EKN-812 Lecture 3

Intertemporal Choice; Demand for Durable Goods

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CV, EV, and Consumer Surplus

- consider the case of a price increase
- $EV = e(p_0, u_1) - e(p_0, u_0)$
  - old prices; new level of utility (*equivalent* variation)
- $CV = e(p_1, u_0) - e(p_0, u_0)$
  - new prices, old level of utility (*compensating* variation)
- remember:
  - $y = e(p_0, u_0) = e(p_1, u_1)$
  - these points lie on the Marshallian demand curve too
- write the differences in $e(p, u)$ as an integral under a Hicksian demand curve

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Proof That $\eta_i = 1$ for Homothetic Demands

- first, suppose that $u(x)$ is homogeneous of degree 1
  - this is stronger than we need: recall utility is ordinal
  - so we only need that there is some increasing f such that $f(u(x))$ is h.d. 1
- suppose $x^M(p, y_0) = x_0^* = \arg\max u(x)$ s.t. $px \leq y_0$
  - let $t > 0$ be given (say $t = 2$ for concreteness)
  - and let $x^M(p, ty_0) = x_1^* = \arg\max u(x)$ s.t. $px \leq ty_0$
- we know $v(p, ty_0) \geq tv(p, y_0)$ by feasibility
  - could always choose tx_0^*
- suppose the inequality is strict, so $v(p, ty_0) = u(x_1^*) > tu(x_0^*)$
  - then $t^{-1}x_1^*$ is feasible when $y = y_0$ (check this)
  - and $u(t^{-1}x_1^*) > v(p, y_0) = u(x_0^*)$ by assumption
  - then x_0^* was not optimal to begin with - a contradiction

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- interpretation: with u homogeneous,
  - if you can do better when rich (x_1^*) than just a scaled-up version of what you did when you were poor (x_0^*)
  - then, you should have chosen a scaled-down version of your choices when rich in the first place
- thus, we have shown that for all t and all y_0,

$$x^M(p, ty_0) \equiv x^M(p, y_0)$$

  - final step: differentiate wrt t and evaluate at $t = 1$

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Implications of Weak Separability

- say we have $u = u(x, v(y, z))$
  - (y, z) are weakly separable from x
- suppose p_y changes
  - conditional on v, there is a within-group substitution effect
  - the cost of v changes, inducing a substitution effect between (x, v)
  - this in turn gives us an income effect on v and thus on y and z
- example: suppose
  - $u(x, v) = x + \log(v)$
  - $v(y, z) = \min\{y, z\}$
  - normalize the price of x to unity
- first, compute the Hicksian demands
  - $y^H(p_y, p_z, v)$ and similarly for z^H
- what is the objective for the cost-minimization problem over (x, v)?

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- what is the objective for the cost-minimization problem over (x, v)?

Implications of Weak Separability

- say we have $u = u(x, v(y, z))$
  - (y, z) are weakly separable from x
- suppose p_y changes
  - conditional on v, there is a within-group substitution effect
  - the cost of v changes, inducing a substitution effect between (x, v)
  - this in turn gives us an income effect on v and thus on y and z
- example: suppose
  - $u(x, v) = x + \log(v)$
  - $v(y, z) = \min\{y, z\}$
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- suppose $y =$ cars and $z =$ fuel
  - would a tax on fuel and a subsidy to cars result in more or less traffic?
  - would people benefit from such a policy?
  - will spending on transport rise or fall?
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- suppose we have a two-period model
  - income in each period $t = 0, 1$ is y_t
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  - there is a capital market offering gross returns of $(1 + r)$
  - saving (possibly negative) is s_0
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- let $p = (1+r)^{-1}$ be the "market discount factor" (relative price of c_1)
- notice that, by the envelope theorem,

$$\frac{\partial u^*}{\partial p} = \lambda^* \cdot (y_1 - c_1^*)$$

- net borrowers are worse off when interest rates rise
  - conversely, borrowers benefit from lower interest rates
- net savers are better off when interest rates rise

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- suppose we have time-separable CRRA utility:

$$v(c_t) = \frac{c_t^{1-\gamma^{-1}}}{1-\gamma^{-1}}$$

- what is the MRS = MRT condition?
  - this is often called the "Euler equation"
- what can we say about the effect of interest rates on consumption over time?
  - here, γ is called the "elasticity of intertemporal substitution"
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  - for convenience, assume $\beta(1+r)=1$
  - can show that
$$\frac{\partial \log c_0}{\partial \log p} = \frac{py_1}{y_0+py_1} - (\gamma-1)\frac{p}{1+p}$$
  - what if y_1 is large relative to y_0?
- notice also that
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- this is a version of the "permanent income hypothesis"
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Life-Cycle Labor Supply

- suppose period-specific utility is

$$u(c_t, h_t) = \frac{c_t^{1-\eta}}{1-\eta} - \alpha \frac{h_t^{1+\gamma}}{1+\gamma}$$

  - here $\alpha > 0$ is some known constant
- suppose you live for T periods and face a given sequence of wages $w_0, w_1, \ldots$
  - if you can borrow and save freely at gross rate $1+r$, what is the budget constraint?
- from the first-order conditions
  - elasticity of substitution for labor supply in different periods is $1/\gamma$
  - people often call this the "Frisch elasticity of labor supply"
- these preferences are useful for studying "dynamic" or life-cycle labor supply
  - $\eta \geq 0$ governs the strength of income effects
  - γ governs the strength of substitution effects
  - see Keane (2011)

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- suppose we have some durable good S_t and a nondurable c_t
  - durables depreciate at rate δ and sell for v_t
  - and, some financial asset A_t with gross returns $1 + r$
- what is the one-period ahead budget constraint ("law of motion" for wealth)?
- suppose we have two periods and impose that $A_2 = 0$
  - this can be justified by $A_2 \geq 0$ (a no-Ponzi condition) + optimality
- what is the present-value form of the intertemporal budget constraint?
  - notice that

$$v_t^* = v_t - v_{t+1}\left(\frac{1-\delta}{1+r}\right)$$

  - this is called the *user cost* of durables: the implied rental rate
    - exactly analogous to nondurables
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