5. The Lucas Critique and Monetary Policy

John B. Taylor, May 6, 2013

Econometric Policy Evaluation: A Critique

- Highly influential (Nobel Prize)
- Adds to the case for policy rules
- Shows difficulties of econometric policy evaluation when forward-looking expectations are introduced
- But it left an impression of a "mission impossible" for monetary economists
  - Tended to draw researchers away from monetary policy research to real business cycle models
- Nevertheless it was constructive
  - An alternative approach suggested through three examples:
    - One focussed on monetary policy
      - inflation-unemployment tradeoff
    - The other two focused on fiscal policy
      - consumption and investment
- Worth studying in the original

First Derive the Inflation-Output Tradeoff

Derive "aggregate supply" function:

Supply y_{it} in market *i* at time *t* is given by

$$y_{it} = y_{it}^P + y_{it}^c$$

where

y_{it}^P is "permanent" or "normal" supply

y_{it}^c is "cyclical" supply

Supply curve in market *i*

$$y_{\mathrm{it}}^{\mathrm{c}} = \beta(p_{it} - p_{it}^e)$$

p_{it} is the log of the actual price in market *i* at time *t*

p_{it}^e is the perceived (in market *i*) general price level in the economy at time *t*

Find *conditional* expectation of general price level

$$p_{it} = p_t + z_{it}$$

p_t is distributed normally with mean $\overline{\mathrm{p}}_\mathrm{t}$ and variance σ^2

z_{it} is distributed normally with mean 0 and variance τ^2

Thus

$$\begin{pmatrix} p_t \\ p_{it} \end{pmatrix} \text{ is distributed N} \left[\begin{pmatrix} \overline{p}_\mathrm{t} \\ \overline{p}_t \end{pmatrix} \begin{pmatrix} \sigma^2 & \sigma^2 \\ \sigma^2 & \sigma^2 + \tau^2 \end{pmatrix} \right]$$

$$p_{it}^e = E(p_t \mid p_{it}, I_{t-1}) = \overline{p}_t + [\sigma^2/(\sigma^2 + \tau^2)](p_{it} - \overline{p}_t)$$

$$= (1-\theta)p_{it} + \theta \overline{p}_t$$

where $\theta = \tau^2/(\sigma^2 + \tau^2)$

Covariance
divided by the variance

Now, substitute the conditional expectation

$$p_{it}^{e} = (1-\theta) p_{it} + \theta \overline{p}_{t}$$

into the market supply function

$$\mathrm{y}_{\mathrm{it}}^{\mathrm{c}} = \beta(p_{it} - p_{it}^{e})$$

to get

$$\mathrm{y}_{\mathrm{it}}^{\mathrm{c}} = \beta[p_{it} - ((1-\theta) p_{it} + \theta \overline{p}_{t})]$$

$$= \theta\beta(p_{it} - \overline{p}_{t})$$

Aggregating and adding in normal level we get :

$$y_{t}^{c} = \theta\beta(p_{t} - \overline{p}_{t})$$

$$y_{t} = \theta\beta(p_{t} - \overline{p}_{t}) + y_{pt}$$

Sometimes called "Lucas Supply Function"

Consider a policy intervention and the critique

Now suppose inflation follows

$$p_t = p_{t-1} + \varepsilon_t$$

where

ε_t has a mean π and variance σ^2

Then the aggregate supply equation becomes

$$y_t = \theta\beta(p_t - p_{t-1}) - \theta\beta\pi + y_{pt}$$

If estimated by regressing the output gap $(y_t - y_{pt})$ on inflation $(p_t - p_{t-1})$ and a constant, the regression equation would appear to show that monetary policy could bring y_t above y_{pt} permanently by raising inflation.

But that would be a seriously mistaken conclusion because the coefficient π would change and therefore the constant in the estimated equation would change.

But a constructive critique? How?

Other examples: consumption

$$c_t = ky_{pt} + u_t$$

$$y_{pt} = (1-\beta)\sum_{i=0}^{\infty} \beta^i E(y_{t+i} | I_t)$$

Friedman's (1957) permanent income model of consumption

if actual income follows the stochastic process

$$y_t = a + w_t + v_t$$

where w_t is a random walk and v_t is serially uncorrelated,

then

$$E(y_{t+i} | I_t) = (1-\lambda)\sum_{j=0}^{\infty} \lambda^j y_{t-j}, \text{for i} > 0 \quad (\lambda \text{ depends on variances of } w, v)$$

Thus, the consumption function is

$$c_t = k(1-\beta)y_t + k\beta(1-\lambda)\sum_{j=0}^{\infty} \lambda^j y_{t-j} + u_t$$

and the coefficients on income can be estimated.

Now consider a policy intervention in the Lucas consumption example

Suppose we cut taxes by x permanently at time 0.

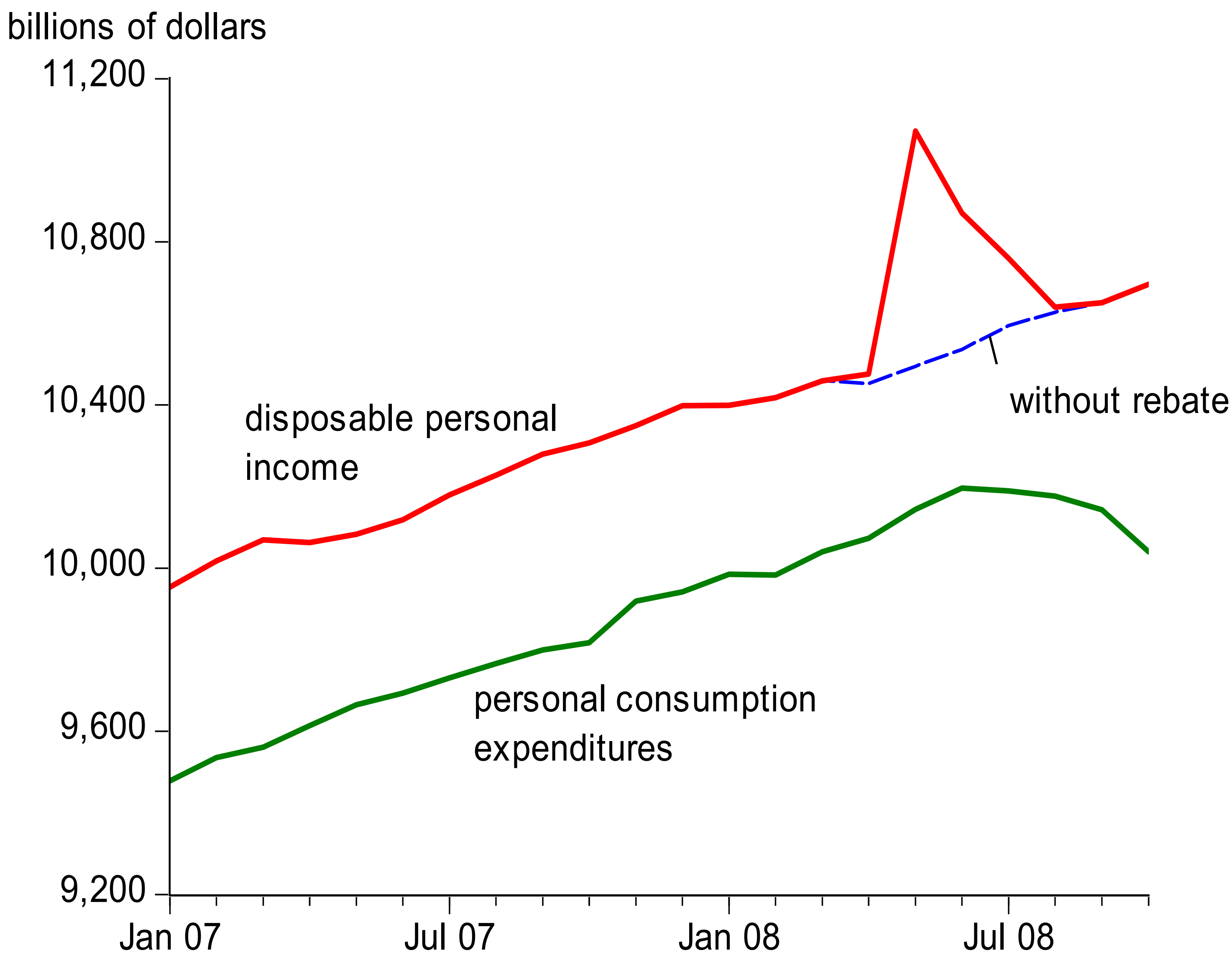
- Then income will rise by x permanently
  - Then $E(y_{0+i}|I_0)$ up by x for all $i \geq 0$.
  - Permanent income y_{p0} will rise by x.
- According to the theory, consumption c_0 will rise by kx
- However, the estimated econometric model

  implies that consumption c_0 increases

  by $k(1-\beta\lambda)x$ which is much less than kx.

  Only over time would c_t rise up to kx.

Application: Temporary Fiscal Stimulus in 2008



Consumption Regressions

Lagged PCE	.794	.832
	(.057)	(.056)
Rebate payments	.048	.081
	(.055)	(.054)
Disp. Pers. Income	.206	.188
(w/o rebate)	(.056)	(.055)
Oil Price ($/bbl	------	-1.007
lagged 3 months)		(.325)
R^2	.999	.999

Dependent variable = PCE
Oil price = West Texas Intermediate.
Sample period is January 2000 to October 2008.
Standard errors in parentheses.

General Formulation of the Critique

Using a framework

$$y_{t+1} = F(y_t, x_t, \theta, \varepsilon_t)$$

to evaluate policy (changes in x_t)

will in general lead to mistakes,

because θ will change when x_t changes.

> *"Everything we know about dynamic economic theory indicates that this presumption is unjustified."* Lucas (1976)

The alternative framework is to specify a policy rule

for the instrument (money growth, interest rate)

$$x_t = G(y_t, \lambda, \eta_t)$$

which implies that

$$y_{t+1} = F(y_t, x_t, \theta(\lambda), \varepsilon_t)$$

A policy change is thus a change in λ which affects θ

and thereby the stochastic process for y_t.