

Connected for Better or Worse?

The Role of Production Networks in Financial Crises

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Frequency and Severity of Sudden Stops

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- ▶ **Question:**

- Can **production structure** account for differential fragility between EMs/AEs?
 - Yes, part of it

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- ▶ **Policy:**
 - We evaluate *non-state contingent* debt and sectoral taxes
 - Policy gains depend on networks and financial depth: There is no one-size-fits-all
 - Planner may trade production efficiency for crisis resilience

Perfect Foresight Model

A Perfect Foresight Economy

- Households:

$$\max_{\{c_t^N, c_t^T, b_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma} - 1}{1-\sigma} \quad \text{s.t.}$$

$$c_t = [\omega (c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta}]^{-\frac{1}{\eta}},$$

$$c_t^T + p_t^N c_t^N + q b_{t+1} = \pi_t^N + \pi_t^T + b_t, \quad q b_{t+1} \geq -\kappa (\pi_t^N + \pi_t^T).$$

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- Production: for each $i \in \{N, T\}$:

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- Market clearing:

$$y_t^N = c_t^N + \sum_{i \in \{N, T\}} m_{Nt}^i, \quad y_t^T = c_t^T + \sum_{i \in \{N, T\}} m_{Tt}^i + q b_{t+1} - b_t$$

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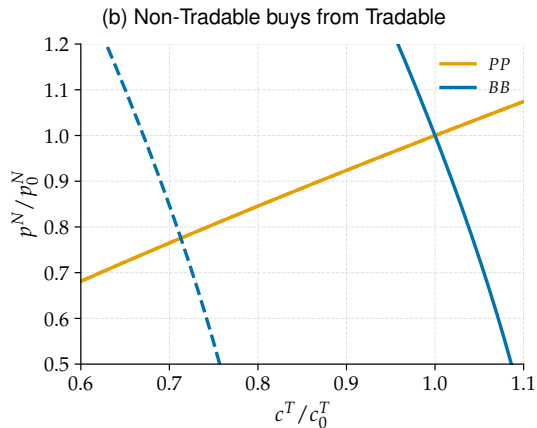
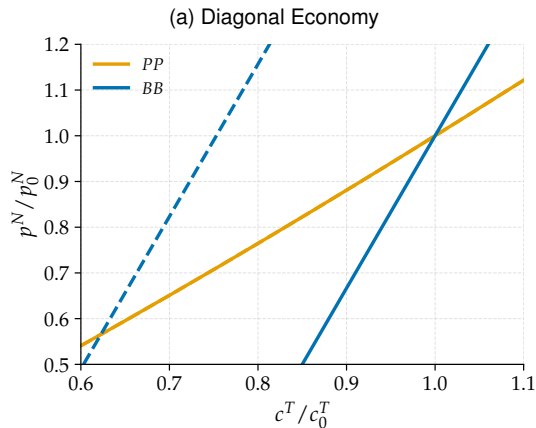
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- Exercise: $\beta R = 1$; Sudden Stop = *wealth-neutral* tradable productivity shock z_t^T

Graphical Illustration



- ▶ Experiment: 10% decline in tradable sector productivity (dashed)
- ▶ Intersectoral linkages hedge adverse shocks
- ▶ Input prices buffer profits and support borrowing capacity

All Networks

Sufficient Statistic

Cross-Country Production Structure

Data

► OECD ICIO tables, 2025 release

Country Groups Sectoral Classification

- 50 industries grouped into commodity (11), tradable (16), and nontradable (23)
- Network facts: 33 EMs and 37 AEs (IMF groupings)
- Sudden stop regressions: 17 EMs and 20 AEs

► Network moments use 1995, the first year with IO data

► Main takeaways:

Details

- **EMs** rely more on **commodities** for production
- **AEs** rely more on **nontradable** inputs for production

Network Structure and Sudden Stops

► Estimate

$$y_{ct} = \alpha + \alpha_c + \alpha_t + \beta_0 \text{SS}_{ct} + \sum_{i \neq j} \beta_{ij} \text{SS}_{ct} \times \omega_{j,c}^i + \sum_k \beta'_k \text{SS}_{ct} \times X_{k,c} + \varepsilon_{ct},$$

- y_{ct} : outcome variable for country c in year t
- $\text{SS}_{ct} = 1$ during a sudden stop [Bianchi and Mendoza, 2020]
- $\omega_{j,c}^i$: sector j 's share in sector i 's intermediate inputs (own share omitted)
- $X_{k,c}$: Controls:
 - Domar weight: $\text{Sales}_{k,c} / \text{nGDP}_c$
 - Intermediate input share: $\text{Inputs}_{k,c} / \text{Sales}_{k,c}$
- IO shares and controls are fixed at 1995 values; controls are demeaned
- Country and year fixed effects: α_c and α_t ; s.e. clustered by country

Network Structure affects Sudden Stops Severity

	Consumption		GDP		CA/GDP	
	(1)	(2)	(3)	(4)	(5)	(6)
SS	-0.0417***	-0.3615*	-0.0406***	-0.1335	0.0146**	0.2081***
SS $\times \omega_{T,c}^C$		-0.0615		-0.0518		-0.2026***
SS $\times \omega_{NT,c}^C$		0.4373**		0.0743		-0.0666
SS $\times \omega_{C,c}^T$		0.2471*		0.2381**		-0.2335***
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SS $\times \omega_{C,c}^{NT}$		0.1996		-0.0876		0.0663
SS $\times \omega_{T,c}^{NT}$		0.3807*		0.2059		0.1060
Controls	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared within	0.042	0.082	0.043	0.092	0.003	0.022
Observations	1463	1463	1517	1517	1434	1434

Note: 1979–2019 annual data. Standard errors clustered by country. Controls: SS interacted with demeaned 1995 Domar weights and intermediate input shares. 37 countries: 17 EMs and 20 AEs.

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- Spain's consumption drop ≈ 4.7 p.p. milder, GDP drop ≈ 2.5 p.p.

Full Table

Quantitative Model

Environment - New Features

- ▶ Extend to 3 sectors
 - Commodity c^C , tradable non-commodity c^X , and nontradable c^N
 - Capture better production asymmetries in the data.
 - Key: differentiated good

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- ▶ Exercise:
 - Compare advanced economy with advanced economy + *EM network structure*

Production Networks affect long-run moments

Moment	EM	AE	AE + EM Network
$E(b/Y)$ %	-30.77	-46.68	-46.23
$\Pr(\text{SS})$ %	3.33	0.88	1.47
$\Pr(\mu_t > 0)$ %	43.68	15.84	29.64
ΔGDP_{SS} %	-12.23	-3.8	-4.94
$\Delta CA/GDP_{SS}$ %	3.9	1.91	2.44

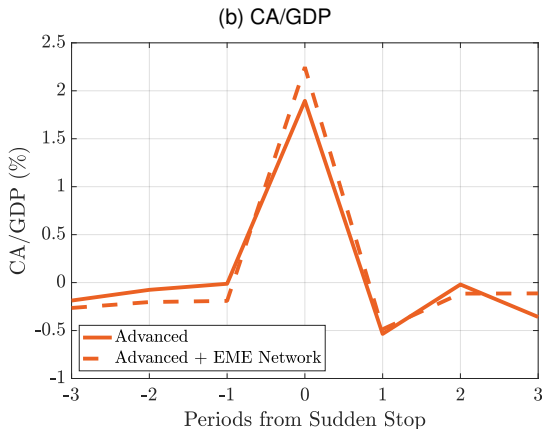
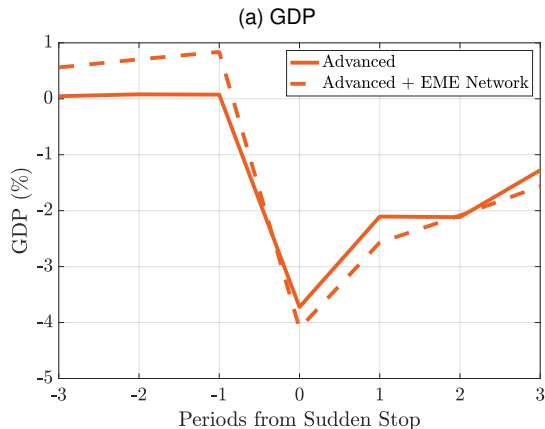
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- ▶ EM supports **less debt** and has a **higher probability of sudden stops** than AE
- ▶ AE and AE + EM Network have:
 - **Similar debt**
 - **About two-thirds higher probability of experiencing a sudden stop** [$\approx 0.6pp$]

Role of Networks - Sudden Stops



- ▶ EM networks amplify GDP drops by 30% and CA reversals by 28%
- ▶ More diversified network structures provide a hedging mechanism
- ▶ Shock nature matters: not all Sudden Stops are created equal

Policy Exercises

Policy: Simple Instruments

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 - A flat non-state contingent tax on borrowing
 - Flat non-state contingent taxes on inputs

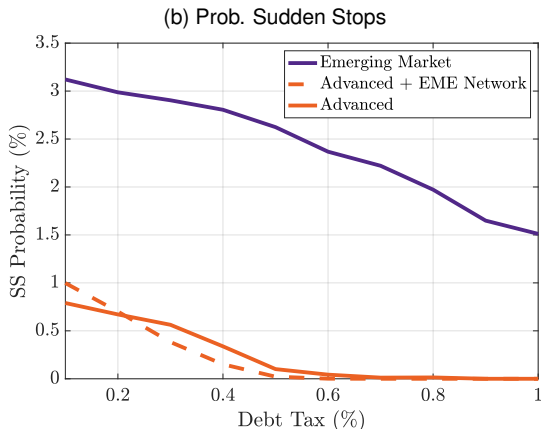
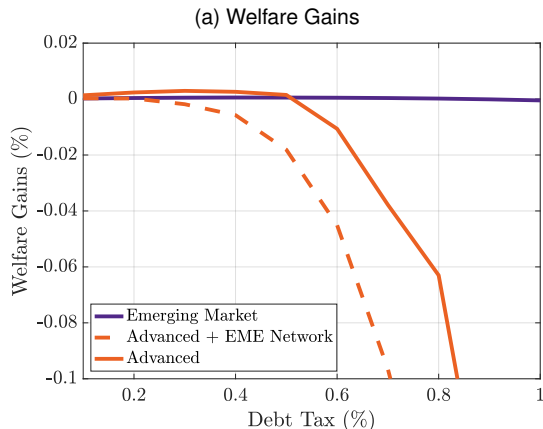
Planner Setup Planner FOCs

Policy: Simple Instruments

- ▶ Pecuniary externalities create room for macroprudential and sectoral policy
 - Incomplete markets + price dependent borrowing constraint
- ▶ We study two kinds of policies:
 - A flat non-state contingent tax on borrowing
 - Flat non-state contingent taxes on inputs
- ▶ Goal:
 - What are their welfare gains?
 - How does the probability of sudden stops change?

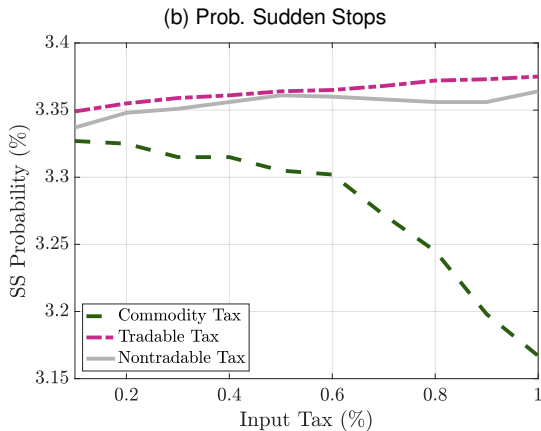
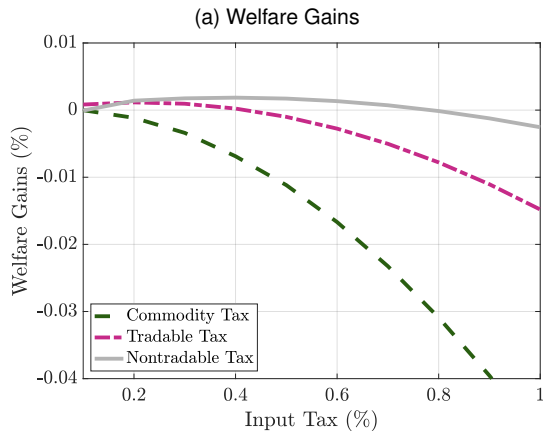
Planner Setup Planner FOCs

A simple debt tax policy is not one-size-fits-all



- ▶ Effect depends on financial development and network structure
- ▶ It can hurt financially developed economies with EM-style networks

Sectoral Input Taxes can help



- ▶ No welfare gains from commodity input tax
- ▶ Other sectoral taxes raise welfare but increase crisis risk slightly

Conclusion

- ▶ Sudden Stops differ in severity and frequency across EMs and AEs
- ▶ Potential explanations in the literature: fin. development and volatility of shocks
- ▶ Our paper emphasizes different **production network structures**
- ▶ **Takeaway:** production networks
 - make Sudden Stops about 30% more severe
 - increase the frequency of Sudden Stops by about two-thirds
- ▶ Simple policies can generate welfare gains
 - but depend on financial development and production network structure

Conclusion

- ▶ Sudden Stops differ in severity and frequency across EMs and AEs
- ▶ Potential explanations in the literature: fin. development and volatility of shocks
- ▶ Our paper emphasizes different **production network structures**
- ▶ **Takeaway:** production networks
 - make Sudden Stops about 30% more severe
 - increase the frequency of Sudden Stops by about two-thirds
- ▶ Simple policies can generate welfare gains
 - but depend on financial development and production network structure
- ▶ Ongoing: optimal policy + more data work + your comments!

Thank you!

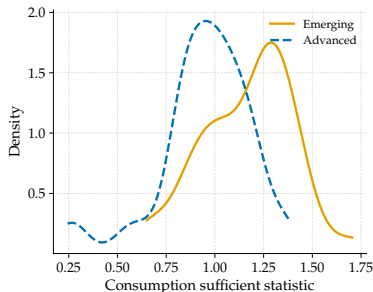
asilvub.github.io

Appendix

Sufficient Statistic in the Data

$$\frac{d \log c_t}{d \log z_t^T} = \mathcal{S}_c(\text{IO shares, profit shares, consumption shares}; \kappa, \eta)$$

- ▶ Country-level consumption response to a tradable shock (two-sector aggregation)
- ▶ Fix $\kappa = 0.3$, $1/(1 + \eta) = 0.83$; solid orange = EM, dashed blue = AE



Calibration - Summary

Parameter	Description	EM	AE
β	subjective discount factor	0.90	0.95
κ	collateral constraint parameter	0.32	0.46
ω_C^C	importance of commodity inputs in commodity production	0.5	0.5
ω_X^C	importance of tradable inputs in commodity production	0.37	0.35
ω_N^C	importance of nontradable inputs in commodity production	0.13	0.15
ω_C^X	importance of commodity inputs in tradable production	0.20	0.13
ω_X^X	importance of tradable inputs in tradable production	0.61	0.59
ω_N^X	importance of nontradable inputs in tradable production	0.19	0.28
ω_C^N	importance of commodity inputs in nontradable production	0.18	0.06
ω_X^N	importance of tradable inputs in nontradable production	0.35	0.34
ω_N^N	importance of nontradable inputs in nontradable production	0.47	0.60
$\{z_L^C, z_H^C\}$	Low-High productivity C	{1.9, 2.05}	{1.735, 1.745}
$\{z_L^X, z_H^X\}$	Low-High productivity X	{1.95, 2.05}	{1.71, 1.77}
$\{z_L^N, z_H^N\}$	Low-High productivity N	{1.98, 2.05}	{1.71, 1.77}

► Key differences: **impatience**, **finance**, and **production structure**

Long-Run Moments

Moment	Emerging	Advanced
$E(b/Y) \%$	-30.77	-46.68
$\sigma(CA/Y) \%$	1.25	0.84
Share C Inputs to Total C Inputs %	48.06	45.39
Share N Inputs to Total C Inputs %	13.91	16.74
Share C Inputs to Total X Inputs %	18.78	11.1
Share N Inputs to Total X Inputs %	19.48	29.39
Share C Inputs to Total N Inputs %	16.59	5.00
Share N Inputs to Total N Inputs %	47.57	61.5
Pr(SS)	3.33	0.88
$Pr(\mu_t > 0)$	43.68	15.84
ΔGDP_{SS}	-12.23	-3.8
$\Delta CA/GDP_{SS}$	3.90	1.91

- ▶ EMs are more volatile and crisis-prone despite lower debt
- ▶ **Role of production structure?**

Role of Networks

- Embed the EM network in the AE calibration; keep shocks fixed

Moment	EM	AE + EM Network	AE
$E(b/Y) \%$	-30.77	-46.23	-46.68
$\sigma(CA/Y) \%$	1.25	0.73	0.84
Share C Inputs to Total C Inputs %	48.06	47.81	45.39
Share N Inputs to Total C Inputs %	13.91	13.9	16.74
Share C Inputs to Total X Inputs %	18.78	18.7	11.1
Share N Inputs to Total X Inputs %	19.48	19.48	29.39
Share C Inputs to Total N Inputs %	16.59	16.52	5.00
Share N Inputs to Total N Inputs %	47.57	47.57	61.5
$Pr(SS) \%$	3.33	1.47	0.88
$Pr(\mu_t > 0) \%$	43.68	29.64	15.84
$\Delta GDP_{SS} \%$	-12.23	-4.94	-3.8
$\Delta CA/GDP_{SS} \%$	3.9	2.44	1.91

- Similar debt, but about two-thirds more crisis-prone

Policy: Social Planner's Problem

- Pecuniary externality: agents ignore price effects of their decisions

[Mendoza (2005), Bianchi (2011), Benigno, Chen, Otrok, Rebucci & Young (2013)]

- This opens space for debt taxes, reserves, and sectoral policy

[Arce et al. (2025), Benigno et al. (2023), Ottonello et al. (2024), Bianchi & Sosa-Padilla (2024)]

$$V(b, e) = \max_{\{\mathbf{c}, \mathbf{m}, b'\}} U(c^C, c^X, c^N) + \beta E(V(b', e')),$$

subject to

$$c^C + m_C^C + m_C^X + m_C^N + qb' = y^C + p^X(\mathbf{c})\hat{c}^X(p^X(\mathbf{c})) + b \quad (\lambda_1),$$

$$c^X + \hat{c}^X(p^X(\mathbf{c})) + m_X^C + m_X^X + m_X^N = y^X \quad (\lambda_2),$$

$$c^N + m_N^C + m_N^X + m_N^N = y^N \quad (\lambda_3),$$

$$qb' \geq -\kappa(\pi^C(p(\mathbf{c})) + \pi^X(p(\mathbf{c})) + \pi^N(p(\mathbf{c}))) \quad (\mu).$$

Social Planner's Problem

- Bonds Euler equation:

$$\lambda_1 = \beta R \mathbb{E}[\lambda'_1] + \mu,$$

$$\lambda_1 = U_C + \underbrace{\frac{\mu \kappa \left(\sum_{i \in C, T, N} \frac{\partial \pi^i}{\partial c^C} \right)}{1 - \frac{\partial p^X}{\partial c^C} \hat{c}^X \frac{\eta_T}{1 + \eta_T}}}_{\text{Pecuniary Externality}} + \underbrace{\frac{U_C \frac{\partial p^X}{\partial c^C} \hat{c}^X \frac{\eta_T}{1 + \eta_T} - \lambda_2 \frac{\partial \hat{c}^X}{\partial c^C}}{1 - \frac{\partial p^X}{\partial c^C} \hat{c}^X \frac{\eta_T}{1 + \eta_T}}}_{\text{Terms of Trade Manipulation}}$$

- Production FOC (commodity input in nontradable production)

$$p^N \frac{\partial y^N}{\partial m_C^N} = \frac{\lambda_1 + \mu \kappa}{U_C + \mu \kappa \left(1 + \sum_{i \in C, T, N} \frac{\partial \pi^i}{\partial c^N} \frac{1}{p^N} \right)}$$

- Production structure affects both distorted first-order conditions

Country Groups

Emerging	Advanced
Argentina	Australia
Brazil	Austria
Chile	Canada
China	Denmark
Colombia	Finland
Hungary	France
Indonesia	Germany
Korea	Greece
Malaysia	Iceland
Mexico	Italy
Morocco	Japan
Peru	Netherlands
Philippines	New Zealand
South Africa	Norway
Thailand	Portugal
Tunisia	Spain
Turkiye	Sweden
	Switzerland
	United Kingdom
	United States

Sudden stop regression sample. Network facts use all 33 EMs and 37 AEs in the OECD ICIO 2025 release (IMF October 2024 groupings; 10 low-income developing countries excluded).

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Sectoral Classification

Commodity (11)	Tradable (16)	Non-Tradable (23)
agriculture and hunting	food, beverages, tobacco	electricity and gas
forestry and logging	textiles and leather	water and waste
fishing and aquaculture	wood	construction
coal and lignite mining	paper and printing	wholesale/retail
crude petroleum and gas	chemicals	land, water, and air transport
metal ores mining	pharmaceuticals	warehousing
other mining and quarrying	rubber and plastics	postal and courier
mining support services	non-metallic minerals	accommodation and food
refined petroleum	fabricated metals	publishing and broadcasting
basic iron and steel	electronics	telecom, IT and information
non-ferrous metals	electrical equipment	finance and insurance
	machinery	real estate
	motor vehicles	professional services
	ships and boats	administrative support
	other transport equipment	public administration
	manufacturing n.e.c.	education, health, arts, other, households

Baseline classification, OECD ICIO 2025 industries (some nontradable rows grouped). Robustness: "standard" (refined petroleum and basic metals in tradables) and "threshold-tradable" (gross trade intensity above 20%).

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Average intermediate input shares across sectors

- Purchases from the supplying sector over buyer gross output, 1995 (%)

Buyer / Seller	Emerging			Advanced			EM – AE		
	C	T	NT	C	T	NT	C	T	NT
Commodity	29.23	7.36	13.77	27.99	11.46	22.60	1.24	-4.10	-8.83
Tradable	19.84	26.27	20.58	11.85	30.27	24.96	7.99	-4.00	-4.38
Nontradable	6.97	9.23	25.05	2.48	9.00	32.80	4.49	0.23	-7.75

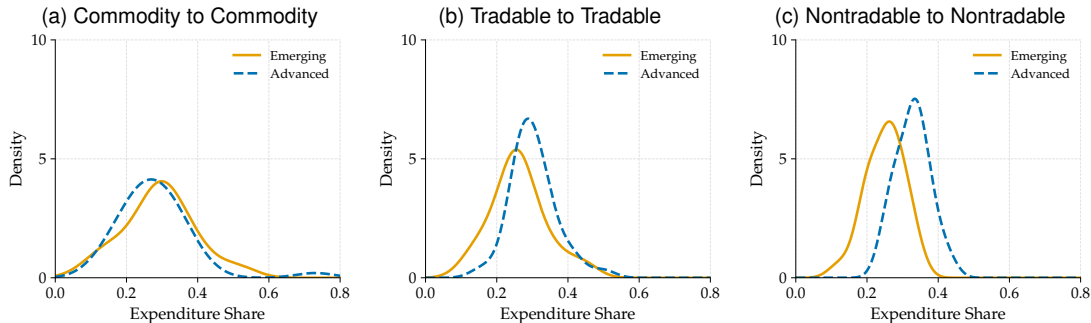
Unweighted country averages; OECD ICIO 2025, baseline classification; 33 EMs and 37 AEs. Inputs are tax-inclusive, domestic and imported.

- **EMs** use more commodity inputs; **AEs** buy more from nontradables

Distributions: Own-sector Commodity Tradable Nontradable

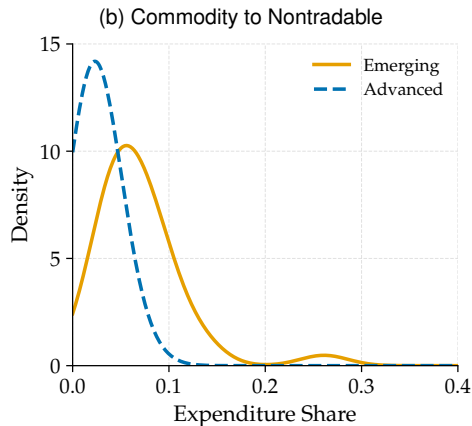
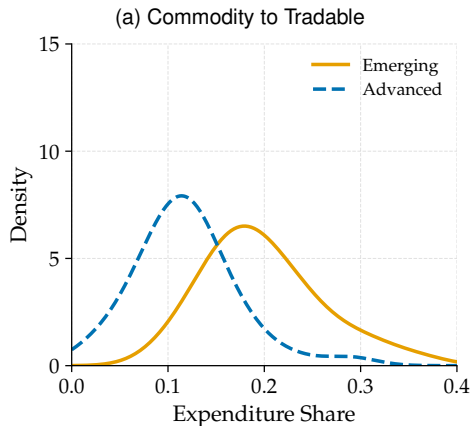
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Own-sector input shares are larger in advanced economies



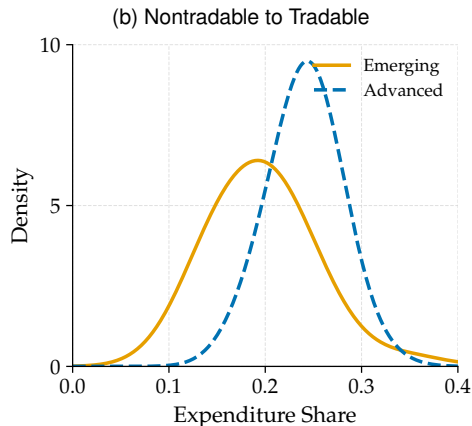
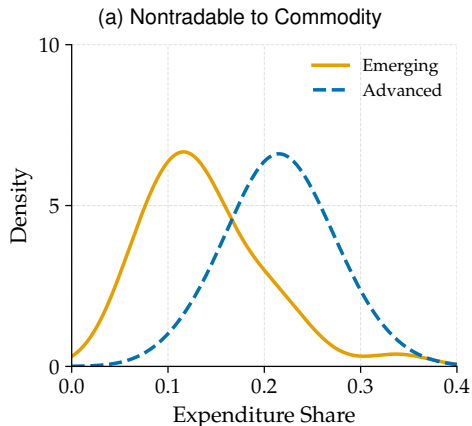
- Own-sector shares over gross output; solid orange = EM, dashed blue = AE.

Emerging markets rely more on commodities for production



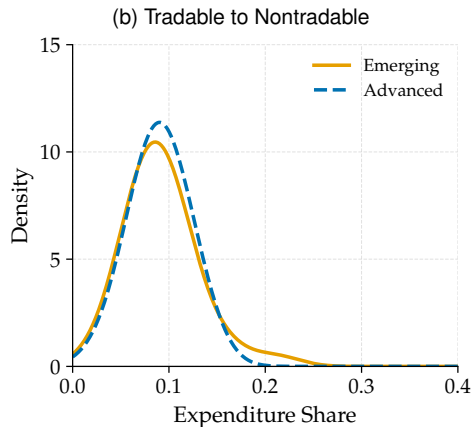
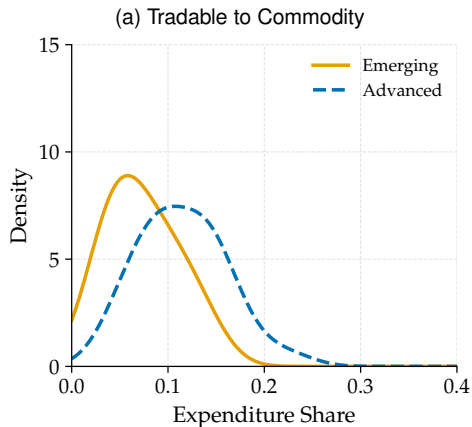
- Commodity inputs over buyer gross output; solid orange = EM, dashed blue = AE.

Advanced economies rely more on non-tradable inputs



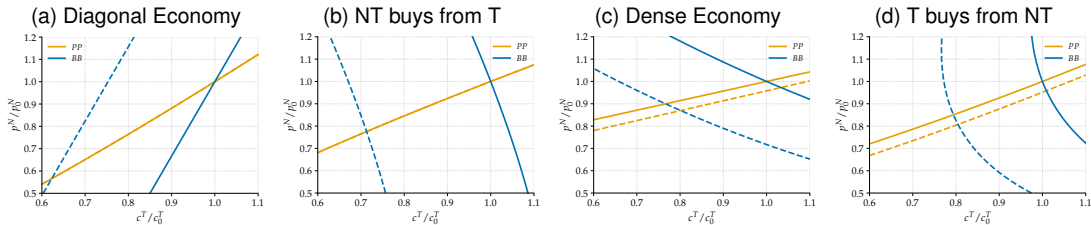
- NT inputs over buyer gross output; solid orange = EM, dashed blue = AE.

Tradable input use is similar in nontradables



- Tradable inputs over buyer gross output; solid orange = EM, dashed blue = AE.

PP and BB curves under different networks



- ▶ PP curve is always upward sloping; BB slope depends on the network structure
- ▶ Dashed: 10% drop in z^T ; $\eta = 0.2035$, $\alpha = 0.5$, $\kappa = 0.3$, $b_0 = -0.3$, $\omega = 0.5$

Quantitative Model - Details

$$\max \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t u(c_t) \right], \quad \text{where } \beta \in (0, 1).$$

subject to

$$c_t^C + p_t^X c_t^X + p_t^N c_t^N + q b_{t+1} = b_t + \pi_t^C + \pi_t^X + \pi_t^N$$

$$q b_{t+1} \geq -\kappa(\pi_t^C + \pi_t^X + \pi_t^N)$$

$$c_t = \left((1 - \omega)(c_t^N)^{-\eta} + \omega(c_t^T)^{-\eta} \right)^{-\frac{1}{\eta}}, \quad c_t^T = \left[\omega_T (c_t^C)^{-\eta_T} + (1 - \omega_T)(c_t^X)^{-\eta_T} \right]^{-\frac{1}{\eta_T}}.$$

Production:

$$y_t^i = z_t^i \left[\left(\sum_{j \in \{C, X, N\}} (\omega_j^i)^{\frac{1}{\chi^i}} (m_{jt}^i)^{\frac{\chi^i - 1}{\chi^i}} \right)^{\frac{\chi^i}{\chi^i - 1}} \right]^{\gamma^i}.$$

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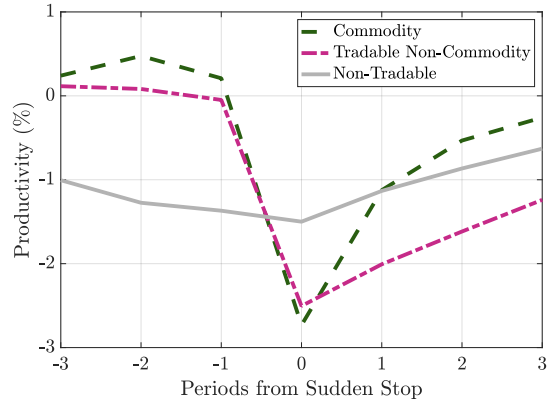
Calibration - Additional Parameters

Parameter	Description	Value
σ	curvature of utility	2
ω	consumption weight of tradables	0.165
ω_T	weight of non-commodity tradables within tradables	0.20
γ	decreasing returns to scale	0.80
χ	elasticity of substitution among varieties	0.60
$1/(1 + \eta) = 1/(1 + \eta_T)$	trade elasticity	0.83
R^*	steady-state world interest rate	1.04
P_C	probability of remaining at low z^C	0.75
P_X	probability of remaining at low z^X	0.90
P_N	probability of remaining at low z^N	0.88

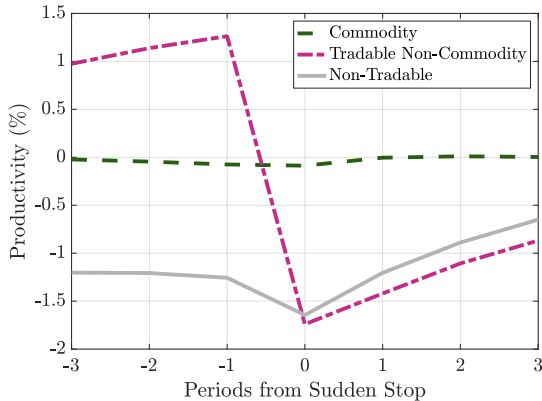
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Sudden Stops - Shocks

Emerging



Advanced



Network Structure and Sudden Stops (Full Table)

	Consumption			GDP			CA/GDP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SS	-0.0417***	-0.0112**	-0.3615*	-0.0406***	-0.0026	-0.1335	0.0146**	0.0106	0.2081***
SS × EM		-0.0528***			-0.0654***			0.0069	
SS × $\omega_{T,c}^C$			-0.0615			-0.0518			-0.2026***
SS × $\omega_{NT,c}^C$			0.4373**			0.0743			-0.0666
SS × $\omega_{C,c}^T$			0.2471*			0.2381**			-0.2335***
SS × $\omega_{NT,c}^T$			0.1061			-0.0079			-0.3200**
SS × $\omega_{C,c}^{NT}$			0.1996			-0.0876			0.0663
SS × $\omega_{T,c}^{NT}$			0.3807*			0.2059			0.1060
SS × Commodity Input Share			0.0046			0.0927			0.2399***
SS × Tradable Input Share			0.3508			0.6375**			-0.0644
SS × Nontradable Input Share			-0.5032			-0.0135			0.5378**
SS × Tradable Size			0.1374			0.0031			-0.1814***
SS × Nontradable Size			0.3382			0.1121			-0.3870***
SS × Commodity Size			-0.0395			-0.2429			-0.3225***
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared within	0.042	0.059	0.082	0.043	0.070	0.092	0.003	0.003	0.022
Observations	1463	1463	1463	1517	1517	1517	1434	1434	1434

1979–2019 annual data. Standard errors clustered by country. Input shares: sector intermediate purchases over gross output; sizes: sales over GDP; both 1995 and demeaned. 37 countries: 17 EMs and 20 AEs.

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