Hall Reading Presentation

ECON2102 Week 8

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Random Walks and Stochastic Processes

- Imagine tossing a coin and walking forward if it lands heads, or backwards if it lands tails
  - Your *position* at any time is a function of the toss you made and your previous position
- $y_t = \lambda y_{t-1} + \epsilon_t$
- ϵ_t is *stochastic* (i.e. a random variable)
- Some process that evolves randomly, potentially with a trend ($\lambda \neq 1$)
- Can be used to model many economic variables, like income and consumption (fundamentally captures **serial correlation**)

Lifecycle Permanent Income Hypothesis

- Lifecycle theory of consumption (Modigliani): individuals plan their consumption based on their expected lifetime income
  - We aim to smooth consumption over our lifetimes, rather than it just being some fixed portion of our current income
- Permanent income hypothesis (Friedman): income is composed of *permanent* and *transitory* components
  - Transitory shocks can modelled stochastically
- Combining the two: if we aim to smooth consumption over our lives, then only changes in permanent income will alter consumption

LPIH: The Maths

- Consumers maximise $\mathbb{E}_t(\sum_{\tau=0}^{T-t} \frac{u(c_{t+\tau})}{(1+\delta)^\tau})$
- All with respect to the budget constraint that assets over their lifetime are zero (i.e. periods of consuming *more* than you earn balance out periods of consuming *less* than you earn)
- From this, Hall proves that $\mathbb{E}_t(u'(c_{t+1})) = \frac{1+\delta}{1+r}u'(c_t)$
  - Apart from the constants r and δ, the only factor affecting the *expected value* of consumption in the next period is consumption in this period

Our First Random Walk

- Hall's theorem: $\mathbb{E}_t(u'(c_{t+1})) = \frac{1+\delta}{1+r}u'(c_t)$
- Hence, $u'(c_{t+1}) = \gamma u'(c_t) + \varepsilon_{t+1}$
  - $\gamma = \frac{1+\delta}{1+r}$
- The marginal utility of consumption follows a random walk

Our Second Random Walk

- With some assumptions, Hall shows this applies, roughly, to consumption itself: $c_{t+1} = \lambda c_t + \varepsilon_{t+1}$
  - λ incorporates r and δ, and a few other things, and is roughly constant over a decade or two
- The parameter ε_t now captures **all new information that becomes available in period t about permanent income**
  - According to the LPIH, consumption only changes from alterations to permanent income, so this random variable represents those alterations, the new information

How to Test the LPIH

- Whole principle of this hypothesis is that consumption is impacted *only by previous consumption*, because consumers include all information about permanent income in that value
  - Any other variables, like y_{t-1}, shouldn't matter, because that is all taken account of in c_{t-1}
- So, compute $\mathbb{E}(c_t|c_{t-1}, \vec{x}_{t-1})$ (for a vector of any economic information $\vec{x}_{t-1}$); the impact of all non-consumption variables should be insignificant (F-test)
- Our hypothesis could be false if:
  - Consumers cannot smooth consumption over transitory fluctuations due to liquidity constraints or practical considerations
  - Or if permanent income is estimated by consumers as a distributed lag of past income

Testing the LPIH: Lagged Consumption

- Regression on the basic random walk of consumption with one lagged period gives R^2 of 0.9988
- But this just shows the serial correlation of consumption, which is obvious!
- We need to incorporate more variables and test whether or not they have a significant impact
- Adding further lags of consumption (back to c_{t-4}) is insignificant

Testing the LPIH: Lagged Income

- Adding lagged disposable income (back to y_{t-12}, working in quarters) is insignificant at the 5% level, but *only just*
- "There is a statistically marginal and numerically small relation between consumption and very recent levels of disposable income"
- Consumers may partly compute permanent income as a distributed lag of past income
- May be due to volatility in income
- *(Personally, I would love to see this investigated in different economic conditions and at different levels of wealth)*

Testing the LPIH: Lagged Stock Prices

- Including lagged stock prices as a measure of wealth (macroeconomically) *is* statistically significant!
- We've found a variable that contributes significantly to estimating consumption in the next period
- But adding more lags doesn't help, so only measures of wealth from the immediately preceding quarter are helpful

Theoretical Adjustment: LPIH 2.0

- Empirical evidence rejects the *pure* LPIH
- But suppose part of consumption takes time to adjust to a change in permanent income?
- Then, any variable correlated with permanent income in the previous period will have predictive power over today's consumption
- I.e. c_{t-1} accumulates data about permanent income changes in the previous periods, but does so with a lag, so variables like s_{t-1} (stock index) will be a bit ahead of it

Policy Implications

- No point in forecasting future income to predict future consumption, all information about future income is already incorporated into today's consumption (because consumers wish to smooth their consumption)
- Forecasts of next-quarter consumption can be improved by taking account of today's wealth (e.g. through stock indices), but this doesn't scale further into the future
- Consumption beyond the immediate future evolves according to a *random walk*, and should be treated as an exogenous variable
- **Policy affects consumption only as much as it affects permanent income**