Domestic Policies and Sovereign Default

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Default and Inflation in Emerging Markets

Emerging countries suffer recurrent sovereign debt crises

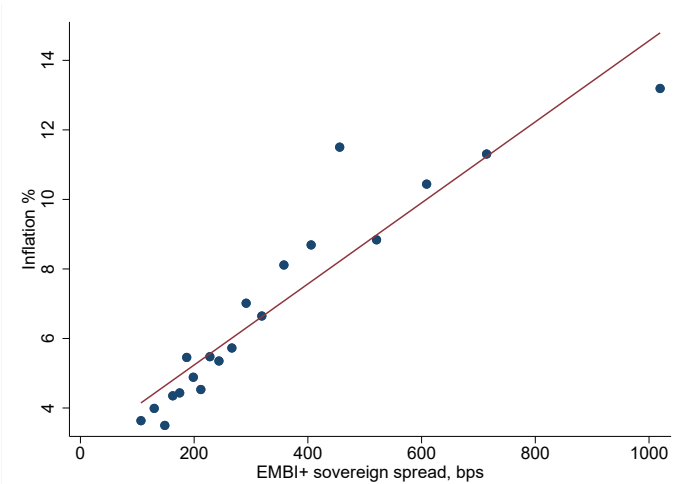
- overborrowing during booms leads to underinsurance against negative shocks

They also experience higher average inflation than developed countries ...

... and inflation surges during debt crises.

Literature is largely silent on the link between sovereign default risk and inflation.

Default Risk and Inflation



This figure is a binscatter (each dot is the mean for a bin containing the same number of observations). We removed outliers, defined as values below the 3rd percentile or above the 97th percentile, for both series. End-of-quarter year-over-year inflation.

This paper

Extend the standard sovereign default model to include distortionary taxes, fiat money and an equilibrium nominal exchange rate in a production economy.

Government cannot commit to future policies or debt repayment.

Mechanism:

- Cost of rolling over debt rises significantly after an adverse shock
- Fiscal response: debt reduction, higher taxes and lower expenditure
- Monetary response: actively support fiscal policy

Result: Tight link between distress in sovereign debt markets and high inflation.

▷ Related literature

Model

Small open economy tradable-nontradable model (TNT as in Uribe and Schmitt-Grohé, 2017, §8) with production, money and sovereign default.

There are three private goods and one public good:

1. Non-tradable good, consumed (c^N) and produced (y^N) domestically.
2. Imported good, consumed (c^T) domestically but not produced.
3. Exported good, produced (y^T) domestically but not consumed.
4. Public good (g), transformed one-to-one from non-tradable output.

Money is motivated by a cash-in-advance constraint.

Firms and households ▷ Details

A representative firm maximizes profits:

$$\max_{y^N, y^T, h} \; p^N y^N + e p^T y^T - wh$$

subject to $F(y^N, y^T) - h \leq 0$.

The problem of the household is

$$V(m, B, \mathcal{I}, s) = \max_{(c^N, c^T, m', h)} u(c^N, c^T) + v(1-h) + \beta \mathbb{E}\left[V(m', B', \mathcal{I}', s') | B, \mathcal{I}, s\right]$$

subject to

$$p^N c^N + e c^T + m'(1+\mu) \leq (1-\tau) wh + m + p^N \gamma \qquad \text{(BC)}$$

$$p^N c^N \leq m \qquad \text{(CIA)}$$

Government Budget Constraint & Balance of Payments

Government budget constraint **(GBC)** in (normalized) units of domestic currency:

$$p^N(g+\gamma) + eB = \tau wh + \mu + eQ(B',s)B'$$

Balance of payments **(BoP)**, expressed in foreign currency:

$$p^T y^T - c^T = B - Q(B',s)B'$$

Combining BoP with GBC:

$$\underbrace{\tau wh - p^N(g+\gamma)}_{\text{primary surplus}} + \underbrace{\mu}_{\text{seigniorage}} = e\underbrace{(p^T y^T - c^T)}_{\text{trade balance}}$$

Repayment vs Default

Government cannot commit to future policies or debt repayment.

Default: temporary exclusion from credit markets; lower productivity; $B = B^D \geq 0$.

The price of external debt satisfies zero profits for international risk-neutral lenders.

At the beginning of period, government chooses between pay (P) and default (D)

$$\hat{\mathcal{V}}(B, s, \varepsilon^P, \varepsilon^D) = \max\{\underbrace{V^P(B, s) + \varepsilon^P}_{\text{Repayment value}}, \underbrace{V^D(s) + \varepsilon^D}_{\text{Default value}}\}$$

Shocks ε^j are iid extreme value $\Rightarrow \mathcal{V}(B, s) = E_\varepsilon[\hat{\mathcal{V}}(B, s, \varepsilon^P, \varepsilon^D)]$

▷ analytical expressions

Government problem in repayment ▷ Default

Government chooses allocations and debt that are implementable in a monetary equilibrium.

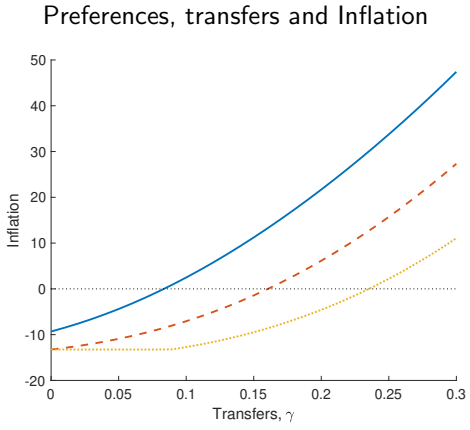
Conditional on repayment, the problem of the government is to maximize household welfare subject to the GBC and BoP in a monetary equilibrium:

$$V^P(B,s) \equiv \max_{B',c^N,c^T,y^T,g} u(c^N,c^T) + v(1-F(c^N+g,y^T)) + \vartheta(g) + \beta\mathbb{E}[\mathcal{V}(B',s')|s]$$

subject to

$$\begin{aligned}
p^T y^T - c^T + Q(B',s)B' - B &= 0 \qquad \text{(BoP)} \\
u_T c^T - \gamma u_T p^T (F_N/F_T) - v_\ell F(c^N+g,y^T) + \beta\mathbb{E}\left[u'_N c^{N\prime}|P,s\right] &= 0 \qquad \text{(GBC)} \\
u_N - u_T p^T (F_N/F_T) &\geq 0 \qquad \text{(NNC)}
\end{aligned}$$

When is monetary policy away from the Friedman Rule? Illustration



Debt choice: The Generalized Euler Equation

$$0 = \underbrace{\mathbb{E}\left[\mathcal{P}(B',s')\left(\frac{\xi}{1+r} - \beta\xi'\right)\Big|s\right]}_{\textit{distortion-smoothing}}$$

$$\underbrace{-\frac{\xi}{\kappa(1+r)}\mathbb{E}\left[\mathcal{P}(B',s')(1-\mathcal{P}(B',s'))(B' - Q^D(s')B^D)\xi'\Big|s\right]}_{\textit{default-risk premium}}$$

$$\underbrace{+\lambda\beta\mathbb{E}\left\{\mathcal{P}(B',s')\left[(u'_N + u'_{NN}\mathcal{C}^{N\prime})\mathcal{C}_B^{N\prime} - \frac{(u'_N\mathcal{C}^{N\prime} - \bar{u}'_N\bar{\mathcal{C}}^{N\prime})(1-\mathcal{P}(B',s'))\xi'}{\kappa}\right]\Big|s\right\}}_{\textit{distortionary policies}}$$

Distortionary policies: How does this channel work?

- Issuing more debt alters: (i) future fiscal and monetary policies in repayment; (ii) future repayment probability.
- These anticipated changes alter households' current money holdings decisions.
- Change in money demand affects GBC in the current period.
- Sign of effect depends on income vs substitution effects in money demand.
  ▷ Details
- Future governments do not internalize this effect.

The role of distortionary policies

Proposition

When lump-sum taxes are available:

- Optimal to set $\tau = 0$
- Monetary policy so that the CIA does not bind, the *Friedman rule*
- No intertemporal tradeoff due to distortionary policies in the GEE

Proposition

Without lump-sum taxes, there is no feasible policy that decentralizes the previous allocation.

Calibration summary

Data for seven Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Uruguay) from 1980 to 2018.

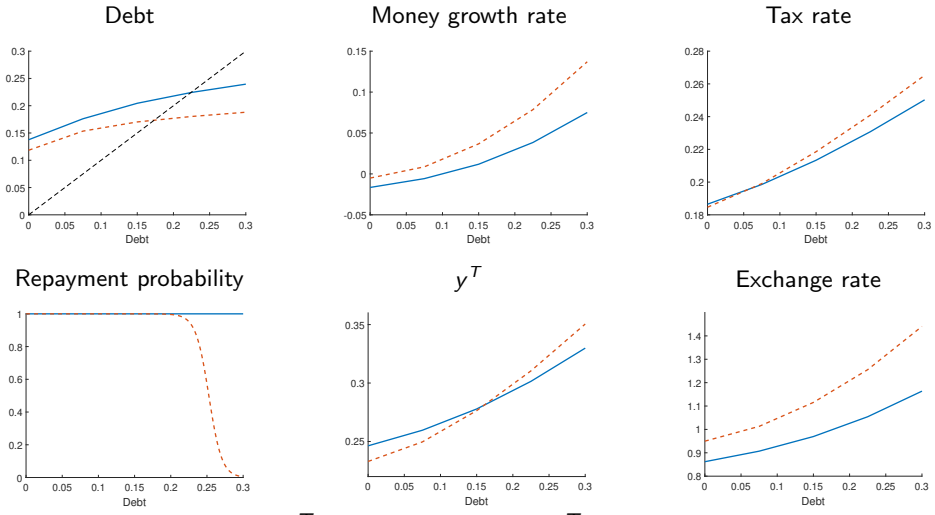
Calibration:

1. Exogenous parameters ▷ functional forms ▷ parameters
2. Model without aggregate shocks to match long-run averages.
   Preference shocks to have a small risk of default in steady state. ▷ Details
3. Model with either productivity or terms-of-trade shocks to calibrate remaining parameters. ▷ Details

Validation:

- Consistent with non-targeted business cycles statistics ▷ Details

Equilibrium policies as functions of debt (terms-of-trade shocks)



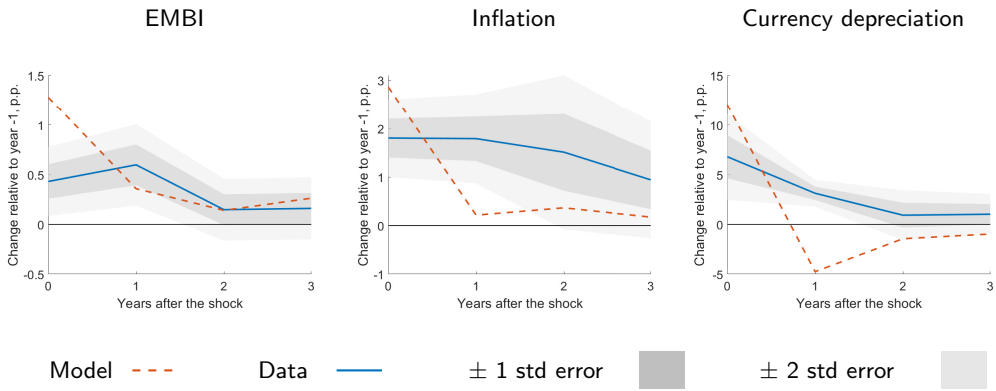
Inflation and Currency Depreciation during Debt Crises

	Data		**Model**	
	Emerging	Latin America	Terms-of-trade	Productivity
Inflation				
1-year interval	6.7	4.8	4.4	12.7
2-year interval	3.8	2.6	2.2	7.2
Currency depreciation				
1-year interval	9.0	7.0	16.8	17.0
2-year interval	9.3	6.9	6.3	7.3

We follow Calvo et al. (2006) and consider spikes on spreads exceeding two standard deviations above the prevailing sample mean.

Response to terms-of-trade shocks (local projections)

Response to a 10% negative p^T shock



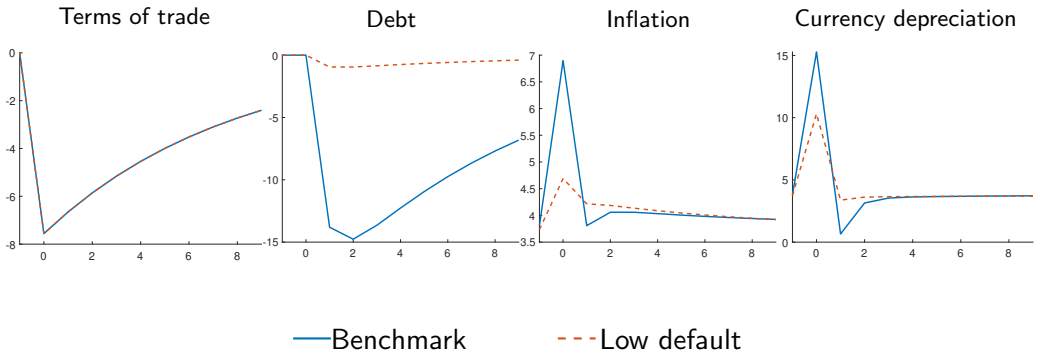
▷ Response to productivity shocks ▷ GDP growth

Cyclical properties of domestic policies

	Data	**Model**	
		Terms-of-trade	Productivity
Std. Dev. (inflation tax)	0.04	0.03	0.05
Correlation (inflation tax, y)	-0.34	-0.53	-0.66
Std. Dev. (personal income tax)	0.03	0.01	0.01
Correlation (personal income tax, y)	-0.17	-0.12	-0.44

The role of sovereign default risk (terms-of-trade shock)

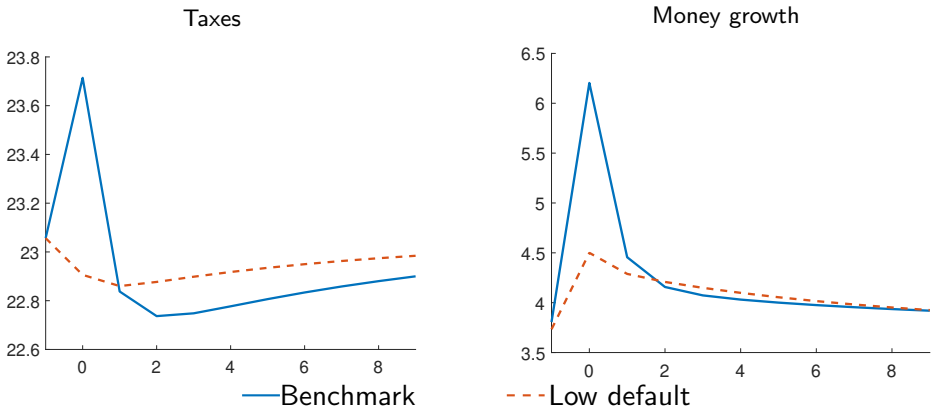
Sovereign default is essential to understand inflation in emerging markets.



▷ Low default calibration ▷ Productivity shock ▷ Variance benchmark vs low default

Domestic policies and default risk (terms-of-trade shock)

Response of domestic policies is dampened when default risk is low.



▷ Productivity shocks

Concluding remarks

We built a model to understand why emerging markets experience high inflation on average and why inflation surges during debt crises.

Essential elements: distortionary policies, limited commitment, sovereign default risk.

Model replicates: standard business cycle statistics; the cyclical properties of government policies; and the response of debt spreads, inflation, currency depreciation and output to shocks to the terms of trade and productivity.

Appendix

Related literature

Sovereign default: Eaton and Gersovitz (1981); Aguiar and Gopinath (2006); Arellano (2008).

Fiscal policy with risk of default: Cuadra, Sánchez, and Sapriza (2010); Bianchi, Ottonello, and Presno (2019); Hatchondo, Roch, and Martinez (2012); Anzoategui (2019).

Fiscal and monetary policies without commitment: Díaz-Giménez, Giovannetti, Marimón, and Teles (2008); Martin (2009, 2011).

Exchange rates/inflation: Na, Schmitt-Grohé, Uribe, and Yue (2018); Sunder-Plassmann (2020); Ottonello and Perez (2019); Arellano, Bai, and Mihalache (2020).

▷ Back.

Firm optimization

A representative firm maximizes profits:

$$\max_{y^N, y^T, h} \; p^N y^N + e p^T y^T - wh$$

subject to

$$F(y^N, y^T) - h \leq 0$$

The FOCs imply expressions w and e:

$$\begin{aligned} w &= \frac{p^N}{F_N} \\ e &= \frac{p^N}{p^T} \frac{F_T}{F_N} \end{aligned}$$

Households

Household takes as given the aggregate state, which contains:

- aggregate debt (B)
- the government default decision ($\mathcal{I}$)
- shocks (s)

Current aggregate state $(B, \mathcal{I}, s)$ maps into current domestic policy (τ, μ) and future aggregate state $(B', \mathcal{I}', s')$.

Household problem

Given individual state m, aggregate state $(B, \mathcal{I}, s)$ and the aggregate laws of motion, the problem of the household is

$$V(m, B, \mathcal{I}, s) = \max_{(c^N, c^T, m', h)} u(c^N, c^T) + v(1-h) + \beta \mathbb{E}\left[V(m', B', \mathcal{I}', s') | B, \mathcal{I}, s\right]$$

subject to

$$p^N c^N + e c^T + m'(1+\mu) \leq (1-\tau) w h + m + p^N \gamma \qquad \text{(HBC)}$$

and

$$p^N c^N \leq m \qquad \text{(CIA)}$$

Domestic policy distortions

The equation characterizing the choice of hours worked is

$$\frac{(1-\tau)wu_T}{e} = v_\ell$$

where the tax rate τ introduces a **wedge** between the marginal utilities of consumption of imported goods and leisure.

The inter-temporal choice is characterized by

$$\frac{(1+\mu)u_T}{e} = \beta\mathbb{E}\left[\frac{u'_N}{p^{N\prime}}\middle| B, \mathcal{I}, s\right]$$

where money growth μ **distorts** the substitution between current imported consumption and future non-tradable consumption (current "credit-goods" vs future "cash-goods") ▷ Back.

Extreme value shocks imply analytical expressions

Probability of repayment, $\mathcal{P}(B,s) \equiv \Pr[V^P(B,s) - V^D(s) \geq -\varepsilon]$, is:

$$\mathcal{P}(B,s) = \frac{\exp[V^P(B,s)/\kappa]}{\exp[V^P(B,s)/\kappa] + \exp[V^D(s)/\kappa]}$$

Expectation of the value function with respect to the utility shocks:

$$\mathcal{V}(B,s) = \mathbb{E}_\varepsilon[\hat{\mathcal{V}}(B,s,\varepsilon^P,\varepsilon^D)] = \kappa \ln\left\{\exp[V^P(B,s)/\kappa] + \exp[V^D(s)/\kappa]\right\}$$

Zero-expected profits by risk-neutral international lenders implies **debt prices**:

$$Q(B',s) = \frac{\mathbb{E}\left[\mathcal{P}(B',s')|s\right]}{1+r}$$

▷ Back

Primal approach (default)

Given state s, the problem of the government in default is

$$V^D(s) \equiv \max_{(c^N, c^T, y^T, g)} u(c^N, c^T) + v(1 - F(c^N + g, y^T)) + \vartheta(g) + \beta \mathbb{E}[\delta \mathcal{V}(B^D, s') + (1 - \delta) V^D(s') | s]$$

subject to

$$\begin{aligned} p^T y^T - c^T &= 0 && \text{(BoP)} \\ u_T c^T - \gamma u_T p^T (F_N / F_T) - v_\ell F(c^N + g, y^T) + \beta \mathbb{E}[u'_N c^{N\prime} | D, s] &= 0 && \text{(GBC)} \\ u_N - u_T p^T (F_N / F_T) &\geq 0 && \text{(NNC)} \end{aligned}$$

There may be penalties while in default (e.g., lower productivity). ▷ Back.

The role of distortionary policies

Assume:

$$u(c^N, c^T) = \alpha^N \frac{\left(c^N\right)^{1-\sigma^N}}{1-\sigma^N} + \alpha^T \frac{\left(c^T\right)^{1-\sigma^T}}{1-\sigma^T}$$

Distortionary policies:

- mitigates debt accumulation motive if $\sigma^N < 1$
- reinforces debt accumulation motive if $\sigma^N > 1$
- The effect vanishes with *log* utility

▷ Back.

Calibration: functional forms

Preferences:

$$u(c^N, c^T) = \alpha^N \frac{\left(c^N\right)^{1-\sigma^N}}{1-\sigma^N} + \alpha^T \frac{\left(c^T\right)^{1-\sigma^T}}{1-\sigma^T}, \quad v(\ell) = \alpha^H \frac{\ell^{1-\varphi}}{1-\varphi}.$$

Labor requirement for production:

$$F(y^N, y^T) = \frac{\left[\left(y^N\right)^\rho + \left(y^T\right)^\rho\right]^{1/\rho}}{A}.$$

Cost of default:

$$A^{def} = A - \Omega(s), \qquad \Omega(s) = \max\left\{\omega_1 + \omega_2 \frac{(s-\bar{s})}{\bar{s}}, 0\right\},$$

▷ Back.

Exogenous parameters

Parameter	Description	Value	Basis
r	risk-free rate	0.03	long-run average
φ	curvature of leisure	1.50	Frisch elasticity
δ	reentry probability	0.17	exclusion duration
α^T	preference share for c^T	1.00	normalization
σ^N	curvature of c^N	0.50	see appendix
σ^T	curvature of c^T	0.50	see appendix
ρ	elasticity of substitution btw y^N and y^T	1.50	see appendix
p^T	terms of trade	1.00	normalization

▷ Back.

Calibration of model without aggregate shocks

Parameter	Value	Statistic	Target/Non-stochastic Model
A	1.4575	Real GDP	1.000
β	0.8675	Inflation, %	3.800
γ	0.1082	Transfers/GDP	0.117
α^N	2.6888	Exports/GDP	0.209
α^H	0.9265	Employment/Population	0.587
α^G	0.4240	Gov. Consumption/GDP	0.133
B^d	0.1854	Debt/GDP	0.185
ω_1	0.0228	Haircut, Share of Debt	0.305
κ	0.0235	Default, %	0.700

▷ Back.

Calibration of Model with Aggregate Shocks

Parameter	Shock		Statistic	Target	Shock	
	p^T	A			p^T	A
B^d	0.149	0.160	Debt/GDP	0.185	0.173	0.169
ω_1	0.087	0.068	Haircut/Debt	0.305	0.257	0.230
ω_2	0.955	1.450	Default, %	2.000	2.140	2.010
ρ_s	0.880	0.863				
σ_s	0.076	0.031				

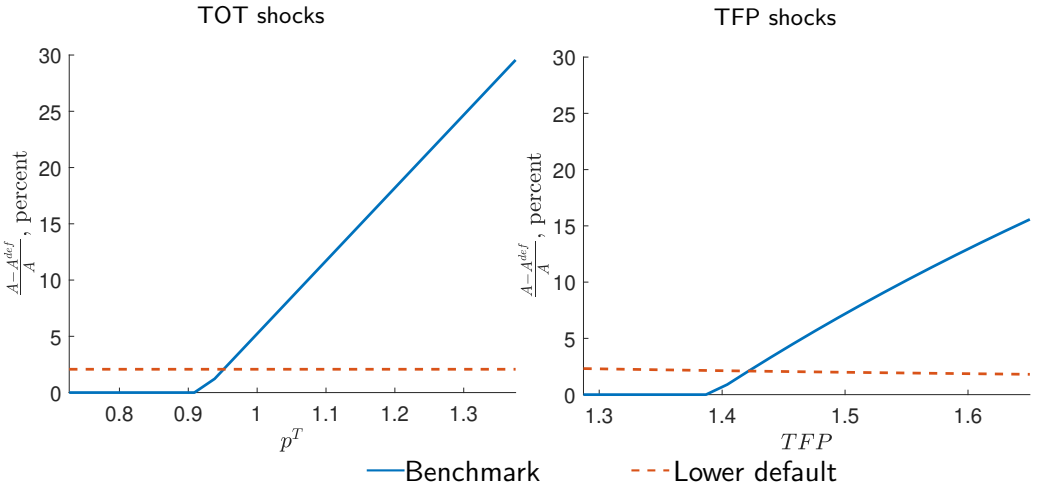
▷ Back.

Validation: Business Cycles Statistics

	Data	Model with p^T shocks	Model with TFP shocks
Std. Dev. (trade bal./Y)	0.035	0.017	0.015
Std. Dev. (spreads)	3.923	3.303	2.315
Std. Dev. (exports/Y)	0.052	0.021	0.015
Correlation(trade bal./Y, y)	-0.357	-0.177	-0.492
Correlation(spreads,y)	-0.362	-0.073	-0.187
Correlation(exports/Y,y)	-0.178	-0.140	-0.556

▷ Back.

Cost of default in terms of reduction in TFP



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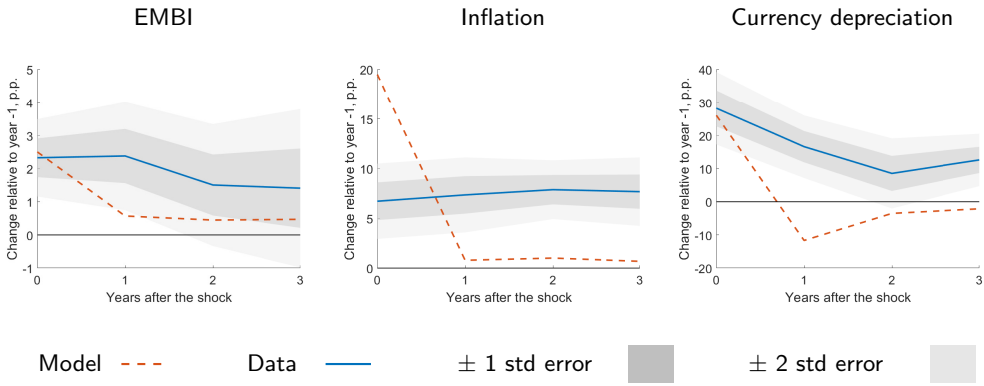
Response to productivity shocks (local projections)



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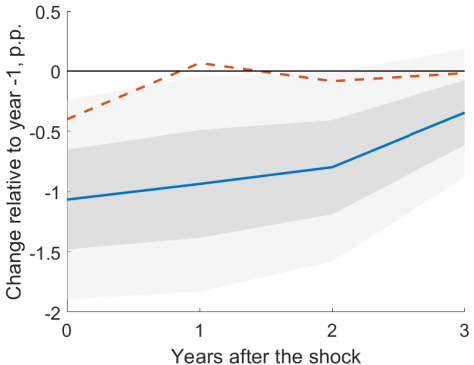
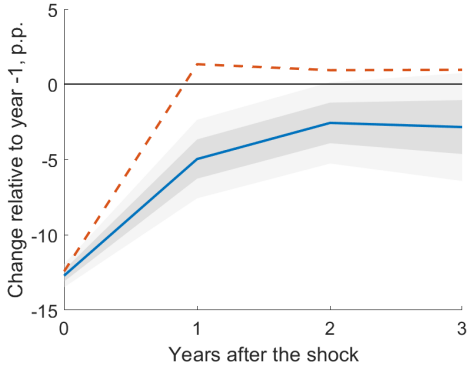
Impact of terms-of-trade shocks on GDP growth



▷ Back.

- Kehoe and Ruhl (2008) show that the first-order effect of changes in terms of trade on real GDP is zero.
- Here: increase in policy distortions to repay debt when the terms of trade deteriorate.

Impact of productivity shocks on GDP growth



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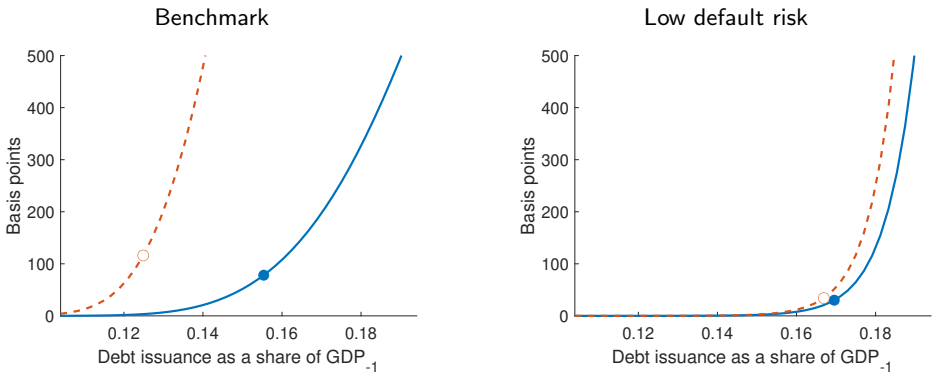
A low sovereign default-risk economy

To study the quantitative importance of sovereign default risk we also consider a (re-calibrated) economy with low default risk. ▷ Cost of default



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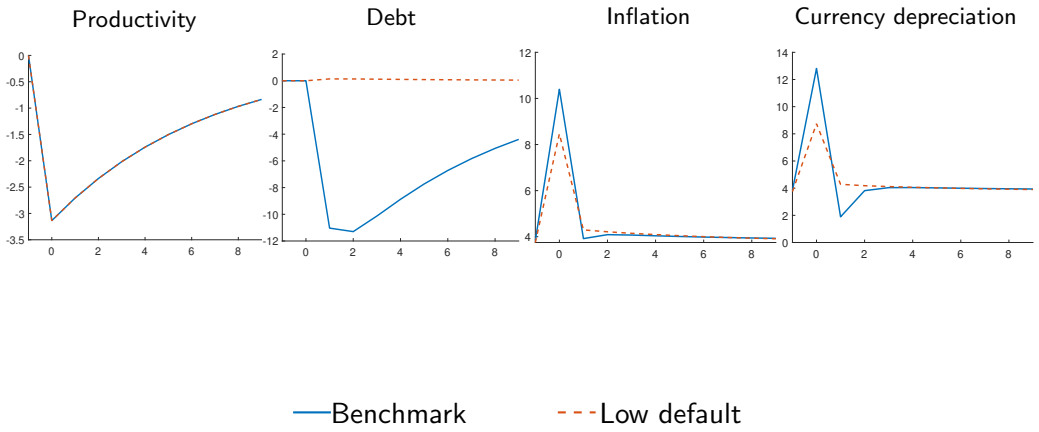
The role of sovereign default risk (productivity shock)



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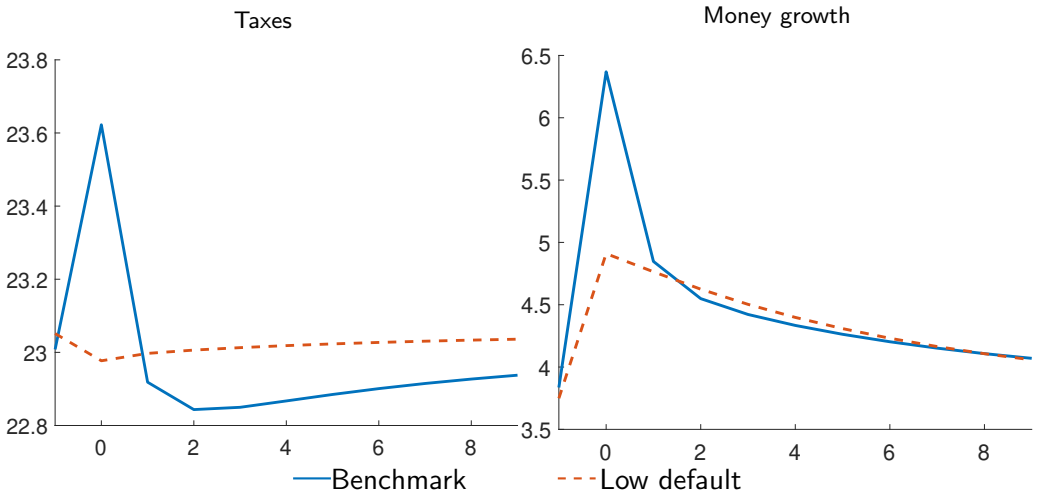
Pro-Cyclical Domestic Policies and Default Risk (TFP shocks)



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Sovereign default risk is essential

	Variance in Low default relative to Benchmark
Inflation	
Terms-of-trade shock	11%
Productivity shock	52%
Currency depreciation	
Terms-of-trade shock	34%
Productivity shock	27%
GDP	
Terms-of-trade shock	10%
Productivity shock	100%

- Lower variance of inflation and currency depreciation with low default risk.
- Default is essential for the importance of terms-of-trade shocks on GDP.

▷ Back.

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