Income Processes/Shocks, Market Structure, and Information

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- How much risk do households face, to what extent does risk affects basic household choices such as consumption, labor supply, and human capital accumulation, and what types of risks matter for explaining behavior?
- A fruitful distinction is between ex-ante and ex-post responses to risk.

- Ex-ante – Behavioural responses in expectation of shocks
  1. precautionary saving or precautionary labor supply
  2. delay in the adjustment in the optimal stock of durable goods in models with fixed adjustment costs
  3. a shift in the optimal asset allocation towards safer assets
  4. responding to “background risk”, i.e., increase the amount of insurance against formally insurable events (i.e., a fire in the home) when the risk of facing an independent, uninsurable event (i.e., lay-off) increases.

- Ex-post responses are the answer to the question: What do people do when they're hit by shocks?
    1. run down assets or even borrow at high(er) cost
    2. change (family) labor supply (at the intensive and extensive margin)
    3. sell durables (eBay)
    4. use family networks, loans from friends, etc.
    5. relocate or migrate (presumably for lack of local job opportunities) or change job (presumably because of increased firm risk)
    6. apply for government provided insurance, use charities, etc.

- The structure of the income process, including the persistence and the volatility of shocks as well as the sources of risk underlies both the ex-ante and the ex-post responses.
- Browning, Hansen and Heckman (1998): ". . . calibrating model economies under imperfect insurance requires a measure of the magnitude of microeconomic uncertainty."
- There has been a large increase in the cross sectional dispersion of wages/earnings.
- This has happened despite the "great moderation" taking place at the aggregate level.

We need some theory to make the point why knowing the income process is important to understand how consumption responds to income changes.

1. Classical PIH
2. Beyond the PIH

- Quadratic period utility
- $\beta(1+r)=1$
- Finite horizon T
- $A_T \geq 0$

Recall:

- Hall (1978) shows that if people have a single asset, the within period utility is quadratic, and the discount rate is equal to the interest rate Then optimal inter-temporal choice implies the PIH and consumption follows a martingale (random walk)

$$c_{it} = c_{i,t-1} + u_{it} \qquad \text{or} \qquad \Delta c_{it} = u_{it}$$

where u_{it} is a consumption innovation that is related to income shocks

Specifically

$$\Delta c_{it} = \frac{r}{1+r}\left[1 - \frac{1}{(1+r)^{T-t+1}}\right]^{-1} \sum_{j=0}^{T} \frac{\mathbb{E}\left(y_{i,t+j}|\Omega_{it}\right) - \mathbb{E}\left(y_{i,t+j}|\Omega_{it-1}\right)}{(1+r)^{j}}$$

- Consumption changes only if new information arrives ($\Omega_{it} \neq \Omega_{i,t-1}$)
- The extent of consumption adjustment to news (the shock) depends on the the persistence of the shock and the remaining time horizon
- Anticipated income changes have no effect on consumption growth (recall $\beta(1+r) = 1$)

- Notice we did not need to specify the income process.
- To get a clearer characterization, suppose income follows an ARMA(1,1) process

$$y_{it} = \rho y_{i,t-1} + \varepsilon_{it} + \theta \varepsilon_{i,,t-1}$$

$$\Delta c_{it} = \frac{r}{1+r}\left[1 - \frac{1}{(1+r)^{T-t+1}}\right]^{-1} \times \left[1 + \frac{\rho+\theta}{1+r-\rho}\left(1 - \left(\frac{\rho}{1+r}\right)^{T-t}\right)\right]\varepsilon_{it}$$

or

$$\Delta c_{it} = \kappa\left(r, \rho, \theta, T-t\right)\varepsilon_{it}$$

The Response of Consumption to Income Shocks with Quadratic Preferences

ρ	θ	$T - t$	κ
1	-0.2	40	0.81
1	0	10	1
0.99	-0.2	40	0.68
0.95	-0.2	40	0.39
0.8	-0.2	40	0.13
0.95	-0.2	30	0.45
0.95	-0.2	20	0.53
0.95	-0.2	10	0.65
0.95	-0.1	40	0.44
0.95	-0.01	40	0.48
1	0	∞	1
0	-0.2	40	0.03

The Response of Consumption to Income Shocks with Quadratic Preferences

1. If income is random walk process ($\rho = 1$, $\theta = 0$), consumption responds one-to-one regardless of time horizon
2. A decrease in the persistence of the shock lowers the value of κ. When $\rho = 0.8$ (and $\theta =$ -0.2) for example, the value of κ is a modest 0.13.
3. A decrease in the persistence of the MA component acts in the same direction (but the magnitude of the response is much attenuated).
4. Finally, a shortening of the planning horizon increases the value of κ.

- The previous ARMA(1,1) process has a single shock ε_{it}
- A very popular generalization (still parsimonious) is to model income as the sum of a random walk and a transitory iid component

Identifying Permanent and Transitory Shocks

- Use data on choices to help learn about the stochastic process for income

- BP want to understand what part of the increases in inequality are due to increases in permanent shocks to income and what part is due to transitory shocks.
- They make the distinction between
    1. Permanent inequality
    2. Transitory uncertainty
- I.e., there is a difference between the year to year ups and downs in an individual's income and a permanent shift of individuals in the income distribution
- Think of permanent shocks as building up, or accumulating over the life time, while transitory shocks appear only for one period
    - Note the difference between a raise of $10,000 and a one-off payment of $10,000 (alternatively, a pay-cut of $10,000 and a one-off loss of $10,000)

- A Stochastic Process for Income

$$y_{it} = \underbrace{y_{it}^P}_{\text{permanent component of income}} + \underbrace{u_{it}}_{\text{transitory component of income}}$$

Let

$$y_{it}^P = \underbrace{y_{i,t-1}^P}_{\text{last period permanent income}} + \underbrace{v_{it}}_{\text{shock}}$$

Identifying assumptions: $cov\left(u_{it}, v_{it}\right) = 0$, $cov(v_{it}, y_{i,t-1}) = cov\left(u_{it}, y_{i,t-1}\right) = 0$.

- Lagging y_{it}^P we have

$$\begin{aligned} y_{i,t-1}^P &= y_{i,t-2}^P + v_{i,t-1} \\ y_{i,t-2}^P &= y_{i,t-3}^P + v_{i,t-2} \\ y_{i,t-3}^P &= y_{i,t-4}^P + v_{i,t-3} \end{aligned}$$

Subbing into above expressions we have

$$y_{it} = \underbrace{v_{it} + v_{i,t-1} + v_{i,t-2} + \ldots + v_{i,0}}_{\text{Here we see permanent shocks accumulating}} + u_{it}$$

- So, take differences

$$y_{it} - y_{i,t-1} = v_{it} + u_{it} - u_{i,t-1}$$

or

$$\underbrace{y_{it}}_{\text{income today}} = \underbrace{y_{i,t-1}}_{\text{income last period}} + \underbrace{v_{it}}_{\text{permanent shock}} + \underbrace{u_{it}}_{\text{transitory shock}} - u_{i,t-1}$$

we can see that u is transitory because it gets subtracted off again next period.

Aside

Suppose we knew the variances of the shocks didn't change over time

$$\begin{aligned} u_{it} &\sim iid\left(0, \sigma_u^2\right) \\ v_{it} &\sim iid\left(0, \sigma_v^2\right) \end{aligned}$$

then if we have panel data on income, we can write

$$\begin{aligned} var\left(\Delta y_{it}\right) &= \sigma_v^2 + 2\sigma_u^2 \\ cov\left(\Delta y_{it}, \Delta y_{i,t-1}\right) &= \sigma_u^2 \end{aligned}$$

and use the data moments on the left to identify the variances on the right

- If, however, we are not willing to assume the variances are constant, we don't have enough information to separate the permanent and transitory components.

- With quadratic preferences

$$\Delta c_{it} = v_{it} + \frac{r}{1+r}\frac{1}{\rho_t}u_{it}$$

where $\rho_t = 1 - (1+r)^{-(T-t+1)}$

- Consumption responds one-for-one to permanent shocks
- Response to the transitory shock depends on the time horizon

Response to the transitory shock depends on the time horizon