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

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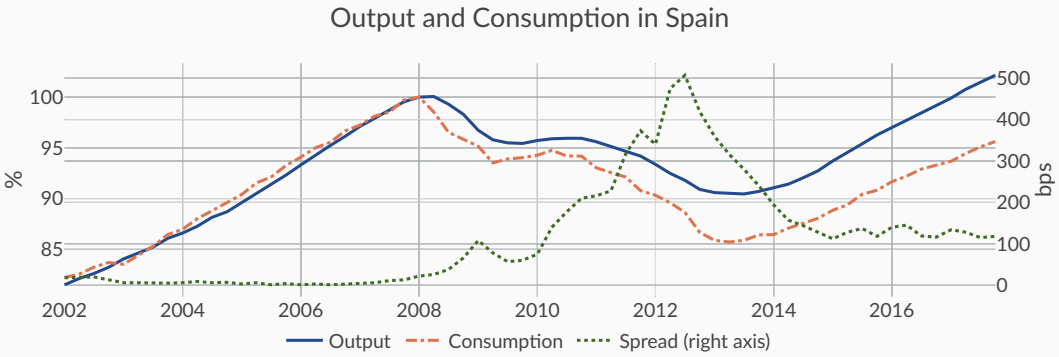
September 2020

Spain in the Eurozone Crisis

- Sovereign risk associated with deep recessions



▸ Detrended data ▸ Trade balance ▸ Low demand? ▸ Nondurable consumption

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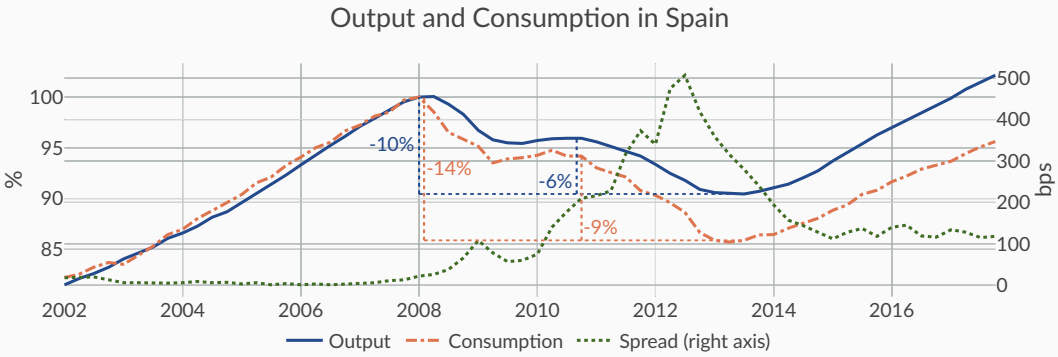

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Sovereign Risk

- 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 ∼100% of GDP pre-crisis. No consumption smoothing? More

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- 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

- 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

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How is sovereign risk costly?

Feedback loop between spreads and output

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

Main Findings

- 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

Related Literature

- **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'Erasmo 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), ...

Roadmap

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

Description of Model

General Description

- 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 ridigities
  - Foreigners
    - Lend to gov't + private agents, price all assets

Government Policy

At each t, the government

- Chooses repayment $h_t \in \{1, 1-\hbar\}$
- 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

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

$\rightarrow$ T_t summarizes a default / austerity tradeoff

Households

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

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

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

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

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

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

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

Exog LoMs for (ϵ,ξ,z); prob of h' given (S,ξ',z')

Households in a crisis

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

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

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

Private Economy

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

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

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

$$Y_{Nt} = L_{Nt}^{\alpha_N}\left(1-\Delta\mathbb{1}_{(\zeta\neq 1)}\right) \qquad Y_{Tt} = z_t L_{Tt}^{\alpha_T}\left(1-\Delta\mathbb{1}_{(\zeta\neq 1)}\right) \qquad w_t \geq \bar{w}$$

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

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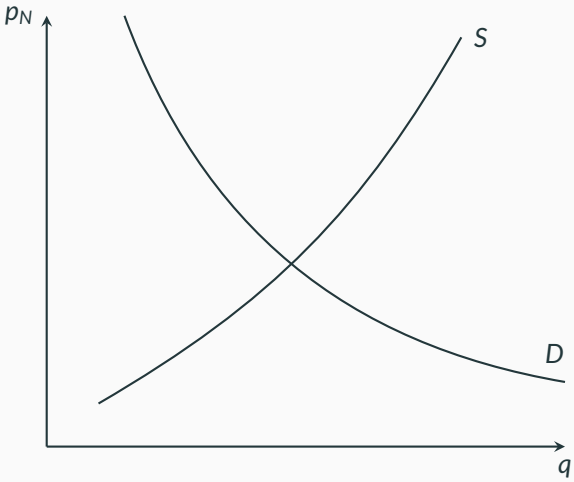
Aggregate Demand

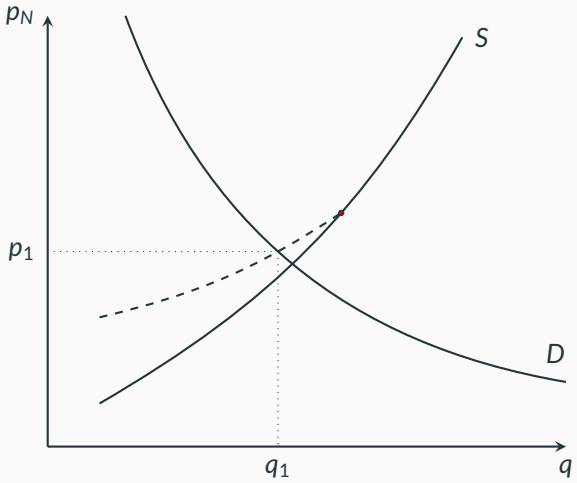


$$Y_N^d = \varpi \left(\frac{p_N}{p_C} \right)^{-\eta} C + \frac{\vartheta_N}{p_N} G$$

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

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

Aggregate Demand



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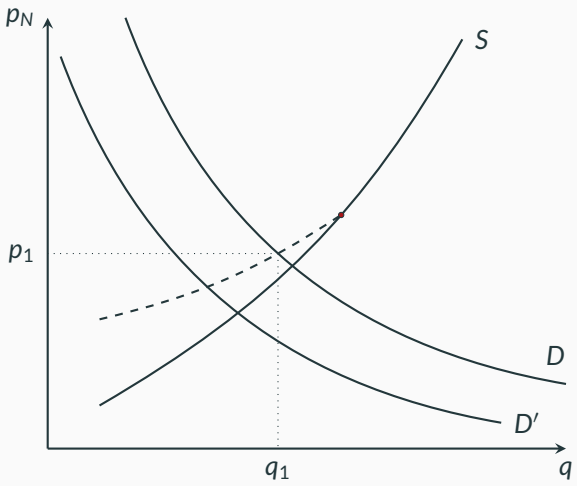

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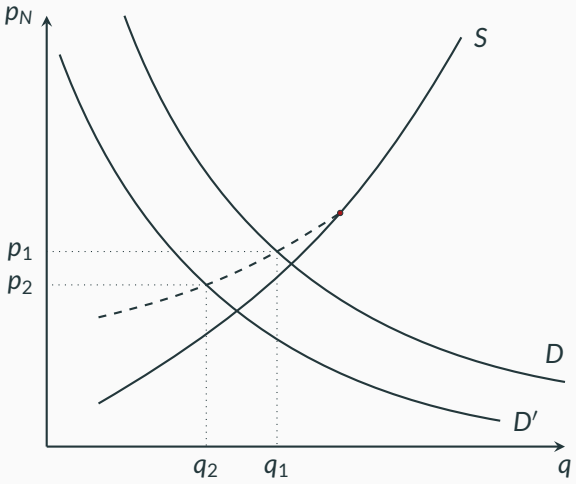

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- $C \downarrow \implies p_N \downarrow \implies w \downarrow$
- Wage rigidity creates price stickiness

The Government's Objective

Back to Timeline

- B'_t and G_t are given functions of $\mathbf{S}_t$
- 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 $\mathbf{S}_{t-1}$ and (ξ_t, z_t)
  - Gov't understands $\mathbf{S}_t = \Psi(\mathbf{S}_{t-1}, \xi_t, z_t, \zeta_t)$
  - Default iff

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

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

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Equilibrium Concept

Definition

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

▸ Algorithm

- A government policy $h'\left(\mathbf{S}, \xi', z'\right), T(\mathbf{S})$
- 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 $\mathcal{W}\left(\Psi(\mathbf{S}, \xi', z', \cdot)\right)$ for gov't, taxes respect budget constraint.

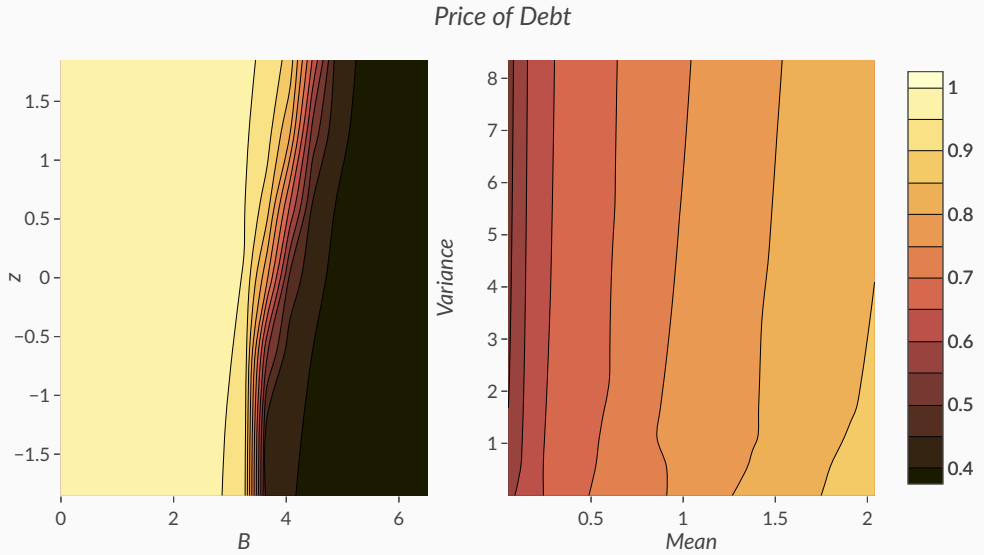
Results and simulations

Calibration

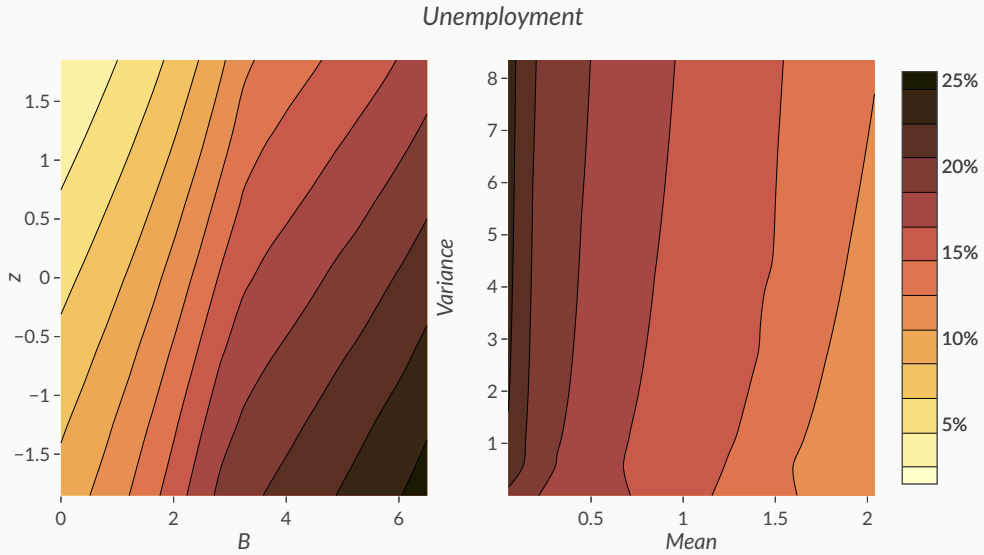
- Simulate model solution for 50000 years
- Agents believe $\lambda_t = \log \mathcal{N}(\mu_t, \sigma_t)$
- Keep track of actual distribution

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%

Spreads


Price of Debt
z
B
Variance
Mean
1.5
1
0.5
0
−0.5
−1
−1.5
0
2
4
6
8
7
6
5
4
3
2
1
0.5
1
1.5
2
1
0.9
0.8
0.7
0.6
0.5
0.4

Unemployment



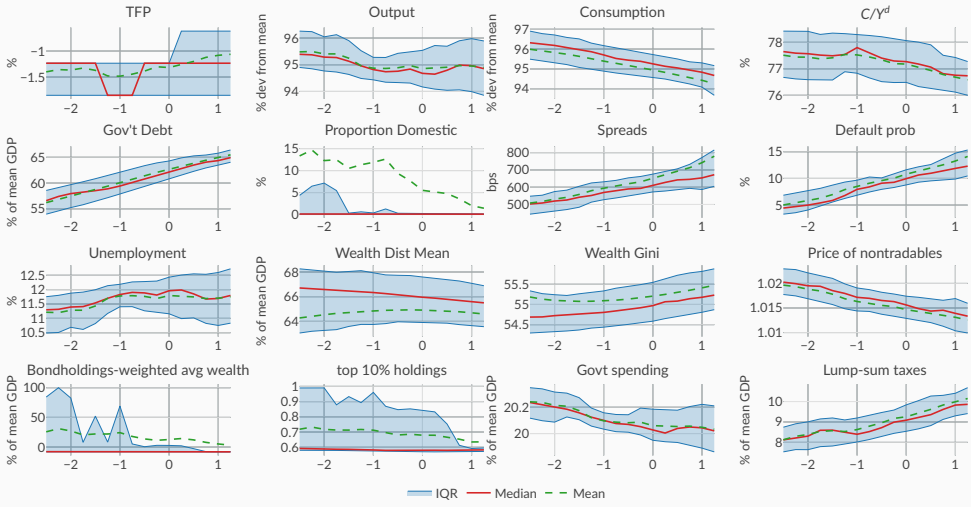
Crises

Distribution of outcomes in crises

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


TFP
%
Output
% dev from mean
Consumption
% dev from mean
C/Y^d
%
Gov't Debt
% of mean GDP
Proportion Domestic
%
Spreads
bps
Default prob
%
Unemployment
%
Wealth Dist Mean
% of mean GDP
Wealth Gini
Price of nontradables
Bondholdings-weighted avg wealth
% of mean GDP
top 10% holdings
Govt spending
% of mean GDP
Lump-sum taxes
% of mean GDP
IQR
Median
Mean

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 $\Longrightarrow$ economies differ in expectations

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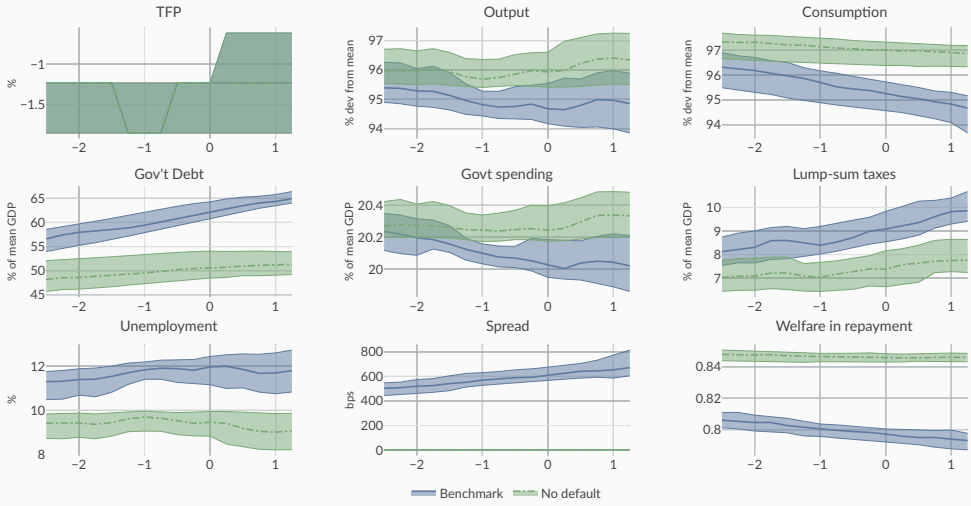
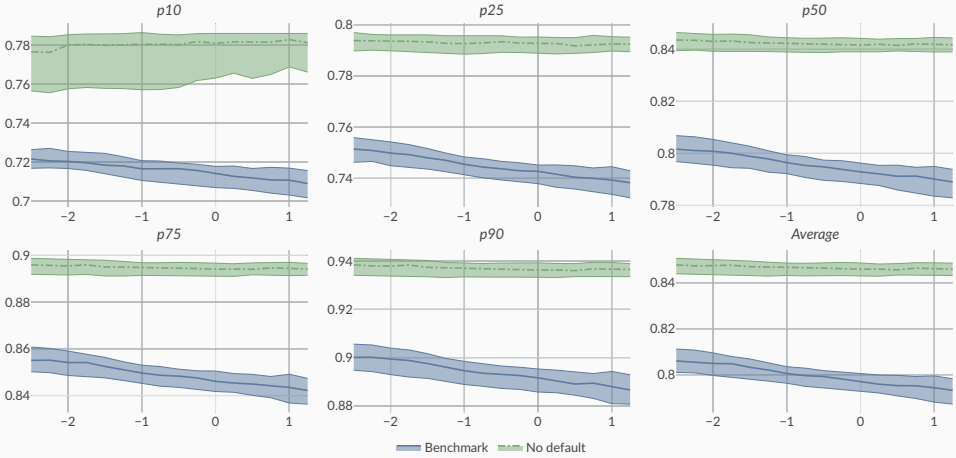
No default benchmark



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

Concluding remarks

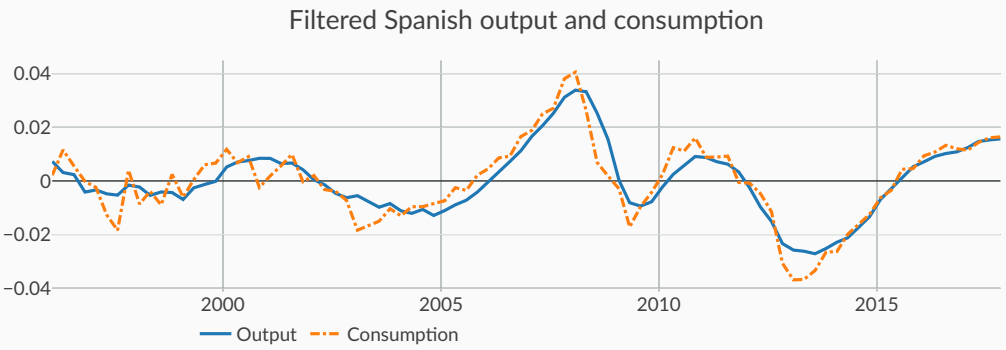
- Interested in interaction between
  1. Sovereign default risk
  2. Precautionary behavior

  \+ 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

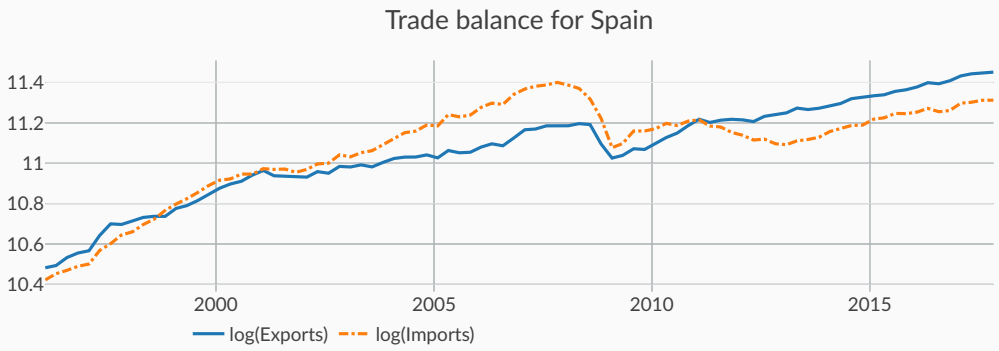
- Key
  - Savings against aggregate + redistributive effects if default
    - Timing flips MPC / transfer argument

Spain in the Eurozone Crisis



Spain in the 2000s

Spain in the Eurozone Crisis



Spain in the 2000s

Low demand?

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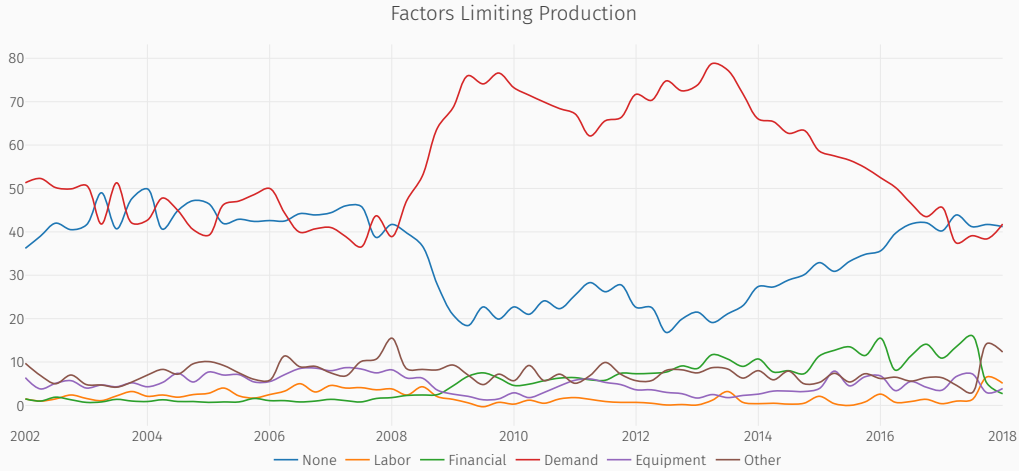

Spanish firms' self-reported limits to production

Source: Eurostat

Nondurable Consumption

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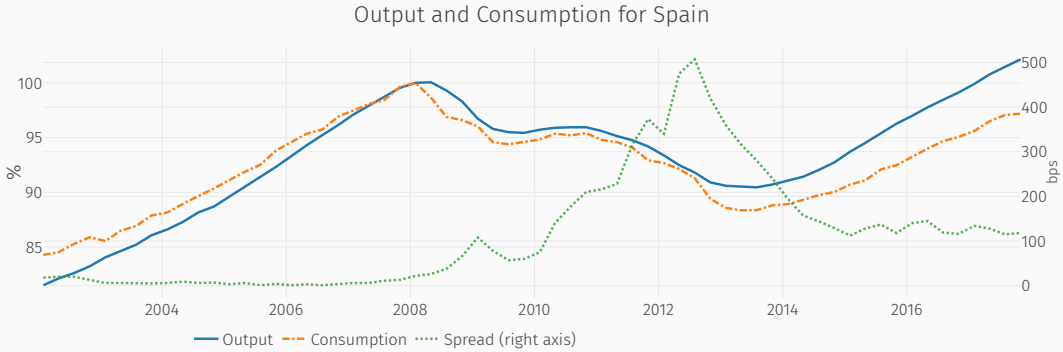

Net Worth of Spanish households

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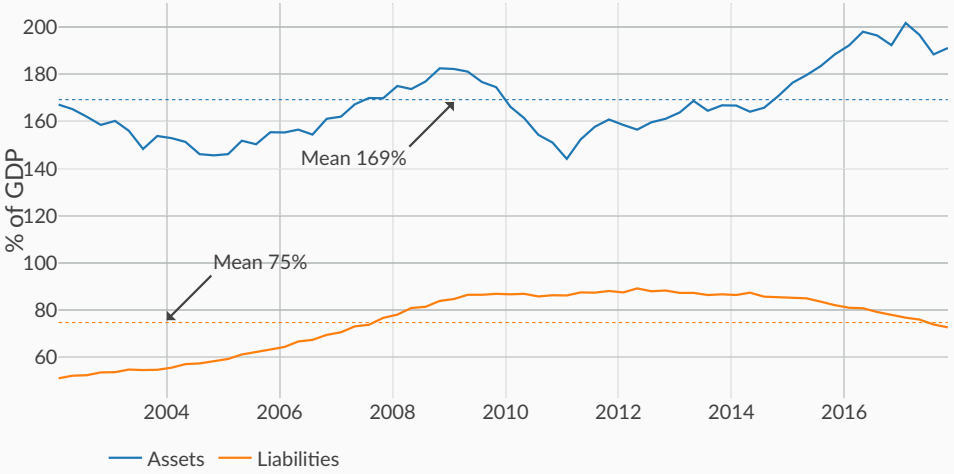

Fiscal Rules

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	G_t/Y_t		$(B'_t - (1-\rho)B_t)/Y_t$	
	(1)	(2)	(3)	(4)
Unemployment$_t$	0.031	0.073***	0.334**	0.346***
	(0.039)	(0.015)	(0.158)	(0.059)
Unemployment$_t^2$	0.002		0.0001	
	(0.001)		(0.006)	
B_t/Y_t	0.010*	−0.017***	−0.010	0.009
	(0.005)	(0.002)	(0.020)	(0.007)
$(B_t/Y_t)^2$	−0.0002***		0.0001	
	(0.00004)		(0.0001)	
Net Exports$_t$	0.009	0.007	0.046	0.019
	(0.019)	(0.012)	(0.075)	(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)

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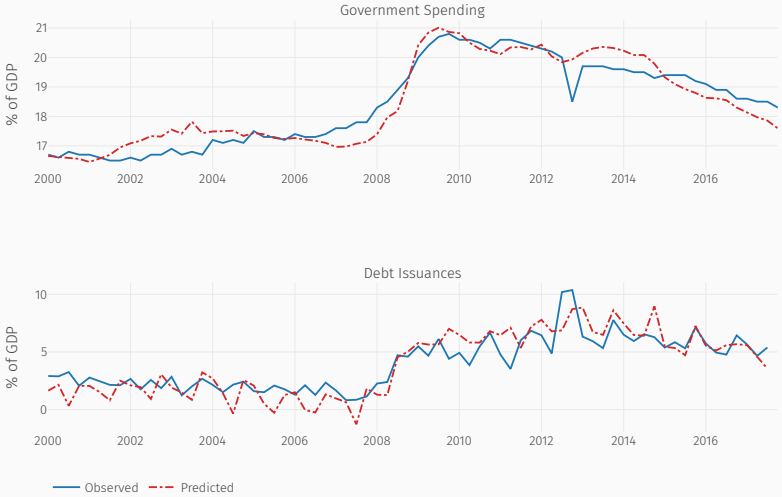

Consumption and Output in the Eurozone Crisis

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	$\log Y_t$		$\log C_t$		$\log C_t$	
	(1)	(2)	(3)	(4)	(5)	(6)
Spread_t	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
B_t/Y_t		-0.001**		-0.002***		-0.002***
		(0.000)		(0.000)		(0.000)
$\log Y_t$					0.995***	0.807***
					(0.091)	(0.067)
Country FE	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓
N	143	143	143	143	143	143
Within-R^2	0.274	0.325	0.420	0.677	0.715	0.857