10. Monetary Policy Rules: Simple Cross Checking

John B. Taylor, May 10, 2013

Another Three Equation Model: Larry Ball (1999)

$$\left.\begin{aligned} y &= -\beta r_{-1} + \lambda y_{-1} + \varepsilon \\ \pi &= \pi_{-1} + \alpha y_{-1} + \eta \end{aligned}\right\}$$

Ball's rationale is that the model captures key empirical facts:
- inertia (recall VAR results)
- policy lags (inflation more than output)
- unanticipated shocks
- short-term, but not long-term, trade-off

Why so simple? *"My simple model yields sharp results with clear economic explanations"*

Why not forward-looking? *"These forward looking models have strong theoretical foundations, but they fail to fit the facts…they do not produce the inertia that appears in the data."*

$$\left.\begin{aligned} \alpha &= 0.4 \\ \lambda &= 0.8 \\ \beta &= 1.0 \end{aligned}\right\}$$

Calibration for annual time period

$$\textit{Find } g_1 \textit{ and } g_2,\ r = g_1 y + g_2 \pi$$

$$\textit{to } \min[Var(y) + \mu Var(\pi)]$$

Loss Function (steady state variances)

$$E[y_{+1}] = -\beta r + \lambda y$$

$$E[y_{+1}] = -qE[\pi_{+1}] = -q(\pi + \alpha y)$$

$$\Rightarrow r = [(\lambda + \alpha q)/\beta]y + [q/\beta]\pi$$

Monetary policy rule, 3rd eq. (find q to min Loss Fcn)

$$\Rightarrow q = .5[-\mu\alpha + \sqrt{\mu^2\alpha^2 + 4\mu}]$$

Optimal value of q, depends on μ

Finding the steady state variance of y and π

$$y = -\beta r_{-1} + \lambda y_{-1} + \varepsilon$$

$$\pi = \pi_{-1} + \alpha y_{-1} + \eta$$

$$r = [(\lambda + \alpha q)/\beta]y + [q/\beta]\pi$$

Now lag the third equation by one period

and substitute it into the first to get

$$\mathrm{y} = -\alpha q \mathrm{y}_{-1} - q\pi_{-1} + \varepsilon$$

$$\pi = \alpha y_{-1} + \pi_{-1} + \eta$$

$$\begin{pmatrix} y \\ \pi \end{pmatrix} = \begin{pmatrix} -\alpha q & -q \\ \alpha & 1 \end{pmatrix} \begin{pmatrix} y_{-1} \\ \pi_{-1} \end{pmatrix} + \begin{pmatrix} \varepsilon \\ \eta \end{pmatrix}$$

which is a standard first order VAR

$$\mathbf{z} = \mathbf{A}\mathbf{z}_{-1} + \mathbf{e} \quad \text{with } E\mathbf{e}\mathbf{e}' = \mathbf{\Sigma}$$

Thus to find $E\mathbf{z}\mathbf{z}' = \mathbf{\Omega}$

$$E\mathbf{z}\mathbf{z}' = E(\mathbf{A}\mathbf{z}_{-1} + \mathbf{e})(\mathbf{z}_{-1}'\mathbf{A}' + \mathbf{e}') = \mathbf{A}E\mathbf{z}_{-1}\mathbf{z}_{-1}'\mathbf{A}' + E\mathbf{e}\mathbf{e}'$$

$$\mathbf{\Omega} = \mathbf{A}\mathbf{\Omega}\mathbf{A}' + \mathbf{\Sigma}$$

Use stationarity assumption here

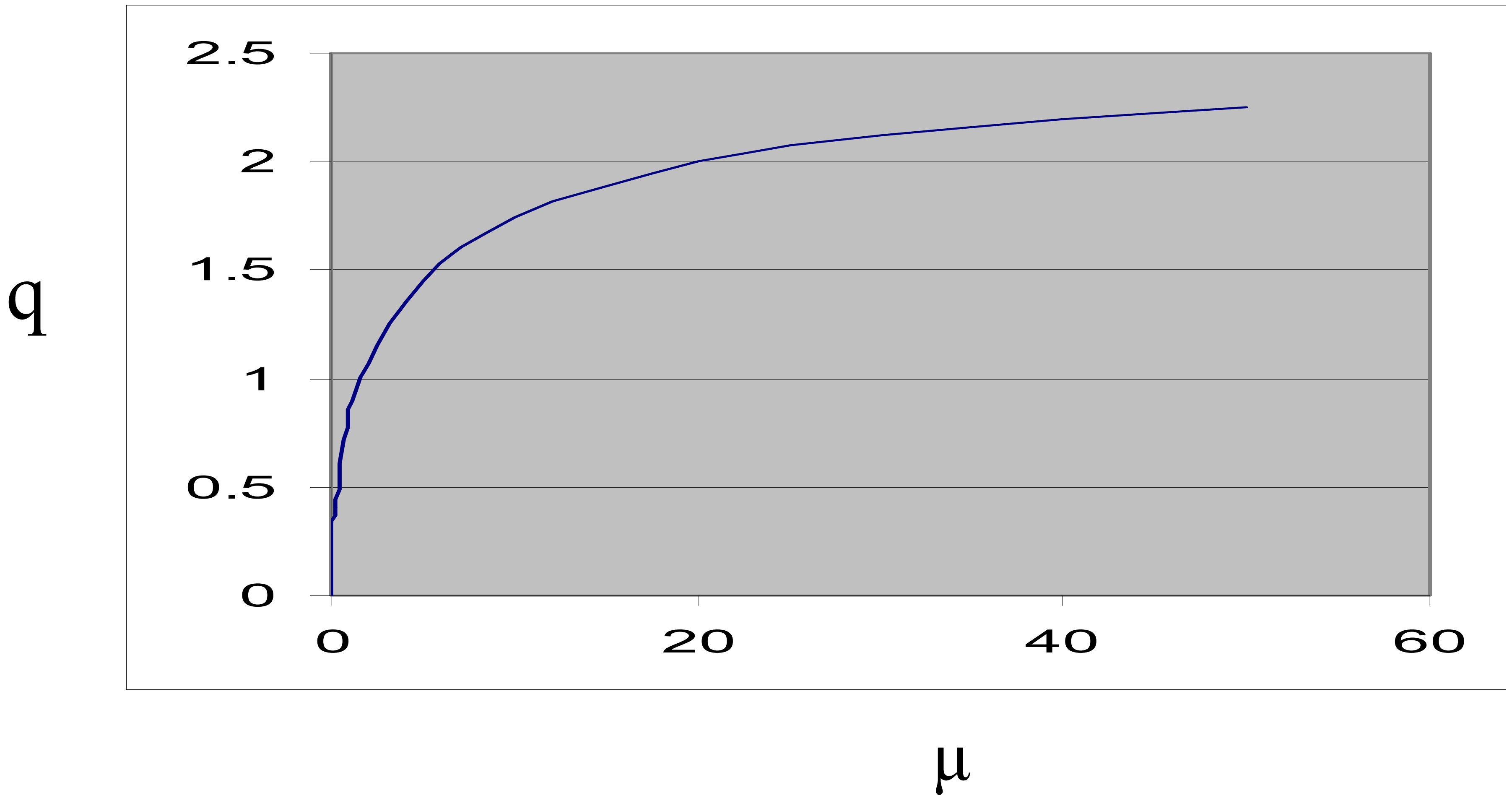
which can be solved for the elements of Ω in terms

of α, $\sigma_\varepsilon, \sigma_\eta$, and the policy parameter q

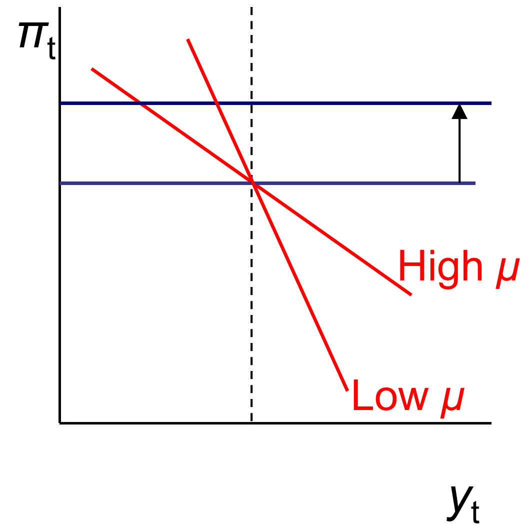
Three equations in three unknowns

Then var π and var y are on the diagonal of Ω

Policy parameter q versus objective function weight μ in the case of α =.4: the more weight on price stability, the higher is q, flatter is AD curve



AD curve flattens
as weight (μ) on inflation rises



And a policy tradeoff curve
is traced out

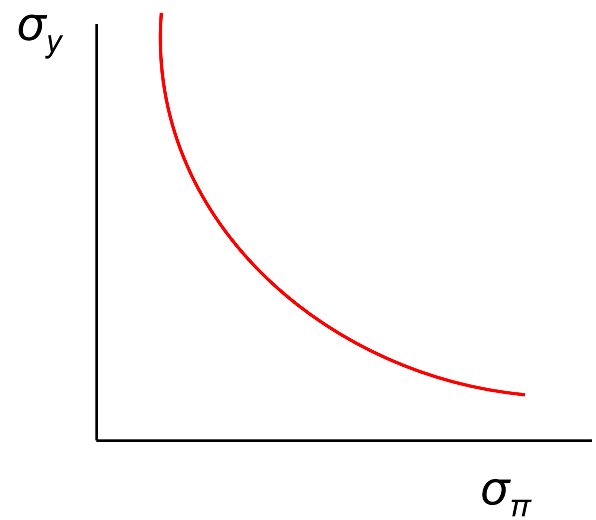
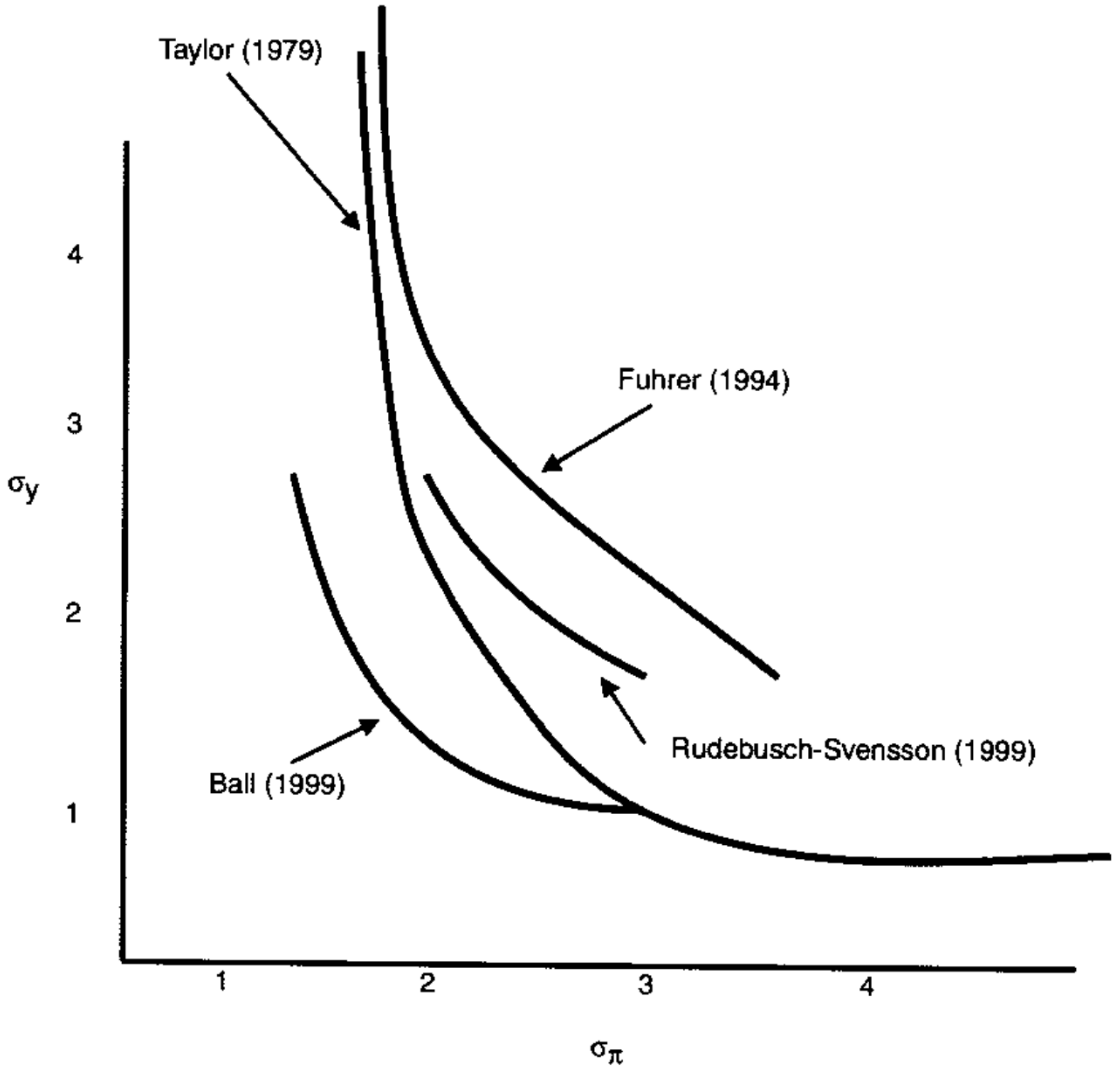


Figure 5.1 Comparison of different estimates of inflation-output variability trade-off curves from 1979 to 1999



Notes: Variability is measured by the standard deviation of inflation (σ_π) and the standard deviation of output as a deviation from trend (σ_y). Although the curves in Figure 5.1 are not exactly the same, the differences seem to be well within the estimation errors of the models. Any shifts in the parameters of the models used to estimate the curves are not large enough to have significantly shifted the curves. In fact, the curves estimated with data into the 1990s seem to be spread around the curve estimated in the 1970s.

From:
Taylor, J.B. "How the Rational Expectations Revolution has Changed Macroeconomic Policy Research," *Advances in Macroeconomics*, Jacques Dreze (ed.),Palgrave 2001

Implications

$$r = [(\lambda + \alpha q)/\beta]y + [q/\beta]\pi$$
$$\text{where } q = [-\mu\alpha + \sqrt{\mu^2\alpha^2 + 4\mu}]/2$$

- Ball: "My model provides formal support" for such a rule
  - Note that the **real** interest rate is on LHS
  - Stating as a **nominal** interest rate rule will require adding π to RHS
- The coefficient on π must therefore be greater than 1
  - What is the economic reasoning behind this condition?
- Positive coefficient on y when only inflation is in loss function
  - What is the economic reasoning behind this result?
- Output coefficient is larger than λ/β =0.8 for Ball parameters
  - Then, maybe 0.5 is too low, but depends on the parameters.

Shifts in the Variability Tradeoff

- Decrease in impact of output on inflation will shift the curve away from the origin (lower α)
  - higher loss (more frequent, more serious recessions).
- Decrease in size of shocks will shift curve toward the origin
  - lower loss (less frequent, less serious recessions)

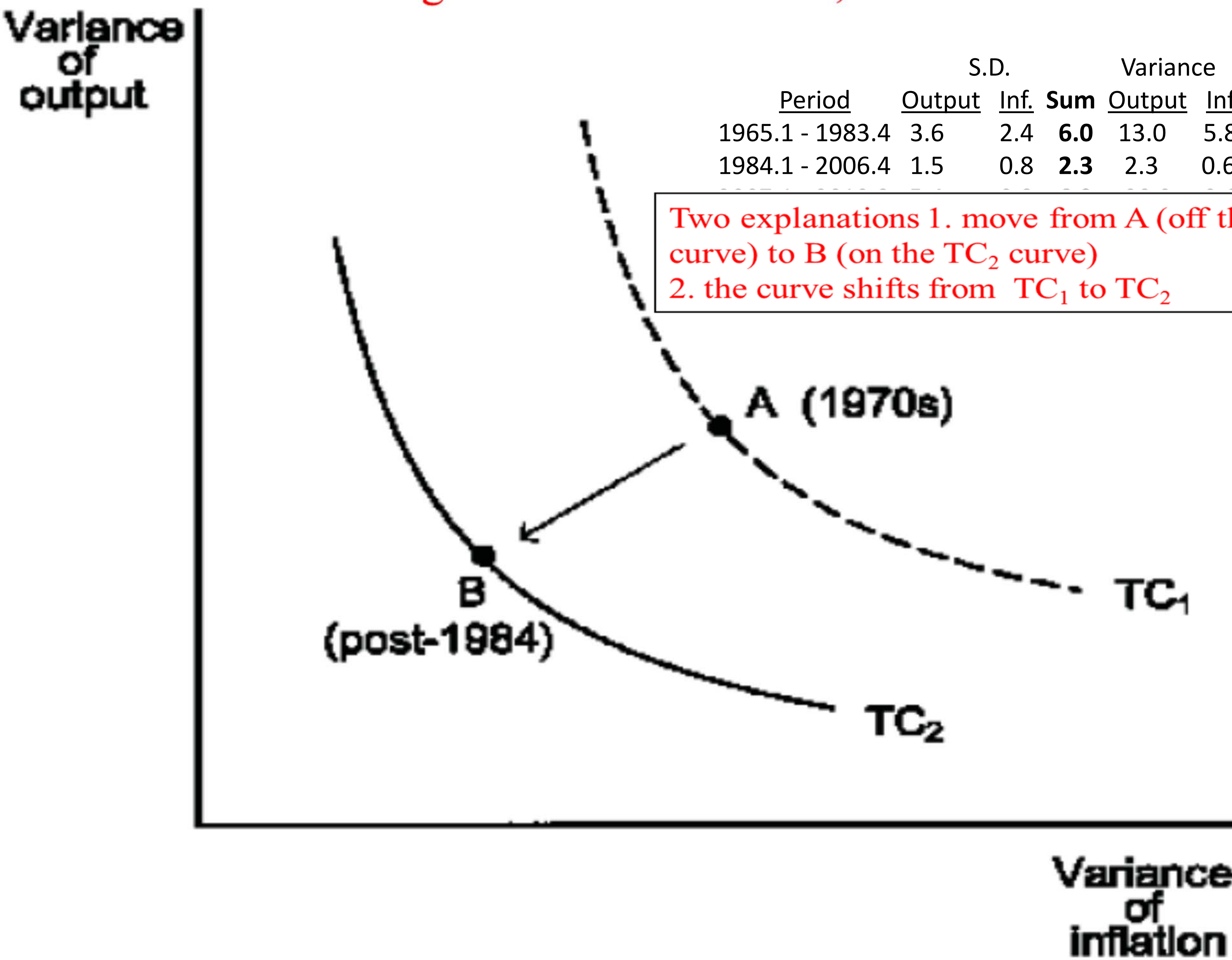
“How can the Great Moderation be explained? Curve suggests two possibilities.” Bernanke (2004)

- Monetary policy changes: ***policy moved southwest***
  - Learned about credibility, rules
  - Responded more quickly and by enough
  - The “Greater than One Principle” was followed post 1984.
  - Boom bust cycle ended
- Structural changes or luck: ***curve moved southwest***
  - Inventory management (see graph on next slide)
  - Services
  - Higher coefficient on output in the tradeoff curve
    - Deregulation
    - Globalization
    - Policy itself
  - Smaller shocks

Figure 1 from Bernanke, “The Great Moderation”

	S.D.			Variance		
Period	Output	Inf.	**Sum**	Output	Inf.	**Sum**
1965.1 - 1983.4	3.6	2.4	**6.0**	13.0	5.8	**18.8**
1984.1 - 2006.4	1.5	0.8	**2.3**	2.3	0.6	**2.9**

Two explanations 1. move from A (off the TC_2 curve) to B (on the TC_2 curve)
2. the curve shifts from TC_1 to TC_2



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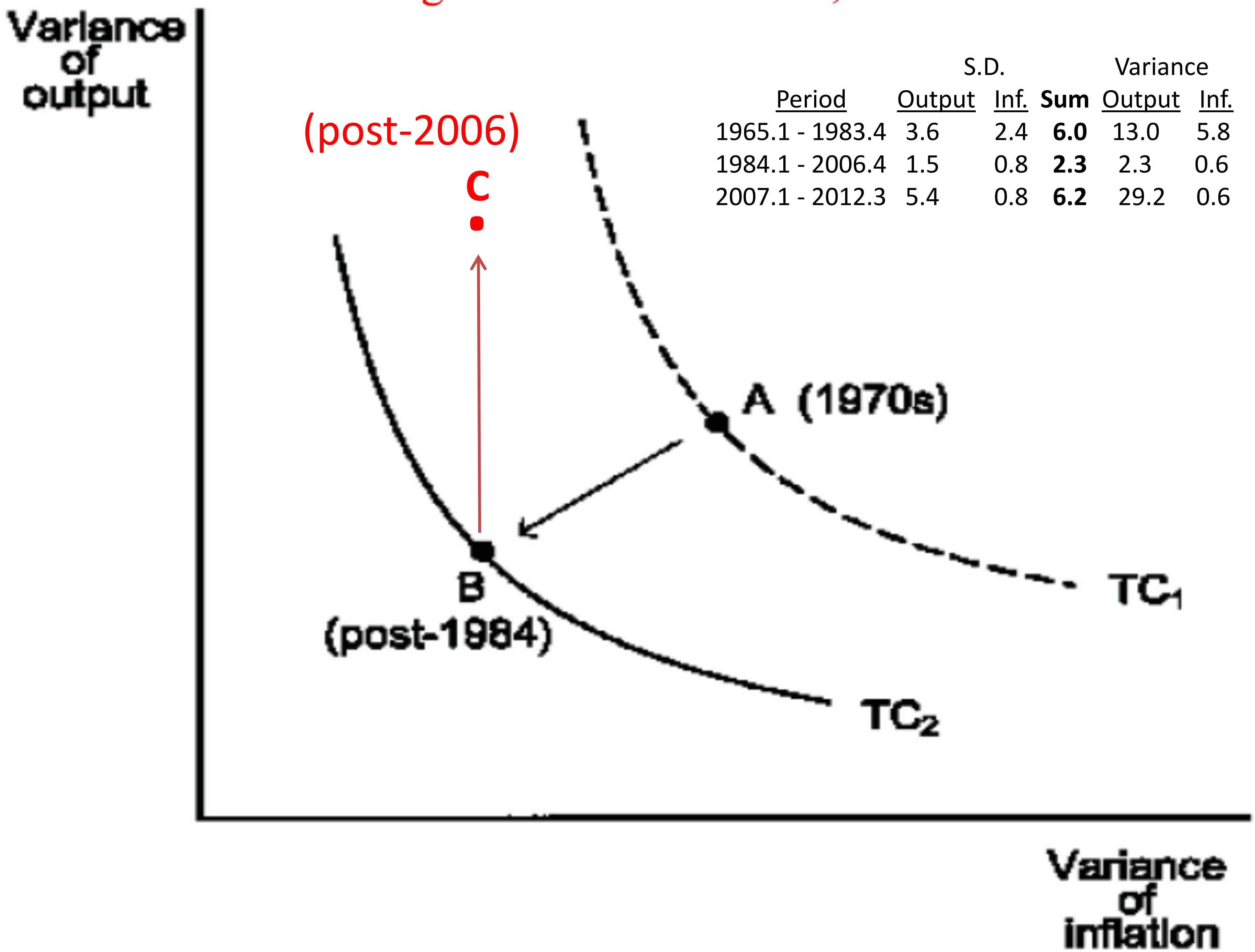
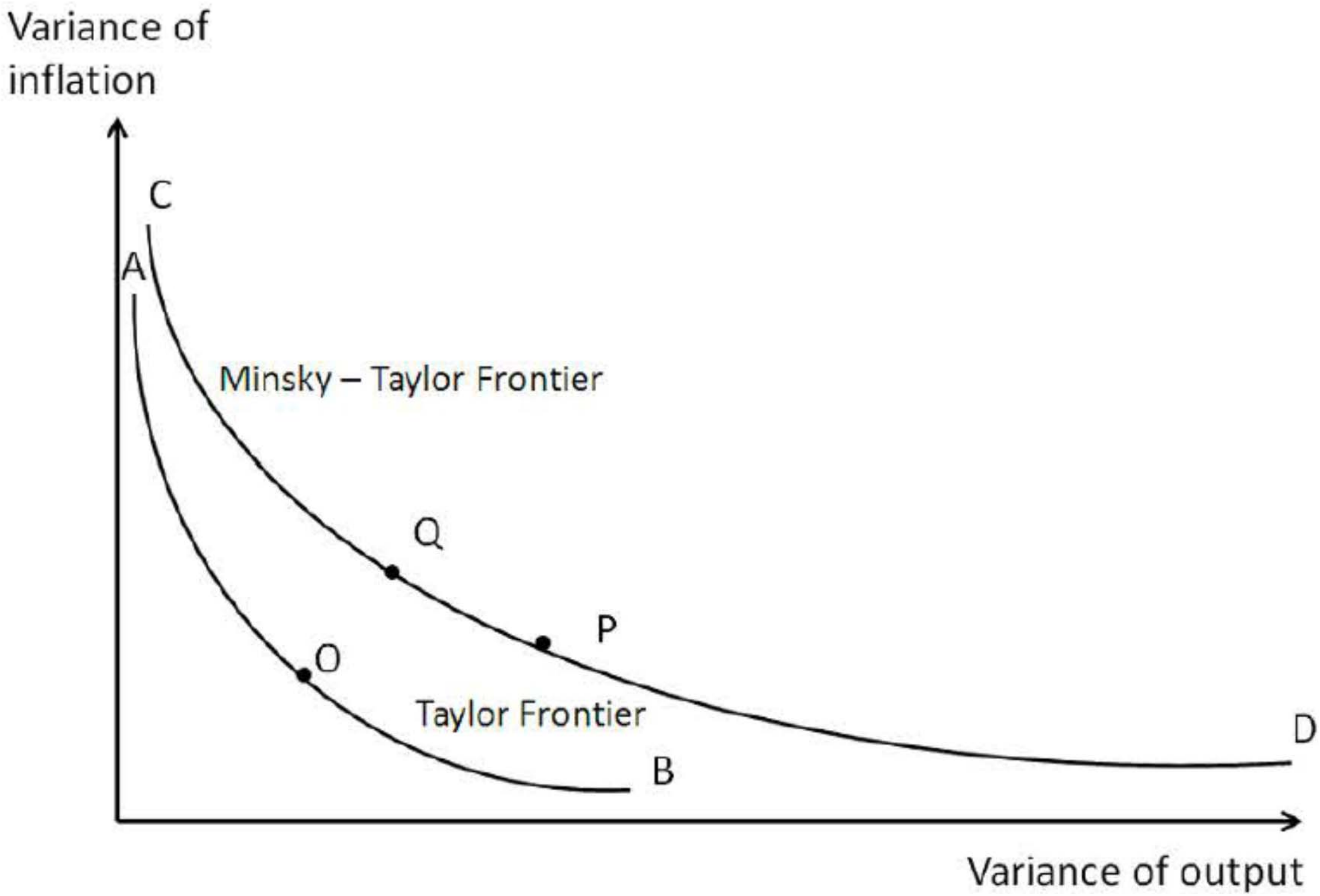
2007.1 - 2012.3	5.4	0.8	**6.2**	29.2	0.6	**29.8**





Source: Mervyn King's Stamp Memorial Lecture, October 9, 2012