LABOR ECONOMICS

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Simple Model of Individual Labor Supply

What is effect of wage increase on labor supply? 
What is effect of taxes and transfers on labor supply? 
Puzzle to economists for two centuries

Simple Labor/Leisure Model, analyze via leisure demand,
Notation:  L (hrs leisure), M (hrs mkt work), C (cons. goods), p, & w
Preferences: U = U(L, C). Convex indiff curves. MRS(L,C) = U_L/U_C
Budget Constraint:  pC = wM = w(T-L)
Rewrite as pC + wL = wT. RHS is **full income**; LHS is "expenditures" on consumption and leisure. Note that "price" of leisure is w.
Choose L & C to Max \( V(L,C) = U(L,C) + \lambda(wL + pC - wT) \)

(1) \( \frac{\partial V}{\partial L} = U_L(L^*,C^*) + \lambda w = 0 \rightarrow U_L(L^*,C^*) = -\lambda w \)

(2) \( \frac{\partial V}{\partial C} = U_C(L^*,C^*) + \lambda p = 0 \rightarrow U_C(L^*,C^*) = -\lambda p \)

(3) \( \frac{\partial V}{\partial \lambda} = wL^* + pC^* - wT = 0 \)

Solution:

Divide (1) by (2) to get \( \frac{U_L(L^*,C^*)}{U_C(L^*,C^*)} = \frac{w}{p} \rightarrow \text{MRS}(L^*,C^*) = \frac{w}{p} \).

Choose L and C such that rate at which ind is willing to trade C for L = rate at which can trade.

Leisure demand function \( L^* = L(w/p) \)

Labor supply function \( M^* = T - L^* = M(w/p) \)

See graph for interior and corner solutions.
Comparative Statics-Individual Labor Supply

What happens to L* when exog inc or wage changes?

For changes in w, this is basic inc/subs effects

Will use method similar to comparative statics of labor demand.

Change in Exogenous Income – add Other Income (E) to budget constraint

Income effect (\(\partial L^*/\partial E\)): If leisure is normal, \(\partial L^*/\partial E > 0\), \(\partial M^*/\partial E < 0\).

EX: winning the lottery, pensions, married women’s labor supply

Not derived from theory, but likely signs

See graph
Comparative Statics (cont.)

**Change in Wage** to find $\partial L^*/\partial w$ and yield indiv labor supply curve

Tricky, b/c like any change in price, there are *income and substitution* effects, which are peculiar and potentially large in this case.

Recall typical inc/subst effect in consumer demand theory

Now apply to leisure demand.

Easy to see problem: if $w^\uparrow$, higher price of leisure, but richer. Conflicting effects on net change in leisure.

Note why diff from typical inc/subst effects analysis

Graphical version
Comparative Statics (cont.)

The **Slutsky Equation** – formal comparative statics of labor supply

Let \( L_U = L(w, E) \) be ordinary (“uncompensated”) demand for leisure

Let \( L_C = L(w, U) \) be compensated (utility constant) demand for leisure.

Let \( E(w, U) \) = expenditure function = minimum amount of non-labor income needed to reach utility level \( U \) at wage \( w \). Show. Can be shown that \( \frac{\partial E}{\partial w} = -M^* \).

Write as an identity: \( L_C(w, U) \equiv L_U(w, E(w, U)) \). Interpret.

Taking derivative wrt \( w \): \( \frac{\partial L_C}{\partial w} \equiv \frac{\partial L_U}{\partial w} + (\frac{\partial L_U}{\partial E}) \times (\frac{\partial E}{\partial w}) \)

Subst for \( (\frac{\partial E}{\partial w}) \) to get: \( \frac{\partial L_C}{\partial w} \equiv \frac{\partial L_U}{\partial w} - M(\frac{\partial L_U}{\partial E}) \)

Rearrange to get Slutsky Equation: \( \frac{\partial L_U}{\partial w} \equiv \frac{\partial L_C}{\partial w} + [M \times (\frac{\partial L_U}{\partial E})] \)
Slutsky Equation (cont.)

\[
\frac{\partial L_U}{\partial w} = \frac{\partial L_C}{\partial w} + [M \times (\frac{\partial L_U}{\partial E})]
\]

Total Effect = Subst Effect + Income Effect

\[
\frac{\partial L_C}{\partial w} < 0; \frac{\partial L_U}{\partial E} > 0; M \geq 0, \text{ so sign of } \frac{\partial L_U}{\partial w} \text{ is:}
\]

In terms of labor supply, \[
\frac{\partial M_U}{\partial w} = \frac{\partial M_C}{\partial w} + [M \times (\frac{\partial M_U}{\partial E})], \text{ where}
\]
\[
\frac{\partial M_C}{\partial w} > 0 \text{ and } \frac{\partial M_U}{\partial E} < 0
\]

Implications:

- if abs value \(\frac{\partial M_C}{\partial w} > [M \times \frac{\partial M}{\partial E}]\) (SE > IE) \(\rightarrow\) \(\frac{\partial M^*}{\partial w} > 0\)
- If abs val \(\frac{\partial M_C}{\partial w} < [M \times \frac{\partial M}{\partial E}]\) (SE < IE) \(\rightarrow\) \(\frac{\partial M^*}{\partial w} < 0\)
- No certain or definite conclusion, except in special cases.
Slutsky Equation—Extensions/Special Cases

\[ \frac{\partial M_U}{\partial w} = \frac{\partial M_C}{\partial w} + [M \times (\frac{\partial M_U}{\partial E})] \]

Income effect is a function of M so will become stronger as M↑.

If \( M = 0 \) (not working) \( \frac{\partial M_U}{\partial w} = \frac{\partial M_C}{\partial w} \geq 0 \) (pure subst effect).

Very important for understanding married women's labor force participation

Other Examples

- Backward-bending labor supply curve
- Overtime premium -- zero or weak income effect
- More generally, can analyze effects of any change by examining change in marginal wage rate and change in income at current labor supply.
Taxes, Transfers, and Individual Labor Supply

Taxes & transfers change ind’s net (after-tax) income and wage rate. Produce income and subst effects that may be very strong, sometimes conflicting, but sometimes reinforcing.

Basic analysis of inc/subst effects applies.

Taxes: increase lowers net wage, but also lowers income @ current M*.

Transfers: Typical Means-Tested transfer, where Benefit=B(Income) and B’< 0

\[ B = G - twM, \text{ where } G = \text{guarantee, } E = \text{Earnings, and } t = \text{benefit reduction rate} \]

\[ \rightarrow \frac{\partial B}{\partial M} = -tw. \]

Total Family Income is \( Y = B + E = G - twM + wM = G + (1-t)wM. \)

Show budget constraint

Inc/subst effects
Taxes and Transfers (cont.)

Tax rate increase lowers net wage, but also lowers net (after-tax) income @ current M*.

Causes potentially conflicting inc/subst effects

Details

Proportional taxes - just like a wage change, if effective from 1\textsuperscript{st} hour worked.

Progressive tax system more complex, but can always examine whether ind is richer/poorer @ current M (for income effect) and/or has higher/lower after-tax wage rate (subst effect).

Examples
Transfers in US: TANF & EITC

**TANF**: “welfare” – cash assistance to poor families with children. Limited duration, not particularly generous. Delaware: $338/month, family of 3

**Structure**: $t=0.67$. Expect very severe labor supply effects

**EITC**: subsidy to working families with low-to-moderate earnings, operates through tax system. Refundable tax credit. Combines wage subsidy @ low earnings levels with means-tested tax @ higher.

Details of EITC benefit regimes:

- **Phase-In**: If $E_i < E^*$, $B=s(N)E_i$, where $s$ is subsidy rate and depends on family size $(N)$
- **Constant**: If $E^* < E_i < E^{**}$, $B=sE^*$
- **Phase-Out**: If $E_i > E^{**}$, $B=sE^* - t(E_i - E^{**})$
## EITC Parameters, Married Couples, US 2012

<table>
<thead>
<tr>
<th>Number of Children</th>
<th>Maximum EITC Amount</th>
<th>Subsidy Rate</th>
<th>E*</th>
<th>E**</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Children</td>
<td>$475</td>
<td>7.6%</td>
<td>$6,210</td>
<td>$12,980</td>
</tr>
<tr>
<td>One</td>
<td>$3,169</td>
<td>34%</td>
<td>$9,320</td>
<td>$22,300</td>
</tr>
<tr>
<td>Two</td>
<td>$5,236</td>
<td>40%</td>
<td>$13,090</td>
<td>$22,300</td>
</tr>
<tr>
<td>Three or More</td>
<td>$5,891</td>
<td>45%</td>
<td>$13,090</td>
<td>$22,300</td>
</tr>
</tbody>
</table>

2011: 27.4 million households received $60.4 billion
EITC Labor Supply Effects

Depending on which portion of EITC benefit schedule $\text{ind}$ is operating:

**Phase-in:** $s > 0 \rightarrow$ equivalent to wage increase $w \text{ inc}/\text{subst effects}$. Strong positive effect on non-participants.

**Constant:** income effect only; negative effect on labor supply.

**Phase-out:** exactly like means-tested transfer program, but benefit reduction rate is not as severe. Indiv is “richer” ($\text{credit} > 0$) and has lower after-tax wage $= w \times (1 - t)$
EITC (cont.)