb{R}$ *such that when* $z_1 < \hat{z}_1^{\psi}$*, a decrease in* ψ_2 *improves the issuance price* q_1*, whereas the reverse occurs for* $z_1 > \hat{z}_1^{\psi}$*.*

Proposition (4)

Assume that $\psi_2 \geq \psi_1$ *and* $\beta_2^A \geq \beta_1$*. Let* $\beta_2^B < \beta_2^A$*. Then there exists a cutoff level* $\hat{z}_1^{\beta} \in \mathbb{R}$ *such that when* $z_1 < \hat{z}_1^{\beta}$*,* q_1 *evaluated at* β_2^A *is smaller than at* β_2^B*, whereas the reverse occurs for* $z_1 > \hat{z}_1^{\beta}$*, holding all other parameters fixed.*

Back

With Recall, Endogenous Threshold

Proposition (5)

Assume that $\psi_2 \geq \psi_1$ *and* $\beta_2^A \geq \beta_1$*, and let* (**??**) *hold. Let* $\beta_2^B < \beta_2^A$*. Then there exist two cutoffs level* $\hat{z}_1^L \leq \hat{z}_1^H \in \mathbb{R}$ *such that when* $z_1 < \hat{z}_1^L$*,* q_1 *evaluated at* β_2^A *is smaller than at* β_2^B*, whereas the reverse occurs for* $z_1 > \hat{z}_1^H$*, holding all other parameters fixed.*

Back