Graduate Labor Economics

Labor Supply Introduction

ScPo, Spring 2018

Based on Cahuc et al. (2014); Blundell et al. (1998); Keane (2011)

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Introduction

Agenda

1. Why should we talk about Labor Supply?
2. Some facts about participation in works and hours supplied.
3. Present static and lifecycle versions of neoclassical labour supply.
4. Look at some empirical applications.

Keane (2011)

- Keane (2011) surveys the vast LS literature.

- Why study LS to start with? Efficient tax design, Mirrless (1971)

  1. Government needs to raise to pay for public goods (+)
  2. Taxing labor income causes people to work less (–)

- There is a $\boxed{\text{lot of disagreement}}$ about the size of elasticities. This is of first order importance: if small, efficiency cost of tax is small.

  - **Male:** majority of studies find small elasticity of tax on LS.
  - **Female:** large elasticities, particularly on **participation margin**.

Keane (2011)

- Imagine **progressive income tax**. What is optimal rate in top bracket?
- Assume govt and society places no value on extra dollar of income for top bracket. (the 1%).
- Government wants to maximize tax revenue.
- This is the xase studied in Saez et al. (2012):

$$\tau = \frac{1}{1 + a \cdot e}$$

with

1. e *labor supply elasticity*: % increase in LS after 1% increase in $w(1-\tau)$
2. $a = \frac{z_m}{z_m - z}$ *pareto parameter*: inverse measure of income inequality within top bracket (starting at z\$ and mean z_m)

Example of importance of LS elasticity

- Many estimates of a put it at around 2.
- What happens to the optimal tax rate if we vary e?

TABLE 1
OPTIMAL TOP BRACKET TAX RATES FOR DIFFERENT LABOR SUPPLY ELASTICITIES

Labor supply elasticity (e)	Optimal top-bracket tax rate (τ)		
	$a = 1.50$	$a = 1.67$	$a = 2.0$
2.0	25%	23%	20%
1.0	40%	37%	33%
0.67	50%	47%	43%
0.5	57%	54%	50%
0.3	69%	67%	63%
0.2	77%	75%	71%
0.1	87%	86%	83%
0.0	100%	100%	100%

Note: These rates assume the government places essentially no value on giving extra income to the top earners.

Example with Flat Rate Tax

Now imagine the same experiment with a **flat rate tax**, i.e. the same rate for all income starting at 0$ of income.

- We have $z = 0$ and $a = \frac{z_m}{z_m} = 1$, hence

$$\tau = \frac{1}{1+e}$$

- It's instructive to derive this equation:

$$\begin{aligned}
\ln(h) =& e\ln(w(1-\tau)) \\
h =& [w(1-\tau)]^e \\
R =& (wh)\tau \text{ (Tax Revenue)} \\
=& (w[w(1-\tau)]^e)\tau \\
\frac{dR}{d\tau} =& \underbrace{w[w(1-\tau)]^e}_{>0} - \underbrace{ew^2[w(1-\tau)]^{e-1} \cdot \tau}_{<0}
\end{aligned}$$

Example with Flat Rate Tax

TABLE 2
REVENUE MAXIMIZING FLAT TAX RATES GIVEN DIFFERENT LABOR SUPPLY ELASTICITIES

Elasticity (e)	Optimal tax rate (τ)	
	$g = 0$	$g = 0.5$
2.0	33%	20%
1.0	50%	33%
0.67	60%	43%
0.5	67%	50%
0.3	77%	63%
0.2	83%	71%
0.1	91%	83%
0.0	100%	100%

Basic Definitions.

- The **Labor Force** are all who are working (whatever the details), or who are looking for a job.
- The **Unemployed**[ILO] are
    - without work,
    - currently available for work,
    - seeking work.
- The **Participation Rate** is Labor Force over working-age population (15-64 years)

Trends in Hours Worked and Labor Productivity

subtitle

- Over the last 40 years, people worked fewer hours on average. `graph`
- In the last 100 years we see large increases in labor productivity. People work less *and* earn more. `graph`
- Male participation has decreased everywhere `Graph`
- Female participation has increased almost everywhere `graph`

Female Labour Supply

- Participation increased particularly amoung married women. `Table`
- The incidence of low paying jobs for women is decreasing. `Graph`
- The majority of countries still have more women in part time work. `Table`
- The gender wage gap is still there. `Graph`

Trends in Leisure

- Male work hours decreased. Where did those hours go?
- Male Leisure is roughly constant in last 50 years, but home work goes up. `Graph`
- Female Leisure experienced ups and downs. `Graph`

Neoclassical Labour Supply

Preferences

- The trade-off between consumption and leisure is based upon the utility function of each individual
  - $U(C, L)$ is the utility function, **increasing** in both C and L (consumption of goods and leisure).
  - L_0 designates the total amount of time that an individual disposes
  - $h = L_0 - L$ is the length of time worked
- The set of consumption and leisure by which the consumer obtains a given level of utility $\overline{U}$, is called an *indifference curve*.

Indifference Curve

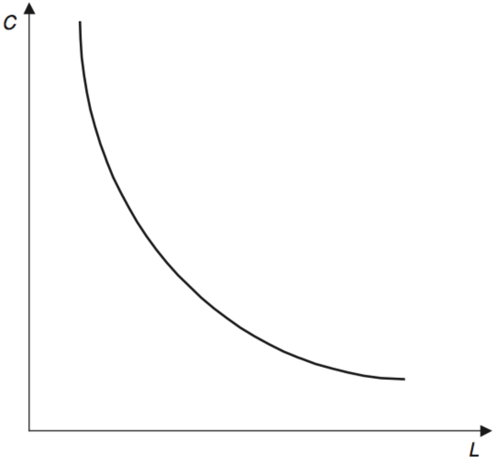

Figure 1.10
An indifference curve, where C = consumption of goods and L = leisure.

Choices

Choices

- The budget constraint of an agent is:

$$C + wL \leq R_0 \equiv \underbrace{wL_0 + R}_{\text{potential income}}$$

  - w is the real hourly wage
  - $wh = w(L_0 - L)$ represents total income
  - R is the income that an individual may acquire outside the labor market

- Thus the problem of the consumer becomes:

$$\max_{\{C>0, L\leq L_0\}} U(C, L) \quad \text{subject to} \quad C + wL \leq R_0 \tag{1}$$

Lagrangian

We ignore $C > 0$ and set the BC to $C + wL = R_0$ by assuming $\frac{\partial U}{\partial C} > 0$. Then the Lagrangian writes

$$\mathcal{L} = U(C,L) - \lambda[C + wL - R_0] - \mu[L - L_0] \tag{2}$$

$$\frac{\partial \mathcal{L}}{\partial C} = 0 \implies \frac{\partial U}{\partial C} = \lambda \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial L} = \frac{\partial U}{\partial L} - \lambda w - \mu \begin{cases} = 0 \text{ if } L_0 - L > 0 \Rightarrow \mu = 0 \\ > 0 \text{ if } L_0 - L = 0 \Rightarrow \mu > 0 \end{cases} \tag{4}$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = 0 \implies C + wL = R_0 \tag{5}$$

- Kuhn-Tucker condition , $\mu \geq 0, \mu \cdot (L_0 - L) = 0$ on (4)
- (4) with equality if $L_0 - L = 0 = h$, otherwise $\mu = 0$.

Solving the Lagrangian

- Solving (3),(4) and (5) yields the **Marshallian demand functions**:
    - $C^*(w, R_0)$: optimal consumption given wage and other income.
    - $L^*(w, R_0)$: optimal leisure (or $h^* = L_0 - L^*(w, R_0)$ optimal hours.)

- Divide (4) by (3) for the marginal rate of substitution between L and C,

$$\text{MRS}_L(C^*, L^*) \equiv \frac{U_L(C^*, L^*)}{U_C(C^*, L^*)} = w \tag{6}$$

  which defines the an **interior** solution, $L^* \in (0, L_0)$.

- The **participation decision** comes from a corner solution, i.e.

$$\text{if MRS}_L(C, L_0) \begin{cases} < w & \text{then work } L_0 \text{ hours} \\ = w_R & \text{then indifferent} \\ > w & \text{then don't work} \end{cases}$$

  and w_R is called the **reservation wage**.

Reservation Wage

- Take $U(C,L) = C^{\alpha}L^{1-\alpha}$
- Recall

$$w_R = \text{MRS}_L(R, L_0) = \frac{1-\alpha}{\alpha}\frac{R}{L_0} \tag{7}$$

- Given preferences (α) R is **only** determinant of participation.
- If leisure is a $\boxed{\text{normal good}}$, then $\frac{dw_R}{dR} > 0$.

Interior Solution

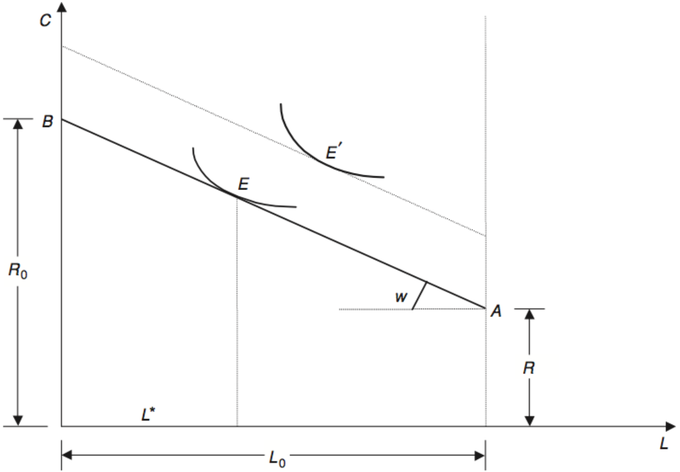

FIGURE 1.11
The trade-off between consumption C and leisure L.

Substitution effect and income effect

- How does Marshallian leisure demand $L^*(w, R_0)$ react to wage changes?

- Recall that $R_0 = wL_0 + R$

$$\frac{dL^*(w,R_0)}{dw} = \underbrace{\frac{\partial L^*(w,R_0)}{\partial w}}_{\text{substitution effect}} + \underbrace{\frac{\partial L^*(w,R_0)}{\partial R_0}\frac{\partial R_0}{\partial w}}_{\text{income effect}}$$

- i.e. we need to work out relative magnitudes of income and substitution effects before we can sign this derivative.

- note that $\frac{\partial R_0}{\partial w} = L_0 > 0$ by definition.

- Suppose wage increases from w to w_1

  1. Let's fix potential income at original level R_0 to get **compensated** non-earned income $R_c = R - (w_1 - w)L_0$. We **compensate** to keep Utility constant.
  2. Then we'll let potential income grow from R_0 to R_1.

Substitution effect and income effect

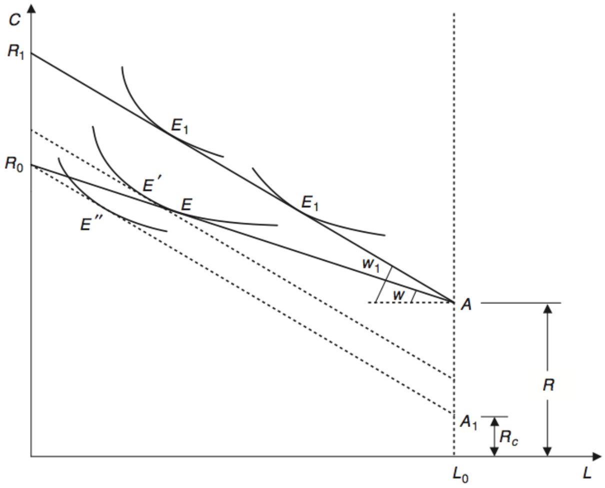

FIGURE 1.12
The effects of a wage increase.

Duality: Hicks demand functions

Setting up the corresponding expenditure minimization problem to (1) means

$$\min_{\{C>0, L\leq L_0\}} C + wL \quad \text{subject to} \quad U(C,L) \geq \overline{U} \tag{8}$$

giving us the **Hicksian demand functions**:

- $C^H(w, \overline{U})$: optimal consumption given wage and desired utility level.
- $L^H(w, \overline{U})$: optimal leisure and $h^H = L_0 - L^H(w, \overline{U})$ optimal hours.

Elasticities

- The Hicksian or $\boxed{\text{compensated}}$ elasticity is:

$$\eta_H = \frac{w}{h^H}\frac{dh^H}{dw} \tag{9}$$

which is like moving from E to E'

- The Marshallian or $\boxed{\text{non-compensated}}$ elasticity is:

$$\eta_M = \frac{w}{h^*}\frac{\mathrm{d}h^*}{\mathrm{d}w} \tag{10}$$

which is like moving from E to E_1

Slutzky Equation

- These two elasticities are linked by the Slutsky equation:

$$\eta_M = \underbrace{\eta_H}_{\text{subst. effect } >0} + \underbrace{\frac{wh^*}{R_0}\eta_{R_0}}_{\text{income effect } <0 \text{ if L normal}} \tag{11}$$

- Where η_{R_0} represents the Marshallian elasticity of labor supply with respect to potential income.

- This equation shows that Marshallian elasticity is the sum of substitution effect (i.e. Hicksian elasticity), and income effect.

- I.e. if $\boxed{\text{leisure is normal}}$, we have a **negative** income effect, hence

$$\eta_M < \eta_H$$

Recap: Income and Substitution Effect

Consider $\uparrow w$:

- Income Effect: you are better off, assuming leisure is not inferior, because you can buy more leisure. So you work less.
- Substitution Effect: the relative price of leisure just got higher. So you substitute away from the now more expensive good and towards more labor. You work more.
- Income and Substitution Effect thus work in opposite directions. LS response is $\boxed{\text{ambiguous}}$.
- Contrast that with the price increase of a consumer good!

Labor Supply Curve

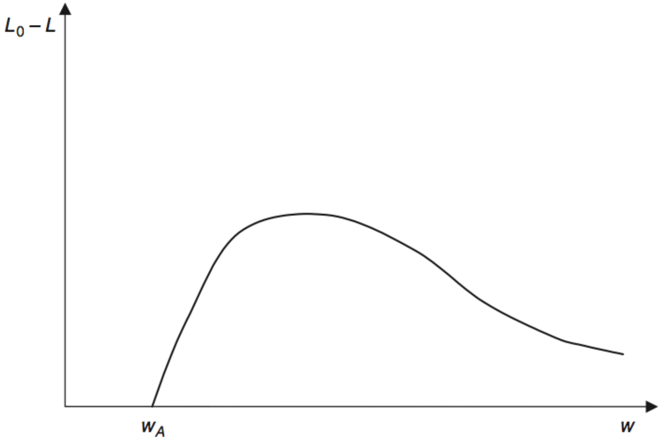

FIGURE 1.13
The individual labor supply.

Limitations

- Form of budget constraint: often piecewise linear because of taxes.
- Fixed costs of working
- inflexible choice of hours.

Life cycle and retirement

- The dynamic theory of labor supply gives a central role to the possibility of substituting for consumption and leisure over time

A dynamic model of labor supply

- Consumer makes his choice over a "life cycle"
- We assume that the utility function is temporally separable. Hence, it is written: $$\sum_{t=0}^{t=T} U(C_t, L_t, t)$$
- The influence of past consumption on the utility of the current period is neglected
- Besides, training increases the human capital and raises the wage-earning prospects, so there must be trade-offs among leisure, working time and time dedicated to training

Intertemporal labor supply

- In this model, we assume the opportunity to save, with r_t the real interest rate
- The evolution of the assets of the consumer is described by:

$$A_t = (1 + r_t)A_{t-1} + B_t + w_t(1 - L_t) - C_t \tag{12}$$

  - A_t designates the consumer's assets
  - B_t designates his income apart from wages
- This equation signifies, at each period t
  - The increase in wealth is due to income from wage labor, $w_t(1 - L_t)$, to income $r_t A_{t-1}$ from savings, and to other income B_t
  - Consumption C_t for the period has to be deducted from these gains
  - The *non-earned* income R_t for the period t is equal to $B_t + r_t A_{t-1}$

Optimal Solutions

- Write down the lagrangian for this problem! Call ν the multiplier.
- First order conditions are

$$U_C(C_t, L_t, t) = \nu_t \text{ and } U_L(C_t, L_t, t) = \nu_t w_t$$
$$\nu_t = (1 + r_{t+1})\nu_{t+1}$$

- At interior solutions, we have:

$$C_t = C(w_t, \nu_t, t), \quad L_t = L(w_t, \nu_t, t) \quad \text{and}$$
$$h_t^F(w_t, \nu_t, t) = 1 - L(w_t, \nu_t, t)$$

- Notice that we have **three different** labor supply functions now:
  1. **Marshallian**: $h^*(w_t, R_t)$
  2. **Hicksian**: $h^H(w_t, \overline{U})$
  3. **Frisch**: $h^F(w_t, \nu_t, t)$

Marginal Utility of Wealth

- According to the FOCs, successive iterations of the logarithms of equation of ν_t entail:

$$\ln \nu_t = \underbrace{- \sum_{\tau=1}^{\tau=t} \ln(1 + r_\tau)}_{\text{common time effect}} + \underbrace{\ln \nu_0}_{\text{personal fixed effect}} \tag{13}$$

- A priori, the value of ν_0 depends on all the wages received by an individual during his lifetime
- The resulting **Frisch elasticity** informs us about impact of transitory wage variation that has a small impact on wealth.
- How much more will I work at t when I observe Δw_t, knowing that my ν_t (and total wealth) stays the same?

Comparing Elastisticies

Frischian vs Hicksian vs Marshallian.

- We know already that if L is normal, then $\eta_M < \eta_H$
- How does η_F enter this relationship?
- Replace R by intertemporal wealth

$$\Omega = \sum_{t=0}^{T} (1 + r_t)^{-t} (w_t + B_t) > 0$$

Can show:

1. $$\eta_M = \eta_F + \frac{w_t h_t}{\Omega} (1 - \gamma \eta_\Omega)$$

2. $$\eta_F = \eta_H + \underbrace{\frac{w_t h_t}{\Omega} (\eta_\Omega)^2}_{>0}$$

Frischian vs Hicksian vs Marshallian Elasticities

Let's line up our elasticities:

$$\eta_F \geq \eta_H \geq \eta_M, \text{ or}$$

$$\frac{\partial h^F(w_t, \overline{U})}{\partial \ln w_t} \geq \frac{\partial h^H(w_t, \overline{U})}{\partial \ln w_t} \geq \frac{\partial h^*(w_t, R_t)}{\partial \ln w_t}$$

- crucial: absent income effects, they are **all identical!**
- Specification of preferences is important:
  - Quasilinear preferences: no income effect at all.
  - Log consumption: income and substitution effects exactly cancel.

The Problem

We face several simultaneity issues in trying to establish

$$w \Rightarrow h$$

i.e. the **causal** relationship of wages on hours worked.

- The **correlation** between wages and hours worked does not necessarily indicate a causal relation.

    1. People with a $\boxed{\text{strong taste for work}}$ could get higher wages (because more motivated) and work longer hours (same reason): $\uparrow w \nRightarrow \uparrow h$.
    2. Or, the same kind of people could get **lower net hourly wages** because of progressive taxation. We would see a negative correlation in hourly wages and hours worked: $\uparrow w \nRightarrow \uparrow h$.

- Solutions: (quasi-) experimental settings and fully structural models.

The Goal

- As seen in Keane (2011), we want an estimate of the **wage elasticity** of labor supply.
- But *which* elasticity exactly? We have three of them!
- This depends on the model assumed. Different types of underlying preferences give rise to different estimation equations.
- We will look at a couple of approaches now.

A typical estimation equation

- Relates hours h_t worked by a given individual at hourly wage w_t at each date t.

$$\ln h_t = \alpha_w \ln w_t + \alpha_R R_t + \mathbf{x}_t \boldsymbol{\theta} + \varepsilon_t \tag{14}$$

  - R_t is a measure of income other than the current wage
  - $\mathbf{x}_t$ is a vector describing individual characteristics
  - $\boldsymbol{\theta}$ is a vector comprising parameters to be estimated
  - α_w and α_R are also parameters to be estimated
  - ε_t a random term reflecting unobserved individual heterogeneity

- α_w measures **wage elasticity** of labor supply. Interpretation of it depends on the assumed model.

Estimating Frischian Elasticities

- **Frisch Elasticity**: change in h_t as result of change in w_t, holding marginal utility of wealth constant.

- Assuming constant r_t, set $\ln v_t = \ln v_0 + \rho t$ in (13) and substitute for R. Then take first differences:

$$\Delta \ln h_t = \rho + \alpha_w \Delta \ln w_t + \Delta \mathbf{x}_t \boldsymbol{\theta} + \Delta \varepsilon_t \tag{15}$$

- This allows to estimate the impact of a **transitory** change in wage.

- It does not allow us to evaluate the impact of a change in the overall wage profile, because this change causes the marginal utility of wealth to vary.

Estimating Hicksian and Marshallian Elasticities

Two-stage budgeting: separate intraperiod from intertemporal decisions.

1. in each t define potential income R_t and maximize utility s.t. $C_t = R_t + w_t h_t$ where

$$R_t = (1 + r_t)A_{t-1} + B_t - A_t$$

   which yields the same solution as in the static case, $h^*(w, R_t)$, defining value function $V(R_t, t)$

2. Solve for optimal path of A_t in

$$\max_{A_t} \sum_{t=0}^{T} V(R_t, t) \text{ s.t. } R_t = (1 + r_t)A_{t-1} + B_t - A_t$$

Estimation of Hicksian and Marshallian Elasticities

- Empirically, can set $R_t = C_t - w_t h_t$ if we observe consumption in (14):

$$\ln h_t = \alpha_w \ln w_t + \alpha_R (C_t - w_t h_t) + \mathbf{x}_t \boldsymbol{\theta} + \varepsilon_t \tag{16}$$

- Then $\frac{\partial \ln h}{\partial \ln w} = \alpha_w$ is the **Marshallian** elasticity: effect of a permanent wage change while non-earned income is held constant.

- Remember the Slutzky Equation (11):

$$\alpha_w = \eta_M = \eta_H + \frac{wh}{R} \eta_R \tag{17}$$

- Now we want to relate

$$\alpha_R = \frac{\partial \ln h}{\partial R} \quad \text{with} \quad \eta_R = \frac{\partial \ln h}{\partial \ln R} \frac{R}{h}$$

Estimation of Hicksian and Marshallian Elasticities

- It is easy to see that

$$\frac{\partial \ln h}{\partial R} wh = \alpha_R wh \Longleftrightarrow \eta_R \frac{wh}{R} = \underbrace{\frac{\partial \ln h}{\partial \ln R} \frac{R}{h}}_{\eta R} \frac{wh}{R}$$

- Plugging that into (17) we find the **Hicksian Elasticity** as

$$\eta_H = \alpha_w - \alpha_R wh$$

- Note that $\eta_H > \eta_M = \alpha_w$ if $\alpha_R < 0$, i.e. if leisure is a **normal good**.

- Let's now turn to how to estimate those objects.

- Introduction
- Neoclassical theory of labor supply
  - The choice between consumption and leisure
  - Life cycle and retirement
- Empirical Aspects of Labor Supply
  - Estimation of Structural Parameters
  - Blundell, Duncan and Meghir (ECTA 1998)
  - Some Highlights from the Literature
- Summary and conclusion

Blundell, Duncan and Meghir (ECTA 1998) [BDM]

- Use UK tax reforms to overcome difficult simultaneity problems plaguing labor supply models.
- Nonlinear tax-schedules, unobserved differences in tastes over leisure and consumption, intertemporal decisions mixed with intratemporal ones.
- E.g. *hard workers* face higher tax rates and thus supply lower hours. This biases wage effect downwards.
- **Tax reform** exogenously changes after-tax wage – bypassing those issues.
- BDM propose a *lifecycle-consistent* approach together with an IV strategy.

BDM: Tax Reforms by Cohort

TABLE II

MARGINAL TAX RATES BY FINANCIAL YEAR, EDUCATION, AND COHORT

	Compulsory Education				Post-compulsory Education				
	< 1940	1940–49	1950–59	1960 +	< 1940	1940–49	1950–59	1960 +	Total
Financial Year									
1978/79	0.29	0.25	0.31	·	0.37	0.31	0.35	·	0.29
1979/80	0.28	0.24	0.26	·	0.32	0.29	0.32	·	0.27
1980/81	0.29	0.24	0.27	·	0.30	0.26	0.34	·	0.28
1981/82	0.29	0.24	0.28	0.31	0.33	0.28	0.33	·	0.28
1982/83	0.27	0.23	0.25	0.36	·	0.30	0.33	·	0.27
1983/84	0.26	0.23	0.24	0.32	·	0.29	0.29	·	0.26
1984/85	0.28	0.21	0.22	0.31	0.30	0.29	0.31	·	0.26
1985/86	0.29	0.24	0.21	0.32	·	0.26	0.30	0.37	0.27
1986/87	0.27	0.23	0.23	0.31	·	0.27	0.30	0.35	0.27
1987/88	0.24	0.23	0.22	0.28	·	0.30	0.30	0.31	0.26
1988/89	0.23	0.22	0.20	0.24	·	0.25	0.26	0.31	0.24
1989/90	0.23	0.25	0.21	0.23	·	0.29	0.26	0.29	0.25
1990/91	0.24	0.25	0.22	0.24	·	0.27	0.26	0.30	0.25
1991/92	0.24	0.26	0.22	0.24	·	0.29	0.27	0.29	0.25
1992/93	0.25	0.27	0.23	0.25		0.27	0.26	0.28	0.26
Total	0.27	0.24	0.24	0.27	0.33	0.28	0.30	0.30	0.26

Note: Cells with a full stop denote either empty cells or cells that were excluded because the number of observations was less than 50.

Blundell et al. (1998)

- The basic idea of BDM is to net out the endogenous changes from wage variations
- The authors first group the individual data by cohort and education
- They construct group means of hours and wages
- Separately, they calculate the means for each group over all periods and the means for each period over all groups
- Then they subtract these groups and period means from the group means calculated in each period
- After this operation, unobserved time-invariant group factors that could influence wage levels and that could also be related to hour levels are eliminated

BDM Diff-in-Diff Setup

- Consider (14) but forget about non-earned income for simplicity:

$$h_{it} = \alpha + \alpha_w \ln w_{it} + \varepsilon_{it} \tag{18}$$

  - $g = T$ is treated group, i.e. affected by tax reform
  - $g = C$ is control group.
- **Identifying assumption:** Common Trend

$$\mathbb{E}\left[\varepsilon_{it} | g, t\right] = \eta_g + m_t \text{ for all } g \text{ and } t \tag{19}$$

  - η_g is a time-invariant group effect and m_t a period effect common to all groups

BDM Estimation

- Conditiong on group and taking first differences of (18):

$$\Delta\mathbb{E}\left[h_{it}|T,t\right] = \alpha_w \Delta\mathbb{E}\ln\left[w_{it}|T,t\right] + \Delta m_t$$
$$\Delta\mathbb{E}\left[h_{it}|C,t\right] = \alpha_w \Delta\mathbb{E}\ln\left[w_{it}|C,t\right] + \Delta m_t$$

- The parameter of interest α_w is identified via

$$\alpha_w = \frac{\Delta\mathbb{E}[h_{it}|T,t] - \Delta\mathbb{E}[h_{it}|C,t]}{\Delta\mathbb{E}[\ln w_{it}|T,t] - \Delta\mathbb{E}[\ln w_{it}|C,t]} \tag{20}$$

- Using sample analogs, we implement

$$\widehat{\alpha}_w = \frac{\Delta\bar{h}_t^T - \Delta\bar{h}_t^C}{\Delta\overline{\ln w}_t^T - \Delta\overline{\ln w}_t^C}$$

BDM estimation for groups

- This is easy to generalize to g groups.
- just condition on g as well:

$$\mathbb{E}\left[h_{it}|g,t\right] = \alpha + \alpha_w \mathbb{E}\ln\left[w_{it}|g,t\right] + \; m_t + g_t \tag{21}$$

- This is easiest implemented with weighted least squares. We estimate

$$\overline{h}_{gt} = \alpha + \alpha_w \overline{\ln w}_{gt} + \; m_t + g_t + \nu_{gt} \tag{22}$$

where $E[\nu_{gt}|w] = 0$ and each group is weighted by its relative size.

BDM: What about Participation?

- One concern comes from the decicion to participate P_{it}.
- Remember common trend (19): $\eta_g + m_t$ should account for compositional changes.
- Very unlikely. E.g. a positive macro shock m_t will cause more people to participate.
- Augment (19):

$$\mathbb{E}\left[\varepsilon_{it} | g, t, P_{it}\right] = \eta_g + m_t + \delta\lambda_{gt} \tag{23}$$

where λ_{gt} is the inverse Mills ratio at $\Phi^{-1}(L_{gt}), L_{gt}$ being participation rate of group g in t.

BDM: Other Extensions

- Non-Earned income
- Kinks in tax schedule (include another selection term)

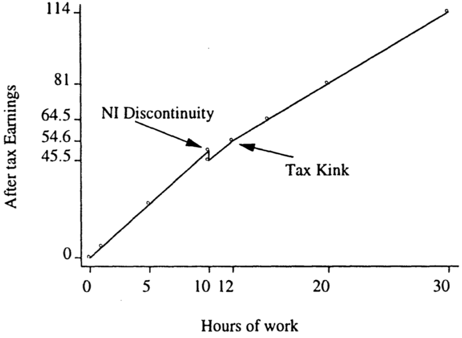

FIGURE 1.—The budget constraint (illustrated for NI rate 9%, tax rate 25%, pre-tax wage £5).

BDM: Implementation – Groups

- 2 Education groups
- four cohorts: born 1930-39,1940-49, 1950-59 and 1960-69
- Hence, there are 8 groups (those are the instrumental variables here.)

They estimate with OLS

$$h_{it} = \eta_g + m_t + \theta' DK_{it} + \beta \ln w_{it} + \gamma \mu_{it} \\ + \delta^w \hat{v}^w_{it} + \delta^\mu \hat{v}^\mu_{it} + \delta^T \hat{v}^T_{it} + e_{it}$$

where DK are demographics, $\mu_{it} = c_{it} - w_{it} h_{it}$, the δ's are residuals from probit for participation, other income, and ordered probit for tax kink.

BDM: Data

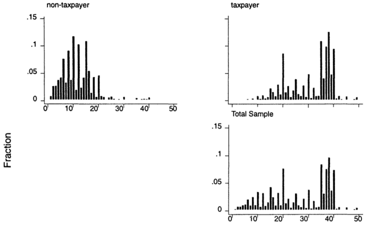

FIGURE 2.—Hours of work by taxpayer status.

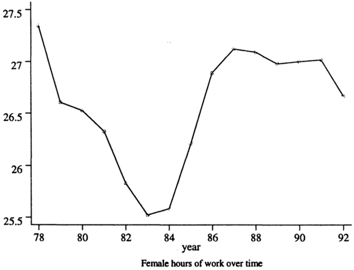

FIGURE 3

- UK FES data 1978-1992, married/co-habitating women aged 20–50 with employed partners.
- 24626 women, 16781 work.
- $E[h] \approx 26$ hours/week
- c measured as weekly nondurable consumption.

BDM: Results

TABLE IV

ELASTICITIES: GROUPING INSTRUMENTS: COHORT AND EDUCATION

	Wage	Compensated Wage	Other Income	Group Means: Hours	Wage	Income
No Children	0.140	0.140	0.000	32	2.97	88.63
	(0.075)	(0.088)	(0.041)			
Youngest Child 0–2	0.205	0.301	−0.185	20	3.36	129.69
	(0.128)	(0.144)	(0.104)			
Youngest Child 3–4	0.371	0.439	−0.173	18	3.10	143.64
	(0.150)	(0.159)	(0.139)			
Youngest Child 5–10	0.132	0.173	−0.102	21	2.86	151.13
	(0.117)	(0.127)	(0.109)			
Youngest Child 11 +	0.130	0.160	−0.063	25	2.83	147.31
	(0.107)	(0.117)	(0.084)			

Note: Asymptotic standard errors in parentheses.

BDM: Results

- All wage elasticities are positive, highest for women with youngest kids.
- All income elasticities are negative
- Hence, all Hicks elasticities are positive.
- Implies that taxation does have **an efficiency cost**: lower post tax wage, lower hours.
- However, elasticites wrt participation are important, and is missing here.

Highlights - Form of labor supply

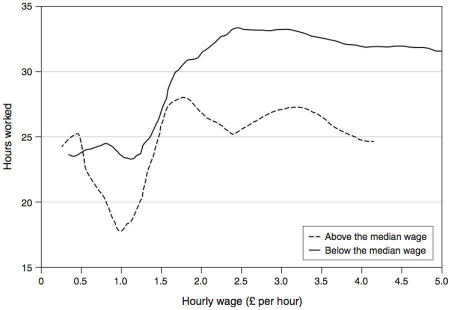

FIGURE 1.16
The labor supply of single mothers.

Source: Blundell et al. (1992).

- Blundell et al (1992) use UK FES data on single mother
- Split sample along high/low **non-earned income**
- Hump-shaped for low non-earned income.

Highlights – Extensive vs intensive margin elasticities

- Extensive-margin elasticity is generally larger than intensive-margin elasticity

- Two reasons explain this result:

  1. **Indivisible Labor**: changes in tax or wage rates are compatible with large extensive-margin responses, even if they have little effect on hours conditional on employment

  2. **Optimization Frictions**: Firm-internal constraints may make adjustment of hours very costly. Workers may have to change jobs to get better-suited timetable

Highlights – Micro vs Macro elasticities

- **Aggregate hours elasticity** is the sum of the extensive and intensive elasticities.
- Chetty et al. (2011b) conducted meta analysis of many studies.
- Micro and Macro estimates of Hicksian elasticities are consistent.
- However, **Frisch** elasticities do not: estimates are small when based on micro evidence but large when based on macro studies.

Highlights – Micro vs Macro elasticities

		Intensive Margin	Extensive Margin	Aggregate Hours
Steady State (Hicksian)	micro	0.33	0.26	0.59
Steady State (Hicksian)	macro	0.33	0.17	0.50
Intertemporal Substitution (Frisch)	micro	0.54	0.28	0.82
Intertemporal Substitution (Frisch)	macro	[0.54]	[2.30]	2.84

Table: Micro vs. Macro Labor Supply Elasticities. Each cell shows a point estimate of the relevant elasticity based on meta analyses of existing micro and macro evidence.

Micro estimates are identified from quasi-experimental studies; macro estimates are identified from cross-country variation in tax rates (steady state elasticities) and business cycle fluctuations (intertemporal substitution elasticities). The aggregate hours elasticity is the sum of the extensive and intensive elasticities. Macro studies do not always decompose intertemporal aggregate hours elasticities into extensive and intensive elasticities. Therefore, the estimates in brackets show the values implied by the macro aggregate hours elasticity if the intensive Frisch elasticity is chosen to match the micro estimate of 0.54.

Source : Chetty et al. (2011, Table 1, p. 2).

Highlights – Micro vs Macro elasticities

Two possibilities:

1. **Micro** estimates are based on models that abstract from important factors that would increase the Frisch response.
2. **Macromodels** of the business cycle are inconsistent with observed agent behaviour.

Summary and conclusion

- According to the neo-classical theory of labor supply, every individual trades off between consuming a good and consuming leisure
- The supply of individual labor is positive if the current wage exceeds the *reservation wage*
  - If labor supply is positive, the marginal rate of substitution between consumption and leisure is equal to the hourly wage
- The relation between the individual supply of labor and the hourly wage is the result of combined substitution and income effects
- The substitution effect implies an increasing relation between the wage and labor supply, while the income effect works in the opposite direction if leisure is a normal good

Summary and conclusion (2)

- When an individual has the opportunity to devote a part of her time to household production, at the optimum, the hourly wage is equal to the marginal productivity of household work
- As a general rule, the mechanism of substitution of leisure over time implies that the permanent component of the evolution of real wages has a smaller effect on labor supply than the transitory component
- The elasticity of labor supply by women is, in general, greater than that of men, which is generally small, although this difference diminishes over time

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APPENDIX

Trend in Labor Productivity

	Amount of time worked				
	1870	1913	1938	1997	2011
Germany	2941	2584	2316	1507	1413
United States	2964	2605	2062	1850	1787
France	2945	2588	1848	1603	1476
United Kingdom	2984	2624	2267	1731	1625
Sweden	2945	2588	2204	1629	1644
	Wages				
Germany	100	185	285	1505	1602
United States	100	189	325	586	603
France	100	205	335	1579	1890
United Kingdom	100	157	256	708	871
Sweden	100	270	521	1601	2011

Table: Hours worked annually per person and real hourly wages in the manufacturing sector. Source: Maddison (1995) for 1870, 1913, 1938 and OECD data for 1997 and 2011.

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Trend in Hours Worked

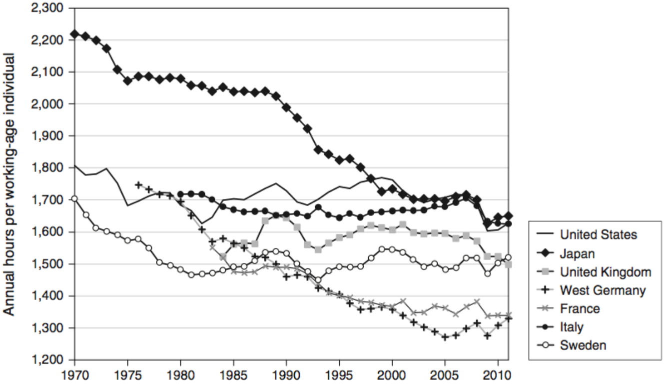

FIGURE 1.1
Amount of time worked annually in 7 OECD countries over the period 1970–2011 (total number of hours worked during the year divided by the average number of persons of working age).

Source: OECD Labor Force Statistics.

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Male participation rates

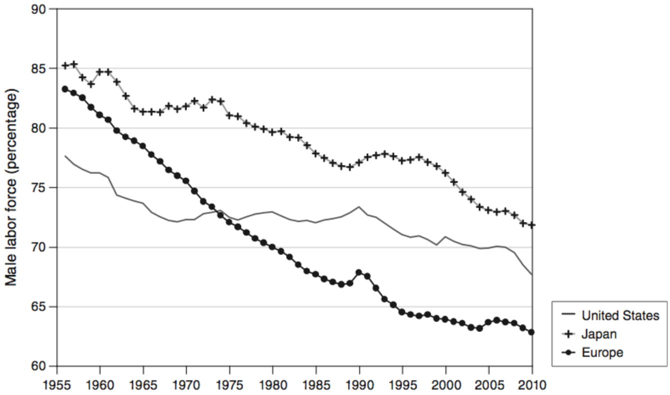

FIGURE 1.3

The evolution in civilian labor force participation rates of men in the United States, Europe, and Japan for persons 15 years of age and older, 1956–2010.

Source: OECD Annual Labor Force Statistics.

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Female participation rates

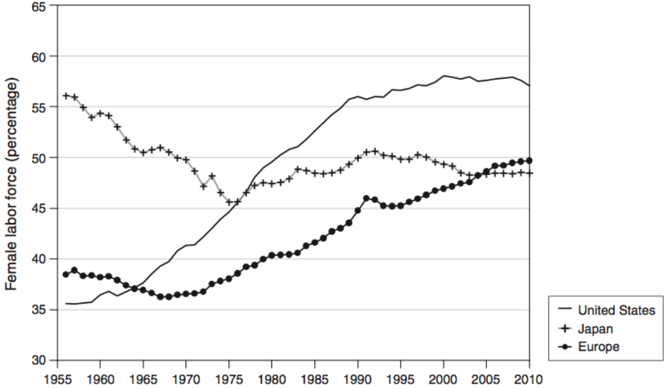

FIGURE 1.4
The evolution in civilian labor force participation rates of women in the United States, Europe, and Japan for persons 15 years of age and older, 1956–2010.

Source: OECD Annual Labor Force Statistics.

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Low Pay for Women

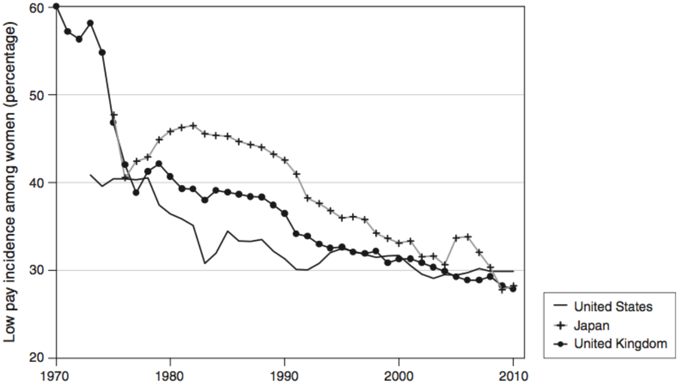

FIGURE 1.5
The incidence of low-paying jobs among women in the United States, Japan, and the United Kingdom. Low pay is defined as less than two thirds of the gross median earnings of all full-time workers.

Source: OECD Earnings Statistics.

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Facts about labor supply (8 bis) - The evolution of participation rates

	Single	Married
1900	45.9	5.6
1950	53.6	21.6
1988	67.7	56.7
2000	68.9	61.1
2010	63.3	61.0

Table: Civilian labor force participation rates of women aged 16 and over, classified by their marital status, in the United States.
Source: Ehrenberg and Smith (1994, Table 6.1, p. 165) for 1900, 1950 and 1988, and Census Bureau for 2010.

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Part-time work by women

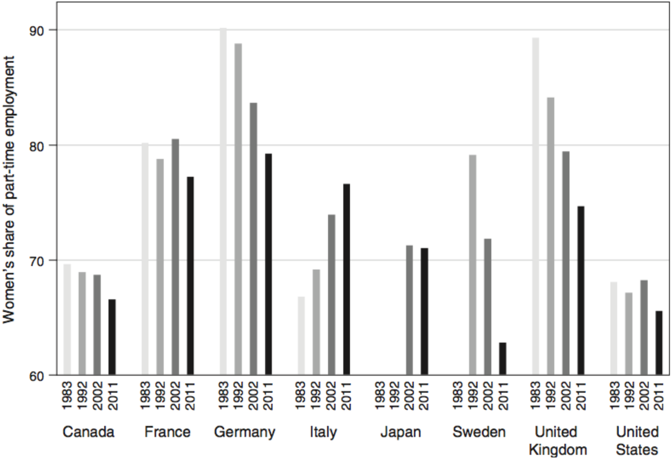

FIGURE 1.6
Women's share of part-time labor (in percentage terms) 1983–2011.

Source: OECD Labor Force Statistics.

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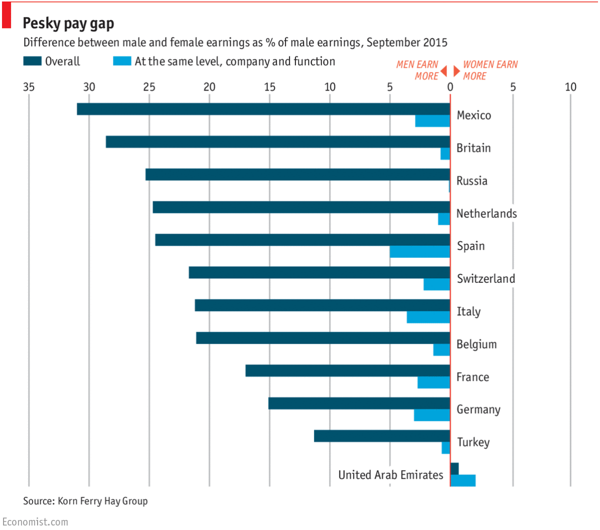
Gender Wage Gap



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Male Leisure and home production

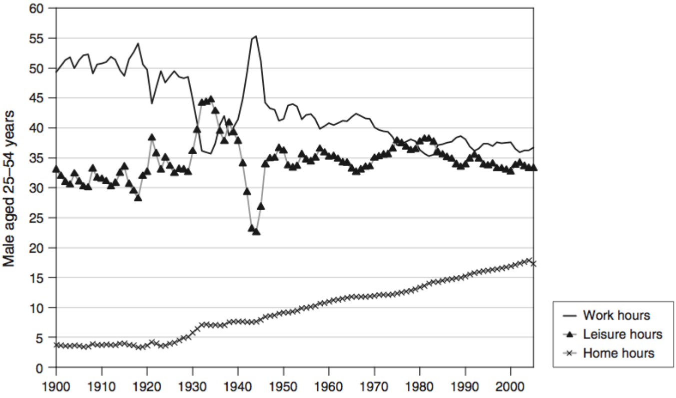

FIGURE 1.8
Work, leisure, and home hours per week of men in the United States 1900–2005.

Source: Francis and Ramey (2009).

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Female Leisure and home production

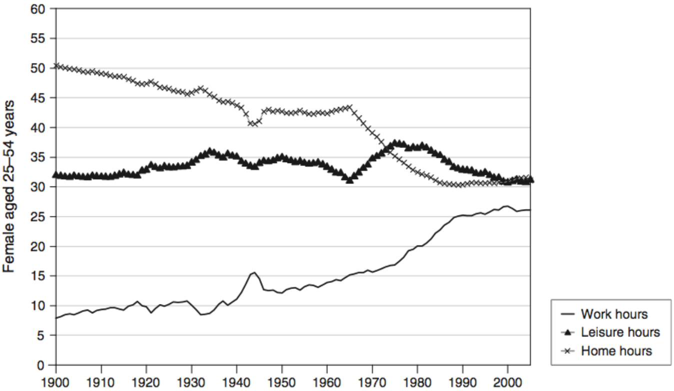

FIGURE 1.9
Work, leisure, and home hours per week of women in the United States 1900–2005.

Source: Francis and Ramey (2009).

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