Real Financing Costs Over The Business Cycle: Emerging Versus Advanced Economies

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What do we do?

- Examining the differences in the response of developed and developing economies to shocks to the real interest rate ($r \approx i - \pi^e$) they face in international financial markets

- Understanding the structural reasons behind these findings

- Contribution of the paper:
  1. New waves of data $\rightarrow$ recover early 2000s literature
  2. Exhaustive comparison emerging-developed

- Two-step paper:
  1. Empirics: Panel BVAR model $\rightarrow$ offer an initial flavour of the data
  2. Theory/structure: RBC-SOE model estimated in a Bayesian fashion

Why should we care?

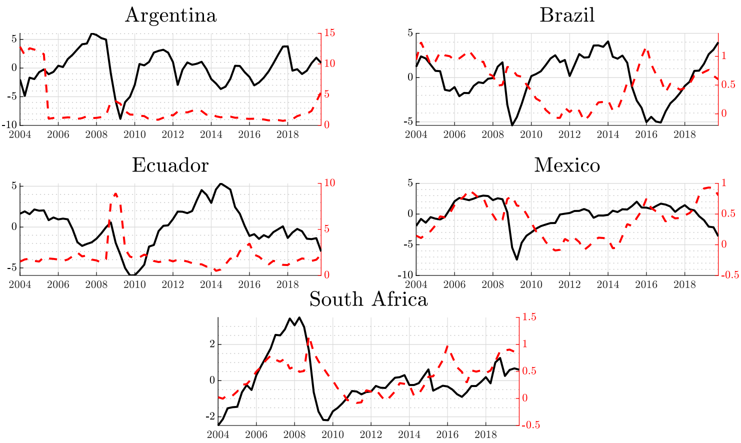

Figure: **GDP and real interest rates for a set of developing economies**. Black, solid line: Gross Domestic Product (log deviations from a quadratic trend, in %); red, solid line: Real interest rates (deviations from a quadratic trend).

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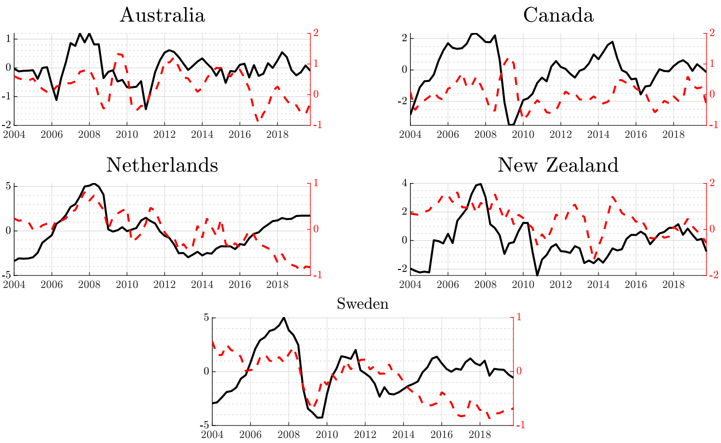

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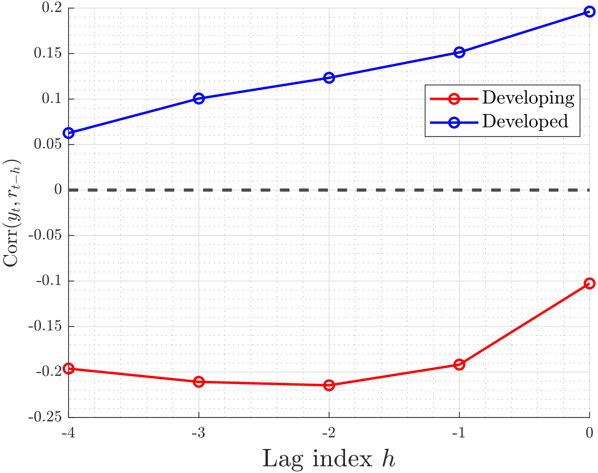
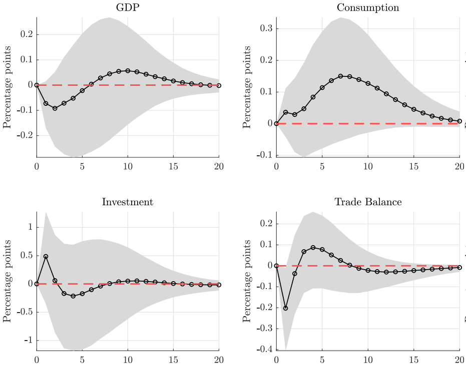


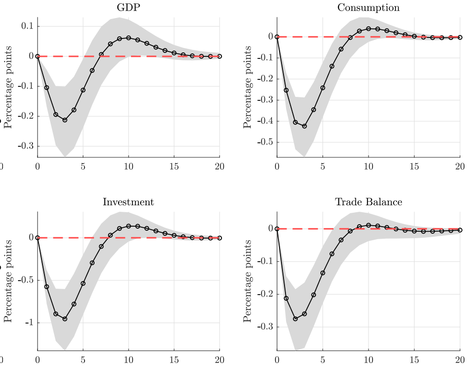
Figure: Correlation between real interest rate and detrended output at different lags

The Empirics: Panel BVAR

- Panel VAR estimated in a Bayesian fashion $\rightarrow$ data are assumed to come from multiple units ("pooled" estimator)
- Countries included:
  1. Developed: Australia, Canada, Sweden, Netherlands, New Zealand
  2. Developing: Argentina, Brazil, Ecuador, Mexico, South Africa
- Variables: GDP, Consumption, GFCF, NX, Real interest rates $(i - \pi^e) \rightarrow$ $\pi^e = 1/4 \sum_j^4 \pi_{t-j}$
- Identification via Cholesky decomposition $\rightarrow$ r_t does not affect the economy on impact
- Data sources: IMF IFS, OECD, Fred



(a) Developed Economies



(b) Developing Economies

Figure: **Impulse responses to a 1% shock to the real rate for developed and developing economies, in %.**

- SOE-RBC model based on (Garcia-Cicco et al., 2010). RH maximizes:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{\left[C_t - \omega^{-1} X_{t-1} H_t^{\omega}\right]^{1-\gamma} - 1}{1-\gamma} \right) Z_t, \tag{1}$$

where

$$\ln Z_t = \rho_Z \ln Z_{t-1} + \varepsilon_t^Z, \qquad \varepsilon_t^Z \sim \mathcal{N}(0, \sigma_Z^2) \tag{2}$$

$$g_t = \frac{X_t}{X_{t-1}} \tag{3}$$

$$\ln\left(\frac{g_t}{g}\right) = \rho_g \ln\left(\frac{g_{t-1}}{g}\right) + \varepsilon_t^g; \qquad \varepsilon_t^g \sim \mathcal{N}(0, \sigma_g^2). \tag{4}$$

- Subject to:

$$\frac{D^h_{t+1}}{1+r_t} = D^h_t - W_t h_t - u_t K_t + C_t + S_t + I_t + \frac{\phi}{2}\left(\frac{K_{t+1}}{K_t} - g\right)^2 K_t - \Pi_t, \tag{5}$$

where $s_t = \frac{S_t}{X_{t-1}}$

$$\ln\left(\frac{s_t}{\bar{s}}\right) = \rho_s \ln\left(\frac{s_{t-1}}{\bar{s}}\right) + \varepsilon^s_t; \qquad \varepsilon^s_t \sim \mathcal{N}(0, \sigma^2_s) \tag{6}$$

- The gross interest rate follows the process:

$$r_t = r^* + \psi\left(e^{D_{t+1}-\bar{D}}\right) + \left(e^{\mu_t - 1} - 1\right), \tag{7}$$

where

$$\ln \mu_t = \rho_\mu \ln \mu_{t-1} + \varepsilon^\mu_t; \qquad \varepsilon^\mu_t \sim \mathcal{N}(0, \sigma^2_\mu). \tag{8}$$

The Model: Firms

- Output produced by representative firm:

$$Y_t = A_t K_t^{\alpha} H_t^{1-\alpha} \tag{9}$$

where

$$\ln A_t = \rho_A \ln A_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \sigma_A^2) \tag{10}$$

- Firms assumed to face WC constraint (Neumeyer and Perri, 2005; Uribe and Yue, 2006; Chang and Fernández, 2013):

$$M_t \geq \eta W_t H_t. \tag{11}$$

- Capital is assumed to follow:

$$K_{t+1} = (1-\delta)K_t + I_t \tag{12}$$

- Firms maximize expected stream of distributed dividends:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \lambda_t X_{t-1}^{-\gamma} \left[\frac{D_{t+1}^f}{1+r_t} - D_t^f - \Delta M_t - u_t K_t - W_t H_t + Y_t \right] \tag{13}$$

- Firm's FOCs:

$$u_t = \alpha \left(\frac{H_t}{K_t} \right)^{1-\alpha} \tag{14}$$

$$W_t = (1-\alpha) A_t \left(\frac{K_t}{H_t} \right)^{\alpha} \left[1 + \eta \frac{r_t}{1+r_t} \right]^{-1} \tag{15}$$

- If $\eta \neq 0 \implies$ WCC creates a wedge between MPL and wage
- Real interest rate shocks have an effect on:
  - Intertemporal substitution of consumption
  - Production side $\rightarrow$ firm's optimal allocations

The Model: Financial Sector

- Continuum mass of identical banks with balance sheet:

$$\frac{D_{t+1}^h + D_{t+1}^f}{1+r_t} = \frac{D_{t+1}}{1+r_t} + M_t. \tag{16}$$

- Bank's profits are assumed to be redistributed to consumers in a lump-sum manner:

$$\Pi_t^b = D_t^h + D_t^f - D_t - M_{t-1}. \tag{17}$$

- Resource constraint:

$$\frac{D_{t+1}}{1+r_t} = D_t + \underbrace{C_t + S_t + I_t + \frac{\phi}{2}\left(\frac{K_{t+1}}{K_t} - g\right)^2 K_t - Y_t}_{\equiv TB_t}. \tag{18}$$

The Model: Parameter Estimation

- CA & BR $\rightarrow$ (yearly) data sourced from the Penn World Tables, version 10.1 (Feenstra et al., 2015). Period: 1951:2019
- Observed variables: (per capita) growth rate of output, consumption, investment, and the trade balance-to-output ratio.
- The posterior distributions for our parameters of interest are obtained using the slice sampler algorithm developed by Planas et al. (2015). Iterations: 13605, burn-in: 13605/2.
- We assume uniform prior distributions for all the estimated parameters following the specification in Hwang and Kim (2022) $\rightarrow$ also based in Garcia-Cicco et al. (2010).

Estimation Results

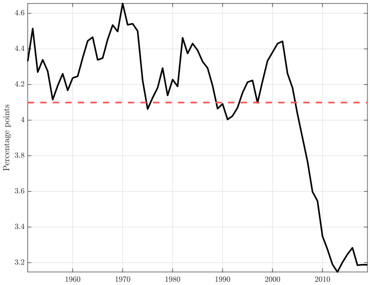
	Prior distribution			Posterior distribution			
				Brazil		Canada	
Parameter	Distribution	Min	Max	Median	Sd	Median	Sd
Shock persistence							
ρ_A	Uniform	0	0.99	0.6554	0.2779	0.8838	0.0246
ρ_g	Uniform	0	0.99	0.7742	0.0502	0.5822	0.2124
ρ_Z	Uniform	0	0.99	0.7598	0.1624	0.9817	0.0133
ρ_s	Uniform	0	0.99	0.5142	0.2839	0.5548	0.2838
ρ_μ	Uniform	0	0.99	0.8961	0.0563	0.9581	0.0376
Shock s.d.							
σ_A	Uniform	0	0.4	0.0021	0.0023	0.0144	0.0017
σ_g	Uniform	0	0.4	0.0157	0.0016	0.0029	0.0018
σ_Z	Uniform	0	0.4	0.1861	0.0643	0.1459	0.0521
σ_s	Uniform	0	0.4	0.0044	0.0037	0.0023	0.0022
σ_μ	Uniform	0	0.4	0.0088	0.0031	0.0010	0.0003
Structural parameters							
g	Uniform	1	1.05	1.0296	0.0074	1.0168	0.0019
ϕ	Uniform	0	8	2.0971	0.7273	2.8367	0.8651
ψ	Uniform	0	5	0.0538	0.0571	0.0014	0.0019
β	Uniform	0.9	0.999	0.9666	0.0177	0.9941	0.0055
δ	Uniform	0.01	0.15	0.1015	0.0212	0.0129	0.0042
α	Uniform	0.3	0.5	0.3200	0.0220	0.3677	0.0435
η	Uniform	0	1	0.0779	0.1529	0.8239	0.1992
Measurement errors							
	Distribution	Mean	Sd	Median	Sd	Median	Sd
$\sigma_{\Delta y}$	Gamma	0.02	0.01	0.0024	0.0008	0.0017	0.0005
$\sigma_{\Delta c}$	Gamma	0.02	0.01	0.0024	0.0009	0.0018	0.0007
$\sigma_{\Delta i}$	Gamma	0.02	0.01	0.0106	0.0033	0.0076	0.0024
$\sigma_{tb/y}$	Gamma	0.02	0.01	0.0016	0.0005	0.0007	0.0003

Table: **Posterior median variance decomposition results (in %).** Measurement errors are not reported given their negligible contribution in driving the observed variables. Standard errors are depicted in parentheses.

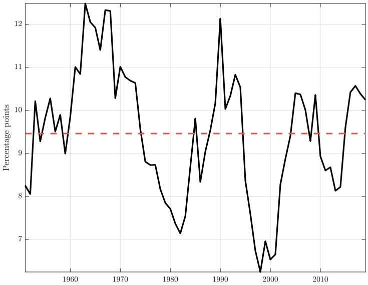
	Brazil				Canada			
Shock	Δy	Δc	Δi	tb/y	Δy	Δc	Δi	tb/y
Technology (stat.)	1.28	0.50	0.11	0.15	92.85	63.23	57.47	7.34
	(5.21)	(3.27)	(2.30)	(1.37)	(8.70)	(9.00)	(10.22)	(5.30)
Trend	93.72	62.79	48.19	20.42	5.63	7.24	5.06	2.81
	(5.40)	(6.51)	(9.19)	(13.78)	(8.70)	(8.45)	(6.87)	(5.93)
Preference	0.52	33.54	2.08	22.54	0.51	25.88	3.83	66.29
	(1.20)	(5.64)	(3.21)	(10.95)	(0.34)	(5.02)	(2.32)	(18.50)
Interest rate	2.90	1.56	46.70	52.61	0.33	1.39	30.67	21.67
	(1.34)	(0.77)	(7.84)	(15.03)	(0.13)	(0.58)	(6.48)	(13.35)
Government spending	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01
	(0.00)	(0.03)	(0.01)	(0.07)	(0.00)	(0.05)	(0.01)	(0.03)

Note: $\Delta y, \Delta c, \Delta i, tb/y$ denote the growth rates of output, consumption, and investment, and the trade balance-to-output ratio, respectively.

Annualized Rates



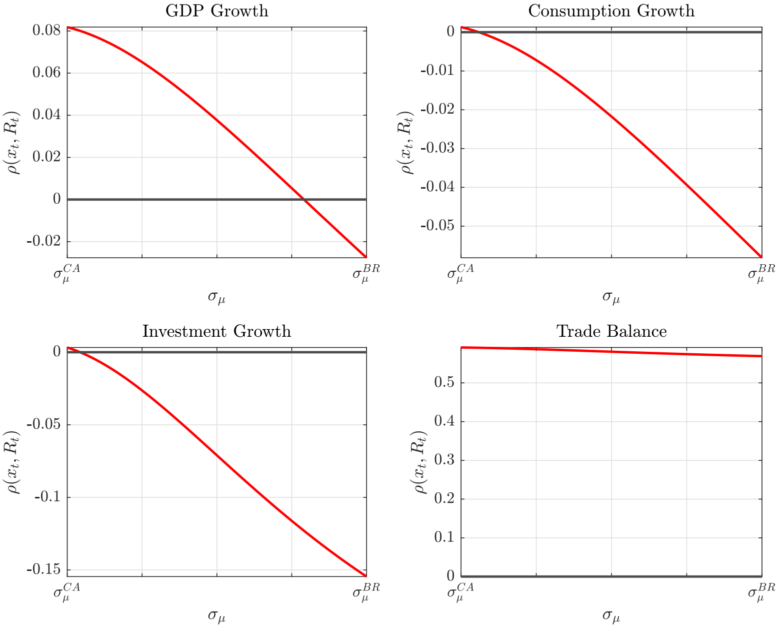
(a) Canada



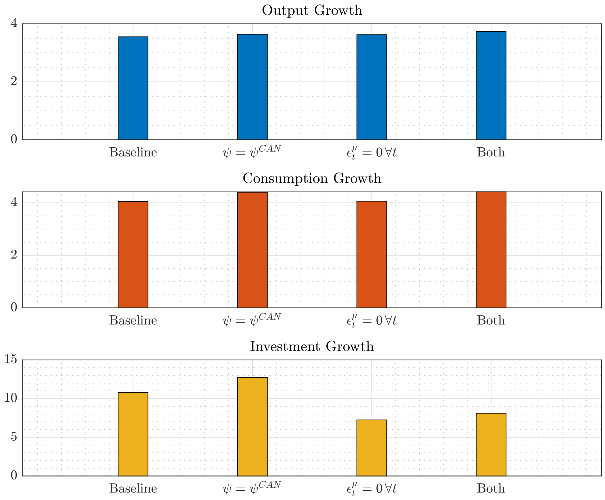
(b) Brazil

Figure: **Smoothed real interest rates for Canada and Brazil (net annualized terms, in %).** Dashed, red horizontal lines depict the average real interest rate over the observed period.

Counterfactual Analsysis



Counterfactual Volatility



On the Source of Financing Shocks

- So far, no notion of the source of shock to real interest rate → "external" (US) versus "internal"?
- Similar model as previously, but only for Brazil and different ordering (Cholesky):

$$y_t = [r_t^{US}, r_t, gdp_t, c_t, i_t, nx_t] \tag{19}$$

- r_t^{US}: FFR Wu and Xia (2016), $r_t = r_t^{US} + EMBI$
- MP instrument Miranda-Agrippino and Ricco (2021); Degasperi and Ricco (2021) as exogenous variable in the system
- Following Uribe and Yue (2006), impose block exogeneity (a.k.a. no Granger causality) for BR→CAN

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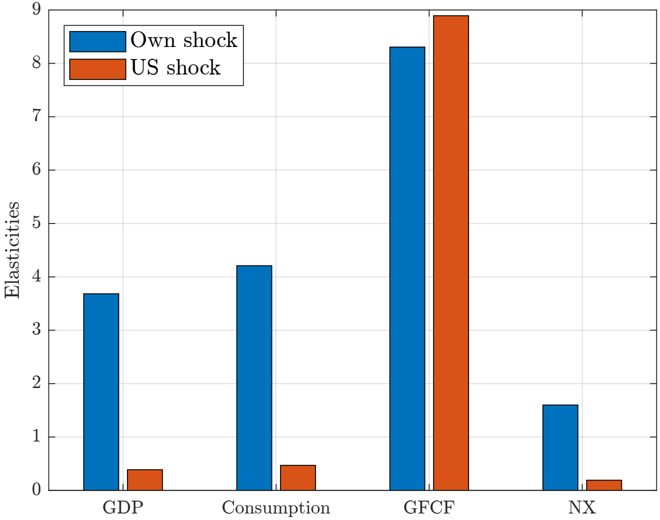

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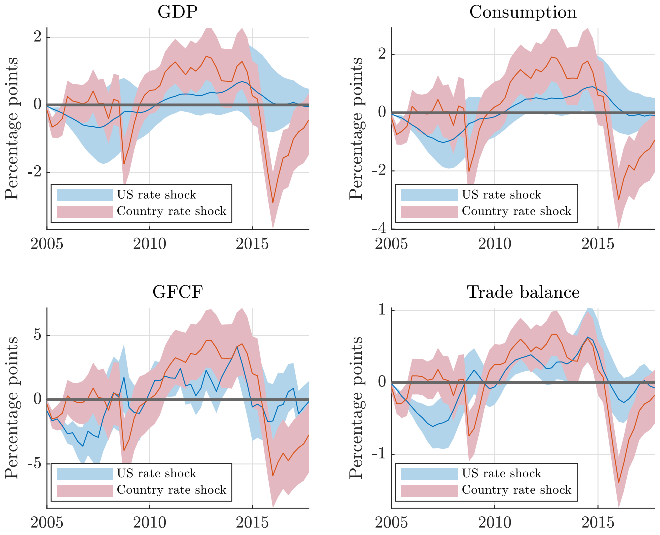

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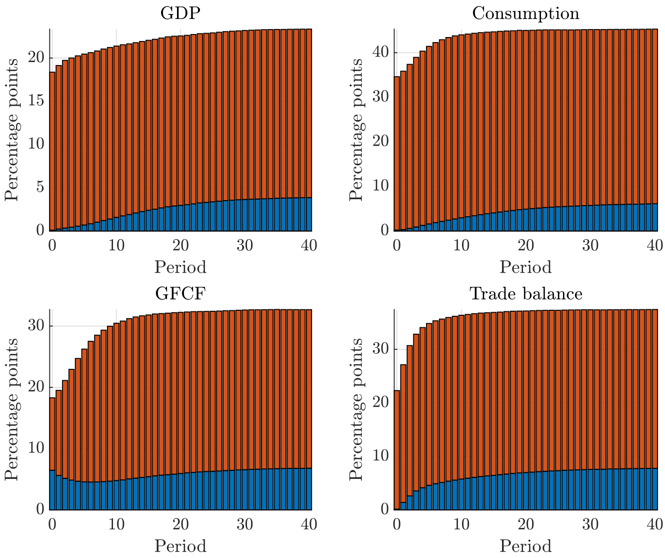

Conclusions

- I examine the differences in the response of developed and developing economies to shocks to their real interest rate
- Empirically → shocks to the real interest rate have more adverse effects in developing economies than in developed ones.
- Theoretical reasons: sensitivity of the interest rate to deviations in the debt level (ψ) + higher rate shock volatility (σ_μ)
- Reductions in σ_μ can reverse the sign of $\rho(R_t, x_t)$
- Setting $\varepsilon^\mu = 0$ → dramatic reduction in investment volatility
- A simple empirical model shows that own spread shocks seem to matter more when explaining the Brazilian business cycle