International Asset Pricing with Recursive Preferences

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- We would like to explain:
    1. The forward premium anomaly: the tendency of high interest rate currencies to appreciate
    2. The Backus and Smith anomaly: the lack of correlation between consumption differentials and FX movements

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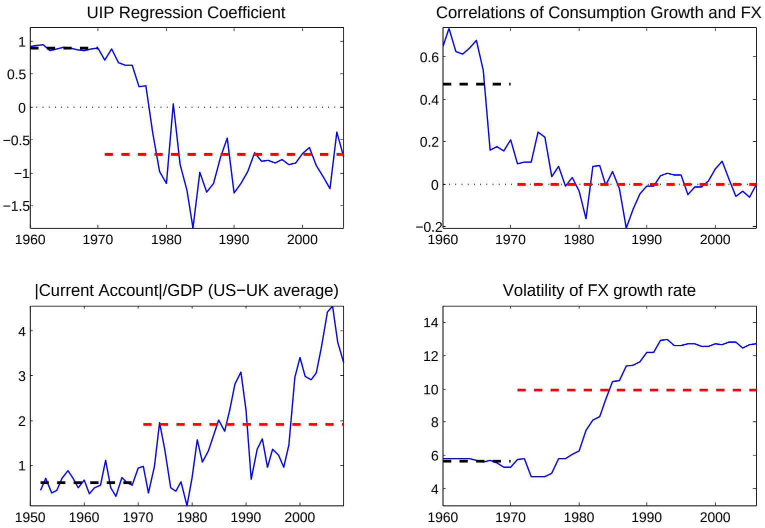
- The model should be consistent with:
  - low int'l correlation of consumption and output
  - smoothness of exchange rates
  - large int'l equity risk premia
  - large int'l correlation of returns
  - volatility of Net Exports
  - ...

Anomalies pre- and post-1970



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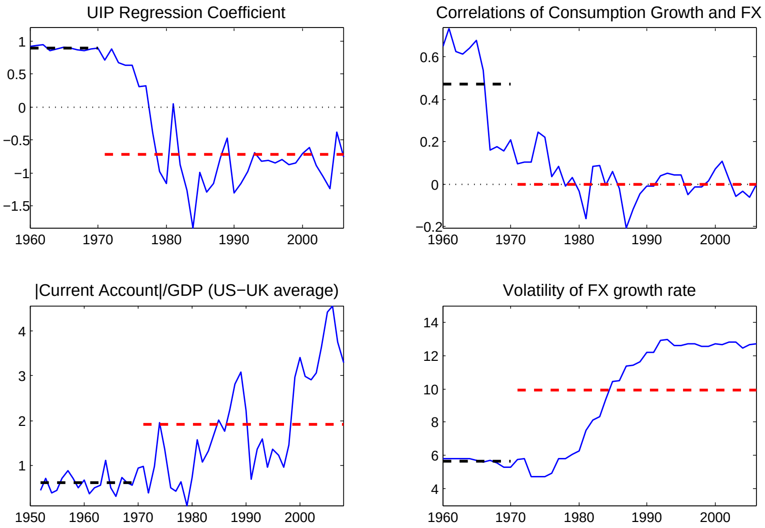

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    - pre-1970 $\rightarrow$ financial autarky
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   - pre-1970 $\rightarrow$ financial autarky
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2. Recursive risk-sharing
   - agents have Epstein-Zin preferences
   - agents consume a bundle of domestic and foreign goods
   - exposure to both and short- and long-run risks

Preferences

- Two countries: home (h) and foreign (f)
- Agents have Epstein and Zin preferences

$$U_{i,t} = (1-\delta)\frac{C_{i,t}^{1-\frac{1}{\psi}}}{1-\frac{1}{\psi}} + \delta E_t\left[U_{i,t+1}^{1-\theta}\right]^{\frac{1}{1-\theta}}, \qquad \forall i \in \{h, f\}$$

where $\theta = \frac{\gamma - 1/\psi}{1-1/\psi}$.

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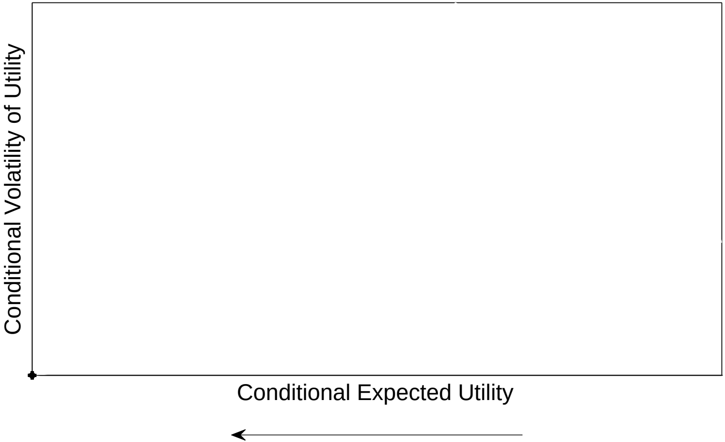

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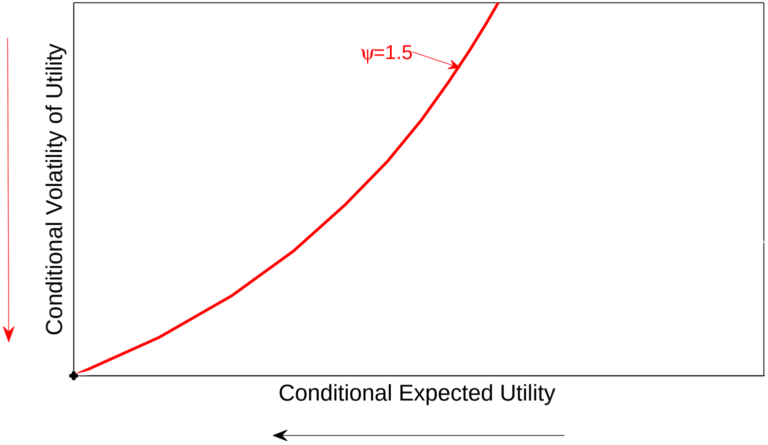

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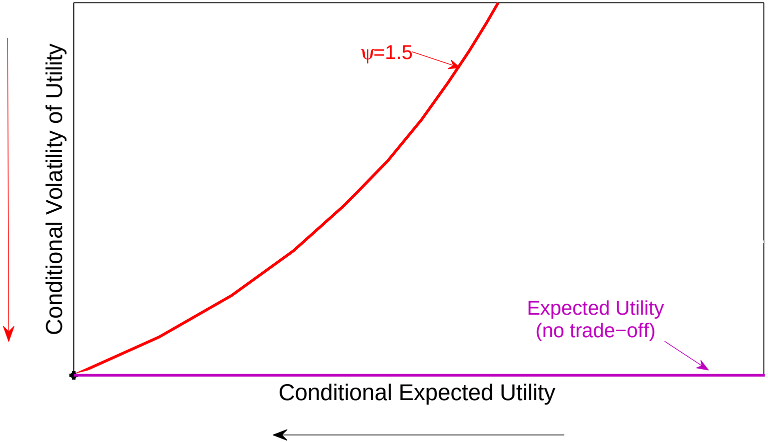

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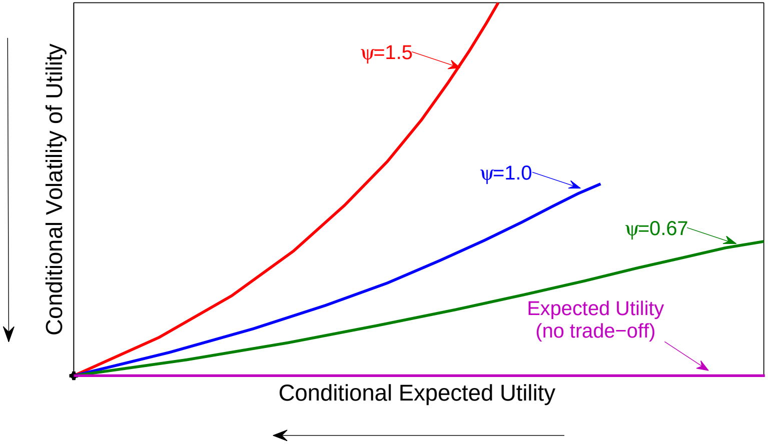
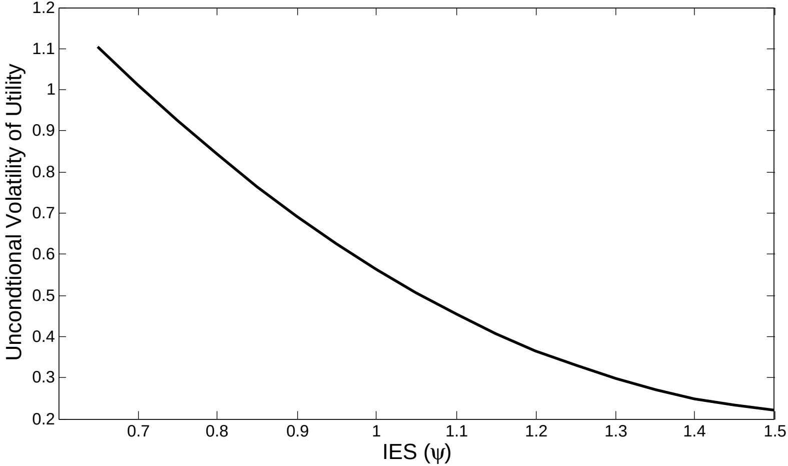


Total Amount of Risk



Total amount of risk decreases in ψ

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- Preferences are defined over consumption aggregates

$$C_{h,t} = (x_{h,t})^{\alpha}(y_{h,t})^{1-\alpha} \quad \text{and} \quad C_{f,t} = (x_{f,t})^{1-\alpha}(y_{f,t})^{\alpha}, \quad \alpha > 1/2.$$

Endowments

- Endowments' growth is *almost* i.i.d.

$$
\begin{aligned}
\Delta \log X_t &= \mu_x + z_{1,t-1} + \varepsilon_{x,t} - \tau \log(X_t/Y_t) \\
\Delta \log Y_t &= \mu_y + \underbrace{z_{2,t-1}}_{LRR} + \underbrace{\varepsilon_{y,t}}_{SRR} + \underbrace{\tau \log(X_t/Y_t)}_{Cointegration}
\end{aligned}
$$

where $z_{1,t}$ and $z_{2,t}$ are small, predictable components

$$
\begin{aligned}
z_{1,t} &= \rho_1 z_{1,t-1} + \varepsilon_{1,t} \\
z_{2,t} &= \rho_2 z_{2,t-1} + \varepsilon_{2,t}
\end{aligned}
$$

- Shocks are homoskedastic.

Markets

- *Home* (*Foreign*) is endowed with good X (Y);
- Complete Markets:

$$x_{h,t} + p_t y_{h,t} + \sum_{s_{t+1}} Q_{t+1}(s_{t+1}) A_{t+1}(s_{t+1}) \leq X_t + A_t \qquad [Home]$$

$$x_{f,t} + p_t y_{f,t} - \sum_{s_{t+1}} Q_{t+1}(s_{t+1}) A_{t+1}(s_{t+1}) \leq p_t Y_t - A_t \qquad [Foreign]$$

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- Financial Autarky: $A_t = 0$.

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$$x_t^{h,aut} = \alpha X_t, \qquad y_t^{h,aut} = (1-\alpha) Y_t$$

- Exchange rate reflects short-run relative supplies:

$$\Delta e_t \quad = \quad (2\alpha - 1)(\Delta x_t - \Delta y_t).$$

Results with Complete Markets

- Allocations:

$$x_t^h = x_t^{h,aut}\left[1+\frac{(1-\alpha)(S_t-1)}{1-\alpha+\alpha S_t}\right], \qquad y_t^h = y_t^{h,aut}\left[1+\frac{\alpha(S_t-1)}{\alpha+(1-\alpha)S_t}\right]$$

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  - Agents are willing to trade-off lower consumption today for smoother future utility profiles.
  - Volatilities are high in bad times and low in good time.

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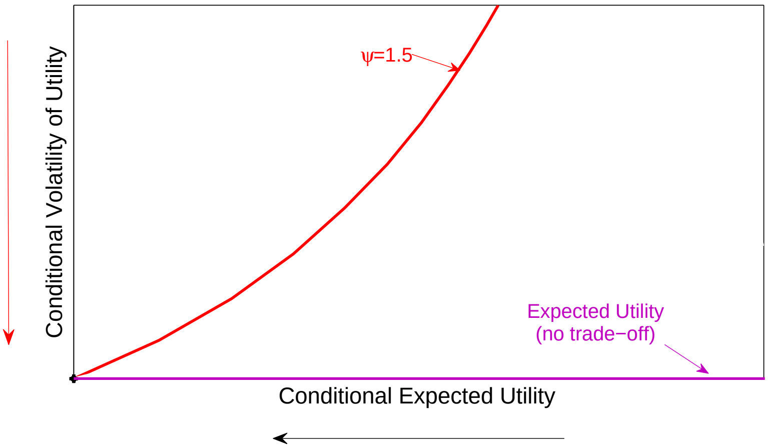

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- Long-run risks should be very correlated to replicate FX volatility

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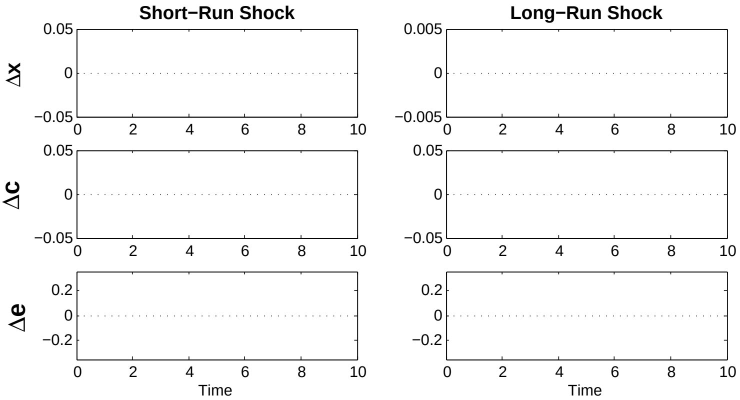

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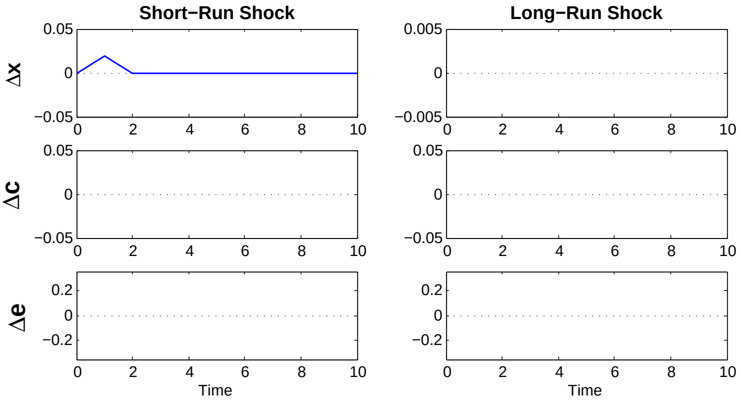

→ Short-run shock to X: home country is happy!

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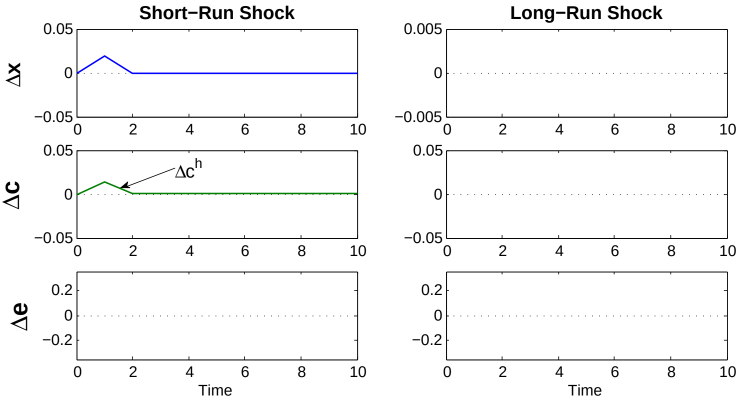

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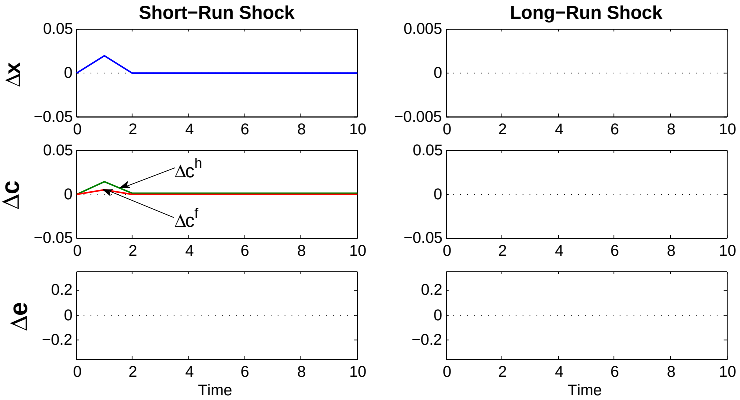

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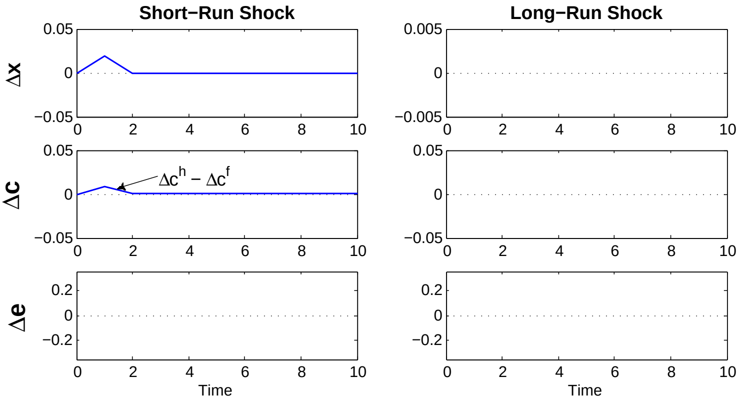

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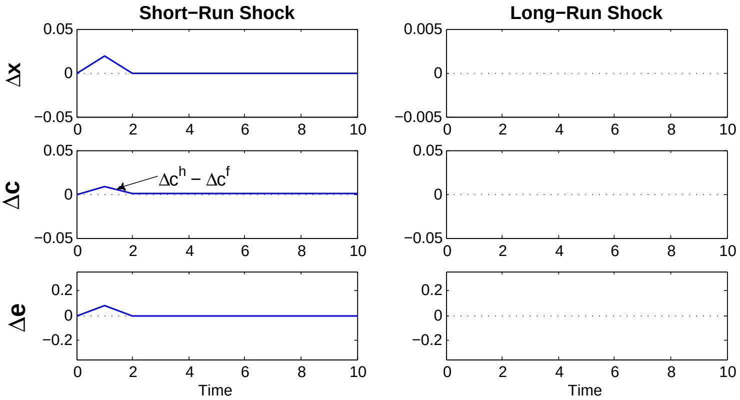

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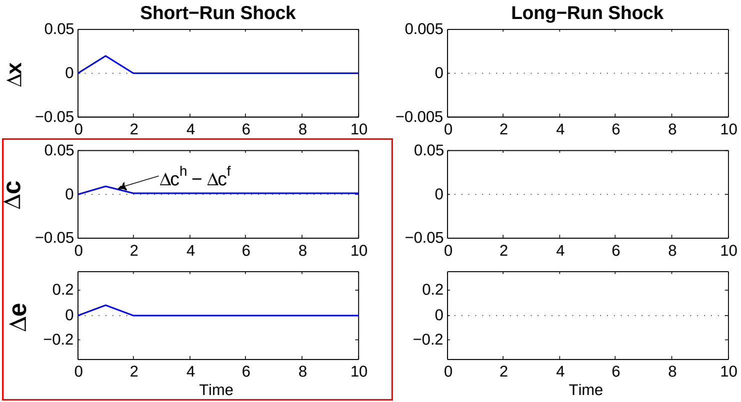

$\rightarrow$ Home currency depreciates: $corr(\Delta c^h - \Delta c^f, \Delta e)$ is positive

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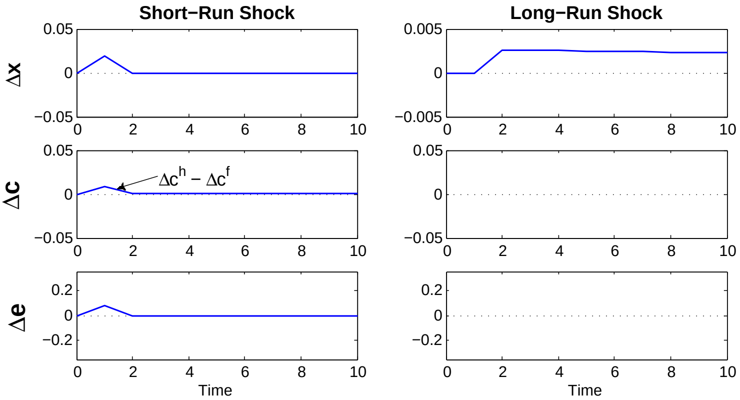

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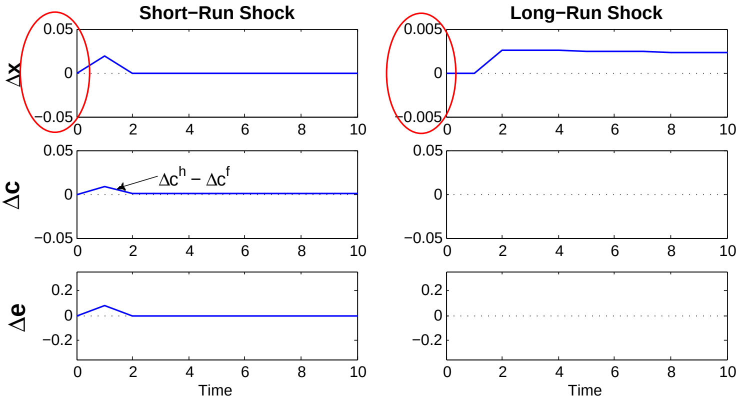

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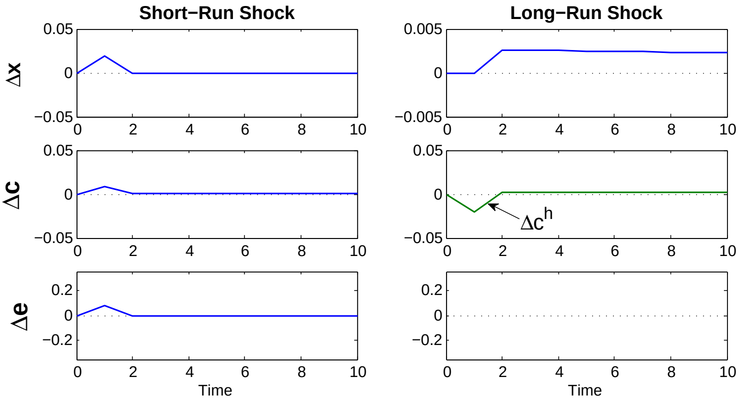

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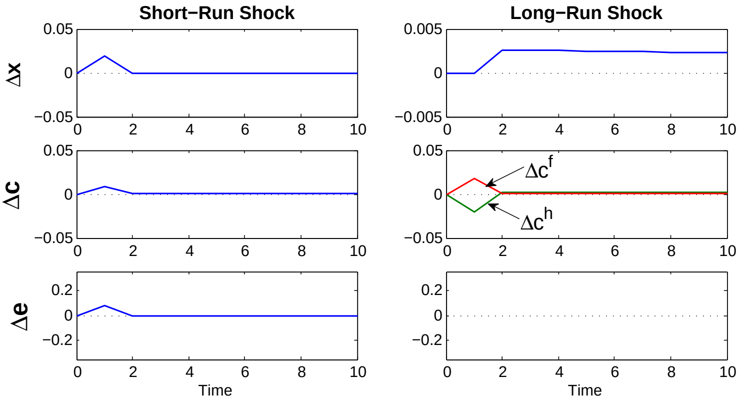

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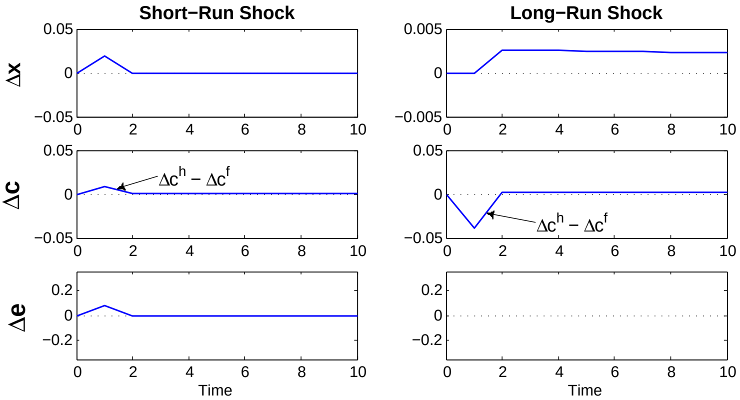

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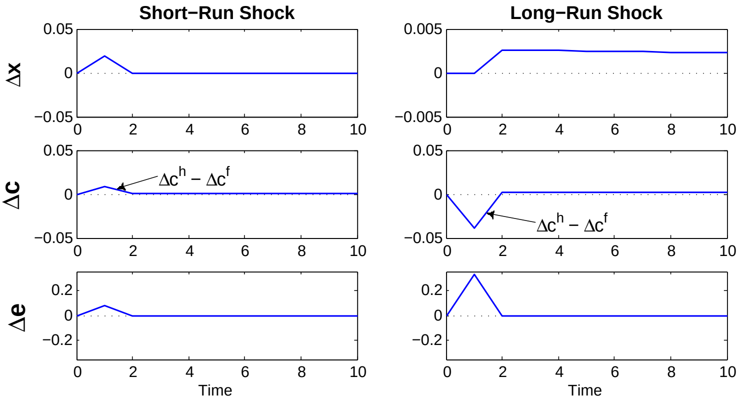

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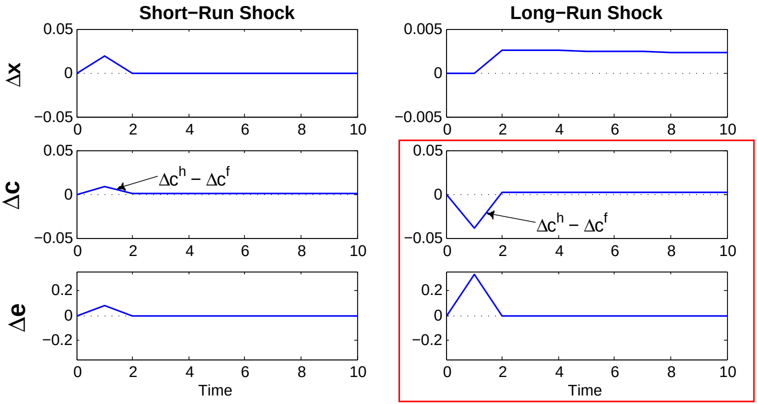

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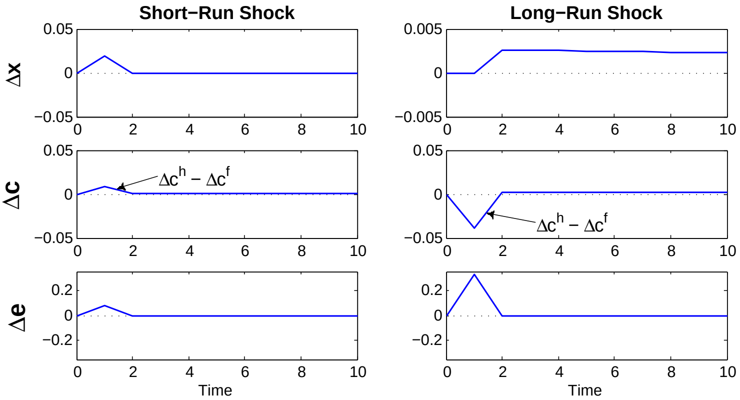

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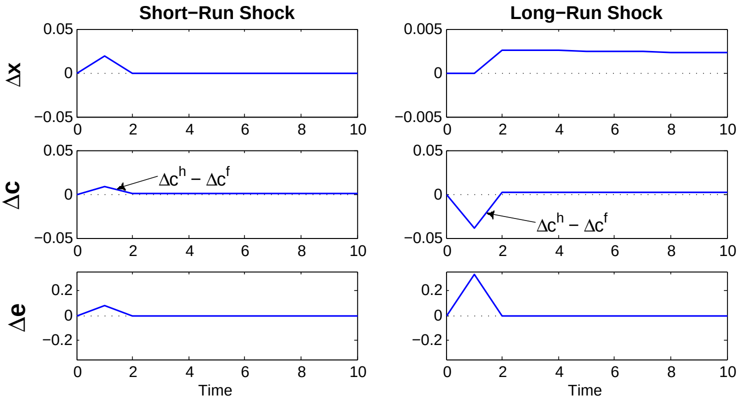

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Interest rate differential

$$r^h_{t-1} - r^f_{t-1} \approx \; E_{t-1}\left[\Delta c^h_t - \Delta c^f_t\right] + \frac{1}{2}\left(V_{t-1}\left[\Delta c^f_t\right] - V_{t-1}\left[\Delta c^h_t\right]\right)$$

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Expected FX growth

$$E_{t-1}\left[\Delta e_t\right] = \; E_{t-1}\left[\Delta c^h_t - \Delta c^f_t\right] + \frac{1}{2\theta^2}\left(Var_{t-1}\left[U^h_t\right] - Var_{t-1}\left[U^f_t\right]\right)$$

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$$\uparrow r^h_{t-1} - r^f_{t-1} \approx \uparrow E_{t-1}\left[\Delta c^h_t - \Delta c^f_t\right] + \frac{1}{2}\left(V_{t-1}\left[\Delta c^f_t\right] - V_{t-1}\left[\Delta c^h_t\right]\right)\uparrow$$

Expected FX growth

$$E_{t-1}\left[\Delta e_t\right] = E_{t-1}\left[\Delta c^h_t - \Delta c^f_t\right] + \frac{1}{2\theta^2}\left(Var_{t-1}\left[U^h_t\right] - Var_{t-1}\left[U^f_t\right]\right)$$

$\rightarrow$ Assume that Home has good long-run news ($\varepsilon_{1,t} \uparrow$)

Forward Premium Anomaly

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Interest rate differential

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Forward Premium Anomaly ✓

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$\rightarrow$ Assume that Home has good long-run news ($\varepsilon_{1,t}\uparrow$)

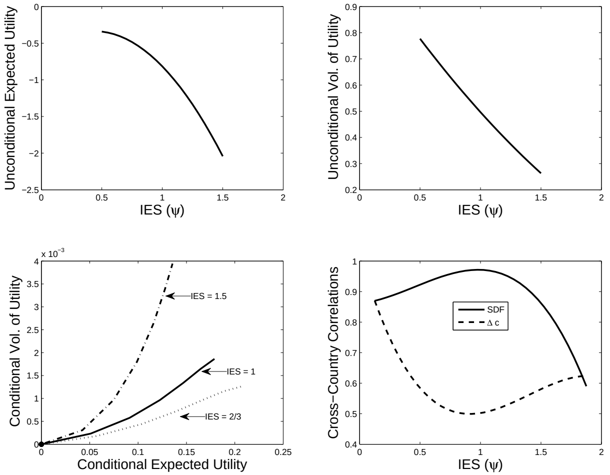
Post-1970: Complete Markets

Specification	DATA	(1)	(2)	(3)	(4)	(5)
IES (ψ)		1.5	1.5	1	0.67	$1/\gamma$
		(with LRR)	(no LRR)		(with LRR)	
Std (Δc) /Std (Δy)	0.87	0.96	0.87	0.99	0.99	0.93
ACF$_1$ (Δc_t)	0.38	0.28	0.04	0.24	0.27	0.31
corr(Δc_t^h,Δc_t^f)	0.55	0.59	0.82	0.42	0.48	0.81
E[r_f]	1.25	1.81	2.93	3.18	5.38	16.46
Std[r_f]	1.15	0.68	0.00	1.15	1.54	9.17
corr($r_{f,t}^h$, $r_{f,t}^f$)	0.64	0.88	-1.00	0.92	0.92	0.97
Std[M]/E[M]		27.83	12.99	70.51	87.78	16.64
Std (Δe_t)	11.65	14.47	7.45	20.58	17.99	10.23
corr($\Delta c_t^h - \Delta c_t^f$, Δe_t)	-0.02	-0.02	1.00	-0.53	-0.34	1.00
β_{UIP}	-0.72	-0.71	-155.69	-2.36	-1.59	1.01
E($r_{d,t}^{ex}$)	6.0	6.68	0.32	3.75	0.74	0.46
corr($r_{d,t}^{ex}$,Δe_t)	0.05	0.08	0.12	-0.14	-0.17	0.06
corr($r_{d,t}^{ex}$,$r_{FX,t}$)	-0.05	0.03	0.03	0.10	0.00	0.00

Pre-1970: Financial Autarky

	Pre-1970			Post-1970 – Pre-1970		
	DATA	Model (with LRR)	Model (no LRR)	DATA	Model (with LRR)	Model (no LRR)
Std (Δc) /Std (Δy)	0.69	0.97	0.97	0.18	0.00	-0.10
ACF_1 (Δc_t)	0.41	0.39	-0.01	-0.03	-0.11	0.01
corr(Δc_t^h,Δc_t^f)	0.02	-0.06	-0.06	0.53	0.68	0.93
E[r_f]	0.61	1.75	2.89	0.65	0.06	0.04
Std[r_f]	1.72	0.85	0.00	-0.57	-0.17	0.01
corr($r_{f,t}^h$, $r_{f,t}^f$)	0.46	0.59	–	0.18	0.29	–
Std[M]/E[M]		27.54	14.55		0.29	-1.56
Std (Δe_t)	5.59	3.53	2.81	6.06**	10.94	3.52
corr($\Delta c_t^h - \Delta c_t^f$, Δe_t)	0.47	1.00	1.00	-0.49***	-1.02	0.00
β_{UIP}	0.94	1.50	–	-1.66**	-2.21	–

The Role of IES



Testable Implications (post-1970)

Contemporaneous Responses

A: Consumption Growth

$\Delta c_t^{US} - \Delta c_t^{UK} = \mu_t + \beta_x \varepsilon_{x,t} + \beta_y \varepsilon_{y,t} + \beta_1 \varepsilon_{1,t} + \beta_2 \varepsilon_{2,t} + \epsilon_t$

	pd only	pd,cy,dy	All
F-stat	0.000	0.000	0.000
Total R^2	0.834	0.875	0.848
Long-run news R^2	0.003	0.007	0.005
β_1 (H_0: $\beta_1 \geq 0$)	-0.013^{***}	-0.018^{***}	-0.003^{***}
β_2 (H_0: $\beta_2 \leq 0$)	0.003^{*}	0.007^{***}	0.005^{***}
β_x (H_0: $\beta_x \leq 0$)	0.005^{***}	0.012^{***}	0.004^{***}
β_y (H_0: $\beta_y \geq 0$)	-0.009^{***}	-0.008^{***}	-0.011^{***}

B: Excess Returns

$r_{ex,t}^{US} - r_{ex,t}^{UK} = \mu_t + \beta_x \varepsilon_{x,t} + \beta_y \varepsilon_{y,t} + \beta_1 \varepsilon_{1,t} + \beta_2 \varepsilon_{2,t} + \epsilon_t$

	pd only	pd,cy,dy	All
F-stat	0.000	0.000	0.000
Total R^2	0.874	0.455	0.493
Long-run news R^2	0.786	0.255	0.356
β_1 (H_0: $\beta_1 \leq 0$)	0.606^{***}	0.299^{***}	0.086^{***}
β_2 (H_0: $\beta_2 \geq 0$)	-0.262^{***}	-0.274^{***}	-0.173^{***}
β_x (H_0: $\beta_x \leq 0$)	0.004	−0.148	−0.003
β_y (H_0: $\beta_y \geq 0$)	0.009	-0.034^{***}	0.046

Equity Risk Premia

C: Realized Variance

$(r_{ex,t}^{US})^2 - (r_{ex,t}^{UK})^2 = \mu_t + \beta_x \varepsilon_{x,t} + \beta_y \varepsilon_{y,t} + \beta_1 \varepsilon_{1,t} + \beta_2 \varepsilon_{2,t} + \epsilon_t$

	pd only	pd,cy,dy	All
F-stat	0.092	0.201	0.234
Total R^2	0.467	0.396	0.341
Long-run news R^2	0.172	0.127	0.172
β_1 (H_0: $\beta_1 \geq 0$)	0.072	-0.091^{*}	-0.058^{**}
β_2 (H_0: $\beta_2 \leq 0$)	0.079^{**}	0.127^{***}	0.085^{**}
β_x (H_0: $\beta_x \geq 0$)	-0.020^{*}	0.025	−0.002
β_y (H_0: $\beta_y \leq 0$)	0.017^{**}	0.047^{***}	−0.001

D: Excess Returns (one period ahead)

$r_{ex,t+1}^{US} - r_{ex,t+1}^{UK} = \mu_t + \beta_x \varepsilon_{x,t} + \beta_y \varepsilon_{y,t} + \beta_1 \varepsilon_{1,t} + \beta_2 \varepsilon_{2,t} + \epsilon_t$

	pd only	pd,cy,dy	All
F-stat	0.001	0.007	0.000
Total R^2	0.169	0.128	0.174
Long-run news R^2	0.158	0.027	0.126
β_1 (H_0: $\beta_1 \leq 0$)	-0.371^{***}	-0.203^{**}	-0.070^{***}
β_2 (H_0: $\beta_2 \leq 0$)	0.172^{***}	0.197^{***}	0.169^{***}
β_x (H_0: $\beta_x \geq 0$)	-0.038^{***}	0.052	-0.033^{**}
β_y (H_0: $\beta_y \leq 0$)	0.007	0.041^{***}	−0.043

Concluding Remarks

A two-countries model with:

- complete markets
- two goods
- long-run risks in the endowments
- recursive preferences

1. generates
   - dynamic risk-sharing scheme
   - endogenously time varying second moments
2. replicates a number of international finance facts

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Tomorrow: 10:15 am, Manchester Grand Hyatt, Elizabeth Ballroom F