2. Labour Supply

KAT.TAL.322 Advanced Course in Labour Economics

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Labour supply

How people choose

- whether to work, and
- how much to work

Today

- Static model
- Household model
- Intertemporal model
- Estimations

Static model

Static labour supply

Model

- Utility from consumption of goods (C) and leisure (L): $U(C, L)$.
- Total time endowment L_0
- Agent chooses h how much time to work such that $L = L_0 - h$.
- Budget constraint is $C \leq wh + Y \Rightarrow C + wL \leq wL_0 + Y$
  - → w is real hourly wage
  - → Y is non-labour income

$$\max_{C,h} U(C, L_0 - h) \quad \text{subject to} \quad C \leq wh + Y$$

Static labour supply

Allocation of time in the data

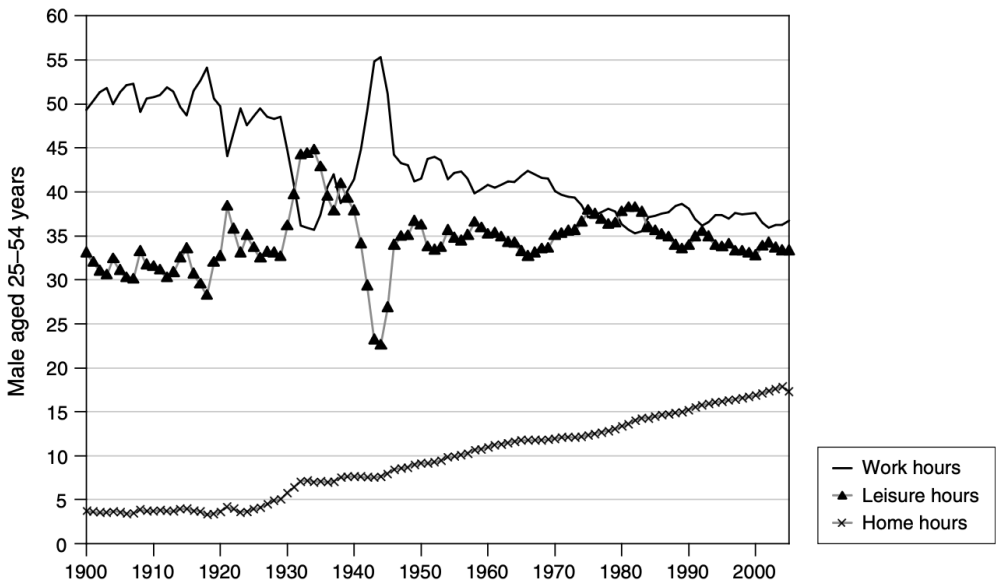


FIGURE 1.8
Work, leisure, and home hours per week of men in the United States 1900–2005.

Source: Francis and Ramey (2009).

Men

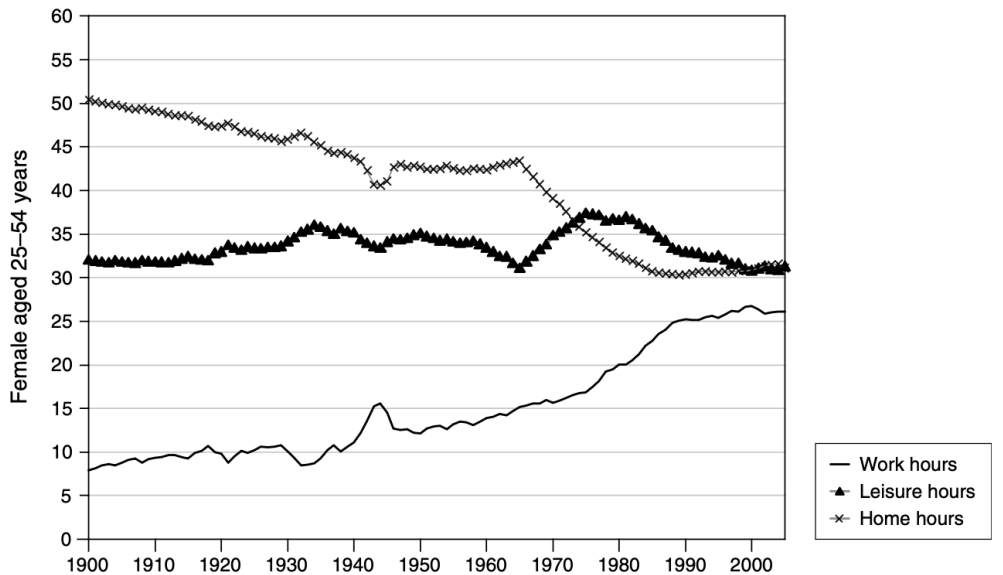


FIGURE 1.9
Work, leisure, and home hours per week of women in the United States 1900–2005.

Source: Francis and Ramey (2009).

Women

Static labour supply

Solution

First-order conditions of the Lagrangian are

$$U_C(C,L) = \lambda \qquad U_L(C,L) = \lambda w$$

Solution pair $C^*(w,Y)$ and $h^*(w,Y)$ satisfies

$$\frac{U_L(C^*,L^*)}{U_C(C^*,L^*)} = w \quad \text{and} \quad C^* = wh^* + Y$$

Static labour supply

Solution

Static labour supply

Comparative statics

How does optimal labour supply change with w*?*

Marshallian (uncompensated) wage elasticity: $\varepsilon_{hw} = \frac{\partial \ln h^*}{\partial \ln w}$

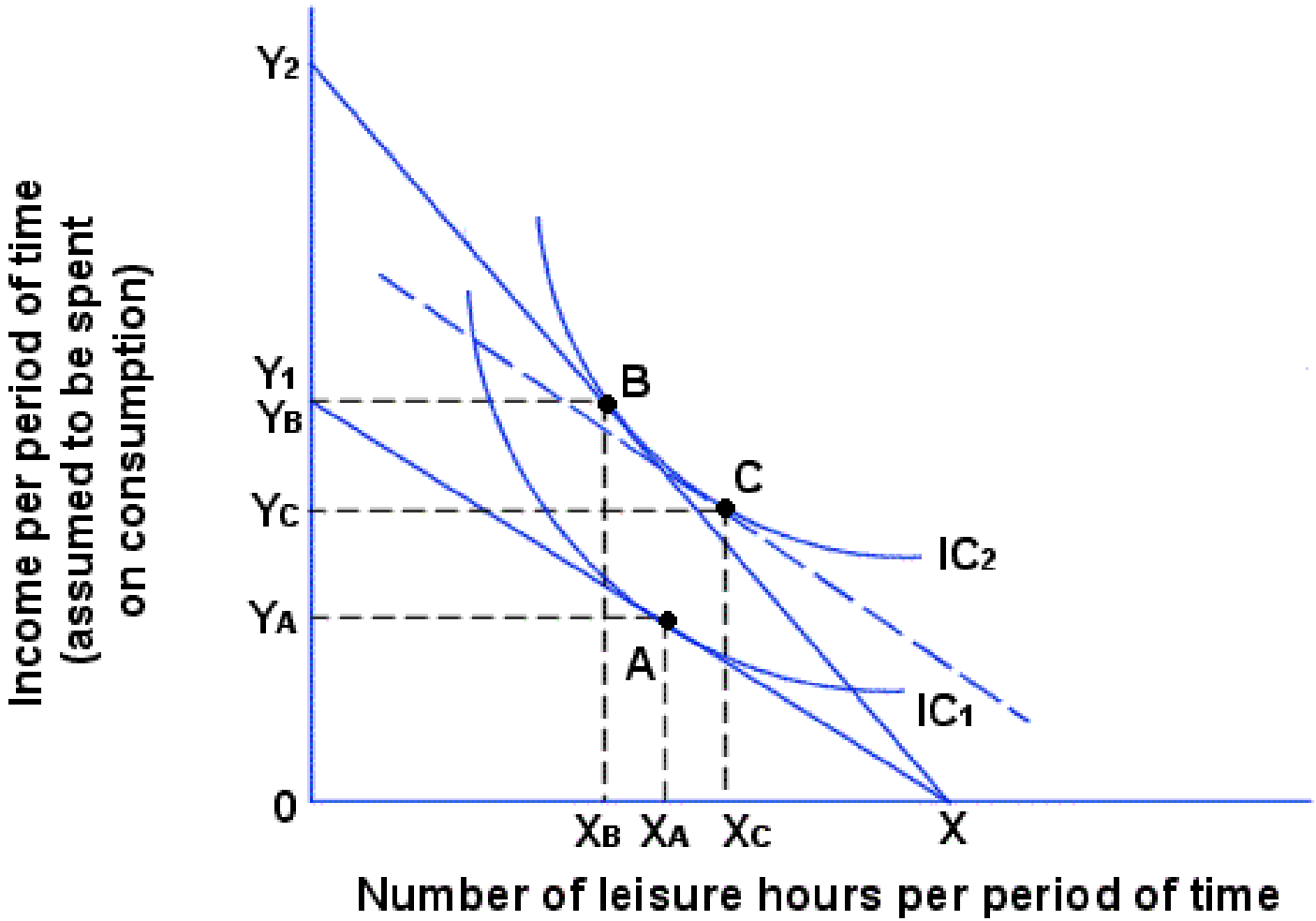
Hicksian (compensated) wage elasticity: $\eta_{hw} = \frac{\partial \ln \hat{h}}{\partial \ln w}$

Decomposition into **substitution** and **income** effects:

$$\varepsilon_{hw} = \eta_{hw} + \frac{wh}{Y}\varepsilon_{hY}$$

Static labour supply

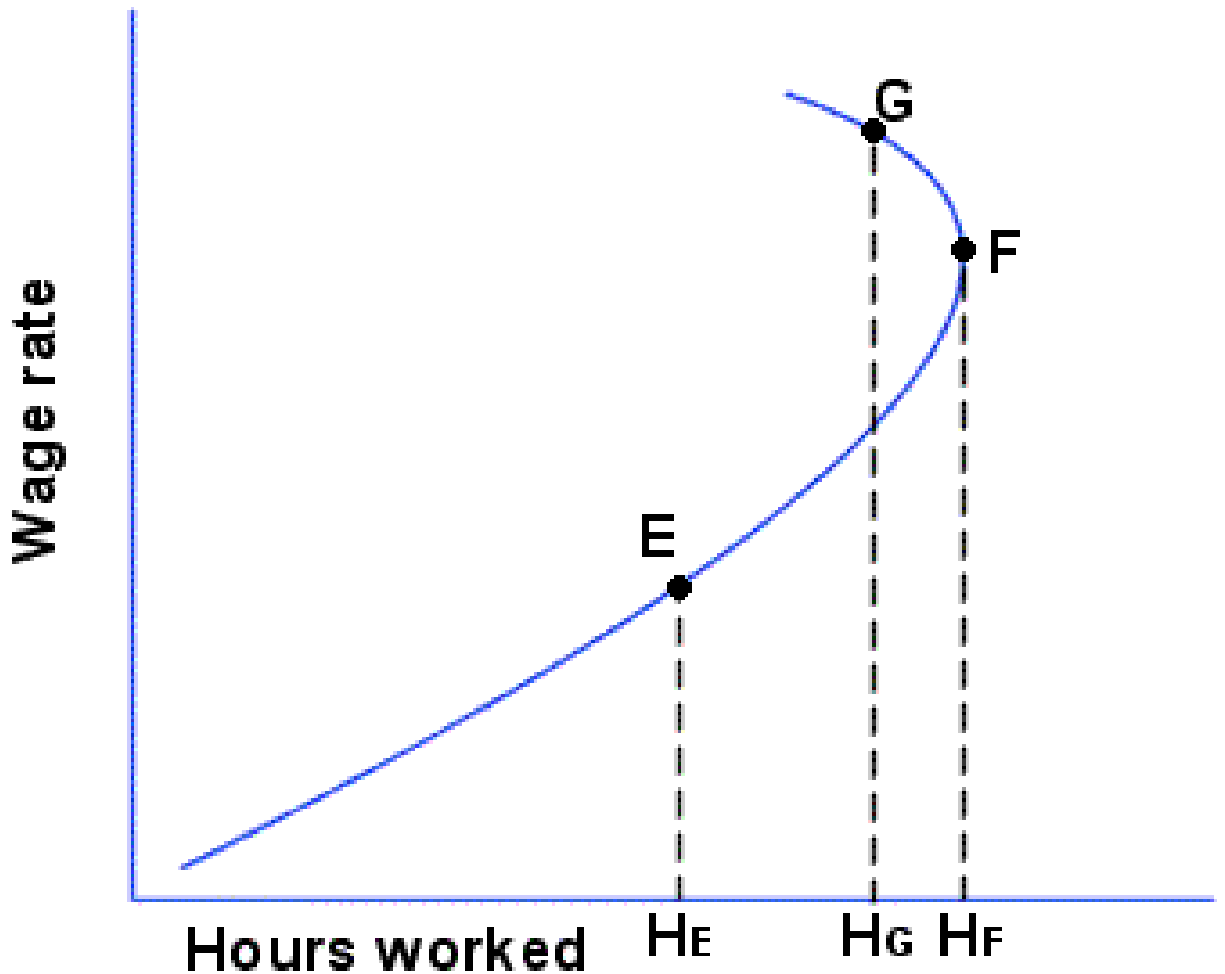
Comparative statics



Source: Wikipedia

Static labour supply

Labour supply curve



Source: Wikipedia

Household model

Intrahousehold labour supply

Unitary model

Household represented by single utility function $U(C, L_1, L_2)$

Budget constraint $C + w_1 L_1 + w_2 L_2 \leq Y_1 + Y_2 + (w_1 + w_2) L_0$

- Simple extension of static model
- Consumption depends on total resources only
- Not consistent with empirical studies

Intrahousehold labour supply

Collective model

Individual utility functions $U_1(C_1, L_1), U_2(C_2, L_2)$

Budget constraint

$$C_1 + C_2 + w_1 L_1 + w_2 L_2 \leq R_1 + R_2 + (w_1 + w_2) L_0$$

$$\max_{C_1, C_2, L_1, L_2} U_1(C_1, L_1) \quad \text{s.t.} \quad \text{budget constraint}$$

$$U_2(C_2, L_2) \geq \bar{U}_2$$

Intrahousehold labour supply

Collective model

Chiappori (1992): equivalent to

$$\max_{C_i, L_i} U_i(C_i, L_i) \quad \text{s.t.} \quad C_i + w_i L_i \leq w_i L_0 + \Phi_i$$

where Φ_i describes how resources $R_1 + R_2$ are shared in the household.

Intertemporal model

Intertemporal labour supply

Model

General utility function $U(C_0, \dots, C_T; L_0, \dots, L_T)$ (intractable)

Separable utility function $\sum_{t=0}^{T} U(C_t, L_t, t)$

Budget constraint $A_t = (1 + r_t)A_{t-1} + B_t + w_t(1 - L_t) - C_t$

- savings rate r_t
- total time normalized to one: $h_t + L_t = 1$
- assets A_t
- non-labour income B_t

Intertemporal labour supply

Solution

$$L = \sum_t U(C_t, L_t, t) - \sum_t \nu_t \left[A_t - (1 + r_t)A_{t-1} - B_t - w_t(1 - L_t) + C_t\right.$$

First-order conditions:

$$\frac{U_L(C_t, L_t, t)}{U_C(C_t, L_t, t)} = w_t \qquad \forall t \in [0, T]$$

$$\nu_t = (1 + r_{t+1})\nu_{t+1}$$

Iterating over all periods: $\ln \nu_t = -\sum_{\tau=1}^{t} \ln(1 + r_\tau) + \ln \nu_0$

Intertemporal labour supply

Wage elasticities of labour supply

- Frisch elasticity ψ_{hw} (holding ν_t constant)
- Marshallian elasticity ε_{hw} (takes into account ν_t)
- Hicksian elasticity η_{hw} (holding lifetime utility constant)

It is possible to show that $\psi_{hw} \geq \eta_{hw} \geq \varepsilon_{hw}$

Interpretation

Transitory changes in wages affect labour supply more than permanent changes.

Intertemporal labour supply

Example

Period utility $U(C_t, L_t, t) = \frac{C_t^{1+\rho}}{1+\rho} - \beta_t \frac{H_t^{1+\gamma}}{1+\gamma}$

FOC: $H_t^{\gamma} = \frac{1}{\beta_t} \nu_t w_t \Rightarrow \ln H_t = \frac{1}{\gamma}(-\ln \beta_t + \ln \nu_t + \ln w_t)$

1. Evolutionary changes along anticipated wage profile $\frac{\partial \ln H_t}{\partial \ln w_t} = \frac{1}{\gamma} > 0$
2. Transitory changes $\frac{\partial \ln H_t}{\partial \ln w_t} = \frac{1}{\gamma}\left(1 + \underbrace{\frac{\partial \ln \nu_0}{\partial \ln w_t}}_{<\approx 0}\right) > 0$
3. Permanent changes $\frac{\partial \ln H_t}{\partial \ln w_t} = \frac{1}{\gamma}\left(1 + \frac{\partial \ln \nu_0}{\partial \ln w_t}\right) \lesseqgtr 0$
4. Lottery win $\frac{\partial \ln H_t}{\partial \ln B_t} = \frac{1}{\gamma} \frac{\partial \ln \nu_0}{\partial \ln B_t} < 0$

Estimations

Empirical specifications

Basic regression equation

$$\ln H_{it} = \alpha_w \ln w_{it} + \alpha_R R_{it} + \theta X_{it} + \upsilon_{it}$$

Interpretation of α_w: Frisch, Marshallian or Hicksian? Depends on R_{it}!

Empirical specifications

Two-stage budgeting

Solution method of lifecycle labour supply models (Blundell and Macurdy 1999)

1. Solve static labour supply model given $C_t = R_t + w_t H_t$
2. Solve for series $R_1, \ldots, R_T$ to maximize lifetime utility

$$\ln H_{it} = \alpha_w \ln w_{it} + \alpha_R \left(C_{it} - w_{it} H_{it}\right) + \theta X_{it} + \upsilon_{it}$$

Marshallian wage elasticity: α_w

Income effect: $\alpha_R \, wH$

Hicksian wage elasticity: $\alpha_w - \alpha_R \, wH$

Empirical specifications

Frisch elasticity

Recall that $\ln \nu_t = -\sum_{\tau=1}^{t} \ln(1 + r_\tau) + \ln \nu_0 \equiv -\ln(1 + r)t + \ln \nu_0$ (if $r_\tau = r \; \forall \tau$)

Substitute $\alpha_R R_{it} = \rho t + \alpha_R \ln \nu_{0,i}$ into basic equation:

$$\ln H_{it} = \rho t + \alpha_w \ln w_{it} + \alpha_R \ln \nu_{0,i} + \theta X_{it} + \upsilon_{it}$$

$$\Delta \ln H_{it} = \rho + \alpha_w \Delta \ln w_{it} + \theta \Delta X_{it} + \Delta \upsilon_{it}$$

Frisch wage elasticity: α_w

Empirical specifications

Practical issues

- Wages and hours worked are endogeneous
- Hours ($H|H>0$) and participation ($H>0$)
- Measurement errors
- Measures of C_{it}
- Individual vs aggregate labour supply

Estimates

Observational data

Table 1.19
Estimates from U.S. nonexperimental data of behavioral responses for men.

	E	*mpe*	*E**
Ashenfelter and Heckman (1973)	−0.16	−0.27	0.12
Bloch (1973)	0.06	−0.06	0.12
Boskin (1973)	−0.29	−0.41	0.12
DaVanzo, DeTray and Greenberg (1973)	−0.15	−0.004	−0.14
Dickinson (1974)	−0.11	0.08	−0.19
Fleisher, Parsons and Porter (1973)	−0.19	−0.23	0.04
Garfinkel (1973)	0	0	0
Greenberg and Kosters (1973)	−0.09	−0.29	0.20
Ham (1982)	−0.16	−0.11	−0.05
Hausman and Ruud (1984)	−0.08	−0.63	0.55
Kniesner (1976a)	−0.17	−0.01	−0.16
Kosters (1966)	−0.09	−0.14	0.04
Masters and Garfinkel (1977)	−0.11	−0.05	−0.06
Wales and Woodland (1979)	0.14	−0.70	0.84

Notes: The estimates reported for DaVanzo, DeTray and Greenberg (1973) correspond to those given on the last line of Table 11 of their Rand report where both the wage rate and nonwage income variables were instrumented. Those for Ham (1982) correspond to those given in column (1) of Table IV of his paper. Those for Kniesner (1976a) apply to those men whose wives were not at work for pay. For Masters and Garfinkel (1977), I took what they described as their "best estimates" of *E* and the *mpe* even though the coefficients reported did not derive from the same regression equation. Boskin's (1973) results are those for white men only. Dickinson's (1974) *mpe* is calculated from his estimate coefficient on "other (nontransfer) family income". Hausman and Ruud's estimates are calculated for a household with an assumed marginal tax rate of 25 percent so the husband's net wage rate is $4.31 and the wife's net wage rate is $2.63.

Source: Pencavel (1986)

Estimates

Experimental data: drop in tax rates in the UK 1978-92

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.

Source: Blundell, Duncan, and Meghir (1998)

Estimates

Intensive vs extensive margin

		Intensive Margin	Extensive Margin	Aggregate Hours
Steady State (Hicksian)	Micro	0.33	0.25	0.58
	Macro	0.33	0.17	0.50
Intertemporal Substitution (Frisch)	Micro	0.54	0.32	0.86
	Macro	[0.54]	[2.77]	3.31

Notes: 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 defined as the sum of the extensive and intensive elasticities. Macro studies report intertemporal aggregate hours elasticities but do not always decompose these values 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. See appendix C for sources of these estimates.

Source: Chetty et al. (2012)

Also some research on work effort for given hours of work (Dickinson 1999)

Estimates

Measurement errors

Classical measurement error in w_{it} attenuates the estimate of α_w

"Denominator bias" $\downarrow \alpha_w$ if wages are computed as ratio of earning and hours with measurement errors. M. P. Keane (2011) computes average Hicksian elasticity

- among all papers: 0.31
- among papers with direct measure of w_{it}: 0.43

Estimates

Measurement of consumption

PSID (US) dataset only includes food consumption data

Consumption measure	Marshall	Hicks	Income	Frisch
PSID unadjusted	-0.442	0.094	-0.536	0.148
Food + imputed (food prices, demographics)	-0.468	0.328	-0.796	0.535
Food + imputed (house value, rent)	-0.313	0.220	-0.533	0.246

Source: (M. P. Keane 2011, Table 5)

Estimates

Micro vs macro elasticities

Macro elasticities of labour supply typically higher than micro estimates

M. Keane and Rogerson (2012) highlight:

- extensive vs intensive margin
- model misspecification due to human capital accumulation
- aggregation is not straightforward

Estimates

Discrete choice dynamic programming

Incorporate discrete choices into model of labour supply

- labour force participation (**Eckstein and Wolpin 1989**)
- marriage (**Van Der Klaauw 1996**)
- fertility (**Francesconi 2002**)

M. P. Keane and Wolpin (**2010**) combine all + school and welfare participation choices

Uncompensated dynamic elasticity	
Eckstein and Wolpin (**1989**)	5.0
Van Der Klaauw (**1996**)	3.6
Francesconi (**2002**)	5.6
M. P. Keane and Wolpin (**2010**)	2.8

Source: M. P. Keane (**2011**)

Summary

- Standard models of labour supply
  - → Static model
  - → Household model
  - → Intertemporal model
- Estimates of labour supply elasticities
  - → Typical issues encountered in data
  - → Variation in estimates and possible extensions
- Mostly covered seminal papers, but many ongoing works
  - → Tax and benefit policies
  - → Cross-wage elasticities

Next lecture: Labour Demand on 01 Sep

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