Exchange-Rate Dynamics
Chapter 1

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Macro Models without Frictions

Aims:

- Explore the links between Exchange Rates and Macro Variables

- Establish a benchmark for judging the empirical success of micro-based models

Macro Models without Frictions

Outline:

1. Preliminaries
   i. Definitions
   ii. Purchasing Power Parity
2. Empirical Characteristics of Real Exchange Rates
   i. Real Exchange Rates and Relative Prices
   ii. Volatility and Autocorrelation
   iii. Unit Roots and Half Lives
   iv. Aggregation Bias
3. Macro Exchange Rate Model
   i. Endowment Economies
   ii. Production Economies

Table 1: Sources of Real Exchange Variation

Horizon (months)	Canada	France	Germany	Italy	Japan
			A: $\mathbb{V}(\Delta\varepsilon_t^{\mathrm{T}})/\mathbb{V}(\Delta\varepsilon_t)$		
1	1.165	1.000	1.010	1.006	1.069
6	0.977	1.000	0.982	0.996	1.018
12	0.928	1.001	0.969	0.996	0.994
36	0.880	1.000	0.934	0.990	0.956
60	0.829	0.997	0.901	0.987	0.942
			B: $\mathbb{CV}(\Delta\varepsilon_t^{\mathrm{T}}, \Delta\varepsilon_t^{\mathrm{NT}})$ ($\times$ 100)		
1	-0.001	-0.006	-0.001	0.000	-0.003
6	-0.001	0.001	0.003	-0.001	-0.009
12	0.003	-0.042	0.015	-0.002	-0.002
36	0.032	-0.037	0.134	0.009	0.073
60	0.066	0.044	0.361	0.027	0.134
			C: $\mathbb{V}(\Delta\varepsilon_t^{\mathrm{T}})/[\mathbb{V}(\Delta\varepsilon_t^{\mathrm{T}}) + \mathbb{V}(\Delta\varepsilon_t^{\mathrm{NT}})]$		
1	0.943	1.000	0.992	0.987	0.981
6	0.954	1.000	0.994	0.993	0.989
12	0.955	1.000	0.993	0.993	0.992
36	0.948	0.999	0.991	0.995	0.990
60	0.919	0.999	0.990	0.997	0.987

Source: Engel (1999)

Volatility and Autocorrelation

Note:

1. Very little of the variation in real depreciation rate attributable to changes in the inflation differential.

2. The strong correlation between real depreciation rates and changes in the terms of trade.

3. Variations in real exchange rates are very persistent.

Table 2: Real and Nominal Exchange Rate Statistics

	EUR/USD	DM/USD	GBP/USD	JPY/USD
$\mathbb{V}(\Delta s_t)$	6.89	11.05	8.92	10.40
$\mathbb{V}(\Delta \varepsilon_t)$	6.85	11.20	9.44	10.90
$\mathbb{CR}(\Delta s_t, \Delta \varepsilon_t)$	0.99	0.99	0.98	0.99
$\mathbb{V}(\Delta \tau_t)$	7.59	11.31	10.02	7.54
$\mathbb{CR}(\Delta \varepsilon_t, \Delta \tau_t)$	0.99	0.97	0.90	0.84
$\mathbb{CR}(\varepsilon_t, \varepsilon_{t-1})$	0.97	0.99	0.97	0.98
$\mathbb{CR}(\varepsilon_t, \varepsilon_{t-2})$	0.94	0.98	0.94	0.96
$\mathbb{CR}(\varepsilon_t, \varepsilon_{t-3})$	0.91	0.96	0.91	0.94
$\mathbb{CR}(\Delta \varepsilon_t, \Delta \varepsilon_{t-1})$	0.15	0.01	0.05	0.09
$\mathbb{CR}(\Delta \varepsilon_t, \Delta \varepsilon_{t-2})$	0.03	0.09	0.00	0.05
$\mathbb{CR}(\Delta \varepsilon_t, \Delta \varepsilon_{t-3})$	-0.08	0.03	-0.013	0.09

Notes: The log real exchange rate in month t, ε_t, is computed as $s_t + \hat{p}_t - p_t$ where s_t is the log spot rate (FX/USD), $\hat{p}_t$ is the log foreign consumer price index, and p_t is the log US consumer price index in month t. The bilateral terms of trade, τ_t, are computed as $s_t + \hat{p}_t^{\mathrm{X}} - p_t^{\mathrm{X}}$ where p_t^{X} and $\hat{p}_t^{\mathrm{X}}$ denote the US and foreign price indices for exports. Depreciation rates are calculated as the monthly difference in the log level, i.e. $\Delta s_t \equiv s_t - s_{t-1}$, $\Delta \varepsilon_t \equiv \varepsilon_t - \varepsilon_{t-1}$, and $\Delta \tau_t = \tau_t - \tau_{t-1}$ multiplied by 100.

Aggregation Bias and the PPP Puzzle

$$\rho_A = 0.925,\ \rho_B = 0.943,\ \lambda = 1/2$$

Note: Economic shocks have different effects that cannot be accurately represented by the time series innovations.

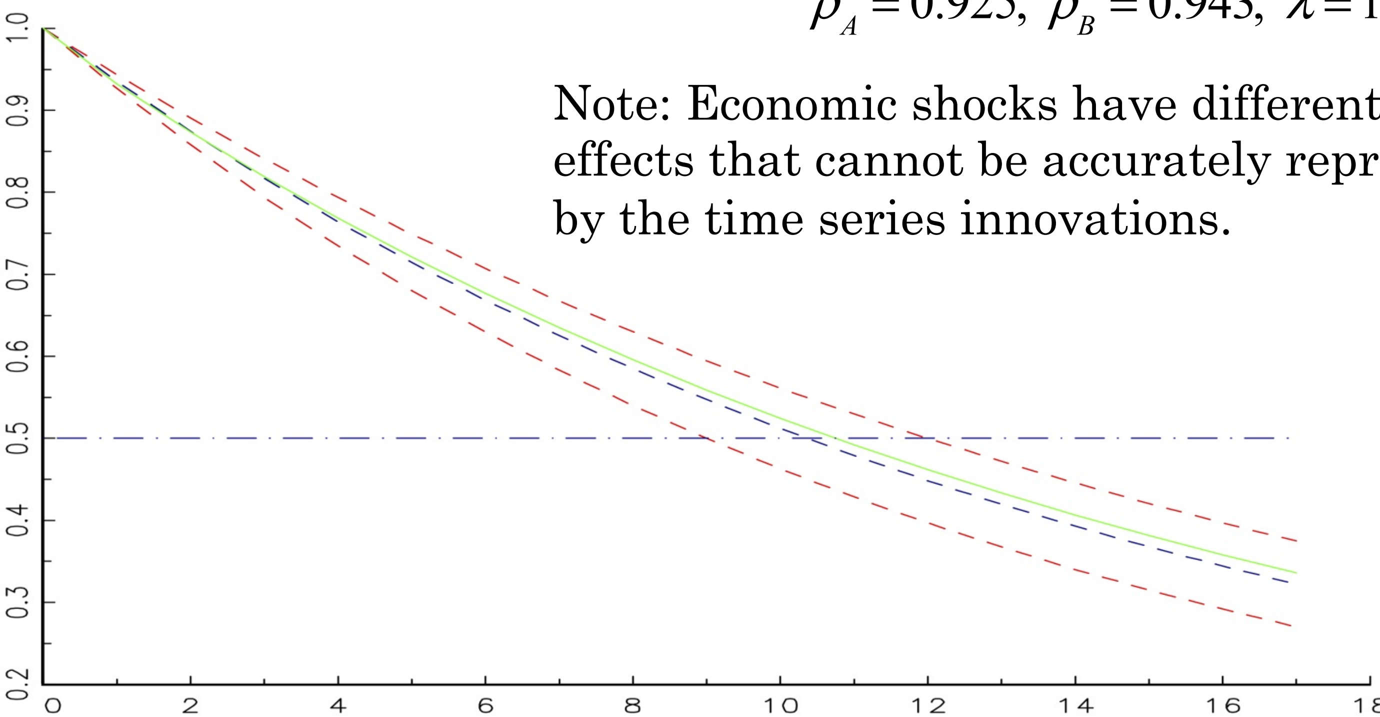
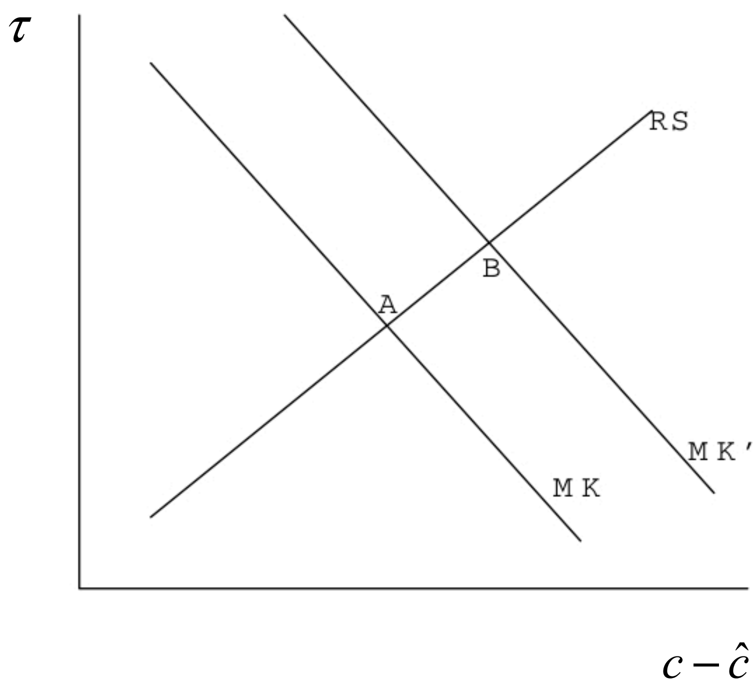


Figure 1: Impulse responses functions: lower dashed red, v_t^{A} shocks; upper dashed red, v_t^{B} shocks; dashed blue, u_t shocks; and solid green, n_t innovations.

Exchange Rates in an Endowment Economy

Figure 2: Goods Market Equilibrium



The Equilibrium Terms of Trade are found by combining the risk-sharing and market clearing conditions:

RS: $\tau_t = \frac{\gamma}{(2\lambda-1)}(c_t - \hat{c}_t) - \frac{2\lambda}{(2\lambda-1)}\bar{\varepsilon}_t$

MK $\tau_t = -\frac{2\lambda-1}{4\lambda\theta(1-\lambda)}(c_t - \hat{c}_t) + \frac{1}{4\lambda\theta(1-\lambda)}(x_t - \hat{x}_t) - \bar{\varepsilon}_t$

A rise in the endowment of the US good moves MK to MK'

Open Economy Case with Imperfect Substitutability:

Table 3: Production Economy Parameters

Parameter	Symbol	Value
discount factor	β	0.997
risk aversion	γ	2.000
consumption share	λ	0.850
consumption elasticity	θ	0.740
depreciation rate	δ	0.020
capital share	η	0.360
productivity AR(1)	ϕ	0.980

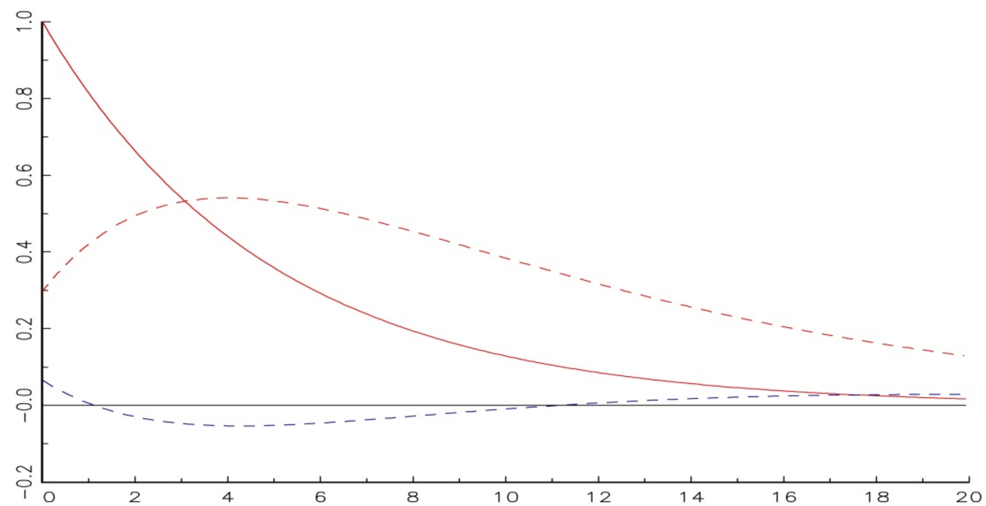


Figure 3: Impulse responses of US productivity (a_t red solid); and traded goods consumption (x_t, US red dashed and $\hat{x}_t$ EU blue dashed)

Open Economy Case with Imperfect Substitutability (cont.):

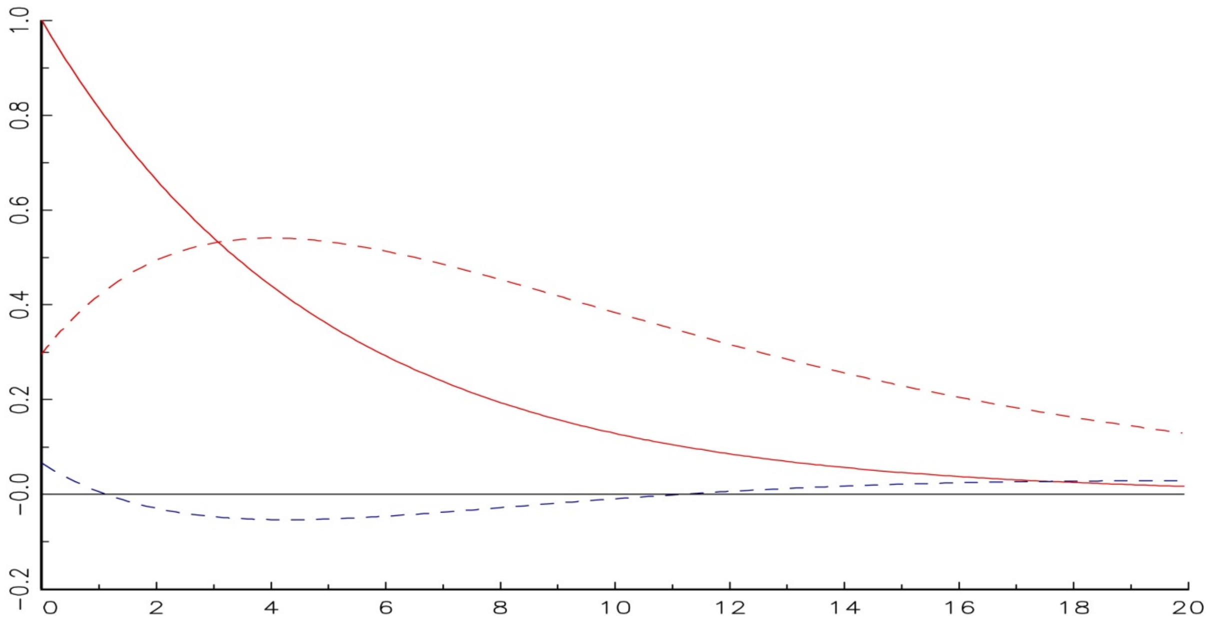


Figure 3: Impulse responses of US productivity (a_t red solid); and traded goods consumption (x_t, US red dashed and $\hat{x}_t$ EU blue dashed)

Note: (i) US and EU MPK differ, (ii) US MPK fall below long run level, and (iii) no initial affect on EU MPK.

Open Economy Case with Imperfect Substitutability (cont.):

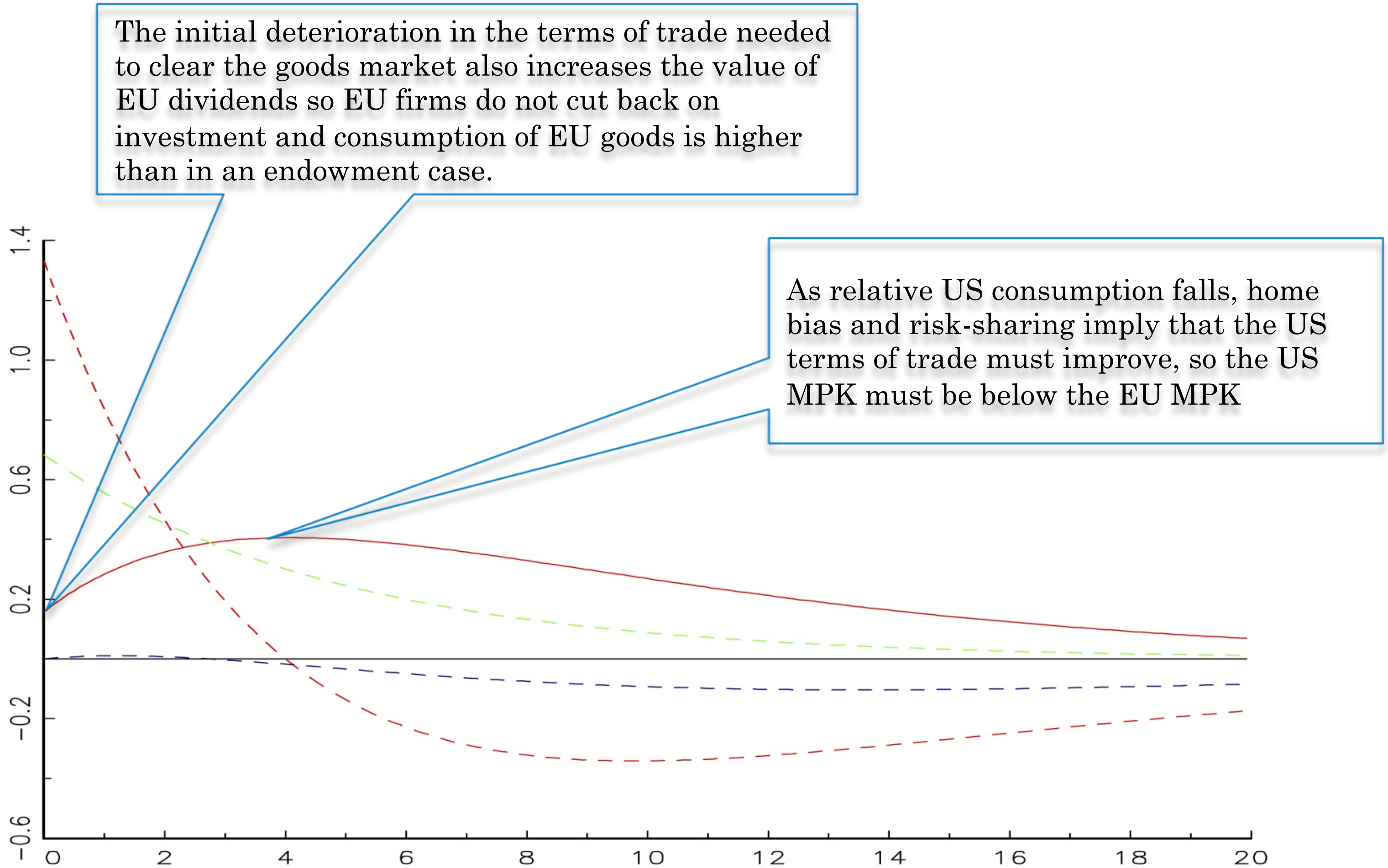


Figure 4: Impulse responses of the terms of trade (τ, solid red), and Marginal Product of Capital (r^k, US dashed red, $\hat{r}^k$, EU dashed blue). (terms of trade in an endowment economy, dashed green)

Open Economy Case with Imperfect Substitutability (cont.):

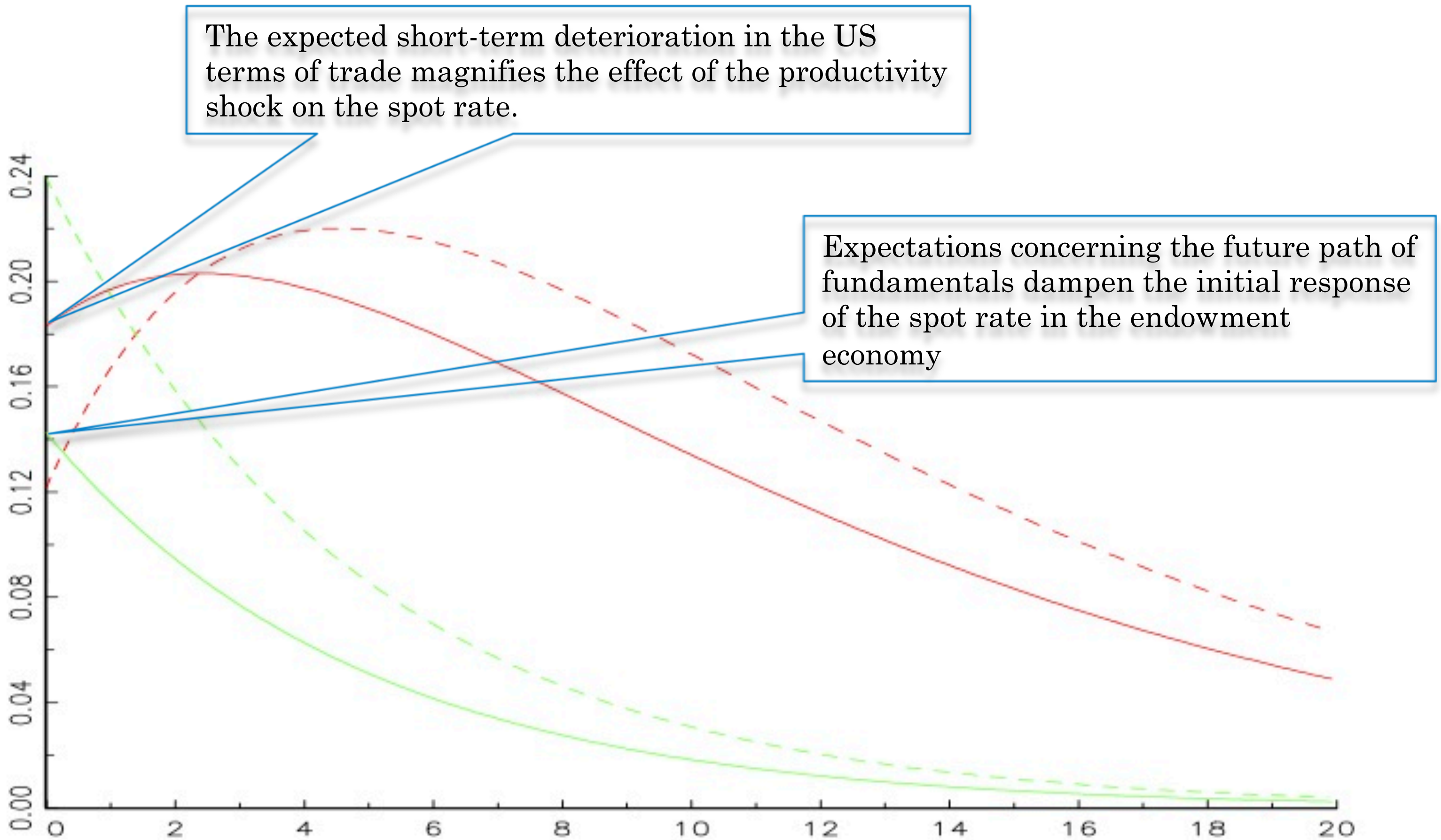


Figure 5: Impulse responses of the real exchange rate (ε, dashed), and the present value ($\mathbb{E}_t \sum_{i=0}^{\infty} b^i \varepsilon_{t+i}$, solid), to a US productivity shock in the Endowment (green) and Production (red) economies.