Exploring the Role of Limited Commitment Constraints in Argentina's "Missing Capital"

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MOTIVATING EVIDENCE

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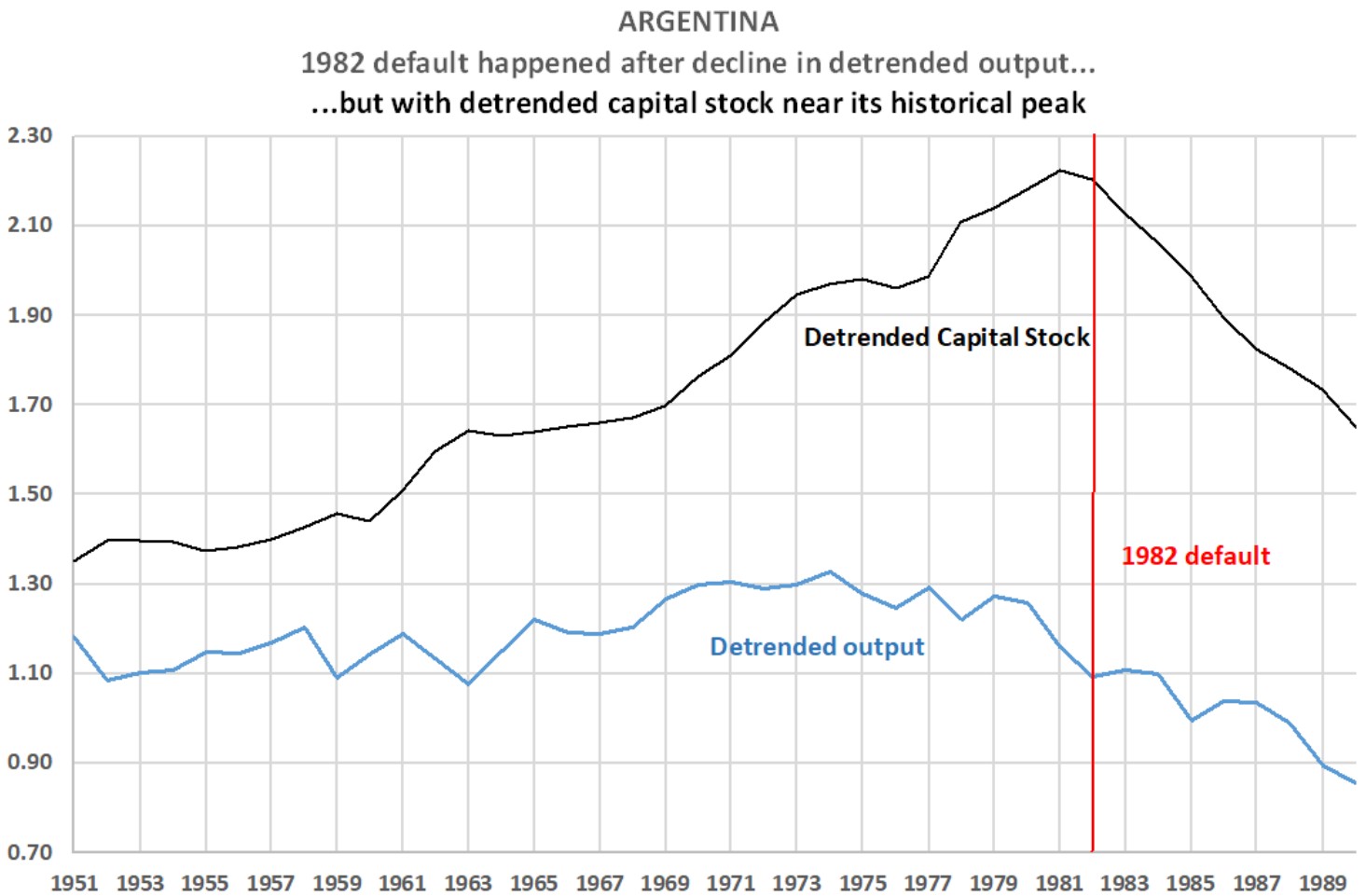
- Why so much capital lost?
- Argentina's history gives ground to conjecture that answer is investors' fears of "opportunistic confiscation of capital."

Argentina's economic conditions at time of 1982 default



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- Argentina's economy conditions not dismal at time of 1982 defaul: capital stock near historical peak then.

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- Paper explores quantitatively ability of those constraints to account for Argentina's "capital shallowing".
- Finding preview: Limited Commitment Constraints can account for 50% to 80% of Argentina's missing capital.

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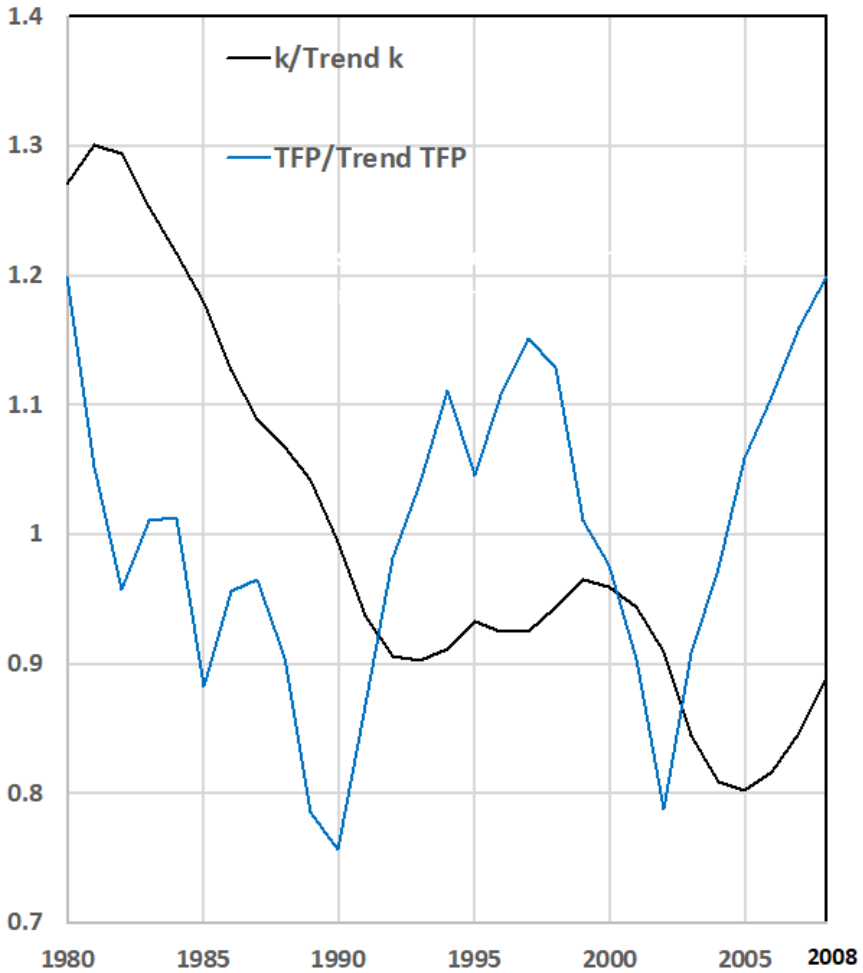
- This paper: LCCs *with* capital adjustment costs and *no* exogenous default costs.

LCCs challenges: capture missing capital AND its asymmetric response to positive and negative TFP changes



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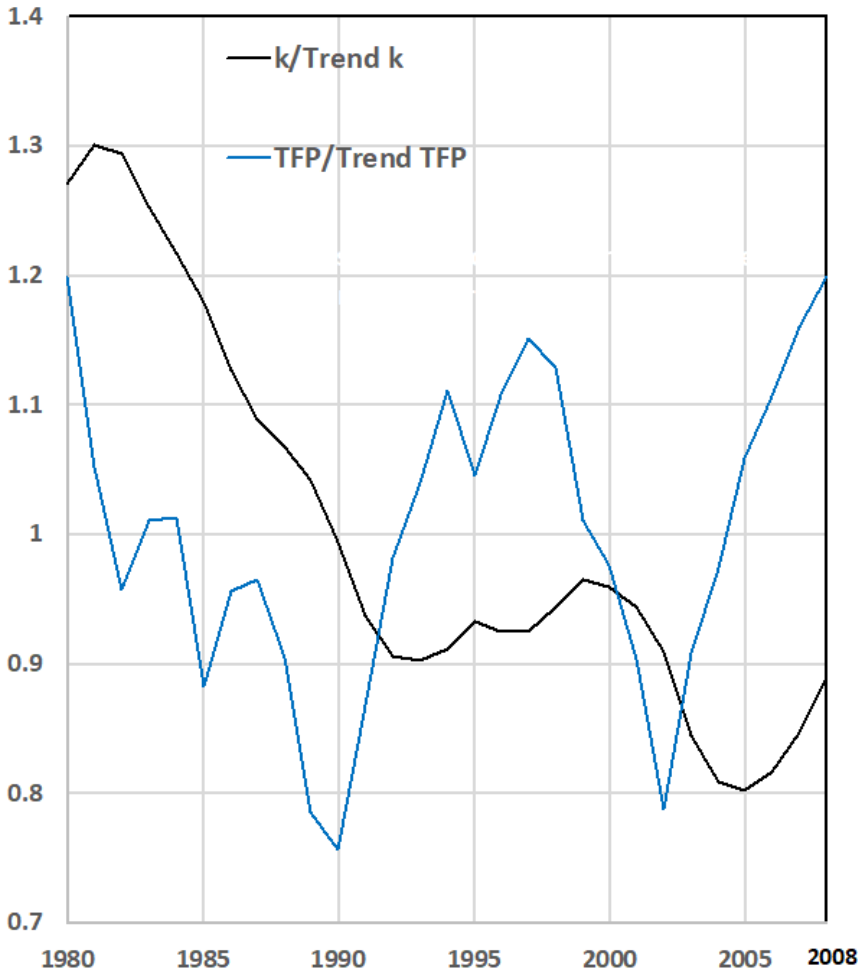

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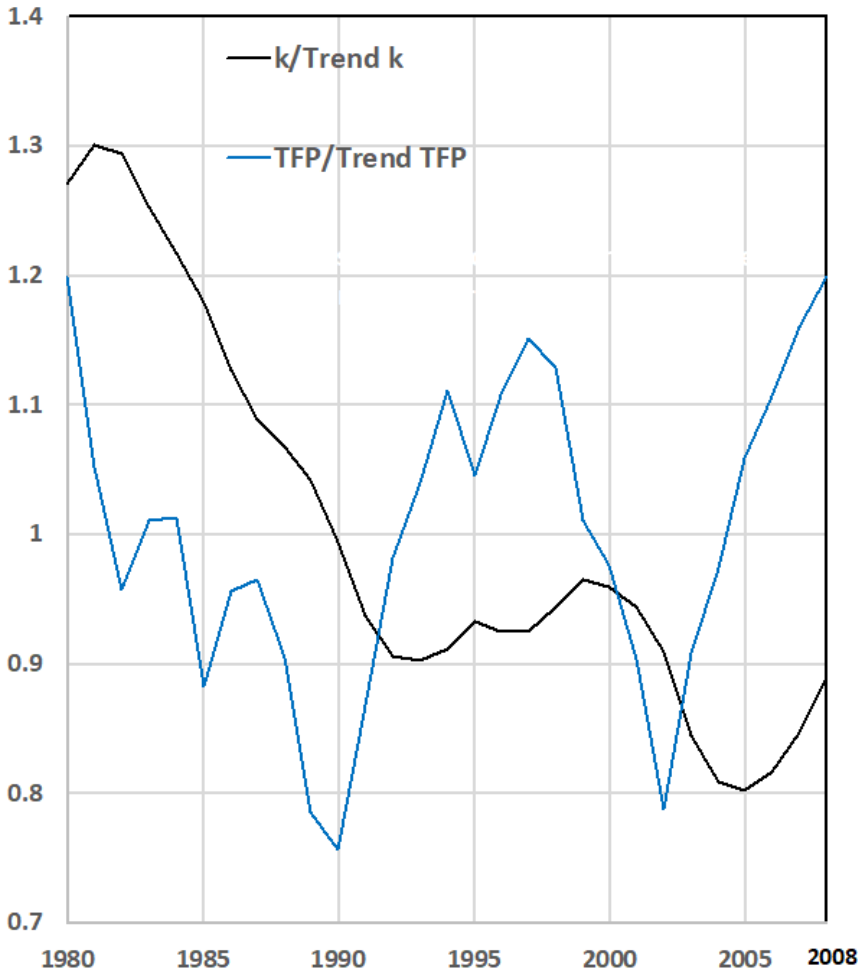

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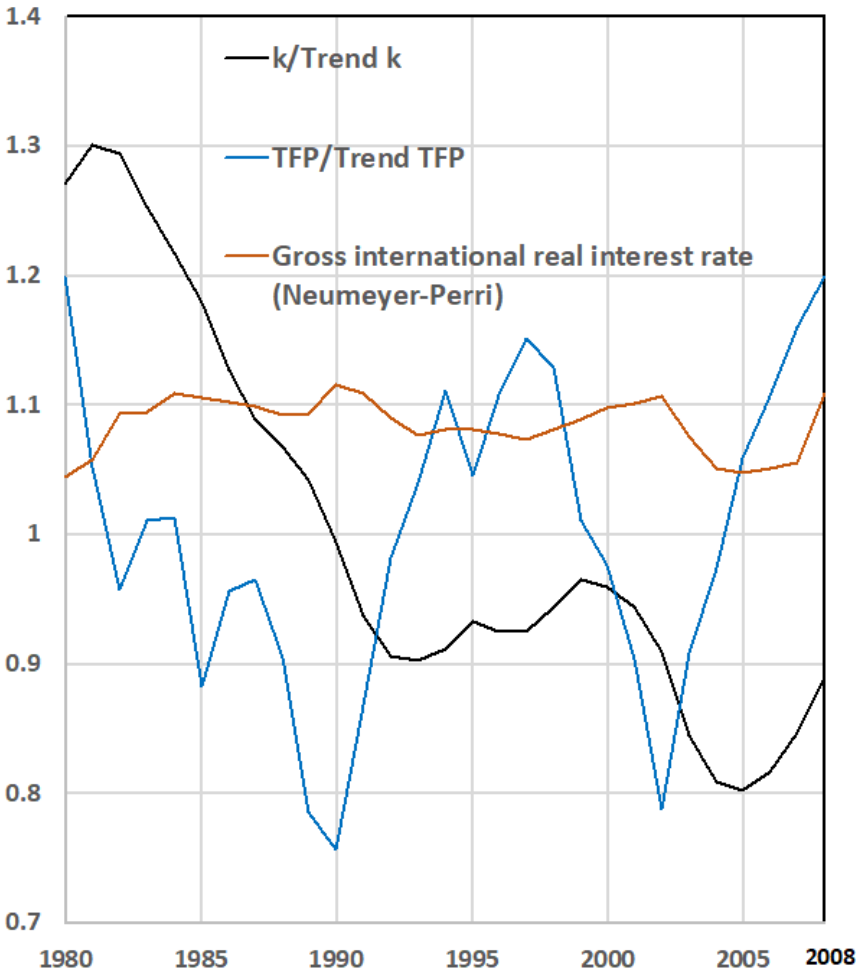
LCCs challenges: capture missing capital AND failure of lower international real interest rates to boost it



Source for international interest rate: MERRILL LYNCH 175 LOW-GRADE CORPORATE BOND YIELD until Nov 84 and MERRILL LYNCH LOW-GRADE CORPORATE BOND YIELD afterwards (almost identical to Neumeyer-Perri for 1982-2001 period).

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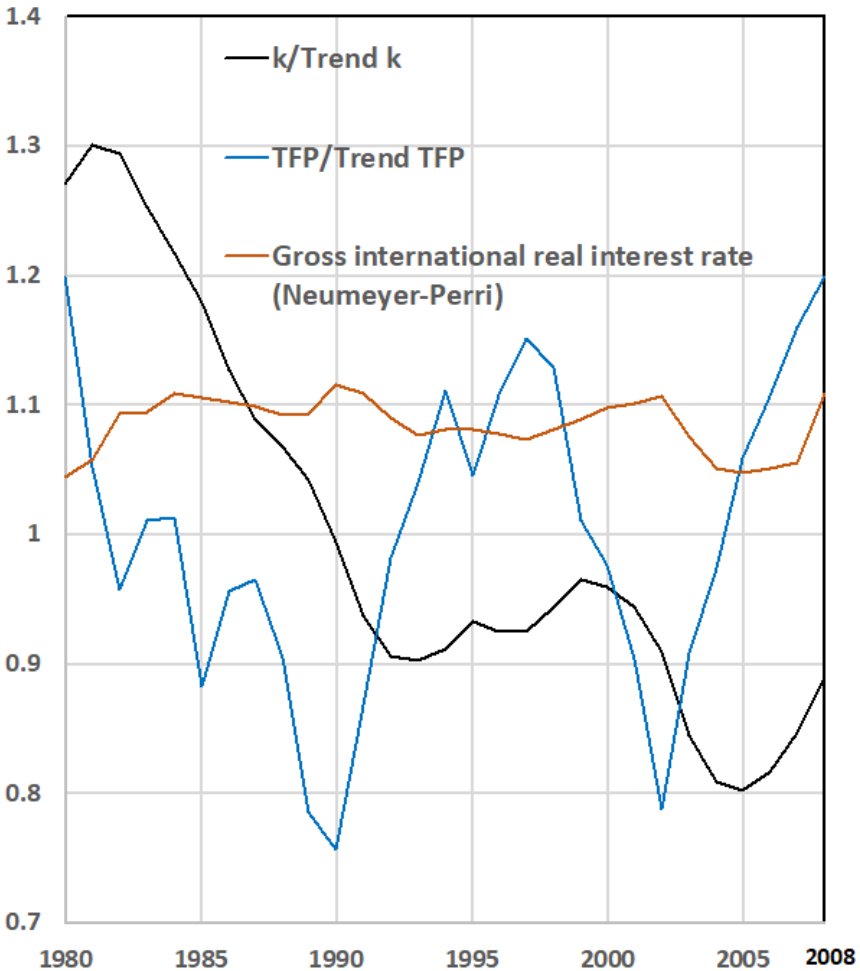
LCCs captures view that Argentina's capital accumulation suffers from a chronic "lost opportunities" problem



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* LCCs formalize "lost opportunities" view that lack of dynamism of Argentina's capital accumulation process has its roots in country's inability to exploit periods of unusually favorable domestic and international economic conditions.

The Limited Commitment Small Open Economy Model

- SOE able to borrow from or lend to risk neutral foreign investors.
- Stand-in household ranks consumption sequences according to:

$$V\left(\{C_t\}\right) = \sum_{t=0}^{\infty} \beta^t N_t U(C_t/N_t), \quad 0 < \beta < 1,$$

where: N_t exogenously given period-t population and $U(.)$ satisfies standard balanced-growth properties.

- Production function:

$$F(A_t, K_t, N_t),$$

where: $K_t \geq 0$ beginning-of-period capital stock and A_t exogenously given TFP.

- Resource constraint:

$$C_t + K_{t+1} + \phi\left(K_t, K_{t+1}\right) = F(A_t, K_t, N_t) + (1-\delta)K_t - B_t,$$

where: $\phi\left(K_t, K_{t+1}\right)$ captures capital adjustment costs, δ is the depreciation rate, B_t denotes net transfers to the lender, and initial capital stock K_0 is given.

The Limited Commitment Small Open Economy Model (cont.)

- Lender discounts future cash flows at period discount rates $\overset{*}{R}_t$.
- Let $\overset{*}{Q}_t = \prod_{j=1}^{t} \overset{*}{R}_j^{-1}$ be the implied discount factor between period 0 and t.
- The lender's present value of its revenue is given by

$$\Pi(\{C_t, K_t\}) = \sum_{t=0}^{\infty} \overset{*}{Q}_t B_t = \sum_{t=0}^{\infty} \overset{*}{Q}_t \left[F(A_t, K_t, N_t) + (1-\delta)K_t - C_t - K_{t+1} - \phi\left(K_t, K_{t+1}\right)\right],$$

interpreted as the initial debt of the country to the lender, d_0.

Optimal contract

- Feasible sequences $\{B_t, C_t, K_{t+1}\}$ that,
- given exogenous sequences $\{N_t, A_t, \overset{*}{R}_t\}$ and initial debt d_0,
- maximize the SOE stand-in household lifetime utility's

$$\sum_{t=0}^{\infty} \beta^t N_t U(C_t/N_t),$$

- subject to the Promise-Keeping Constraint for the lender:

$$\sum_{t=0}^{\infty} \overset{*}{Q}_t B_t \geq d_0,$$

- and the Limited Commitment Constraint:

$$\sum_{j=0}^{\infty} \beta^j N_{t+j} U\left(\frac{C_{t+j}}{N_{t+j}}\right) \geq V_t^{\text{aut}}(K_t) \text{ for all t} \geqslant 0.$$

- the resource constraint:

$$F(A_t, K_t, N_t) + (1-\delta)K_t - K_{t+1} - \phi\left(K_t, K_{t+1}\right) - C_t \geq B_t$$

Quantitative implementation

- Balanced-growth: $N_t = (1+\eta)^t N_0$ and labor-augmenting technological progress $A_t = A(1+\gamma)^{(1-\theta)t}$.
- Utility function:

$$U(C) = \frac{C^{1-\sigma}}{1-\sigma}.$$

- Production function:

$$F(A_t, K_t, N_t) = A_t K_t^{\theta} N_t^{1-\theta}.$$

- Capital adjustment cost function:

$$\phi(K_t, K_{t+1}) = \frac{\kappa}{2}\left(\frac{K_{t+1} - (1+\eta)(1+\gamma)K_t}{K_t}\right)^2 K_t$$

- A_t detrended by $(1+\gamma)^{1-\theta}$, other variables by $(1+\eta)(1+\gamma)$ as appropriate.
- Constraints and first order conditions modified accordingly (see paper).

Consumption dynamics induced by LCCs

- Consider expression obtained from evaluating FOC for consumption in two consecutive periods for $(1+\gamma)^{\sigma}/\beta R^{*}_{t+1} = 1$:

$$\frac{U'(c_{t+1})}{U'(c_t)} = \frac{1+\sum_{s=0}^{t}\mu_s}{1+\sum_{s=0}^{t+1}\mu_s}.$$

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- Suppose that the only LCC that binds is for period $t+n+1$. It follows that:

$$\frac{U'(c_{t+n+1})}{U'(c_{t+n})} = \frac{1}{\mu_{t+n+1}} \text{ and}$$

$$\frac{U'(c_{t+n+1+i})}{U'(c_{t+n+i})} = 1, \text{ all } i > 1$$

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- For these conditions to be satisfied, $c_{t+n+1} > c_{t+n}$ and $c_{t+n+1} = c_{t+n+1+i}$,all $i > 1$:
  - consumption increases *permanently* after a limited commitment constraint starts binding in any given period t.

Numerical experiments

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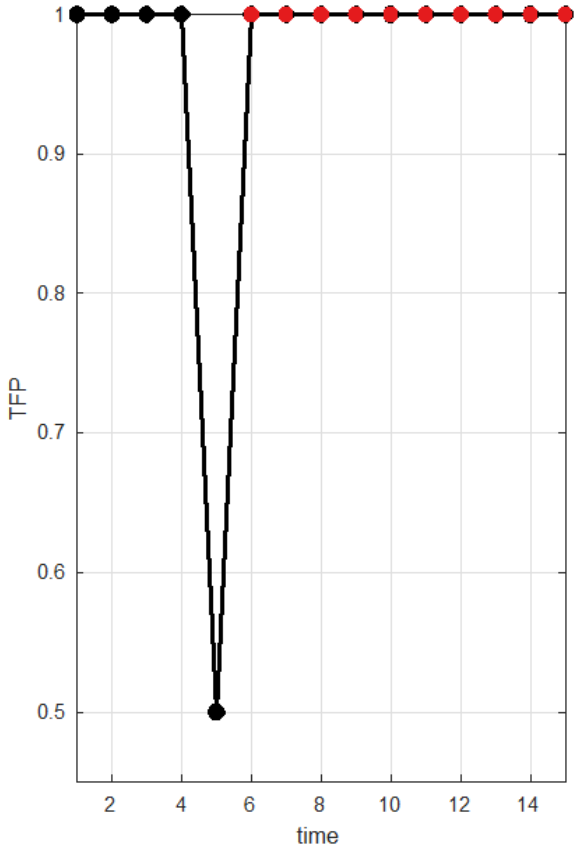
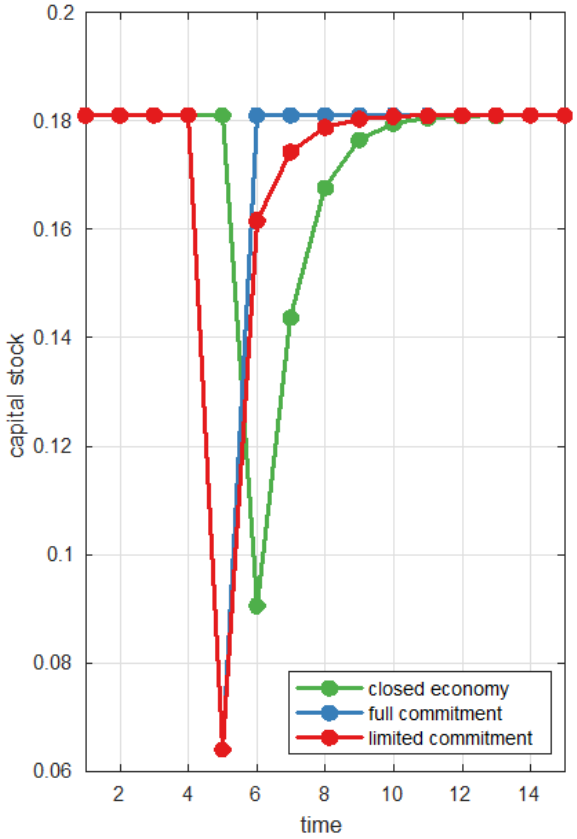
- Parameter values common to all experiments:

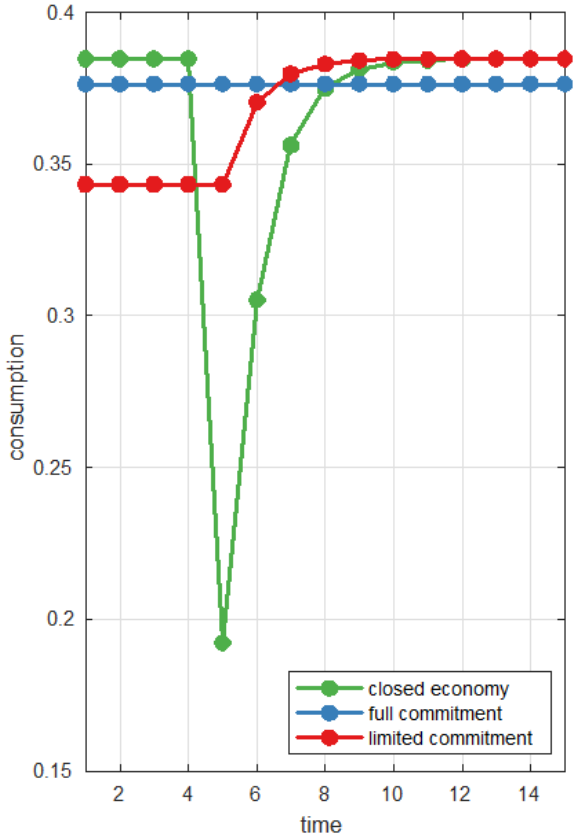
σ	θ	β	γ	η	d_0	κ
1.0	$\frac{1}{3}$	0.96	0.	0	0	0



TFP



Capital Stock

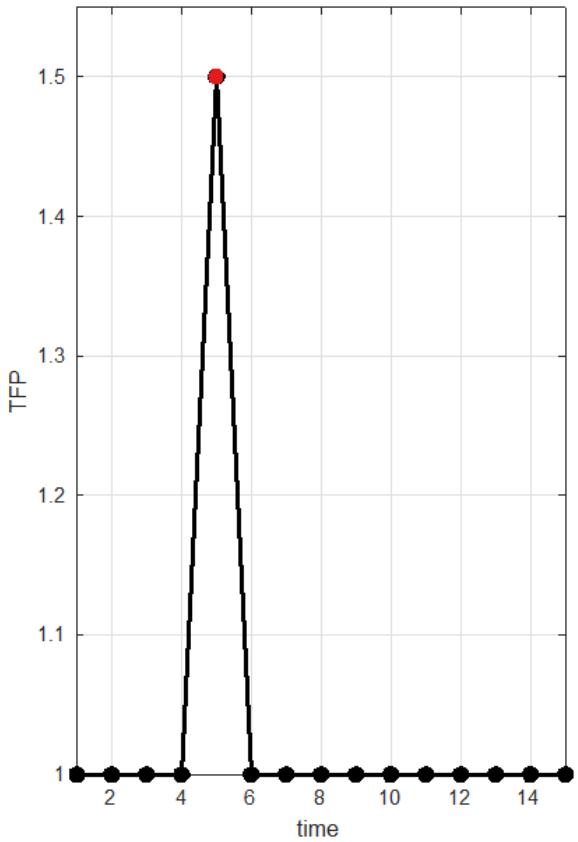


Consumption

Numerical experiment 1

Response to fully anticipated temporary *decrease* in TFP 5-periods ahead.

$\beta \overset{*}{R} = 1$, full depreciation and no adjustment costs



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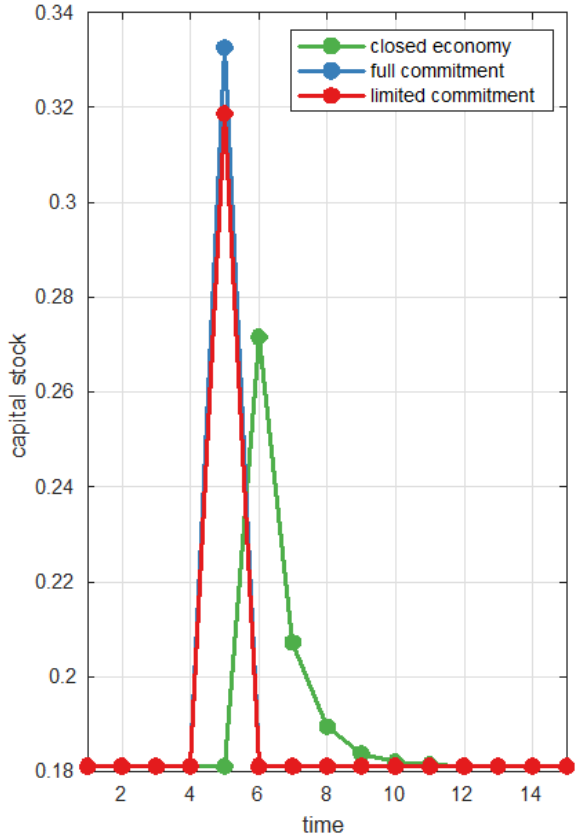

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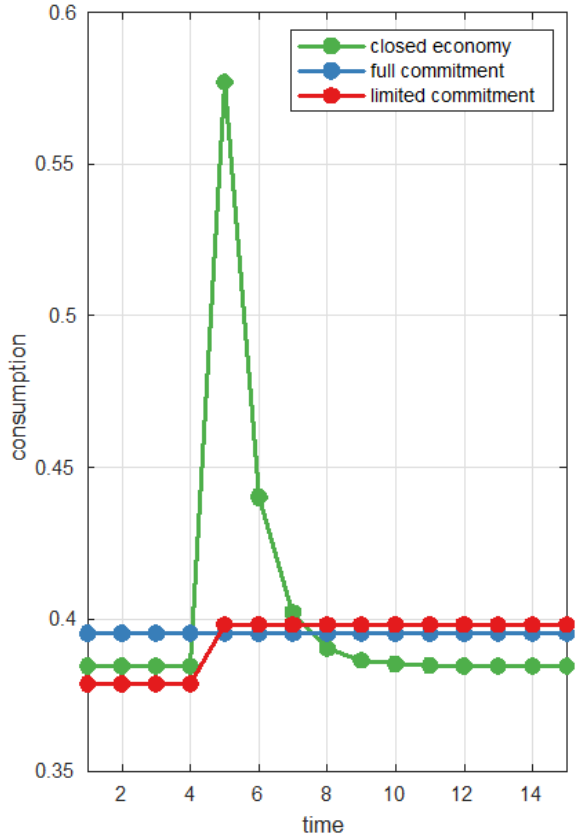

Consumption

Numerical experiment 2

Response to fully anticipated temporary *increase* in TFP 5-periods ahead.

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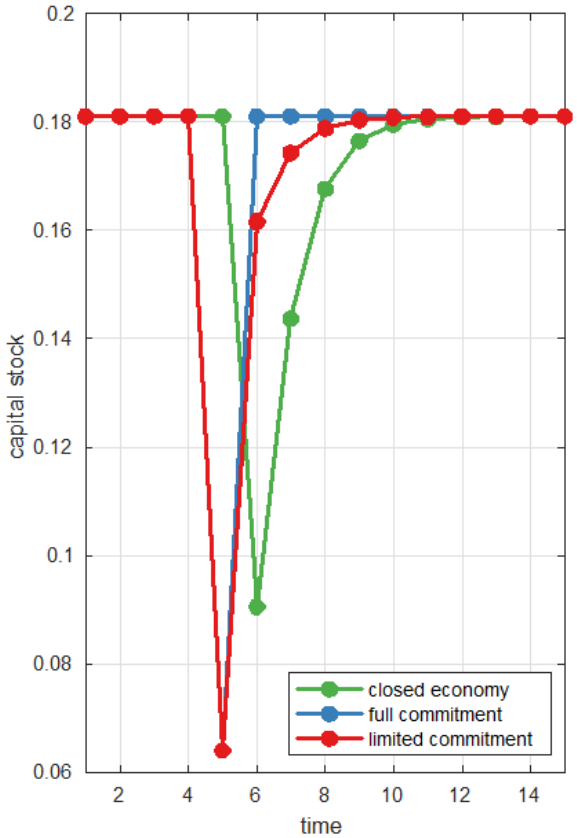
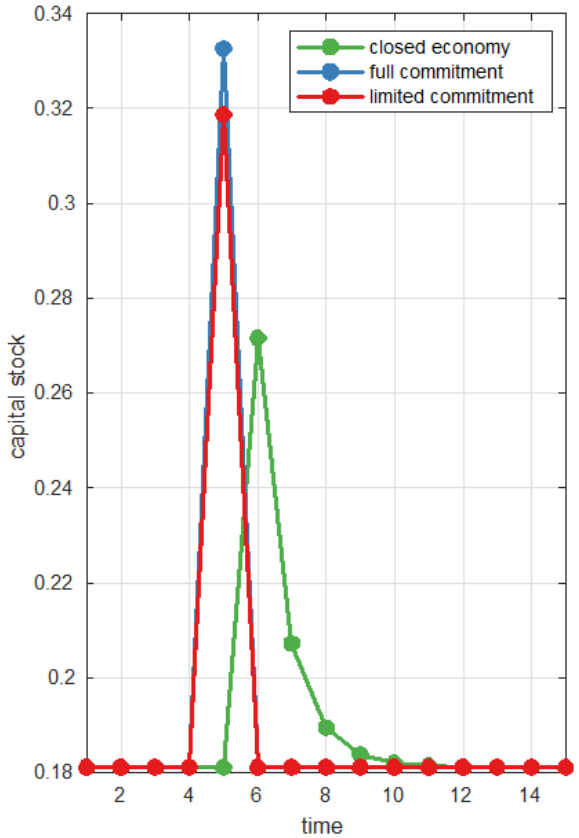
LCCs reproduce observed asymmetric response of capital stock to positive and negative TFP changes

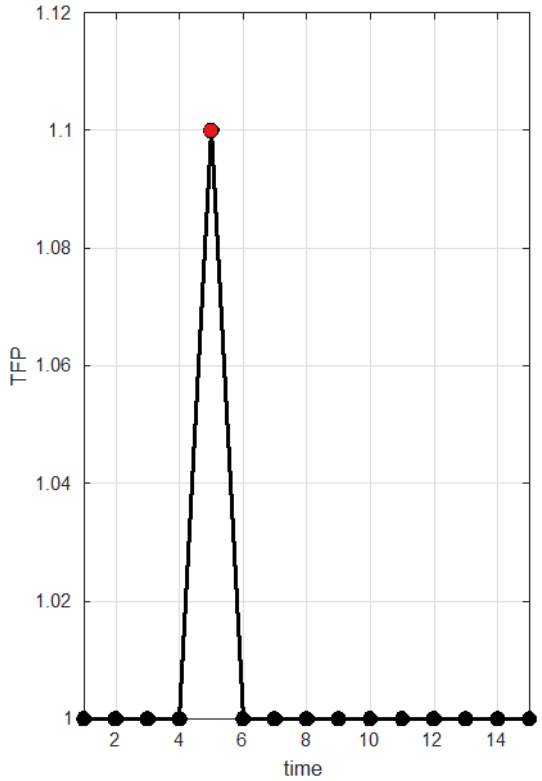


TFP 50% down $\Longrightarrow$
Capital stock falls as much as without LCCs



TFP 50% up $\Longrightarrow$
Capital stock rises less than without LCCs

Lower international real interest rate tightens LCCs



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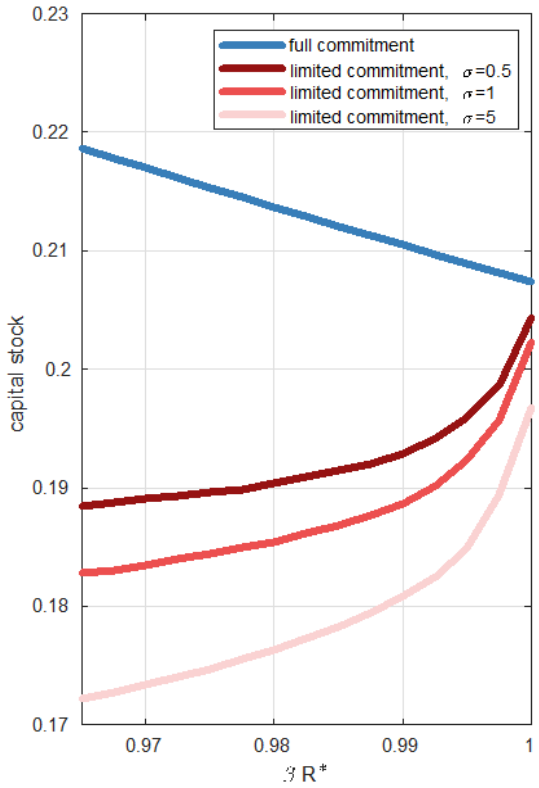
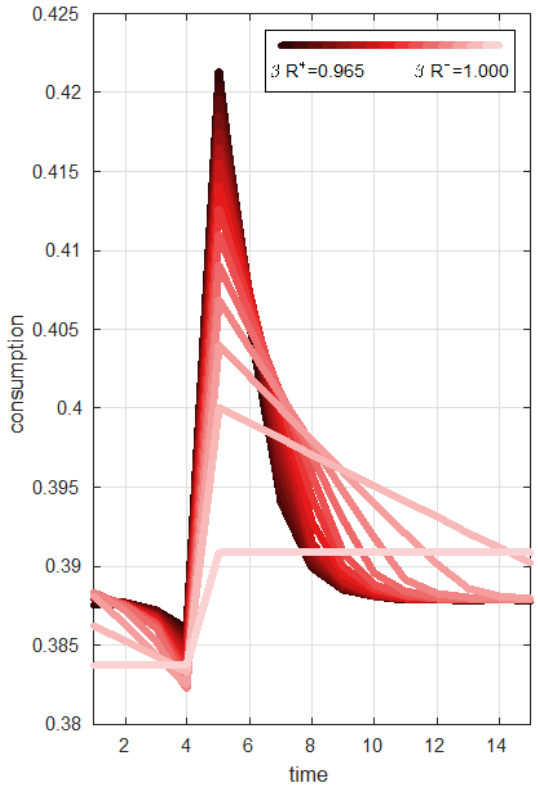


Capital stock in period 5 as a function of $\beta \overset{*}{R}$. No adjustment costs.



Consumption for various values of $\beta \overset{*}{R}$ and $\sigma = 1$. Darker color = lower $\overset{*}{R}$.

Some intuition behind counterintuitive lower R-star effect

$$\overset{*}{R}_{t+1} = (f_{k,t+1} + 1 - \delta)\left(1 - \frac{\mu_{t+1}}{1 + \sum_{s=0}^{t+1} \mu_s} \frac{U'\left(g_{t+1}^{aut}(k_{t+1})\right)}{U'(c_{t+1})}\right)$$

(Implied by FOC in k)

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  2. severity of LCC, captured by $\mu_{t+1}/(1 + \sum_{s=0}^{t+1}) = 1 - \beta \overset{*}{R}_{t+1} \frac{U'(c_{t+1})}{U'(c_t)}$ (shift forward FOC in c). Rises as $\overset{*}{R}_{t+1}$ falls.

     For LCC still not to bind ($\mu_{t+1} = 0$) after $\overset{*}{R}_{t+1}$ declines, $U'(c_{t+1})$ must be increased by letting c_{t+1} fall as much as necessary. Temptation to avoid decline in consumption by switching to autarky prevented by not allowing c_{t+1} to fall that much $\Longrightarrow \mu_{t+1} > 0$.

Calibration preliminaries

Model economy steady-state

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- In closed economy:

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Corollary: If targeted (calibrated) capital-output ratio smaller than $\left(\frac{k}{y}\right)_{ss}^{fb}$, then $\overset{*}{R}_{ss} < (1+\lambda)^{\sigma}/\beta$ and $\left(\frac{k}{y}\right)_{ss}^{cal} = \left(\frac{k}{y}\right)_{ss}^{cl} < \left(\frac{k}{y}\right)_{ss}^{fb}$.

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  - Non-residential structures: 40 years.
  - Machinery and equipment: 15 years.
- Annual geometric depreciation rate for asset type i, $\delta(i)$, obtained by solving equation:

$$[1 - \delta(i)]^{T(i)} = \frac{1}{T(i)},$$

where $T(i)$ is useful lifetime of asset type i.

Calibration details

- Series for relevant variables available for period 1950-1980.
  - Initial year, 1950, first for which perpetual inventory method produces "reliable" estimate of capital stock under residual values assumptions.
  - End year, 2008, last one for which reliable data on National Accounts are available, according to World Bank:
    - *Constant price GDP and CPI data that are officially reported by the National Statistics and Censuses Institute of Argentina have been restored. The International Monetary Fund has, however, issued a declaration of censure and called on Argentina to adopt remedial measures to address the quality of the official GDP and CPI data. Alternative data sources have shown significantly lower real growth and higher inflation than the official data since 2008.* (https://datahelpdesk.worldbank.org/knowledgebase/articles/906522).

Benchmark calibration

- σ (reciprocal IES) $= 2$;
- θ (capital income share) $= 0.4$;
- δ (depreciation rate) $= 0.117$ (average 1980-2008);
- γ (TFP growth rate factor) $= 0.015$ (average 1980-2008);
- η (population growth rate) $= 0.014$ (average 1980-2008);
- $\left(\frac{k}{y}\right)_{ss}^{lcc} = 1.656$ (average 1980-2008) $\Longrightarrow \beta = 0.916$;
- $\overset{*}{R}_{ss} = 1.085$ (average 1980-2008 Merrill Lynch Low Grade Corporate Bond Yields series);
  - **Note**: $\beta \overset{*}{R}_{ss} = 0.916 \; x \; 1.085 = 0.994 < (1+\gamma)^2 \Longrightarrow$convergence to closed economy by Proposition 1.
- κ (adjustment cost parameter) $=$ LCC economy investment volatility target $= 0.417$.

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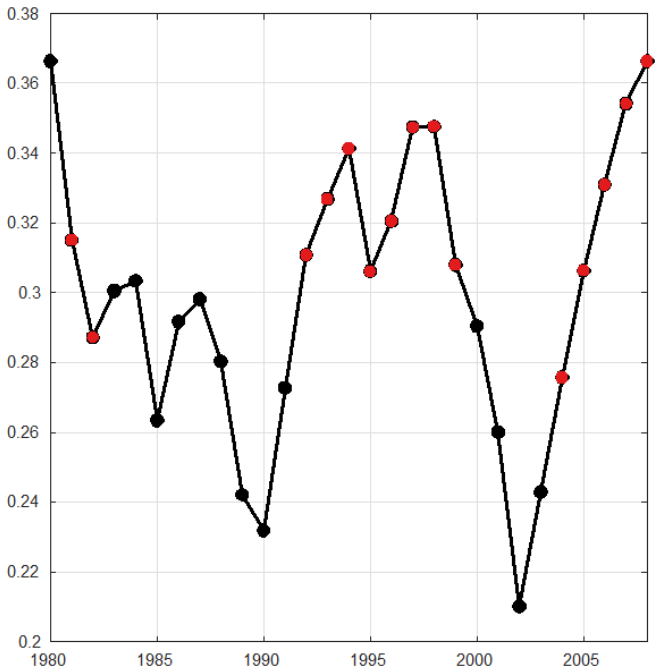
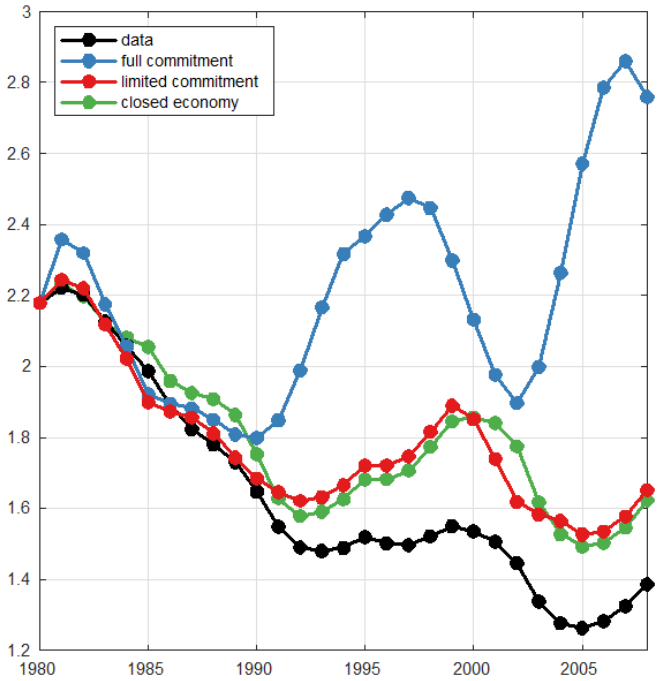
Results for benchmark calibration



TFP. Red dots indicate years LCC binds



Capital stock

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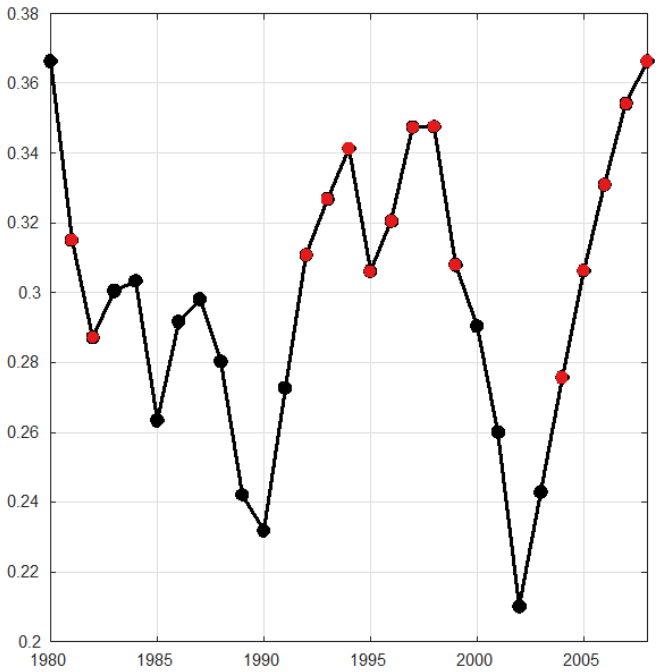

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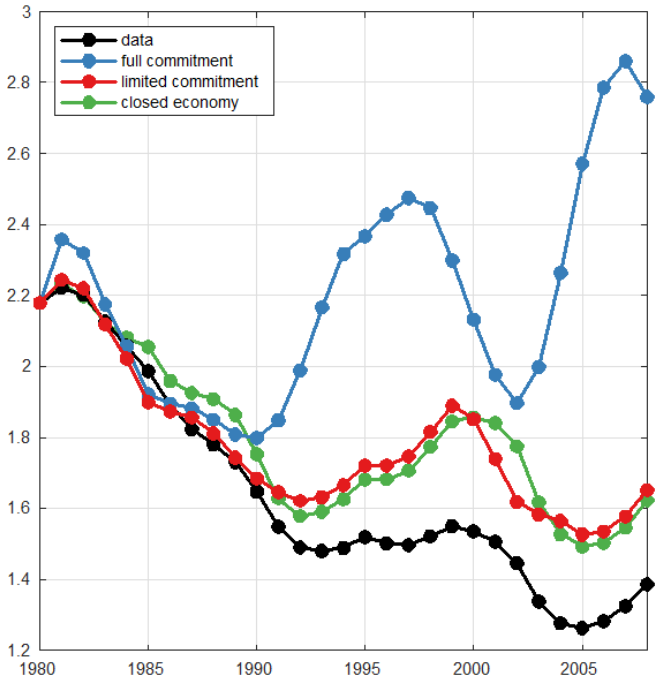

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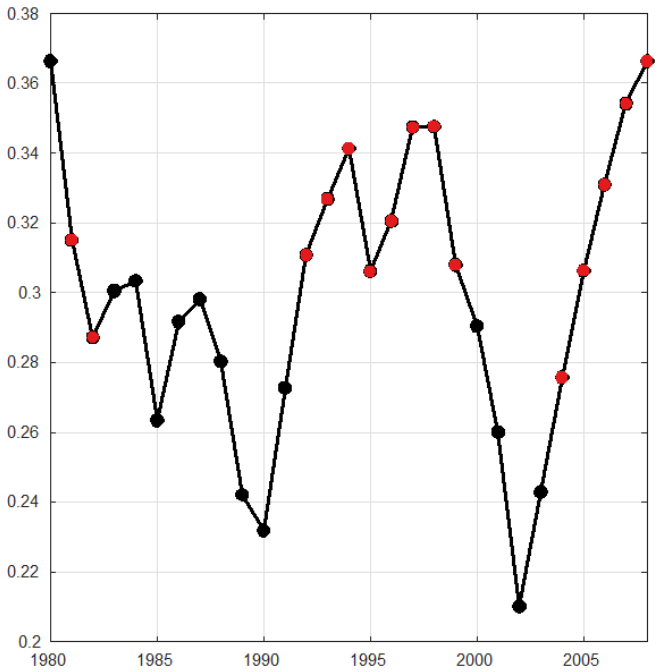

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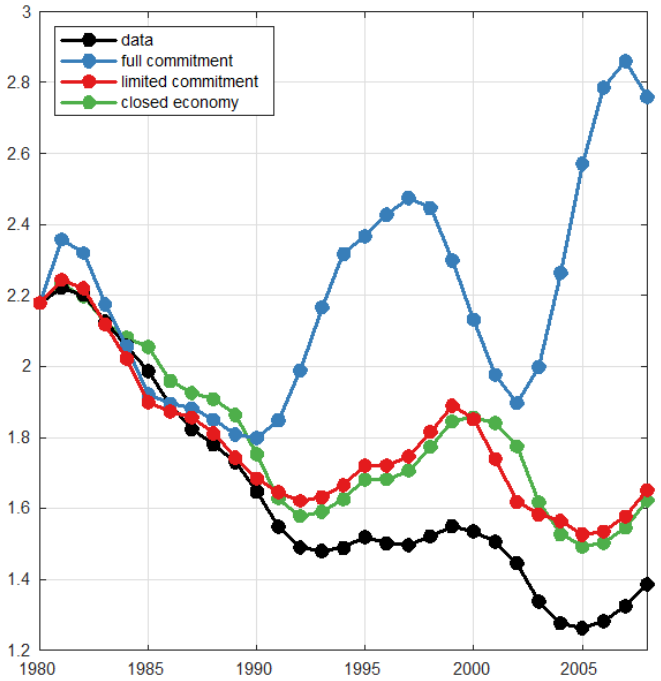

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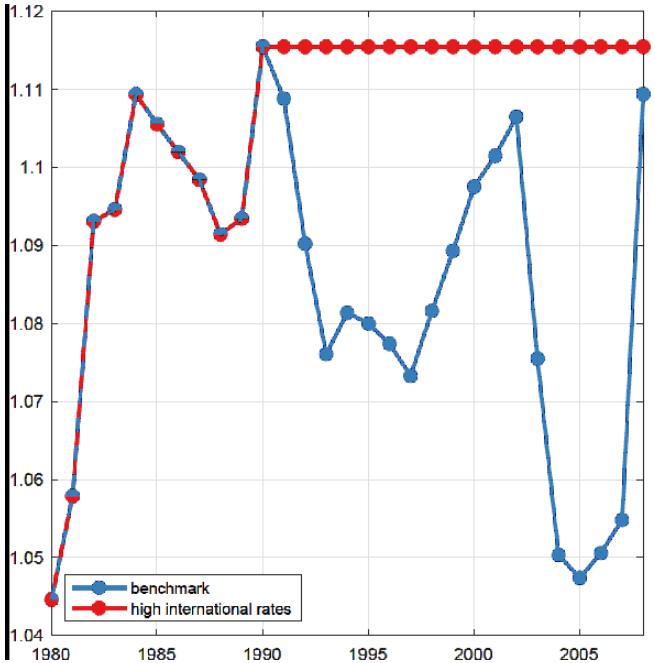
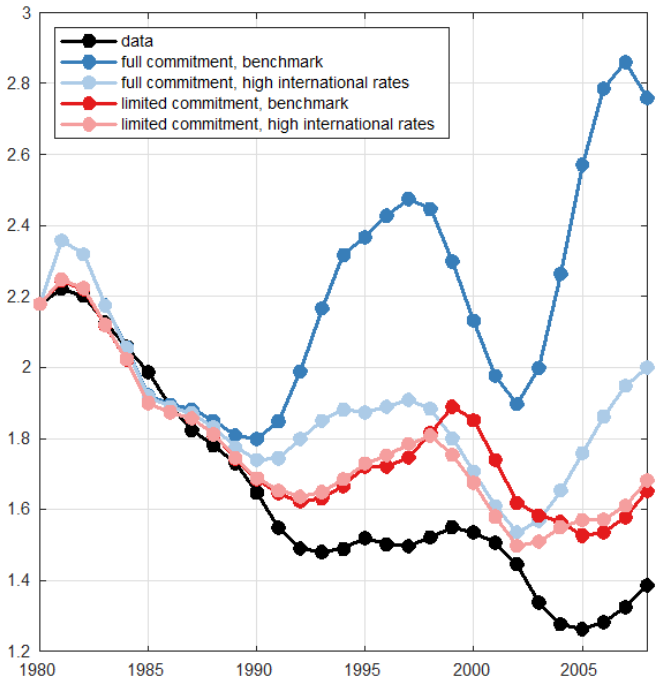
- Note asymmetric response of capital stock during periods of declining and rising TFP.

Assessing lower international real interest rate effect



Conterfactually higher international real interest rate experiment



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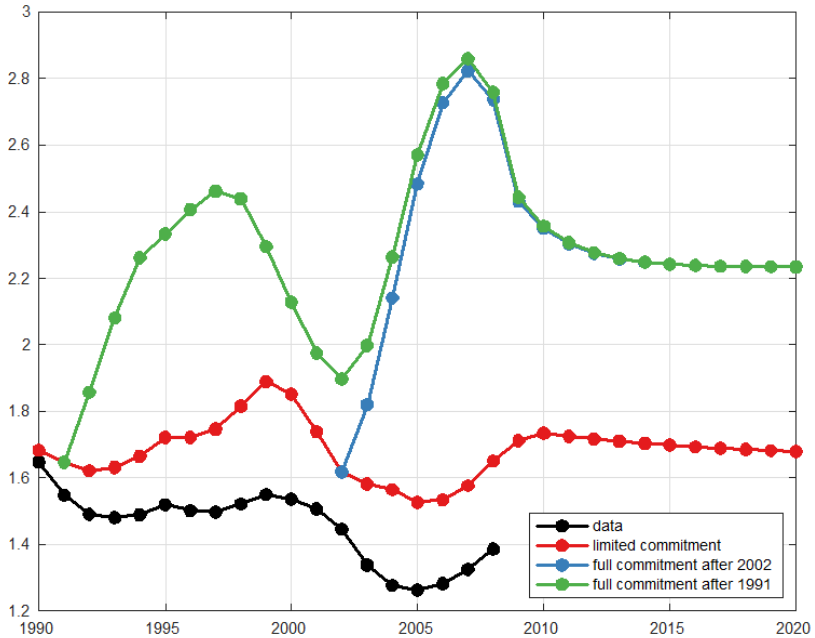

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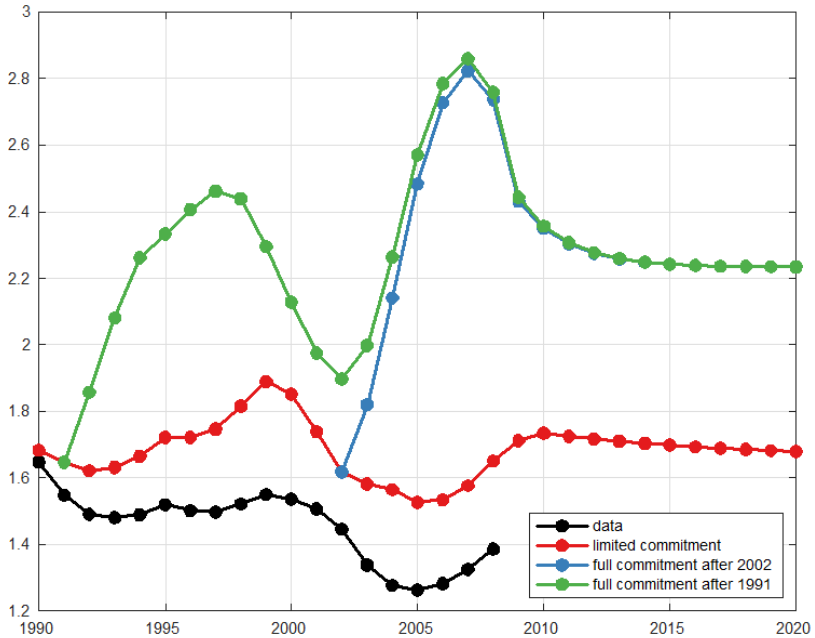

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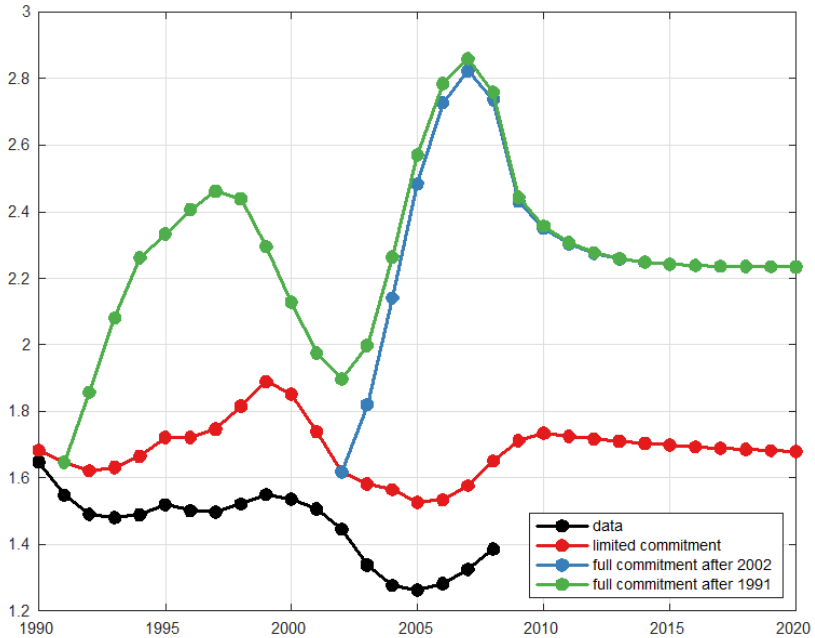

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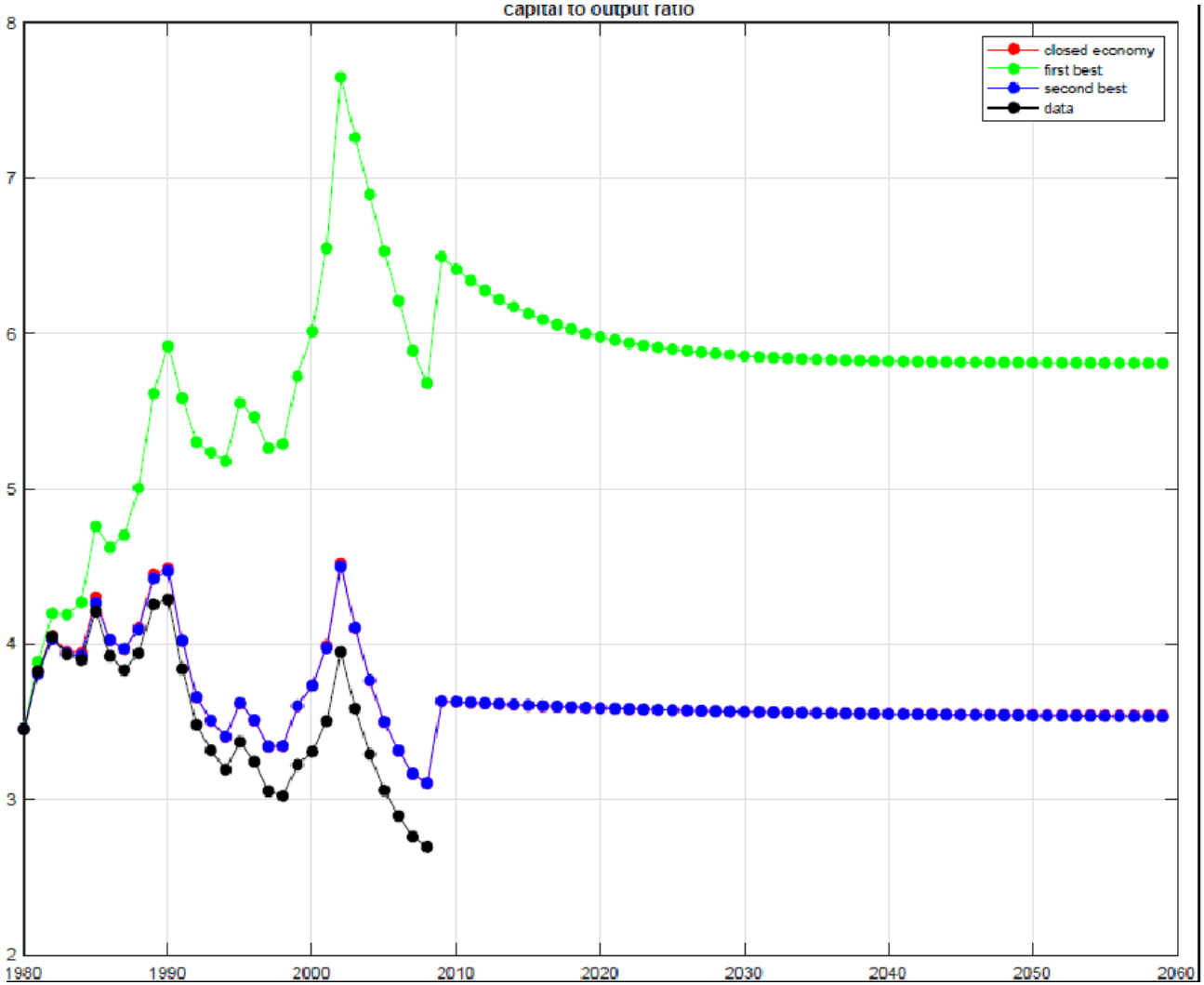
- Real wages permanently 13% higher in steady state, a whopping 25% higher in 2007.

Removal of limited commitment lifts steady-state capital-output ratio



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- Calibrated parameter values suggest real wage gains from regaining foreign investors' trust are large.