Default and Development

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Why So Much Default?

- Why are some countries' governments so much more likely to default than others, even at comparable debt to GDP ratios and fundamentals?
  - Current thinking: institutions, political economy, "original sin," ...
  - Our theory: *sectoral composition* and structural transformation.

- Will countries eventually *graduate* to more orderly fiscal policy?

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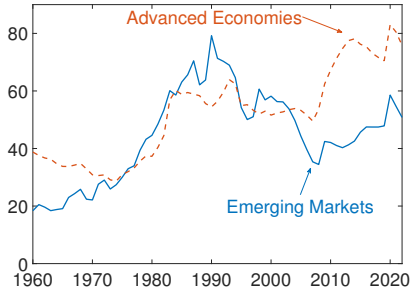
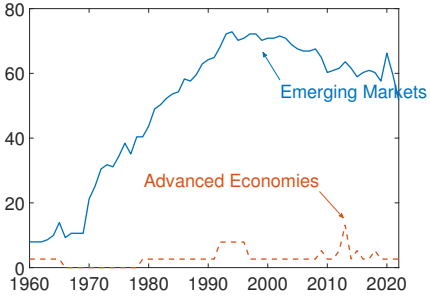
- Will countries eventually *graduate* to more orderly fiscal policy?

- Sketch of mechanism:
  1. Sovereign default harms domestic banks' *balance sheets*.
  2. Resulting tight financial conditions harm sectors heterogenously. E.g., manufacturing *more finance-intensive* than agriculture.
  3. Structural transformation: lower share of income/employment from agriculture, more manufacturing. *Costlier defaults*.

Default and Development



(a) Debt to GDP by Group



(b) Share of Group in Default

NOTE: International Monetary Fund country classification. A country is coded as being in default if any government debt is in default, using the BoC–BoE database of Beers, Ndukwe, and Charron (2023).

Structural Transformation and Spreads, the Philippines

The Philippines	1990s	2000s	2010s
Agriculture Share of Employment (%)	46.7	39.0	32.0
Government Spread (%)	3.2	2.9	1.4

- Default propensity is *associated* with sectoral composition.
  - Over time and across countries.
- Difficult to assess quantitatively directly.
  - Not informed by relatively high frequency variation.
  - Confounded by local and global developments.
- What we do: theory + suggestive quantitative analysis (the Philippines)

The Share of Agriculture in Employment and Default Propensity

Default	(1)	(2)	(3)
Employment Share of Agriculture	0.185	0.174	0.171
	(0.020)	(0.026)	(0.045)
Debt to GDP		0.019	0.016
		(0.009)	(0.012)
Country FE	×	×	×
Year FE			×
N	812	584	584

NOTE: Conditional panel logit estimates. The dependent variable is a dummy encoding whether the country's government (panel unit) had any debt in default in a particular year, from Beers, Ndukwe, and Charron (2023). The main explanatory variable is the share of employment in agriculture, from Hamilton and Vries (2023). Debt to GDP is from IMF WEO. OIM standard errors in parentheses.

Closed economy, real model with...

- Households
  - Send out *workers* to supply labor, and
  - *bankers* to operate the financial intermediaries.
  - Save in risk-free deposits.
- Financial Intermediaries
  - Extend working capital loans to producers.
  - Hold *defaultable* government debt and take *risk-free* deposits.
  - *Net worth* constraint.
- Producers (Two Sectors)
  - Hire workers, fund wage bill with *working capital* loans.
- Fiscal Authority
  - *Default*, borrowing, and public spending decisions.

Households

- Quasi-linear preferences, for tractability: $\mathbf{E}_t \sum_{\iota=0}^{\infty} \beta^{\iota} \left(C_{t+\iota} - \frac{1}{1+\sigma} \ell_{t+\iota}^{1+\sigma} \right)$
- Budget constraint (in unit of final, composite good):

$$C_t + q_t^s s_t + N_t = w_t \ell_t + s_{t-1} + F_t + \sum_{i \in \{a,m\}} \Pi_{i,t}$$

Income from...

- wages $w_t \ell_t$,
- bank deposits s_{t-1},
- financial intermediation F_t and production $\Pi_{i,t}$ profits.

Endow new bankers with net worth $N_t = \overline{n} + (1 - D_t)(1 - \lambda) q_t B_t$.

Financial Intermediaries

- Bankers operate the financial intermediary for one period, then retire.
- Start with N_t, maximize expected profits $\beta \mathbf{E}_t F_{t+1}$, with

$$F_{t+1} = (1 - D_{t+1})(\kappa + (1 - \lambda) q_{t+1}) B_{t+1} + (1 + r_t^w) b_t - s_t$$

  subject to
  - Budget constraint $q_t B_{t+1} + b_t = q_t^s s_t + N_t$
  - Leverage constraint $q_t^s s_t \leq q_t B_{t+1} + \phi b_t$
  - Together, *net worth constraint*

$$b_t \leq \frac{1}{1 - \phi} N_t$$

- b_t working capital loans, B_t sovereign debt, s_t risk-free deposits.

Long-Term Public Debt

- Government debt is *long term*.
- Each outstanding unit
  - Calls for service payment κ.
  - Fraction λ "matures," rest remains outstanding. *Macaulay Duration* $\approx \frac{1}{\lambda}$
  - Government sells or buys back units each period.

- In equilibrium, bond prices satisfy

$$q_t = \beta \mathbf{E}_t (1 - D_{t+1})(\kappa + (1 - \lambda) q_{t+1})$$

  Note, full repudiation upon default, no recovery.

Producers: Agriculture and Manufacturing

- Same problem for agriculture and manufacturing, $i \in \{a, m\}$
- Competitive, employ labor subject to working capital requirement

$$\max_{\ell_{i,t}} (1-\tau) p_{i,t} y_{i,t} - w_t \ell_{i,t} - (1 + r_t^w) b_{i,t}$$

- DRS technology $y_{i,t} = A_{i,t} \ell_{i,t}^{\alpha}$
- Revenue tax τ
- Working capital loan $b_{i,t} = \theta_i w_t \ell_{i,t}$

  θ_i share of wage bill must be financed with loan, ahead of production, at market rate r^w

Final Good

- Final good from agriculture and manufacturing goods
- Competitive, *non-homothetic* aggregator

$$Y_t = \left((1-\omega) \left(y_{a,t} - \overline{y}_a \right)^{\frac{\eta-1}{\eta}} + \omega y_{m,t}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}$$

- Price index $P_t = \left((1-\omega)^{\eta} p_{a,t}^{1-\eta} + \omega^{\eta} p_{m,t}^{1-\eta} \right)^{\frac{1}{1-\eta}} = 1$
- GDP $p_{a,t} y_{a,t} + p_{m,t} y_{m,t} = \text{GDP}_t = Y_t + p_{a,t} \overline{y}_a$

- "Standard recipe" for *structural transformation*:
  subsistence consumption + faster productivity growth in agriculture

The Government

- Risk-averse, values public spending, stochastic utility cost of default

$$\mathbf{E}_t \sum_{\iota=0}^{\infty} \beta_g^{\iota} \left(\frac{G_{t+\iota}^{1-\sigma_g}}{1-\sigma^g} - D_{t+\iota} \nu_{t+\iota} \right)$$

- Government budget constraint

$$(1-D_t)\kappa B_t + G_t = q_t[B_{t+1} - (1-D_t)(1-\lambda)B_t] + \tau \sum_{i \in \{a,m\}} p_{i,t} y_{i,t}$$

- Chooses default D_t and next period's debt position B_{t+1}
- No "market exclusion" upon default

- Costs of default: utility ν_t and endogenous loss of tax revenue

Equilibrium

- Recursive *Markov Perfect Equilibrium* with
  - exogenous states $S = \langle A_a, A_m, \nu \rangle$, and
  - endogenous state B.

- Can characterize private sector outcomes for all $\langle S, B \rangle$ and arbitrary $\langle D, B' \rangle$
  - Static system of 16 eq's and unk'ns ▸ Private System

- Government policy under *discretion*
  - Internalizes impact on the tax revenue this period, takes future policies as given
  - No commitment over future default or debt issuance behavior
  - *Debt dilution* with long-term debt

- Computation with *discrete choice methods*, Mihalache (2024)

Financial Conditions in Equilibrium

Given net worth, after the government decided whether to default D_t,

$$N_t = \overline{n} + (1 - D_t)(1 - \lambda)q_t B_t$$

bond prices and working capital rates satisfy:

- Bond price for risk-free deposits $q^s = \beta$
- Sovereign bonds $q_t = \beta \mathbf{E}_t (1 - D_{t+1})(\kappa + (1 - \lambda)q_{t+1})$
- Working capital loan interest rate

$$\beta(1 + r_t^w) = 1 + (1 - \phi)\zeta_t$$

with ζ_t the Lagrange multiplier on *net worth constraint*.

Loose and Tight Financial Conditions

- *Loose* financial conditions:

$$\underbrace{\left(\frac{N_t}{1-\phi} - b_t\right)}_{>0}\underbrace{\left(1 + r_t^w - \frac{1}{\beta}\right)}_{=0} = 0$$

- *Tight* financial conditions:

$$\underbrace{\left(\frac{N_t}{1-\phi} - b_t\right)}_{=0}\underbrace{\left(1 + r_t^w - \frac{1}{\beta}\right)}_{>0} = 0$$

- *Default* means $N_t \searrow \overline{n}$ and likely tight conditions
- Tight conditions have $r_t^w > \frac{1}{\beta} - 1$, *depressed employment and production*

Quantitative Evaluation Roadmap

1. Calibrate to the Philippines, 1990s sample

2. Illustrate mechanism
   - Consequences of default (risk) for the private sector
   - The liquidity provision role of public debt

3. Induce structural transformation
   - Match sectoral composition in 2000s sample
   - Comparative static: sovereign spread and agriculture employment

Shock Processes

$$
\begin{aligned}
A_{m,t+1} &= \overline{A}_m \\
A_{a,t+1} &= (1-\rho_a)\overline{A}_a + \rho_a A_{a,t} + \varepsilon_{a,t+1} \\
\nu_{t+1} &= (1-\rho_\nu)\overline{\nu} + \rho_\nu \nu_t + \varepsilon_{\nu,t+1}
\end{aligned}
$$

- Stationary shocks
- A_m constant, stochastic A_a
- AR(1) ν and A_a
- Soon, induce structural transformation with $\overline{A}_a \uparrow$

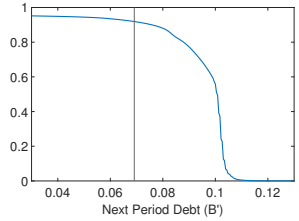
Parameters Set Externally

	Value	Description	Target or Source
Household			
β	0.96	Household discounting	4% risk-free rate
σ^{-1}	0.75	Frisch labor supply elasticity	Arellano, Bai, and Bocola (2024)
Government			
σ_g	2.00	Government CRRA	Standard value
τ	0.20	Tax rate	Share of tax revenue in GDP
λ	0.20	Public debt maturity	5 years Macaulay duration
κ	0.24	Debt service payment	Normalization
Production			
α	0.67	Decreasing returns to labor	Standard value
$\overline{A_a}$	0.90	Mean productivity, agriculture	Normalization of mean GDP
η	0.85	CES elasticity of substitution	Herrendorf, Rogerson, and Valentinyi (2013)
ω	0.65	CES share, agriculture	Normalization
θ_a	0.00	Working capital, agriculture	Normalization

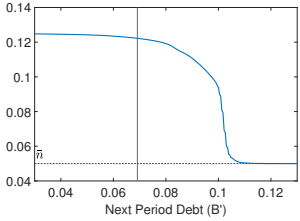
Parameters Set Jointly

	Value	Description	Target	Data	Model
Debt and default					
β_g	0.85	Government discounting	Mean spread	3.22	3.28
$\overline{v}$	1.87	Utility default cost	Debt to GDP	0.59	0.30
ρ_v	0.85	Autocorrelation cost	Autocorellation spread	0.64	0.61
Std $\varepsilon_{v,t}$	0.14	Innovation, cost	Std G / Std GDP	1.90	1.85
Working capital					
$\frac{\overline{n}}{1-\phi}$	0.05	N lower bound	Corr GDP & spread	-0.46	-0.43
θ_m	1.00	Working capital, mnfg.	Std spread	1.24	1.05
Production					
ρ_a	0.93	Autocorrelation productivity	Autocorrelation GDP	0.46	0.46
Std $\varepsilon_{a,t}$	0.013	Innovation, agriculture	Std GDP	2.00	2.30
$\overline{y}_a$	0.10	Subsistence level, ag.	Share of labor in ag.	0.47	0.47

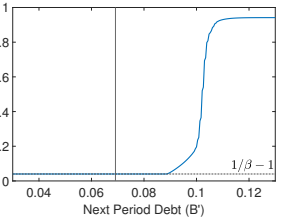
Sovereign Borrowing and Private Outcomes



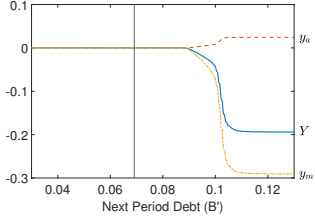
(a) Bond Price (q)



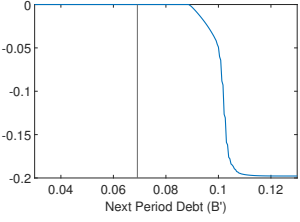
(b) Net Worth (N)



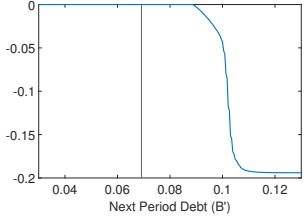
(c) Working Capital Rate (r^w)



(d) Output, % (Y, y_a, y_m)

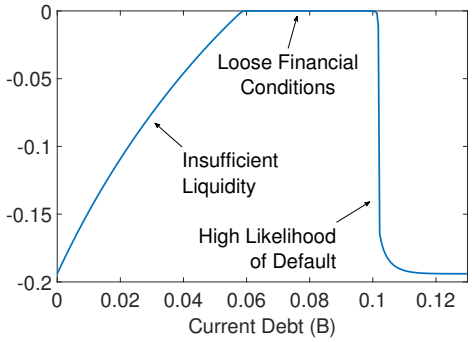


(e) Employment, % (ℓ)



(f) Tax Revenue, % (T)

Public Debt as Liquidity Provision



Output, % (mean $A_{a,t}$)

Financial conditions driven by *net worth*

$$N_t = \overline{n} + (1 - D_t)(1 - \lambda) q_t B_t$$

Can possibly be low because

- Default today, $D_t = 1$
- Default likely soon, low q_t
- Little outstanding public debt, low B_t

In this model, either *too much* or *too little* government debt depressed production.

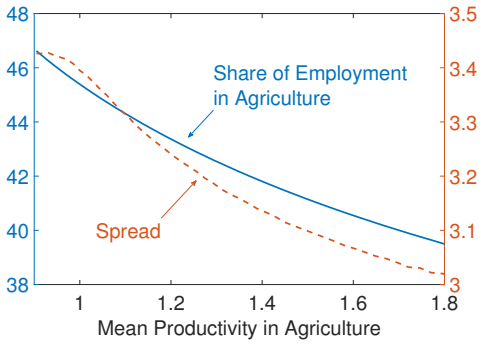
Structural Transformation and Spreads

	1990s		2000s	
	Data	Model	Data	Model
Mean Productivity in Agriculture ($\overline{A}_a$)		0.9		1.8
Agriculture Share of Employment (%)	46.7	47.0	39.0	39.4
Mean Government Spread (%)	3.2	3.3	2.9	3.0

Counterfactual experiment:

- Calibrate model to 1990s data (The Philippines)
- Induce structural transformation
  - $\overline{A}_a \uparrow$ to match 2000s sectoral makeup
  - Keep all other parameters same
- Evaluate default risk (spreads) in the new ergodic distribution

Structural Transformation and Default



- Monotonic comparative static in $\overline{A}_a$
  - Helpful to interpret as $\frac{\overline{A}_a}{A_m}$
- Not relying on trend growth
  - Stationary model
  - Fixed A_m, stationary A_a
- In the limit…
  - Employment $\approx 100\%$ in manufacturing
  - Maximum endogenous default cost
  - Less frequent default *but still*…
    - $\beta_g < \beta$
    - Util cost ν risk

Summary

- If…
  - Agriculture is less finance-reliant than other sectors, and
  - Financial intermediaries' balance sheets are sensitive to sovereign bond prices,
- then *structural transformation* makes default costlier for sovereigns.

- Standard structural transformation mechanism, from
  - Non-homotheticity in consumption (subsistence level of ag. consumption)
  - (Faster) productivity growth in agriculture.

- Usual extensions should not alter main message:
  some of the debt help abroad, recovery, risk-averse households, …

- Model predicts less default in the future. Largely silent on welfare.
  Still important to think of P.E. ($\beta_g < \beta$) and costs to policymakers (ν).

Appendix

Private Sector Equilibrium: Labor and Production

$$\ell_i = \left((1-\tau)\alpha \frac{p_i A_i}{(1+\theta_i r^w) w} \right)^{\frac{1}{1-\alpha}}, \quad i \in \{a, m\} \qquad \text{(Labor Demand)}$$

$$w = \chi \ell^{\sigma} \qquad \text{(labor Supply)}$$

$$\ell = \sum_{i \in \{a,m\}} \ell_i \qquad \text{(Labor Market Clearing)}$$

$$y_i = A_i \ell_i^{\alpha}, \quad i \in \{a, m\} \qquad \text{(Sectoral Production)}$$

$$Y = \left((1-\omega) \left(y_a - \overline{y}_a \right)^{\frac{\eta-1}{\eta}} + \omega y_m^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \qquad \text{(Final Output)}$$

Back

Private Sector Equilibrium: Prices

$$p_a = (1-\omega)\left((1-\omega)\left(y_a - \overline{y}_a\right)^{\frac{\eta-1}{\eta}} + \omega y_m^{\frac{\eta-1}{\eta}}\right)^{\frac{1}{\eta-1}} \left(y_a - \overline{y}_a\right)^{-\frac{1}{\eta}}$$

(Price of Agriculture)

$$p_m = \omega\left((1-\omega)\left(y_a - \overline{y}_a\right)^{\frac{\eta-1}{\eta}} + \omega y_m^{\frac{\eta-1}{\eta}}\right)^{\frac{1}{\eta-1}} y_m^{-\frac{1}{\eta}}$$

(Price of Manufacturing)

$$P_t = \left((1-\omega)^{\eta} p_{a,t}^{1-\eta} + \omega^{\eta} p_{m,t}^{1-\eta}\right)^{\frac{1}{1-\eta}} = 1$$

(Price Index)

Back

Private Sector Equilibrium: Working Capital Market

$$b_i = \theta_i w \ell_i, \quad i \in \{a, m\} \qquad \text{(Working Capital Demand)}$$

$$\underbrace{\left(\frac{N}{1-\phi} - b\right)}_{\geq 0} \underbrace{\left(1 + r^w - \frac{1}{\beta}\right)}_{\geq 0} = 0 \text{ with c.s.} \qquad \text{(Working Capital Supply)}$$

$$b = \sum_{i \in \{a,m\}} b_i \qquad \text{(Working Capital Market Clearing)}$$

$$q^s = \beta \qquad \text{(Deposit Demand)}$$

$$N + q^s s = qB' + b \qquad \text{(Deposit Supply)}$$

$$Y = C + G \qquad \text{(Resource Constraint)}$$

Back