Transparency

- Modern monetary policy is the management of expectations
  (Woodford 05 JH, Svensson-Woodford "Implementing...", Svensson "Further Devs.")
  Example: Simple New Keynesian model

$$\begin{aligned}\pi_t &= \delta\pi_{t+1|t} + \kappa x_t \\ x_t &= x_{t+1|t} - \sigma(r_t - \bar{r}_t) \\ r_t &\equiv i_t - \pi_{t+1|t}\end{aligned}$$

Assume $\pi_{t+T|t} \to 0, x_{t+T|t} \to 0$ $(T \to \infty)$, $(\pi^* = 0)$, $\left|\sum_{\tau=0}^{\infty} x_{t+\tau|t}\right| < 0$, $\left|\sum_{\tau=0}^{\infty}(r_{t+\tau|t} - \bar{r}_{t+\tau|t})\right| < 0$,

$$\pi_t = \kappa \sum_{\tau=0}^{\infty} \delta^{\tau} x_{t+\tau|t},$$

$$\begin{aligned}x_t &= -\sigma \sum_{\tau=0}^{\infty}(r_{t+\tau|t} - \bar{r}_{t+\tau|t}) \\ &= -\sigma \sum_{\tau=0}^{\infty}(i_{t+\tau|t} - \pi_{t+1+\tau|t} - \bar{r}_{t+\tau|t}), \\ &\approx -\sigma T(r_t^T - \bar{r}_t^T)\end{aligned}$$

Long real interest and long real neutral interest rate of maturity T, expectations hypothesis

$$r_t^T \equiv \frac{1}{T}\sum_{\tau=0}^{T-1} r_{t+\tau|t}, \qquad \bar{r}_t^T \equiv \frac{1}{T}\sum_{\tau=0}^{T-1} \bar{r}_{t+\tau|t}, \qquad T \text{ large}$$

- Expectations about future i_t, π_t, x_t matter, current i_t does not matter much
- Expectations about future π_t, x_t affects current π_t, x_t (Svensson-Woodford)

- Practical conclusions
  - Most effective implementation of monetary policy amounts to announcing optimal forecasts of $\pi^t \equiv \{\pi_{t+\tau,t}\}_{\tau=0}^{\infty}$, x^t, i^t
  - Lively debate about i^t (constant interest rate, market expectations, instrument rule, optimal)
    * Constant (ECB, previously Bank of England, Riksbank): Unrealistic, indeterminacy, inconsistency, not optimal, not best forecast
    * Market expectations (Bank of England, Riksbank): More realistic (not always), possible indeterminacy, risk of CB following market, not optimal, not best forecast
    * Reaction function (RBNZ?): Not necessarily optimal, not best forecast
    * Optimal (Norway, RBNZ?): Best forecast, best information for private sector, risk of commitment?

- Is more public information always good?
  - Morris-Shin (02 AER), Amato-Morris-Shin, Amato-Shin: No
  - Same model: Svensson (06 AER): Yes, for reasonable parameters
  - Different models: Angeletos-Pavan (04), Cornand-Heinemann (04), Hellwig (04), Woodford (05 JH): Yes
  - More general model and discussion: Angeletos-Pavan (05)

$[0,1]$ continuum of economic agents. Agent $i \in [0,1]$ chooses action $a_i \in \mathrm{R}$. a action profile over all agents. Agent i utility function

$$u_i(a,\theta) \equiv -\left[(1-r)(a_i-\theta)^2 + r(L_i - \bar{L})\right], \tag{1}$$

$r \in (0,1)$ constant; θ state variable, state of the economy, "fundamentals",
$L_i \equiv \int_0^1 (a_j - a_i)^2 dj$, $\bar{L} \equiv \int_0^1 L_j dj$.

First term of (1) standard fundamentals-related utility component: it is higher the closer the action is to the state of the economy.
Second term zero-sum coordination game, guessing other agents' actions, Keynes's beauty-contest example.
$r, 1-r$ weights on the terms

Realized social welfare, $W(a,\theta)$, average utility of the agents (normalized by $1-r$),

$$W(a,\theta) \equiv \frac{1}{1-r}\int_0^1 u_i(a,\theta)di = -\int_0^1 (a_i-\theta)^2 di. \tag{2}$$

Depends only on the fundamentals-related utility component.

Public signal of θ, $y = \theta + \eta$, $\eta \sim N(0, \sigma_\eta^2)$.
Individual private signal, $x_i = \theta + \varepsilon_i$, $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$; ε_i, ε_j independent for $i \neq j$.

After receiving signals, each agent chooses a_i to maximize utility. Unique equilibrium action satisfies

$$a_i = \frac{\alpha y + (1-r)\beta x_i}{\alpha + (1-r)\beta}, \tag{3}$$

$\alpha \equiv 1/\sigma_\eta^2$ precision of public information,
$\beta \equiv 1/\sigma_\varepsilon^2$ precision of private information.

Because the public signal is common knowledge, in equilibrium each agent gives extra weight to the public signal

Standard signal-extraction,

$$\mathrm{E}_i\theta = \frac{\alpha y + \beta x_i}{\alpha + \beta}.$$

Proof that (3) is an equilibrium:

$$\mathrm{E}_i\theta = \frac{\alpha y + \beta x_i}{\alpha + \beta}$$

Guess linear strategy

$$a_j = \kappa x_j + (1-\kappa)y \tag{4}$$

$$\begin{aligned}
\mathrm{E}_i\bar{a} &= \mathrm{E}_i \int a_j dj \;=\; \kappa \mathrm{E}_i \int x_j dj + (1-\kappa)y \;=\; \kappa \mathrm{E}_i\theta + (1-\kappa)y \\
&= \kappa \frac{\alpha y + \beta x_i}{\alpha + \beta} + (1-\kappa)y \\
&= \frac{\kappa\beta}{\alpha+\beta}x_i + \left(1 - \frac{\kappa\beta}{\alpha+\beta}\right)y
\end{aligned}$$

FOC

$$\frac{\partial \mathrm{E}_i u(a,\theta)}{\partial a_i} = -\,\mathrm{E}_i 2[(1-r)(a_i-\theta) + r(a_i - \int a_j dj)]$$

$$\begin{aligned}
a_i &= (1-r)\mathrm{E}_i\theta + r\mathrm{E}_i\bar{a} \\
&= (1-r)\frac{\alpha y + \beta x_i}{\alpha+\beta} + r\left[\frac{\kappa\beta}{\alpha+\beta}x_i + \left(1 - \frac{\kappa\beta}{\alpha+\beta}\right)y\right] \\
&= \frac{\beta(r\kappa + 1 - r)}{\alpha+\beta}x_i + \left(1 - \frac{\beta(r\kappa+1-r)}{\alpha+\beta}\right)y
\end{aligned} \tag{5}$$

Compare (4) and (5):

$$\kappa = \frac{\beta(r\kappa + 1 - r)}{\alpha+\beta}$$

$$\kappa = \frac{\beta(1-r)}{\alpha + \beta(1-r)}.$$

QED.

Proof of uniqueness: Use higher-order expectations

$$
\begin{aligned}
a_i &= (1-r)\mathrm{E}_i\theta + r\mathrm{E}_i(\bar{a}) \\
&= (1-r)\mathrm{E}_i\theta + r\mathrm{E}_i \int [(1-r)\mathrm{E}_j\theta + r\mathrm{E}_j(\bar{a})]dj \\
&= (1-r)\mathrm{E}_i\theta + (1-r)r\mathrm{E}_i(\bar{\mathrm{E}}\theta) + r^2\mathrm{E}_i \int \mathrm{E}_j(\bar{a})dj] \\
&= (1-r)\mathrm{E}_i\theta + (1-r)r\mathrm{E}_i(\bar{\mathrm{E}}\theta) + (1-r)r^2\mathrm{E}_i(\bar{\mathrm{E}}^2\theta) + ... \\
&= (1-r)\sum_{k=0}^{\infty} r^k \mathrm{E}_i(\bar{\mathrm{E}}^k\theta) \qquad (6)
\end{aligned}
$$

$\bar{\mathrm{E}}^k$ expectations of order k.

$$\bar{\mathrm{E}}\theta = \int \mathrm{E}_i\theta d_i = \int \frac{\alpha y + \beta x_i}{\alpha+\beta}di = \frac{\alpha y + \beta\theta}{\alpha+\beta}$$

$$\mathrm{E}_i(\bar{\mathrm{E}}\theta) = \mathrm{E}_i\frac{\alpha y + \beta\theta}{\alpha+\beta} = \frac{\alpha y + \beta \mathrm{E}_i\theta}{\alpha+\beta} = \frac{\alpha y + \beta\frac{\alpha y + \beta x_i}{\alpha+\beta}}{\alpha+\beta} = \frac{\left[(\alpha+\beta)^2 - \beta^2\right]y + \beta x_i}{(\alpha+\beta)^2}$$

$$\bar{\mathrm{E}}^2\theta = \int \mathrm{E}_i\bar{\mathrm{E}}\theta di = \frac{\left[(\alpha+\beta)^2 - \beta^2\right]y + \beta\theta}{(\alpha+\beta)^2}$$

Lemma: For any k,

$$
\begin{aligned}
\bar{\mathrm{E}}^k\theta &= (1-\mu^k)y + \mu^k\theta \\
\mathrm{E}_i(\bar{\mathrm{E}}^k\theta) &= (1-\mu^{k+1})y + \mu^{k+1}x_i
\end{aligned}
$$

where $\mu \equiv \frac{\beta}{\alpha+\beta}$.

Higher-order expectations depend in the limit only on public information, y. Substitute into (6). Show (3). QED.

From (2) and (3) follows (expected) social welfare

$$\mathrm{E}[W(a,\theta)] = -\frac{\alpha + \beta(1-r)^2}{[\alpha + \beta(1-r)]^2} \equiv V(\alpha). \tag{7}$$

Examine $V(\alpha)$ as a function of α for given β and r.
Transparency, precision of the public signal, α.

Effect of marginal increase in transparency

$$V'(\alpha) = \frac{\alpha - f(r)\beta}{[\alpha + \beta(1-r)]^3}, \tag{8}$$
$$f(r) \equiv (2r-1)(1-r)$$

Morris and Shin's main result: Social welfare is decreasing in transparency, $V'(\alpha) < 0$, if and only if

$$\frac{\alpha}{\beta} < f(r). \tag{9}$$

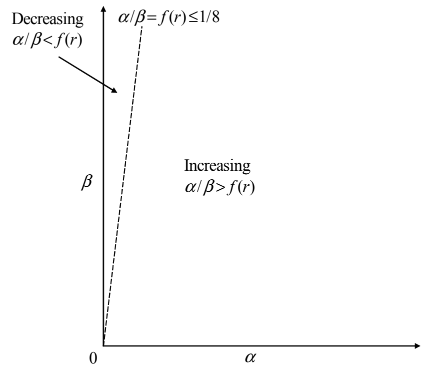
But, for reasonable assumptions, the condition is very likely to be violated. Then more transparency increases welfare.

First, for (9), $r \in (\frac{1}{2}, 1)$. Else, if $r \in [0, \frac{1}{2}]$ or $r = 1$, we have $f(r) \leq 0$, and (9) is violated. Thus, each agent must give more (but not all) weight to the beauty contest than to the fundamentals-related utility component. If not, social welfare is increasing in transparency.

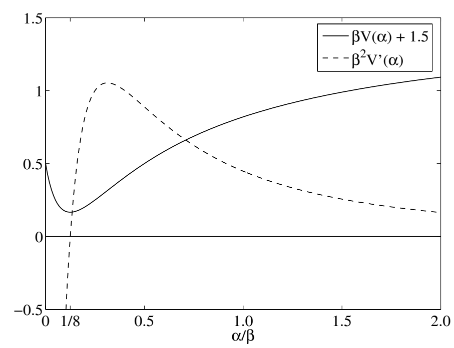
Second, $f(r) \leq f(\frac{3}{4}) = \frac{1}{8}$. $f(r)$ has a maximum equal to $\frac{1}{8}$ for $r = \frac{3}{4}$. Even if condition $r \in (\frac{1}{2}, 1)$ holds, condition (9) is violated, if $\alpha/\beta \geq 1/8$.

Possible benchmark: $\alpha = \beta$. Central banks allocate many more resources to collecting, processing, and analyzing data about the economy than any private agent. Romer and Romer: Federal Reserve Board forecasts are more accurate than private-sector forecasts (but Fulford 06!)

Regions of social welfare increasing or decreasing in transparency



Social welfare as a function of transparency



Non-marginal changes in transparency. Threshold

$$\bar{\alpha} = \min\{\alpha \mid V(\alpha) \geq V(0) = -1/\beta$$

$$\bar{\alpha} = \beta(2r - 1) < \beta \qquad (r < 1), \tag{10}$$

For $\alpha = \beta$, $V(\alpha) > V(0)$.
$\alpha = 0$ hypothetical situation of no public information. Realistically, minimum $\alpha > 0$, not at local maximum. Lower threshold.

- For reasonable parameters, social welfare is increasing in transparency in the Morris and Shin model.
- A conservative benchmark of equal precision of the public and private signals leads to higher social welfare than when there is no public information.
- The Morris-Shin result has been largely misinterpreted as an anti-transparency result, but it is actually pro-transparency.

Woodford 05 JH

Suppose loss function has no (unmotivated) $\bar{L}$ term

$$u_i(a, \theta) \equiv -\left[(1-r)(a_i - \theta)^2 + r\int_0^1 (a_j - a_i)^2 dj\right],$$

Same equilibrium action (3). But (expected) social welfare is then

$$\mathrm{E}[W(a,\theta)] = -\frac{\alpha + \beta(1-r^2)}{[\alpha + \beta(1-r)]^2} \equiv V(\alpha)$$

$$\begin{aligned} V'(\alpha) &= -\frac{[\alpha + \beta(1-r)]^2 - \left[\alpha + \beta(1-r^2)\right] 2[\alpha + \beta(1-r)]}{[\alpha + \beta(1-r)]^4} \\ &= -\frac{\alpha + \beta(1-r) - 2\left[\alpha + \beta(1-r^2)\right]}{[\alpha + \beta(1-r)]^3} \\ &= \frac{\alpha + \beta(1 + r - 2r^2)}{[\alpha + \beta(1-r)]^4} > 0 \end{aligned}$$

Social welfare increasing in transparency