Liquidity, Default Risk, and the Information Sensitivity of Sovereign Debt

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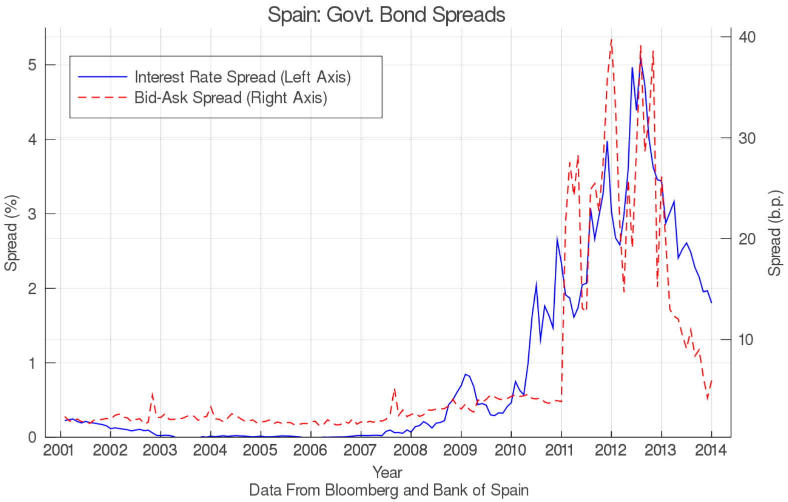
This Paper

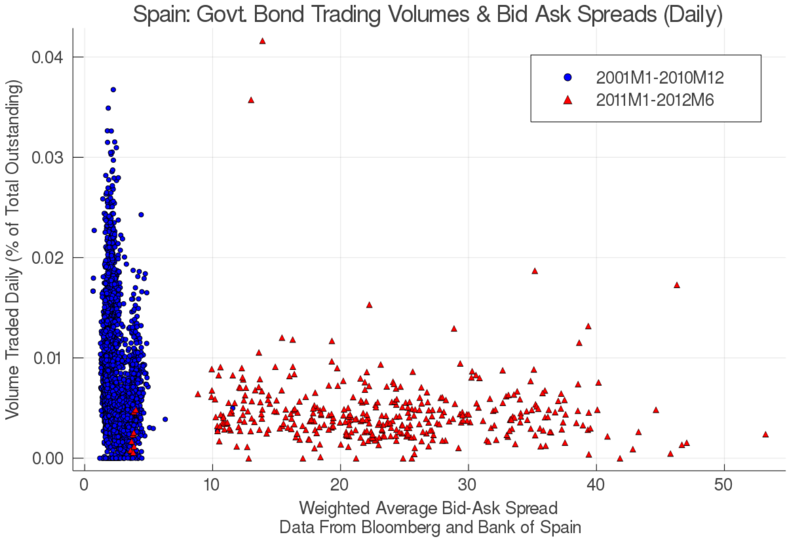
- Document empirical relationships between interest rate spreads, liquidity, and default risk in Spain.
  - Bid-Ask Spread $= Y\bar{T}M_{Bid} - Y\bar{T}M_{ASK}$
- Explain variation in liquidity measures as the equilibrium result of some traders having private information.
- Match business cycle patterns of debt accumulation in a developed country using more flexible preferences.

Bid-Ask Spreads and Interest Rates: Spain



▸ vs. CDS S ▸ Bid-Ask Spread Time Series ▸ Interest Rate Spread Time Series

Liquidity and Bid-Ask Spreads: Spain



Monthly Data

Literature Review

- Passadore and Xu (2018) and Chaumont (2018):
  - This paper has no search frictions in secondary markets.
  - Differences in valuations not driven by permanent changes in investor preferences (good investor vs. bad investor).
- Gorton and Ordonez (2014 and 2019) and Dang, Gorton, and Holmstrom (2015):
  - This paper implements a version of their "information sensitivity" concept.

Key Ingredients

- Model of external sovereign debt a la Eaton Gersovitz (1981).
- Add model of secondary market interactions with:
  1. Ability of some agents to acquire private, payoff-relevant information
  2. Anonymous trading
  3. Random differences in fundamental valuations of bonds between buyers and sellers

Environment

- Small open economy.
- Output is a Markov Process $y(s)$.
- Benevolent government and representative consumer. Recursive preferences.
- Single long term bond: maturity rate λ & coupon rate κ
- While in default, output is reduced.
- Continuum $[0, \bar{B}]$ of risk neutral, competitive international investors, each of whom can hold a unit of debt.
- Current investors may spend $f(\pi)$ to access information about $y(s')$ one period ahead of time with probability π.

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1. Income and reentry realized.
2. Default decisions.
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6. Secondary market opens:
   - Random matching.
   - Bid and ask prices submitted simultaneously.
   - If $p_{bid} \geq p_{ask}$, the transaction clears at p_{bid}.
   - New purchasers replace exiting sellers.

Government Problem

$$W(s,b) = max_{d\in\{0,1\}}(1-d)W^R(s,b) + dW^D(s) \tag{1}$$

Conditional on repayment:

$$W^R(s,b) = max_{c,b'},U(c,\bar{W}(s,b')) \tag{2}$$

such that

$$c + (\lambda + (1-\lambda)\kappa)b = y(s) + q(s,b')(b' - (1-\lambda)b) \tag{3}$$

Conditional on default:

$$W^D(s) = U(y(s) - \phi(s), \bar{W}^D(s)) \tag{4}$$

where $\mu(.)$ is a certainty equivalent operator and:

$$\bar{W}(s,b') = \mu(W(s',b')|s) \qquad \bar{W}^D(s) = \mu(W(s',0), W^D(s')|s) \tag{5}$$

Secondary Markets

- Risk neutrality and competitiveness of lenders:

$$q(s, b') = \max_{\pi} (1 - \pi) q_U(s, b') + \pi q_I(s, b') - f(\pi) \tag{6}$$

- $\pi_S(s, b')$ = equilibrium proportion of current investors who obtain access to $\hat{y}'$.
- $q_U(.), q_I(.)$ = value of being uninformed or informed, respectively.
- $\pi_S(s, b') \in (0, 1)$ implies:

$$q_I(s, b') - f'(\pi) = q_U(s, b') \tag{7}$$

Secondary Markets - Notation

- v denotes the undiscounted unit value of the asset to an uninformed agent.

$$v(s, b') = E[(1 - d(s', b'))(\lambda + (1 - \lambda)(\kappa + q(s', b''(s', b'))))|s] \quad (8)$$

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$$\hat{v}(s, \hat{y}', b') = E[(1 - d(s', b'))(\lambda + (1 - \lambda)(\kappa + q(s', b''(s', b'))))|s, \hat{y}'] \quad (9)$$

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- $\hat{\delta} \sim F(.)$ denotes the random taste shock of current investors.
- δ denotes the constant, known taste shock of new investors.

Secondary Markets - Sellers

Given any bid strategy of buyers and their own $\hat{\delta}$, sellers solve:

$$q_U(v|\hat{\delta}) = max_{p_{S,U}} \mathbf{1}\{p_{S,U} > p_B\}\hat{\delta}v + \mathbf{1}\{p_{S,U} \leq p_B\}p_B \tag{10}$$

or:

$$q_I(\hat{v}|\hat{\delta}) = max_{p_{S,I}} \mathbf{1}\{p_{S,I} > p_B\}\hat{\delta}\hat{v} + \mathbf{1}\{p_{S,I} \leq p_B\}p_B \tag{11}$$

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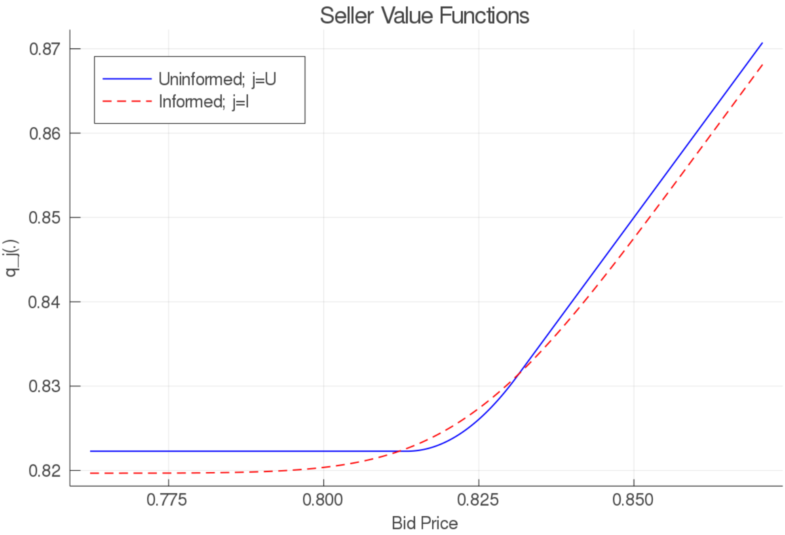
Since transactions clear at the bid price:

$$p^{\star}_{S,U}(\hat{\delta}, v) = \hat{\delta}v \qquad\qquad p^{\star}_{S,I}(\hat{\delta}, \hat{v}) = \hat{\delta}\hat{v} \tag{12}$$

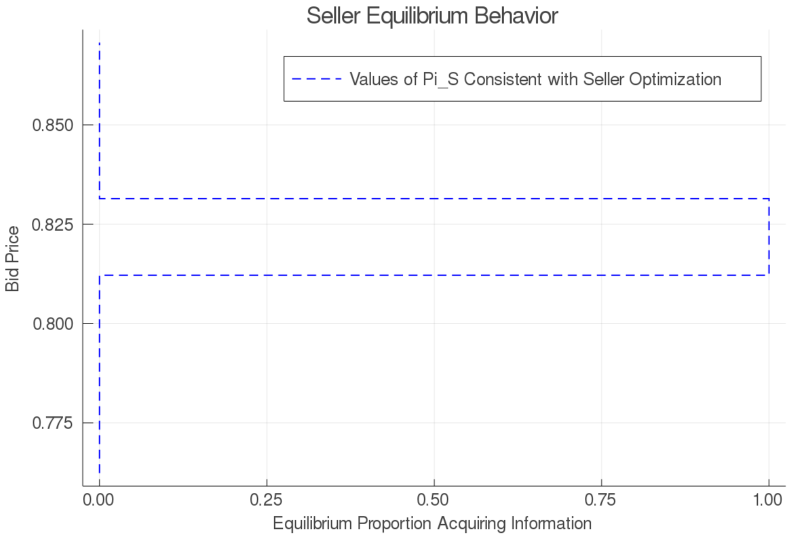
Probabilities of trading at a given bid price p_B:

$$Pr(Trade|U, v)(p_B) = F(\frac{p_B}{v}) \qquad Pr(Trade|I, \hat{v})(p_B) = F(\frac{p_B}{\hat{v}}) \tag{13}$$

Secondary Markets - Seller Values



Secondary Markets - Seller Equilibrium Behavior



Secondary Markets - Buyers

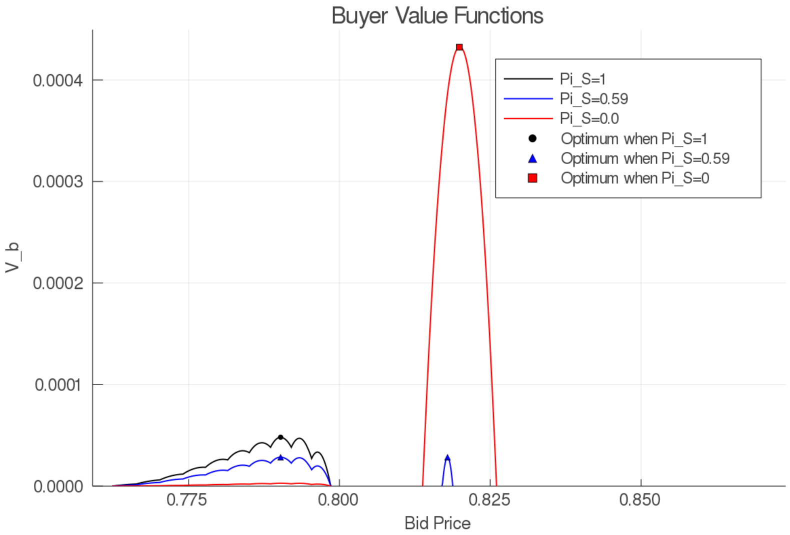
- Buyers then solve:

$$max_{p_B}(1-\pi_S)(\delta v - p_B)F(\frac{p_B}{v})$$
$$+\pi_S\left(-Pr(\hat{v}=0)p_B + \int_V (\delta\hat{v} - p_B)F(\frac{p_B}{\hat{v}})dG(\hat{v})\right) \tag{14}$$

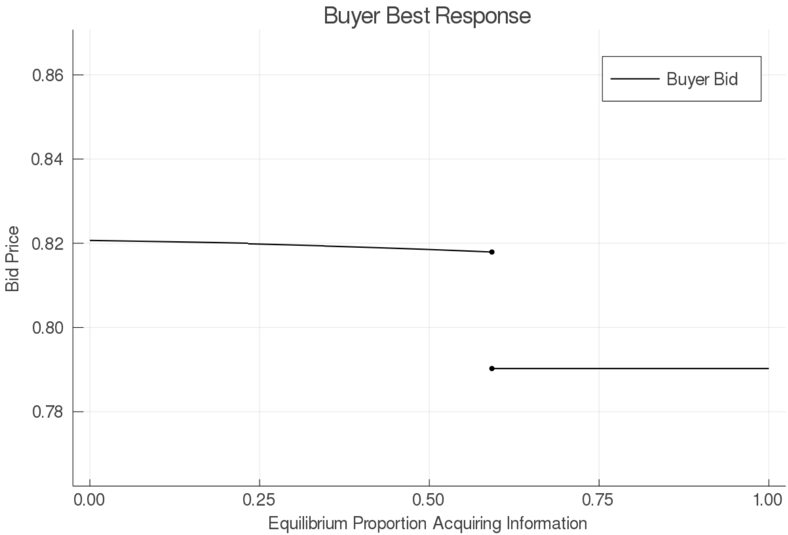
- Mechanism driving bid ask spreads:

  $(\delta\hat{v} - p_B)$ negatively correlated with $F(\frac{p_B}{\hat{v}})$

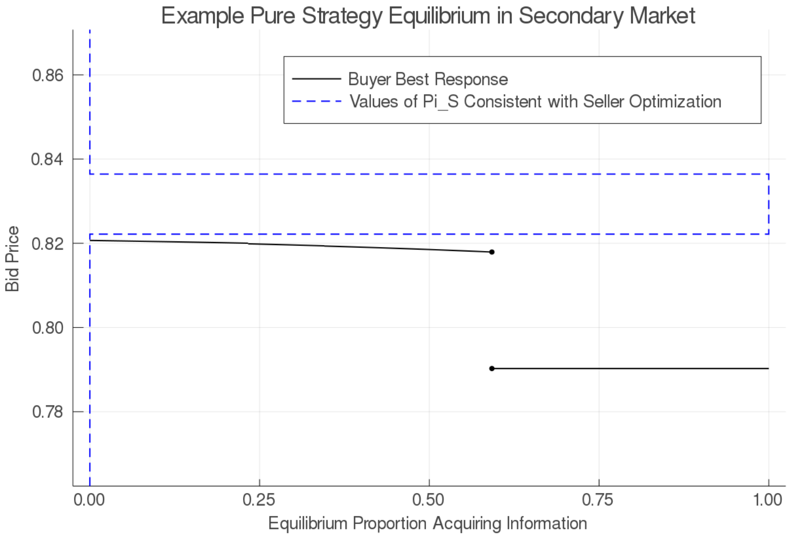
Secondary Markets - Buyer Values



Secondary Markets - Buyer Best Response



Secondary Markets - Equilibrium



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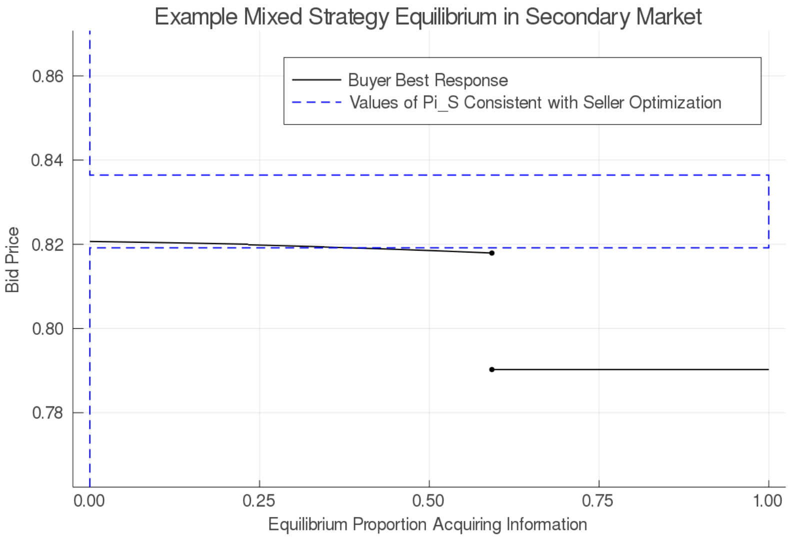


▸ Eqm. With Both Mixing

Functional Forms

- Epstein-Zin Preferences:

$$U(c, \bar{W}'(s)) = ((1-\beta)c^{1-\psi} + \beta \bar{W}'(s)^{1-\psi})^{\frac{1}{1-\psi}} \tag{15}$$

$$\bar{W}'(s) = E[W(s')^{1-\gamma}|s]^{\frac{1}{1-\gamma}} \tag{16}$$

- $y(s) = \tilde{y} + m$

$$\tilde{y}' = \rho\tilde{y} + \eta \qquad \eta \sim^{iid} N(0, \sigma_\eta^2) \qquad m \sim^{iid} TN(0, \sigma_m^2, -\bar{m}, \bar{m}) \tag{17}$$

- $\hat{\delta} \sim U(\underline{\delta}, \bar{\delta})$
- $\hat{y}'$ parametrized as the true $\tilde{y}'$ plus a noise term:

$$\hat{y}' = \tilde{y}' + \epsilon \qquad \epsilon \sim^{iid} N(0, \sigma_\epsilon^2) \tag{18}$$

Calibration

All parameter values are monthly, where applicable.

Table 1: Fixed Parameters

Parameter	**Value**	**Notes**
ρ	0.9918	SE: 0.007
σ_η	0.0049	SE: 0.0005
σ_m	0.0015	SE: 0.0004
$\bar{m}$	0.0031	
θ	0.0130	CE 2012
$\underline{\delta}$	0.990	Fix implied $r_f = 0.33\%$ when $\pi_S = 0$
δ	0.999	Fix B-A Spread = 2.5 b.p. when $\pi_S = 0$
$\bar{\delta}$	1.001	Fix volumes=37% when $\pi_S = 0$
λ	0.0122	Weighted Average Maturity of Debt
κ	0.0041	Average Coupon of Debt

Calibration

This leaves the parameters below.

Table 2: Calibrated Parameters

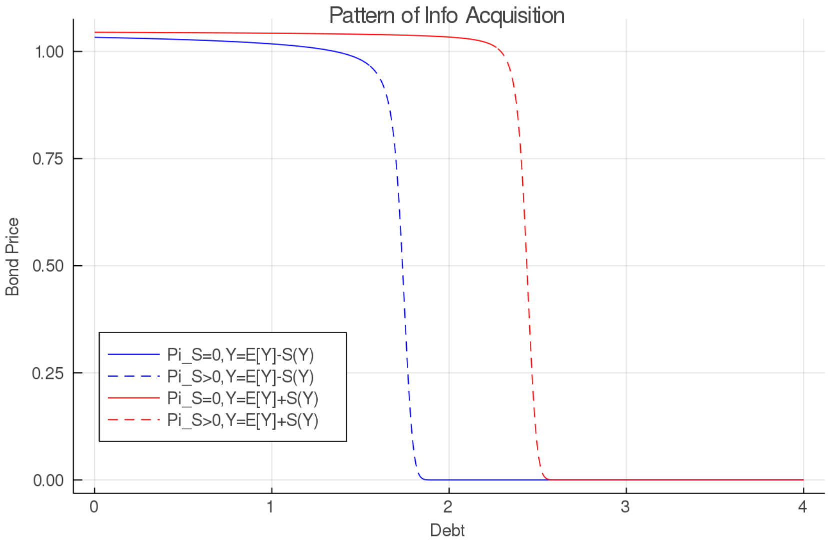
Parameter	**Value**	**Notes**
ψ	11.73	Govt Inverse IES
γ	4.83	Govt Risk Aversion
β	0.992	Govt Discount Factor
d_0	-0.110	Linear Default Cost
d_1	0.142	Quadratic Default Cost
f	0.000125	Cost of Information (Linear)
σ_ϵ	0.037	SD of Noise in $\hat{y}$

Results

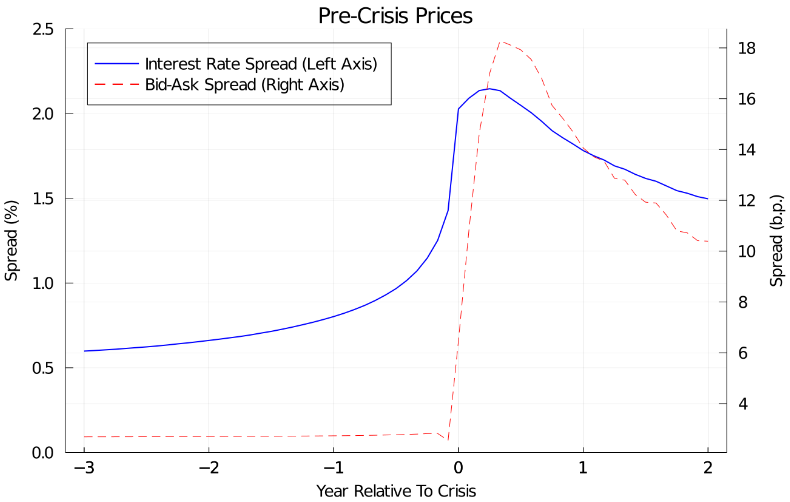
Table 3: Targeted Moments (Annualized Values)

Moment	Period	Data	Model
$E[B'/Y]$	Jan 1 2001 - June 30 2012	11.9%	13.5%
$\rho(B'/Y, ln(Y))$	Jan 1 2001 - June 30 2012	-0.76	-0.49
$\rho(NX/Y, ln(Y))$	Jan 1 2001 - June 30 2012	-0.78	-0.10
$E[r - r^f]$	Jan 1 2001 - June 30 2012	0.72%	0.83%
$\sigma(r - r^f)$	Jan 1 2001 - June 30 2012	1.13%	1.05%
$E[BA]$	Jan 1 2001 - June 30 2012	5.5 b.p.	5.4 b.p.
$\rho(BA, r - r^f)$	Jan 1 2001 - June 30 2012	0.84	0.80

Results - Mechanism



Results - Crises



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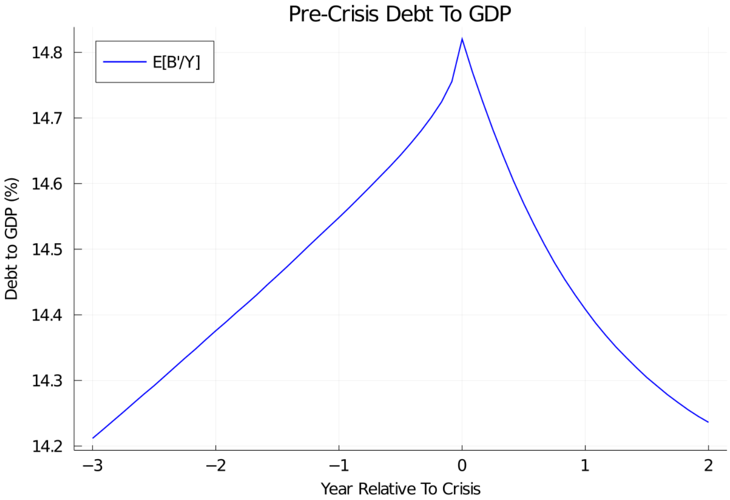
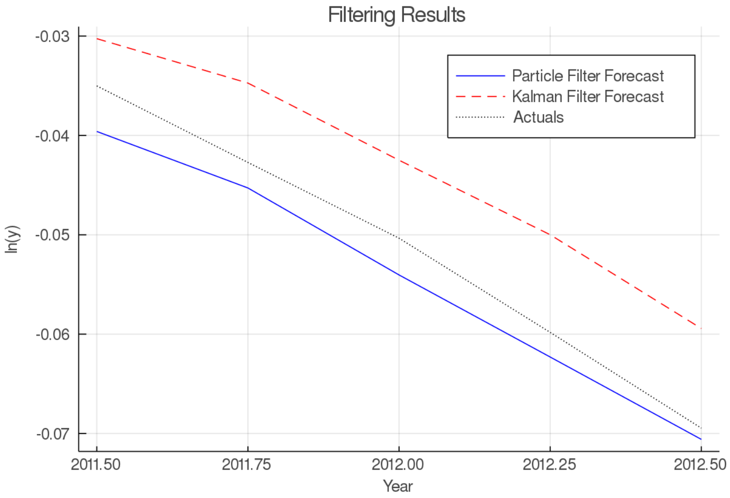


Results - Validation

- In the model, realized bid-ask spreads depend on the distribution of forecasts obtained by investors.
- Those forecasts in turn depend on the true value of future output.
- Therefore, bid-ask spreads should provide information on future output.
- Does including this information improve forecasts of Spanish output during the crisis relative to the one-step ahead prediction of the Kalman Filter?

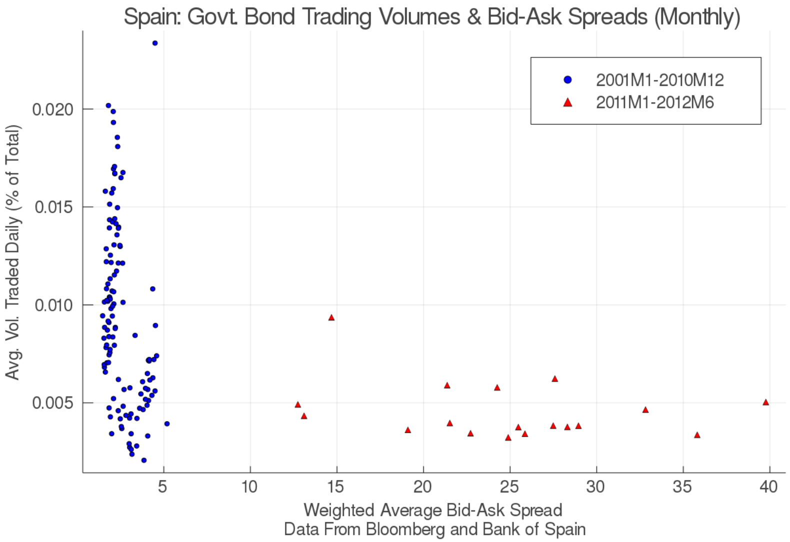
Results - Validation



Conclusions

- A model of costly acquisition of private information by traders can rationalize the type of relationship between bid-ask spreads and interest rate spreads/default risk observed in the data.
- Predictions the model makes about the relationship between bid-ask spreads and future realizations of output are borne out in the data.

Liquidity and Bid-Ask Spreads: Spain



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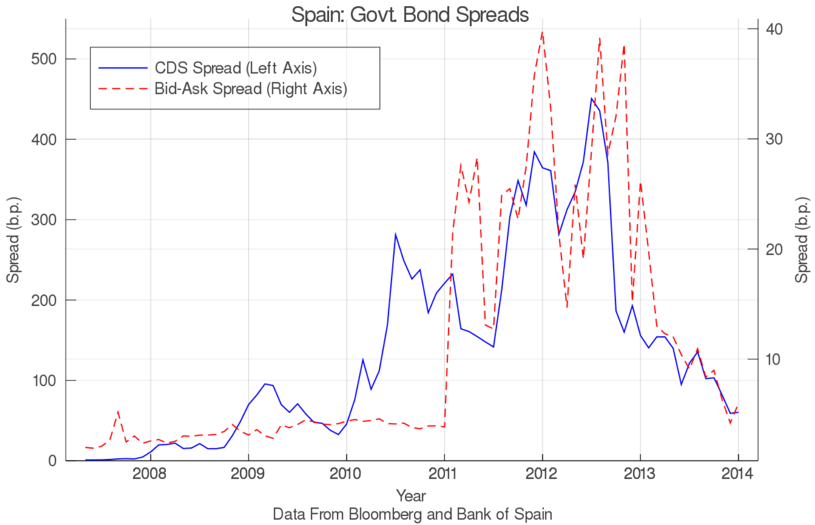
Bid-Ask Spreads and CDS Spreads: Spain



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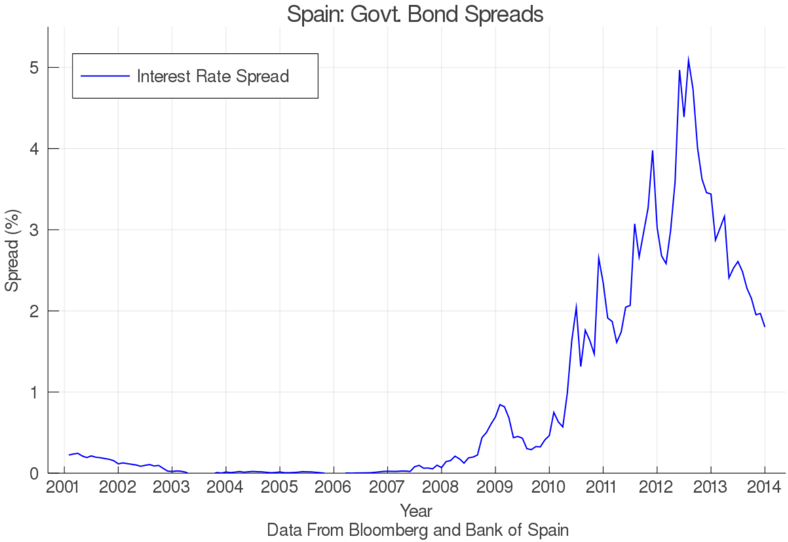
Interest Rates: Spain



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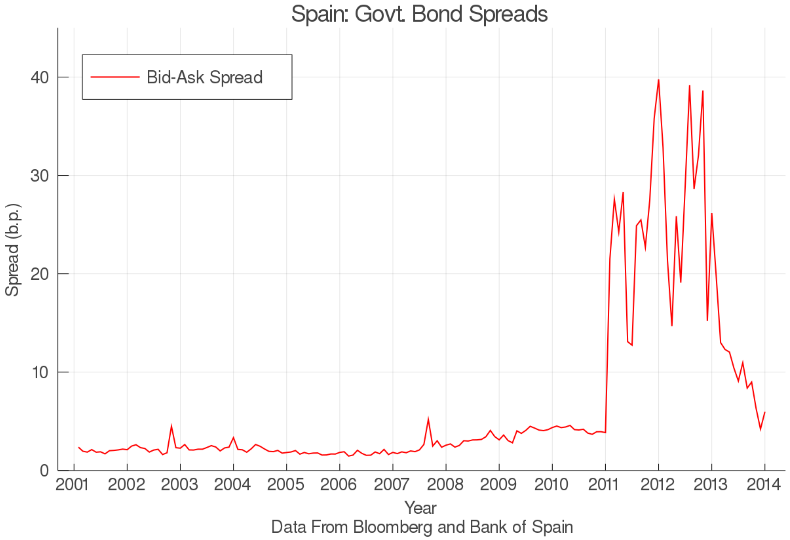
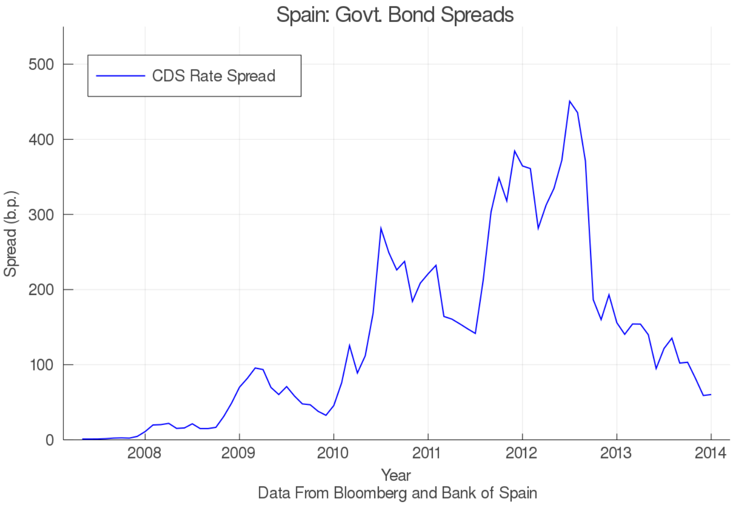
Bid-Ask Spreads: Spain



◂ Back to Int/BA ◂ Back to CDS/BA

CDS Spreads: Spain



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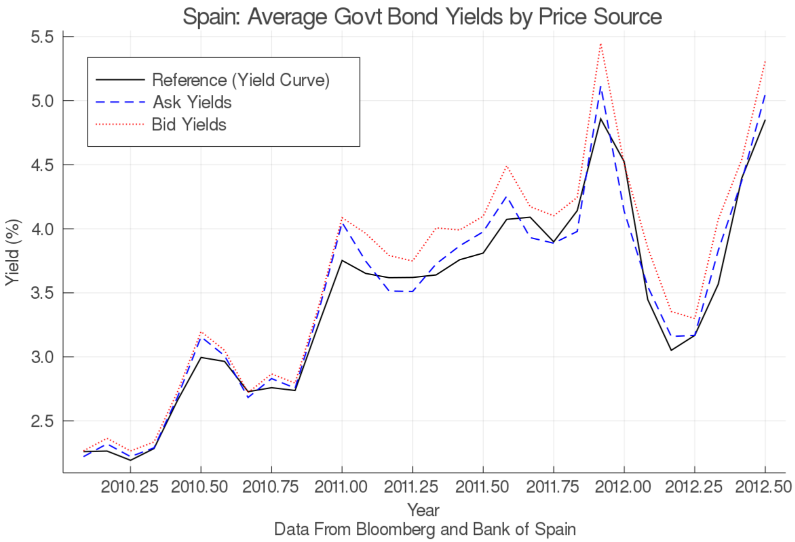
Bid-Ask Spreads: Spain



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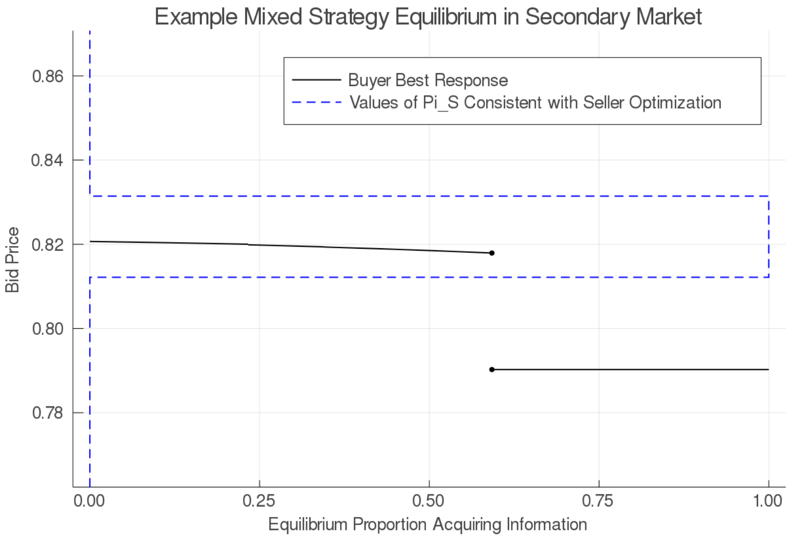
Secondary Markets - Equilibrium



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