Using Consumption Data to Extract Information Sets (Extract II)

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Identifying information set for given insurance configuration

- Can consumption and income data be useful in identifying information set or learn more about the nature of the income process?
- Consider a simple extension of an example used by Browning, Hansen and Heckman (1999).
- Assume that the income process is given by the sum of a random walk ($p_{i,a,t}$), a transitory shock ($\varepsilon_{i,a,t}$) and a measurement error ($m_{i,a,t}$, which may even reflect "superior information," i.e., information that is observed by the individual but not by an econometrician):

$$
\begin{aligned}
y_{i,a,t} &= p_{i,a,t} + \varepsilon_{i,a,t} + m_{i,a,t} \\
p_{i,a,t} &= p_{i,a-1,t-1} + \zeta_{i,a,t}
\end{aligned}
$$

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- Written in first differences:

$$\Delta y_{i,a,t} = \zeta_{i,a,t} + \Delta \varepsilon_{i,a,t} + \Delta m_{i,a,t}$$

- One cannot separately identify transitory shocks and measurement error without further information.
- Assume that preferences are quadratic, $\beta(1 + r) = 1$ and that the consumer's horizon is infinite for simplicity.

- The change in consumption is given by permanent income equation adapted to the infinite horizon case:

$$\Delta C_{i,a,t} = \zeta_{i,a,t} + \frac{r}{1+r}\varepsilon_{i,a,t} \tag{1}$$

- The component $m_{i,a,t}$ does not enter (1) because consumption does not respond to measurement error in income.
- However, if $m_{i,a,t}$ represented "superior information", then this assumption would have behavioral content: it would be violated if liquidity constraints were binding - and hence $m_{i,a,t}$ would belong to (1).

- Suppose a researcher has access to panel data on consumption and income (a very stringent requirement, as it turns out).
- Then one can use the following covariance restrictions:

$$
\begin{aligned}
var\left(\Delta y_{i,a,t}\right) &= \sigma_{\zeta}^{2}+2\left(\sigma_{\varepsilon}^{2}+\sigma_{m}^{2}\right) \\
cov\left(\Delta y_{i,a,t},\Delta y_{i,a-1,t-1}\right) &= -\left(\sigma_{\varepsilon}^{2}+\sigma_{m}^{2}\right) \\
var\left(\Delta c_{i,a,t}\right) &= \sigma_{\zeta}^{2}+\left(\frac{r}{1+r}\right)^{2}\sigma_{\varepsilon}^{2}
\end{aligned}
$$

- As is clear from the first two moments, σ_{ε}^{2} and σ_{m}^{2} cannot be told apart from income data alone (although the variance of permanent shocks can actually be identified - e.g., using $\sigma_{\zeta}^{2}=var\left(\Delta y_{i,a,t}\right)+2cov\left(\Delta y_{i,a,t},\Delta y_{i,a-1,t-1}\right)$, the stationary version of equation above).

- However, the availability of consumption data solves the identification problem.
- In particular, one could identify the variance of transitory shocks from, e.g.

$$\sigma_\varepsilon^2 = \left(\frac{r}{1+r}\right)^{-2} \left[var\left(\Delta c_{i,a,t}\right) - var\left(\Delta y_{i,a,t}\right) \right. \\ \left. -2cov\left(\Delta y_{i,a,t}, \Delta y_{i,a-1,t-1}\right)\right] \tag{2}$$

- Note also that if one is willing to use the covariance between changes in consumption and changes in income ($cov\left(\Delta c_{i,a,t}, \Delta y_{i,a,t}\right) = \sigma_\zeta^2 + \left(\frac{r}{1+r}\right)\sigma_\varepsilon^2$), then there is even an overidentifying restriction that can be used to test the model.