Commodity shocks with diverse impacts: how can different central banks tailor their policies?

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Background

- More frequent and/or virulent shocks to prices of commodities and critical inputs. Supply shortages caused by:
  - Geopolitical events
  - Climate-related events
- Other policies need to be put in place to deal with shortages and price swings
- Monetary policy needs to address the residual impact not tackled by other policies

The Question

How does the inflation targeting framework, supported with fully flexible ER, fare in an environment subject to commodity price swings?

Perspectives of

- Advanced economies that are commodity exporters
- Emerging and developing economies that are commodity exporters
- Advanced economies that are commodity importers
- Emerging and developing economies that are commodity importers

Model summary: starting point

- Small open economy New Keynesian setting building on Svensson (2000), Obstfeld and Rogoff (1995) and Gali and Monacelli (2005)
  - Forward looking households maximise their utility over consumption and leisure choices as well as asset holdings, subject to their budget constraints
  - Firms optimise profits, given technology
  - There is monopolistic competition in the domestic good sector and prices are sticky

Model summary: commodities and financial markets

- Commodities are traded in globally competitive markets. Prices are flexible.
- Commodities enter the import and/or export baskets (Hevia and Nicolini, 2003)
- They are used in consumption or as an input in production (e.g., Guerrieri, Marcussen, Reichlin and Tenreyro, 2023)
- Imperfect global financial markets (different from Gali-Monacelli's perfect risk sharing)
- Critically, risk premium in international financial markets may be affected by commodity prices
  - Captures pro-cyclicality of credit - e.g., when soy prices increase, Argentina can borrow at better terms (Drechsel and Tenreyro, 2018)

Commodity prices and Argentine real spreads

- Simple correlation: -0.78
- Range of semi-elasticicities from regressions using different measures and various controls: -0.23 to -0.31. Regression table
- Evidence for other countries, e.g. Bastourre et al (2012)

Linearized model

Households.

$$
\begin{aligned}
\hat{c}_{h,t} &= \alpha\hat{\tau}_t + \hat{c}_t \\
\hat{c}_{f,t} &= (\alpha-1)\hat{\tau}_t + \hat{c}_t \\
\hat{c}^*_{h,t} &= \hat{\tau}_t - \alpha_{\tilde{c}}\hat{p}^*_{\tilde{c},t} + \hat{c}^*_t \\
\hat{c}_{nc,t} &= \hat{p}_{f,t} - \hat{p}_{nc,t} + \hat{c}_{f,t} \\
\hat{c}_{\tilde{c},t} &= \hat{p}_{f,t} - \hat{p}_{\tilde{c},t} + \hat{c}_{f,t} \\
\varphi\hat{n}_t + \hat{c}_t &= \hat{w}_t - \hat{p}_t \\
\hat{c}_t &= -(i_t - \mathbb{E}_t\hat{\pi}_{t+1}) + \mathbb{E}_t\hat{c}_{t+1} \\
i_t - \mathbb{E}_t\hat{\pi}_{t+1} &= i^*_t - \mathbb{E}_t\hat{\pi}^*_{t+1} + \mathbb{E}_t\hat{s}_{t+1} - \hat{s}_t + \hat{\phi}_t \\
\hat{\phi}_t &= \phi_{\tilde{c}}\hat{p}_{\tilde{c},t} - \phi_c\hat{p}_{c,t} - \phi_B\hat{b}_t \\
\beta\hat{b}_t - \hat{b}_{t-1} &= \frac{s_{m,ss}}{\nu}(\hat{y}_{c,t} + \hat{p}^*_{c,t}) + s_{c^*,ss}\hat{c}^*_t + \\
&\quad -\mu(\hat{x}_{\tilde{c},t} + \hat{p}^*_{\tilde{c},t}) - \frac{\alpha s_{c,ss}}{1-\alpha}(\hat{c}_{f,t} + \alpha_{\tilde{c}}\hat{p}^*_{\tilde{c},t})
\end{aligned}
$$

Prices and resource constraint.

$$
\begin{aligned}
\hat{p}_t &= \alpha\hat{p}_{f,t} + (1-\alpha)\hat{p}_{h,t} \\
\hat{p}_{f,t} &= \alpha_{\tilde{c}}\hat{p}_{\tilde{c},t} + (1-\alpha_{\tilde{c}})\hat{p}_{nc,t} \\
\hat{\tau}_t &= \hat{p}_{f,t} - \hat{p}_{h,t} \\
\hat{s}_t &= (1-\alpha)\hat{\tau}_t - \alpha_{\tilde{c}}\hat{p}^*_{\tilde{c},t} \\
\Delta\hat{e}_t &= \Delta\hat{s}_t + \hat{\pi}_t - \hat{\pi}^*_{f,t} \\
\hat{y}_{h,t} &= s_{c,ss}\hat{c}_{h,t} + s_{c^*,ss}\hat{c}^*_{h,t} + s_{m,ss}\hat{m}_{h,t}
\end{aligned}
$$

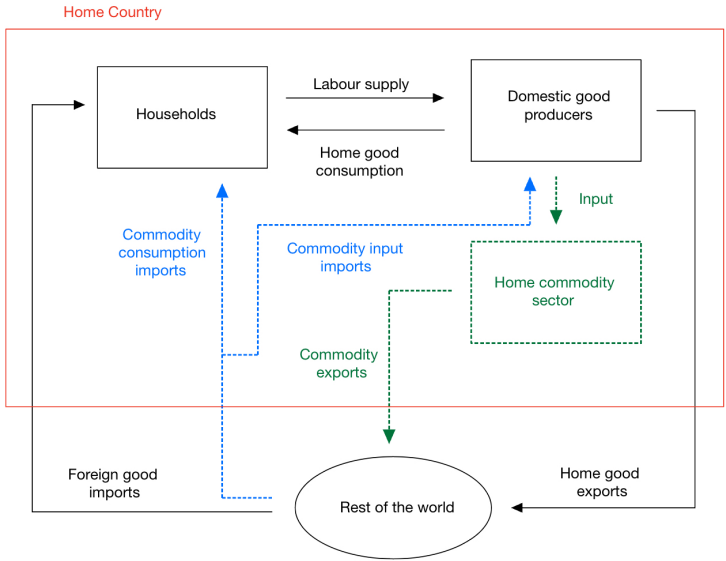
Domestic goods sector.

$$
\begin{aligned}
\hat{y}_{h,t} &= \hat{a}_{h,t} + (1-\mu)\hat{n}_t + \mu\hat{x}_{\tilde{c},t} \\
\hat{\pi}_{h,t} &= \beta\mathbb{E}_t\hat{\pi}_{h,t+1} + \kappa\hat{m}c_t \\
\hat{m}c_t &= (1-\mu)(\hat{w}_t - \hat{p}_t) + \mu(\hat{p}^*_{\tilde{c},t} + \hat{s}_t) + \alpha\hat{\tau}_t - \hat{a}_{h,t} \\
\hat{x}_{\tilde{c},t} &= \hat{n}_t + (\hat{w}_t - \hat{p}_t) - (\hat{p}^*_{\tilde{c},t} + \hat{s}_t)
\end{aligned}
$$

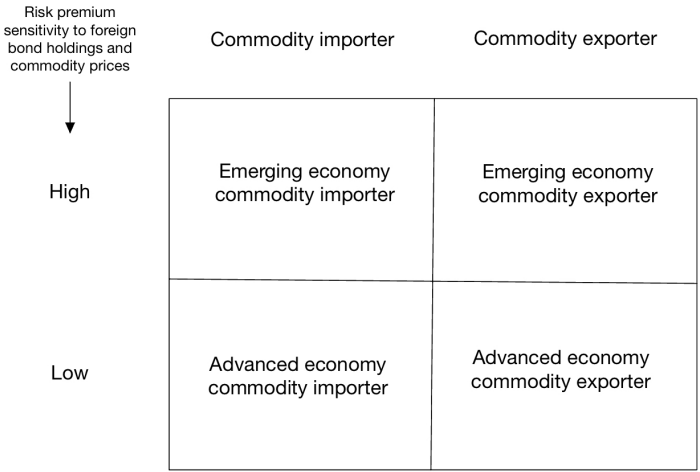
Commodity export sector.

$$
\begin{aligned}
\hat{y}_{c,t} &= \hat{a}_{c,t} + \nu\hat{m}_{h,t} \\
(1-\nu)\hat{m}_{h,t} &= \hat{p}^*_{c,t} + \alpha\hat{\tau}_t + \hat{s}_t + \hat{a}_{c,t}
\end{aligned}
$$

Productive structure of the economy



Types of economies



Policy Frameworks

1. Fixed exchange rate regime
2. Flexible exchange rate regime. Taylor rules:
   - Weight on CPI inflation
   - Weight on Domestic Price Inflation

Compare outcomes with efficient allocation (from a "national" social planner perspective. Future: global social planner)

Channels reflected in the trade balance

The linearised trade balance can be written as

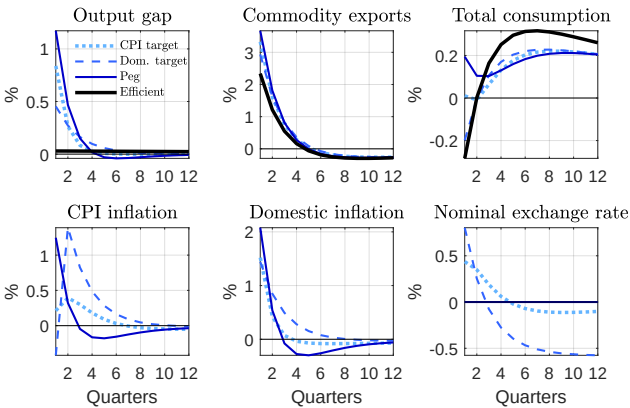
$$\hat{tb}_t = \frac{s_{m,ss}}{\nu}(\underbrace{\hat{p}^*_{c,t}}_{1} + \underbrace{\hat{y}_{c,t}}_{2}) + s_{c^*,ss}\hat{c}^*_t - \mu(\hat{x}_{\tilde{c},t} + \underbrace{\hat{p}^*_{\tilde{c},t}}_{3}) - \frac{\alpha s_{c,ss}}{1-\alpha}(\underbrace{\hat{c}_{f,t}}_{5} + \underbrace{\alpha_{\tilde{c}}\hat{p}^*_{\tilde{c},t}}_{4}),$$

1. For an exporter, increase in $\hat{p}^*_{c,t}$ leads to **windfall income channel**.
2. Expansion in output ($\hat{y}_{c,t}$) until (upward sloping) marginal cost equals the new, higher price, via an **export supply channel**.
3. For an importer a rise in $\hat{p}^*_{\tilde{c},t}$ makes production more costly via a **domestic production channel**.
4. The same import basket becomes more costly, by $\alpha_{\tilde{c}}\hat{p}^*_{\tilde{c},t}$, worsening the trade balance - a **direct consumption channel**.
5. A **risk premium channel**

Calibration

Parameter	Description	**Value**	**Calibration target/source**
$1-\alpha$	Home bias	0.6	Gali and Monacelli (2005)
ϕ	Inverse Frisch elasticity	3	Gali and Monacelli (2005)
β	Discount factor	0.996	Steady state interest rate $\approx 1.5\%$
$1-\theta$	Price re-set probability	0.25	Standard value for Calvo pricing
ϵ	Elasticity of substitution	6	Gives markup of 20%
ν	Returns of scale in comm. prod.	0.6	Gives $s_{m,ss} = 0.4$

Advanced economy comm. exporter - export price shock



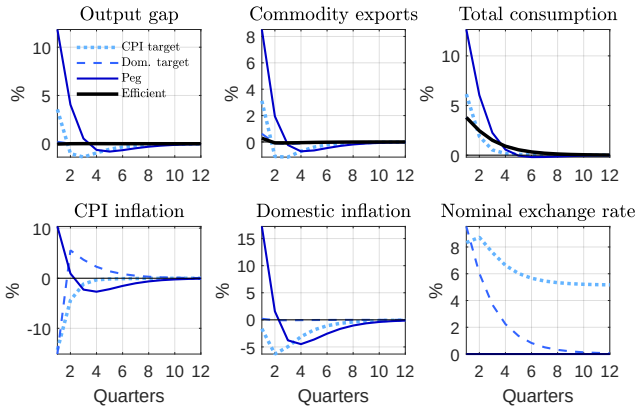
- Peg amplifies boom; output gap is too high compared to efficient allocation
- Efficient allocation would call for bigger appreciation
- Inflation-based Taylor rules dominate peg

Advanced economy comm. exporter - export price shock

implied standard deviations across policies

	CPI inf. target	**Dom. inf. target**	**Nominal peg**
CPI inflation	0.15	0.44	0.33
Domestic inflation	0.40	0.44	0.56
Efficient output gap	0.86	0.52	1.25

EME/DE commodity exporter - export price shock



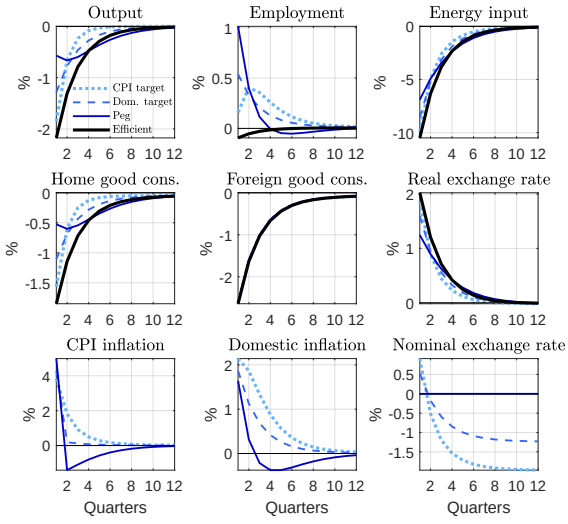
- Fall in risk premium exacerbates the consumption boom and creates a more difficult trade-off for policy makers
- Peg is by far the worst option, leading to enormous boom and domestic inflation overshoot.

EME/DE commodity exporter - export price shock

implied standard deviations across policies

	CPI inf. target	Dom. inf. target	Nominal peg
CPI inflation	3.75	4.20	2.84
Domestic inflation	2.26	0.09	4.73
Efficient output gap	4.16	0.23	12.54

ADVANCED ECONOMY COMM. IMPORTER - IMPORT PRICE SHOCK



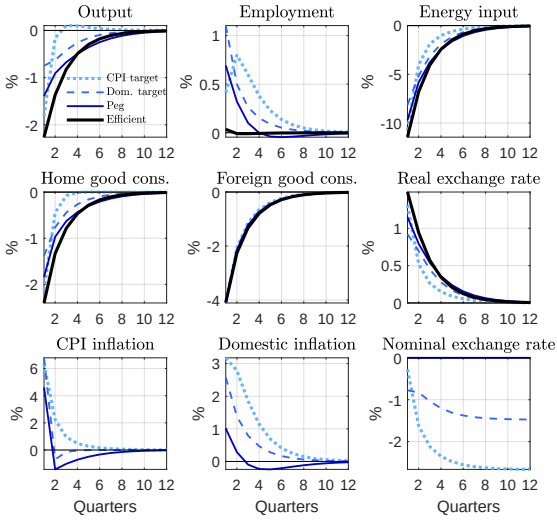
- Efficient allocation implies little change in employment, lower imports and output
- All rules are a bit loose relative to efficient allocation
- No big difference across policies. Increasing weight on Taylor rule (domestic IT) should get closer to the efficient allocation

Advanced economy comm. importer - import price shock

implied standard deviations across policies

	CPI inf. target	**Dom. inf. target**	**Nominal peg**
CPI inflation	1.09	1.07	1.35
Domestic inflation	0.83	0.59	0.46
Efficient output gap	1.07	1.14	1.78

EME/DE commodity importer - import price shock



- Peg does better than Taylor rules at stabilising inflation
- Risk premium increases less under the peg
- Even with extreme Taylor coefficients, peg still stabilises domestic inflation better than CPI rule.

EME/DE commodity importer - energy import price shock

implied standard deviations across policies

	CPI inf. target	Dom. inf. target	Nominal peg
CPI inflation	1.70	1.71	1.26
Domestic inflation	1.21	0.77	0.29
Efficient output gap	1.75	1.76	1.00

Tentative conclusions

- Some form of IT performs better than pegs in response to commodity shocks under 3 of the 4 model configurations.
  - For AE comodity *exporters*, pegs create more volatility in inflation and output.
  - For EME/DE comodity *exporters*, volatility is amplified by an endogenous loosening of financial conditions, made worse by the peg. Domestic IT achieves a better balance.
  - For AE commodity *importers*, there is a smaller difference between the various policies.
  - For EME/DE comodity *importers*, there are some more distinct advantages to the exchange rate peg. A rise in the risk premium leads to a more depreciated currency under inflation targeting rules, which the peg prevents. By doing so, the peg is able to limit the volatility in both domestic and CPI inflation, relative to Taylor rules targeting those variables

Next Steps

- Individually, despite different exposure to commodity price shocks, "national" social planners want to appreciate.
- Not feasible globally
  - In equilibrium, more of the adjustment happens via global interest rates
  - To explore: policy coordination
  - In the context of the war in Ukraine, perhaps currencies could have appreciated vis-a-vis the USD given that the US is self-sufficient in gas. But another large development blurring the picture: US fiscal stimulus.
- Two big omissions: lags and inertia from wage catch-up effects.

Outside of the Model

- Other policies suitable to tackle climate and geopolitical shocks

- Need for a "real-side" policy strategy to prevent, mitigate and cope with geopolitical or climate related shocks
  1. Investment on technological diversification, focused on low substitutability inputs or technologies (Koren and Tenreyro, 2010)

  2. Deeper trade integration with low geopolitical-risk countries to lower exposure to domestic shocks to specific suppliers/buyers, reducing volatility (Caselli, Koren, Lisicky, and Tenreyro, 2020)

  3. Inventory base to prepare for shortages in critical inputs (energy, water, etc.)

Back to torsten and ulf's questions

- Is IT with full exchange rate flexibility the best practice?
  - Or are there situations in which the central bank should intervene and lean against exchange-rate movements?
  - Should exchange rate stability be part of nominal stability? Does the answer differ for large/small or developed/developing economies?

- Obstfeld (2002, 2020) provide thorough answers to these questions. Take away: ER flexibility is the soundest option.

- We look at commodity shocks and their interaction with risk premia. Take away: IT with ER flexibility most beneficial option, with the exception of commodity importers, where there are some advantages to the peg, as it is able to limit the volatility in both domestic and CPI inflation, relative to the calibrated Taylor rules.

Commodity prices and Argentine real spreads

	(1)	(2)	(3)	(4)	(5)
LHS variable	Real spread (based on World Bank measure)				
Commodity price	-0.278***	-0.233***	-0.307***	-0.313***	-0.260***
	(0.073)	(0.065)	(0.080)	(0.077)	(0.070)
Output growth		-0.668**			-0.664**
		(0.236)			(0.235)
Trade balance			-0.273		0.231
			(0.306)		(0.508)
Debt-to-GDP ratio				-0.058	-0.087
				(0.046)	(0.079)
Constant	0.049**	0.054***	0.055***	0.086**	0.105**
	(0.017)	(0.015)	(0.019)	(0.034)	(0.044)
Observations	22	22	22	22	22
R-squared	0.423	0.594	0.446	0.468	0.640

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Back