Commodity Terms of Trade Volatility and Industry Growth

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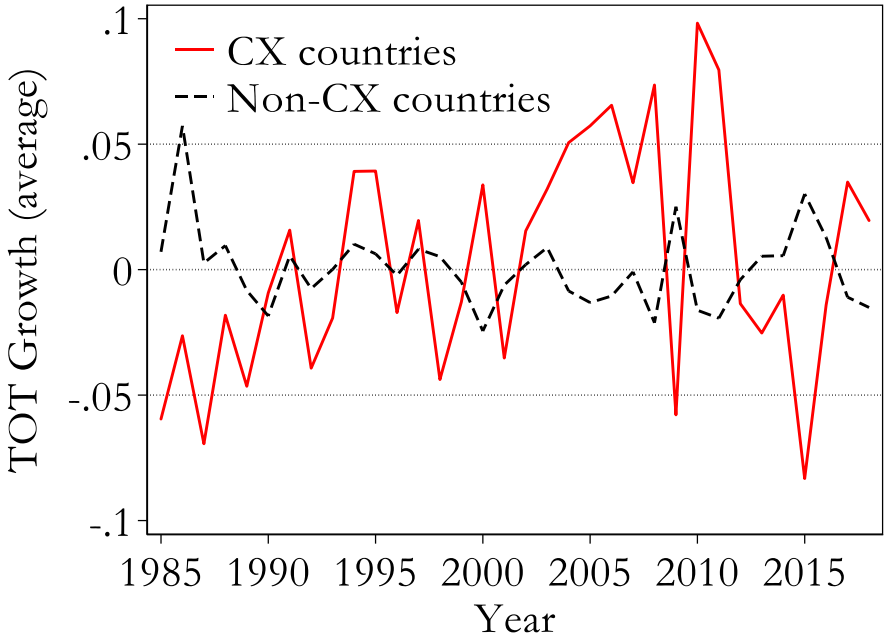
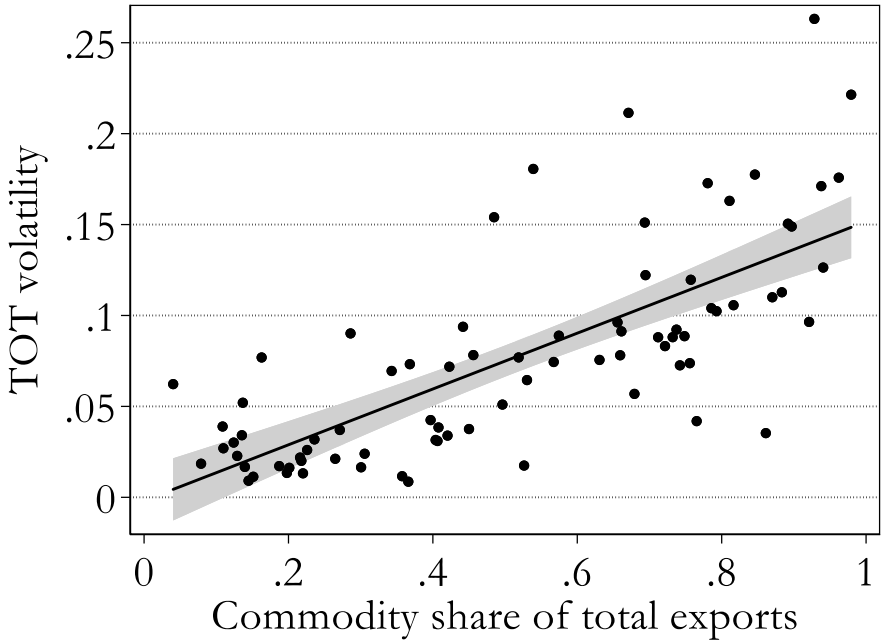
Motivating Fact I

- TOT (= p^x/p^m) more volatile in commodity-dependent countries
  - Earlier evidence: Jacks, O'Rourke, Williamson (2011 *REStat*)





Note: 80 countries, 1985–2018. Source: OECD & WB's WDI.

Motivating Fact II

- TOT volatility↑ ⇒ Uncertainty on dollar export revenue↑

  ⇒ Sovereign yield spread↑

  - For a risk-neutral lender:

$$(1+i^*) \quad = \quad \underbrace{(1-\pi)\times[1+(i^*+z)]}_{\text{E[return|no default]}} \quad + \quad \underbrace{\pi\times(0)}_{\text{E[return|default]}}$$

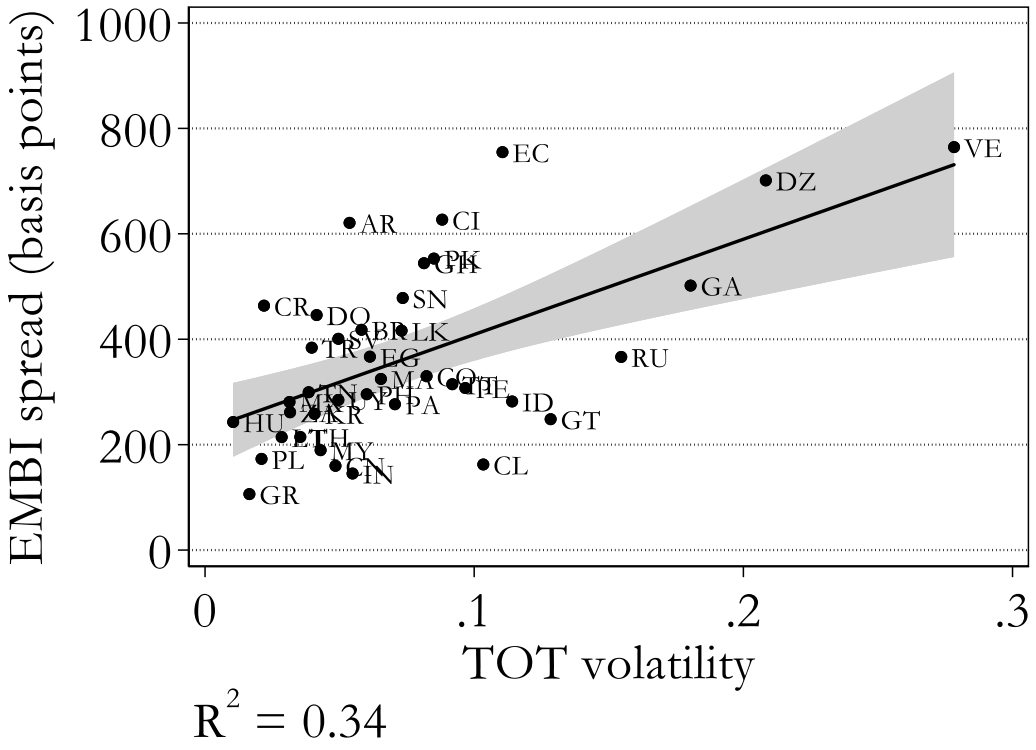
where i^* is a risk-free rate and π is the probability of default with $\partial\pi/\partial\sigma^{\Delta TOT} > 0$.

Solving for the risk premium z:

$$z = \frac{\pi}{(1-\pi)}(1+i^*)$$

Thus, $\frac{\partial z}{\partial \sigma^{\Delta TOT}} > 0 \Rightarrow$ A cost of capital increases with TOT volatility.

- Empirical evidence:



Note: 39 countries, 1997–2018. Source: OECD, WB's WDI & GEM.

Research Questions

- Does volatile CTOT play a central role in depressing the growth of non-commodity sectors in commodity-rich economies?

- If so, what are the channels through which the volatility affects industry growth?

My Approach

- The role of credit constraints in transmitting CTOT uncertainty
  - Two credit constraint indicators:
    - ✓ External finance dependence (*EFD*): long-term fixed investment
    - ✓ Liquidity needs (*LIQ*): short-term working capital

- Industry-level data
  - Adopt the identification strategy developed by Samaniego and Sun (2015 *EER*) in the spirit of Rajan and Zingales (1998 *AER*)
  - Causality from CTOT volatility into sectoral growth

- Growth accounting: operating channels of CTOT volatility effect

Main Findings

- CTOT volatility decreases the growth of manufacturing sectors more prone to financial vulnerabilities.
  - Such effect significant only in commodity-exporting countries
  - Mainly through the volatility of p^x rather than p^m
  - Remarkably robust
    - ✓ Controlling for the CTOT growth
    - ✓ Alternative CTOT and credit constraints
    - ✓ Excluding small manufacturing countries
- Firms w/ *EFD* suffer from $g_A \downarrow$ and firms w/ *LIQ* from $g_K \downarrow$.
- Offers a complementary explanation for the 'resource curse' through the credit constraint channel

Related Literature

- Resource curse
  - Seminal work: Sachs & Warner (1995 NBER, 1999 *JDE*, 2001 *EER*)
  - Proposed justifications:
    - ✓ Dutch disease: Corden & Neary (1982 *EJ*), van der Ploeg & Venables (2013 *JDE*)
    - ✓ Reduced human capital: Gylfason, Herbertsson, Zoega (1999 *MD*)
    - ✓ Rent-seeking: Tornell & Lane (1999 *AER*), Torvik (2002 *JDE*)
    - ✓ Bad institutions: Mehlum, Moene, Torvik (2006 *EJ*)
    - ✓ Volatility of unanticipated growth: van der Ploeg and Poelhekke (2009 *OEP*)
    - ✓ CTOT volatility: Cavalcanti, Mohaddes, Raissi (2015 *JAE*)

⇒ C1: Financial constraints as a channel transmitting CTOT volatility

⇒ C2: Micro approach → causal link & underlying mechanisms

- Macro impacts of interaction b/w uncertainty and financial frictions
  - Theory: Alfaro, Bloom, Lin (2018 NBER), Arellano, Bai, Kehoe (2019 *JPE*)
  - Empirics: Levchenko, Rancière, Thoenig (2009 *JDE*), Caldara, Fuentes-Albero, Gilchrist, Zakrajšek (2016 *EER*), Choi, Furceri, Huang, Loungani (2018 *JIMF*)

⇒ C3: Transmission of uncertainty from a commodity into manufacturing

- Commodity prices and sovereign default risk
  - Hilscher & Nosbusch (2010 *RF*), Arezki & Brückner (2011 *WBER*), Boehm, Eichler, Giessler (2021 *JIMF*)

⇒ C4: Real consequences of commodity-sovereign risk dependence

Data and Sources

- United Nations Industrial Development Organization (UNIDO)
  - Sample period: 1969–2018
  - 51 countries (commodity share of exports > 50%), 22 manufacturing sectors
  - Output, value-added, gross fixed capital formation, employment, etc.
  - Deflate nominal dollar values using price levels from PWT
- *CTOT* (Gruss and Kebhaj, 2019)
- *EFD* = (capital expenditures – internal funds)/capital expenditures
  - Rajan and Zingales (1998), Choi et al. (2022)
- *LIQ* = inventories/sales
  - Raddatz (2006)

Identification Strategy

$$\Delta y_{ci,t} = \alpha_1\left(\sigma_{ct}^{\Delta CTOT} \times EFD_i\right) + \alpha_2 s_{ci,0} + \delta_{ct} + \delta_{it} + \delta_{ci} + \varepsilon_{ci,t}$$

$$\Delta y_{ci,t} = \beta_1\left(\sigma_{ct}^{\Delta CTOT} \times LIQ_i\right) + \beta_2 s_{ci,0} + \delta_{ct} + \delta_{it} + \delta_{ci} + \varepsilon_{ci,t}$$

- $y_{ci,t}$ is the log of the value added in country c, industry i, and time t
- $s_{ci,0}$ is the initial industry share
- $\delta_{ct}, \delta_{it}, \delta_{ci} \Rightarrow$ omitted variable bias$\downarrow$ and simultaneity$\downarrow$
- Identification comes from t variation within each c and i
- Non-overlapping five-year averages $\Rightarrow$ 10 periods for each c
- My hypothesis: $\alpha_1 < 0$ and $\beta_1 < 0$

Economic Significance

- Given a one-S.D. increase in $\sigma^{\Delta CTOT}$, growth differentials b/w relatively more and less financially-constrained industries are:

$$\hat{\alpha}_1 \times \text{S.D.}\left(\sigma^{\Delta CTOT}\right) \times \left(EFD_{75\text{th}} - EFD_{25\text{th}}\right)$$

$$\hat{\beta}_1 \times \text{S.D.}\left(\sigma^{\Delta CTOT}\right) \times \left(LIQ_{75\text{th}} - LIQ_{25\text{th}}\right)$$

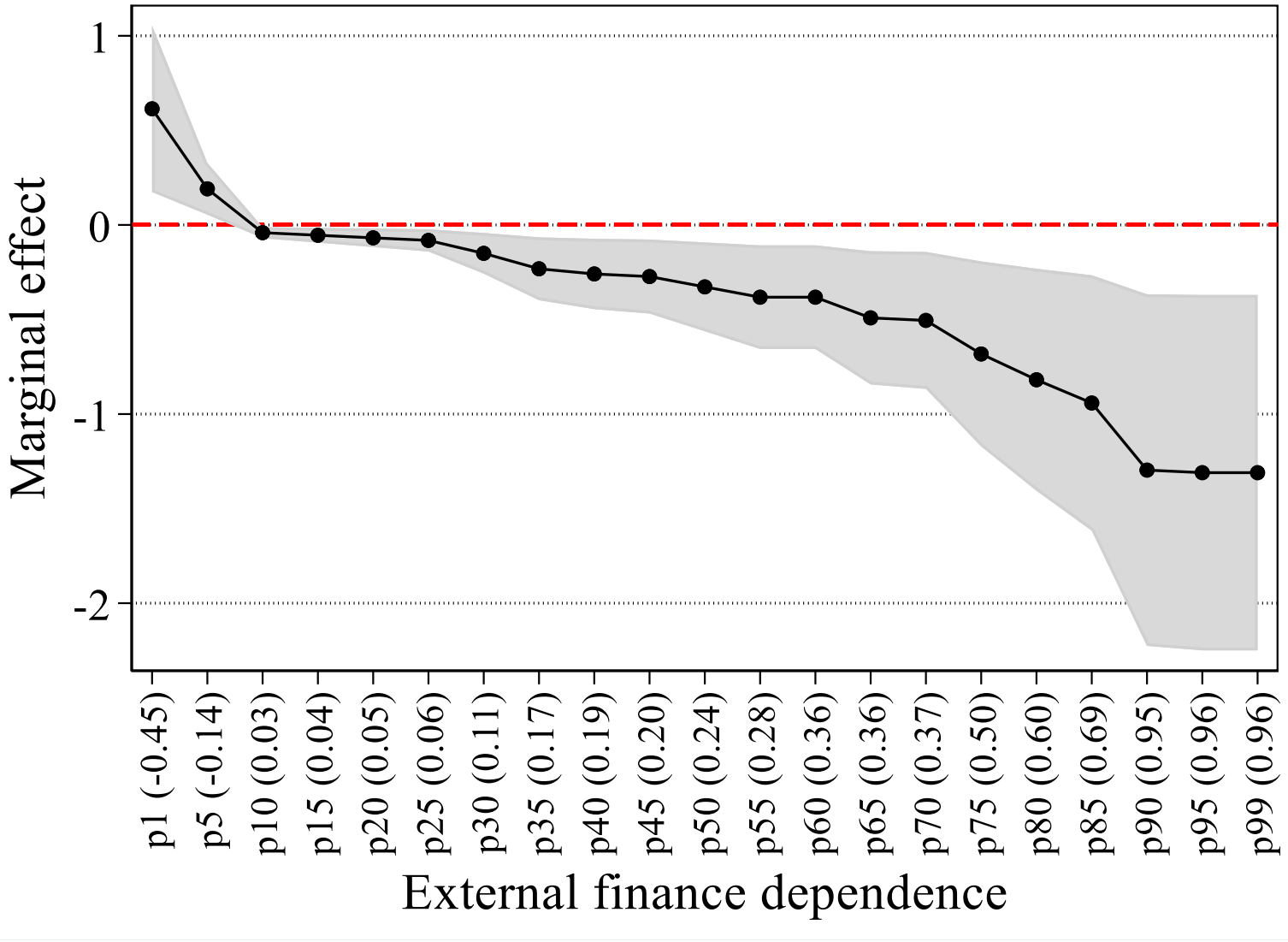
	75th percentile	25th percentile
EFD	Chemical products	Non-metallic mineral products
LIQ	Vehicles and transport equipment	Paper products

Main Results

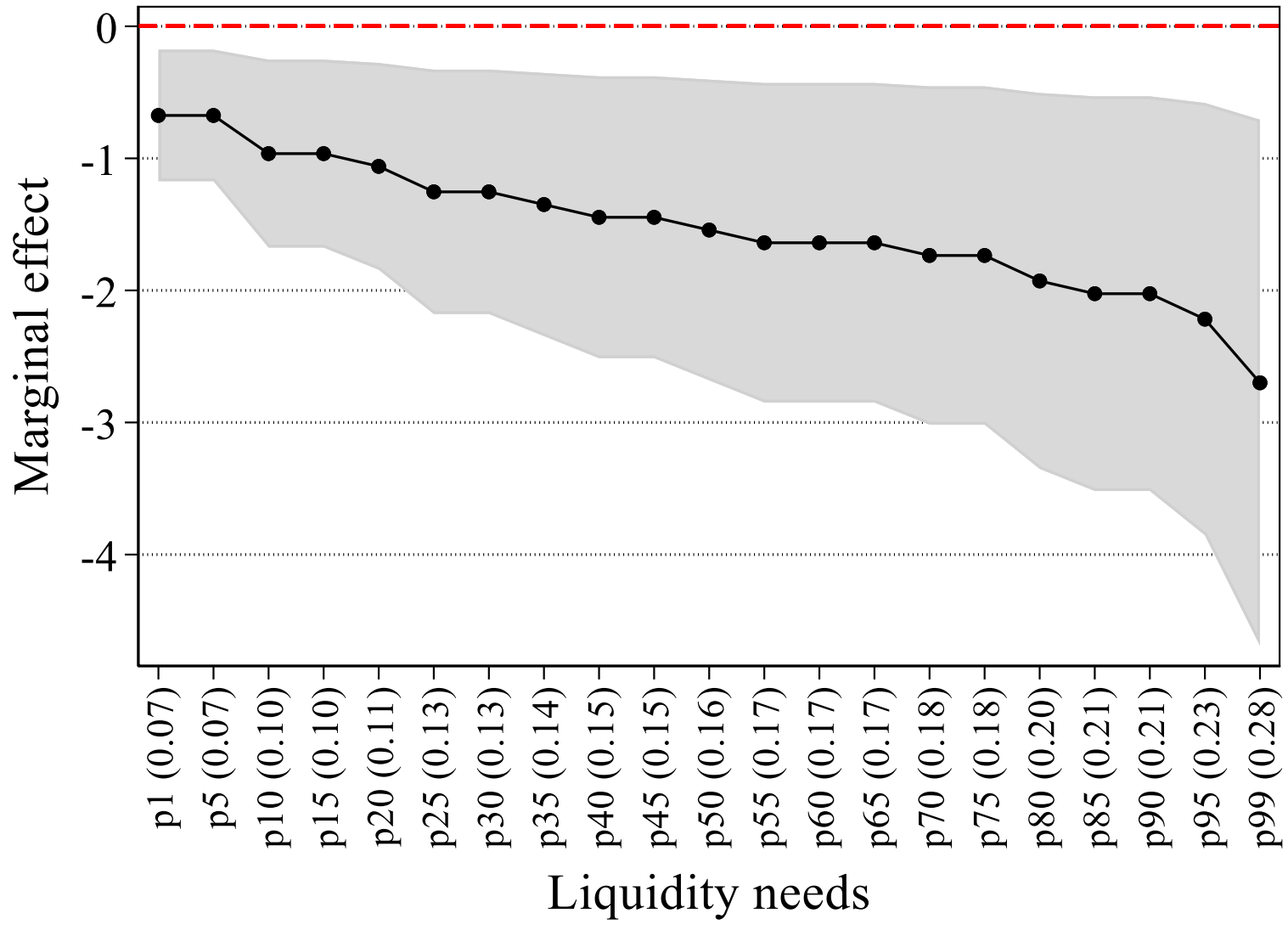
	Dependent variable: VA growth							
	Full sample		Commodity exporters		Fuel exporters		Non-commodity exporters	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
α_1	**-1.17****		**-1.37*****		**-1.15**		**0.71**	
	(0.47)		(0.50)		(0.85)		(1.19)	
β_1		**-8.77*****		**-9.64*****		**-11.02***		**4.33**
		(3.18)		(3.63)		(5.96)		(6.01)
α_2 or β_2	-0.12***	-0.12***	-0.09*	-0.09*	-0.03	-0.02	-0.19***	-0.18***
	(0.04)	(0.04)	(0.05)	(0.05)	(0.08)	(0.08)	(0.06)	(0.06)
N. countries	100	100	51	51	14	14	49	49
Obs.	13,809	13,809	6,729	6,729	1,821	1,821	7,077	7,077
R^2	0.46	0.46	0.45	0.45	0.53	0.53	0.50	0.50
ave. g (%)	2.79		3.04		4.45		2.56	
g diff. (ppt)	**-1.08**	**-0.92**	**-1.68**	**-1.35**	**-2.03**	**-2.20**	**-0.36**	**-0.43**

Note: SEs are clustered at the country-sector level.

Marginal Effects of Volatility as a Function of EFD



Marginal Effects of Volatility as a Function of LIQ



Numerator vs. Denominator of CTOT

	Dependent variable: VA growth			
	X = p^{cx}		X = p^{cm}	
	(1)	(2)	(3)	(4)
X volatility × EFD	**-1.21*****		**0.23**	
	(0.47)		(1.40)	
X volatility × LIQ		**-7.61****		**-0.25**
		(3.27)		(8.16)
Initial industry share	-0.09*	-0.09*	-0.09*	-0.09*
	(0.05)	(0.05)	(0.05)	(0.05)
Obs.	6,729	6,729	6,729	6,729
R^2	0.45	0.45	0.45	0.45
g diff. (ppt)	**-1.28**	**-0.91**	**0.12**	**-0.02**

When Controlling for the CTOT Growth

Filtering techniques:	Dependent variable: VA growth							
	HP filter				Hamilton (2018) filter			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CTOT volatility × EFD	**-0.02****		**-0.02****		**-0.01***		**-0.01***	
	(0.01)		(0.01)		(0.004)		(0.01)	
CTOT volatility × LIQ		**-0.14*****		**-0.14*****		**-0.05***		**-0.07****
		(0.05)		(0.05)		(0.03)		(0.03)
CTOT growth × EFD			0.30				-0.15	
			(0.55)				(0.50)	
CTOT growth × LIQ				-0.66				-4.56
				(3.23)				(3.18)
Initial industry share	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*	-0.09*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Obs.	6,729	6,729	6,729	6,729	6,729	6,729	6,729	6,729
R^2	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
g diff. (ppt)	**-1.04**	**-0.95**	**-0.96**	**-0.96**	**-0.71**	**-0.61**	**-0.82**	**-0.77**

Operating Channels

- Growth accounting based on a Cobb-Douglas production function
  - $g_Y = g_A + \alpha g_L + (1-\alpha) g_K$
- $A_{ci,t} = Y_{ci,t} / \left(L_{ci,t}\right)^{\alpha} \left(K_{ci,t}\right)^{1-\alpha}$ with $\alpha = 0.7$
- $K_{ci,t} = (1-\delta) K_{ci,t-1} + I_{ci,t}$ with $\delta = 0.08$
  - Assume a steady state in the initial period so that $K_{ci,0} = I_{ci,0}/\delta$.
- Regression model:

$$\Delta \boldsymbol{X}_{ci,t} = \gamma_1 \left(\sigma_{ct}^{\Delta CTOT} \times FIN_i\right) + \gamma_2 s_{ci,0} + \delta_{ct} + \delta_{it} + \delta_{ci} + e_{ci,t}$$

where $\boldsymbol{X} \in \{L, K, TFP, PROD, I\}$ and $FIN \in \{EFD, LIQ\}$

Growth Accounting in Industries with EFD

Dependent variable is the growth rate of:	*L*	*K*	*TFP*	*PROD*	*I*
	(1)	(2)	(3)	(4)	(5)
CTOT volatility × EFD	**-1.43*****	**0.60**	**-1.69*****	**-0.82***	**-1.01**
	(0.55)	(0.84)	(0.65)	(0.49)	(1.22)
Initial industry share	-0.03	0.13	-0.37***	-0.24***	-0.23
	(0.04)	(0.11)	(0.09)	(0.06)	(0.17)
Obs.	6,117	4,057	4,014	6,117	4,057
R^2	0.42	0.34	0.43	0.38	0.41
Ave. g (%)	1.70	3.48	0.75	1.11	3.28
g diff. (ppt)	**-1.76**	**0.74**	**-2.09**	**-1.01**	**-1.25**

Growth Accounting in Industries with LIQ

Dependent variable is the growth rate of:	*L*	*K*	*TFP*	*PROD*	*I*
	(1)	(2)	(3)	(4)	(5)
CTOT volatility × LIQ	**-5.16**†	**-14.29****	**-3.23**	**-3.20**	**-18.77****
	(3.20)	(6.76)	(4.12)	(2.78)	(7.83)
Initial industry share	-0.03	0.14	-0.37***	-0.24***	-0.22
	(0.05)	(0.11)	(0.09)	(0.06)	(0.17)
Obs.	6,117	4,057	4,014	6,117	4,057
R^2	0.42	0.34	0.43	0.38	0.41
Ave. g (%)	1.70	3.48	0.75	1.11	3.28
g diff. (ppt)	**-0.72**	**-2.00**	**-0.45**	**-0.45**	**-2.63**

Conclusion

- One reason for stagnant growth in commodity-rich countries:
  - CTOT volatility↑ ⇒ Cost of capital↑ ⇒ Likelihood of binding credit constraints↑ ⇒ Industry growth↓
  - Firms with *EFD* suffer from g_A↓ and firms with *LIQ* from g_K↓
  - Complement the 'resource curse' through a financial constraint

- Policies promoting industrialization by smoothing CTOT volatility:
  - Financial development and integration
  - International reserves and SWF
  - Macroprudential regulations
  - Better institutions