Learning and the Welfare Implications of Changing Inflation Targets

Safe Haven

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- Largely deemed a success
- Nevertheless, should periodically consider some modifications to the policy

Question

What are the welfare benefits of lowering the inflation target of monetary authorities from 2% to 0%?

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- At time t, announcement that π^T is now zero.
- Solve for the transition towards the new steady state
- Draw welfare implications

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- Dynamic Optimization and General Equilibrium under constraint of:
  - Nominal rigidities (price and/or wages)
  - Various adjustment costs
  - Interest rate targeting rule for monetary policy

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- Accounting for transition towards new, low-inflation steady state:

$$u\left[(1+\mu)c_1^H, (1+\mu)c_2^H, n^H\right] = \sum_{t=0}^{\infty} \beta^t u[c_{1t}^L, c_{2t}^L, n_t^L].$$

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- Additional capital accumulation
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- Credibility of the shift
  - The inflation target shift may not be immediately be credible and incorporated fully into private agents' expectations: this may delay convergence towards new steady state
  - Implement this idea by assuming private agents update beliefs about the inflation target using Bayesian learning
  - Calibrate such learning effects to match facts about recent disinflation episodes

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- Even when learning is rapid, welfare benefits significantly reduced (by one half) relative to comparison between steady states;
- Results appear robust to parametrization of model; likely to be robust to alternative modeling choices
- ***key message***: welfare benefits of lowering inflation are significantly lower (at least by half) than they appear from comparisons between steady states

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- Discussion and possible extensions

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- Bailey (1956): welfare benefits of lower inflation computed as the area under the money demand curve
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- Present paper
  - The New Keynesian model is the tool of analysis
  - Computations take the transition into account
  - Learning behaviour is incorporated (Erceg and Levin, 2003, Andolfatto and Gomme, 2003, Shorfheide, 2005)

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- Monetary Policy Rule followed by monetary authorities (with incomplete information and learning)
- Closed Economy, superneutrality, homogenous impact of monetary policy

Households

- Optimization problem:

$$\max_{c_{1t},c_{2t},M_{t+1},h_t,k_{t+1},B_t} E_0 \sum_{t=0}^{\infty} \beta^t u(c_{1t}, c_{2t}, h_t),$$

with respect to

$$c_{1t} + \frac{B_{t+1}}{P_t} \leq \frac{M_t + X_t + R_{t-1}B_t}{P_t}$$

$$\begin{aligned} \frac{M_{t+1}}{P_t} + c_{2t} + i_t \quad \leq \quad & (1-\tau_k) r_t k_t + (1-\tau_n)\frac{W_t}{P_t} n_t + D_t + \Gamma_t \\ & + \delta \tau_k k_t + [\frac{M_t^c + X_t + R_{t-1}B_t - B_{t+1}}{P_t} - c_{1t}] \end{aligned}$$

$$k_{t+1} = (1-\delta)k_t + i_t - F(i_t, i_{t-1}), \text{ (CEE, 2005)}$$

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- Meanwhile, inflation reduces the purchasing power of that income
- Result: households substitute out of market goods (consumption) and into non-market goods (leisure)

Representative Final Good Producer

- Profit maximization

$$\max_{\{y_{jt}\}} \left[P_t Y_t - \int_0^1 p_{jt} y_{jt} \, \mathrm{d}j \right], \text{ with respect to}$$

$$Y_t = \left(\int_0^1 y_{jt}^{\frac{\theta-1}{\theta}} \, \mathrm{d}j \right)^{\frac{\theta}{\theta-1}}, \ \theta > 1.$$

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- First-order condition:

$$y_{jt} = \left(\frac{p_{jt}}{P_t} \right)^{-\theta} Y_t.$$

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- No Profit Condition $\rightarrow$

$$P_t = \left(\int_0^1 {p_{jt}}^{1-\theta} \, \mathrm{d}j \right)^{\frac{1}{1-\theta}}$$

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- Profit Maximization:

$$\max_{\{\tilde{p}_{jt}\}} E_0 \left[\sum_{k=0}^{\infty} (\beta\phi)^k \lambda_{t+k} \cdot \left(\frac{\widetilde{p}_{jt+k} y_{jt+k}}{P_{t+k}} - TC_{t+k} \right) \right], \text{ with respect to}$$

$$k_{jt+k}^{\alpha} h_{jt+k}^{1-\alpha} \geq y_{jt+k} = \left(\frac{\widetilde{p}_{jt+k}}{P_{t+k}} \right)^{-\theta} Y_{t+k};$$

$$\widetilde{p}_{jt+k} = \prod_{s=0}^{k-1} \pi_{t+s} \widetilde{p}_{jt}.$$

'New Keynesian' Phillips curve

- First order condition for price decisions lead to following, optimization-based Phillips curve:

$$\widehat{\pi}_t = \frac{\beta}{1+\beta}\widehat{\pi}_{t+1} + \frac{1}{(1+\beta)}\widehat{\pi}_{t-1} + \frac{(1-\phi)(1-\beta\phi)}{\phi(1+\beta)}\widehat{mc}_t;$$

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- Alternatives forms/extensions: 'indexation' parameter (Smets and Wouters, 2003), similar structure for wage indexation (Erceg et al, 2000)

Monetary Policy and Target Shifts

- Interest rate targeting rule:

$$i_t = (1-\rho)[r^{ss} + \pi^T + \lambda_\pi(\pi_t - \pi^T) + \lambda_y \widehat{y}_t] + \rho i_{t-1} + u_t$$

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- u_t: transitory monetary policy shock
- π^T : inflation target of monetary authority.
- At time t, π^T is reduced from π^H to π^L. After the shift, the rule is

$$i_t = (1-\rho)[r^{ss} + \pi^L + \lambda_\pi(\pi_t - \pi^L) + \lambda_y \widehat{y}_t] + \rho i_{t-1} + u_t$$

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- Signal extraction problem is similar to learning about the mean of u_t^*. Starting from an initial level m_0, beliefs about this mean evolve according to

$$m_{t+k} = \frac{v}{v+k}m_0 + \frac{k}{v+k}\overline{u_t^*}$$

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- parameter v: confidence in initial belief; governs 'learning speed'.
  $\rightarrow$ calibrated to match features of disinflation episodes (Erceg and Levin, 2003)

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- Markets clear (labour, money, final goods, bonds)

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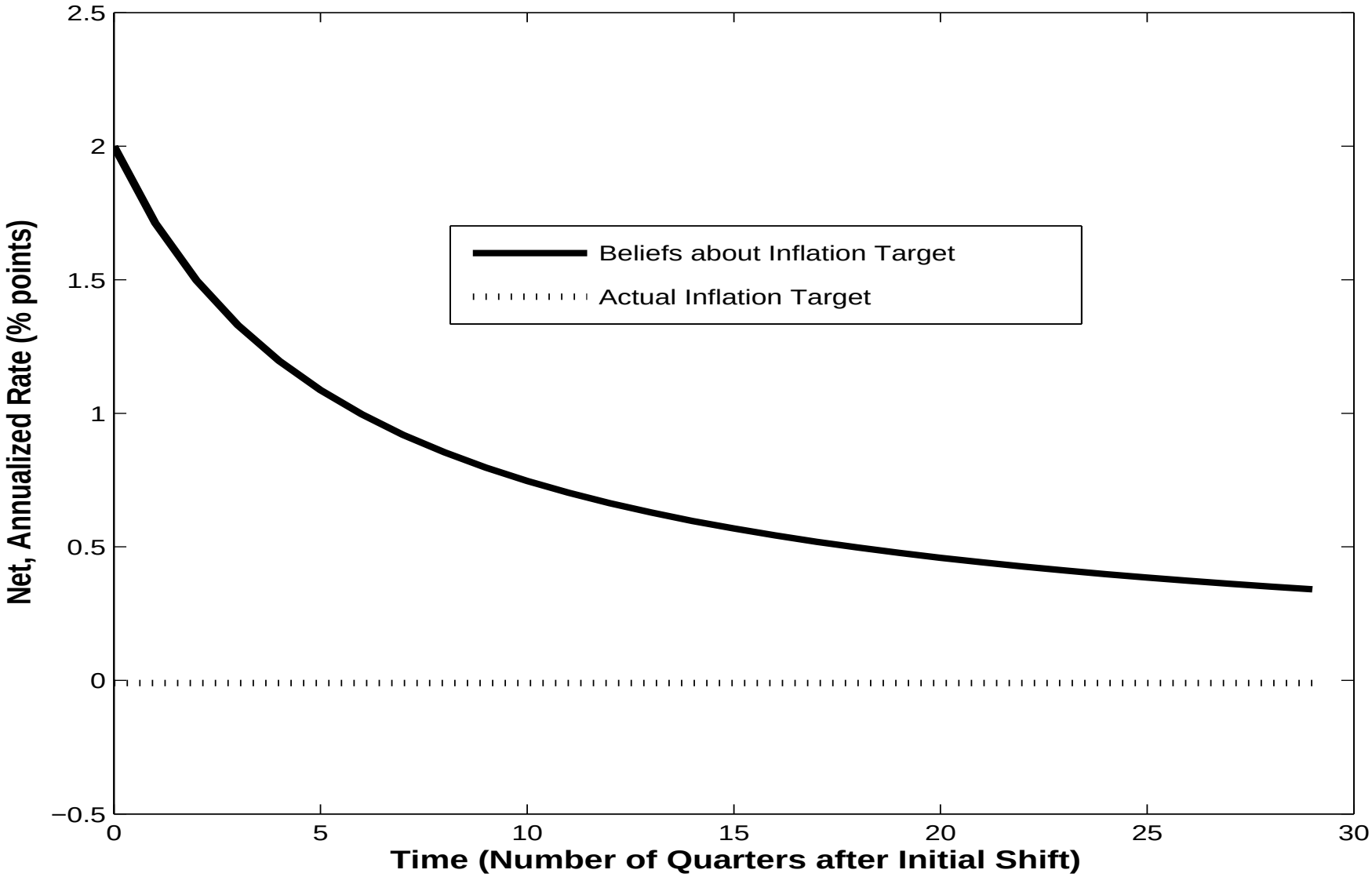
- Monetary Policy: empirical estimates. This leads to $\lambda_\pi = 2.0$, $\lambda_y = 0.25$, $\rho = 0.5$.
- Confidence in prior about inflation target: Empirical estimates (Erceg and Levin, 2003) about closing gap between expected and actual inflation. This leads to $v = 4$ so that half the gap is closed within four quarters.

Learning Mechanism in Practice



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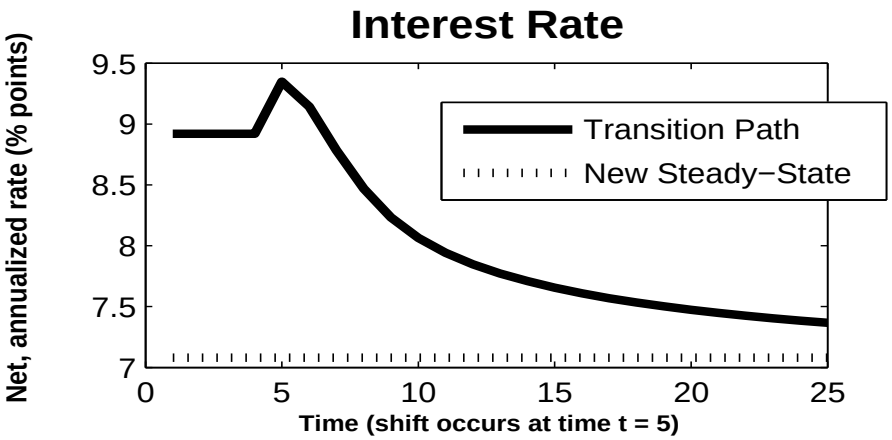
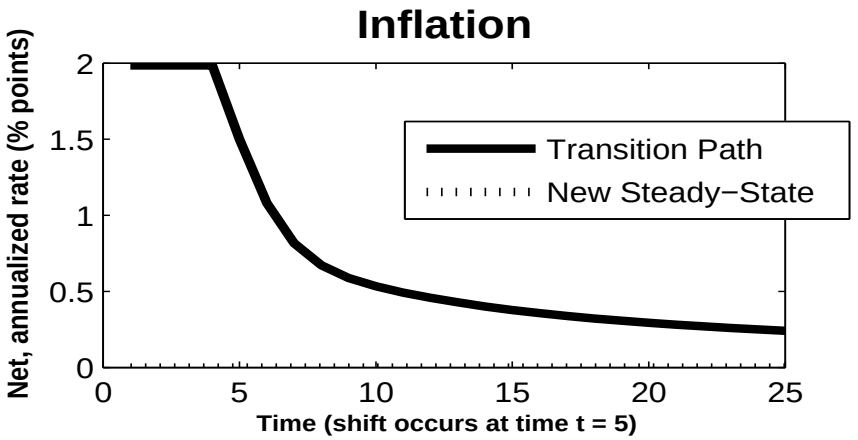
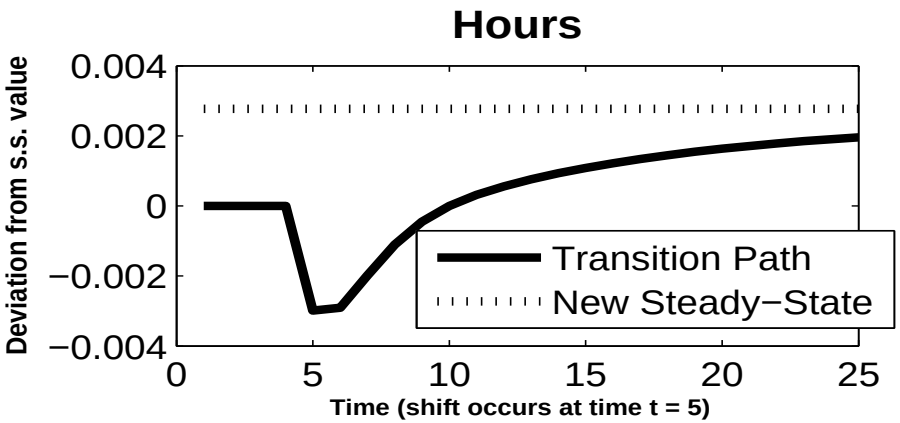
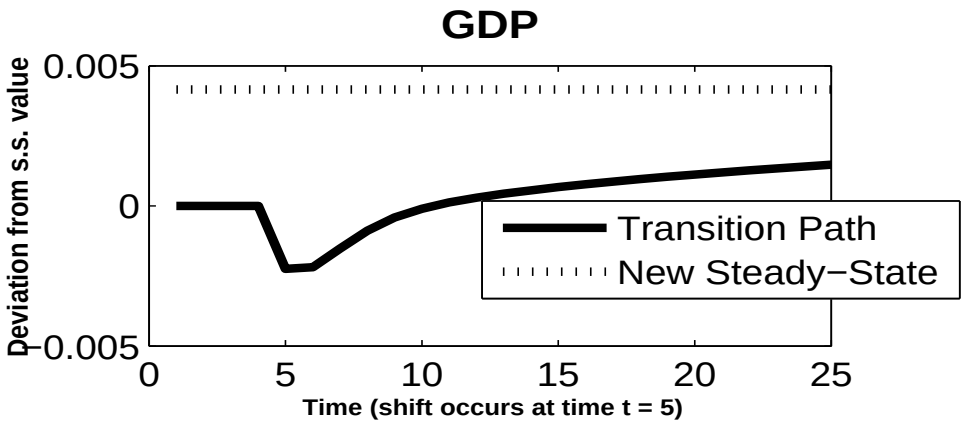
- Draw welfare implications (keep 5000 periods)

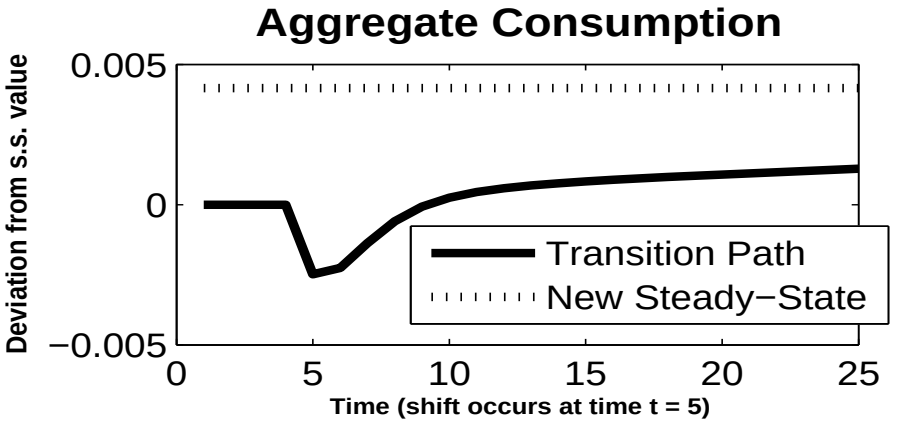
Responses of the Economy

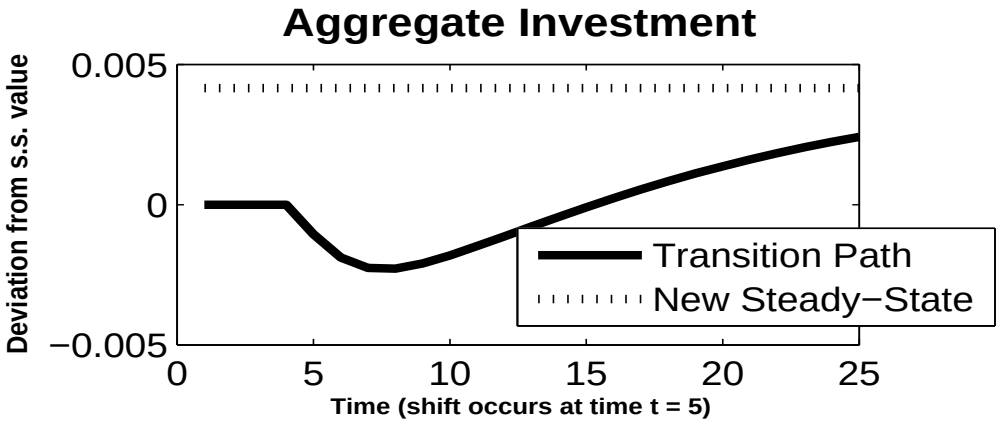












Benchmark Results

Table 1. Welfare Benefits of Reducing Inflation from Two Percent to Zero

	Steady-State Comparison	Complete Information Transition	Bayesian Transition
Consumption Equivalent μ	0.26%	0.13%	0.09%
$\diamond$ as a fraction of steady-state comparison	—	0.499	0.353

Sensitivity Analysis

Specification	Steady-State Comparison	Complete Information Transition	Bayesian Transition
Benchmark Case	0.26%	49.9%	35.3%
Panel A: Modifications to the Monetary Policy Rule			
Higher inflation response ($\lambda_\pi = 2.5$)	0.26%	49.7%	33.4%
Lower inflation response ($\lambda_\pi = 1.5$)	0.26%	50.4%	38.3%
Higher smoothing ($\rho = 0.75$)	0.26%	47.2%	30.7%
No smoothing ($\rho = 0.0$)	0.26%	51.2%	41.3%
Higher output response ($\lambda_y = 0.5$)	0.26%	49.8%	35.7%
No output response ($\lambda_y = 0$)	0.26%	50.6%	37.9%
Higher confidence ($v_1 = 8$)	0.26%	49.9%	27.2%

Sensitivity Analysis: II

Specification	Steady-State Comparison	Complete Information Transition	Bayesian Transition
Benchmark Case	0.26%	49.9%	35.3%
Panel B: Alternative Modeling Choices			
Investment and wage income in cash-in-advance constraint	0.54%	33.2%	23.5%
Habit formation in consumption	0.47%	21.3%	17.7%
Partial wage indexation	0.47%	19.0%	15.0%

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- The paper computes the welfare implications of lowering the inflation target from 2% to 0%, using a standard version of the New Keynesian Model
- It reports that although the welfare benefits of the shift appear significant in comparisons between two-steady states, the benefits are greatly reduced, at least by half and up to 85%, when the transition towards the new, low inflation steady state is taken into account
- This conclusion is likely to be robust to several modeling choices; in cases where only the comparison between steady states is available, prudent to significantly discount computed welfare benefits

Extensions

- Elements of open-economy analysis

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- Growth effects from lower inflation

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- Elements of open-economy analysis
- Growth effects from lower inflation
- Combine with model that includes second-order effects of monetary policy on economy (stochastic transition to new steady state)

Books by Carl Hiassen

- Sick Puppy
- Skinny Dip
- Basket Case
- Lucky You
- Stormy Weather