Global shocks, terms of trade and Small Open Economies business cycles

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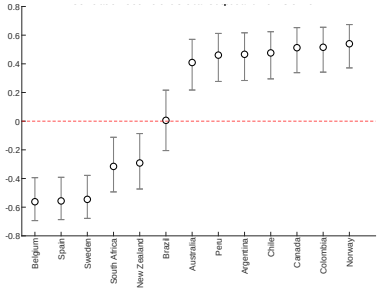
Motivation

- Large participation of commodities in trade for some SOEs.
  $\rightarrow$ **high importance of terms of trade for SOE business cycles?**
- High correlation with global output. $\rightarrow$ **is there a common driver?**

Correlation Global Output and terms of trade



- *Are SOEs' business cycles driven by global movements or terms of trade specific fluctuations? is the sensitivity symmetric between emerging and developed markets?*

This paper

- New identification strategy to disentangle global shocks [common movements] and terms of trade idiosyncratic fluctuations.
- Quarterly data for 13 SOEs divided into three groups
- Impact of **Global component**:
  - ▷ Explains around a half of the volatility in the foreign bloc and one-third in the domestic.
- Effect of idiosyncratic **terms of trade** shocks:
  - ▷ Not significant impact on domestic variables with low explanation power (<10 % in output).
- Observed **asymmetries**:
  - ▷ Larger response to GS in emerging markets ($\sim$ 40 % in real variables) than in developed markets ($\sim$ 20 %)

- A set of variables Y modeled as an VAR that accepts a Wold representation.
- Let being $S^i(\underline{t}, \bar{t})$ the cumulative FEV of the i variable during the time span $[\underline{t}, \bar{t}]$

$$S^i(\underline{t}, \bar{t}) = \sum_{h=\underline{t}}^{\bar{t}} \mathbb{E}\left[\left(Y_{t+h} - E[Y_{t+h,t}]\right) \left(Y_{t+h} - E[Y_{t+h,t}]\right)' \right] \tag{1}$$

- We can define $S^i_\gamma(\underline{t}, \bar{t})$ as the [cumulative] variance explained by the shock ϵ^γ
- Common approach: Finding ϵ^γ that maximizes one-specific $S^i_\gamma(\underline{t}, \bar{t})$
- Instead of that, I exploit the variability of the whole foreign bloc.

Identification of Global shocks

- Let being γ an identification vector that maps the response of Y to ϵ^{γ}

- A global shock is identified by finding $\hat{\gamma}$ such that its respective $\hat{\epsilon}^{\gamma}$ has the highest participation in the foreign bloc volatility. Then:

$$\max_{\gamma} \quad \sum_{i \in y^f} \frac{S^i_{\gamma}(\underline{\tau}, \overline{\tau})}{S^i(\underline{\tau}, \overline{\tau})}$$

$$\text{s.t.} \quad \gamma'\gamma = 1 \quad \rightarrow \textbf{identification constraint}$$

where $\frac{S^i_{\gamma}}{S^i}$ is the share of ϵ^{γ} in the variance decomposition of the i-variable

- The solution of this system takes the form of an eigenvalue-eigenvector problem.

Identification of the idiosyncratic component of ToT

- Let defining ψ as a second identification vector related to the shock of term of trade

- I identify ψ by solving:

$$\begin{aligned} \max_{\psi} \quad & S_{\psi}^{tot}(\underline{\tau}, \overline{\tau}) \\ \text{s.t.} \quad & \psi'\psi = 1 \\ & \psi'\gamma = 0 \quad \rightarrow \textbf{orthogonality constraint} \end{aligned}$$

  which means that conditional on γ, $\hat{\psi}$ is such that ϵ^{tot} explains the largest portion of the remained variance of terms of trade.

- The solution takes the form of an generalized eigenvalue problem.

Data

- A **common** foreign block:
  - p_t : global commodity price index (in logs) deflated by manufacturing good prices
  - gdp_t^{G20} : index of real activity in the G20 countries (in logs)
  - BAA_t : Spread between Moody's BAA bond and Fed Funds
- Country-specific terms of trade $\tau_t^{(i)}$
- Domestic block $y^{(i)}$:
  - Real variables: : GDP, consumption, and investment (logs)
  - nx_t : Net export to GDP ratio
  - q_t: real effective exchange rate
  - r_t : real interest rate

Estimation

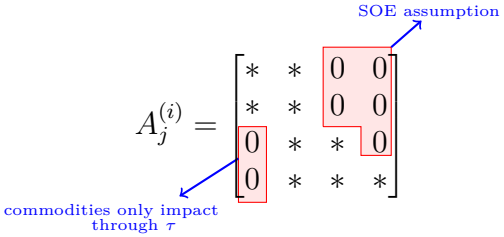
- Quarterly data from 1997Q1 to 2019Q4
- Country specific VARs in levels with two lags (based on BIC criteria).
- 3 groups of Small Open Economies:
  - **(a)** Emerging Com. Exporters (Arg., Brazil, Chile, Colombia, Peru, , South Afr.)
  - **(b)** Developed Com. Exporters (Austr., Canada, Norway, New Zealand),
  - **(c)** Developed No Com. Exporters (Belgium, Spain, Sweden)
- Time span $[\underline{t}, \overline{t}] = [1, 12]$
- Pooled estimator for the median response.
- Blocks-by-blocks bootstrapping keeping 5000 stationary simulations.
- Confidence interval for 16th and 84th percentiles.

Empirical Model

The empirical implementation relies in the following VAR model:

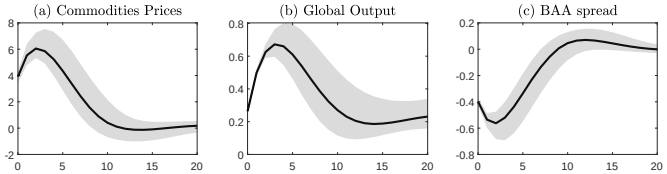
$$\begin{bmatrix} p_t^f \\ y_t^f \\ \tau_t^i \\ y_t^i \end{bmatrix} = A_1^{(i)} \begin{bmatrix} p_{t-1}^f \\ y_{t-1}^f \\ \tau_{t-1}^i \\ y_{t-1}^i \end{bmatrix} + A_2^{(i)} \begin{bmatrix} p_{t-2}^f \\ y_{t-2}^f \\ \tau_{t-2}^i \\ y_{t-2}^i \end{bmatrix} + u_{it}$$

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

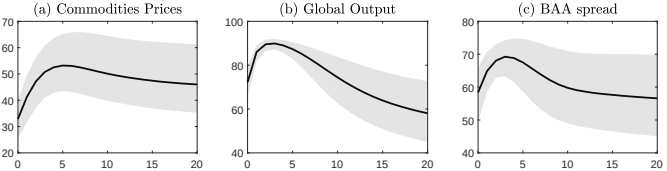


Effect of Global Component innovations on external variables

(a) Impulse-response functions



(b) Contribution to Forecast Error Variance

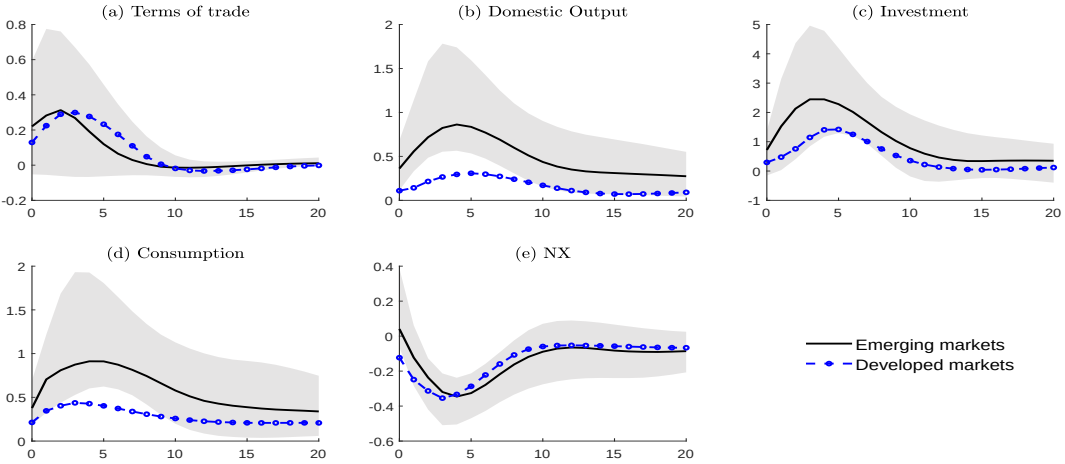


Note: The gray area is the 68 confidence interval

Response of domestic variables after a Global Component shock

table

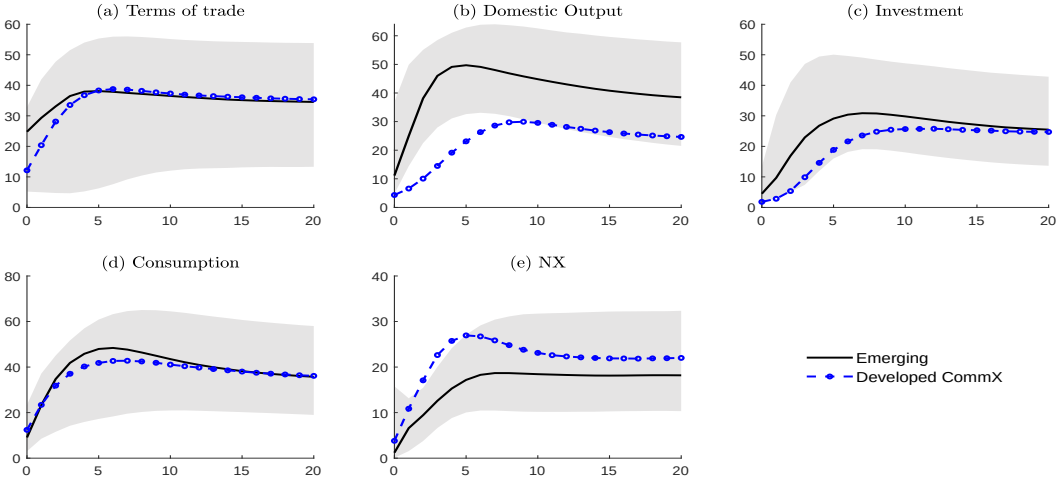
Among commodities exporters, EM exhibit larger response than developed economies.



Note: 68% confidence interval for emerging markets.

Contribution of Global Component to domestic FEV

table

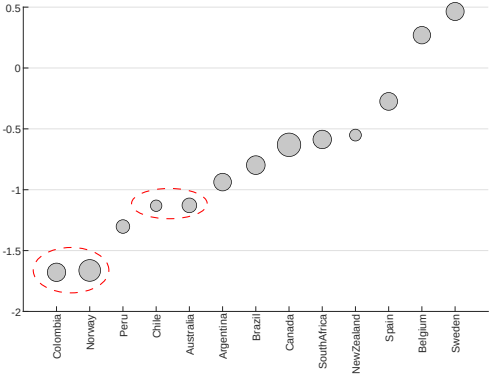


Note: 68% confidence interval for emerging markets.

$\tau = 20$ $\tau = 32$ $p = 4$

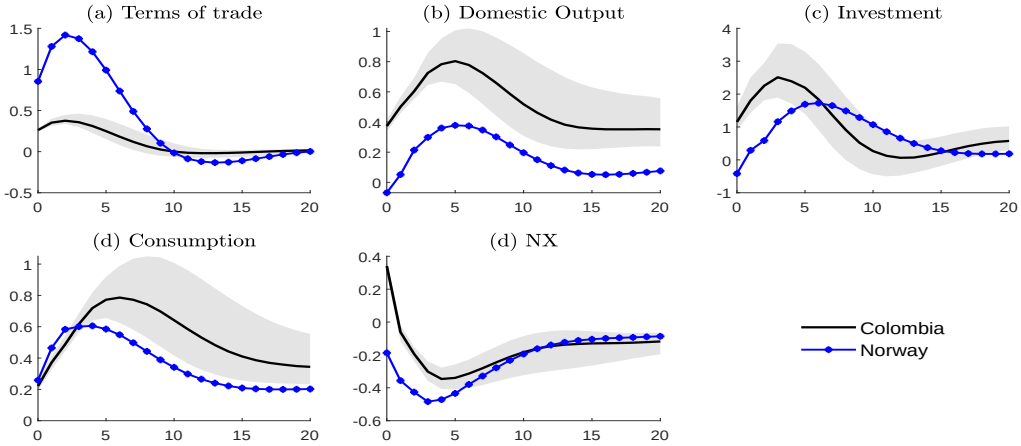
Country-specific comparison

Figure: Complexity index of Exported Goods

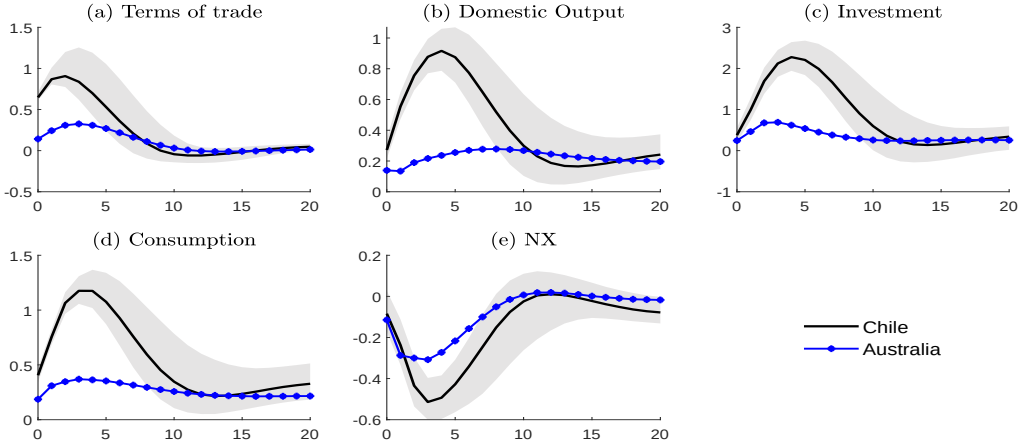


Note:: The aggregate complexity index were calculated based on 4-digits STICs complexity reported by the Atlas of Economic Complexity weigthed by the average share of each sector in their export basket since 1998. The size of the circle were adjusted by the relative variance of the serie.

Response of domestic variables to Global Shocks: Fuel Exporters

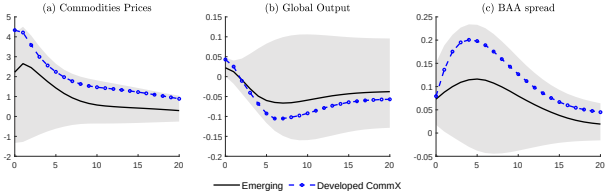


Response of domestic variables to Global Shocks: Mining Exporters

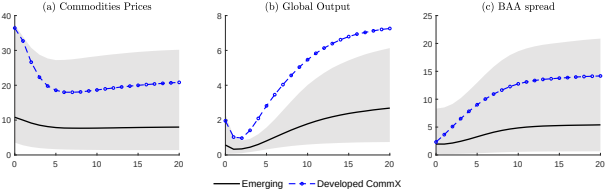


Impact of Terms of trade innovations

(a) Impulse-response functions

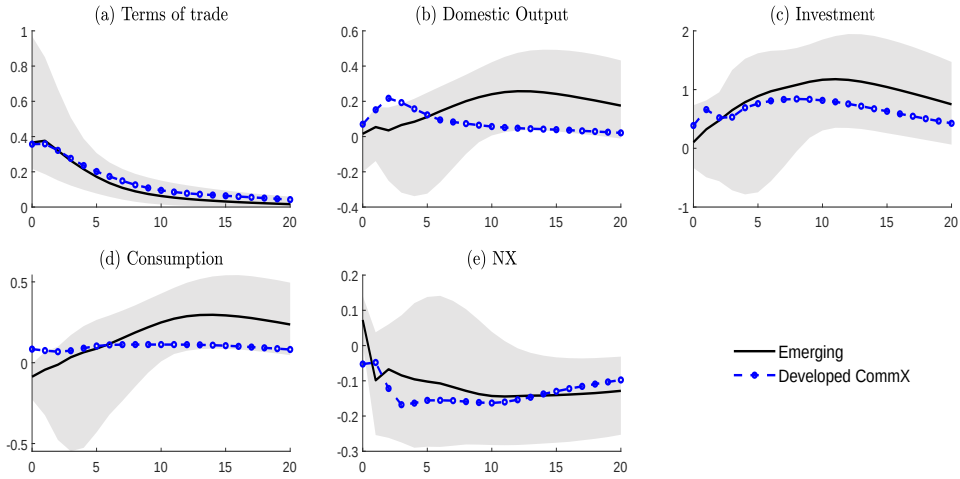


(b) Contribution to Forecast Error Variance



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

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



... which explain less than 10 percent in output and consumption,, while higher explanation power on investment. comparison

Table: Contribution of terms of trade innovation to domestic forecastability

	H	Terms of trade	Output	Investment	Consumption	NX/GDP	REER	Real Interest rate
Emerging markets	*h=1*	73.1	0.7	1.4	0.8	0.9	3.6	0.5
	h=20	57.1	5.5	12.4	5.4	9.9	7.1	4.4
	maximum	73.1	5.6	12.6	5.5	10.1	7.2	4.5
Developed Commodity Exporters	*h=1*	83.0	1.5	2.2	1.7	0.6	13.2	6.7
	h=20	59.6	7.8	19.5	6.3	13.2	18.4	7.5
	maximum	83.0	8.3	19.8	6.4	13.5	18.6	8.3
Developed Non Commodity Exporters	*h=1*	72.4	0.9	1.8	1.1	0.6	4.9	5.5
	h=20	55.2	10.8	17.5	8.2	5.0	12.7	12.1
	maximum	72.4	11.0	17.8	8.4	5.2	12.9	12.2

Robustness checks on results

I perform the additional exercises

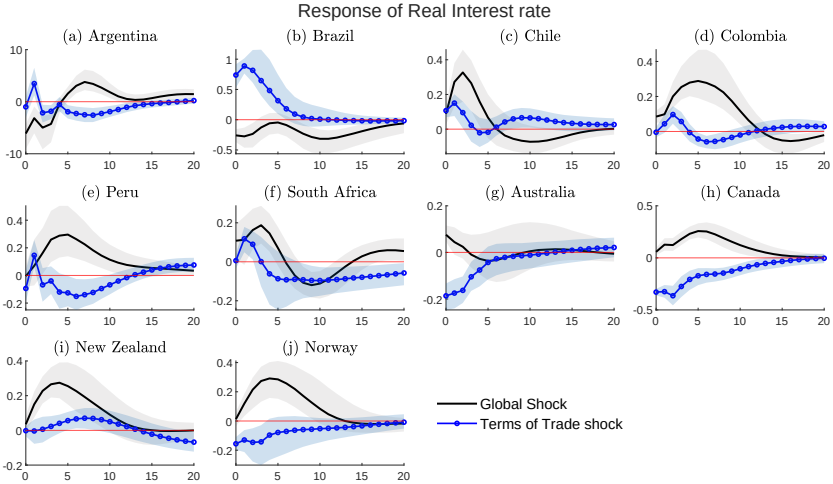
- Impact of ***common shocks*** specific to commodities prices
- Effect of ***common commodity-supply shocks*** on "Global Shocks".

Conclusions

- The proposed methodology allows to disentangle global shocks from terms of trade deviations
- Global shocks explain around one third of the forecastability for SOEs.
- Terms of trade idiosyncratic fluctuations has a small explanation power.

  $\rightarrow$ roughly 10 percent of output fluctuations.
- Conditional of being commodity exporter, exposure level to global shocks is higher for Emerging Markets

Comparison GS vs τ shock



Response of domestic variables after a Global Component shock

return

		Response to Global shocks									
		p*	y*	Baa spread	ToT	Y	I	C	NX	REER	r
Emerging markets	0				0.2	0.4	0.7	0.4	0.0	1.1	0.0
	4				0.2	0.9	2.4	0.9	-0.3	1.8	0.2
	20				0.0	0.3	0.4	0.3	-0.1	0.0	0.0
	max				0.3	0.9	2.4	0.9	-0.3	2.0	0.2
Developed commodities exporters	0	3.8	0.3	-0.4	0.1	0.1	0.3	0.2	-0.1	1.1	0.0
	4	5.0	0.7	-0.5	0.3	0.3	1.4	0.4	-0.3	1.3	0.2
	20	0.1	0.3	0.0	0.0	0.1	0.1	0.2	-0.1	0.1	0.0
	max	5.8	0.7	0.6	0.3	0.3	1.4	0.4	-0.4	2.2	0.2
Developed non commodities exporters	0				-0.2	0.2	0.0	0.2	0.1	0.3	0.0
	4				-0.2	0.7	1.7	0.4	0.0	0.1	0.0
	20				0.0	0.2	0.2	0.2	0.0	0.0	-0.1
	max				0.3	0.7	1.7	0.4	0.1	0.3	0.2

Contribution Global Component shock

return

Country Group	H	Terms of Trade	Output	Investment	Consumption	NX/GDP	REER	Real interest rate
Emerging Markets	$h = 1$	24.5	12.3	4.4	8.9	1.1	10.7	1.3
	$h = 20$	34.6	39.3	26.0	37.4	19.4	26.6	11.1
	maximum	38.0	49.4	31.1	49.2	20.0	27.0	11.2
Developed Commodity exporters	$h = 1$	12.7	4.8	1.8	13.6	3.2	22.9	0.4
	$h = 20$	36.3	24.9	22.9	37.1	20.8	32.2	15.1
	maximum	39.7	30.5	23.5	43.3	25.8	41.2	15.2
Developed Non Commodity exporters	$h = 1$	25.7	31.9	1.1	16.8	4.1	6.8	0.3
	$h = 20$	41.7	52.0	40.2	42.9	14.1	13.6	15.0
	maximum	44.4	65.2	54.2	49.4	14.2	13.7	15.2

Figure: Contribution of global conditions to domestic forecastability $\tau = 20$ return

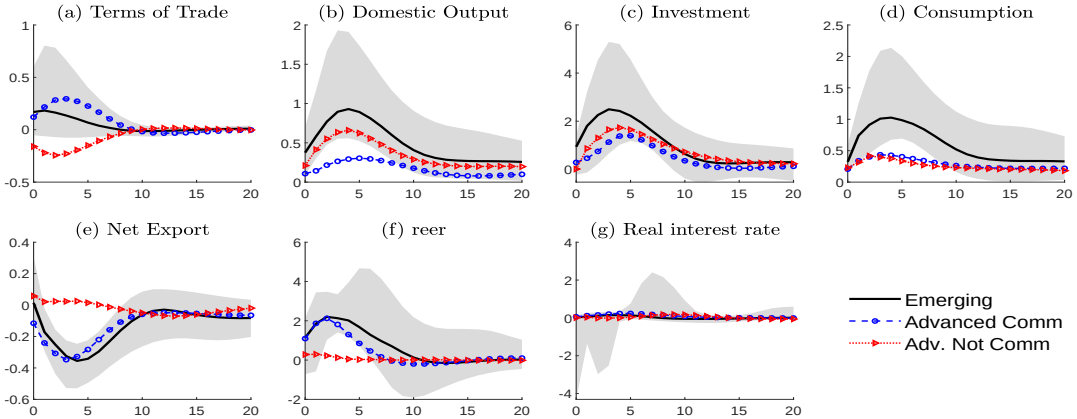


Figure: Contribution of global conditions to domestic forecastability $\tau = 32$ return

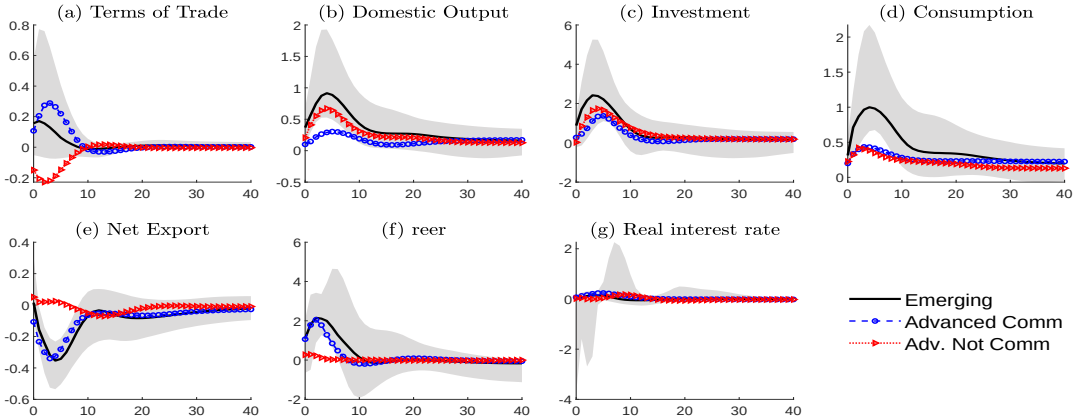
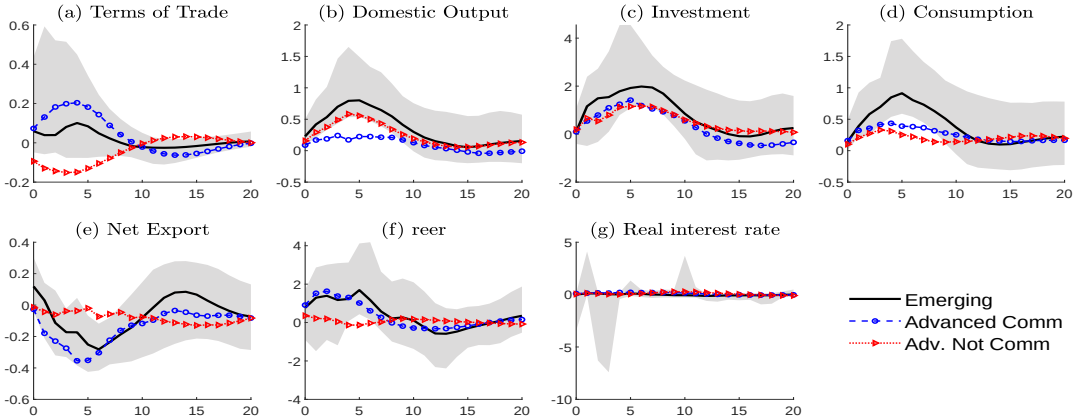


Figure: Contribution of global conditions to domestic forecastability $p = 4$ return



Impact of common shocks specific to commodities prices

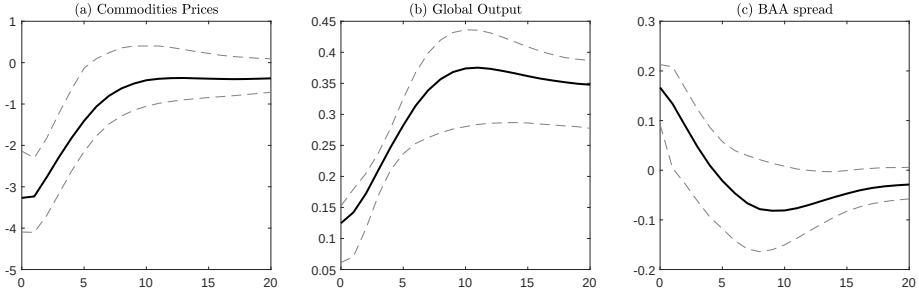
- Finding a shock that explains mostly variation of commodity prices

$$\begin{aligned} \max_{\vartheta} \quad & S_{\vartheta}^{p^f}(\underline{t}, \overline{t}) \\ \text{s.t.} \quad & \vartheta'\vartheta = 1 \\ & \vartheta'\gamma = 0 \end{aligned}$$

- The model runs with the same structure than before but without terms of trade
- It allows to identify commodities global-demand shocks.

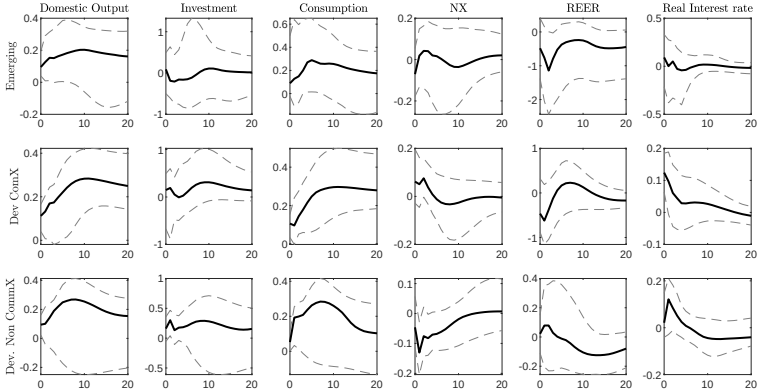
Impact of common shocks specific to commodities prices

Figure: Impact of commodities prices shock on foreign variables



Impact of common shocks specific to commodities prices

Figure: Impact of commodities prices shock on domestic variables



Common commodity-supply shocks and Global Shocks

- Following Stuermer 2018, I use a LR identification to extract supply shocks.
- I estimate the following model for 12 different commodities:

$$\begin{bmatrix}\Delta y_t^f & \Delta q_t^{(j)} & \Delta p_t^{(j)}\end{bmatrix}' = A^{(j)} \begin{bmatrix}\Delta y_{t-1}^f & \Delta q_{t-1}^{(j)} & \Delta p_{t-1}^{(j)}\end{bmatrix}' + U_{jt}$$

  y_t^f is the real global GDP, $q_t^{(j)}$ is the world production of the commodity j and $p_t^{(j)}$ its international price

- Data runs from 1900 in an annual frequency
- The identification assumes:

$$\begin{bmatrix}\Delta y_{t+\infty}^f \\ \Delta q_{t+\infty}^{(j)} \\ \Delta p_{t+\infty}^{(j)}\end{bmatrix} = \begin{bmatrix}* & 0 & 0 \\ * & * & 0 \\ * & * & *\end{bmatrix} * \begin{bmatrix}e_1 \\ e^{j,supply} \\ e^{j,demand}\end{bmatrix}$$

Common commodity-supply shocks and Global Shocks

- I extract the first principal component of the 12 identified supply shocks.
  - barley, rice, wheat, coffee, sugar, copper, lead, tin, zinc, cotton, and crude
- To make both comparable I annualized the Global shocks.
- I run a regression of GS on commodities supply shocks
- Result shows a correlation coefficient close to -0.7(significant at 1 percent) and explanation power around 32 percent.

Comparison with ToT news-augmented shocks

return

- Is this identification different from a new-augmented terms of trade approach?
- From before we have:γ and ψ_1
- Lets τ being the identification vector related with the shock that explains terms of trade variability
- For each bootstrapp replication j I calculate $\gamma^{(j)} - \tau^{(j)}$ and $\psi^{(j)} - \tau^{(j)}$

Differences among identification vectors

return