Optimal Sovereign Debt Default

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Introduction

- Provide a normative & quantitative analysis of sovereign default:

  When is it optimal for a sovereign to default?

- To the best of our knowledge:

  First paper determining fully optimal sovereign default

  => **Ramsey policy with full commitment**

- **Dominant view:** sovereign default (SD) is inefficient

  Policy discussions:

  ex-post costs associated with SD

  default ‘inefficient’ $=>$ private plans in disarray, fin. & ec. collapse

  Academic view:

  limited commitment: SD ex-post efficient but ex-ante inefficient

  Ramsey policy literature: full repayment assumed & no SD

- Important economic role for SD: resource transfer in times of scarcity

  SD *ex-ante efficient* if other insurance mechanisms more costly or unavailable

- Government bond markets incomplete:

  partial repayment can be optimal under commitment

Introduction

- Ramsey policy literature:

  Assumes market incompleteness, but also *assumes* full repayment

  Aiyagari et al. (2002), Angeletos (2002), Chari et al. (1991), Sims (2001), Schmitt-Grohe & Uribe (2004), Adam (2011)

- Show that full repayment is inconsistent with optimality for empirically plausible levels of 'default costs'

- Sizable welfare gains possible:1-2% cons. equiv.

  Even if default costs are large!

- Incompleteness arises endogenously from contracting frictions.

Introduction

- Quantitative analysis:
  Default tends to be suboptimal following BC cycle-sized shocks, unless country close to maximally sustainable net foreign debt position.

- Full repayment assumption:
  'Reasonable' approx. to opt. repayment decisions
  An exact approximation only for very high levels of default costs

- Introduce economic disaster risk (Barro and Jin (2011):
  Default optimal following occurrence of a disaster shock
  Optimal even if far from maximal net foreign debt position
  & even if sufficient resources for repayment available!

Outline of Remaining Talk

1. Introduce the model
2. Contracting frictions and optimal debt contract
3. Ramsey problem
4. Quantitative results & welfare analysis

Model Setup: Households and Firms

- Small open economy with investment & shocks to domestic productivity

- Representative risk-averse consumer:

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$$

subsistence consumption: $c_t \geq \bar{c} \geq 0$

- Domestic income risk:

$$y_t = z_t k_{t-1}^{\alpha},$$

$z_t \in Z = \{z^1, ..., z^N\}$,transition law $\pi(z'|z)$

- Risk neutral foreign investors

Model Setup: Government

- Fully committed government max'es utility of representative HH
- Seeks to smooth consumption implications of domestic income risk
- Can accumulate & decumulate foreign bonds/reserves:

  assumed risk free 1 period bonds (longer maturities possible)
- Internationally borrow by issuing own debt contracts:

  arbitrary repayment profiles allowed

Model Setup: Government Debt Contracts

- Debt contract consists of an **explicit & implicit** component
  - explicit repayment profile: specified in the legal text of the contract
  - implicit repayment profile: not formalized, but commonly(!) understood
- **Default:** implicitly promised payment falls short of explicit one

Model Setup: Government Debt Contracts

- Achieving a desired state-contingent repayment profile:

  explicit contract: costly, as requires input of resources (laywers,...)

  implicit contract: common understanding may be lost after maturity date

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  - default event exposes government to risk of being sued for full repayment (limited commitment on lender's side)
  - to protect the gov from such action: needs to reach an *explicit* legal settlement: costly $=>$ default costs.

Model Setup: Government Debt Contracts

- Panizza, Sturzenegger, Zettelmeyer (JEL, 2009):
  'sovereign immunity' & 'act of state doctrine' not too much bite
- US Foreign Sovereign Immunities Act (FSIA) of 1976 allows to sue governments

The Optimal Government Debt Contract

- Contracting costs:

  Costs of non-contingent debt ($I^n = 1$ for all n) normalized to zero

  Explicit contracting: proportional fee λ of the value

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- Cost of explicitly incorporating a contingency $I^n \leq 1$ into the bond:

$$\lambda \left(1 - I^n\right)$$

The Optimal Government Debt Contract

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  ...but when reaching the contingency default settlement :

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- **Implicit contracting dominates:**
  costs have to be paid only with certain probability (& later)!

Model Setup: Government's Policy Problem

- Debt optimally non-contingent in explicit terms (not in implicit terms)

  Default gives rise to proportional default costs λ

- From now on:

  Model with non-contigent (explicit) bonds & default costs $\lambda \geq 0$

Optimal Policy Problem

- Ramsey allocation problem

$$\max_{\left\{G_t^L \geq 0, G_t^S \geq 0, \Delta_t \in [0,1]^N, k_t \geq 0, c_t \geq \bar{c}\right\}} \quad E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$$

$$\begin{aligned} s.t.: c_t + k_t + \frac{G_t^L}{1+r} &= w_t + \frac{G_t^S}{1+R(z_t, \Delta_t)} \\ w_{t+1} &\geq NBL(z_{t+1}) \quad \forall t \, \forall z_{t+1} \in Z \\ w_0 &: \text{given} \end{aligned}$$

- Beginning-of-period wealth:

$$w_t \equiv z_t k_{t-1}^{\alpha} + G_{t-1}^L - G_{t-1}^S \cdot (1 - (1 - \lambda^b)\delta_{t-1}^{I(z_t)}).$$

Foreign Lenders & Lower Bound on Default Costs

- Risk neutral international investors:

$$1 + r = \frac{1 - (1 + \lambda^l) \sum_{n=1}^{N} \delta^n \Pi(z^n | z_t)}{\frac{1}{1+R(z_t,\Delta)}}$$

- Allows estimating lower bound on default costs λ^l
- Combine data from Klingen, Weder, Zettelmeyer (2004) & Cruces and Trebesch (2011)

$$\lambda^l = 7.5\%$$

- $\lambda = \lambda^b + \lambda^l =>$ quantitative analysis: $\lambda = 10\%$ and $\lambda = 20\%$

Optimal Policy Problem

- Optimal policy surprisingly difficult to solve....
- Borrowing limits:
  very loose => non-existence of optimal policies
  too tight => exclude feasible policies
- Loosest constraints consistent w existence & non-explosive debt:
  show how to compute & uniqueness
- Interest rate $R(z_t, \Delta_t)$ depends on default policy: unclear if problem is concave & use of FOCs justified....
- Many occasionally binding inequality constraints $G_t^L \geq 0$, $G_t^S \geq 0$ and particular $\Delta_t \in [0,1]^N$ that are difficult to handle computationally
- Optimal default policies Δ_t turn out to be non-continuous, complicating numerical solutions.

Optimal Policy Problem

- Derive an equivalent formulation of problem:
    - concave (can use FOCs)
    - economizes on inequality constraints
    - continuous optimal policies

Equivalent Problem

- Equivalent optimization problem:

$$\max_{\{b_t, a_t \geq 0, k_t \geq 0, c_t \geq \bar{c}\}} \quad E_0 \sum_{t=0}^{\infty} \beta^t u(c_t)$$

$$s.t. \ \ \forall t : c_t = \widetilde{w}_t - k_t - \frac{1}{1+r} b_t - p_t \cdot a_t$$

$$\widetilde{w}_{t+1} \geq NBL(z_{t+1}) \quad \forall z_{t+1} \in Z$$

$b \gtrless 0$: riskless bond

a : vector of Arrow securities

p_t : price vector for Arrow securities: indep. of government policy!

$\widetilde{w}_0 = w_0$: initial condition

- Beginning-of-period wealth

$$\widetilde{w}_t \equiv z_t k_{t-1}^{\alpha} + b_{t-1} + (1-\lambda) a_{t-1}(z_t)$$

- Problem concave and economizes on inequality constraints

Equivalent Problem

- Equivalence proof in paper.....
- b has an interpretation as the net foreign asset position

$$b_t = G_t^L - G_t^S,$$

- Arrow securities capture state contingent default policies on own bonds
- In a setting with 2 productivity states:

$$a_t = \begin{pmatrix} G_t^S \delta^1 \\ G_t^S \delta^2 \end{pmatrix}$$

Optimal Default Policies

- For $\lambda = 0$ default completes the market:

  Proposition: For $\lambda = 0$

  - complete consumption smoothing optimal
  - default happens in all but the best productivity state
  - default proportional to news about PV of domestic value added

- Generalizes Grossman and van Huyck (1988, section II): optimal default endowment economy with iid income risk and $\lambda = 0$

- Trade-off emerges only for $\lambda > 0$: no analytical results possible

Optimal Policies with Default Costs

- Calibrate the model at annual frequency $z^h = 1.0133$, $z^l = 0.9868$
- Transition matrix for the states, given by

$$\pi = \begin{pmatrix} 0.8077 & 0.1923 \\ 0.1923 & 0.8077 \end{pmatrix}$$

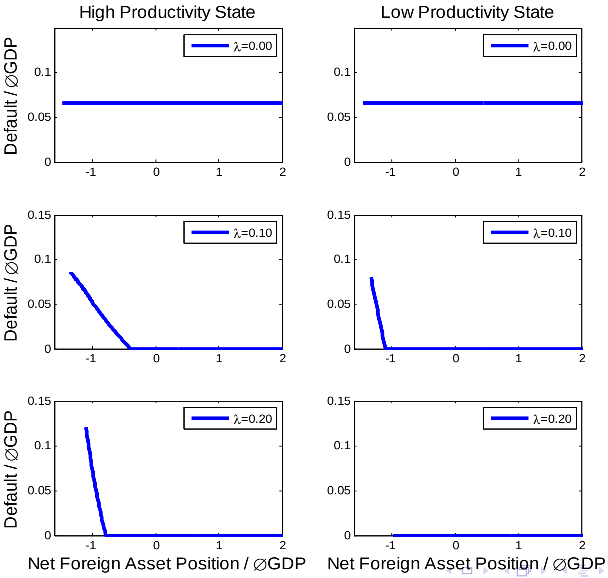
- Utility function is given by

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

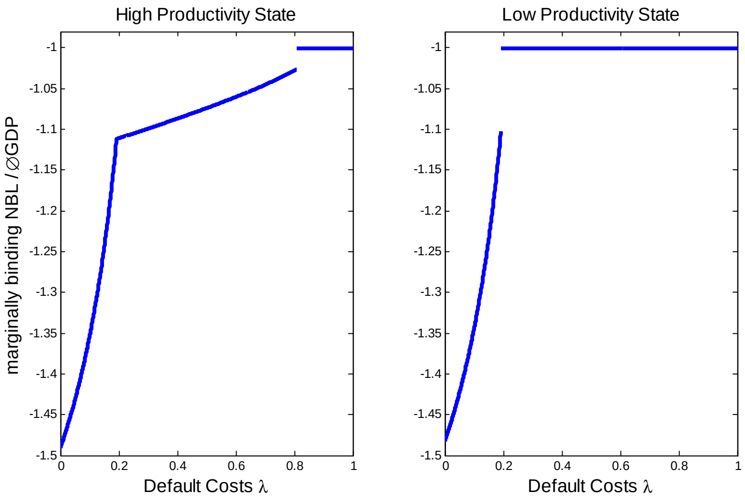
- $\bar{c}$: if bonds must be repaid always, max sustainable NFA equals -100% of GDP (Lane and Milesi-Ferretti (2007))
- Remaining parameters:

α	β	σ	$\bar{c}$	1+r
0.34	0.97	2	0.357	$1/\beta - 0.0005$

Optimal Default Policies



The Effect of Default Costs



Optimal Default and Economic Disasters

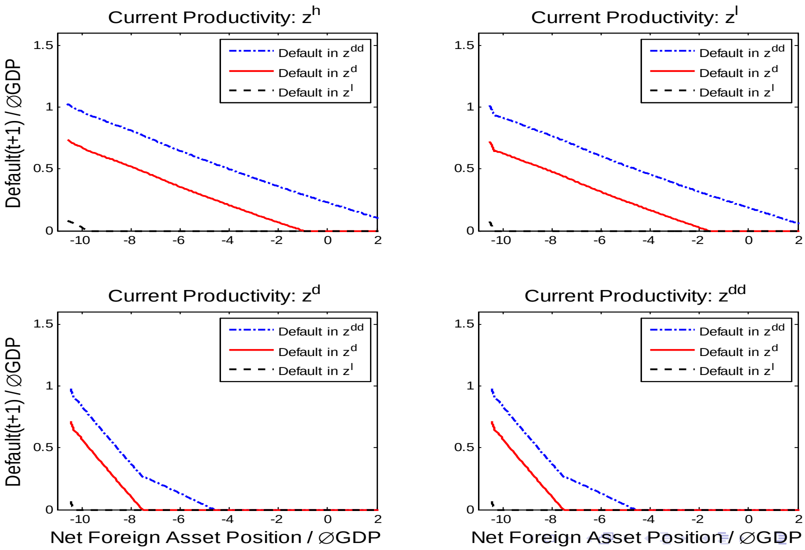
- Calibrating Economic Disasters following Barro and Jin (2011):

  shock process
  $Z = \left\{z^h, z^l, z^d, z^{dd}\right\} = \{1.0133, 0.9868, 0.9224, 0.6696\}$
  with transition matrix

$$\pi = \begin{pmatrix} 0.7770 & 0.1850 & 0.019 & 0.019 \\ 0.1850 & 0.7770 & 0.019 & 0.019 \\ 0.1429 & 0.1429 & 0.3571 & 0.3571 \\ 0.1429 & 0.1429 & 0.3571 & 0.3571 \end{pmatrix}.$$

- Recalibrate the subsistence level of consumption to $\bar{c} = 0.198$.

Optimal Default with Disaster Risk



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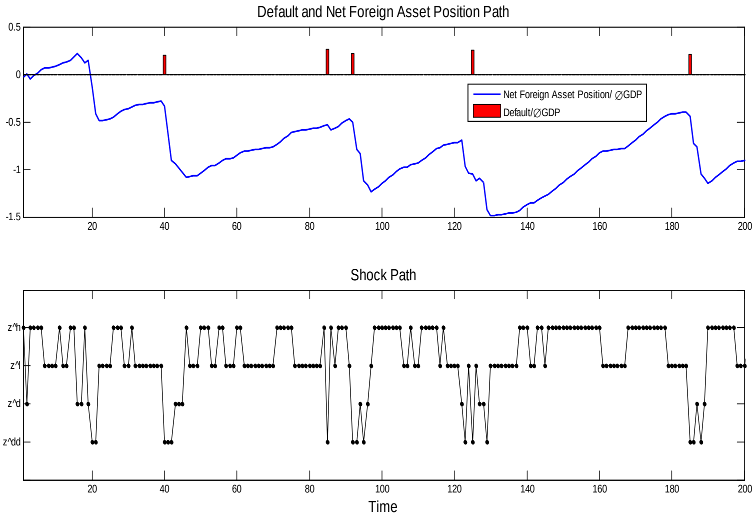


Welfare Implications of Optimal Default

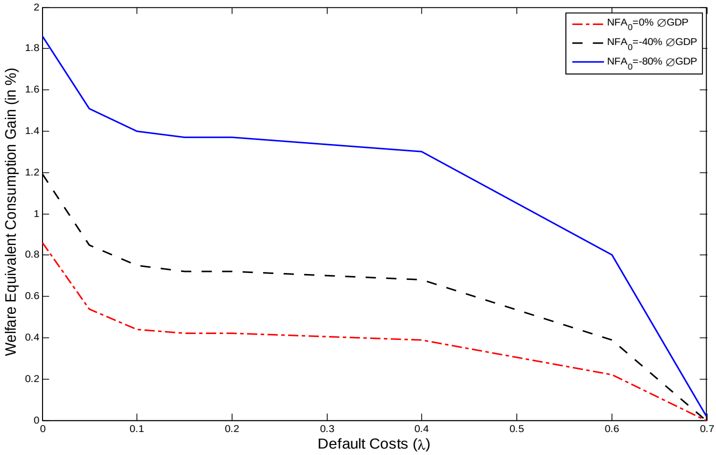
- Welfare equivalent consumption gain from default (first 500 years)
- Compute consumption change ω solving

$$E_0\left[\sum_{t=0}^{500}\beta^t\frac{((c_t^1(1+\omega)-\bar{c}))^{1-\gamma}}{1-\gamma}\right]=E_0\left[\sum_{t=0}^{500}\beta^t\frac{(c_t^2-\bar{c})^{1-\gamma}}{1-\gamma}\right]$$

c_t^1 : optimal consumption path in the no-default economy (repayment assumed)

c_t^2 : the corresponding consumption path with optimal (costly) default.

Welfare Implications of Optimal Default



Long Maturities

- No difference from introducing long foreign bonds: no value for insurance
- No difference from long domestic bonds if repayment is assumed (unlike in Angeletos(2001))
- Long domestic bonds with default option:

  (partial) default *in the future* after bad event *today* $=>$ bonds fall in value

  repurchase at depreciated value & realize a capital gain
- Improvements possible: if repurchase has lower costs than default....

Conclusion

- Sovereign default is optimal under commitment if bond markets incomplete
- Relaxes borrowing limits, increases welfare & optimal after bad output realizations
- Welfare gains large (1-2% of cons.) & not very sensitive to default costs
- Long bonds coupled with buyback potentially even more efficient

Conclusion

Commitment view on SD of normative interest...

... upon closer inspection also reasonable from a positive perspective

Commitment view

- Can rationalize high outstanding debt levels (default option *relaxes* the borrowing limits)
- Optimal default can look like a 'willingness to pay problem'

  sufficient resources for repayment available!
- Default optimal following negative shocks to domestic income.