Terms of Trade and Small Open Economies Business Cycles: The Role of Global Shocks

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Motivation

- Large participation of commodities in international trade for SOEs. (52% in Colombia, 60 % in Peru, 40% in Australia, 50% in Chile, ...)
- High importance of terms of trade for SOE business cycles is commonly accepted, but...
- Large volatility in current estimates of ToT impact on SOE business cycles.
- The high correlation between ToT and global output suggests an underlying common source. ▸ cor

Main questions

- Are SOEs' business cycles driven by global movements or country-specific terms of trade fluctuations?
  - 1.1 Is the exposure to global conditions asymmetric between developed and emerging markets?

This paper

- Argue that two sources can explain terms-of-trade fluctuations:
  - **global shocks**: Changes in global conditions that affects all countries
  - **country-specific**: Changes that affect only to the SOEs.
- Propose a sequential approach to disentangle both shocks.
  - **First stage**: Identifying global shocks as main drivers of global volatility
  - **Second stage**: Identifying country-specific ToT shocks as main drivers of ToT and orthogonal to global shocks.
- Apply the methodology to 10 SOEs
  - Divided into two groups: 6 emerging and 4 developed markets
  - Two-block SVAR analysis
  - Compare IRFs and FEVD between shocks and country groups
- Compare Global Shocks to other aggregate macro shocks: US-TFP, monetary policy, China's activity, and Financial cycle.

Main results

1. **Global shocks**:
   - Explains around half of the volatility in the foreign bloc
   - In average, this shock contributes to 30% of real output, consumption, and investment volatility.
2. **Country-specific terms of trade** shocks:
   - Close to 80% of terms-of-trade variability is explain by country-specific terms of trade
   - Low explanation power for SOE's business cycle (<10%).
3. Observed **asymmetries**:
   - Higher response to GS in emerging markets ($\sim$ 40 % in real variables) than in developed markets ($\sim$ 20 %)
4. Results are robust to different horizons and country-by-country inspection.
5. Among other aggregate macro shocks, global shocks are more related to the global financial cycle.

Related Literature

- **Terms of trade, commodities prices**: Schmitt-Grohé and Uribe (2015), Shousha (2016), Ben Zeev, Pappa, and Vicondoa (2017) Fernández, Schmitt-Grohé, and Uribe (2017), ...
- **Business cycles in SOEs and transmission of foreign shocks**: García-Cicco, Pancrazi, and Uribe (2010), Finlay and Jääskelä (2014) , Drechsel and Tenreyro (2018), Guerrón-Quintana (2013), Chen and Crucini (2014), ...
- **News literature**: Uhlig (2004) , Beaudry and Portier (2006), Kamber et al. (2017), Jaimovich and Rebelo (2008), ...

Outline

Econometric Framework

Let $\mathbf{Y}_t^{(d)} = \begin{bmatrix} \mathbf{y}_t^{(f)} \\ \mathbf{y}_t^{(d)} \end{bmatrix}$ be a vector of foreign (f) and domestic (d) variables, with the reduce form VAR representation:

$$\mathbf{Y}_t = \mathbf{F}_1 \mathbf{Y}_{t-1} + \cdots + \mathbf{F}_p \mathbf{Y}_{t-p} + \mathbf{u}_t$$

Let $\mathbf{C}$ be a orthogonalization matrix such that $\mathbf{u}_t = \mathbf{C}\mathbf{e}_t$, and $\mathbb{E}[\mathbf{e}'\mathbf{e}] = \mathbf{I}$.

$$\mathbf{Y}_t = \mathcal{R}(L)\mathbf{C}\mathbf{e}_t$$

where $\mathcal{R}(L) = \sum_{h=0}^{\infty} \mathbf{R}_h L^h$ is the polynomial of reduced-form impulse-response. Defining $\widetilde{\mathcal{R}}(L) = \mathcal{R}(L)\mathbf{C}$ and $\mathbf{\Gamma}$ as a matrix that maps structural shocks $\boldsymbol{\epsilon}$ to e_t

$$\mathbf{Y}_t = \widetilde{\mathcal{R}}(L)\mathbf{\Gamma}\epsilon_t$$

- Let $\Omega^{(h)}$ be the $h - step$ forecast variance-covariance matrix
- Define $S^i(\underline{t}, \bar{t})$ as the cumulative forecast error variance of the variable i over the interval $[\underline{t} : \bar{t}]$:

$$S^i(\underline{t}, \bar{t}) = \sum_{h=\underline{t}}^{\bar{t}} \Omega_{i,i}^{(h)}$$

- Define $S_\gamma^i(\underline{t}, \bar{t})$ as the share explained by the shock γ

$$S_j^i(\underline{t}, \bar{t}) = \left(\sum_{h=\underline{t}}^{\bar{t}} \sum_{l=0}^{h} \tilde{R}_l \boldsymbol{\gamma}_j \boldsymbol{\gamma}_j' \tilde{R}_l' \right)_{i,i} = \boldsymbol{\gamma}_j' \Lambda^{(i)}(\underline{t}, \bar{t}) \boldsymbol{\gamma}_j$$

with $\Lambda^{(i)}(\underline{t}, \bar{t}) = \sum_l^h \left(\bar{t} + 1 - \max(\underline{t}, l) \right) \tilde{R}_l^{(i)'} \tilde{R}_l^{(i)}$

- **Common approach**: Finding γ^* that maximizes one-specific $S_\gamma^i(\underline{t}, \bar{t})$

Identification of Global shocks

A global shock is identified by finding the factor with the highest participation in the foreign volatility, then:

$$\begin{aligned} \hat{\gamma}^{gs} = \underset{\gamma_j}{\text{argmax}} \quad & \sum_{i \in \text{foreign}} s_j^i(\underline{t}, \bar{t}) \\ \text{s.t.} \quad & \gamma_j' \gamma_j = 1 \end{aligned}$$

where $s_j^i(\underline{t}, \bar{t}) = \frac{S_j^i(\underline{t}, \bar{t})}{S^i(\underline{t}, \bar{t})}$ is the contribution of the j-structural shock.
After some algebra, γ^* is the maximum eigenvalue of

$$\begin{aligned} \hat{\gamma}^{gs} = \underset{\gamma_j}{\text{argmax}} \quad & \gamma_j' \xi \gamma_j \\ \text{s.t.} \quad & \gamma_j' \gamma_j = 1 \end{aligned}$$

where $\boldsymbol{\xi} = \sum_{i \in f} \frac{1}{S^{(i)}(\underline{\tau}, \bar{\tau})} \Lambda^{(i)}(\underline{\tau}, \bar{\tau})$ is the sum of the covariance matrices $\Lambda^{(i)}$ associated to foreign variables weighted by the inverse of their cumulative forecast error variance.

Identification of country-specific ToT shocks

Country-specific terms-of-trade shock is assumed to be the main driver of the forecastability of terms of trade (τ) not explained by ϵ^{gs}

$$\begin{aligned} \hat{\gamma}^{\tau} = \underset{\gamma_j}{\text{argmax}} \quad & s_j^{\tau}(\underline{t}, \bar{t}) \\ \text{s.t.} \quad & \gamma_j' \gamma_j = 1 \\ & \gamma_j' \gamma^{gs} = 0 \end{aligned}$$

The solution implies a generalized eigenvalue-eigenvector problem:

$$\Lambda_{\Xi}^{(\tau)} \varphi = \lambda \Xi \varphi$$

where Ξ, and ψ are auxiliary matrices from which $\hat{\varphi}$ can be recovered.

Econometric Procedure and Data

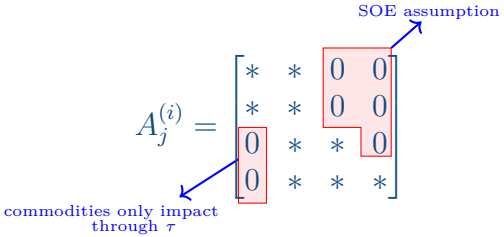
- Quarterly data from 1997Q1 until 2019Q4
- A common foreign block:
  - p_t : global commodity price index (in logs)
  - gdp_t^{G20} : index of real activity in the G20 countries (in logs)
  - BAA_t : Spread between Moody's BAA bond and Fed Funds
- Small Open Economies:
  - **Emerging Markets**: Argentina, Brazil, Chile, Colombia, Peru, and South Africa.
  - **Developed Economies**: Australia, Canada, New Zealand, and Norway.

Empirical Model

The empirical implementation relies on the following VAR model:

$$\begin{bmatrix} p_t^f \\ y_t^f \\ \tau_t^i \\ y_t^i \end{bmatrix} = A_1^{(i)} \begin{bmatrix} p_{t-1}^f \\ y_{t-1}^f \\ \tau_{t-1}^i \\ y_{t-1}^i \end{bmatrix} + A_2^{(i)} \begin{bmatrix} p_{t-2}^f \\ y_{t-2}^f \\ \tau_{t-2}^i \\ y_{t-2}^i \end{bmatrix} + u_{it}$$

where the matrices A_j^i, $j = \{1, 2\}$ have the restrictions:



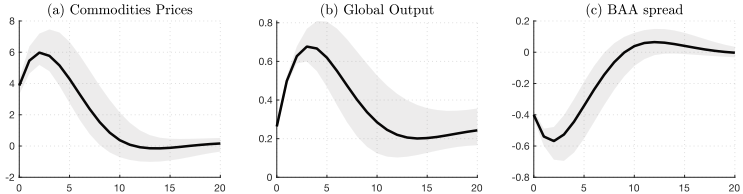
$\tau_t^{(i)}$ =terms of trade, $y_t^{(i)}$ = (GDP, consumption, investment, nx, q and r)

Estimation

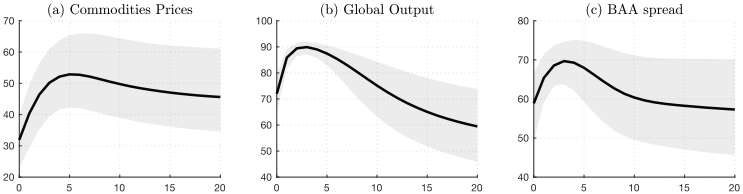
- Country-specific VARs with two lags (based on BIC criteria).
- Estimation in levels (checking stationarity).
- Blocks-by-blocks bootstrapping keeping 5000 stationary simulations.
- Pooled estimator for the median response.
- Confidence interval for 16th and 84th percentiles.

Effect of Global Shocks on foreign block

(a) Impulse response functions

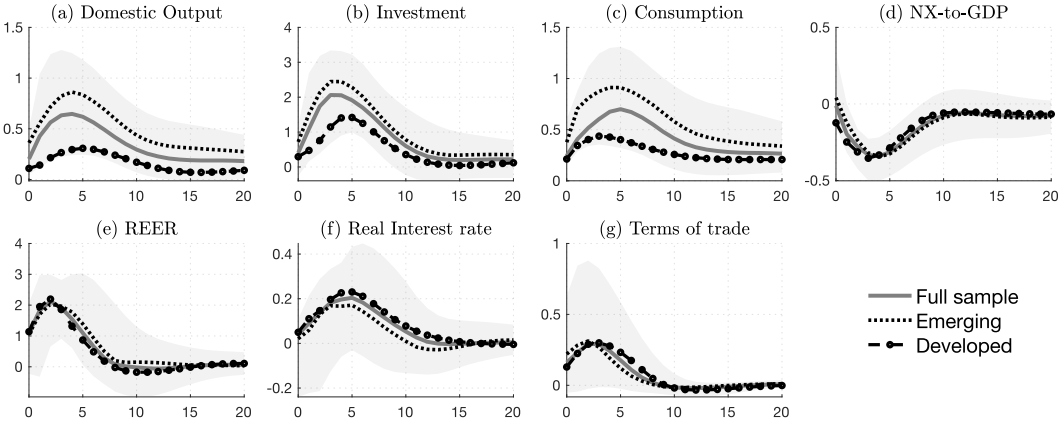


(b) Contribution to Forecast Error Variance



Effect of Global Shocks on the domestic block: IRFs

Among commodities exporters, EM exhibits a larger response than developed economies.

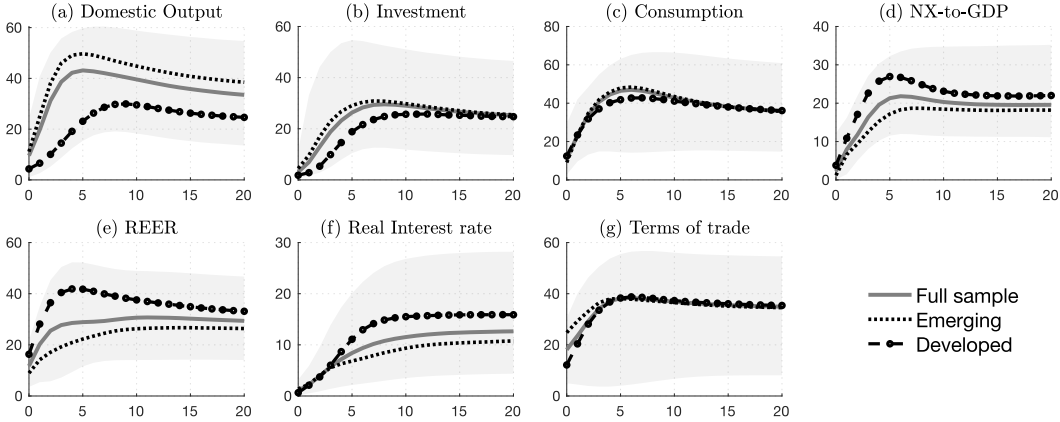


Note: 68% confidence interval for emerging markets.

table check

Effect of Global Shocks on the domestic block: FEV

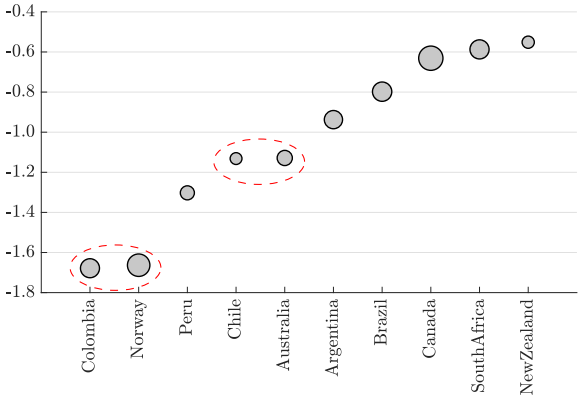
Similar story in terms of volatility (except for consumption)



Note: 68% confidence interval for emerging markets.

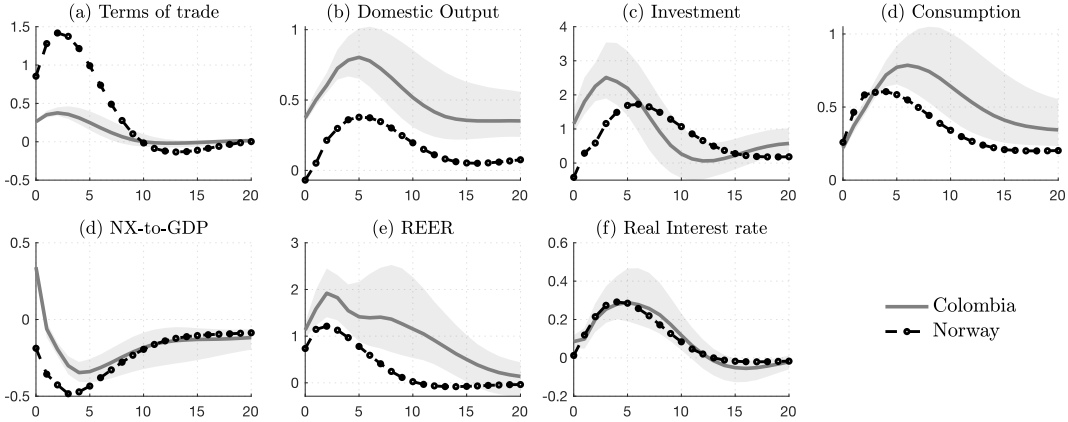
Country-to-country comparison

Figure: Complexity index of Exported Goods

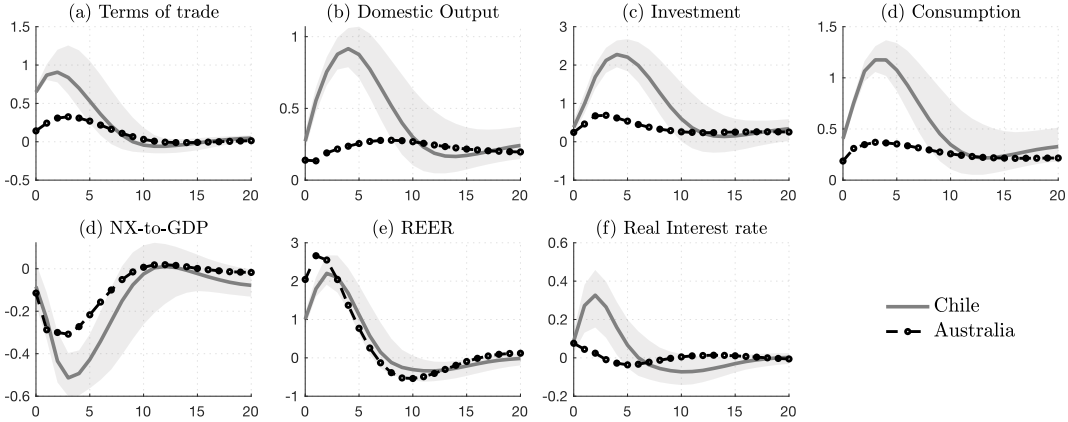


Note:: The aggregate complexity index was calculated based on 4-digits STICs complexity reported by the Atlas of Economic Complexity weighted by the average share of each sector in their export basket since 1998. The relative variance of the series adjusted the size of the circle.

Response of domestic variables to Global Shocks: Fuel Exporters

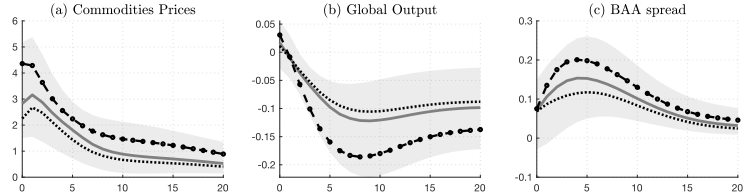


Response of domestic variables to Global Shocks: Mining Exporters

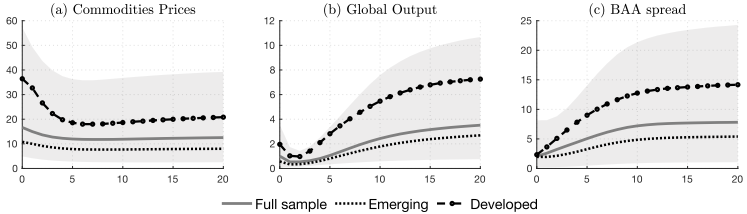


Effect of Country-specific ToT shocks on the foreign block

(a) Impulse response

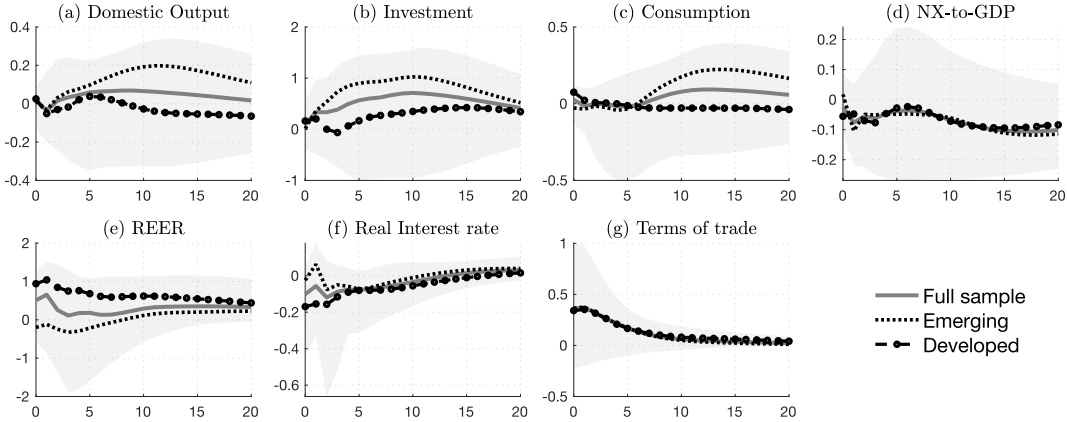


(b) Contribution to Forecast Error Variance



Large variance in the effect of terms of trade deviations impact...

Figure: Impact of Terms of Trade on domestic variables: IRF functions



... which explains less than 10 percent in output and consumption

Table: Contribution of terms of trade to domestic forecastability

Country Group	horizon	Terms of trade	Production	Investment	Consumption	Net Exports to GDP ratio	Real Exchange Rate	i^{real}
Full Sample	$h = 0$	79.2	0.9	1.5	1.3	0.7	7.8	1.3
	$h = 4$	62.4	3.1	5.2	2.2	4.4	8.2	3.1
	$h = 12$	59.3	5.0	11.9	4.6	8.8	11.2	4.9
	$h = 20$	58.6	6.5	14.9	6.2	11.5	12.0	5.5
Emerging	$h = 0$	72.9	0.7	1.2	0.8	0.7	5.7	0.4
	$h = 4$	61.4	1.9	4.6	2.0	3.3	7.1	2.3
	$h = 12$	58.5	4.3	10.3	4.4	8.0	8.5	4.1
	$h = 20$	57.2	5.8	13.5	6.1	11.1	9.4	4.7
Developed	$h = 0$	83.9	1.5	2.3	2.2	0.8	11.0	5.1
	$h = 4$	62.9	7.9	6.8	2.6	6.4	10.1	7.3
	$h = 12$	60.6	6.8	15.7	5.2	10.4	16.3	6.8
	$h = 20$	60.9	7.9	18.2	6.5	12.3	18.5	7.0

Global shocks and external variables

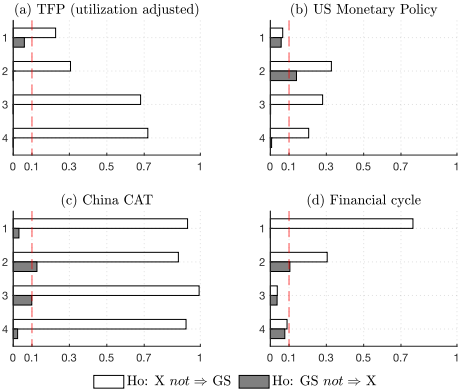
- Baseline identification lacks narrative.
- Checking the relationship between Global shocks and other shocks can shed light on this .
- Shocks : (i) US-TFP, (ii) proxy for monetary policy shocks by Bu et al. [2021], (iii) China's economic activity by Fernald et al. [2019], and (iv) global financial cycle by Miranda-Agrippino and Rey [2022]
- Two exercises:
  - Granger causality test
  - FEVD using a VAR with two lags and ordered as:

$$\text{TFP} \rightarrow \text{Financial cycle} \rightarrow \text{US monetary policy} \rightarrow \text{China's CAT} \rightarrow \text{Global shocks}$$

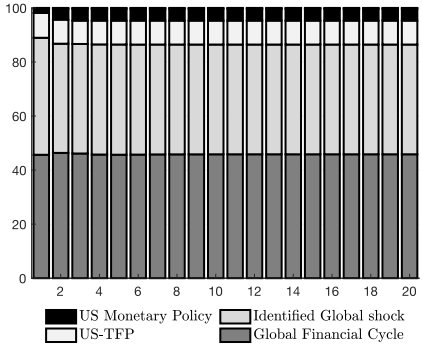
Global shocks and external variables

Figure: Global shocks vs foreign structural shocks

(a) Granger causality test



(b) FEVD of Global Shocks



Conclusions

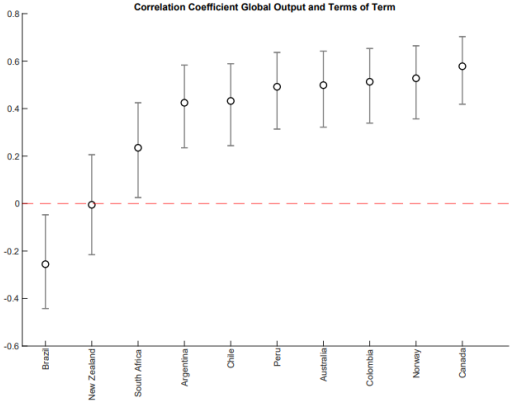
- The proposed methodology allows to disentangling global shocks from country-specific terms of trade deviations
- Global shocks explain almost 40 percent of output forecastability
- Terms of trade fluctuations explanation power reduces after control for common components

  $\rightarrow$ roughly 10 percent of output fluctuations.
- Conditional of being commodity exporter, exposure level to global shocks are higher in emerging markets

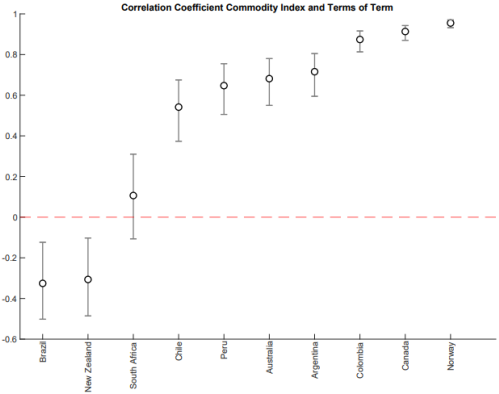
APPENDIX

Correlation with terms of trade

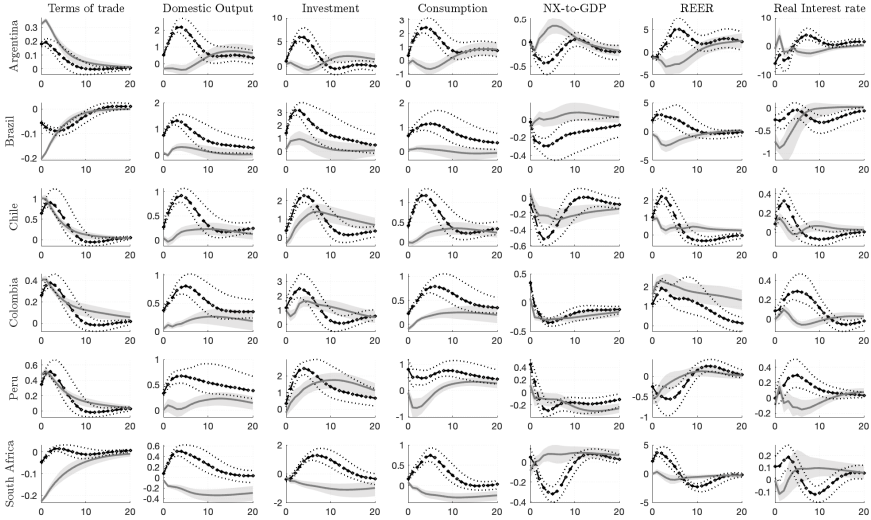
(a) Global Output



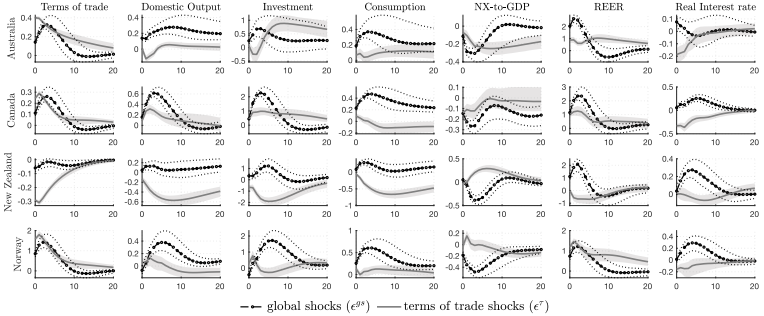
(b) Commodity price index return



Comparison with terms of trade news by country: IRFs EM



Comparison with terms of trade news by country: IRF DE



Contribution Global Component shock

return

Table: Contribution of global conditions to domestic forecastability

Country Group	horizon	Terms of trade	Production	Investment	Consumption	Net Exports to GDP ratio	Real Exchange Rate	i^{real}
Full Sample	$h = 0$	17.9	9.6	3.1	10.7	2.2	11.7	1.0
	$h = 4$	37.0	42.0	23.2	44.5	19.5	28.6	7.1
	$h = 12$	36.2	38.0	28.0	40.7	19.8	30.6	12.0
	$h = 20$	34.8	33.5	25.3	36.0	19.5	29.4	12.6
Emerging	$h = 0$	24.7	11.2	4.4	9.1	1.2	8.9	1.4
	$h = 4$	37.9	49.0	26.7	45.7	15.3	20.8	6.3
	$h = 12$	35.8	43.0	28.6	40.9	18.1	26.5	10.0
	$h = 20$	34.5	38.5	25.5	35.8	18.0	26.1	10.7
Developed	$h = 0$	12.1	4.4	1.8	12.4	3.7	16.3	0.6
	$h = 4$	36.7	19.2	14.6	40.2	25.7	41.7	8.6
	$h = 12$	36.6	28.5	25.5	40.1	22.3	36.3	15.5
	$h = 20$	35.3	25.0	24.4	36.6	22.0	33.0	15.7

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