

Global Shocks: Heterogeneous Effects in Small Open Economies

Christian Velasquez

Boston College

Motivation

- Large participation of commodities in trade for SOEs. (52% in Colombia, 60 % in Norway, 40% in Australia, 50% in Chile, ...)
→ high importance of terms of trade?
- High correlation wrt. global output. ▶ cor ▶ partners
- Relevance [for policy] of knowing the source of movements.

Research question

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

This paper

- New identification strategy to “*discriminate*” between common movements and terms of trade 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 **terms of trade**:
 - Not significant impact on domestic variables with low explanation power (<10 % in output).
- Observed **asymmetries**:
 - Higher response to GS in emerging markets (~ 40 % in real variables) than in developed markets (~ 20 %)

Outline

- 1 Related Literature
- 2 Econometric Framework
- 3 Econometric Strategy
- 4 Empirical results
- 5 Robustness
- 6 Conclusions

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), ...

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 reduced form VAR representation:

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

We can write its Wold representation as:

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

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

Identification of Global shocks

- Let $S^i(\underline{t}, \bar{t})$ being the cumulative forecast error variance of the i variable during the time span $[\underline{t}, \bar{t}]$

$$S^i(\underline{t}, \bar{t}) = \sum_{h=\underline{t}}^{\bar{t}} \sum_{s=0}^h \mathbb{E} \left[(Y_{t+s} - E[Y_{t+s,t}])^2 \right]$$

- Then, we can define $S^i_{\gamma}(\underline{t}, \bar{t})$ as the share explained by the shock γ
- Common approach: Finding γ^* that maximizes one-specific $S^i_{\gamma}(\underline{t}, \bar{t})$
- In this paper: I exploit the variability of the whole foreign bloc.

Identification of Global shocks

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

$$\begin{aligned} \max_{\gamma} \quad & \sum_{i \in y^f} \frac{S^i(\underline{\tau}, \bar{\tau} | \gamma)}{S^i(\underline{\tau}, \bar{\tau})} \\ \text{s.t.} \quad & \gamma' \gamma = 1 \end{aligned}$$

After some algebra γ^* is the maximum eigenvalue of

$$\xi = \sum_{i \in f} \omega_i \sum_{h=\underline{t}}^{\bar{t}} \sum_{s=0}^h R_s'^{(i)} R_s^{(i)}$$

which is a weighted sum of cumulative FEVs with $\omega_i = \left(\prod_{j=1, j \neq i}^{n^*} S^j(\underline{\tau}, \bar{\tau}) \right)$

Identification of ToT innovations

After γ^* is identified, we can isolate the main drive of the remaining variance in terms of trade:

$$\begin{aligned} \psi^* = \underset{\psi}{\operatorname{argmax}} \quad & \psi' \Lambda^{(i)} \psi \\ \text{s.t.} \quad & \psi' \psi = 1 \\ & \psi' \gamma = 0 \end{aligned}$$

This problem takes the form:

$$\Lambda_{\Xi} * \varphi = \lambda \Xi \varphi$$

where $\chi \varphi = \psi$, $\Lambda_{\Xi} = \chi' \Lambda^{(tot)} \chi'$, and $\Xi = \chi' \chi$ with χ being a matrix that ensures orthogonality.

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
- 3 groups of Small Open Economies:
 - **Emerging Com. Exporters:** Argentina, Brazil, Chile, Colombia, Peru, and South Africa.
 - **Developed Com. Exporters:** Australia, Canada, New Zealand, and Norway.
 - **Developed No Com. Exporters:** Belgium, Spain, Sweden

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: $A_j^{(i)} = \begin{bmatrix} * & * & 0 & 0 \\ * & * & 0 & 0 \\ 0 & * & * & 0 \\ 0 & * & * & * \end{bmatrix}$

$\tau_t^{(i)}$ is the terms of trade index

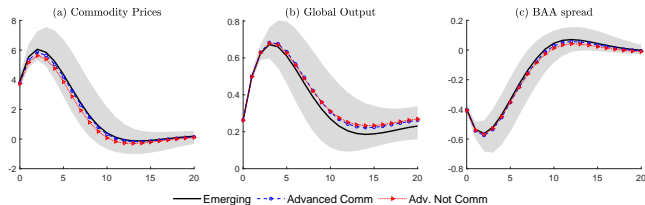
$y_t^{(i)}$ is a vector of domestic variables (GDP, consumption, investment, nx, q and r)

Estimation

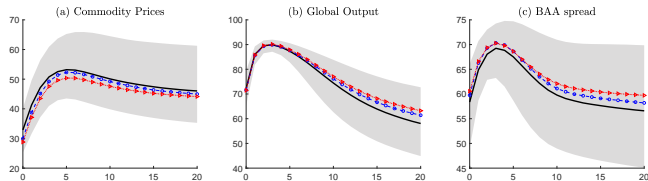
- Country specific VARs with two lags.
- Estimation in levels (checking stationarity).
- Blocks-by-blocks bootstrapping keeping 5000 stationary simulations.
- Pooled estimator for the median response.
- Confidence interval for 16th and 84th percentiles.

Effect of Global Component innovations on external variables

(a) Impulse-response functions



(b) Contribution to Forecast Error Variance

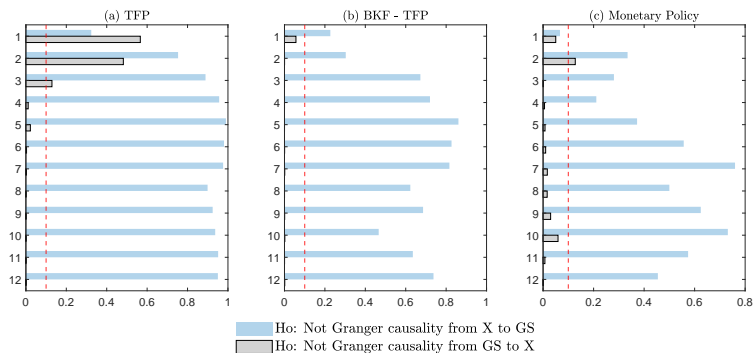


Note: The gray area is the 68 confidence interval for emerging markets

The global shock nature

The identified global shock causes *à la* Granger to broadly used shocks.

Figure: Granger Causality Test

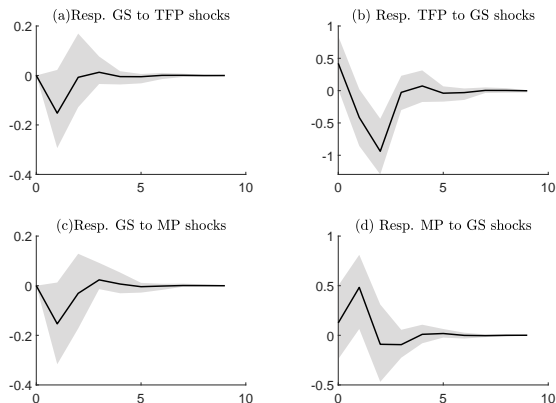


Note: The Granger causality tests were conducted for bivariate models under different lag structures. Under the null hypothesis, all the coefficients associated to lags of the other variable are equal to zero. The black outline bars are the significance levels of the null hypothesis under which Global Shocks lags are not helpful to predict movements in TFP/Monetary shocks. The skyblue bars are the significance level for the null hypothesis of TFP/MP lags are not helpful for predict global shocks. The dotted red line are the pvalue of 10 percent.

The global shock nature II

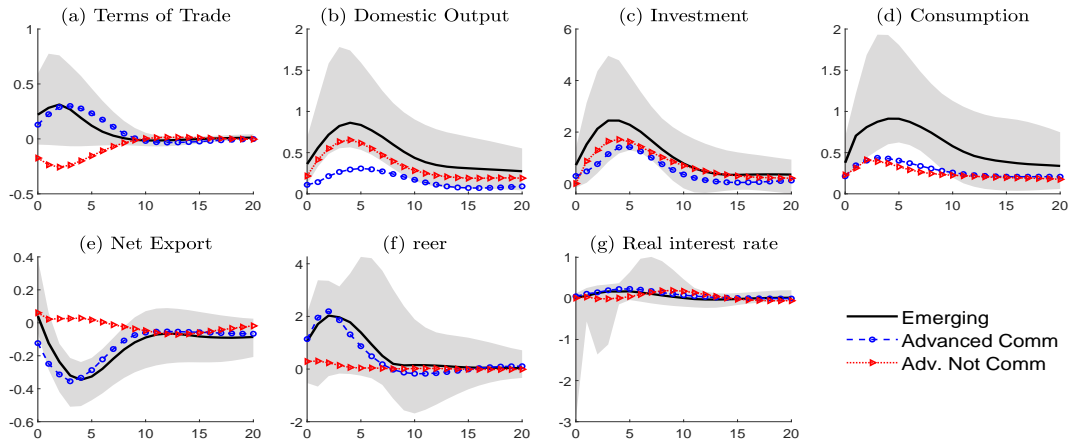
Possibly, global shocks are associated with improvement in expectations.

Figure: Impulse response functions



Response of domestic variables after a Global Component shock [▶ table](#) [▶ check](#)

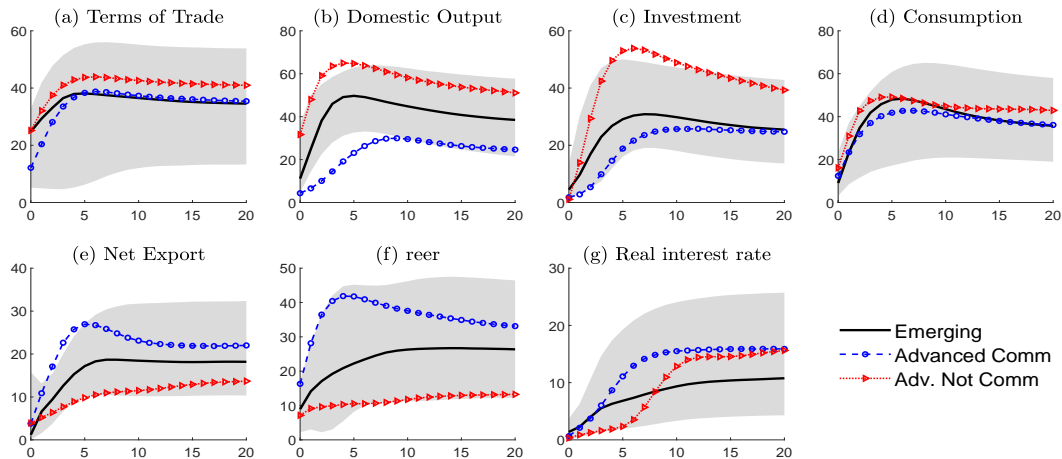
Among commodities exporters, EM exhibit larger response than developed economies.



Note: 68% confidence interval for emerging markets.

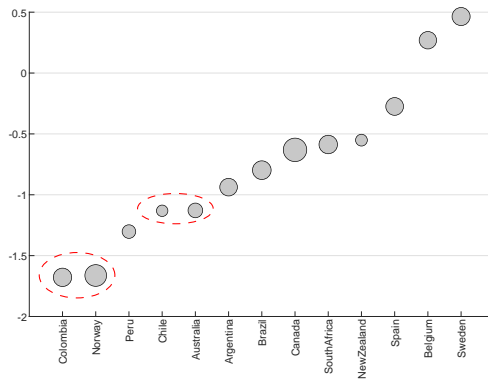
Contribution of Global Component to domestic FEV [▶ table](#) [▶ check](#)

Similar story in terms of volatility (except for consumption)



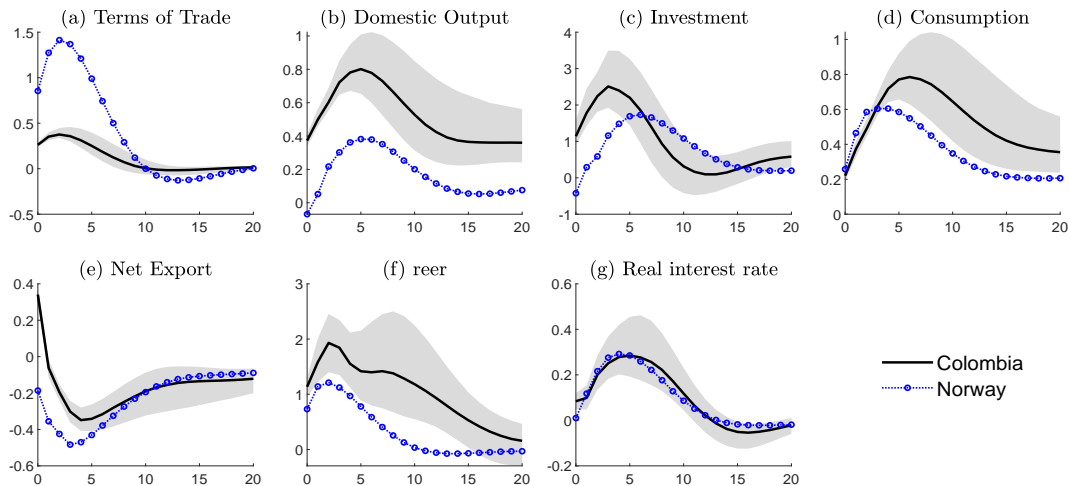
Complexity index of Exported Goods

Figure: Complexity index of Exported Goods

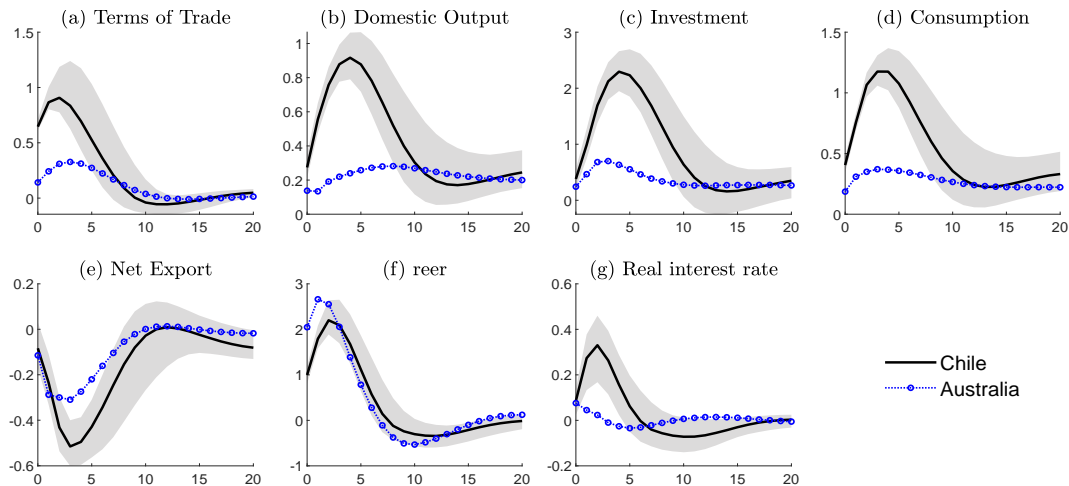


Note:: The aggregate complexity index were calculated based on 4-digits STICs complexity reported by the Atlas of Economic Complexity weighed by the average share of each sector in their export basket since 1998. The size of the circle were adjusted by the relative variance of the serie.

Response of domestic variables to Global Shocks: Fuel Exporters

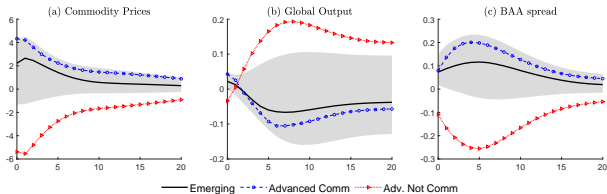


Response of domestic variables to Global Shocks: Mining Exporters

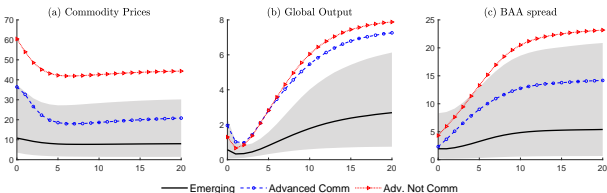


ToT: Opposite response between commodity and non-commodity exporters.

(a) Impulse-response functions

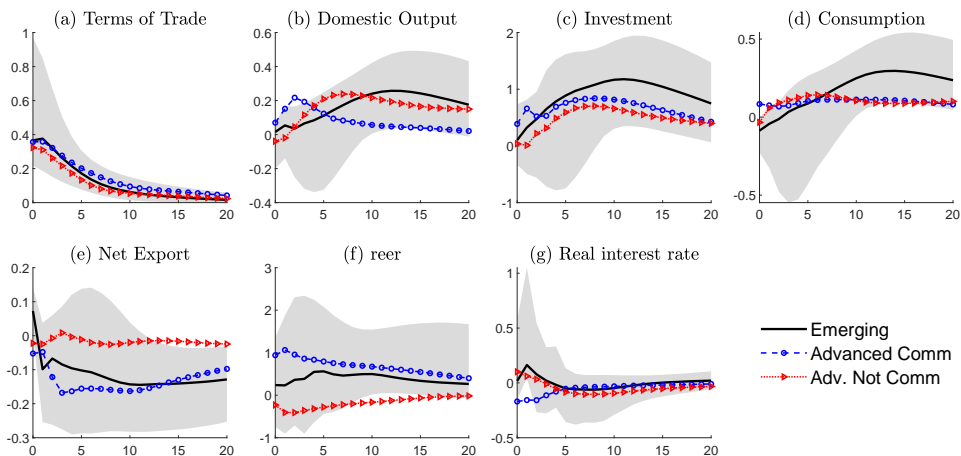


(b) Contribution to Forecast Error Variance



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

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

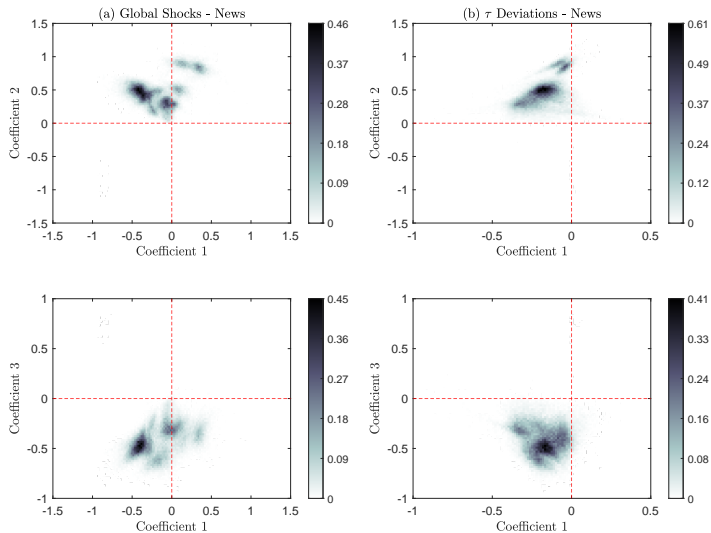


... which explain less than 10 percent in output and consumption,, while higher explanation power on investment.

Table: Contribution of terms of trade innovation to domestic forecastability

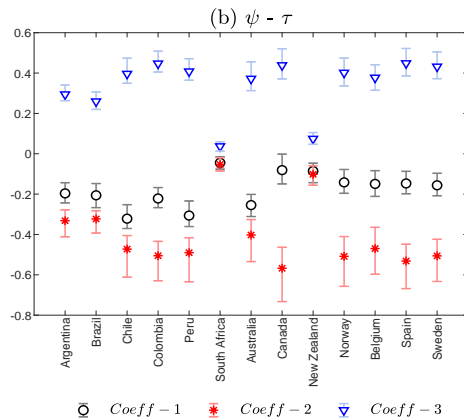
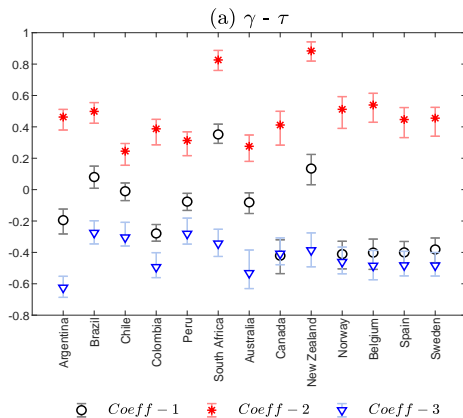
	H	Terms of trade	Output	Investment	Consumption	NX/GDP	REER	Real Interest rate
Emerging markets	<i>h=1</i>	73.1	0.7	1.4	0.8	0.9	3.6	0.5
	<i>h=20</i>	57.1	5.5	12.4	5.4	9.9	7.1	4.4
	<i>maximum</i>	73.1	5.6	12.6	5.5	10.1	7.2	4.5
Developed Commodity Exporters	<i>h=1</i>	83.0	1.5	2.2	1.7	0.6	13.2	6.7
	<i>h=20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

Differences with respect to only terms of trade news?

[▶ Table](#)

Comparison with terms of trade news by country

Figure: Methodology comparison, by country

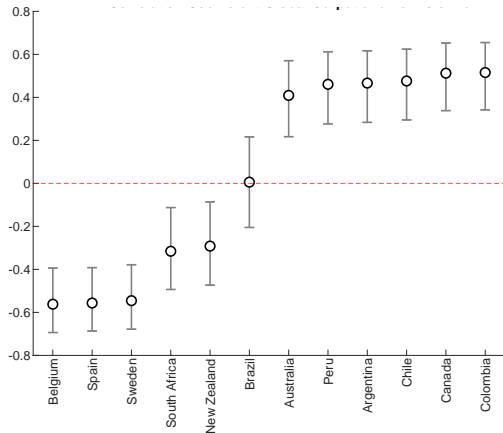


Conclusions

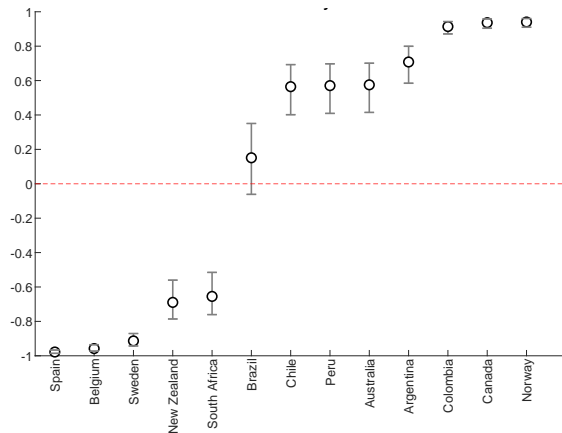
- The proposed methodology allows to disentangle global shocks from terms of trade deviations
- Global shocks explain almost 40 percent of output forecastability
- Terms of trade fluctuations explanation power reduces after control for common components
 - roughly 10 percent of output fluctuations.
- 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](#)



Main trade partners by country [▶ return](#)

Country	Partner	Share	Country	Partner	Share
Argentina	Brazil	17.9	South Africa	China	14.6
	China	14.1		Germany	8.9
	USA	9.1		USA	6.8
Brazil	China	24.3	Australia	China	32.8
	USA	16.1		Japan	11.3
	Argentina	5.0		USA	7.5
Colombia	USA	27.8	Canada	USA	63.0
	China	16.8		China	8.2
	Mexico	5.7		Mexico	3.7
Chile	China	28.1	New Zealand	China	23.9
	USA	16.5		Australia	13.0
	Brazil	6.3		USA	9.7
Peru	China	26.9	Norway	United Kingdom	13.3
	USA	16.4		Germany	12.8
	Brazil	4.4		Sweden	9.5

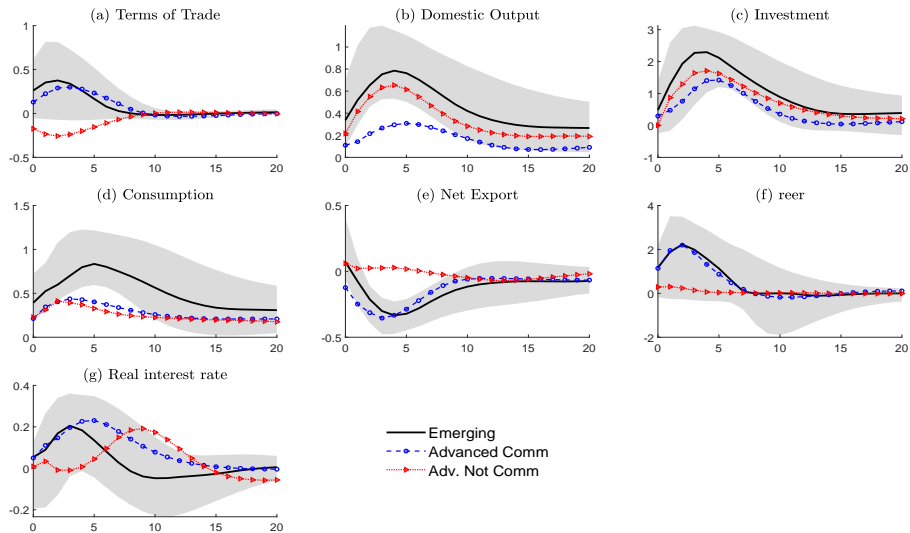
Response of domestic variables after a Global Component shock [▶ return](#)

		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

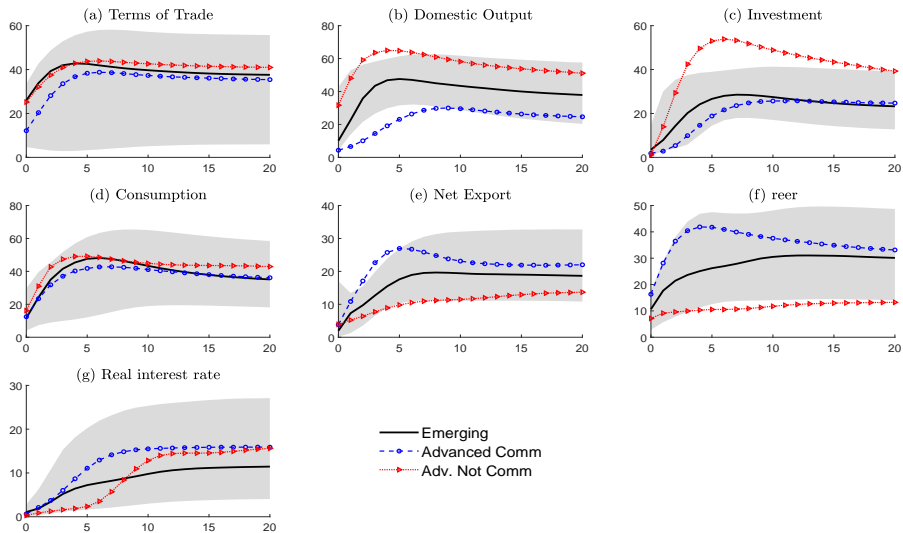
Contribution Global Component shock [► return](#)

		Contribution of Global shocks									
		p*	y*	Baa spread	ToT	Y	I	C	NX	REER	r
Emerging markets	0				24.8	11.1	4.5	9.1	1.2	8.9	1.4
	4				37.9	49.1	26.8	45.8	15.3	20.9	6.3
	20				34.5	38.5	25.5	35.7	18.2	26.4	10.8
	max				38.1	49.7	30.9	48.4	18.7	26.7	10.8
Developed commodities exporters	0	29.9	71.6	59.7	12.1	4.3	1.8	12.4	3.8	16.3	0.6
	4	51.4	89.1	69.9	36.7	19.1	14.6	40.3	25.7	41.9	8.7
	20	45.0	61.4	58.2	35.4	24.6	24.7	36.1	22.0	33.1	15.9
	max	52.3	89.9	70.3	38.8	29.9	25.8	42.8	27.0	41.9	15.9
Developed non commodities exporters	0				25.2	31.7	1.1	16.2	3.9	7.1	0.3
	4				42.9	65.0	49.6	49.0	8.9	10.3	1.9
	20				41.0	51.1	39.3	42.9	13.7	13.2	15.6
	max				43.9	65.0	53.9	49.2	13.7	13.2	15.6

Response of domestic variables after a Global Component shock ▶ return



Contribution of global conditions to domestic forecastability [▶ return](#)







Appendix





Figure: Contribution of global conditions to domestic forecastability [▶ return](#)

		News of Terms of Trade							Terms of Trade deviations						
		ToT	Y	I	C	NX	REER	r	ToT	Y	I	C	NX	REER	r
Emerging markets	0	95.5	5.7	2.9	2.5	2.2	6.7	1.1	73.1	0.7	1.4	0.8	0.9	3.6	0.5
	4	97.4	19.4	20.3	11.5	8.4	7.2	6.8	61.3	1.9	5.0	1.7	3.0	4.7	2.4
	20	89.8	24.9	26.1	18.5	17.2	14.8	9.6	57.0	5.6	12.6	5.5	10.1	7.2	4.5
	max	97.9	24.9	26.1	18.5	17.2	14.8	9.6	73.1	5.6	12.6	5.5	10.1	7.2	4.5
Developed commodities exporters	0	92.0	3.6	2.3	10.4	2.2	39.1	3.3	83.0	1.5	2.2	1.7	0.6	13.2	6.7
	4	97.0	18.7	16.3	24.2	16.4	39.8	4.1	61.5	8.0	7.2	2.2	7.5	12.5	8.0
	20	90.0	27.7	31.9	30.2	22.6	37.2	6.9	59.6	7.8	19.8	6.4	13.5	18.6	7.6
	max	97.2	32.1	31.9	30.9	22.6	40.1	6.9	83.0	8.3	19.8	6.4	13.5	18.6	8.3
Developed non commodities exporters	0	95.8	19.2	3.1	10.2	3.4	9.1	3.7	72.4	0.9	1.8	1.1	0.6	4.9	5.5
	4	97.8	19.7	13.3	18.0	8.8	19.5	4.5	55.8	2.6	3.8	4.2	2.2	10.4	4.9
	20	91.5	13.6	12.6	12.9	12.3	19.4	19.7	55.2	11.0	17.8	8.4	5.2	12.9	12.2
	max	98.2	24.3	13.5	18.8	12.3	19.9	20.1	72.4	11.0	17.8	8.4	5.2	12.9	12.2




References I

-  Paul Beaudry and Franck Portier, *Stock prices, news, and economic fluctuations*, The American Economic Review **96** (2006), no. 4, 1293–1307.
-  Nadav Ben Zeev, Evi Pappa, and Alejandro Vicondoa, *Emerging economies business cycles: The role of commodity terms of trade news*, Journal of International Economics **108** (2017), 368 – 376.
-  Thomas Drechsel and Silvana Tenreyro, *Commodity booms and busts in emerging economies*, Journal of International Economics **112** (2018), 200 – 218.
-  Richard Finlay and Jarkko P. Jääskelä, *Credit supply shocks and the global financial crisis in three small open economies*, Journal of Macroeconomics **40** (2014), 270 – 276.

References II

-  Andrés Fernández, Stephanie Schmitt-Grohé, and Martín Uribe, *World shocks, world prices, and business cycles: An empirical investigation*, Journal of International Economics **108** (2017), S2 – S14, 39th Annual NBER International Seminar on Macroeconomics.
-  Javier García-Cicco, Roberto Pancrazi, and Martín Uribe, *Real business cycles in emerging countries?*, American Economic Review **100** (2010), no. 5, 2510–31.
-  Nir Jaimovich and Sergio Rebelo, *News and business cycles in open economies*, Journal of Money, Credit and Banking **40** (2008), no. 8, 1699–1711.
-  Güneş Kamber, Konstantinos Theodoridis, and Christoph Thoenissen, *News-driven business cycles in small open economies*, Journal of International Economics **105** (2017), 77 – 89.

References III

-  Stephanie Schmitt-Grohé and Martín Uribe, *How important are terms of trade shocks?*, Working Paper 21253, National Bureau of Economic Research, June 2015.
-  S. Shousha, *Macroeconomic effects of commodity booms and busts : The role of financial frictions job market paper*, 2016.
-  Harald Uhlig, *Do Technology Shocks Lead to a Fall in Total Hours Worked?*, Journal of the European Economic Association **2** (2004), no. 2-3, 361–371.