3 The Standard Real Business Cycle (RBC) Model

- Perfectly competitive economy
- Optimal growth model + Labor decisions
- 2 types of agents
  - Households
  - Firms
- Shocks to productivity
- Pareto optimal economy

- Can be solved using a Social Planner program or solving for a competitive equilibrium

- We will solve for the equilibrium

3.1 The Household

- Mass of agents = 1 (no population growth)
- Identical agents + All face the same aggregate shocks (no idiosyncratic uncertainty)
- $\rightsquigarrow$ Representative agents

- Infinitely lived rational agent with intertemporal utility

$$E_t \sum_{s=0} \beta^s U_{t+s}$$

$\beta \in (0,1)$: discount factor,

- Preferences over
  – a consumption bundle
  – leisure
- $\rightsquigarrow U_t = U(C_t, \ell_t)$ with $U(\cdot,\cdot)$
  – class $\mathcal{C}^2$, strictly increasing, concave and satisfy Inada con-

ditions

– compatible with balanced growth [more below]:

$$U(C_t,\ell_t)=\begin{cases}\frac{C_t^{1-\sigma}}{1-\sigma}v(\ell_t) & \text{if } \sigma\in\mathbb{R}^+\backslash\{1\}\\ \log(C_t)+v(\ell_t) & \text{if } \sigma=1\end{cases}$$

Preferences are therefore given by

$$E_t\left[\sum_{s=0}^{\infty}\beta^s U\big(C_{t+s},\ell_{t+s}\big)\right]$$

- Household faces two constraints

- Time constraint

$$h_{t+s}+\ell_{t+s}\leqslant T=1$$

(for convenience T=1)

- Budget constraint

$$\underbrace{B_{t+s}}_{Bond\ purchases} + \underbrace{C_{t+s} + I_{t+s}}_{Good\ purchases}$$

$$\leqslant \underbrace{(1 + r_{t+s-1})B_{t+s-1}}_{Bond\ revenus} + \underbrace{W_{t+s}h_{t+s}}_{Wages} + \underbrace{z_{t+s}K_{t+s}}_{Capital\ revenus}$$

- Capital Accumulation

$$K_{t+s+1} = I_{t+s} + (1 - \delta)K_{t+s}$$

$\delta \in (0, 1)$: Depreciation rate

The household decides on consumption, labor, leisure, investment, bond holdings and capital formation maximizing utility constraint, taking the constraints into account

$$\max_{\{C_{t+s},h_{t+s},\ell_{t+s},I_{t+s},K_{t+s+1},B_{t+s}\}_{t=0}^{\infty}} E_t \left[\sum_{s=0}^{\infty} \beta^s U\big(C_{t+s}, \ell_{t+s}\big) \right]$$

subject to the sequence of constraints

$$\begin{cases} h_{t+s} + \ell_{t+s} \leqslant 1 \\ B_{t+s} + C_{t+s} + I_{t+s} \leqslant \big(1 + r_{t+s-1}\big) B_{t+s-1} + W_{t+s} h_{t+s} + z_{t+s} K_{t+s} \\ K_{t+s+1} = I_{t+s} + (1-\delta) K_{t+s} \\ K_t,\ B_{t-1} \text{ given} \end{cases}$$

$$\max_{\{C_{t+s}, h_{t+s}, K_{t+1}, B_{t+s}\}_{t=0}^{\infty}} E_t \left[\sum_{s=0}^{\infty} \beta^s U(C_{t+s}, 1 - h_{t+s}) \right]$$

subject to

$$B_{t+s} + C_{t+s} + K_{t+s+1} \leqslant (1 + r_{t+s-1}) B_{t+s-1} + W_{t+s} h_{t+s} + (z_{t+s} + 1 - \delta) K_{t+s}$$

Write the Lagrangian

$$\mathcal{L}_t = E_t \sum_{s=0}^{\infty} \beta^s \Bigg[U(C_{t+s}, 1 - h_{t+s}) + \Lambda_{t+s} \Bigg((1 + r_{t+s-1}) B_{t+s-1} +$$

$$+ W_{t+s} h_{t+s} + (z_{t+s} + 1 - \delta) K_{t+s} - C_{t+s} - B_{t+s} - K_{t+s+1} \Bigg) \Bigg]$$

First order conditions ($\forall\ s \geq 0$)

$$
\begin{aligned}
C_{t+s} &: E_t U_c(C_{t+s}, 1 - h_{t+s}) = E_t \Lambda_{t+s} \\
h_{t+s} &: E_t U_\ell(C_{t+s}, 1 - h_{t+s}) = E_t(\Lambda_{t+s} W_{t+s}) \\
B_{t+s} &: E_t \Lambda_{t+s} = \beta E_t((1 + r_{t+s})\Lambda_{t+s+1}) \\
K_{t+s+1} &: E_t \Lambda_{t+s} = \beta E_t(\Lambda_{t+s+1}(z_{t+s+1} + 1 - \delta))
\end{aligned}
$$

and the transversality condition

$$\lim_{s \longrightarrow +\infty} \beta^s E_t \Lambda_{t+s}(B_{t+s} + K_{t+s+1}) = 0$$

Rearranging terms:

$$h_{t+s} : E_t U_\ell(C_{t+s}, 1 - h_{t+s}) = E_t U_c(C_{t+s}, 1 - h_{t+s}) W_{t+s}$$
$$B_{t+s} : E_t U_c(C_{t+s}, 1 - h_{t+s}) = \beta E_t((1 + r_{t+s}) E_t U_c(C_{t+s+1}, 1 - h_{t+s+1})$$
$$K_{t+s+1} : E_t U_c(C_{t+s}, 1 - h_{t+s}) = \beta E_t(U_c(C_{t+s+1}, 1 - h_{t+s+1})(z_{t+s+1} + 1$$

and the transversality condition

$$\lim_{s \longrightarrow +\infty} \beta^s E_t U_c(C_{t+s}, 1 - h_{t+s})(B_{t+s} + K_{t+s+1}) = 0$$

Simple example : Assume $U(C_t, \ell_t) = \log(C_t) + \theta \log(1 - h_t)$

$$\begin{array}{ll} h_{t+s} & : E_t \frac{1}{1-h_{t+s}} = E_t \frac{W_{t+s}}{C_{t+s}} \\ B_{t+s} & : E_t \frac{1}{C_{t+s}} = \beta E_t (1 + r_{t+s}) \frac{1}{C_{t+s+1}} \\ K_{t+s+1} & : E_t \frac{1}{C_{t+s}} = \beta E_t \frac{1}{C_{t+s+1}} (z_{t+s+1} + 1 - \delta) \end{array}$$

and the transversality condition

$$\lim_{s \longrightarrow +\infty} E_t \beta^s \frac{K_{t+s+1} + B_{t+s}}{C_{t+s}} = 0$$

Remark :

- It is convenient to write and interpret FOC for $s = 0$:

$$
\begin{aligned}
h_t \quad &: U_\ell(C_t, 1-h_t) = E_t U_c(C_t, 1-h_t) W_t \\
B_t \quad &: U_c(C_t, 1-h_t) = \beta E_t\big((1+r_t) E_t U_c(C_{t+1}, 1-h_{t+1})\big) \\
K_{t+1} &: U_c(C_t, 1-h_t) = \beta E_t\big(U_c(C_{t+1}, 1-h_{t+1})(z_{t+1} + 1 - \delta)\big)
\end{aligned}
$$

and the transversality condition

$$
\lim_{s \longrightarrow +\infty} E_t \beta^s \frac{K_{t+s+1} + B_{t+s}}{C_{t+s}} = 0
$$

- We have consumption smoothing and
- We have labor smoothing

$$\frac{\theta}{W_t(1-h_t)} = \beta(1+r_t)E_t\frac{\theta}{W_{t+1}(1-h_{t+1})}$$

3.2 The Firm

- Mass of firms = 1
- Identical firms + All face the same aggregate shocks (no idiosyncratic uncertainty)

$\rightsquigarrow$ Representative firm

- Produce an homogenous good that is consumed or invested
- by means of capital and labor
- Constant returns to scale technology (important)

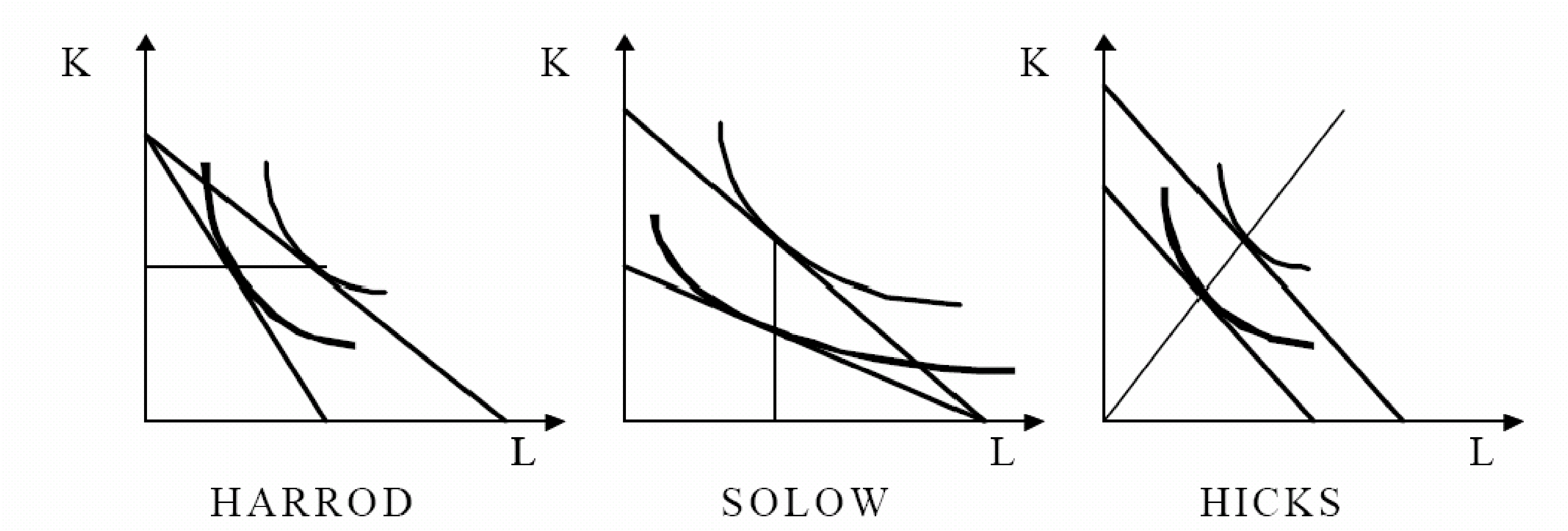
$$Y_t = A_t F(K_t, \Gamma_t h_t)$$

- $\Gamma_t = \gamma \Gamma_{t-1}$ Harrod neutral technological progress ($\gamma \geqslant 1$), A_t stationary (does not explain growth)

- Remark: one could introduce long run technical progress in three different ways:

$$Y_t = \widehat{\Gamma}_t F(\widetilde{\Gamma}_t K_t, \Gamma_t h_t)$$

-$\widehat{\Gamma}_t$ is Hicks Neutral, $\widetilde{\Gamma}_t$ is Solow neutral


K
L
HARROD
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HICKS

- Harrod neutral technical progress and the preferences specified above are needed for the existence of a *Balanced Growth Path* that replicates *Kaldor Stylized Facts*:

1. The shares of national income received by labor and capital are roughly constant over long periods of time
2. The rate of growth of the capital stock is roughly constant over long periods of time
3. The rate of growth of output per worker is roughly constant over long periods of time
4. The capital/output ratio is roughly constant over long periods of time
5. The rate of return on investment is roughly constant over long periods of time
6. The real wage grows over time

- End of the remark

$$Y_t = A_t F(K_t, \Gamma_t h_t)$$

- $\Gamma_t = \gamma \Gamma_{t-1}$ Harrod neutral technological progress ($\gamma \geqslant 1$), A_t stationary (does not explain growth)

- A_t are shocks to technology. AR(1) exogenous process

$$\log(A_t) = \rho \log(A_{t-1}) + (1-\rho)\log(\overline{A}) + \varepsilon_t$$

with $\varepsilon_t \rightsquigarrow \mathcal{N}(0, \sigma^2)$.

The firm decides on production plan maximizing profits

$$\max_{\{K_t, h_t\}} A_t F(K_t, \Gamma_t h_t) - W_t h_t - z_t K_t$$

First order conditions:

$$K_t : A_t F_K(K_t, \Gamma_t h_t) = z_t$$
$$h_t : A_t F_h(K_t, \Gamma_t h_t) = W_t$$

Simple Example: Cobb–Douglas production function

$$Y_t = A_t K_t^{\alpha} (\Gamma_t h_t)^{1-\alpha}$$

First order conditions

$$K_t : \alpha Y_t / K_t = z_t$$
$$h_t : (1-\alpha) Y_t / h_t = W_t$$

3.3 Equilibrium

The (RBC) Model Equilibrium is given by the following equations ($\forall\ t \geq 0$):

1. Exogenous Processes : $\log(A_t) = \rho \log(A_{t-1}) + (1-\rho)\log(\overline{A}) + \varepsilon_t$ and $\Gamma_t = \gamma\Gamma_{t-1}$

2. Law of motion of Capital : $K_{t+1} = I_t + (1-\delta)K_t$

3. Bond market equilibrium : $B_t = 0$

4. Good Markets equilibrium : $Y_t = C_t + I_t$

5. Labor market equilibrium : $\frac{U_\ell(C_t,1-h_t)}{U_c(C_t,\ell_t)} = A_t F_h(K_t, \Gamma_t h_t)$

6. Consumption/saving decision + Capital market equilibrium :

$$U_c(C_t, 1-h_t) = \beta E_t \left[U_c(C_{t+1}, 1-h_{t+1})(A_{t+1} F_K(K_{t+1}, \Gamma_{t+1} h_{t+1}) + 1 - \delta) \right]$$

7. Financial markets :

$$1 + r_t = \frac{E_t \left[U_c(C_{t+1}, 1-h_{t+1})(A_{t+1} F_K(K_{t+1}, \Gamma_{t+1} h_{t+1}) + 1 - \delta) \right]}{E_t U_c(C_{t+1}, 1-h_{t+1})}$$

3.4 An Analytical Example

- $U(C_t, \ell_t) = \log(C_t) + \theta \log(\ell_t), \qquad Y_t = A_t K_t^{\alpha} (\Gamma_t h_t)^{1-\alpha}$

- Equilibrium

$$\frac{\theta C_t}{1 - h_t} = (1 - \alpha) \frac{Y_t}{h_t}$$

$$\frac{1}{C_t} = \beta E_t \left[\frac{1}{C_{t+1}} \left(\frac{Y_{t+1}}{K_{t+1}} + 1 - \delta \right) \right]$$

$$K_{t+1} = Y_t - C_t + (1 - \delta) K_t$$

$$Y_t = A_t K_t^{\alpha} (\Gamma_t h_t)^{1-\alpha}$$

$$\lim_{s \longrightarrow \infty} \beta^s E_t \left[\frac{K_{t+1+s}}{C_{t+s}} \right] = 0$$

3.5 Stationarization

- We want a stationary equilibrium (technical reasons)
- Deflate the model for the growth component Γ_t
- On the example: $x_t = X_t/\Gamma_t$

- Deflated Equilibrium

$$\frac{\theta c_t}{1-h_t} = (1-\alpha)\frac{y_t}{h_t}$$

$$\frac{1}{c_t} = \frac{\beta}{\gamma}E_t\left[\frac{1}{c_{t+1}}\left(\frac{y_{t+1}}{k_{t+1}} + 1 - \delta\right)\right]$$

$$\gamma k_{t+1} = y_t - c_t + (1-\delta)k_t$$

$$y_t = A_t k_t^\alpha h_t^{1-\alpha}$$

$$\lim_{s\longrightarrow\infty} \beta^s \frac{\gamma k_{t+1+s}}{c_{t+s}} = 0$$

4 Solving the Model

4.1 In General

- Non–linear system of stochastic finite difference equations under rational expectations
- Very complicated
- In general no analytical solution, need to rely on numerical approximation methods

4.2 The Nice Analytical Case

- $U(c, \ell) = \log(c) + \theta \log(\ell)$, $\gamma = 1$ (not needed) and $\delta = 1$

- Equilibrium

$$\frac{\theta c_t}{1 - h_t} = (1 - \alpha)\frac{y_t}{h_t}$$

$$\frac{1}{c_t} = \beta E_t \left[\frac{1}{c_{t+1}} \left(\frac{y_{t+1}}{k_{t+1}} \right) \right]$$

$$k_{t+1} = y_t - c_t$$

$$y_t = A_t k_t^{\alpha} h_t^{1-\alpha}$$

$$\lim_{s \longrightarrow \infty} \beta^s \frac{\gamma k_{t+1+s}}{c_{t+s}} = 0$$

- The solution is: $c_t = (1 - \alpha\beta)y_t$

- $h_t = \overline{h} = \frac{1-\alpha}{1-\alpha+\theta(1-\alpha\beta)} \Rightarrow k_{t+1} = \alpha\beta\kappa A_t k_t^{\alpha}$ with $\kappa = \overline{h}^{1-\alpha}$

4.3 Numerical solution

- Unfortunately: No closed form solution in general
- Have to adopt a numerical approach
- Log–linearize the equilibrium around the steady state (limits?)
- Solve the linearized model using standard techniques

- The solution to the log–linearize version of the model takes the form

$$X_{t+1} = M_x X_t + M_z Z_t \quad (1)$$

$$Z_{t+1} = \rho Z_t + \varepsilon_{t+1} \quad (2)$$

$$Y_t = P_x X_t + P_z Z_t \quad (3)$$

where X_t, Z_t and Y_t collect, respectively, the state variables, the shocks and the variables of interest

- Resembles a VAR model

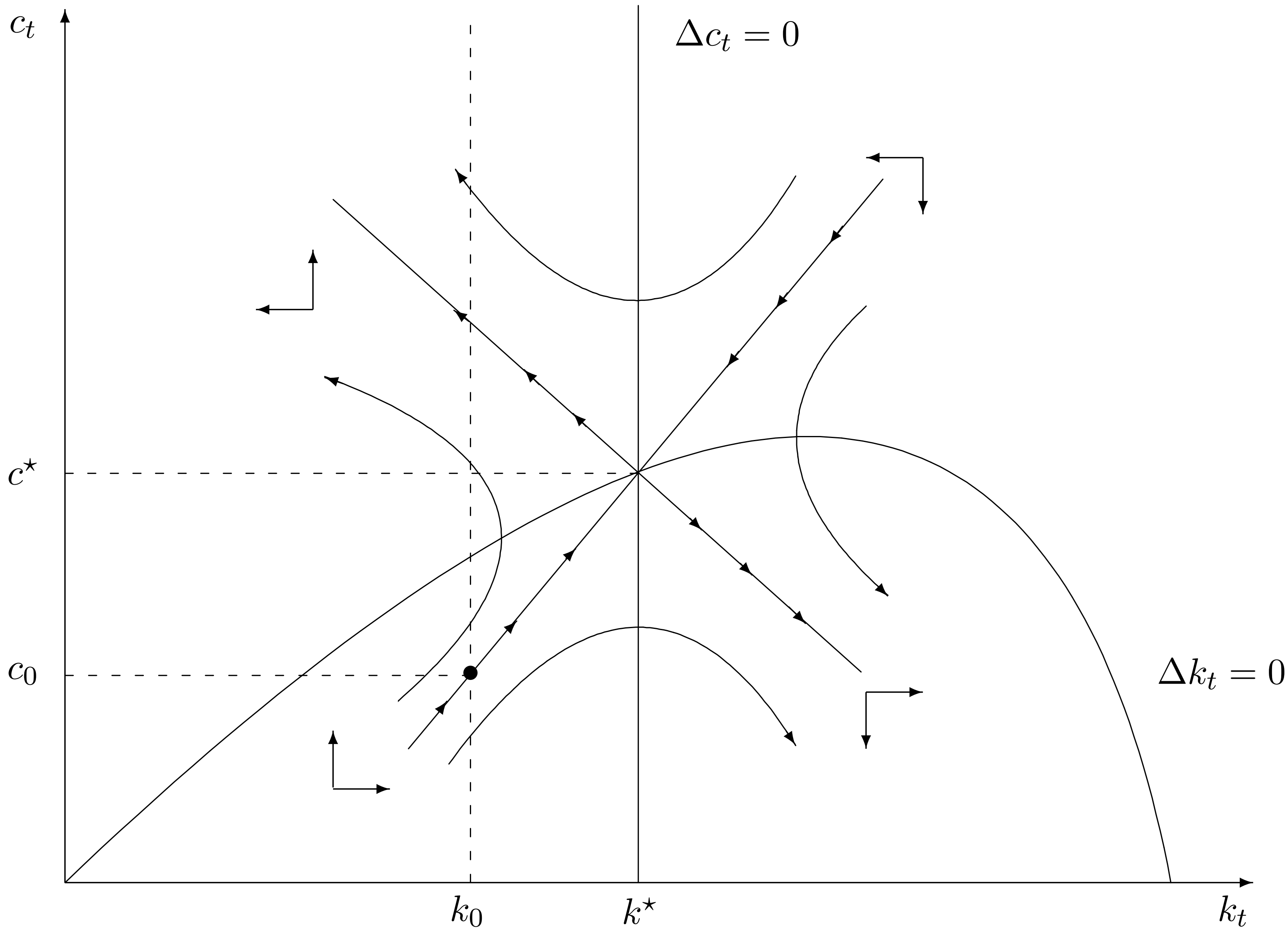
- In the basic RBC model

$$X_t = \{k_t\} \tag{4}$$

$$Z_t = \{a_t\} \tag{5}$$

$$Y_t = \{y_t, c_t, i_t, h_t\} \tag{6}$$

- Let's evaluate the **quantitative** ability of the model to account for and explain the cycle.


c_t
$\Delta c_t = 0$
$c^\star$
c_0
$\Delta k_t = 0$
k_0
$k^\star$
k_t

5 Quantitative Evaluation

5.1 Calibration

- Need to assign numerical values to the parameters
- This is the **calibration** step
- What does calibration mean?
  - Make explicit use of the model to set the parameters
  - A lot of discipline, but no systematic recipe
  - Have to set $(\alpha, \beta, \theta, \delta, \gamma, \rho, \sigma, \overline{A})$

– Use data: $(k/y, c/y, i/y, h, wh/y, r)$

– Compute $(k/y, c/y, i/y, h, wh/y, r)$ in the model

- In the data $\Delta y = 0.9\%$ per quarter $\rightsquigarrow \gamma = 1.009$.

- In the data $i/k = 0.076$ on annual data. Use capital accumulation to get annual depreciation.

$$i/k(\text{model}) = gamma - (1-\delta) \rightsquigarrow \delta = 0.01$$

- In the data $wh/y = 0.6$, in the model $wh/y = 1-\alpha \rightsquigarrow \alpha = 0.4$.

- In the data $k/y = 3.32$ on annual data. Using the Euler equation

$$\beta = \frac{\gamma}{\alpha y/k + (1-\delta)}$$

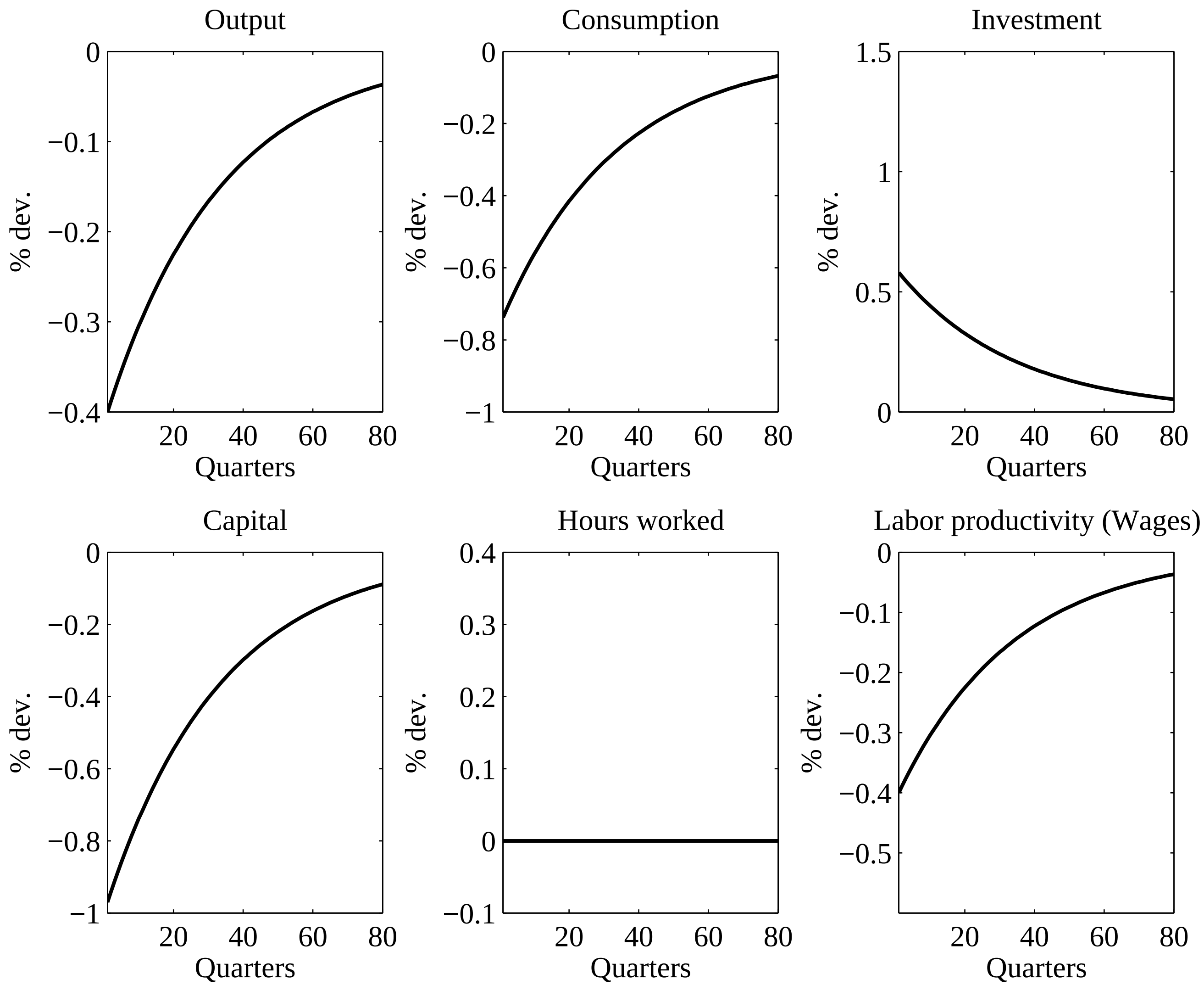
  Then $\beta = 0.98$

- $h = 0.31$, such that $\theta = \frac{(1-\alpha)(1-h)}{hc/y}$

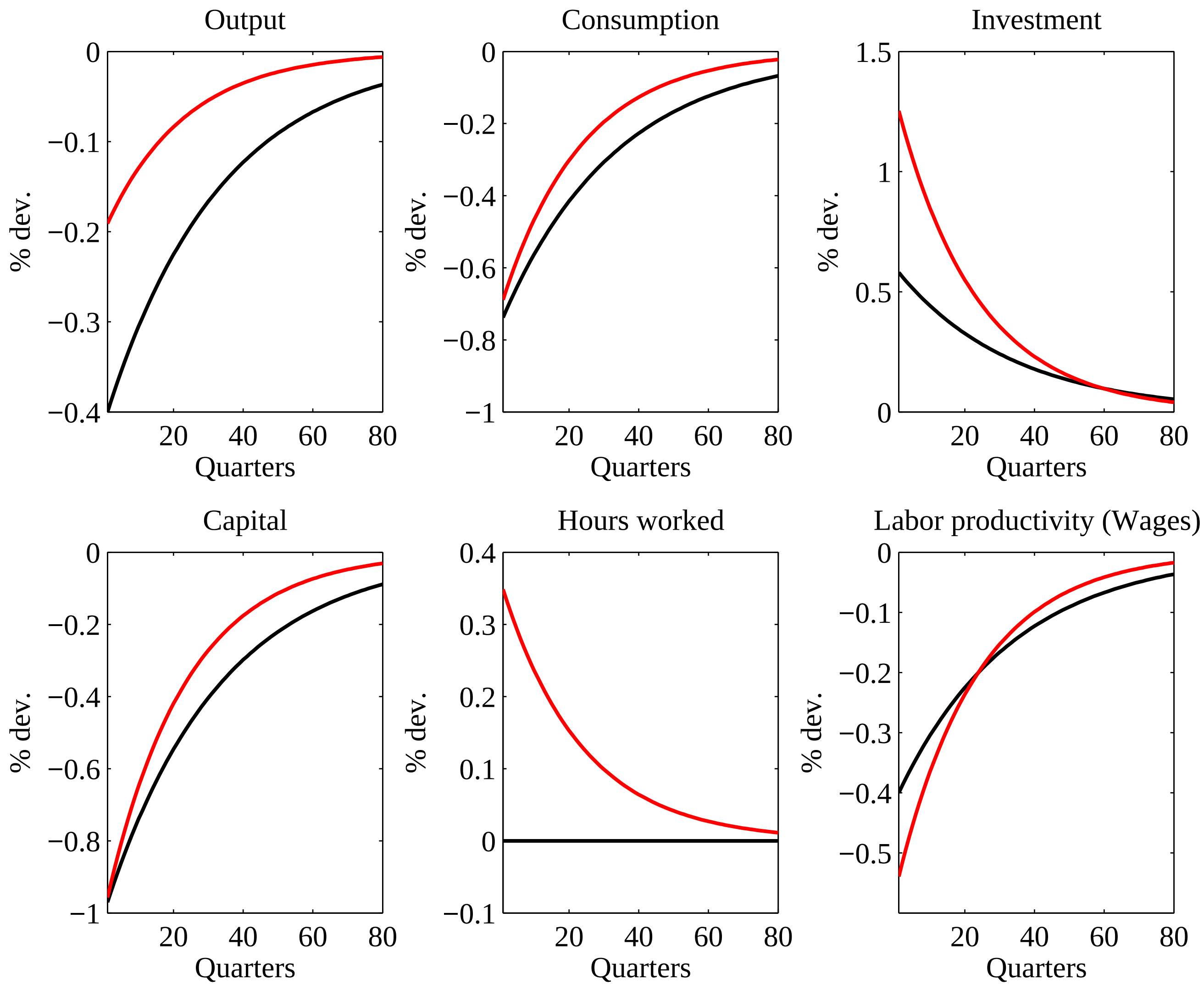
5.2 Can the Business Cycle be Driven by Capital Dynamics?

- Want to see whether capital dynamics can account for BC.
- Perfect foresights dynamics
- We study a case with fixed labor ($h = \overline{h}$) and a variable labor case ($U(c, 1-h)$)

Capital shock - Fixed hours



Capital shock - Variable hours



- The answer is clearly that capital dynamics cannot be the story for the business cycle.
- Solow (1957): capital accumulation accounts for 1/8th of output growth.
- Technical progress, not capital accumulation, is the engine of growth.
- At the business frequency: transitional dynamics does not conform to the data (c and i for ex).
- More (shocks?) is needed to understand the BC

- That's why the RBC literature proposes technological shocks (Brock & Mirman, 1972)

5.3 Technological Shocks

- How to calibrate the shocks?

- We have

$$\log(A_t) = \log(y_t) - \alpha \log(k_t) - (1-\alpha)\log(h_t)$$

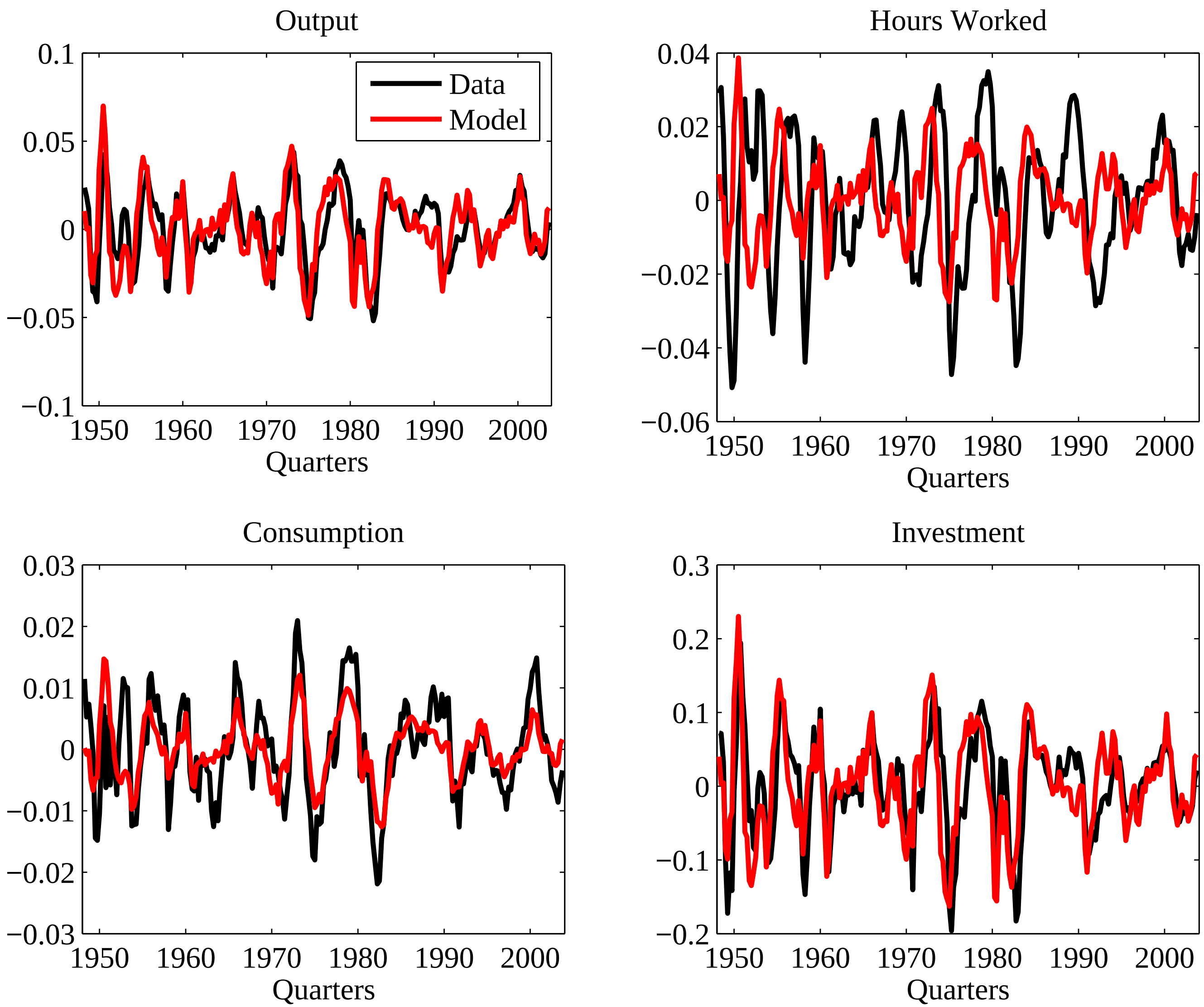
- How to get k_t? Use Capital accumulation with $k_0 = (k/y)y_0$

- Estimate

$$\log(A_t) = \rho \log(A_{t-1}) + \varepsilon_t$$

We get $\rho = 0.95$ and $\sigma = 0.0079$. We set $\overline{A} = 1$ without loss of generality.

A good fit with estimated shocks



A first success?

- Accounts for the main events in the data
- The model correctly predicts the data: corr(y, y^m)=0.75, corr(c, c^m)=0.73, corr(i, i^m)=0.70.
- BUT: corr(h, h^m)=0.06
- Let's compute unconditional moments in the model (simulate-HP filter-compute moments)

5.4 Results from Model Simulations

Variable	$\sigma(\cdot)$	$\sigma(\cdot)/\sigma(y)$	$\rho(\cdot, y)$	$\rho(\cdot, h)$	Auto
Output	1.70	–	–	–	0.84
	1.49	–	–	–	0.68
Consumption	0.80	0.47	0.78	–	0.83
	0.37	0.25	0.81	–	0.82
Investment	6.49	3.83	0.84	–	0.81
	5.00	3.35	0.99	–	0.68
Hours worked	1.69	1.00	0.86	–	0.89
	0.85	0.57	0.98	–	0.68
Labor productivity	0.90	0.53	0.41	0.09	0.69
	0.67	0.45	0.97	0.92	0.72

(model in yellow)

5.5 A success(?)

- The model correctly predicts the amplitude, serial correlation and relative variability of fluctuations
- It accounts for a large part of output volatility
- Correct ranking of the volatility of c, i, y, . . .
- Large serial correlation, although it is smaller than in the data.
- **But**

– C and N are not volatile enough

– w (and r) are to too procyclical

6 Criticisms

6.1 In General

- The research on RBC became so successful because
  - Propose a coherent platform to analyse growth and cycles
  - It somewhat fails such that there is room for work
- Main victory: methodological (part of the toolkit of macroeconomists)
- Main criticisms

- incorrect/implausible calibration of parameters (IES, Labor supply) $\rightsquigarrow$ need for sensibility analysis
- counterfactual prediction for some prices:
  * real wage is strongly procyclical in the model,
  * CRRA preferences are not compatible with the equity premium
  * price level is too strongly countercyclical

6.2 The Measure of Technological Shocks

- Key problem: Are technological shocks at the source of BC?

- Prescott [1986]: Technology shocks account for 70% of output volatility, but
  - Too volatile
  - Little evidence of large supply shocks (except oil prices)
  - Recessions have to be explained by technological regressions
  - Measurement problems (contamination by demand shocks if increasing returns, imperfect competition, labor hoarding) ; in the growth accounting literature, the SR was

a measure of our ignorance, now it is the engine of the model.

6.3 The Need for Persistent Shocks

- Recall that

$$\log(A_t) = \rho \log(A_{t-1}) + \varepsilon_t$$

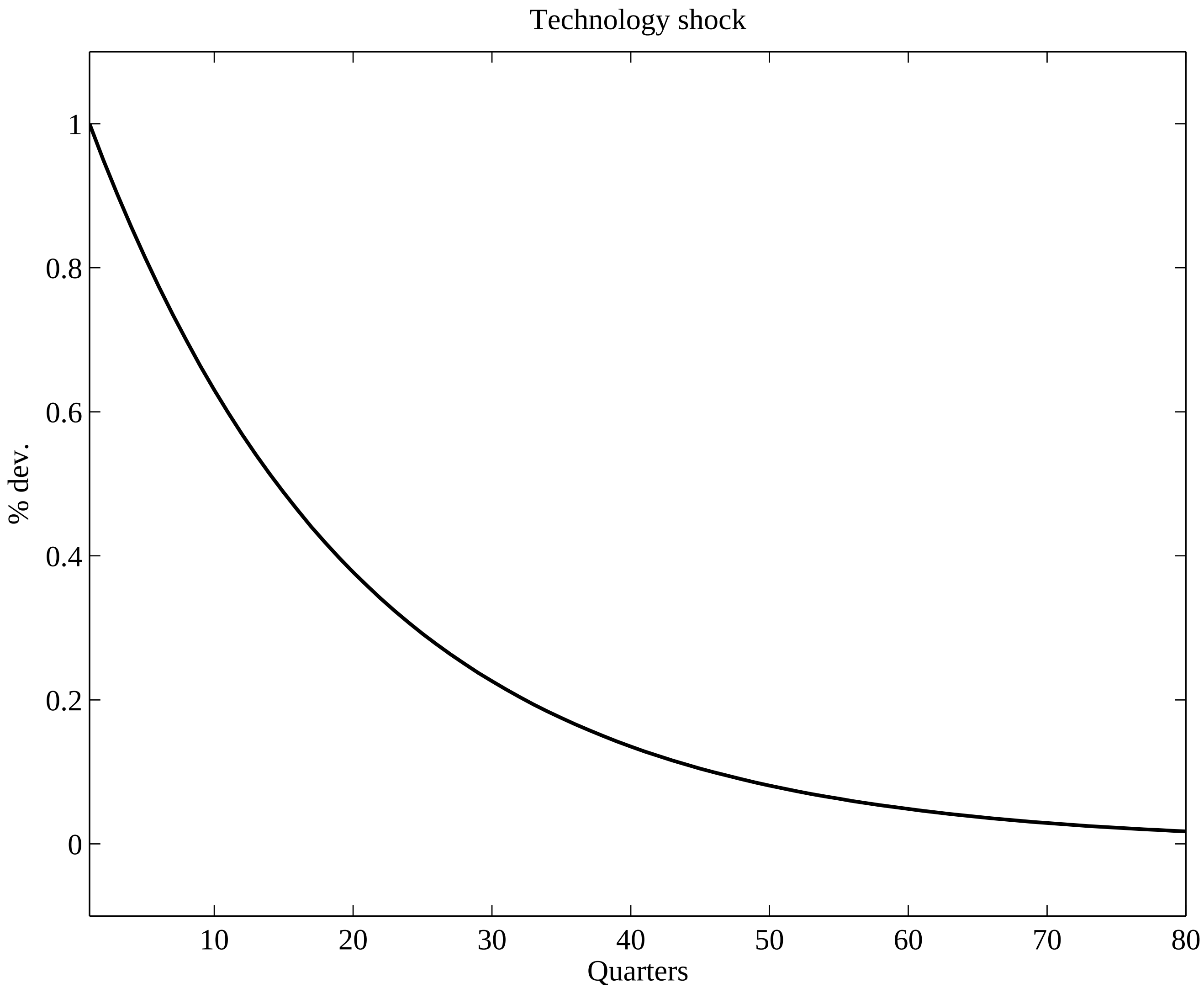
and ρ is large

- Why do we need so persistent shocks?

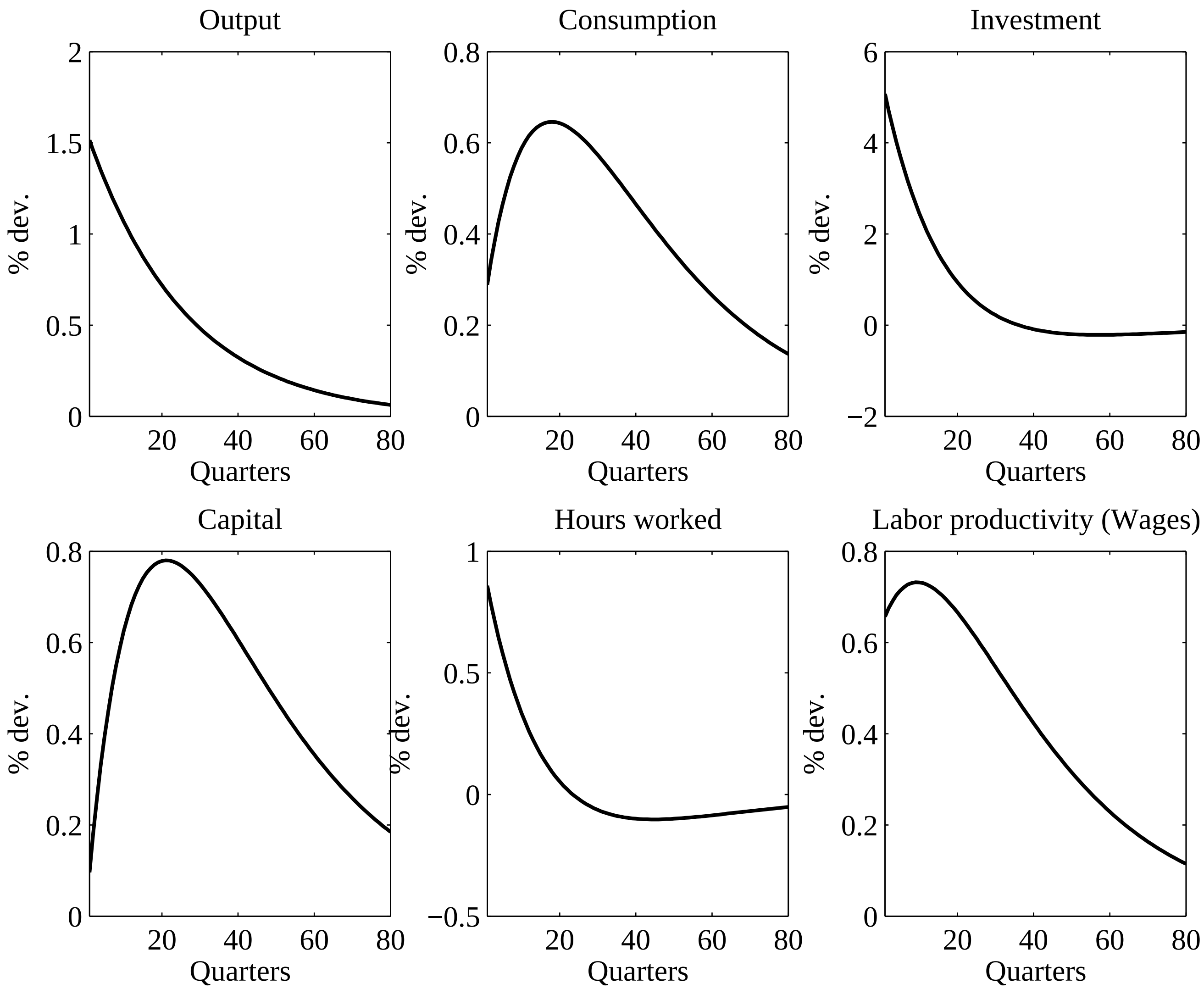
- Because the model possesses weak propagation mechanisms

- Let's see that in details

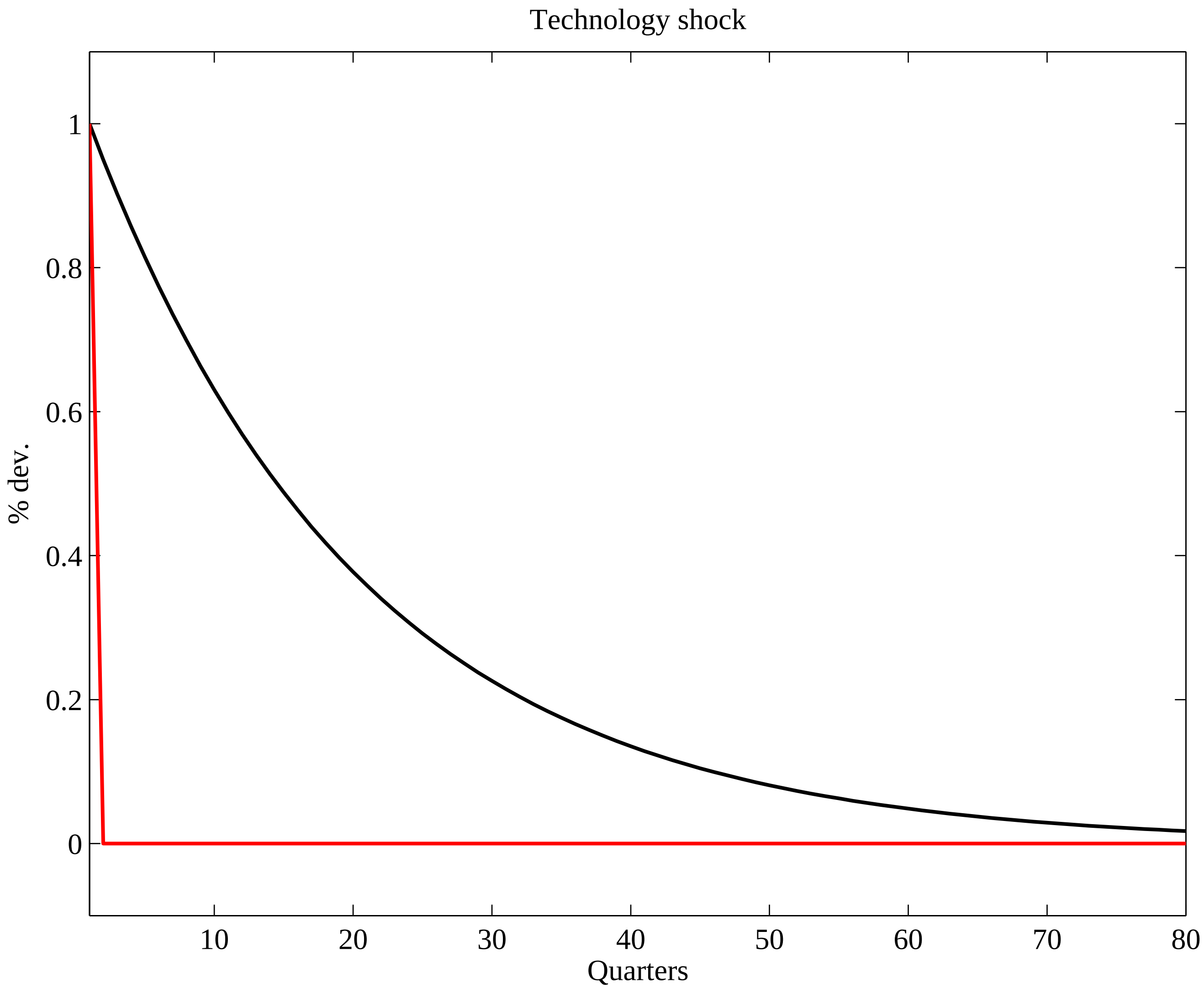
IRF to A Technological Shock



IRF to A Technological Shock



IRF to A Technological Shock: Temporary *vs* Persistent



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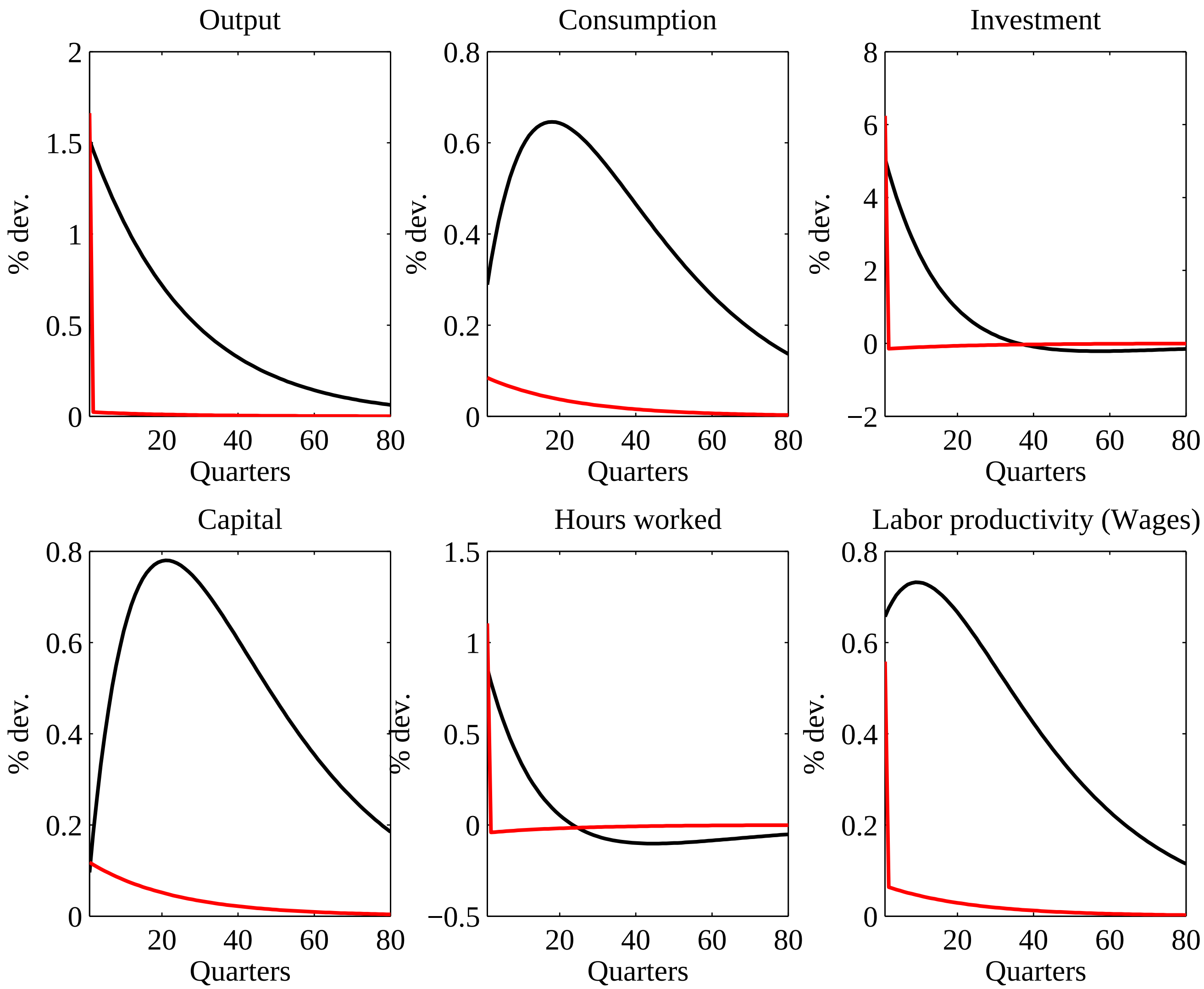
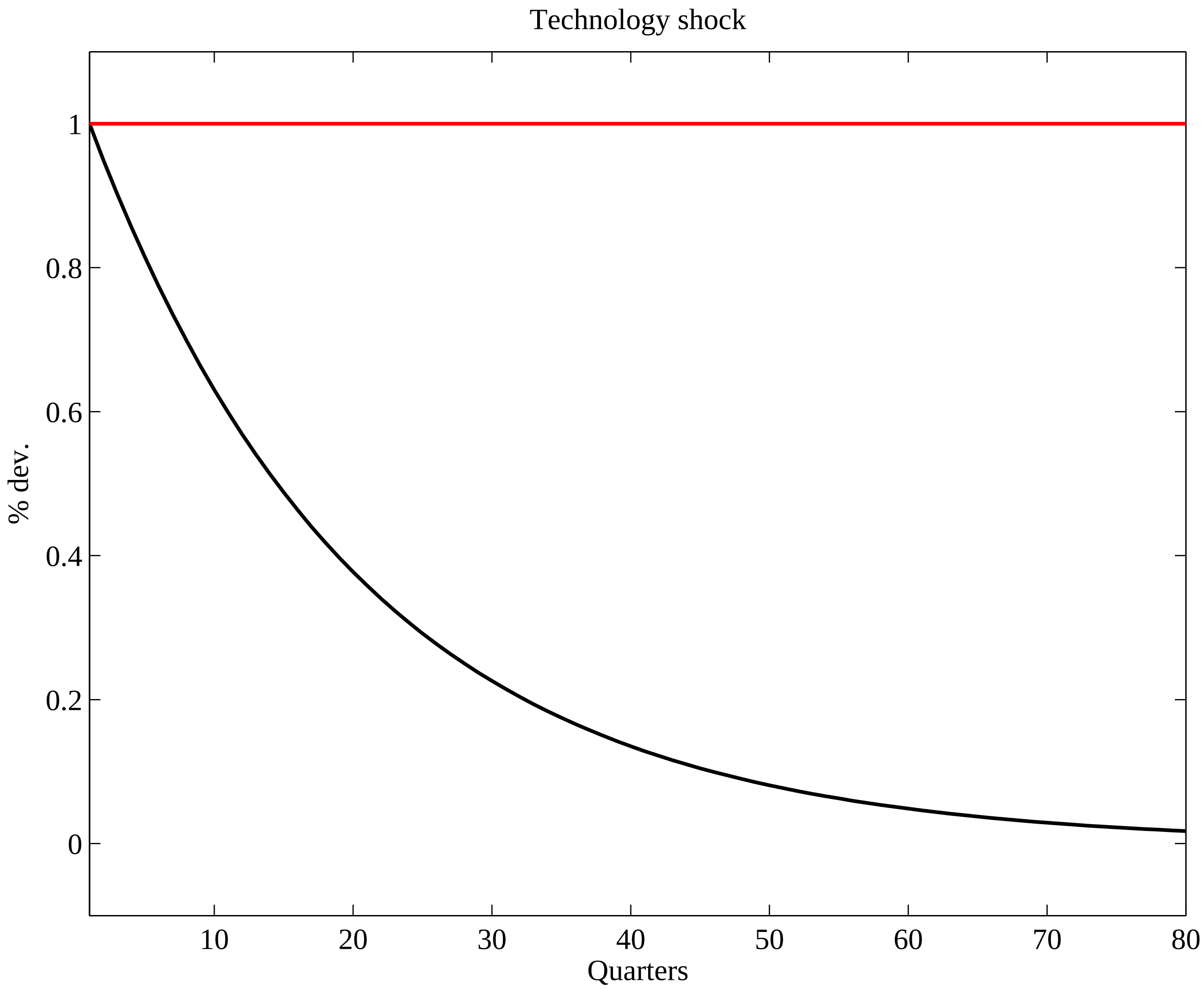
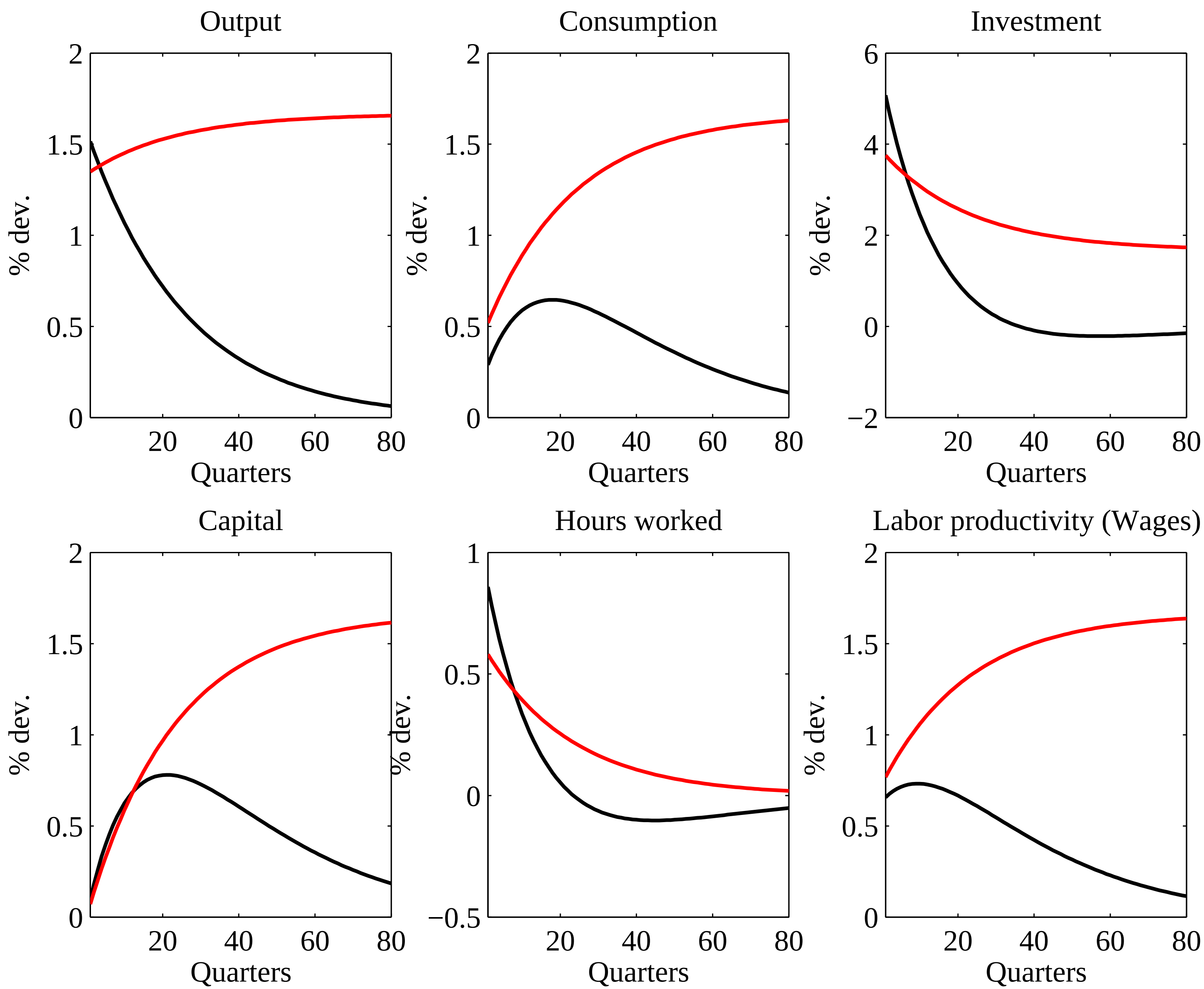


IRF to A Technological Shock: Persistent *vs* Permanent



IRF to A Technological Shock: Persistent *vs* Permanent



- How to improve the model:
  - Introducing additional shocks
  - Improving the propagation mechanisms

7 Solving the puzzles?

7.1 Adding Demand Shocks

- Government Expenditures
- Change the Household's budget constraint:

$$B_{t+1} + C_t + I_t + \boxed{T_t} \leqslant (1 + r_{t-1})B_t + W_t h_t + z_t K_t$$

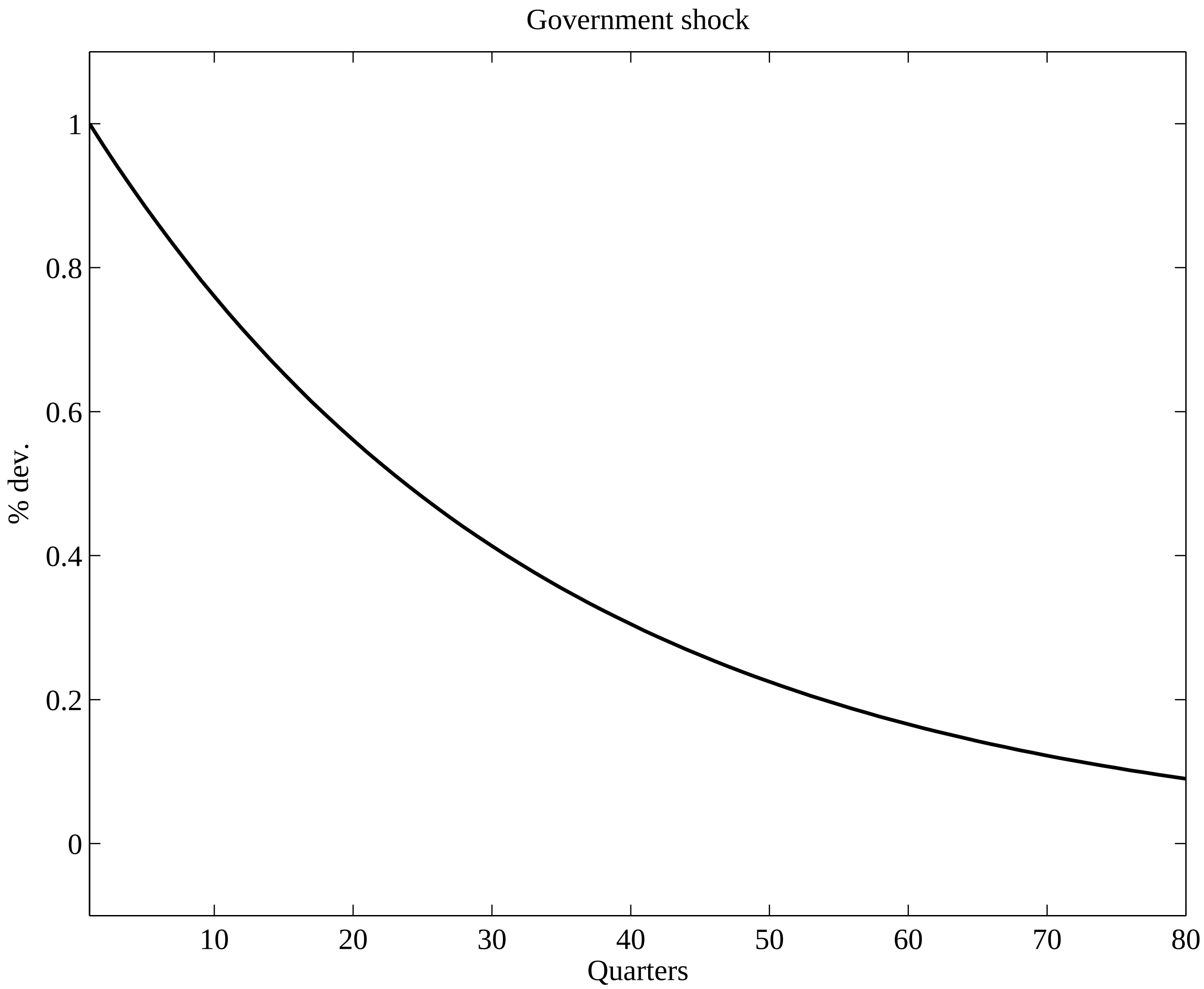
- Government Balanced Budget: $T_t = G_t$
- Government expenditures are modeled as

$$\log(G_t) = \rho \log(G_{t-1}) + (1 - \rho_g) \log(\overline{G}) + \varepsilon_{g,t}$$

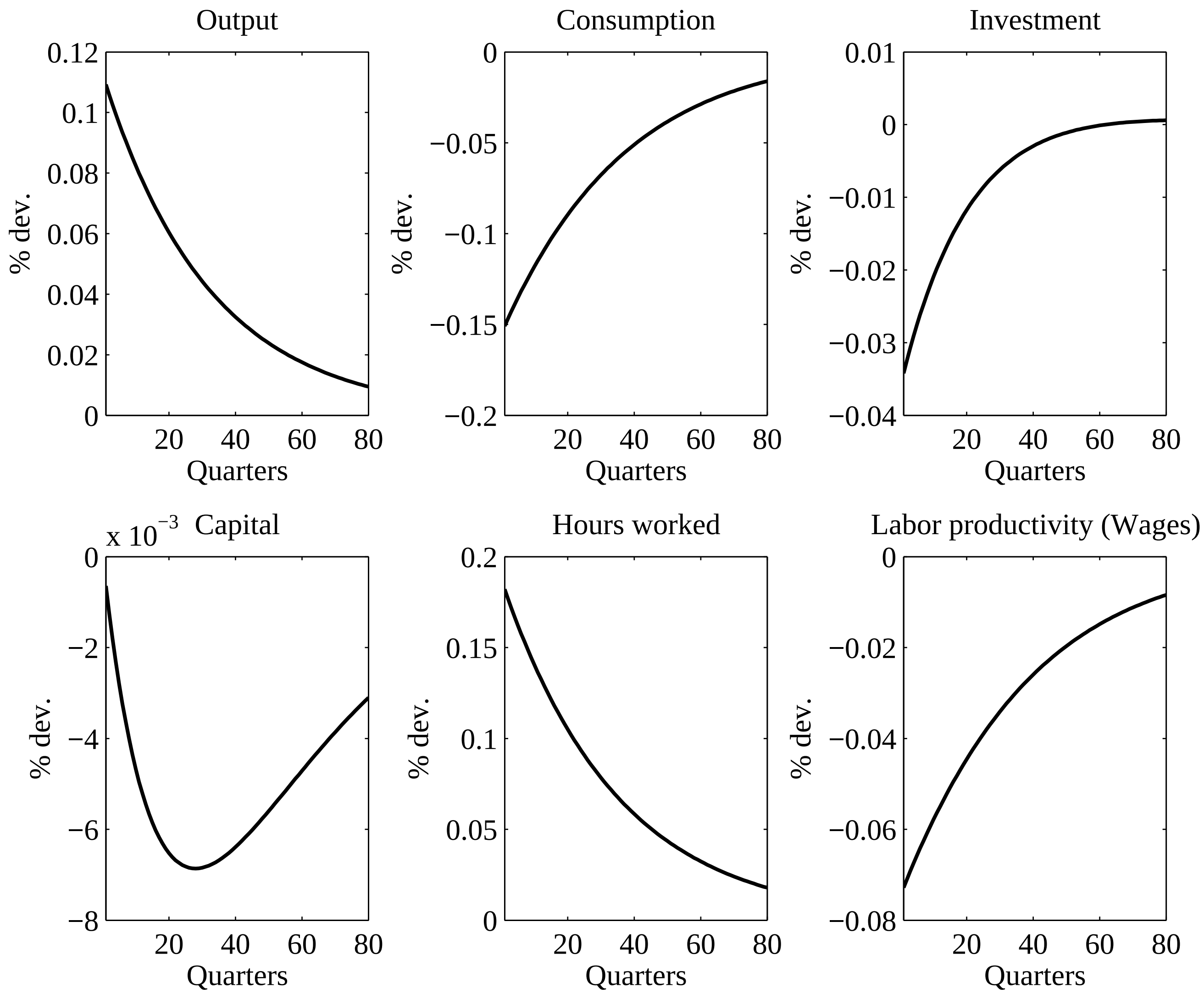
with $\varepsilon_{g,t} \rightsquigarrow \mathcal{N}(0, \sigma_t^2)$.

- $G/Y = 0.2$, $\rho_g = 0.97$, $\sigma_g = 0.02$.

IRF to A Government Spending Shock



IRF to A Government Spending Shock



Technological and Government Spending Model

Variable	$\sigma(\cdot)$	$\sigma(\cdot)/\sigma(y)$	$\rho(\cdot,y)$	$\rho(\cdot,h)$	
Output	1.70	–	–	–	0.84
	1.43	–	–	–	0.68
Consumption	0.80	0.47	0.78	–	0.83
	0.62	0.43	0.54	–	0.75
Investment	6.49	3.83	0.84	–	0.81
	4.62	3.24	0.97	–	0.68
Hours worked	1.69	1.00	0.86	–	0.89
	0.85	0.59	0.90	–	0.68
Labor productivity	0.90	0.53	0.41	0.09	0.69
	0.76	0.53	0.87	0.58	0.72

(model in yellow)

7.2 Labor indivisibility

- Hansen [1985]: work a fixed amount of hours or does not
- Preferences

$$U(C_t, 1-h_t) = \begin{cases} \log(C^e_{it}) + \theta \log(1-h_0) & \text{if she works} \\ \log(C^u_{it}) + \theta \log(1) & \text{if not} \end{cases}$$

- Randomly drawn with probability π_t

$$U_t = \pi_{it} \left(\log(C^e_{it}) + \log(1-n_0)\right) + (1-\pi_{it}) \left(\log(C^u_{it}) + \log(1)\right)$$

$$= \pi_{it} \log(C^e_{it}) + (1-\pi_{it}) \log(C^u_{it}) - \theta h_t$$

where $h_{it} = \pi_{it} n_0$

- There exists full insurance

$$\begin{cases} C^e_{it} + \tau_t A_{it} + K^e_{it+1} \leqslant (z_t + 1 - \delta)K_t + w_t h_0 & \text{if she works} \\ C^u_{it} + \tau_t A_{it} + K^u_{it+1} \leqslant (z_t + 1 - \delta)K_t + A_{it} & \text{if not} \end{cases}$$

- Risk neutral insurance companies: $\tau_t = \pi_t$

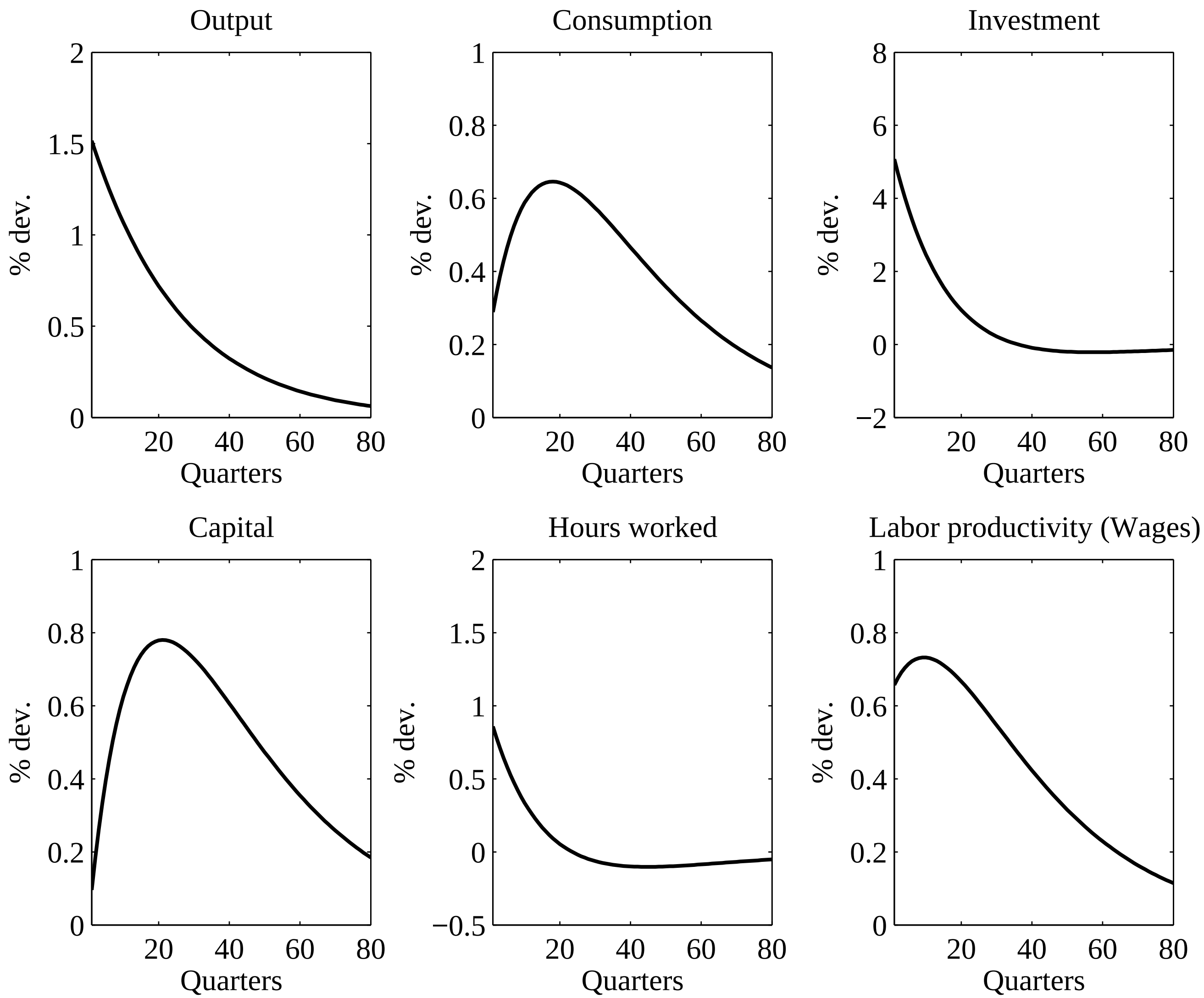
Labor indivisibility

- Utility collapses to

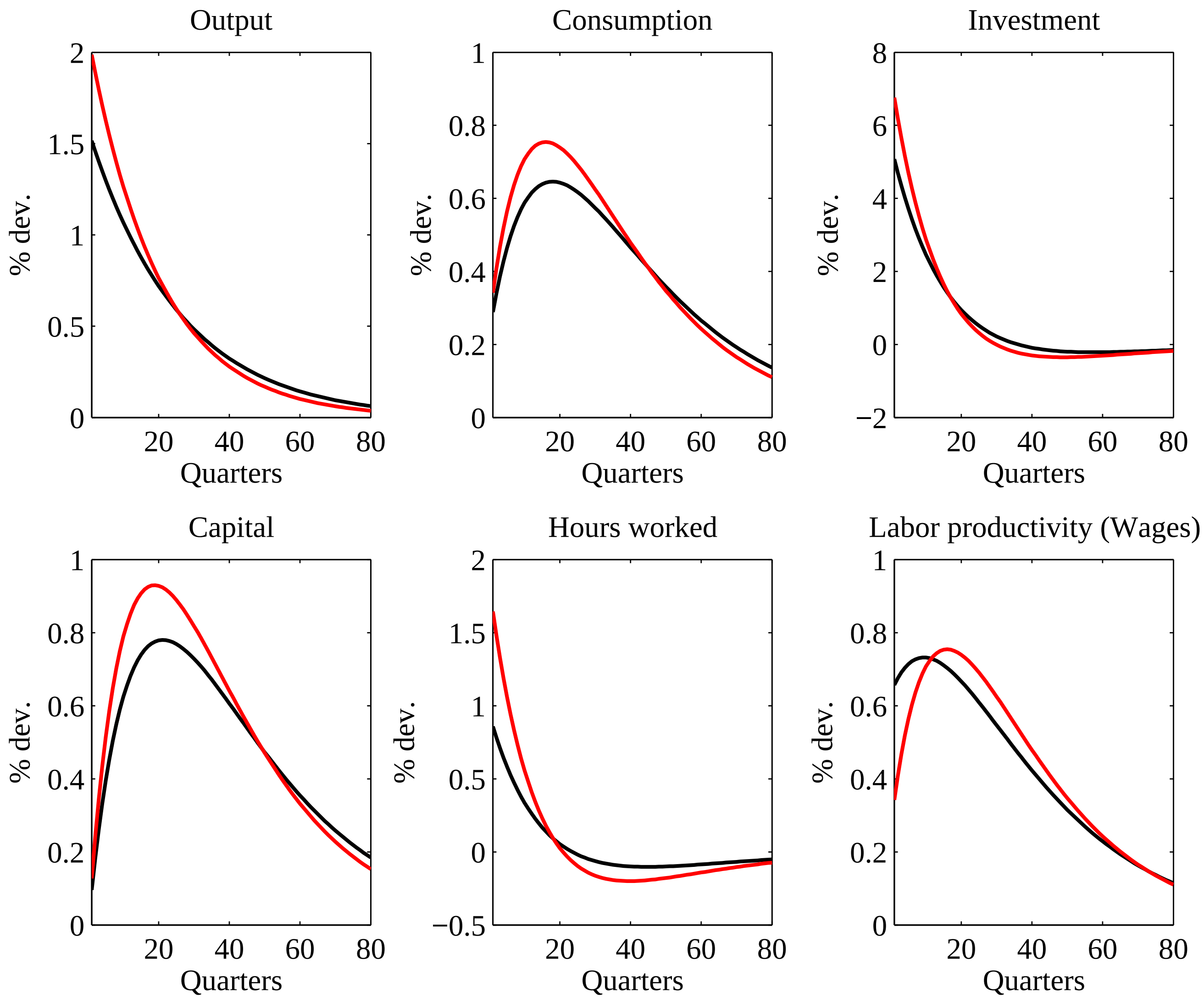
$$U(C_t, 1 - h_t) = \log(C_t) - h_t$$

- the rest remains unchanged

IRF to A Technological Shock - Indivisible Labor Model



IRF to A Technological Shock - Indivisible Labor Model



Indivisible Labor Model

Variable	$\sigma(\cdot)$	$\sigma(\cdot)/\sigma(y)$	$\rho(\cdot, y)$	$\rho(\cdot, h)$	
Output	1.70	–	–	–	0.84
	1.95	–	–	–	0.68
Consumption	0.80	0.47	0.78	–	0.83
	0.45	0.23	0.78	–	0.83
Investment	6.49	3.83	0.84	–	0.81
	6.66	3.40	0.99	–	0.67
Hours worked	1.69	1.00	0.86	–	0.89
	1.63	0.83	0.98	–	0.67
Labor productivity	0.90	0.53	0.41	0.09	0.69
	0.45	0.23	0.77	0.65	0.83

(model in yellow)

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