On the new Keynesian model

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April 17, 2006

- The new Keynesian model is "[...] the closest thing there is to a standard specification... " (McCallum).
- But it has many important limitations.
  - It cannot produce plausible inflation and output dynamics following
    - a monetary shock: The delayed, hump shaped response of inflation documented by Christiano, Eichenbaum and Evans, 2005.
    - a supply shock: Namely the gradual movements in inflation and output.
  - It cannot explain inflation persistence (Fuhrer and Moore, 1995, Chari, Kehoe and McGrattan, 2002).

- It cannot generate a liquidity effect following a monetary shock (Gali, 2003).
- It is inconsistent with the acceleration hypothesis (the positive relation between economic activity and the change in the inflation rate, Mankiw and Reis, 2002).
- It cannot generate serial correlation in inflation forecast errors (Mankiw et al., 2003).

Fixes

Maintain rational expectations

- Introduce sluggish real adjustments
  - Habit formation, adjustment costs on investment, variable capital utilization, firm specific capital,.. as in Christiano et al, 2004, 2005.
  - Predetermined expenditure (time to plan): Rotemberg and Woodford, 1997.
- Use sticky information rather than sticky prices (Mankiw and Reis, 2002). The Phillips curve contains past expectations of current economic conditions, which gives rise to inertial inflation behavior.

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  It does not work once informational time warps have been ruled out. The inclusion of real rigidities does not help.

Figure: Price rigidity, **full** rationality. Adding real rigidities to the basic NK model

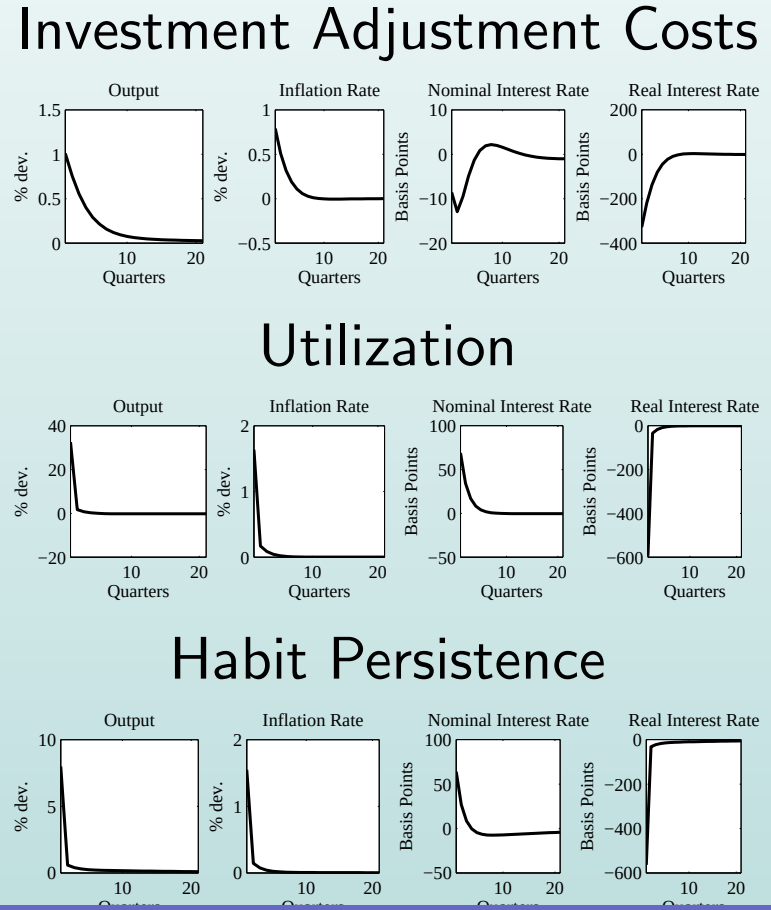


Figure: Price rigidity, **full rationality**. Combined effect of real rigidities

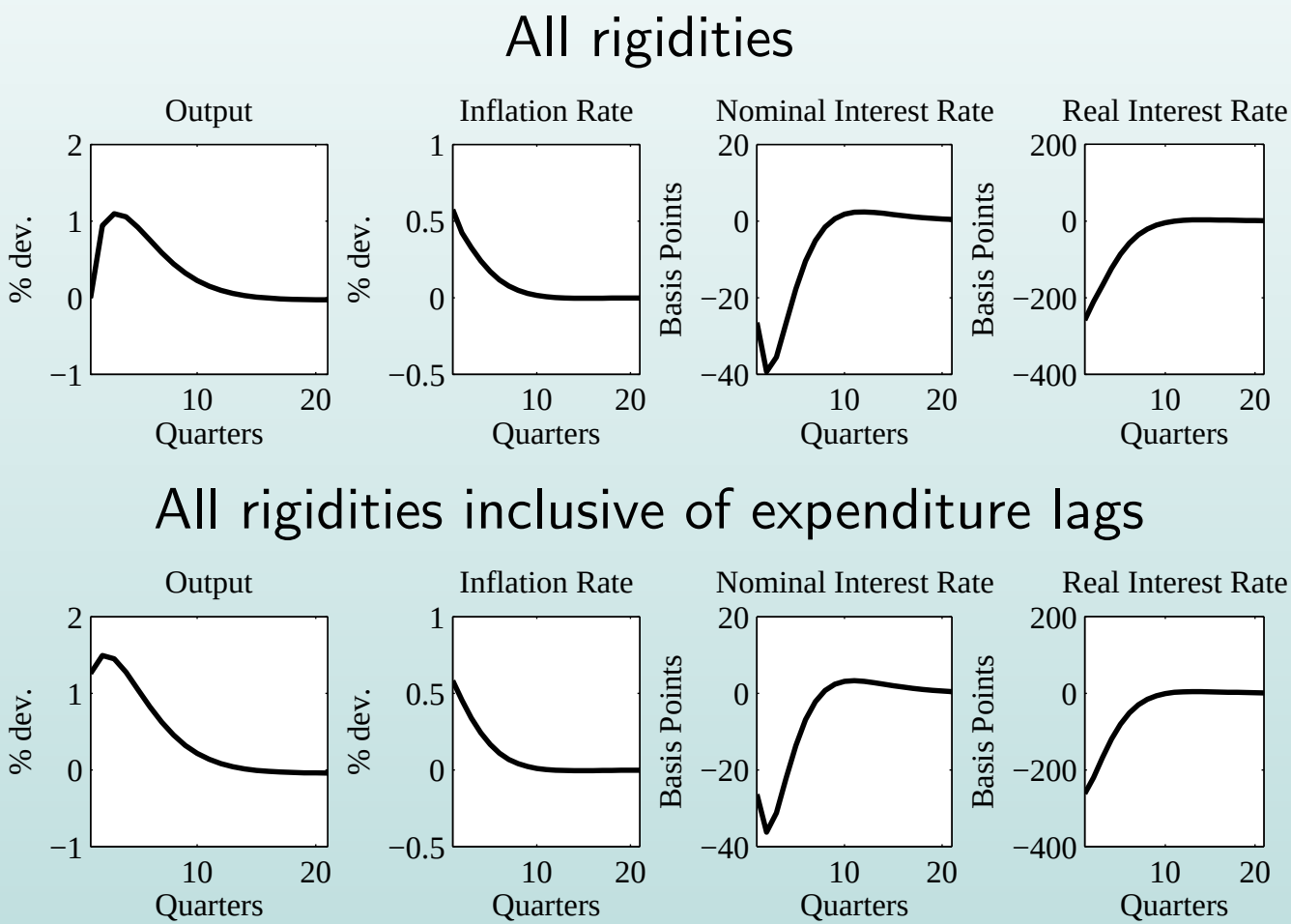
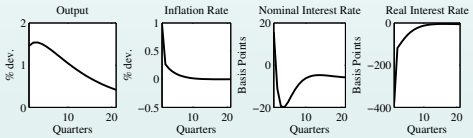
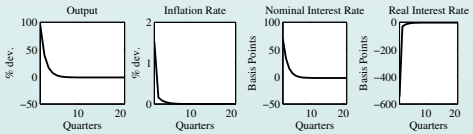


Figure: Wage rigidity, **full** rationality. Real rigidities

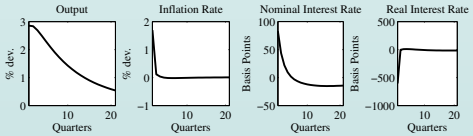
Investment Adjustment Costs



Utilization



Habit Persistence



All three

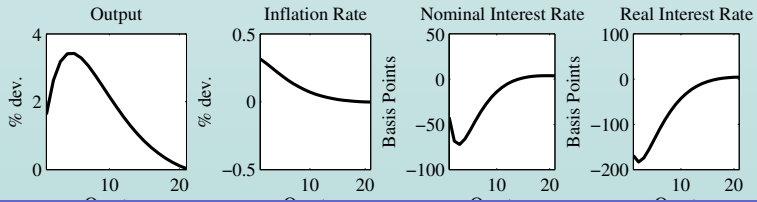


Figure: Alleged Impulse Response Functions to a Money Shock in the Mankiw-Reis model

(c) Money Supply Shock

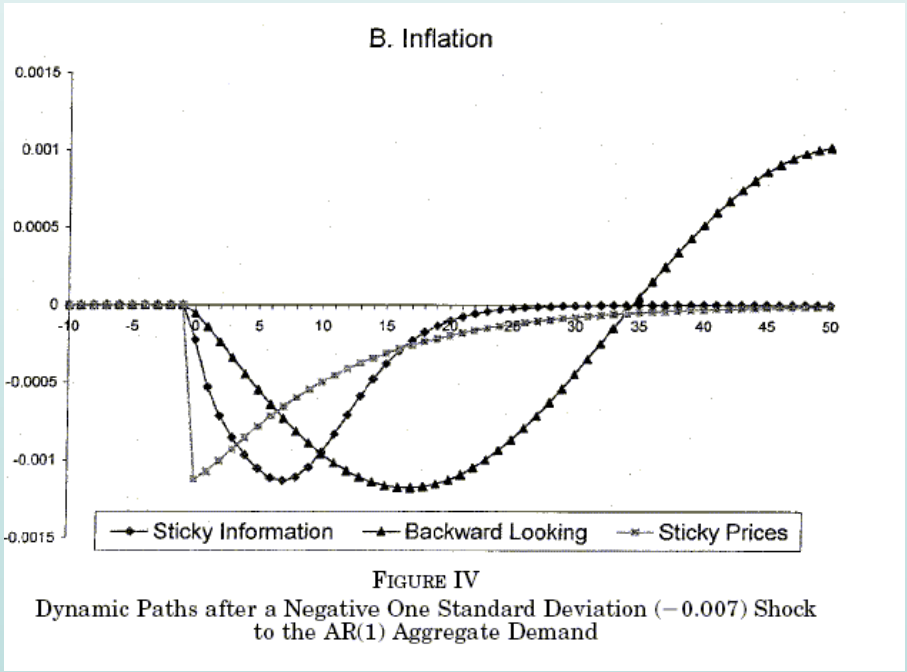


FIGURE IV
Dynamic Paths after a Negative One Standard Deviation (−0.007) Shock to the AR(1) Aggregate Demand

Figure: Impulse Response Function to a Money Shock ($N = 4$)

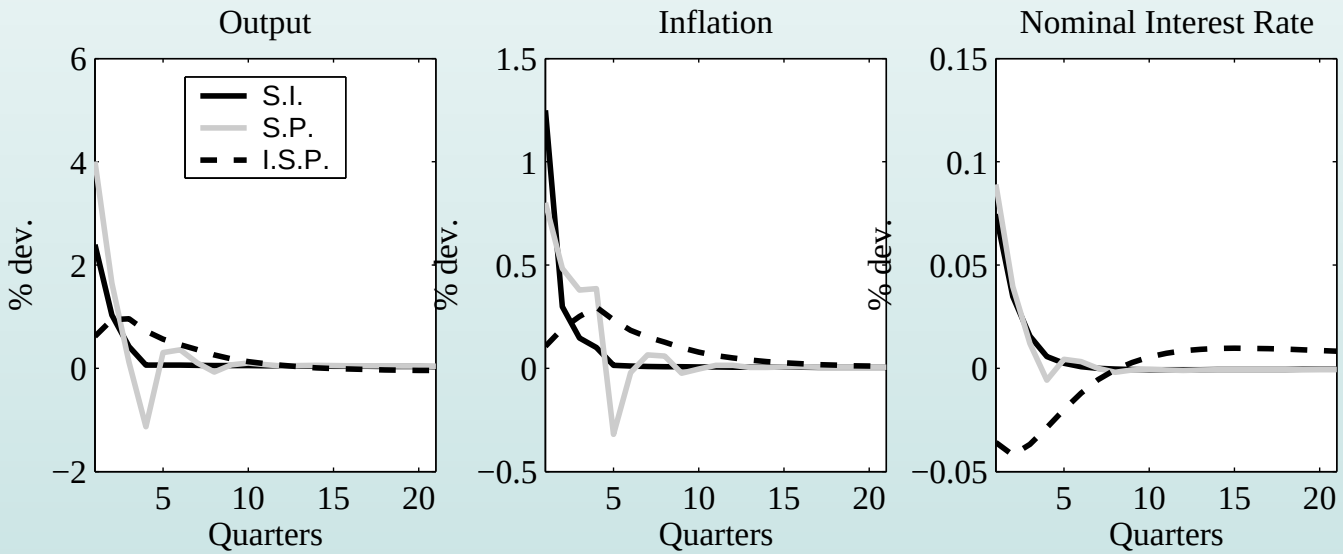
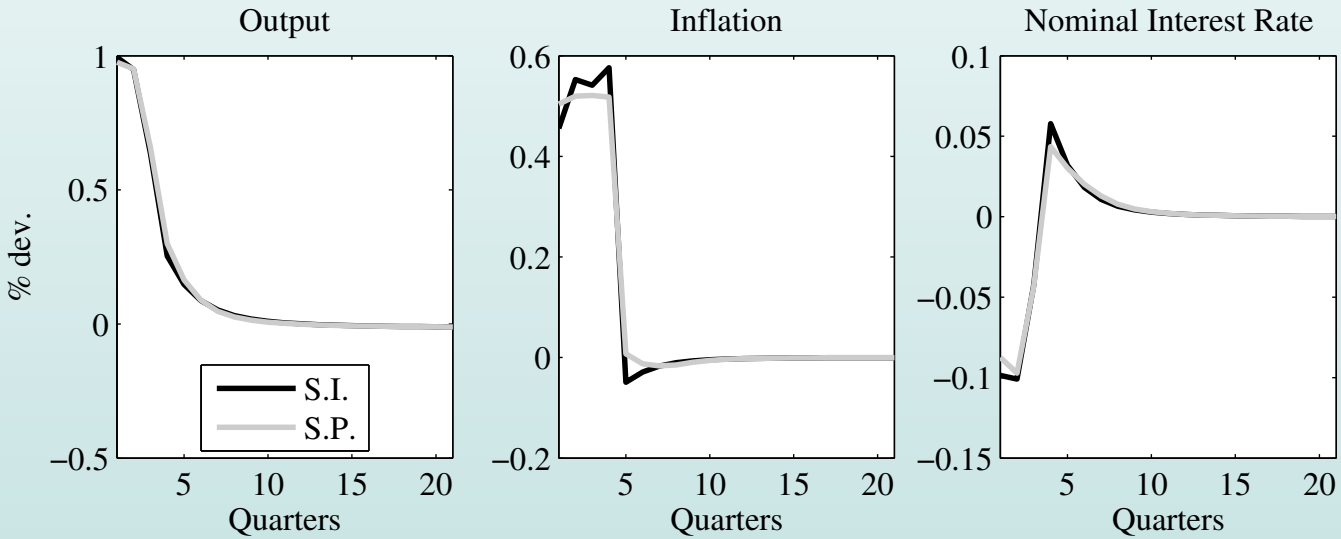


Figure: Impulse Response Functions in the Mankiw-Reis model: The case of real rigidities, N=4



Drop rational expectations

- Myopic price setting, price indexation schemes. A fraction of the population adjusts prices in a backward looking or myopic way (Gali and Gertler, 1999, Christiano, Eichenbaum and Evans, 2005).
- Adaptive expectations (Roberts, 2001, Ireland, 2001).

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Such specifications –combined with *particular* real rigidities– generate a Phillips curve that contains lagged inflation. This gives rise to a delayed inflation response and inflation persistence.

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Problem: The CEE assumption of indexation to past inflation is grossly at variance with observed pricing patterns (ECB report, 2005). It also implies that nearly all price changes at the firm level are equal to the aggregate inflation rate.

We propose an alternative solution that is plausible, intellectually satisfying and seems to work.
Imperfect information and gradual learning: The shocks are not observed. The agents gradually learn the true state of the economy (using the Kalman filter).
We examine the ability of the model to

- take care of the main weakness of the NK model
- have satisfactory overall performance (moment fitting)

The household

Preferences

$$\mathbb{E}_t \sum_{\tau=0}^{\infty} \beta^{\tau} \left[\log(c_{t+\tau} - \vartheta c_{t+\tau-1}) + \frac{\nu^m}{1-\sigma_m} \left(\frac{M_{t+\tau}}{P_{t+\tau}} \right)^{1-\sigma_m} - \frac{\nu^h}{1+\sigma_h} h_{t+\tau}^{1+\sigma_h} \right] \quad (1)$$

The budget constraint

$$E_t B_{t+1} Q_t + M_t + P_t(c_t + i_t + a(u_t)k_t) = B_t + M_{t-1} + P_t z_t u_t k_t + W_t h_t + \Omega_t + \Pi_t \quad (2$$

Capital accumulation

$$k_{t+1} = (1-\delta)k_t + \Phi(i_t, i_{t-1}, k_t) \quad (3)$$

- Goods: Final sector

$$Y_t = \left(\int_0^1 X_t(i)^\theta \mathrm{d}i \right)^{\frac{1}{\theta}} \tag{4}$$

The final good may be used for consumption — private or public— and investment purposes.

- Intermediate goods

$$X_t(i) = A_t K_t(i)^\alpha h_t(i)^{1-\alpha} \tag{5}$$

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Intermediate goods producers are monopolistically competitive, and therefore set prices for the good they produce (Calvo)

Pricing:
Optimizing firms: Standard maximization of expected profits
The non-optimizing firms may:

- Keep their prices perfectly constant until they get a call (our model)
- Adjust price according to a backward indexation scheme (CEE)

$$P_{it} = \xi_t P_{it-1} \tag{6}$$

The monetary authorities
(i) an exogenous money supply rule

$$M_t = \exp(\mu_t) M_{t-1} \tag{7}$$

Table: Calibration

Discount factor	β	0.988
Habit persistence	ϑ	0.650
Inverse labor supply elasticity	σ_h	1.000
Money demand elasticity	σ_m	10.500
Capital elasticity of intermediate output	α	0.281
Parameter of markup	θ	0.850
Depreciation rate	δ	0.025
Adjustment costs parameter	φ	0.330
Probability of price resetting	γ	0.250
Steady state money supply growth (gross)	μ	1.000
Share of government spending	g/y	0.200

Table: Shocks

	ρ	σ
Technology	0.9500	0.0042
Fiscal	0.9684	0.0104
Money supply	0.5000	0.0017

For mis–measured variable x $x_t^\star = x_t^{\mathrm{T}} + \xi_t$
$E(\xi_t) = 0$ for all t; $E(\xi_t \varepsilon_{a,t}) = E(\xi_t \varepsilon_{g,t}) = 0$; and

$$E(\xi_t \xi_k) = \begin{cases} \sigma_\xi^2 & \text{if } t = k \\ 0 & \text{Otherwise} \end{cases}$$

Informational issues

- Knowledge of the *aggregate* state of the economy matters for the agents.
- The specification of information satisfies two principles.
  - First, it does not allow agents to immediately infer the true state of the economy based on the available signals.
  - Second, the informational constraints are sensible (plausible location, timing and amount of noise).
- Agents receive noisy signals on the key aggregate nominal variables, $\{R, \pi, \mu\}$, and in particular on the vector $\{R_t, \pi_t, \pi_{t-1}, \pi_{t-2}, \mu_t, \mu_{t-1}, \mu_{t-2}\}$.
- New information on the lagged π's and μ's becomes available as time progresses (due perhaps to data revisions).

Calibrate the variance of the noise by matching the first 8 periods in the IRF of inflation to a money shock in the CEE model.

Table: Volatility of noise

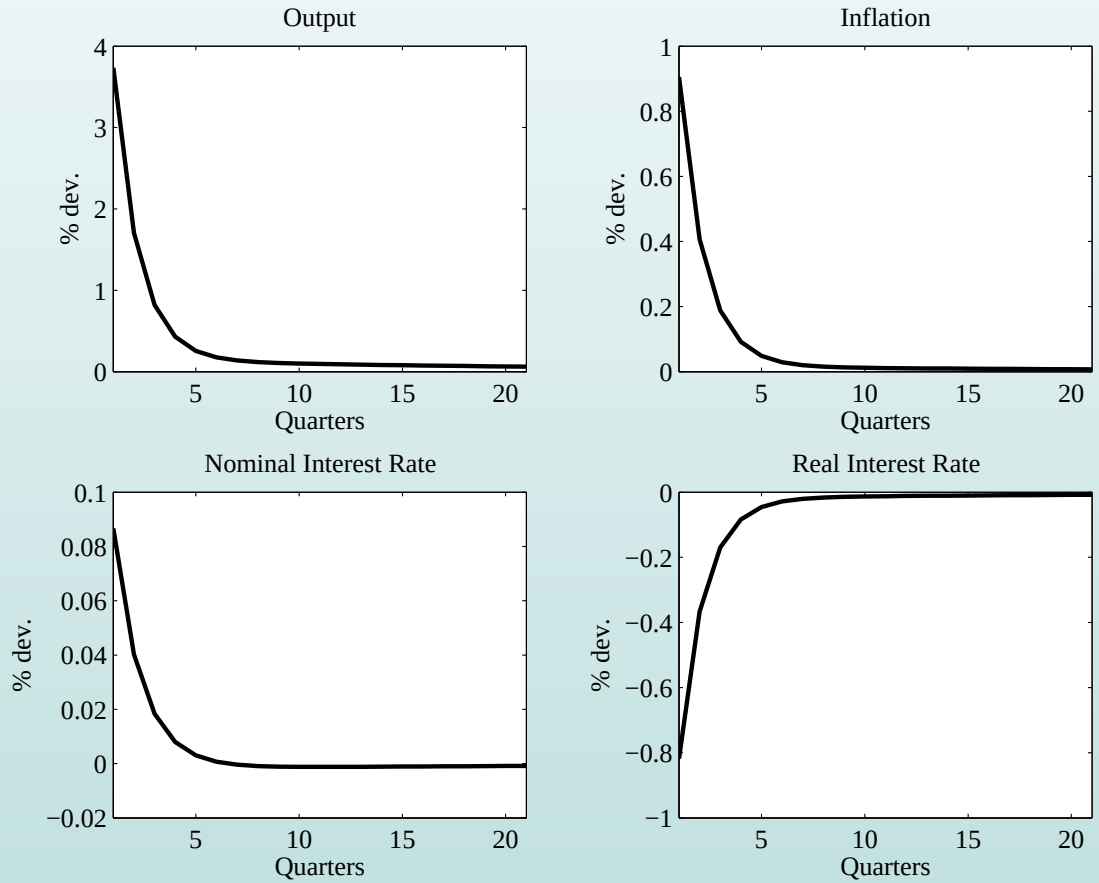
R_t	π_t	π_{t-1}	π_{t-2}	μ_t	μ_{t-1}	μ_{t-2}
2.23045e-4	3.1301e-3	1.5707e-3	7.8817e-4	8.2173e-3	4.1161e-3	2.0618e-3

Are these values plausible?

- BEA: SD of the difference between announced and revised values for GDP deflator is 0.48% (1999-2003).
- Coenen, Levin and Wieland, 2005: Mean absolute revision for the GDP price deflator of 0.11% and 0.14% one and two quarters respectively following the initial publication. For M3, the monthly MAR (in percent) is {0.16, 0.08, 0.06, 0.03, 0.05, 0.04, 0.03} for the months following the initial release.
- Real time data (Philadelphia FED): Over 1999:1-2004:4, the standard error of revisions in the *growth* rate of M2 in the 2nd, 3rd and 4th quarter following the initial release was in the range 0.2% to 0.25%.

Figure: IRF to a money supply shock

(a) Perfect Information



(b) Imperfect Information vs the CEE model

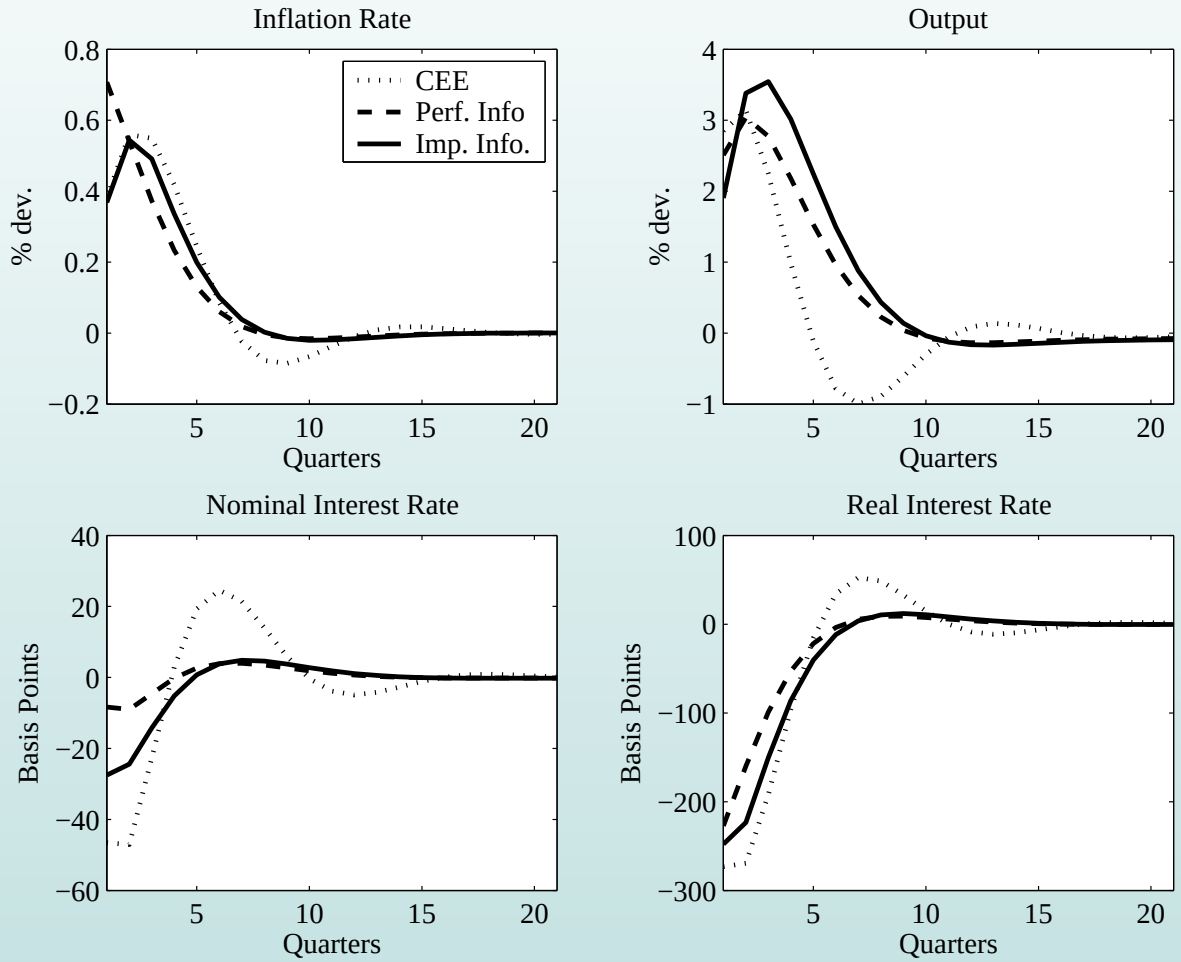


Table: HP moments

Var.	Std	Rel. Std	$\rho(\cdot, y)$	$\rho(1)$	Std	Rel. Std	$\rho(\cdot, y)$	$\rho(1)$
	Data				Standard NK (no indexation)			
y	1.49	1.00	1.00	0.88	1.35	1.00	1.00	0.87
c	0.80	0.54	0.86	0.87	0.21	0.16	0.86	0.88
i	6.03	4.04	0.92	0.83	4.12	3.06	0.94	0.90
h	1.88	1.26	0.83	0.92	0.83	0.61	0.88	0.76
π	0.16	0.11	0.32	0.33	0.16	0.12	0.61	0.56
R_{nom}	0.40	0.27	0.21	0.81	0.01	0.01	-0.53	0.80
R_{real}	0.33	0.22	0.10	0.73	0.12	0.09	-0.63	0.56
	CEE (indexation)				Signal extraction			
y	1.49	1.00	1.00	0.84	1.51	1.00	1.00	0.83
c	0.23	0.16	0.90	0.86	0.21	0.14	0.91	0.87
i	4.49	3.01	0.95	0.88	4.19	2.77	0.94	0.89
h	0.87	0.58	0.90	0.74	1.08	0.71	0.91	0.74
π	0.16	0.11	0.54	0.81	0.16	0.11	0.74	0.62
R_{nom}	0.04	0.03	-0.75	0.74	0.02	0.02	-0.23	0.67
R_{real}	0.18	0.12	-0.71	0.70	0.15	0.10	-0.57	0.66

Concluding remarks

- The new Keynesian model has important empirical limitations.
- Existing, suggested solutions are either conceptually unsatisfactory (do not adhere to rational expectations), empirically tenuous (inconsistent with pricing behavior) or do not work (sticky info).
- Imperfect information and signal extraction seem to represent a plausible solution.
  1. The model has good empirical properties
  2. It has also theoretical appeal
  3. But is has its own problems too
- Next step: Build a small scale macroeconomic model (as in Rotemberg and Woodford, 1997, Smets and Wouters, 2003) incorporating learning as well a other standard features. Compare its performance to that of its main rivals.