

Aggregate Demand and Sovereign Debt Crises

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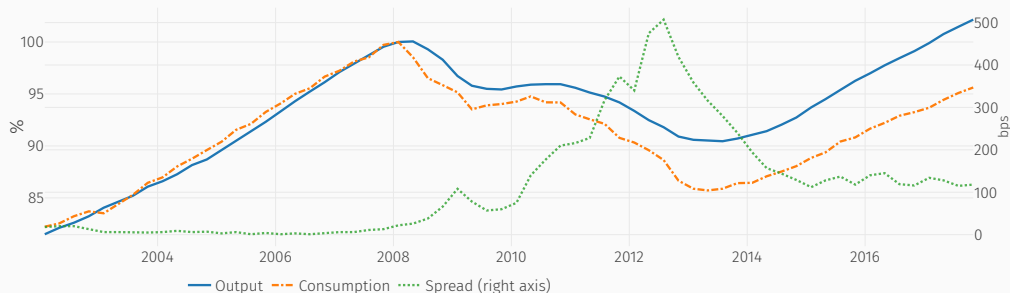
September 2019

^aThe views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

SPAIN IN THE EUROZONE CRISIS

- Sovereign debt crises associated with **deep** recessions [▶ More](#)

Output and Consumption for Spain



- Conventional view: low output \Rightarrow high spreads

[▶ Detrended data](#)

[▶ Trade balance](#)

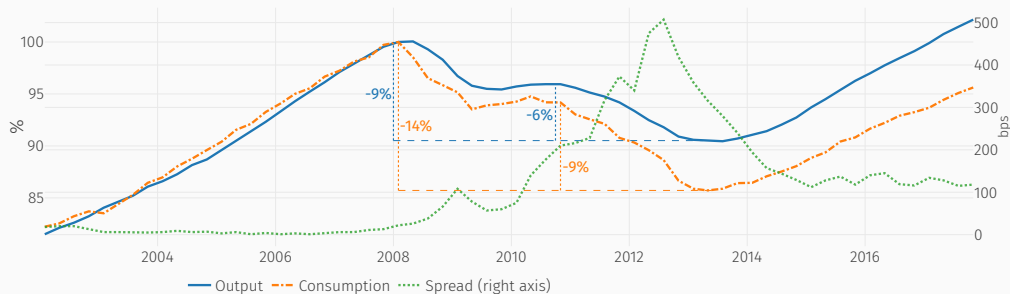
[▶ Low demand?](#)

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SOVEREIGN RISK

- Spain: large output and consumption drops
 - $|\Delta C| > |\Delta Y| \implies$ Saving rate \uparrow in the crisis
- IVs on Eurozone country-level data show
 1. High spreads cause output to fall
 2. High spreads cause consumption to fall **more** than output
- Huidrom et al. (2019): weak fiscal positions erode consumption demand
- Large literature about costs of sovereign default – silent about costs of default **risk**
 - Agg demand irrelevant with Hand-to-mouth households / Law of One Price
 - Saving rate in the crisis?
 - Consequences?
 - Household sector manages substantial wealth (avg 96% of GDP) [▶ Spanish data](#)
 - Substantial fraction of government debt held by residents [▶ Spanish data](#)

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- I propose a model of sovereign debt **crises**
 - Prominent role for household consumption/savings decision
 - Heterogeneous domestic savers can **choose** to be exposed to government debt
 - Endogenous wealth distribution that interacts with gov't default choice
- Model
 - Defaults create
 - Aggregate income losses ← TFP costs of default
 - Redistributive effects ← Domestic debt holdings
 - ... Those who benefit from redistribution: high MPCs from current income, low from future income
 - Economy looks **riskier** when the default probability increases
 - Default risk **interacts** with precautionary behavior

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How is sovereign risk costly?

Feedback loop between spreads and output

\uparrow Spreads \implies \downarrow Demand \implies \downarrow Output

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 - Redistributive effects \longleftarrow Domestic debt holdings
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MAIN FINDINGS

- Sovereign risk makes the response of output to shocks
 - Nonlinear
 - State-dependent
- Feedback effect explains significant portion of the crisis
 - 20% – 40% of output contraction attributable to default
- Large welfare effects
 - Volatility of output and consumption 25% and 55% lower without default
 - Unemployment halved
 - Households would give up 10% of permanent consumption to avoid defaults
- New light on Aguiar-Gopinath facts [▶ More](#)
 - Amplification of negative shocks, demand-driven recessions
 - In downturns volatility of $C >$ volatility of Y

- **Sovereign risk affecting the supply side through finance**

Neumeyer and Perri (2005), Bocola (2016), Arellano, Bai, and Mihalache (2018), Balke (2017)

- **Domestic debt and default incentives**

Gennaioli, Martin, and Rossi (2014), Mengus (2014), Mallucci (2015), Pérez (2016), Sosa-Padilla (2018), D'Erasmus and Mendoza (2016), Ferriere (2016), ...

- **Sovereign risk and fiscal austerity**

Cuadra, Sánchez, and Sapriza (2010), Romei (2015), Bianchi, Ottonello, and Presno (2016), Anzoategui (2017), Philippon and Roldán (2018)

- **Shocks affecting aggregate demand through redistribution**

Auclert (2017), Eggertsson and Krugman (2012), Korinek and Simsek (2016), ...

- Evidence
- Description of Model
- Model Results
- Simulations
- Crises

EVIDENCE

MAIN SPECIFICATION

- Regress outcome variable Q_{jt} on country j 's spread

$$Q_{jt} = \beta \Delta Spread_{jt} + \gamma X_{jt} + \delta_t + \mu_j + \epsilon_{jt}$$

where $Q_{jt} = \log Y_{jt}, \log C_{jt}$

- IV strategy (based on Martin and Philippon, 2017)

$$\Delta Spread_{jt} = \underbrace{\phi B_{jo} + \delta_t}_{Z_{jt}} + \eta_{jt}$$

- Data for 11 European countries between 2010Q1 – 2013Q1

Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain

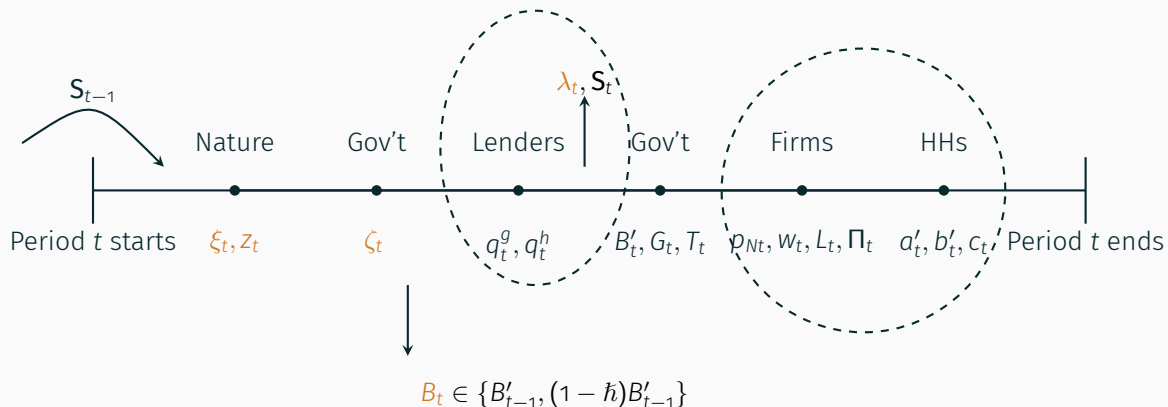
	<i>Dependent variable:</i>			
	$\log Y_{jt}$ (1)	$\log C_{jt}$ (2)	$\log Y_{jt}$ (3)	$\log C_{jt}$ (4)
$\Delta Spread_{jt}$	-0.008*** (0.001)	-0.013*** (0.001)		
$\Delta Spread_{jt}$ (IV)			-0.006** (0.002)	-0.010*** (0.003)
Country + Time FE	✓	✓	✓	✓
Observations	143	143	143	143
Adj. R^2	0.772	0.784	0.765	0.776

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

DESCRIPTION OF MODEL

GENERAL DESCRIPTION

- Small open economy with
 - Uninsurable idiosyncratic income risk + Incomplete markets
 - Default risk
 - Nominal rigidities
- Actors:
 - A government
 - Issues long-term debt, purchases goods, decides **repayment**
 - Households
 - Consume, work, save in the gov't **bond** + risk-free **debt**
 - Differ in 'cash' holdings, idiosyncratic income shock
 - Firms
 - Produce the goods with labor, subject to **wage rigidities**
 - Foreigners
 - Lend to the government and to the private sector
 - Price all assets



Decisions within a period
Dashed ellipses encircle simultaneous decisions

At each t , the government

- Chooses **repayment** $h_t \in \{1, 1 - \bar{h}\}$
- Follows fiscal rules for new **issuances** $B'(S_t)$ and spending $G(S_t)$
 - Can depend on full state: $(B_t, \lambda_t, \xi_t, \zeta_t, Z_t)$ ► Fiscal rules
- Must satisfy its budget constraint

$$\underbrace{q_t^g}_{\text{debt price}} \underbrace{(B'_t - (1 - \rho)B_t)}_{\text{new debt issued}} + \underbrace{T_t}_{\text{lump-sum}} + \underbrace{\tau W_t L_t}_{\text{payroll tax}} = \underbrace{G_t}_{\text{spending}} + \underbrace{\kappa B_t}_{\text{coupon}}$$

→ T_t summarizes a default / austerity tradeoff

Given a government policy $h(\mathbf{S}, \xi', z'), B'(\mathbf{S}), T(\mathbf{S}, q^g)$, in a **comp eq'm**

- Risk-neutral foreigners ► General Formulation
 - Price all assets

$$q^h(\mathbf{S}) = \frac{1}{1 + r^*}$$

$$q^g(\mathbf{S}) = \frac{1}{1 + r^*} \mathbb{E} \left[\underbrace{\mathbb{1}_{(\zeta'=1)}(1 - \xi')\kappa}_{\text{coupon}} + \underbrace{(1 - \rho)}_{\text{depreciation}} \underbrace{(1 - \hbar \mathbb{1}_{(\zeta=1 \cap \zeta' \neq 1)})}_{\text{potential haircut}} \underbrace{q^g(\mathbf{S}')}_{\text{resale price}} \mid \mathbf{S} \right]$$

PRIVATE ECONOMY

Given a government policy $h(\mathbf{S}, \xi', z'), B'(\mathbf{S}), T(\mathbf{S}, q^g)$, in a **comp eq'm**

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- Firms
 - Traded and nontraded goods, CES aggregator, wage rigidities

$$Y_{Nt} = L_{Nt}^{\alpha_N} (1 - \Delta \mathbb{1}_{(\zeta \neq 1)})$$

$$Y_{Tt} = z_t L_{Tt}^{\alpha_T} (1 - \Delta \mathbb{1}_{(\zeta \neq 1)})$$

$$w_t \geq \bar{w}$$

Given a government policy $h(\mathbf{S}, \xi', z'), B'(\mathbf{S}), T(\mathbf{S}, q^g)$, in a **comp eq'm**

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- Households
 - Access to both assets with borrowing limits, inelastic labor supply
- **Approximation**: $\lambda_t = \log \mathcal{N}(\mu_t, \Sigma_t)$. So $\mathbf{S} = (B, \mu, \sigma, \xi, \zeta, z)$

- Given govt's policies, aggregates, and evolution of the state

$$v(\omega, \epsilon, \mathbf{S})^{\frac{\psi-1}{\psi}} = \max_{c, a', b'} (1 - \beta) c^{\frac{\psi-1}{\psi}} + \beta \mathbb{E} \left[\left(v(\underbrace{a' + R_{\mathbf{S}, \mathbf{S}'} b'}_{=\omega'}, \epsilon', \mathbf{S}') \right)^{1-\gamma} \middle| \omega, \epsilon, \mathbf{S} \right]^{\frac{\psi-1}{\psi(1-\gamma)}}$$

$$\text{subject to } p_c(\mathbf{S})c + q^h(\mathbf{S})a' + q^g(\mathbf{S})b' = \omega + \ell(\mathbf{S})\epsilon - T(\mathbf{S})$$

$$\ell(\mathbf{S}) = w(\mathbf{S})L(\mathbf{S})(1 - \tau) + \Pi(\mathbf{S})$$

$$R_{\mathbf{S}, \mathbf{S}'} = \mathbb{1}_{(\zeta'=1)}\kappa + (1 - \rho) (1 - \hbar \mathbb{1}_{(\zeta=1)(\zeta' \neq 1)}) q^g(\mathbf{S}')$$

$$a' \geq \bar{a}; \quad b' \geq 0$$

$$\mathbf{S}' = \Psi(\mathbf{S}, \xi', z', h')$$

$$\text{Exog LoMs for } (\epsilon, \xi, z); \text{ prob of } h' \text{ given } (\mathbf{S}, \xi', z')$$

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In crisis times

- $\pi \uparrow \implies \mathbb{E}[w'L'] = \pi \mathbb{E}[w'L' | \zeta' \neq 1] + (1 - \pi) \mathbb{E}[w'L' | \zeta' = 1] \downarrow$ \leftarrow Aggregate effect
- $q^g \downarrow \implies \omega \downarrow$ for all \leftarrow Distributional effect
- $\text{cov}(R_{\mathbf{S}, \mathbf{S}'}, \text{sdf}' | \mathbf{S}) \downarrow$ \leftarrow 'Savings technology' effect

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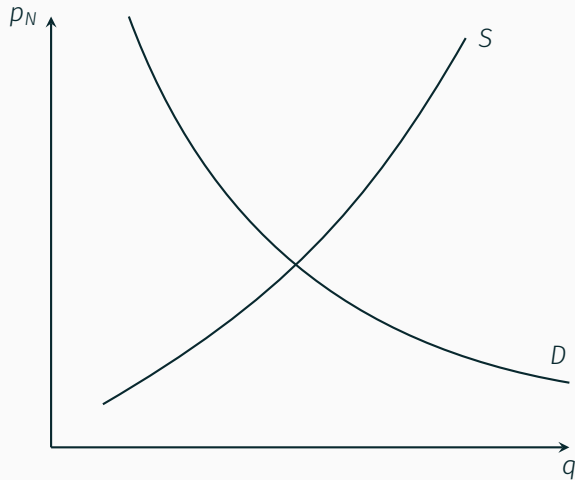
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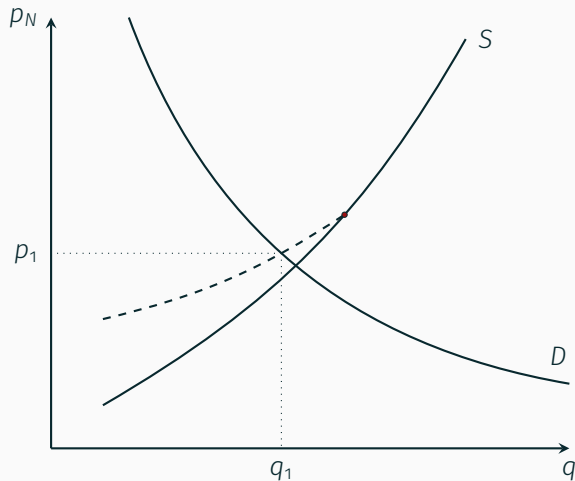


$$Y_N^d = C\varpi \left(\frac{p_N}{p_C} \right)^{-\eta} + \frac{\vartheta_N}{p_N} G$$

$$Y_N^s = L_N^{\alpha_N} (1 - \mathbb{1}_{(\zeta \neq 1)} \Delta)$$

$$L_N^d = \left(\alpha_N \frac{p_N}{w} \right)^{\frac{1}{1-\alpha_N}}$$

AGGREGATE DEMAND

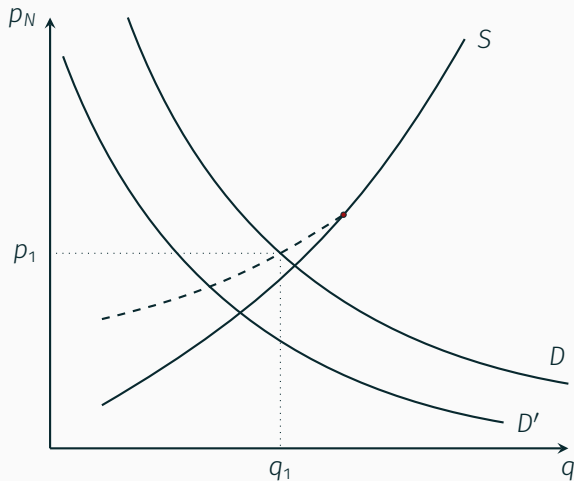


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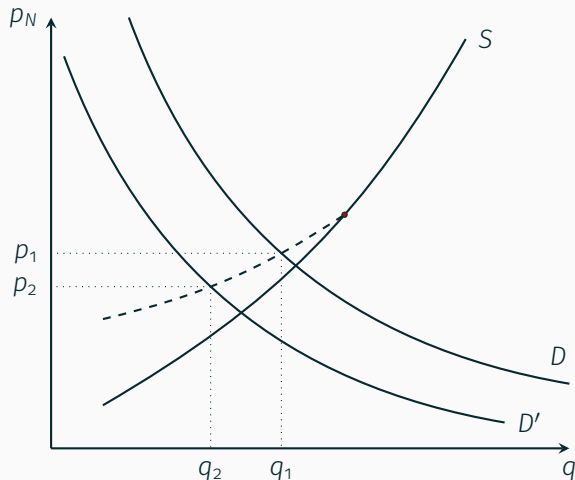
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- $C \downarrow \implies p_N \downarrow \implies w \downarrow$
- Wage rigidity creates price stickiness

- B'_t and G_t are given functions of S_t
- Default / Repayment is an optimal **choice**
 - Utilitarian objective

$$\mathcal{W}(S) = \int v(s, S) d\lambda_s(s)$$

- In period t , observe S_{t-1} and (ξ_t, z_t)
- Gov't understands $S_t = \Psi(S_{t-1}, \xi_t, z_t, \zeta_t)$ [▶ Distribution](#)
- Default iff

$$\underbrace{\mathcal{W}(\Psi(S_{t-1}, \xi_t, z_t, \zeta_t \neq 1))}_{v \text{ under def}} - \underbrace{\mathcal{W}(\Psi(S_{t-1}, \xi_t, z_t, \zeta_t = 1))}_{v \text{ under rep}} \geq \sigma_g \xi_t^{\text{def}}$$

where $\xi_t^{\text{def}} \stackrel{iid}{\sim} \mathcal{N}(0, 1)$

- B'_t and G_t are given functions of S_t
- Default / Repayment is an optimal **choice**
 - Utilitarian objective

$$\mathcal{W}(S) = \int v(s, S) d\lambda_s(s)$$

- But B_t, ζ_t are part of S_t !
- Gov't understands $S_t = \Psi(S_{t-1}, \xi_t, Z_t, \zeta_t)$ ► Distribution
- Default iff

$$\underbrace{\mathcal{W}(\Psi(S_{t-1}, \xi_t, Z_t, \zeta_t \neq 1))}_{v \text{ under def}} - \underbrace{\mathcal{W}(\Psi(S_{t-1}, \xi_t, Z_t, \zeta_t = 1))}_{v \text{ under rep}} \geq \sigma_g \xi_t^{\text{def}}$$

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EQUILIBRIUM CONCEPT

Definition

Given fiscal rules $B'(\mathbf{S}), G(\mathbf{S})$, an *equilibrium* consists of

► Algorithm

- A government policy $h'(\mathbf{S}, \xi', z'), T(\mathbf{S})$
- Policy functions $\{\phi_a, \phi_b, \phi_c\}(\mathbf{s}, \mathbf{S})$
- Prices $p_C(\mathbf{S}), p_N(\mathbf{S}), w(\mathbf{S}), q^g(\mathbf{S})$. Quantities $L_N(\mathbf{S}), L_T(\mathbf{S}), \Pi(\mathbf{S}), T(\mathbf{S})$
- Laws of motion $\mu'(\mathbf{S}, \xi', z'; h), \sigma'(\mathbf{S}, \xi', z'; h)$

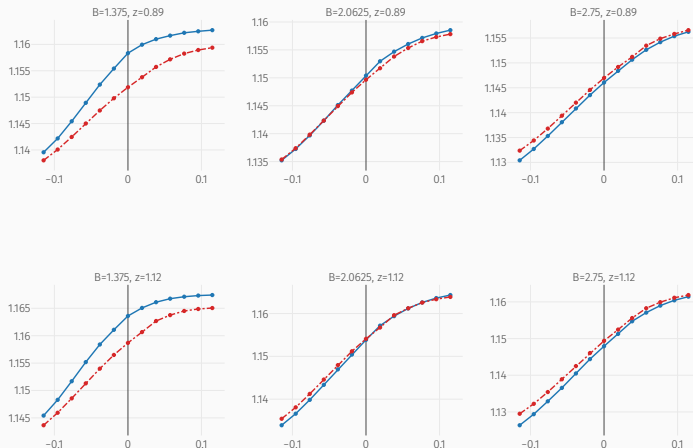
such that

- The policy functions solve the household's problem
- The laws of motion are consistent with the policy functions
- Firms maximize profits, $w(\mathbf{S}) \geq \bar{w}$, markets clear
- h' maximizes $\mathcal{W}(\Psi(\mathbf{S}, \xi', z', \cdot))$ for gov't, taxes respect budget constraint.

► Market Clearing

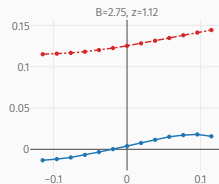
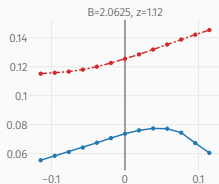
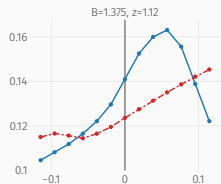
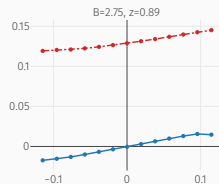
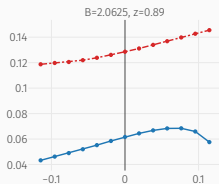
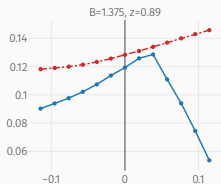
MODEL RESULTS

OBJECTIVE FUNCTION



Anticipated objective function
Blue: repayment, red: default

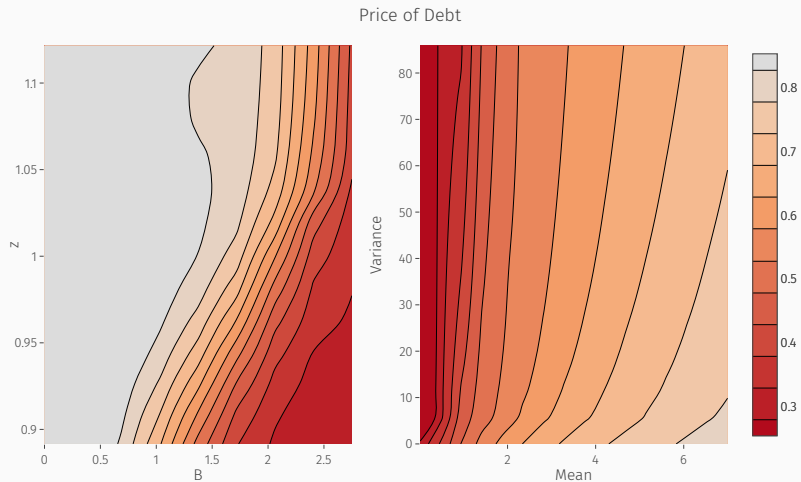
TRANSFERS



Transfers

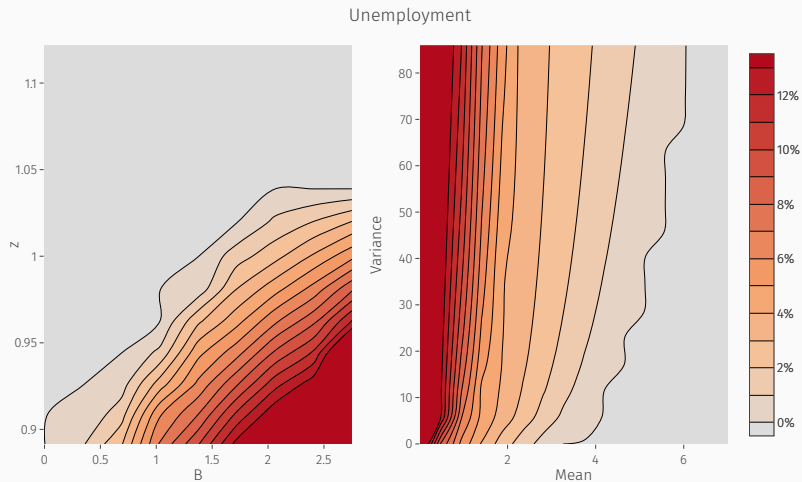
Blue: repayment, red: default

PRICE OF DEBT



Model: Benchmark

UNEMPLOYMENT



Model: Benchmark

SIMULATIONS

CALIBRATION

Description	Parameter	Value	Source
Risk-free rate	r^*	4% ann.	Anzoategui (2017)
Haircut in case of default	\bar{h}	50%	Philippon and Roldán (2018)
TFP loss in case of default	Δ	10%	Philippon and Roldán (2018)
Share of nontraded in prod	ϖ	0.74	Anzoategui (2017)
Share of nontraded in G	ϑ_N	88%	Anzoategui (2017)
Idiosyncratic income	$\rho_\epsilon, \sigma_\epsilon$	(0.978, 0.022)	D'Erasmus and Mendoza (2016)
Internally calibrated		Target (Spain)	
Discount rate of HHs	$1/\beta - 1$	4.46% ann.	Moments in Table 1
Risk aversion	γ	14.3	Moments in Table 1
Progressivity of tax schedule	τ	19.4%	Moments in Table 1
Wage minimum	\bar{w}	1.15	Moments in Table 1
TFP process	ρ_z, σ_z	(0.886, 0.0371)	Moments in Table 1
Mean risk premium	$\bar{\xi}$	1.39%	Moments in Table 1
Risk premium AR(1)	ρ_ξ, σ_ξ	(0.948, 0.00195)	Moments in Table 1

CALIBRATION (CONT'D)

- Simulate model solution for 8000 years
- Agents' believe $\lambda_t = \log \mathcal{N}(\mu_t, \sigma_t)$
- Keep track of actual distribution

Target	Model	Data
AR(1) coef $\log(Y_t)$	0.994	0.966
Std coef $\log(Y_t)$	0.0399	0.0129
AR(1) coef $\log(C_t)$	0.998	0.962
Std coef $\log(C_t)$	0.0157	0.0166
AR(1) coef spread	0.987	0.967
Std coef spread	0.064	0.103
Avg Debt-to-GDP	72.8%	64.6%
Std Debt-to-GDP	17.4%	23.5%
Avg unemployment	17.4%	15.9%
Std unemployment	8.65%	6.09%
Median dom holdings	53.6%	56.5%
Avg wealth-to-GDP	56.8%	94.5%

Table 1: Model Fit

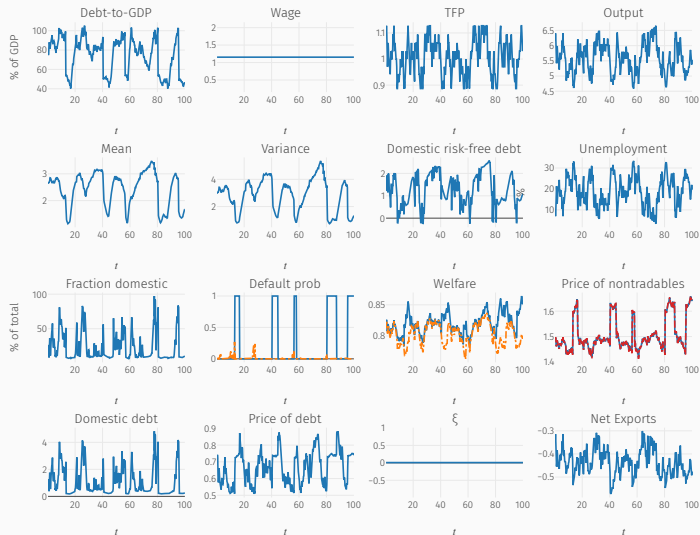
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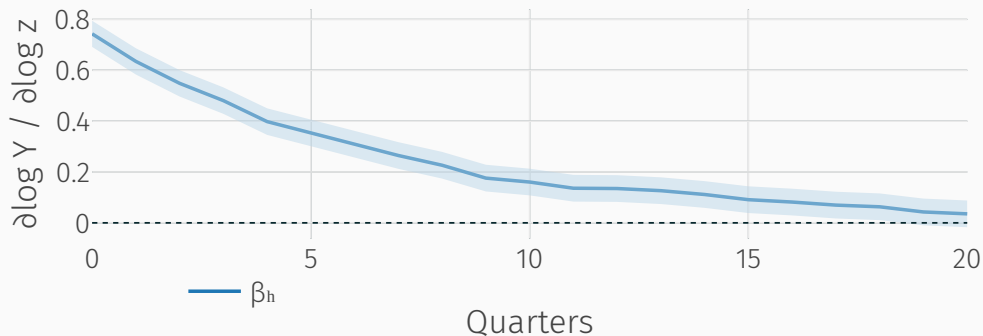
Table 1: Model Fit

SIMULATED PATHS



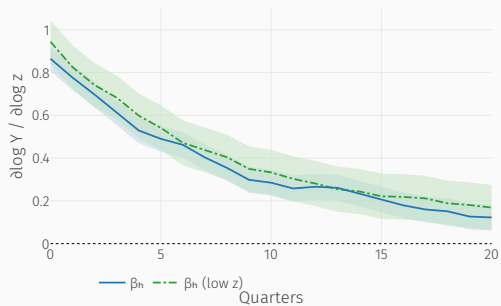
AMPLIFICATION OF TFP SHOCKS

$$\log Y_{t+h} = \alpha + \beta_h \log \epsilon_t^Z + \eta_{t+h}$$

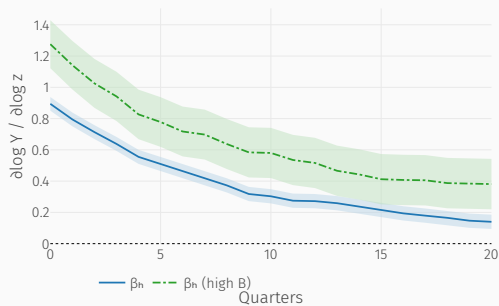


Response of Output to a TFP shock

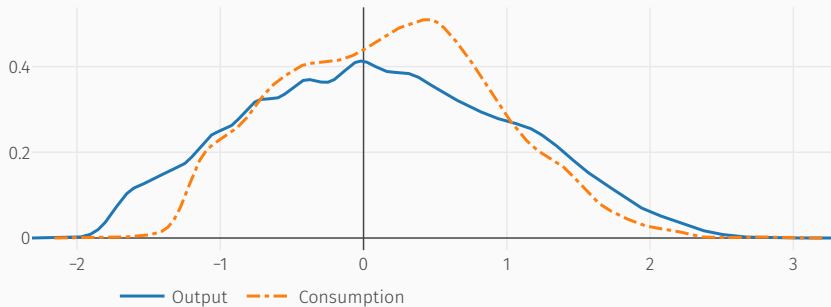
AMPLIFICATION OF TFP SHOCKS (CONT'D)



For large shocks



For indebted economies



Ergodic Densities for Normalized Output and Consumption

CRISES

In simulated data

- Record all episodes of
 - i.* High spreads for 7 quarters
 - ii.* Default
- Take 2-year windows around each
 - Left with 178 defaults ($\sim 4.5\%$ annual freq)
- Compute distribution of endogenous variables around them

- Decompose output contraction between
 - TFP + wage rigidities
 - Aggregate demand
- Compare against a **no default** benchmark
 - Give the no-default economy the same shocks as the benchmarks
 - Extract the same t 's

Key

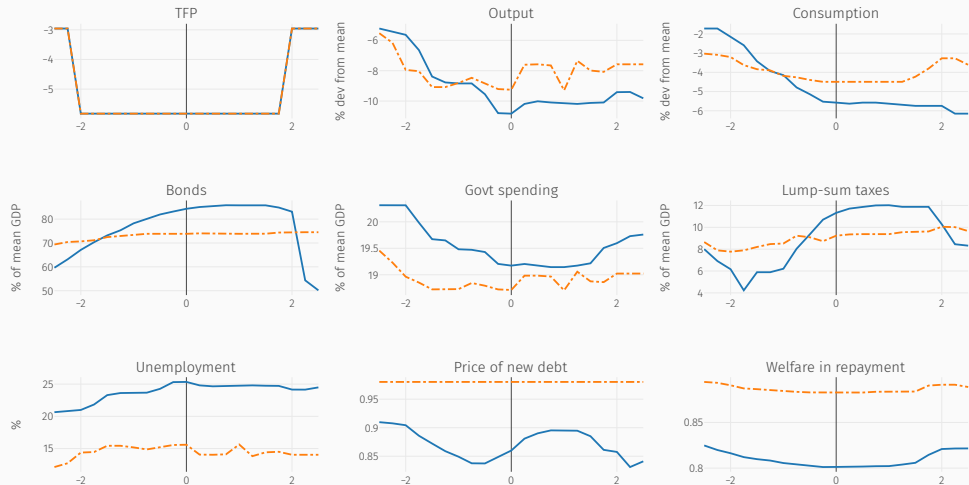
Conditioning on high spreads only \implies economies **only** differ in expectations

- Decompose output contraction between
 - TFP + wage rigidities
 - Aggregate demand
- Compare against a **no default** benchmark
 - Give the no-default economy the same shocks as the benchmarks
 - Extract the same t 's

Key

Conditioning on high spreads only \implies economies **only** differ in expectations

SIMULATED DATA – NO DEFAULT BENCHMARK



Blue: Benchmark, Dashed orange: No default

Target	Benchmark	No default
AR(1) coef $\log(Y_t)$	0.994	0.998
Std coef $\log(Y_t)$	0.0399	0.0306
AR(1) coef $\log(C_t)$	0.998	0.998
Std coef $\log(C_t)$	0.0157	0.00699
AR(1) coef spread	0.987	1
Std coef spread	0.064	0.000471
Avg Debt-to-GDP	72.8%	57.5%
Std Debt-to-GDP	17.4%	24.5%
Avg unemployment	17.4%	8.27%
Std unemployment	8.65%	7.13%
Median dom holdings	53.6%	130%
Avg wealth-to-GDP	56.8%	93.3%

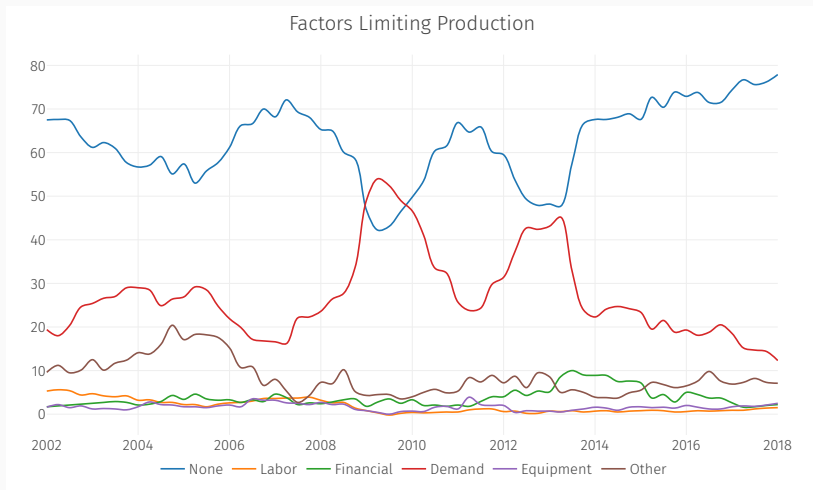
Table 2: Models

- Compare episodes of high spreads in simulated data against
 - i.* No TFP costs of default \leftarrow shuts down aggregate income losses
 - $\Delta = 0$
 - ii.* Only TFP costs of default \leftarrow shuts down redistributive wealth effects
 - Keep paying coupons in default + $\bar{h} = 0$

$\rightarrow (i) + (ii) = \text{no default}$
- Compare against representative agent benchmark

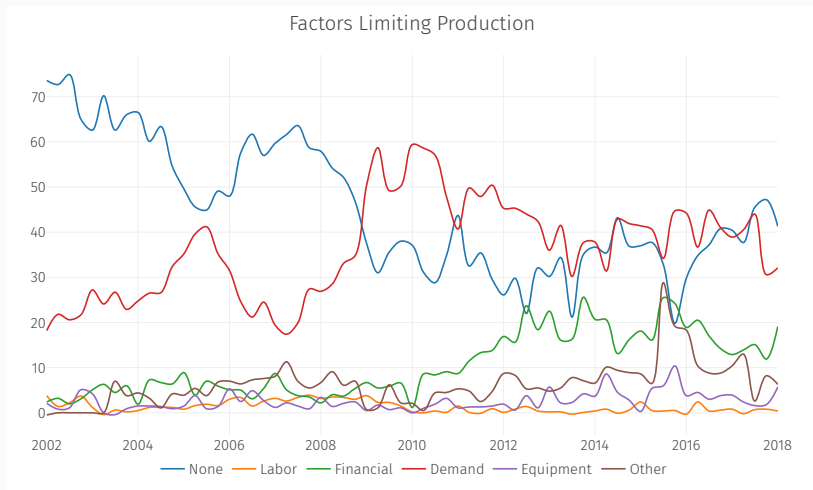
CONCLUDING REMARKS

- Interested in **interaction** of
 - Default risk
 - Precautionary behavior
- + implications for **amplification** of shocks
- Channel helps explain severity of recessions in debt crises
 - Default risk creates high **volatility** of consumption and unemployment
 - Large welfare **costs** of sovereign risk – up to 10% of permanent consumption
- Key:
 - Aggregate + redistributive wealth effects if default
 - Agents take precautions against those
 - Timing flips usual MPC / transfer argument



Italian firms' self-reported limits to production

Source: Eurostat

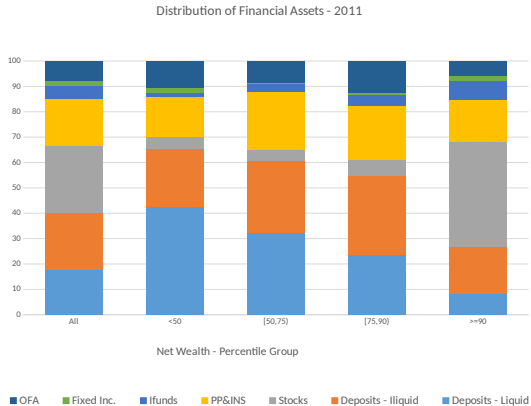


Greek firms' self-reported limits to production

Source: Eurostat

HOUSEHOLD SURVEY

- Companion paper: dom exp to Spanish sovereign risk [◀ Back](#)



MEASURING EXPOSURES TO SOVEREIGN DEBT - BANKS

Measure exposure based on Philippon and Salord (2017)

- study European banks resolutions in Cyprus
- average total recapitalization need was around 17.4% of assets
- private investors provided 33% of need via loss in equity (91%), junior debt (53%) and senior debt (14%)
- remaining 2/3 came from government intervention

→ assumed not possible in Spain!

→ remaining need comes from senior debt and depositors

MEASURING EXPOSURES TO SOVEREIGN DEBT - DEPOSITS

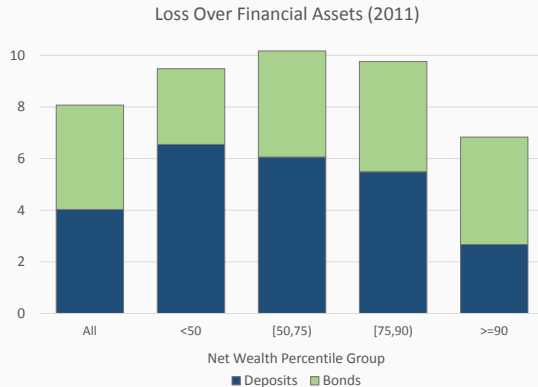
Work with different scenarios of loss on deposits:

Scenario	SD Loss	Dep. Loss
Extreme	25%	14%
Mild	50%	10%
Conservative	75%	5%

Table 3: Expected losses on deposits

- Assume a 50% haircut on public debt that triggers a bank crisis
- Loss for depositors of 10%
- Overall, public debt and bank crisis would induce a fall of between 8% and 10% of financial assets

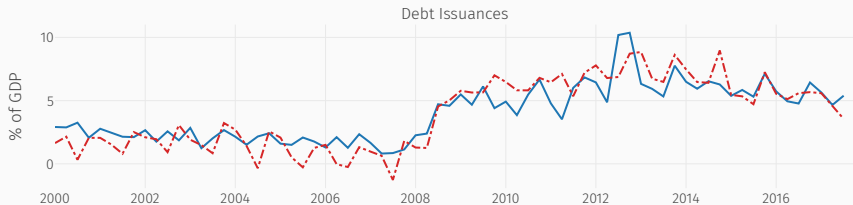
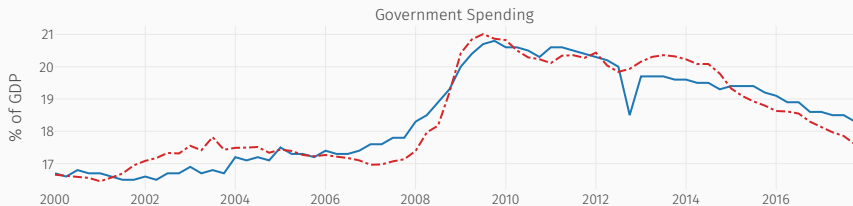
- Companion paper: dom exp to Spanish sovereign risk [▶ More](#)
- Pension funds, mutual funds, insurance – perfect passthrough
- Deposits – more complicated
 - Philippon and Salord (2017): bank resolutions in Cyprus [▶ Details](#)



	G_t/Y_t		$(B'_t - (1 - \rho)B_t) / Y_t$	
	(1)	(2)	(3)	(4)
Unemployment _t	0.031 (0.039)	0.073*** (0.015)	0.334** (0.158)	0.346*** (0.059)
Unemployment _t ²	0.002 (0.001)		0.0001 (0.006)	
B_t/Y_t	0.010* (0.005)	-0.017*** (0.002)	-0.010 (0.020)	0.009 (0.007)
$(B_t/Y_t)^2$	-0.0002*** (0.00004)		0.0001 (0.0001)	
Net Exports _t	0.009 (0.019)	0.007 (0.012)	0.046 (0.075)	0.019 (0.046)
Net Exports _t ²	-0.0001 (0.001)		-0.001 (0.003)	
Mean FE	20.675	21.085	1.079	0.571
Country + Time FE	✓	✓	✓	✓
Observations	968	968	957	957
Adj. R^2	0.904	0.901	0.697	0.698

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

FISCAL RULES (CONT'D)

[◀ BACK](#)

— Observed - - - Predicted

EVOLUTION OF THE DISTRIBUTION

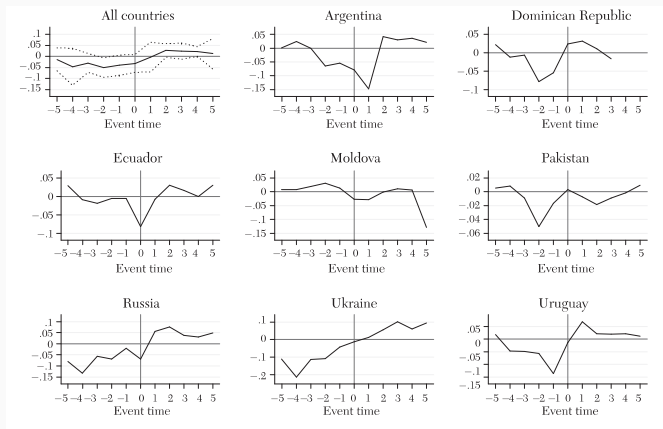
The law of motion for λ

- Policy functions ϕ_a, ϕ_b at \mathbf{S}_t determine assets at $t + 1$
- After seeing z_{t+1} , the government decides **repayment**
- At \mathbf{S}_{t+1} , relationship between $q^g(\mathbf{S}_{t+1})$, $R_b(\mathbf{S}_{t+1})$, μ_{t+1} , σ_{t+1}

$$R_b(\mathbf{S}_{t+1}) = \mathbb{I}_{(\zeta_{t+1}=1)}\kappa + (1 - \rho)q^g(\mathbf{S}_{t+1})$$

$$\int \omega d\lambda_{t+1} = \int \phi_a(\mathbf{S}_t) + R_b(\mathbf{S}_{t+1})\phi_b(\mathbf{S}_t) d\lambda_t$$

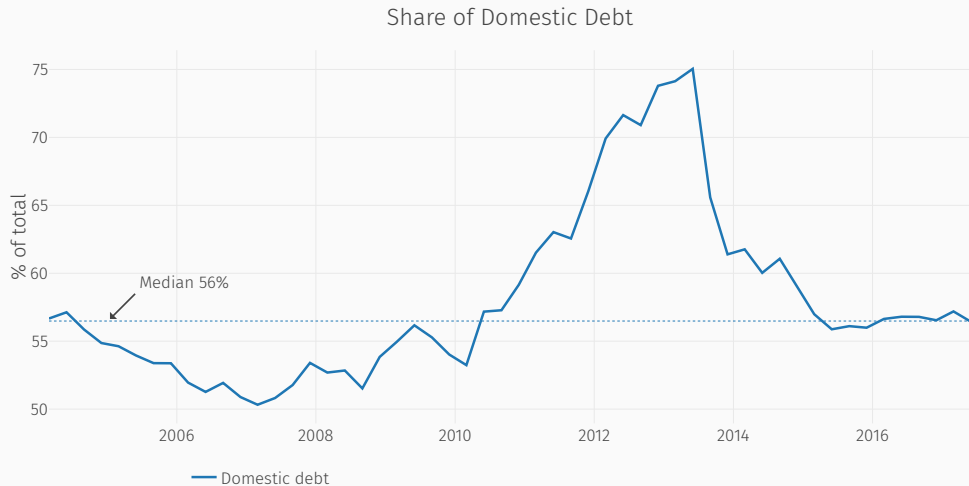
$$\int \omega^2 d\lambda_{t+1} = \int (\phi_a(\mathbf{S}_t) + R_b(\mathbf{S}_{t+1})\phi_b(\mathbf{S}_t))^2 d\lambda_t$$



Defaults and output growth

Source: Panizza, Sturzenegger, and Zettelmeyer (2009)

SHARE OF DOMESTIC DEBT

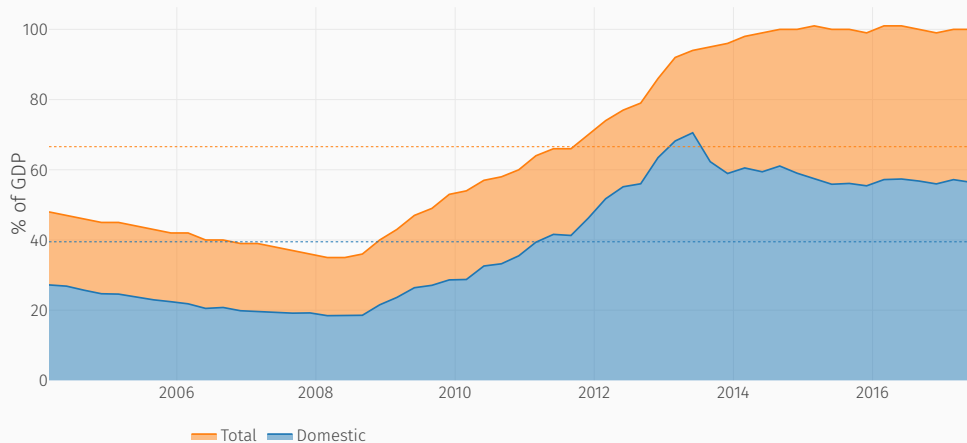
[◀ BACK](#)

Source: Morelli and Roldán (2018) on Banco de España

SHARE OF DOMESTIC DEBT

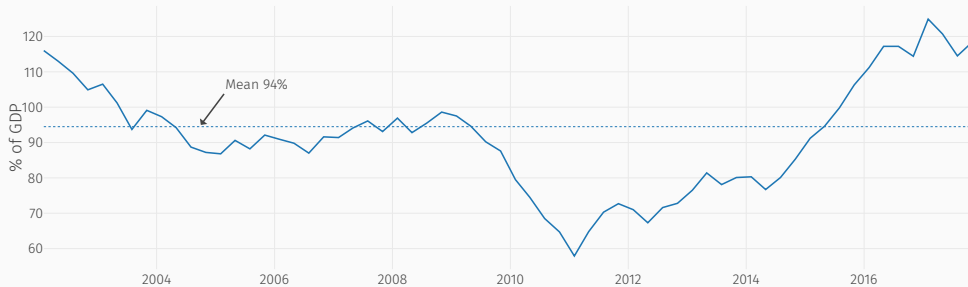
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Spanish Government Debt



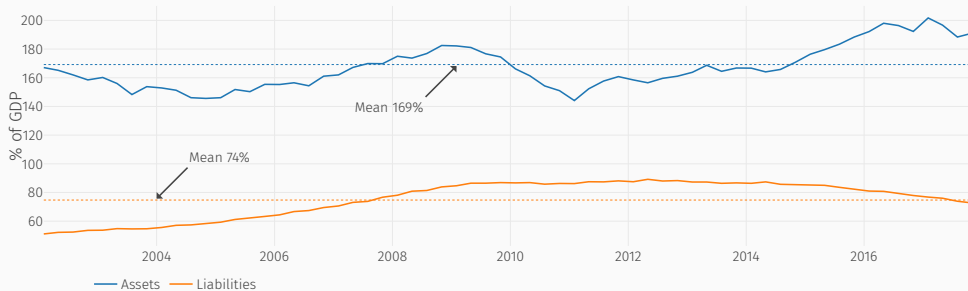
Source: Morelli and Roldán (2018) on Banco de España
Dotted lines are sample averages

Net Worth of Spanish Households



Source: Eurostat
Dotted lines are sample averages

Net Worth of Spanish Households



Source: Eurostat
Dotted lines are sample averages

GENERAL SDF OF FOREIGNERS

- If risk-averse foreigners

$$q_t^h = \frac{1}{1+r^*} \mathbb{E}_t \left[\left(\frac{C_{t+1}^f}{C_t^f} \right)^{-\gamma_f} \right]$$
$$q_t^g = \frac{1}{1+r^*} \mathbb{E}_t \left[\left(\frac{C_{t+1}^f}{C_t^f} \right)^{-\gamma_f} R_{t,t+1}^b \right]$$

where $R_{t,t+1}^b = \mathbb{1}_{(\zeta_{t+1}=1)} \tilde{\kappa} + (1-\rho)(1-\hbar \mathbb{1}_{(\zeta_t=1 \cap \zeta_{t+1} \neq 1)}) q_{t+1}^g$

- Reduces to risk-neutral if

$$\text{cov} \left(\left(\frac{C_{t+1}^f}{C_t^f} \right)^{-\gamma_f}, R_{t,t+1}^b \right) = 0$$

SOLUTION METHOD

- Guess a policy for the government
 - Guess a law of motion for the distribution
 - Compute $q^g(\mathbf{S})$, q^h from lenders' sdf.
 - Compute w, L_N, L_T, Π, T as functions of (\mathbf{S}, p_N)
 - Guess a relative price of nontraded goods p_N
 - Solve the household's problem at $(\mathbf{s}, \mathbf{S}, p_N)$
 - Check market clearing for nontraded goods.
 - Iterate until $p_N(\mathbf{S})$ converges
 - Iterate until the law of motion converges
- Iterate on the government's policy

	Unemployment _{jt}			Saving rate _{jt}		
	(1)	(2)	(3)	(4)	(5)	(6)
Spread _{jt}	1.381*** (0.064)			0.461*** (0.097)		
Spread _{jt} (IV)		2.372*** (0.826)	1.951** (0.896)		1.634 (1.186)	2.048 (1.515)
Spread Non-fin _{jt}		-0.172 (0.297)	-0.450 (0.306)		0.654 (0.628)	0.832 (0.626)
Spread Fin _{jt}		-0.364 (0.530)	0.076 (0.601)		-0.265 (0.666)	-0.595 (0.901)
B_{jt}/Y_{jt}			0.040*** (0.012)			-0.035 (0.035)
Model	OLS	IV	IV	OLS	IV	IV
Country FE	Y	Y	Y	Y	Y	Y
Quad Time Trend	Y	Y	Y	Y	Y	Y
Observations	968	304	304	569	179	179
Adj. R ²	0.731	0.715	0.713	0.450	0.420	0.398

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Gilchrist-Mojon (2017) indices of corporate spreads for FRA, DEU, ITA, ESP. 2000Q1 – 2017Q4

- Three markets need to clear

$$Y_{Nt} = C_{Nt} + \frac{\vartheta_N}{p_{Nt}} G_t$$

$$Y_{Tt} = C_{Tt} + (1 - \vartheta_N) G_t - \mathbf{NFI}_t$$

$$(L_{Nt} + L_{Tt} - 1)(w_t - \gamma w_{t-1}) = 0$$

where net foreign inflows are

$$\mathbf{NFI}_t = \int (\omega - q_t^h \phi_a - q_t^g \phi_b) d\lambda_t - \kappa B_{t-1} + q_t^g (B_t - (1 - \rho) B_{t-1})$$

	<i>Dependent variable Q_{jt}:</i>							
	$\log Y_{jt}$				$\log C_{jt}$			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Spread_{jt}	-0.011^{***} (0.003)				-0.011^{***} (0.002)			
$\text{Spread}_{jt} \text{ (IV)}$		-0.048^{**} (0.019)	-0.031 (0.023)	-0.031 (0.024)		-0.088^{***} (0.022)	-0.035^{**} (0.017)	-0.035^{**} (0.016)
R_{jt}^h			0.054^{***} (0.010)	0.049^{***} (0.011)			0.004 (0.007)	-0.009 (0.007)
R_{jt}^s				0.013 (0.046)				0.036 (0.031)
Model	OLS	IV	IV	IV	OLS	IV	IV	IV
Country + Time FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	968	968	540	540	968	968	540	540
Adj. R^2	0.995	0.994	0.997	0.997	0.997	0.993	0.999	0.999

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

ECB borrowing rates for AUT, BEL, DEU, ESP, FRA, IRL, ITA, NLD, PRT. 2003Q1 – 2017Q4

Dependent variable Q_{jt}

					(7)	(8)
$Spread_{jt}$						
$Spread_{jt} \text{ (IV)}$					0.035** (0.017)	-0.035** (0.016)
R_{jt}^h					0.004 (0.007)	-0.009 (0.007)
R_{jt}^S						0.036 (0.031)
Model					IV	IV
Country + Time FE					✓	✓
Observations					540	540
Adj. R^2					0.999	0.999

What if *Spreads* affect Q through W ?

... if $W \perp U \mid S, Q$

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

ECB borrowing rates for AUT, BEL, DEU, ESP, FRA, IRL, ITA, NLD, PRT. 2003Q1 – 2017Q4

THE CYCLE IS THE TREND

[◀ BACK TO MOTIVATION](#)[◀ BACK TO EVIDENCE](#)

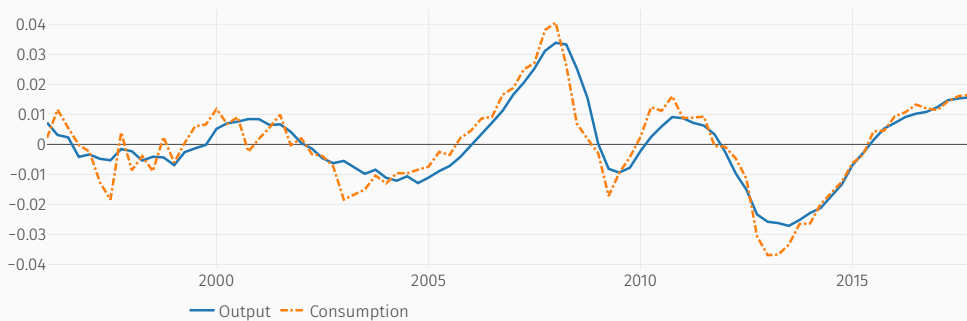
	$\sigma(C)$	$\sigma(Y)$	$\sigma(C)/\sigma(Y)$	$\sigma(C)/\sigma(Y)$ (AG)
Austria	0.716	0.782	0.916	0.870
Belgium	0.556	0.795	0.700	0.810
Denmark	1.047	1.178	0.889	1.190
Finland	1.278	1.957	0.653	0.940
France	0.780	0.773	1.009	—
Germany	0.692	0.867	0.799	—
Ireland	3.140	3.680	0.853	—
Italy	1.165	0.978	1.191	—
Netherlands	1.726	1.244	1.388	1.070
Portugal	1.827	1.576	1.160	1.020
Spain	1.901	1.396	1.362	1.110

HP filtered data with $\lambda = 1600$. Std deviations in %.

SPAIN IN THE EUROZONE CRISIS

[◀ BACK](#)

Filtered Spanish output and consumption

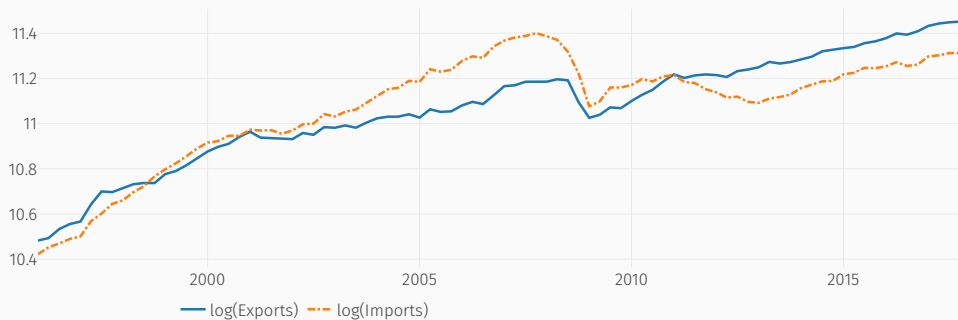


Spain in the 2000s

SPAIN IN THE EUROZONE CRISIS

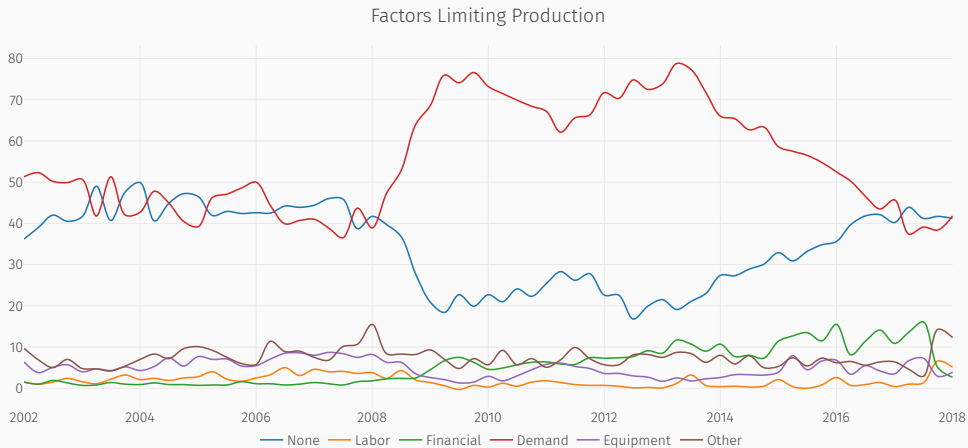
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Trade balance for Spain



Spain in the 2000s

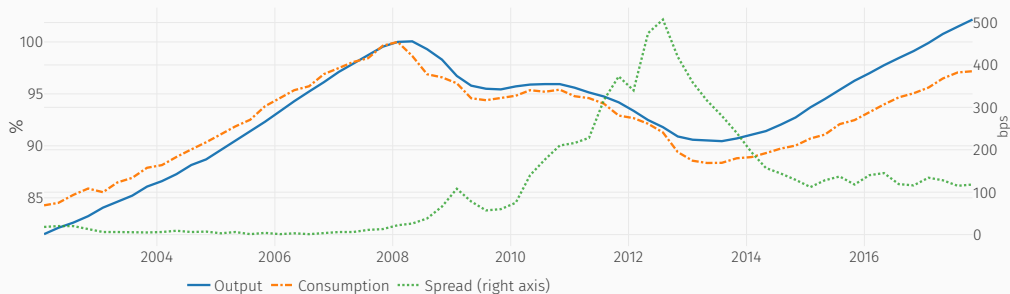
LOW DEMAND?

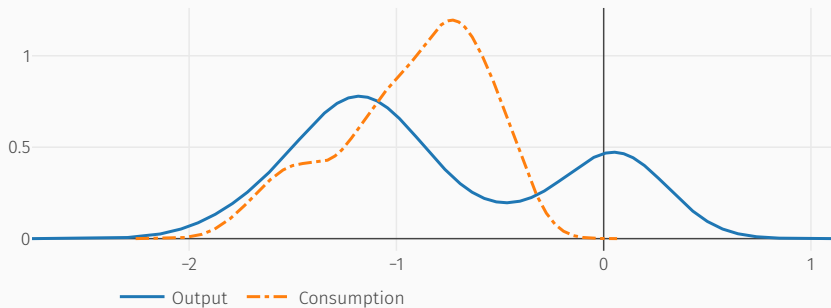
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Spanish firms' self-reported limits to production

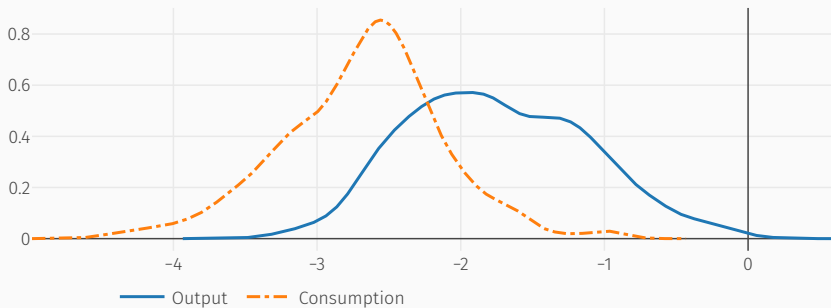
Source: Eurostat

Output and Consumption for Spain

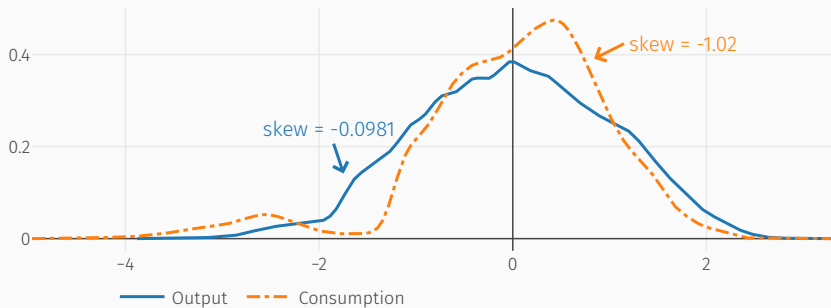




Densities for Output and Consumption during Crises ($\pi \geq 15\%$)



Densities for Output and Consumption during Defaults



Unconditional Ergodic Densities for Output and Consumption

SIMULATED DATA – DEFAULT EPISODES

[◀ BACK](#)

Red: Median, Shaded blue: [0.25, 0.75] percentiles, Dashed green: Mean

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