

# The Aggregate-Demand Doom Loop: Precautionary Motives and the Welfare Costs of Sovereign Risk

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IMF

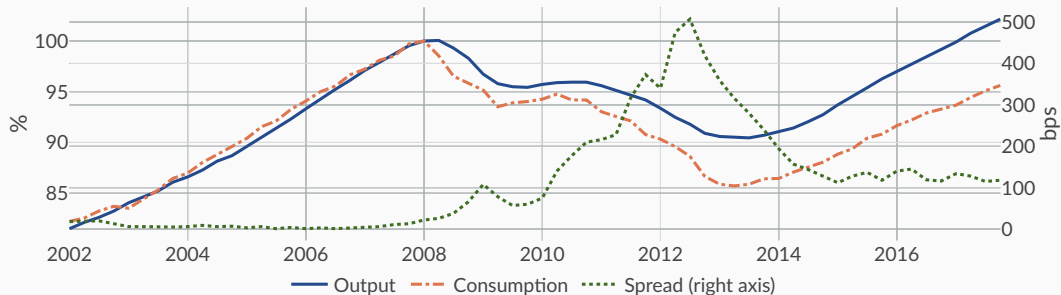
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October 2020

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# Spain in the Eurozone Crisis

- Sovereign risk associated with **deep** recessions

Output and Consumption in Spain



► Detrended data

► Trade balance

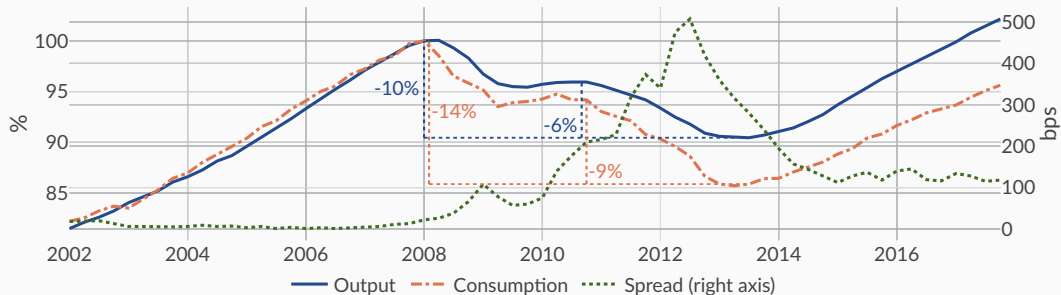
► Low demand?

► Nondurable consumption

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# Sovereign Risk

- Spain: large contractions in **output** and **consumption**  
...  $|\Delta C| > |\Delta Y|$
- Pattern consistent across EU countries
  - Spreads associated with contractions in output, consumption, and APCs [▶ More](#)

## This paper

- Aggregate-demand **doom loop** rationalizes big recessions in response to sovereign risk
- Key: sovereign default risk boosts **precautionary motives**
- New light on consumption response to sovereign risk
  - Spanish households' wealth  $\sim 100\%$  of GDP pre-crisis. No consumption smoothing? [▶ More](#)

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- **Potential** 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
- Extend a quantitative model of sovereign debt
  - Prominent role for households' income-fluctuations problem
    - Consumption vs savings, **precautionary motives**
    - **Exposures** to sovereign risk
  - Endogenous wealth distribution that interacts with gov't default choice
    - **Bewley** setup + portfolio choice
  - Nominal rigidities
    - Externality: households cut consumption **more** than planner
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## How is sovereign risk costly?

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**Feedback** loop between spreads and output

$\uparrow \text{Spreads} \implies \downarrow \text{Demand} \implies \downarrow \text{Output} \implies \uparrow \text{Spreads}$

# Main Findings

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- **Feedback** explain significant portion of the crisis
  - 30% of output contraction
  - 40% of agg. consumption contraction
- Large welfare costs of sovereign risk
  - Volatility of output **doubled** with sovereign risk
  - Volatility of agg. consumption increases by an order of magnitude
  - Eliminating sovereign risk worth on average 1.76% of permanent consumption
    - As much as 6.8% at height of **crisis**
- Distributional effects
  - Value of removing default risk **ranges** from 10.2% to 5.6% of consumption

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

Arellano, Bai and Mihalache (2020), Bocola (2016), Arellano, Bai and Bocola (2017), Arellano, Bai and Mihalache (2018), Balke (2017)

- **Domestic debt and default incentives**

Gennaioli, Martin and Rossi (2014), Mengus (2014), Mallucci (2015), Pérez (2018), Sosa-Padilla (2018), D'Erasmus and Mendoza (2016), Ferriere (2016), Deng (2020) ...

- **Sovereign risk and fiscal austerity**

Cuadra, Sánchez, and Sapriza (2010), Romei (2015), Bianchi, Ottonello and Presno (2016), Anzoategui (2020), Philippon and Roldán (2018)

- **Shocks affecting aggregate demand through redistribution**

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

- Description of Model
- Calibration and simulations
- Crises
- Concluding remarks

## Description of Model

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# General Description

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- Small open economy with
  - Sovereign default risk
  - Uninsurable idiosyncratic risk + incomplete markets
  - Nominal rigidities
- Actors
  - Government
    - Issues long-term debt, purchases goods, decides **repayment**
  - Domestic households
    - Choose consumption, savings, and **portfolio choice** btw gov't bond + risk-free asset
    - Differ in ex-post wealth + idiosyncratic income shock
  - Firms
    - Produce goods with labor subject to **wage rigidities**
  - Foreigners
    - Lend to gov't + private agents, **price** all assets

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

# Households

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

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

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

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

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

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

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

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



## Households in a crisis

$$\pi \uparrow \implies \mathbb{E}[w'L'] = \pi \mathbb{E}[w'L'|\zeta' \neq 1] + (1 - \pi) \mathbb{E}[w'L'|\zeta' = 1] \downarrow$$

$$q^g \downarrow \implies \text{ex-post capital losses : } \omega \downarrow \text{ for all}$$

$$\text{cov}(R_{S,S'}, sdf' \mid S) \downarrow$$

# Private Economy

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

- Risk-neutral foreigners

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

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

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

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

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

- Households
  - Approximation:  $\lambda_t = \log \mathcal{N}(\mu_t, \Sigma_t)$ . So  $S = (B, \mu, \sigma, \xi, \zeta, z)$

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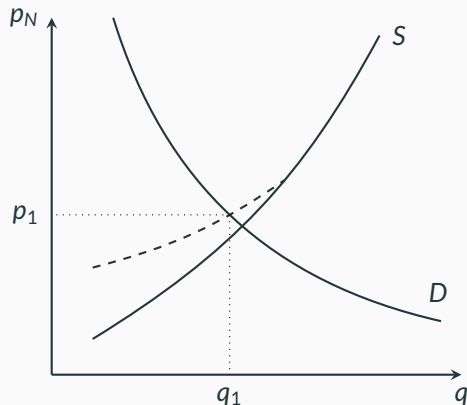
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# Aggregate Demand



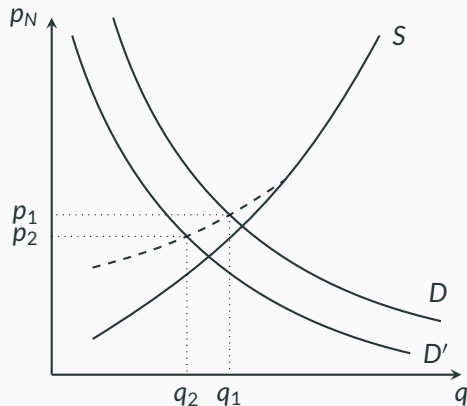
$$Y_N^d = \varpi \left( \frac{p_N}{p_C} \right)^{-\eta} C + \frac{\vartheta_N}{p_N} G$$

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

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

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

# Aggregate Demand



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

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

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

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

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

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# Equilibrium Concept

## Definition

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

► Algorithm

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

such that

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

# Calibration and simulations

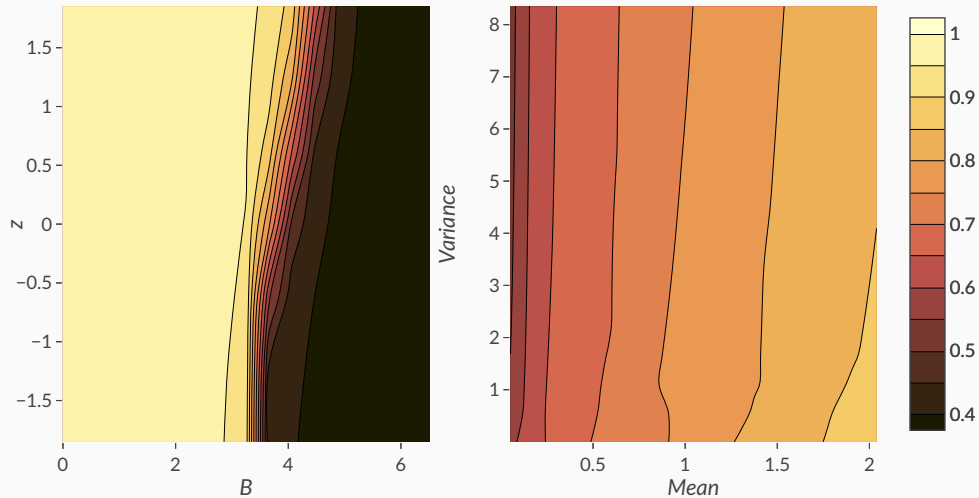
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# Calibration

- Simulate model solution for 50000 years
- Agents believe  $\lambda_t = \log \mathcal{N}(\mu_t, \sigma_t)$
- Keep track of actual distribution

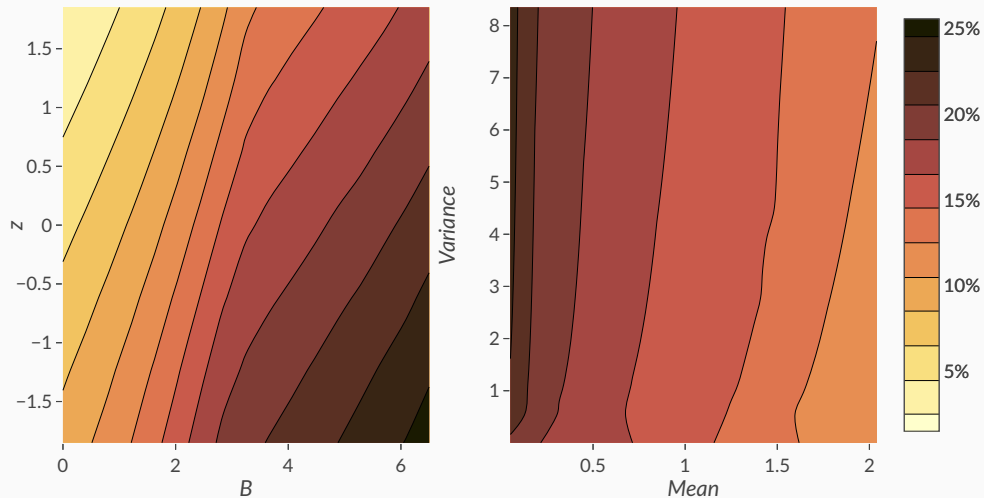
Target	Model	Data
AR(1) coef $\log(Y_t)$	0.965	0.966
Std coef $\log(Y_t)$	0.0134	0.0129
AR(1) coef $\log(C_t)$	0.974	0.962
Std coef $\log(C_t)$	0.0114	0.0166
AR(1) coef spread	0.975	0.967
Std coef spread	0.382	0.32
Avg Debt-to-GDP	31.6%	64.6%
Std Debt-to-GDP	12.8%	23.5%
Avg unemployment	7.01%	15.9%
Std unemployment	5.84%	6.09%
Median dom holdings	39.2%	56.5%
Avg wealth-to-GDP	63.8%	94.5%
Avg wealth Gini	57.2%	57.5%

*Price of Debt*



# Unemployment

Unemployment



# Crises

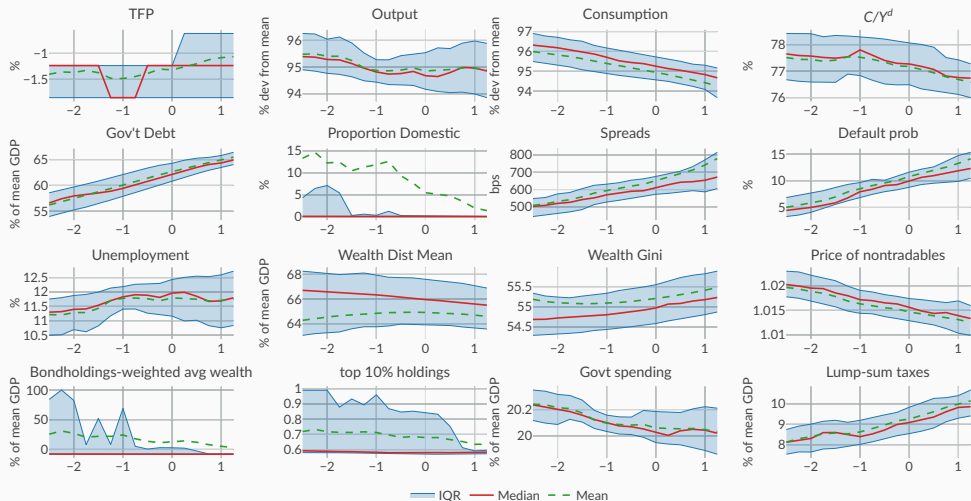
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## In simulated data

- Record all episodes of
  - ... default probability  $\geq 6\%$  (match output 5% below 'trend')
  - ... but no default
  - ... for 11 quarters (2010 – September 2012)
- Plot distribution of endogenous variables



# Crises



# Decomposition

- Decompose output contraction between
  - Shocks + wage rigidity
  - Aggregate demand + default risk
- Compare against a **no-default** benchmark
  - Simulate the no-default economy with the **same shocks**
  - Extract the same time periods

## Key

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

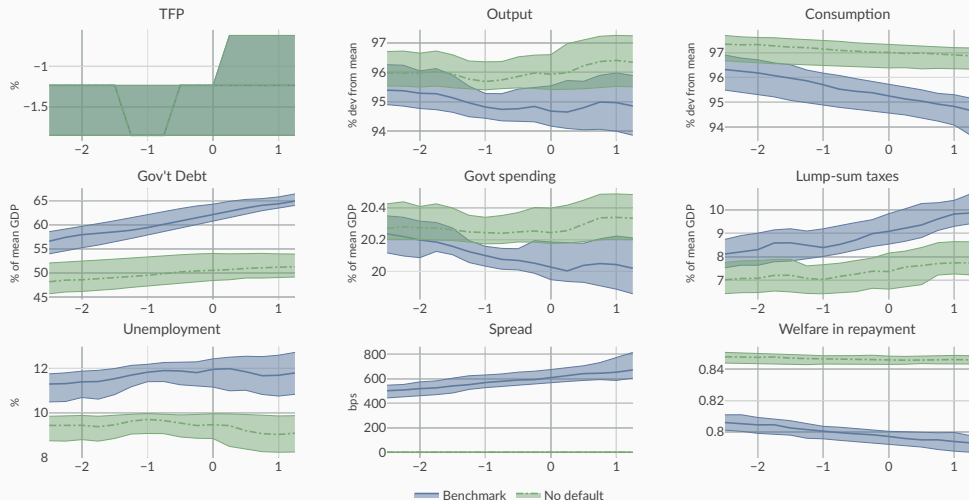
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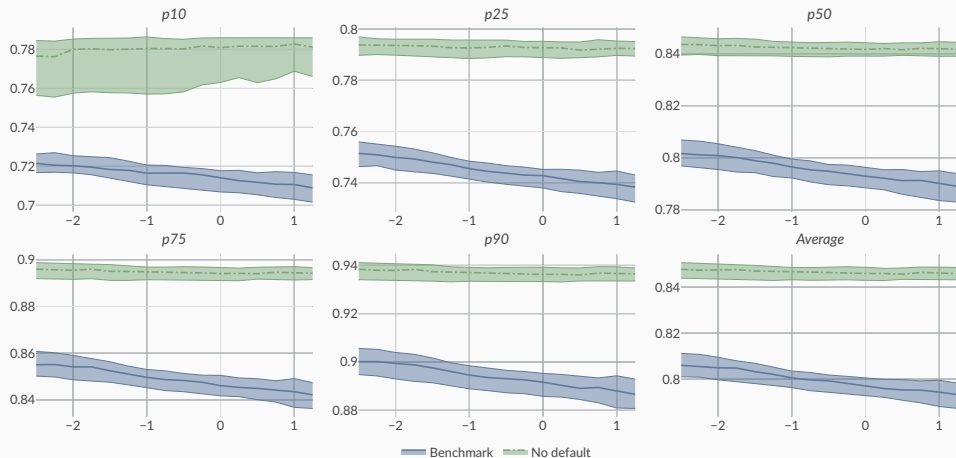
## Key

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

# No default benchmark



# Costs of sovereign risk across the wealth distribution



# Models

Moment	Benchmark	$\Delta = 0$	No dom. holdings	No default
AR(1) coef $\log(Y_t)$	0.965	0.977	0.966	0.973
Std coef $\log(Y_t)$	0.0134	0.00641	0.014	0.0056
AR(1) coef $\log(C_t)$	0.974	1.01	0.976	0.999
Std coef $\log(C_t)$	0.0114	0.00221	0.0116	0.00107
AR(1) coef spread	0.975	0.998	0.975	0.871
Std coef spread	0.382	0.972	0.505	0.00135
Avg Debt-to-GDP	31.6%	38.8%	32.7%	31.7%
Std Debt-to-GDP	12.8%	9.44%	13.2%	11.8%
Avg unemployment	7.01%	6.65%	7.32%	5.63%
Std unemployment	5.84%	2.45%	6.06%	2.29%
Median dom holdings	39.2%	1.45%	0%	184%
Avg wealth-to-GDP	63.8%	57%	64.6%	56.4%
Avg wealth Gini	57.2%	60%	56.7%	60.5%
Default frequency	1.11%	2.57%	1.27%	0%
Welfare in repayment	0.854	0.855	0.84	0.869

## Concluding remarks

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# Concluding remarks

- Interested in **interaction** between
  1. Sovereign default risk
  2. Precautionary behavior
  - + implications for **amplification** of shocks
- Channel helps explain severity of recessions in debt crises
  - Default risk exacerbates **volatility** of consumption and output
  - Large welfare costs of sovereign risk
    - about **1.76%** of permanent consumption in unconditional average
    - as much as **6.8%** during crises
    - Wide variation across wealth **distribution**
- Key
  - Savings against aggregate + redistributive effects **if** default
    - Timing flips MPC / transfer argument

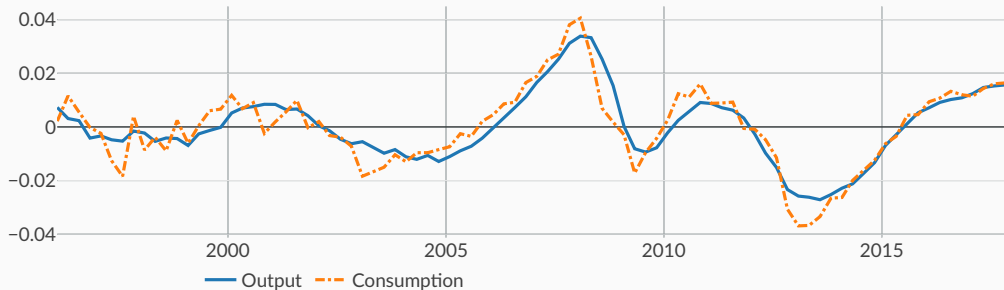




# Spain in the Eurozone Crisis

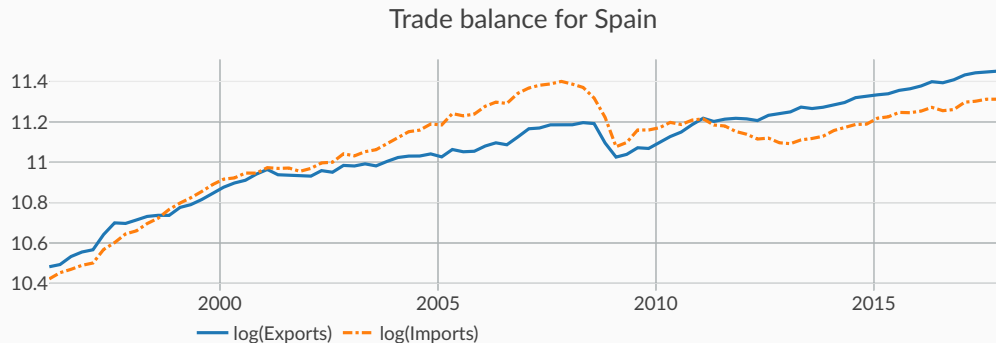
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Filtered Spanish output and consumption



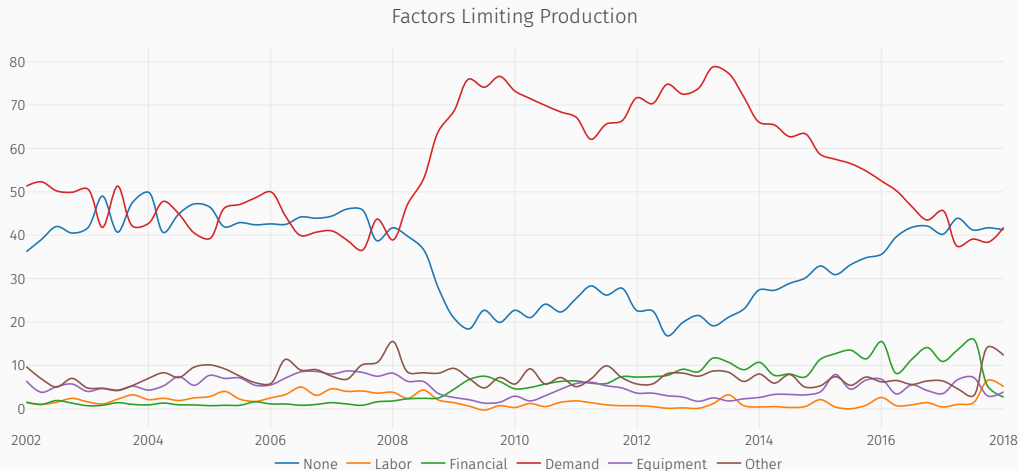
Spain in the 2000s

# Spain in the Eurozone Crisis

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Spain in the 2000s

# Low demand?

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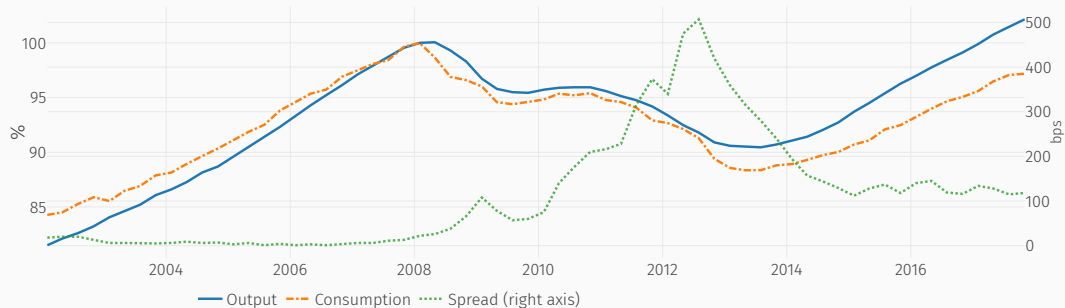
Spanish firms' self-reported limits to production

Source: Eurostat

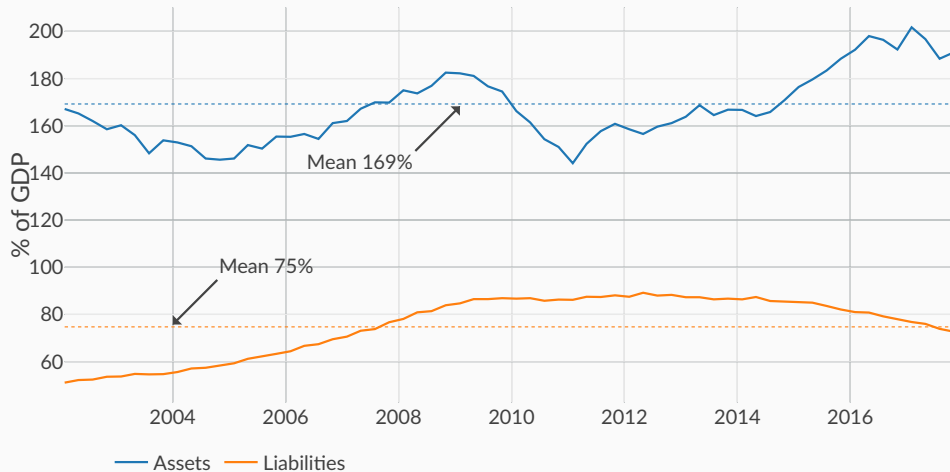
# Nondurable Consumption

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Output and Consumption for Spain



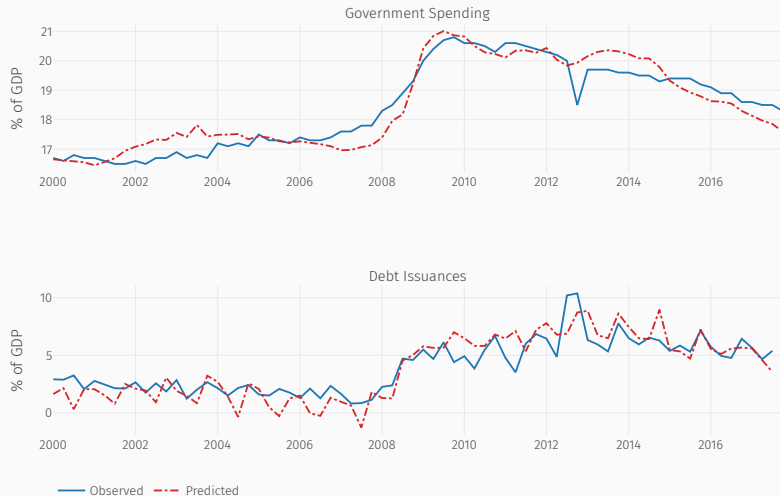
# Net Worth of Spanish households

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	$G_t/Y_t$		$(B'_t - (1 - \rho)B_t) / Y_t$	
	(1)	(2)	(3)	(4)
Unemployment <sub>t</sub>	0.031 (0.039)	0.073*** (0.015)	0.334** (0.158)	0.346*** (0.059)
Unemployment <sub>t</sub> <sup>2</sup>	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 <sub>t</sub>	0.009 (0.019)	0.007 (0.012)	0.046 (0.075)	0.019 (0.046)
Net Exports <sub>t</sub> <sup>2</sup>	−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 <sup>2</sup>	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)

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# Consumption and Output in the Eurozone Crisis

	log $Y_t$		log $C_t$		log $C_t$	
	(1)	(2)	(3)	(4)	(5)	(6)
Spread <sub>t</sub>	-0.007*** (0.001)	-0.006*** (0.001)	-0.014*** (0.002)	-0.009*** (0.001)	-0.007*** (0.001)	-0.004*** (0.001)
$B_t/Y_t$		-0.001** (0.000)		-0.002*** (0.000)		-0.002*** (0.000)
log $Y_t$					0.995*** (0.091)	0.807*** (0.067)
Country + Time FE	✓	✓	✓	✓	✓	✓
N	143	143	143	143	143	143
Within- $R^2$	0.274	0.325	0.420	0.677	0.715	0.857

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