Domestic Policies and Sovereign Default

Emilio Espino
UTDT

Julian Kozlowski
FRB St. Louis

Fernando M. Martin
FRB St. Louis

Juan M. Sánchez
FRB St. Louis

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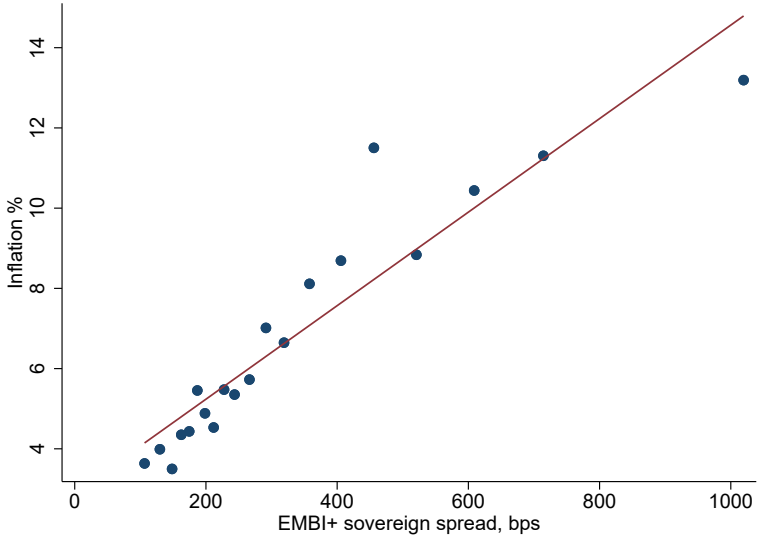
Default and Inflation in Emerging Markets

Emerging countries suffer recurrent sovereign debt crises

They also experience higher inflation than developed countries . . .
. . . and inflation surges during crises

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

Country Risk and Inflation



This Paper

Mechanism:

- Governments cannot commit to either repay debt, nor fiscal or monetary policies $\rightarrow$ cost of rolling over debt rises significantly after adverse shocks.
- Fiscal policy responds with higher taxes and lower expenditure.
- Government actively use monetary policy to support fiscal policy.
- Tight connection between distress in sovereign debt markets and high inflation.

Build a model consistent with this mechanism and take it to the data.

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); Ottonello and Perez (2019); Arellano, Bai, and Mihalache (2020).

▷ Back.

Model

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.

Government

Government lacks the ability to commit and chooses policy every period.

Government expenditures: public good g and (exogenous) transfers γ.

Government income:

- labor income tax τ
- Money growth rate μ
- One-period foreign currency defaultable bonds B', risk-neutral foreign lenders

Government budget constraint (GBC) & Balance of payments (BoP)

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

$$p^T y^T - c^T = B - Q(B', s)B' \qquad \text{(BoP)}$$

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:

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

Household problem

Measure 1 of infinitely-lived, identical agents.

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

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

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

Domestic policy distortions

The tax rate τ introduces a **intra-temporal wedge** between the marginal utilities of consumption of imported goods and leisure.

The money growth μ introduces a **inter-temporal wedge** between current imported consumption and future non-tradable consumption.

Government problem

Primal approach

Formulate the problem of the government as selecting allocations and debt choices that are implementable in a monetary equilibrium.

Use equilibrium conditions to replace prices (p^N, w, e) and policies (μ, τ) in the government budget constraint (GBC).

The price of external debt satisfies zero profits for international risk-neutral lenders: $q = Q(B', s)$, which appears in the balance of payments (BoP).

Non-tradable resource constraint: $c^N + g = y^N$.

Non-negativity constraint in a monetary equilibrium: $u_N/F_N - u_T(p^T/F_T) \geq 0$.

▷ Markov-perfect equilibrium

Repayment vs Default

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

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

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

where shocks ε^j are iid extreme value.

Let $\varepsilon \equiv \varepsilon^P - \varepsilon^D$, which has zero mean and is distributed logistic with scaling parameter $\kappa > 0$.

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**:

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

Government problem in repayment

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

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

▷ Government problem in default.

Formulating the government's problem

When the government repays, its policies are a function of the state (B, s):

$$\{\mathcal{B}, \mathcal{C}^N, \mathcal{C}^T, \mathcal{Y}^T, \mathcal{G}\}$$

When the government is in default, its policies are a function of the state s:

$$\{\bar{\mathcal{C}}^N, \bar{\mathcal{C}}^T, \bar{\mathcal{Y}}^T, \bar{\mathcal{G}}\}$$

These policy functions span continuation functions $V^P(B, s)$, $V^D(s)$ and $\mathcal{V}(B, s)$.

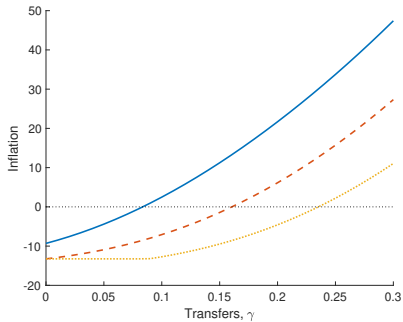
Government's problem is a best-response to anticipated policy functions.

A Markov-perfect equilibrium is a fixed-point in policy functions.

Characterization

1. Positive opportunity cost of holding money

Derive conditions such that the CIA constraint is binding, consistent with positive and elevated inflation.



$\sigma_T = 0.5$ $\sigma_T = 1.0$ $\sigma_T = 1.5$

where $u(c^T) = \frac{(c^T)^{1-\sigma^T}-1}{1-\sigma^T}$

2. Debt choice: The Generalized Euler Equation

$$
\begin{aligned}
0 \;=\; & \underbrace{\mathbb{E}\left[\mathcal{P}(B',s')\left(\frac{\xi}{1+r} \;-\; \beta\xi'\right)\Big|s\right]}_{\textit{distortion-smoothing}} \\
& \underbrace{-\frac{\xi}{\kappa(1+r)}\mathbb{E}\left[\mathcal{P}(B',s')(1-\mathcal{P}(B',s'))(B'-Q^D(s')B^D)\xi'\Big|s\right]}_{\textit{default-risk premium}} \\
& \underbrace{+\lambda\beta\mathbb{E}\left\{\mathcal{P}(B',s')\left[(u'_N+u'_{NN}\mathcal{C}^{N\prime})\mathcal{C}_B^{N\prime}-\frac{(u'_N\mathcal{C}^{N\prime}-\bar{u}'_N\bar{\mathcal{C}}^{N\prime})(1-\mathcal{P}(B',s'))\xi'}{\kappa}\right]\Big|s\right\}}_{\textit{distortionary policies}}
\end{aligned}
$$

where ξ and λ be the Lagrange multipliers of the BoP and GBC constraints.

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.

3. The Role of Distortionary Policies

When lump-sum taxes are available:

– The GBC is satisfied by lump-sum taxes
– 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

Without lump-sum taxes:

– There is no feasible policy that decentralizes the previous allocation.

Quantitative Evaluation

Calibration summary

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

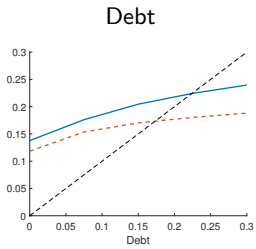
Calibration:

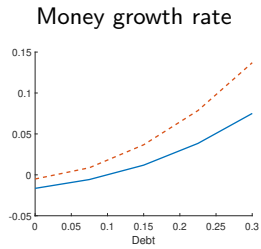
1. Exogenous parameters ▷ functional forms, ▷ parameters.

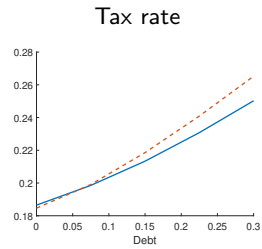
2. Model without aggregate shocks to match long-run averages.
   Preference shocks to have a small risk of default in steady state. ▷ Details.

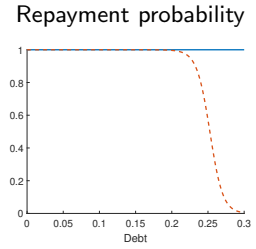
3. Model with either productivity or terms-of-trade shocks to calibrate remaining parameters. ▷ Details.

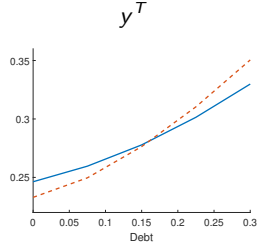
Equilibrium policies as functions of debt (terms-of-trade shocks)

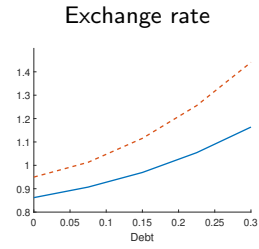












Validation: Model consistent with business cycles statistics

	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

Validation: Fluctuations of Domestic Policies

	Data	Model, shocks	
		Terms-of-trade	Productivity
Std. Dev. (inflation tax)	0.04	0.03	0.05
Correlation (inflation tax, y)	-0.34	-0.53	-0.67
Std. Dev. (personal income tax)	0.03	0.01	0.01
Correlation (personal income tax, y)	-0.17	-0.12	-0.44

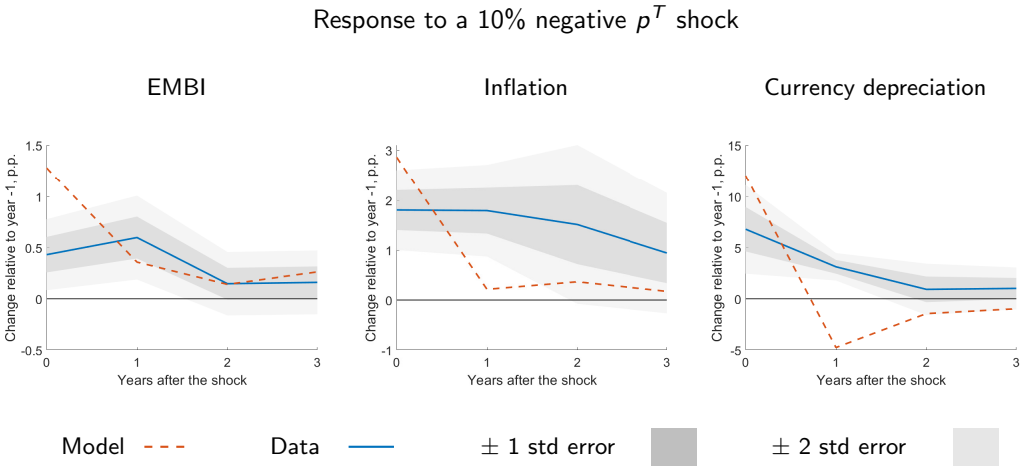
Understanding Aggregate Fluctuations in Emerging Markets

Inflation and Currency Depreciation during Debt Crises

Event study: Sovereign debt crises

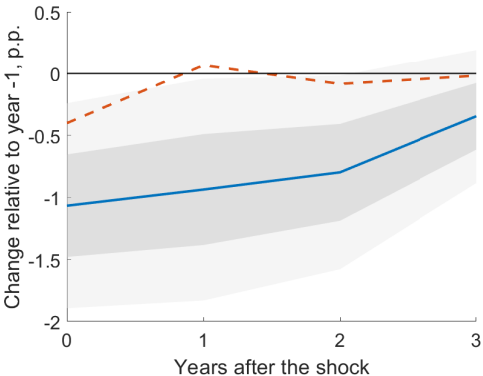
	Mean percentage point change	
	Inflation	Currency depreciation
All countries	6.7	9.0
Latin America	4.8	7.0
Model with terms-of-trade shocks	4.4	16.8
Model with productivity shocks	12.7	17.0

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



▷ Response to productivity shocks.

Impact of terms-of-trade shocks on GDP growth



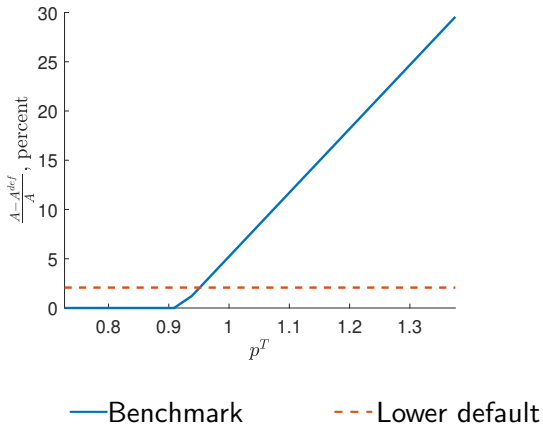
- Kehoe and Ruhl (2008) show that the first-order effect of changes in terms of trade on real GDP is zero.
- Here GDP declines because policy distortions increase to repay debt when the terms of trade deteriorate.

▷ Response to productivity shocks.

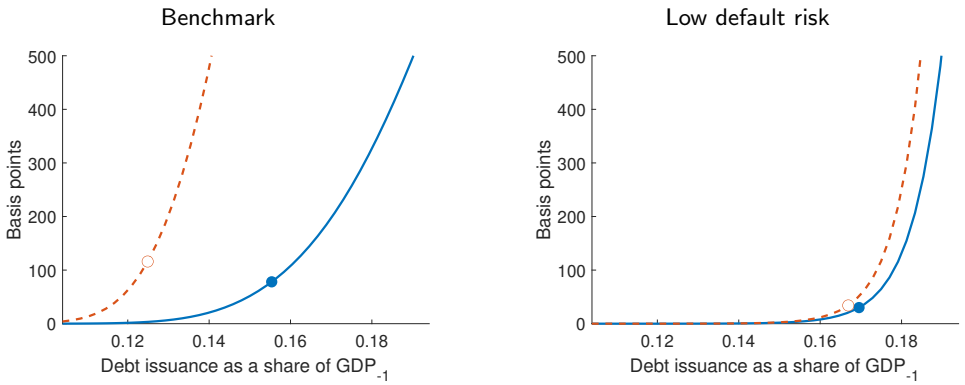
The Role of Sovereign Default Risk

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.

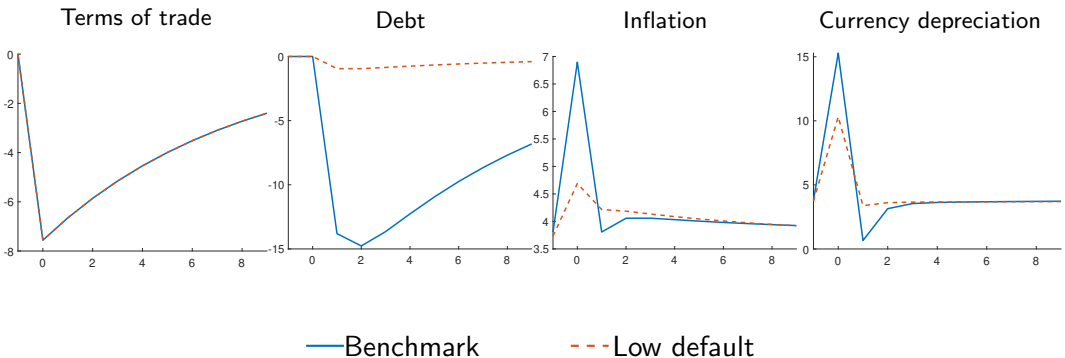


A low sovereign default-risk economy



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

Sovereign default is essential to understand inflation in emerging markets.



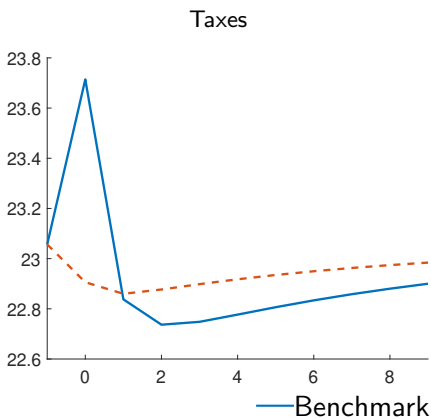
▷ Productivity shock.

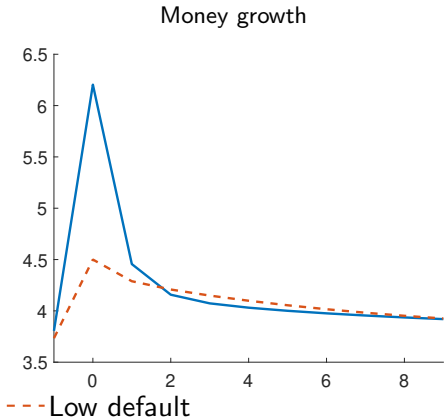
Sovereign default risk is essential for fluctuations

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

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

Pro-Cyclical Domestic Policies and Default Risk (p^T shocks)





▷ Productivity shocks.

Conclusions

Concluding remarks

We constructed a model to understand why emerging markets experience high inflation

Main frictions are distortionary policies and limited commitment to future policies and debt repayment

The model reproduces standard business cycles statistics, the cyclical properties of fiscal and monetary policies, the policy response to shocks, and the increase in inflation during debt crises.

Distortionary policies and default risk are crucial for explaining the dynamics of inflation in emerging markets.

Appendices

Theory

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 $(B', \mathcal{I}', s')$.

▷ Back.

Primal approach (default)

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

$$V^D(s) \equiv \max_{(c^N, c^T, y^T, g)} u(c^N, c^T) + v(1 - F(c^N + g, y^T)) + \vartheta(g) + \beta \mathbb{E}[\delta \mathcal{V}(0, s') + (1 - \delta) V^D(s') | s]$$

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.

When is inflation above the Friedman Rule?

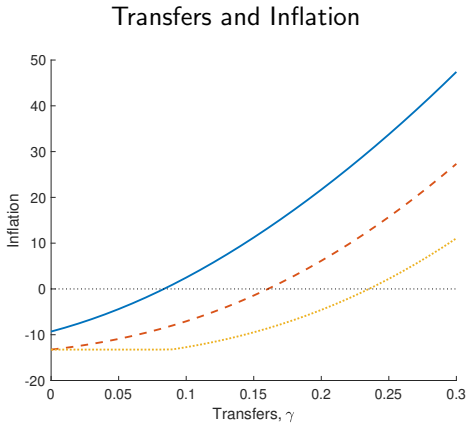
Proposition

(i) Assume that $\gamma = 0$. The non-negativity constraint is slack if and only if $\frac{-u_{TT}c^T}{u_T} \leq 1$. Policy is away from the Friedman rule if and only if $\frac{-u_{TT}c^T}{u_T} < 1$.

(ii) Assume that $\gamma > 0$. There exists a $\hat{\sigma}^T > 1$ such that if $\frac{-u_{TT}c^T}{u_T} \in \left(0, \hat{\sigma}^T\right)$ then the non-negativity constraint is satisfied with strict inequality. Policy is away from the Friedman rule if $\frac{-u_{TT}c^T}{u_T} < \hat{\sigma}^T$.

When is inflation above the Friedman Rule?

$$u(c^T) = \frac{(c^T)^{1-\sigma^T} - 1}{1-\sigma^T}$$



The role of distortionary policies

$u(c^N) = \frac{(c^N)^{1-\sigma^N}-1}{1-\sigma^N}$ and $u(c^T) = \frac{(c^T)^{1-\sigma^T}-1}{1-\sigma^T}$

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.

Quantitative Results

Calibration: functional forms

Preferences:

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

Labor requirement for production:

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

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
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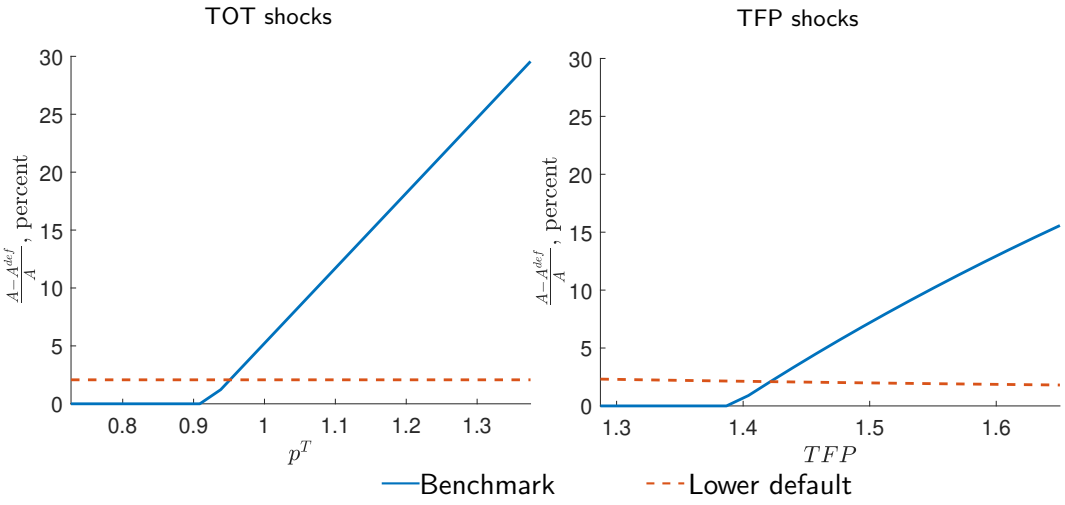
▷ Back.

Cost of default in terms of reduction in TFP



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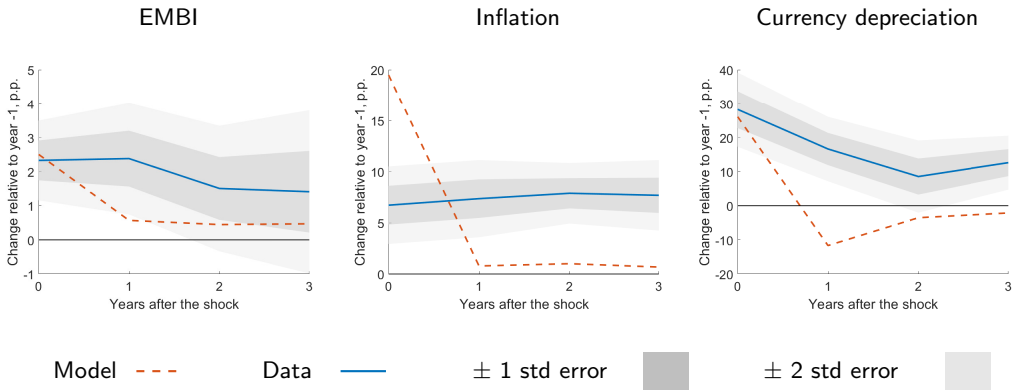
Response to productivity shocks (local projections)



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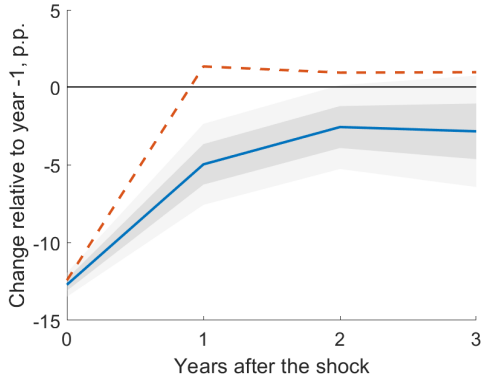
Impact of productivity shocks on GDP growth



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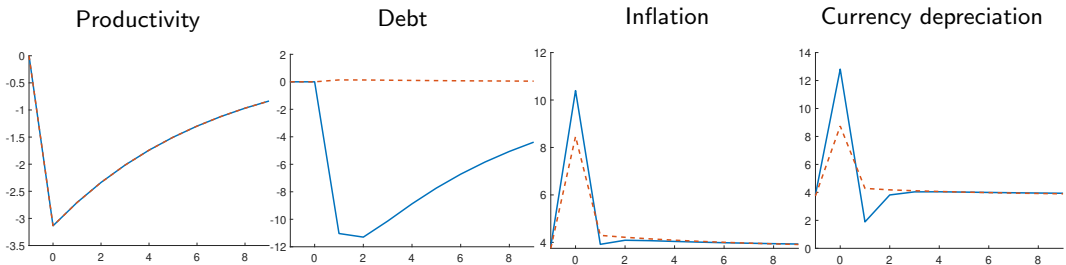
The role of sovereign default risk (productivity shock)



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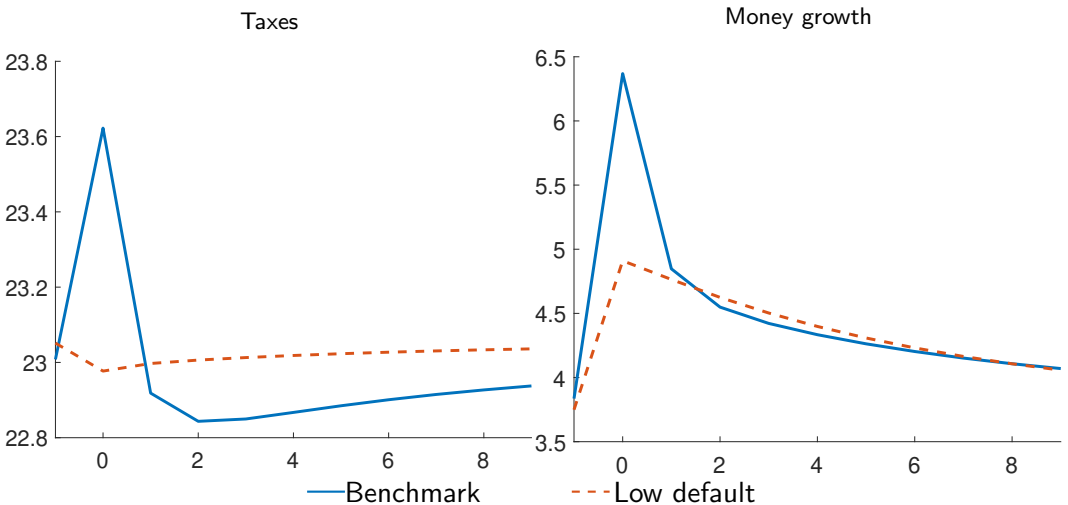
Pro-Cyclical Domestic Policies and Default Risk (TFP shocks)



▷ Back.

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