Labor and Taxes Lecture

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Labor Supply/Demand Model

- In this lecture, we'll try to understand the equilibrium labor model
- It uses basic utility and production microeconomic models
- You don't have to understand these on a deep level, and I'll try to give you a crash course
- If you want more references, please ask

Labor Supply/Demand

- Two sides of the market: households supply labor and consume, firms demand labor and produce
- Wages move to clear markets, so labor supplied is equal to labor demanded
- Let's look at the household problem

Household problem

- Households like two things: they like consumption c and leisure ℓ, which we might write as total free time (normalized to one) minus labor hours n:

$$u(c, 1-n)$$

- Presumably, they always want more consumption and more labor:

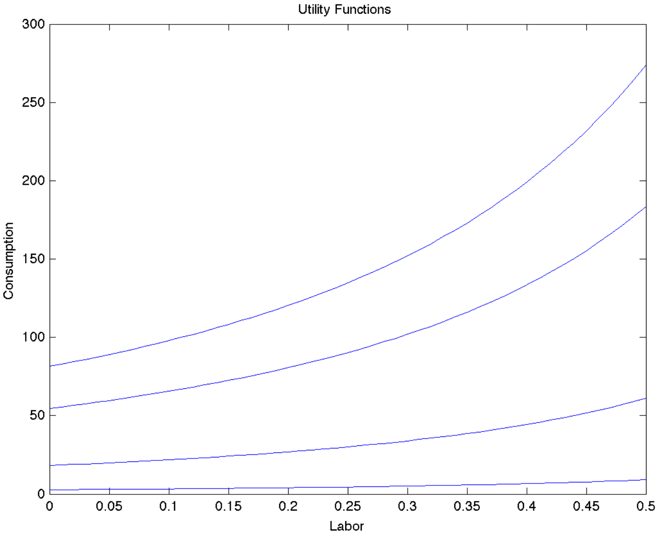
$$\frac{\partial u}{\partial c} > 0 \quad \frac{\partial u}{\partial \ell} > 0$$

- But have diminishing marginal utility from each:

$$\frac{\partial^2 u}{\partial c^2} < 0 \quad \frac{\partial^2 u}{\partial \ell^2} < 0$$

- We can examine what we think their isoutility curves look like

Isoutility Curves



People are happier as they go to top left (more leisure, more consumption)

Household budget constraint

- People want to maximize utility by choosing c and ℓ (or n)
- But how? What's the tradeoff?
- Budget constraint! In simple world, consumption c must equal wage per unit of time w times amount of time worked n, plus any other income the household has ν:

$$c = wn + \nu$$

Household Maximization Problem

- Household wants to maximize $U(c, 1-n)$ subject to the budget constraint
- Maximization problem:

$$\mathcal{L} = U(c, 1-n) + \lambda(wL + \nu - c)$$

  They can maximize this by taking first-order conditions:

$$\frac{\partial \mathcal{L}}{\partial c} = 0, \qquad \frac{\partial \mathcal{L}}{\partial n} = 0$$

- Which give:

$$\frac{\partial U}{\partial c} = \lambda$$

$$\frac{1}{w}\frac{\partial U}{\partial n} = \lambda$$

- λ is super important: if ν goes up by 1, U goes up by λ

Household Maximization Problem

$$\frac{\partial U}{\partial c} = \lambda$$
$$\frac{1}{w}\frac{\partial U}{\partial n} = \lambda$$

- λ is the Lagrange multiplier: value in terms of utility of another dollar (utility-dollar conversion rate) at margin
- If you had another dollar from the sky, what could you do with it? Two possibilities:
  1. Consume it, in which case you get $\frac{\partial U}{\partial c}$
  2. Work less, in which case you buy $\frac{1}{w}$ fewer units of working and get $\frac{\partial U}{\partial n}$ utility per unit
- At margin, the two must be equal!

$$\frac{\partial U}{\partial c} = \frac{1}{w}\frac{\partial U}{\partial n}$$

or:

$$\underbrace{\frac{\partial U}{\partial n} \Big/ \frac{\partial U}{\partial c}}_{\text{MRS}} = \underbrace{w}_{\text{MRTS}}$$

Household Maximization Problem

$$\underbrace{\frac{\partial U}{\partial n} \Big/ \frac{\partial U}{\partial c}}_{\text{MRS}} = \underbrace{w}_{\text{MRTS}}$$

- Intuitively, what you get from trading off a unit of consumption for a unit of leisure (MRS) must equal the price (the wage/MRTS)

- Fundamentally, this gives us an individual supply curve of labor: $\frac{\partial U}{\partial n} / \frac{\partial U}{\partial c}$ is really just a function of n (because $c = wn + \nu$), ν, and U.

- As wage increases, can trace out labor supply curve

- Let's give an example:

Labor Supply Curve: Example

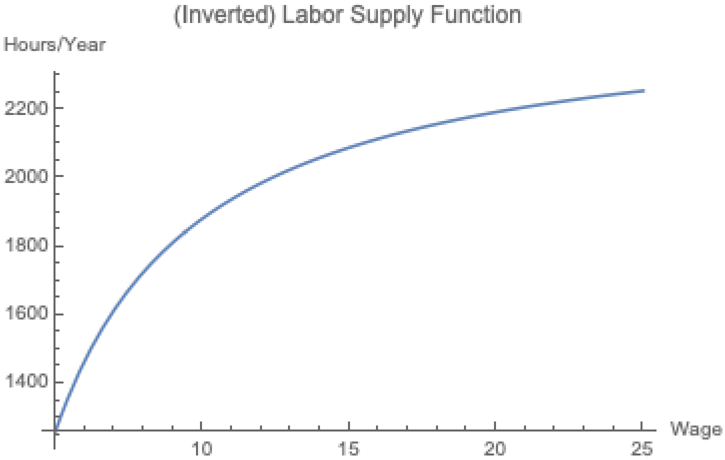
$$U(c, 1-n) = \log(c) + \psi \log(8760 - n)$$

- Free time/year = 24*365=8760
- Where $\psi = 2.5$, and $c = wn + \nu$, $\nu = 8700$
- Can solve for labor:

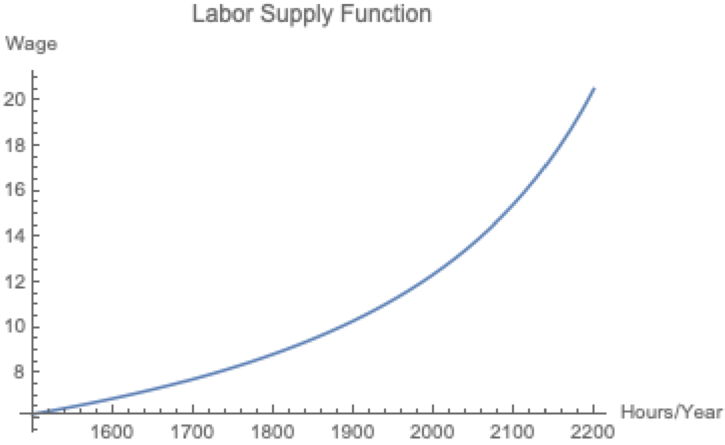
$$w = \frac{\nu\psi}{8760 - n(\psi + 1)}$$

- Let's graph it out!

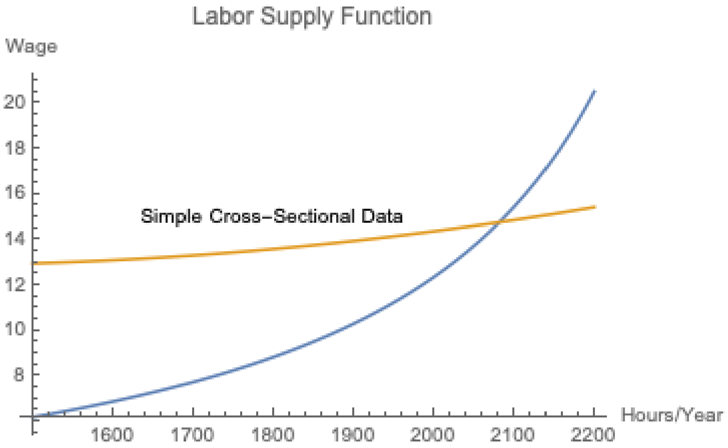
Labor Supply Curve: Example



Labor Supply Curve: Example



Labor Supply Curve: Example



If we include cross-sectional estimates (wrong!)

What about Labor Demand?

- We have our first labor supply curve...what about labor demand?
- Imagine a firm that takes in labor L and capital K at per-unit costs w and r
- Produces $F(K, L)$, cost is wL and rK. Define profit π:

$$\pi = F(K, L) - wL - rK$$

- Maximizes by choosing K and L. Let's focus on L

What about Labor Demand?

$$\pi = F(K, L) - wL - rK$$

$$\frac{\partial \pi}{\partial L} = 0$$

or:

$$\frac{\partial F(K, L)}{\partial L} = w$$

- Marginal benefit (amount produced when hire one more unit of labor) $\frac{\partial F(K,L)}{\partial L}$ equals marginal cost (wage, price paid for that extra unit) w
- What do labor demand curves look like?

Labor Demand Curve: Example

$$\pi = F(K, L) - wL - rK$$

- Let:

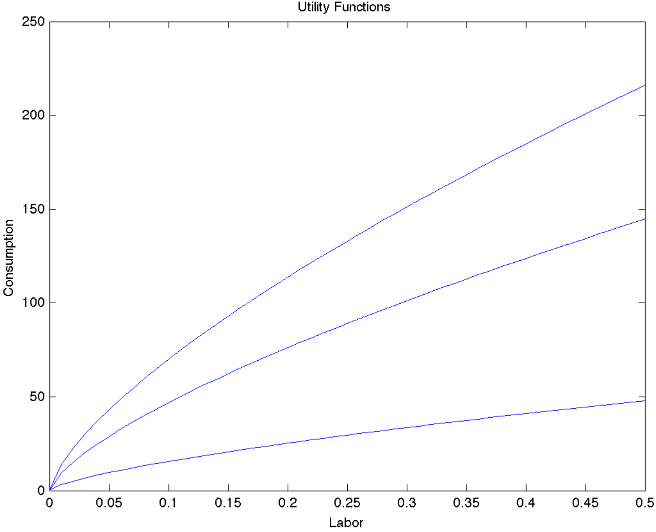
$$F(K, L) = AK^{\alpha}L^{1-\alpha}$$

- so:

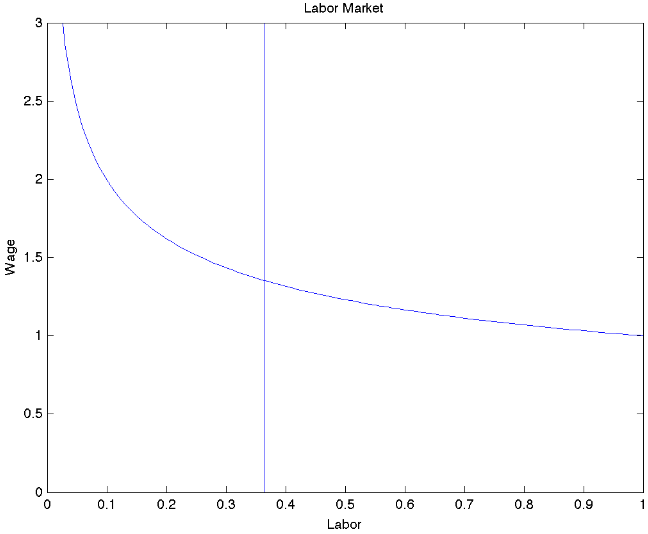
$$\frac{\partial F}{\partial L} = (1-\alpha)A\left(\frac{K}{L}\right)^{\alpha}$$

- Productivity of L is increasing in K and decreasing in L
- Let's take a look!

Isoproduction Curves



Labor demand curves, holding K fixed



Labor Demand Curve: Example

- Equilibrium is when both firm and household problems are satisfied

$$\frac{\frac{\partial U}{\partial n}}{\frac{\partial U}{\partial c}} = w$$

- And:

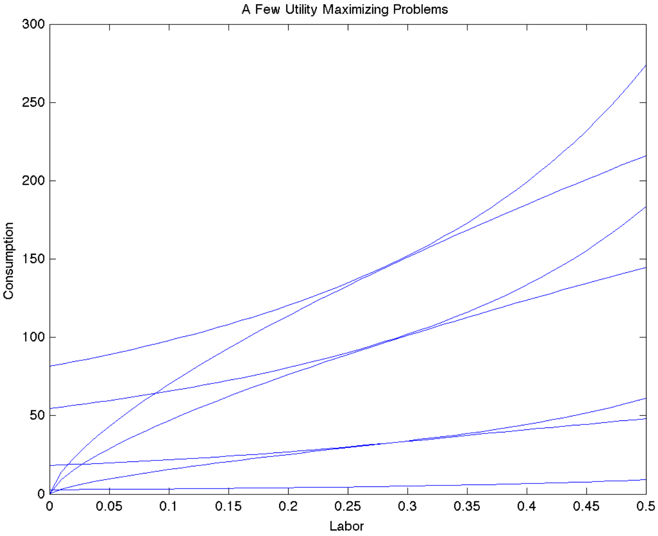
$$\frac{\partial F(K,L)}{\partial L} = w$$

- Gives, as an equliibrium condition:

$$\frac{\frac{\partial U}{\partial n}}{\frac{\partial U}{\partial c}} = \frac{\partial F(K,L)}{\partial L}$$

- What does this look like in our isoutility/isoproduction framework?

Labor Market Equilibria



What about labor demand/supply? Just put them together!

Note about preferences

- Normally we use preferences like: $\log(c) + \psi \log(1 - n)$
- If you solve:

$$\mathcal{L} = \log(c) + \psi \log(1 - n)$$

- S.t. $c = wn$ (i.e. $\nu = 0$) or if ν covaries 1-1 with w then:

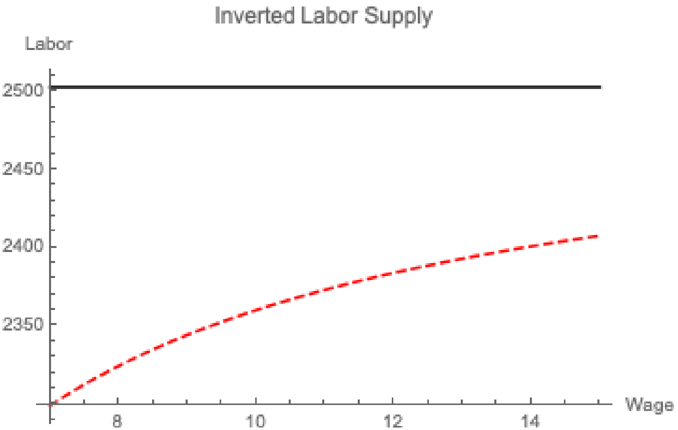
$$\frac{\partial \mathcal{L}}{\partial n} = \frac{w}{wn} - \frac{\psi}{1 - n} = 0$$

- Or:

$$n^* = \frac{1}{1 + \psi}$$

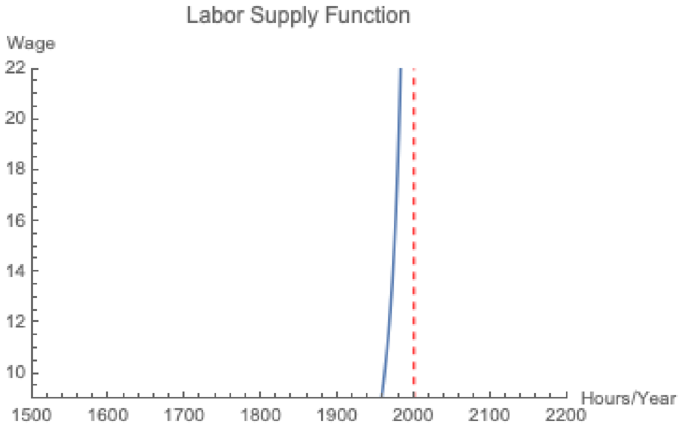
- Labor demand is perfectly inelastic in this model!
- But there's some evidence for this...

Inverted Labor Supply

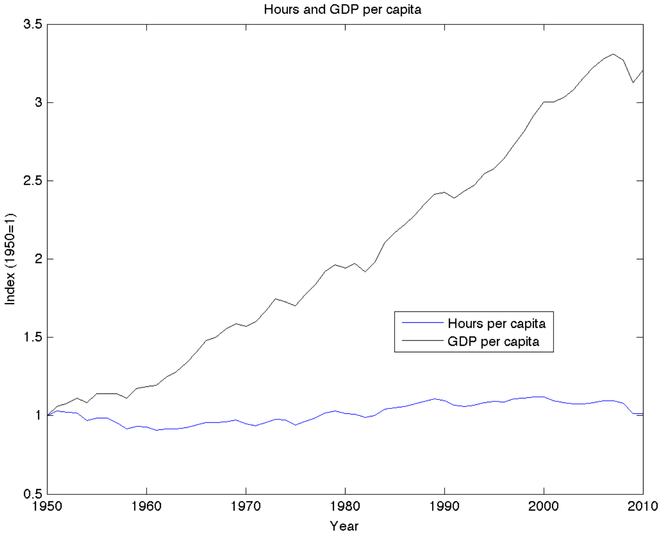


$\nu = 0$ vs $\nu = 2000$

Labor Supply

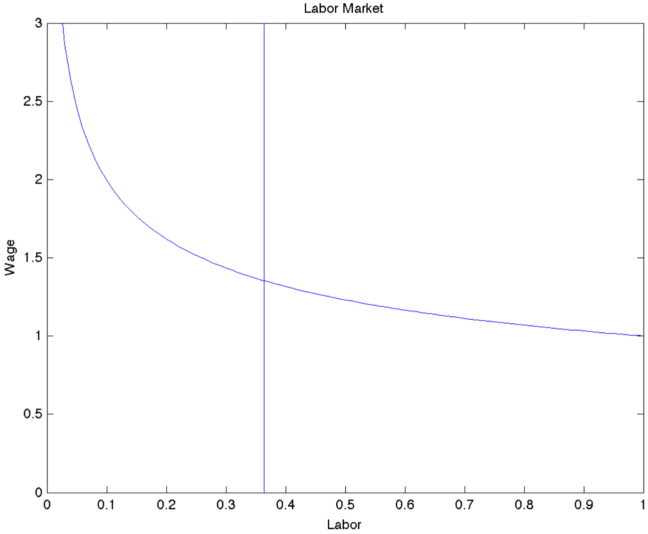


Inelastic Labor Supply



Okay, now let's put labor supply and demand together!

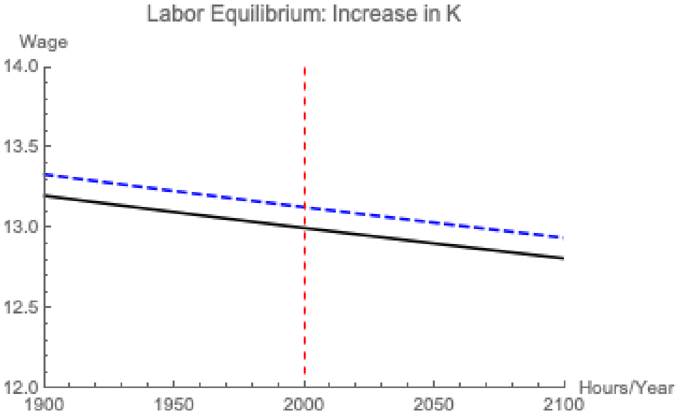
Supply and Demand



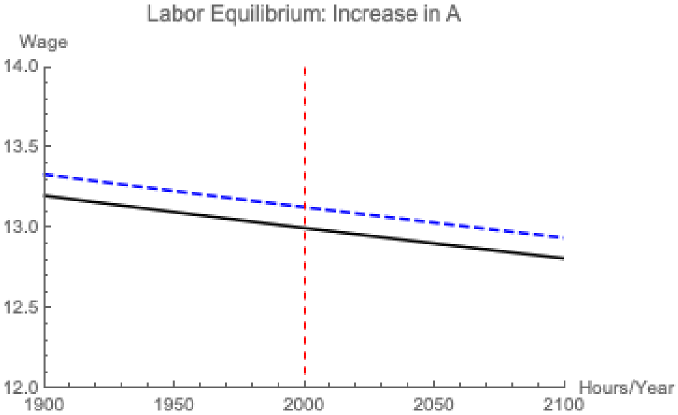
Inelastic Labor Supply

- You can think of what I gave you as a bit like our “long-run” model of supply and demand in labor markets.
- What happens when technology gets better (holding capital constant?)
- What happens when capital increases (holding technology constant)?
- What happens when we transfer more? (all else constant)

More Capital shifts Labor Demand



Higher TFP shifts Labor Demand



What about Taxes?

- This is a public policy course isn't it? Who cares about wages?
- Taxes just affect wages. Before, budget constraint was:

$$c = wn + \nu$$

- With taxes, it's just:

$$(1 + \tau^c)c = (1 - \tau)wn + \nu - T$$

- Where τ is the marginal tax rate and T is transfer, lump-sum tax, (or possibly "virtual income")
- But we could have just written:

$$c = w^* n + \nu^*$$

- Where $w^* = \frac{1-\tau}{1+\tau^c}$ and $\nu^* = \frac{\nu - T}{1+\tau^c}$

What about Taxes on Firms?

- Ordinary firm problem goes from:

$$\pi = F(K, L) - wL - rK$$

- To:

$$\pi = F(K, L) - (1 + \tau_L^F)wL - rK$$

- Let's look at labor market equilibrium

What about Taxes on Firms?

- Ordinary firm problem goes from:

$$\pi = F(K, L) - wL - rK$$

- To:

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- Let's look at labor market equilibrium

Labor Market Equilibrium With Taxes

- Labor market equilibrium:

$$\frac{\frac{\partial U}{\partial n}}{\frac{\partial U}{\partial c}} = \frac{\partial F(K,L)}{\partial L}$$

- Changes to:

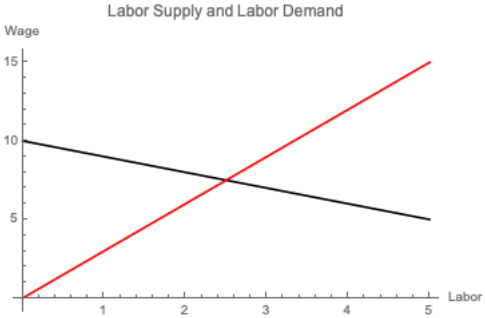
$$\frac{\frac{\partial U}{\partial n}}{\frac{\partial U}{\partial c}} = \frac{1-\tau}{(1+\tau_L^F)(1+\tau^c)}\frac{\partial F(K,L)}{\partial L}$$

- All three taxes are really doing the same thing: creating a wedge between what I get when I work and what I make when I work

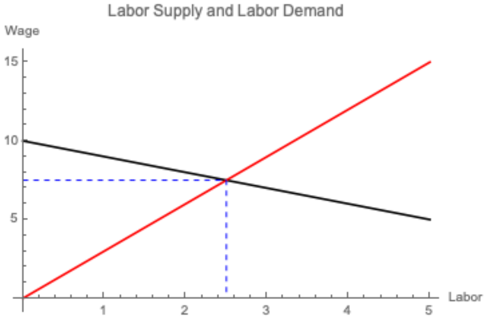
- When I give up an hour, all I care about is what I can eat with it, not if a lower leisure-consumption tradeoff comes from lower wage, higher labor taxes, or higher consumption taxes.

- Also! Important implication, it doesn't matter WHO is taxed!

Tax Incidence - Irrelevancy



Tax Incidence - Irrelevancy



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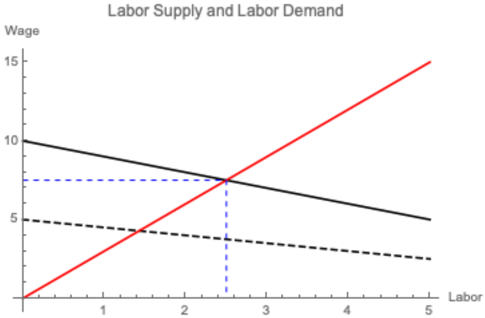

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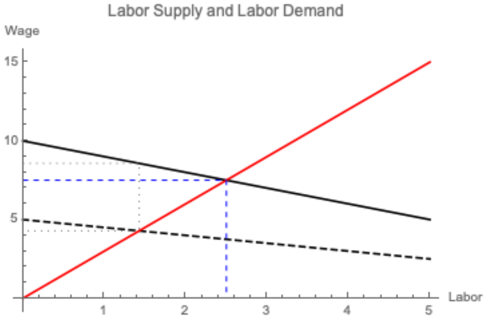

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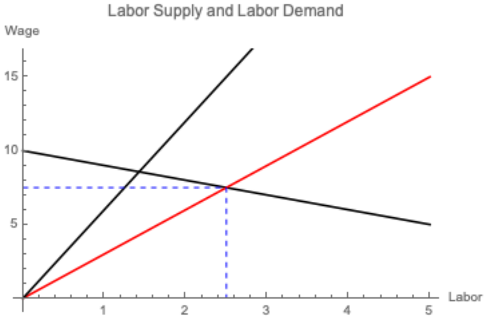
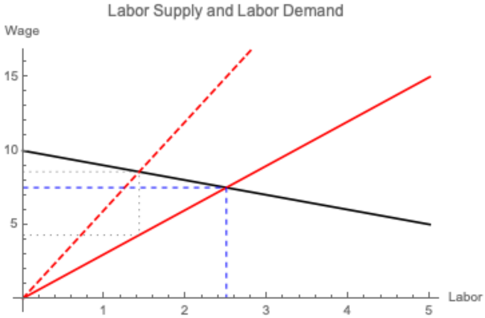


Tax Incidence - Irrelevancy



Tax Incidence - Irrelevancy

- Claim: it doesn't matter who you statutorily put the tax on, the after-tax prices and quantities will be the same
- BOLD
- Where might we expect deviations?
  - Tax avoidance
  - Minimum market prices
- Let's look at some evidence

Gasoline Tax

- Doyle and Samphantharak 2008
- IL and IN temporarily suspend gas taxes, then reinstate (political ploy)
- Sales taxes formally fall on gas stations, not consumers
- How do consumer prices respond? Will gas firms give consumers money out of the goodness of their hearts?
  - Yes!(?)

Gasoline Tax

Figure IIA: Summer 2000 Difference in Log Gas Prices
IL/IN vs. Neighboring States: MI, OH, MO, IA, WI

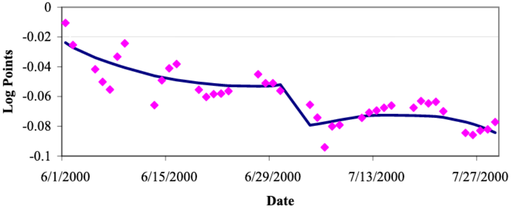


Figure IIB: Fall 2000 Difference in Log Gas Prices
IN vs. Neighboring States: MI, OH, IL

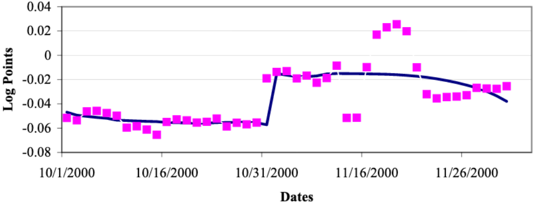


Figure IIC: Winter 2000/2001 Difference in Log Gas Prices
IL vs. Neighboring States: MO, IA, WI, IN

EITC and Incidence Summary

- Thinking through tax incidence is important!
- Can't just tax firms and think it won't pass through to consumers: always on the pair
- Nearly 100% (sometimes estimated more) of cigarette taxes passed on to consumers (Evans, Ringel, Stech 1999)
- Similarly, potentially 70% of EITC goes to firms, not workers(!) (Rothstein 2010)

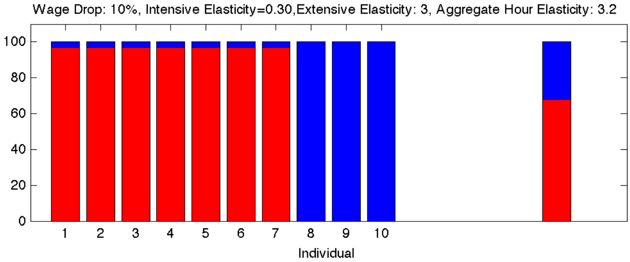
Labor Supply

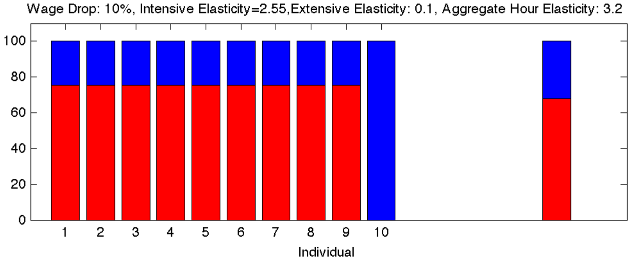
- The fundamental models of labor supply macroeconomists use don't differ too greatly from this, just adds bells and whistles to make it more realistic, such as, for the family:
  - Family labor supply (spousal labor and presence of children)
  - Discrete labor supply
  - Occupational/industrial choice
  - Taxes and transfers
  - Dynamic concerns, learning by doing, human capital
  - Health insurance, retirement
- And for the firm:
  - Many types of labor (high-skilled, low-skilled)
  - Taxes
  - Wage stickiness
  - Price stickiness
  - Matching frictions (fairly differnet)
- And much, much more: but these are some core tradeoffs

Four Elasticities

- There are four elasticities labor economists study and macroeconomists covet
- I'll define them roughly
  - Frisch (wage) elasticity of labor supply: how people respond to temporary wage shocks
  - Hicksian (wage) elasticity of labor supply: how people respond to a tax+transfer
  - Marshallian (wage) elasticity of labor supply: how labor changes when wages increase forever
  - Income elasticity of labor supply: how lifetime income falls when income (but not wage) increases
- Note that these are all wrong: Frisch is elasticity holding marginal utility of income constant, Hicksian holds utility constant, and Marshallian is full derivative, but they capture household reactions
- Sometimes people break these up into "intensive" (hours/worker) and "extensive" (# workers) elasticities

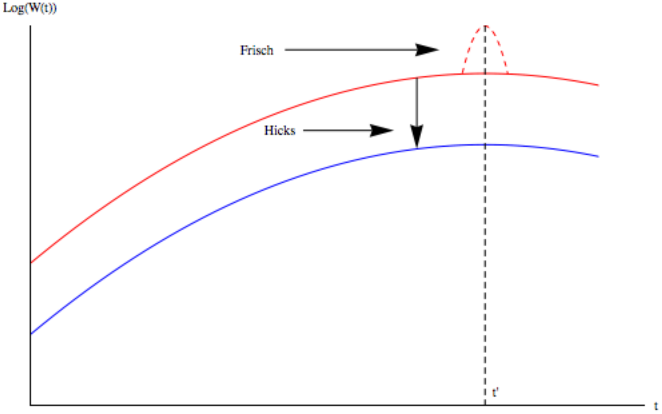
Three Elasticities





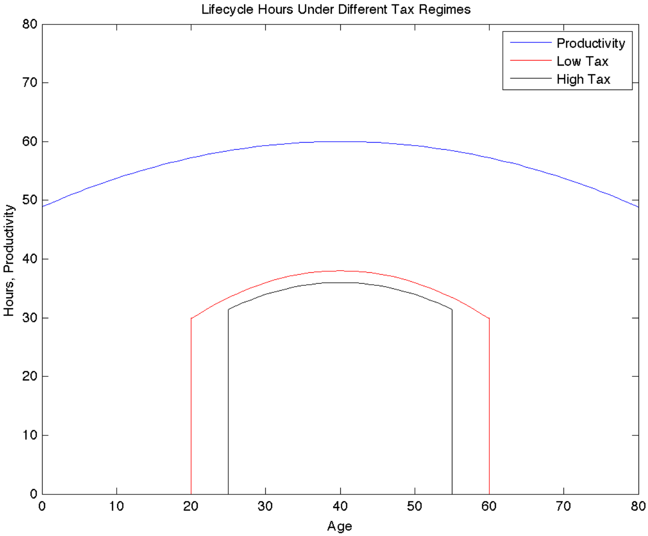
Two ways of getting an aggregate elasticity

Three Elasticities



Frisch vs Hicksian

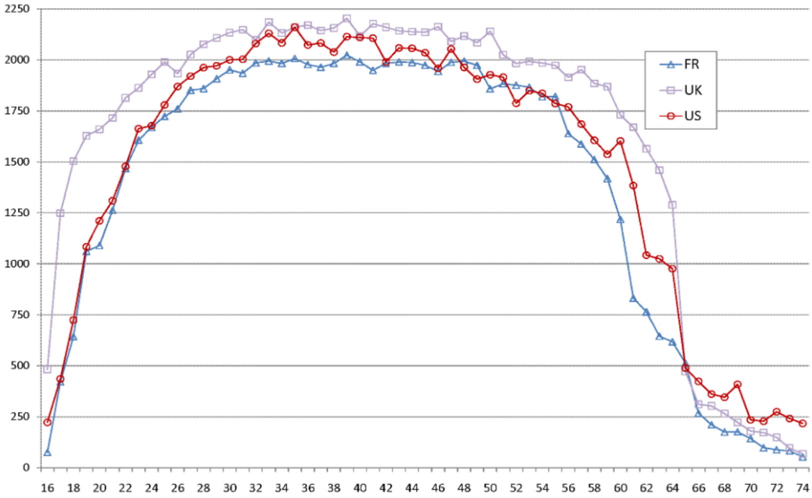
Three Elasticities



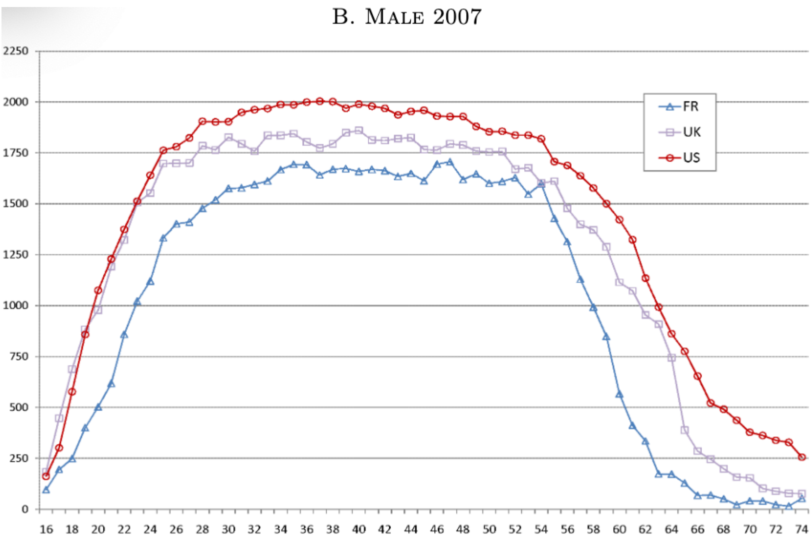
Example of extensive elasticity via retirement

Blundell, Bozio, Laroque

A. Male 1977

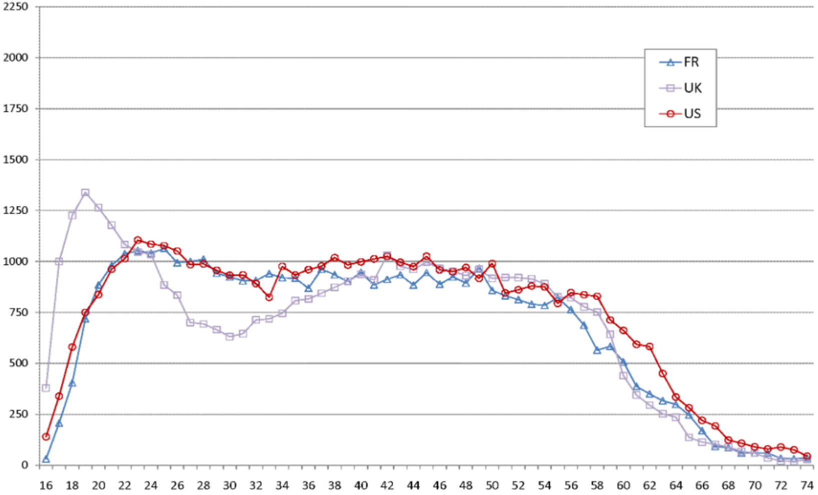


Blundell, Bozio, Laroque

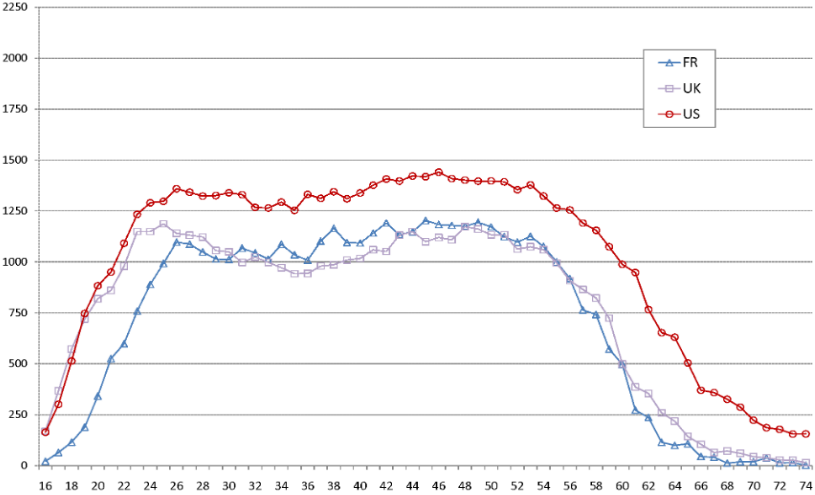


Blundell, Bozio, Laroque

A. Female 1977



B. Female 2007

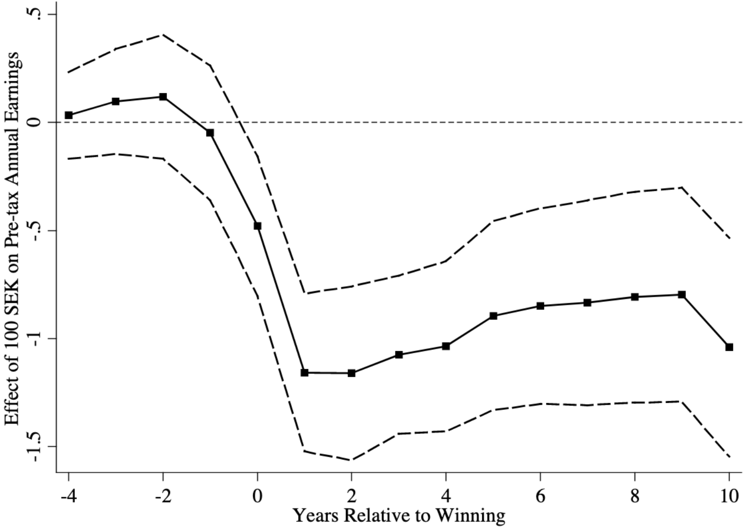


Estimates

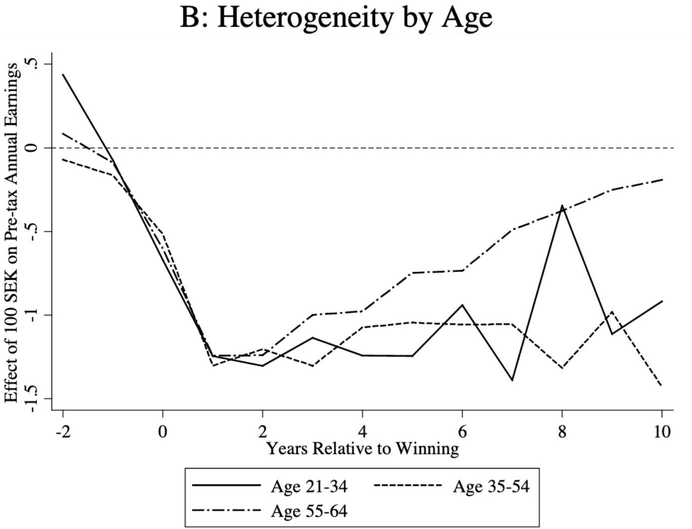
- In case you're curious about estimated elasticities
- Enormous controversy about all
- But what I find most convincing for aggregate hours:
  - Frisch: -0.75
  - Hicksian: -0.5
  - Income: -0.15
  - Marshallian: 0 to -0.2
- Some disagree!

Income Effect: Lottery

Figure 1. Effect of Wealth on Individual Earnings



Income Effect: Lottery

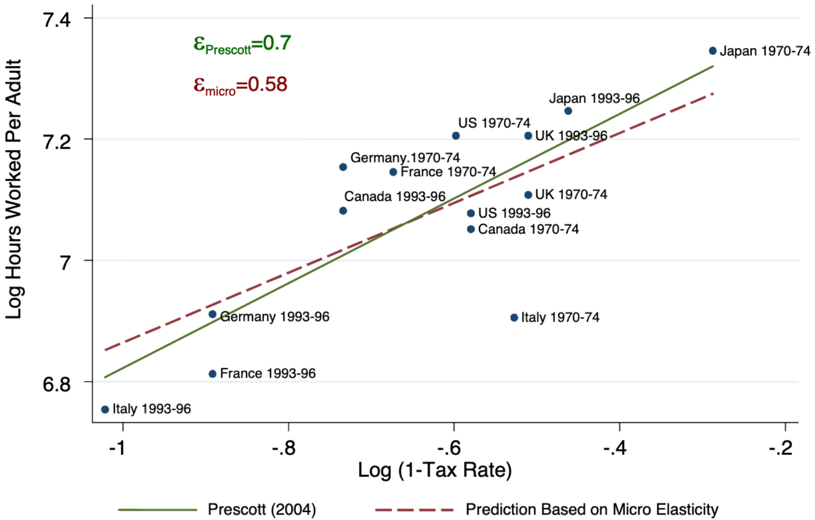


Prescott 2004: Hicksian Elasticities

Period	Country	Labor Supply* Actual	Labor Supply* Predicted	Differences (Predicted Less Actual)	Prediction Factors: Tax Rate τ	Prediction Factors: Consumption/Output (c/y)
1993–96	Germany	19.3	19.5	.2	.59	.74
	France	17.5	19.5	2.0	.59	.74
	Italy	16.5	18.8	2.3	.64	.69
	Canada	22.9	21.3	–1.6	.52	.77
	United Kingdom	22.8	22.8	0	.44	.83
	Japan	27.0	29.0	2.0	.37	.68
	United States	25.9	24.6	–1.3	.40	.81
1970–74	Germany	24.6	24.6	0	.52	.66
	France	24.4	25.4	1.0	.49	.66
	Italy	19.2	28.3	9.1	.41	.66
	Canada	22.2	25.6	3.4	.44	.72
	United Kingdom	25.9	24.0	–1.9	.45	.77
	Japan	29.8	35.8	6.0	.25	.60
	United States	23.5	26.4	2.9	.40	.74

Prescott 2004: Hicksian Elasticities

a) Aggregate Hours vs. Net-of-Tax Rates Across Countries (Prescott Data)



Chetty 2012

- There's a weird disconnect between micro studies and macro studies
- Chetty (2012) proposes it's because one is long-run/large variation (macro) and the other is small changes
- Big differences if there are optimization frictions
- How big do optimization frictions on hours have to be to reconcile the literatures?

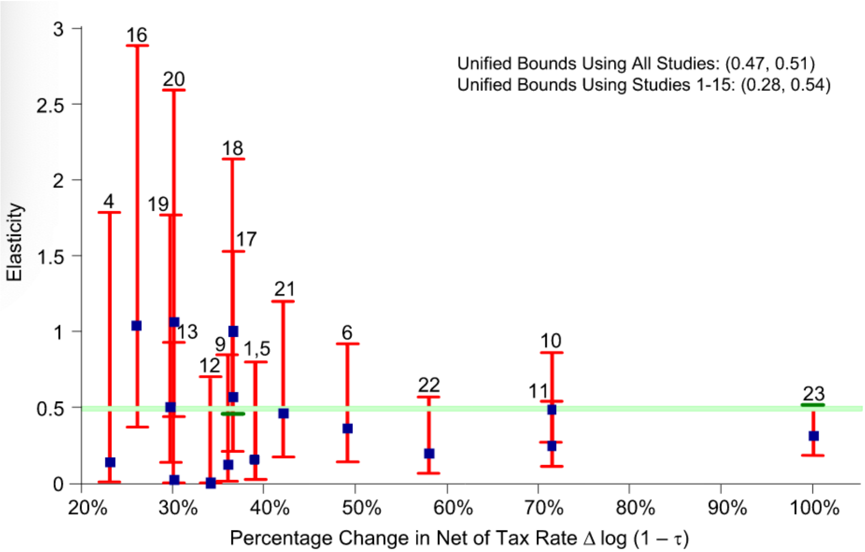
Chetty 2012

Study (1)	Identification (2)	$\hat{\varepsilon}$ (3)	s.e.($\hat{\varepsilon}$) (4)
A. Hours Elasticities			
1. MaCurdy (1981)	Life-cycle wage variation, 1967–1976	0.15	0.15
2. Eissa and Hoynes (1998)	U.S. EITC expansions, 1984–1996, men	0.20	0.07
3. Eissa and Hoynes (1998)	U.S. EITC expansions, 1984–1996, women	0.09	0.07
4. Blundell, Duncan, and Meghir (1998)	U.K. tax reforms, 1978–1992	0.14	0.09
5. Ziliak and Kniesner (1999)	Life-cycle wage, tax variation 1978–1987	0.15	0.07
	Mean observed elasticity	0.15	
B. Taxable Income Elasticities			
6. Bianchi, Gudmundsson, and Zoega (2001)	Iceland 1987 zero tax year	0.37	0.05
7. Gruber and Saez (2002)	U.S. tax reforms 1979–1991	0.14	0.14
8. Saez (2004)	U.S. tax reforms 1960–2000	0.09	0.04
9. Jacob and Ludwig (2008)	Chicago housing voucher lottery	0.12	0.03
10. Gelber (2010)	Sweden, 1991 tax reform, women	0.49	0.02
11. Gelber (2010)	Sweden, 1991 tax reform, men	0.25	0.02
12. Saez (2010)	U.S., 1st EITC kink, 1995–2004	0.00	0.02
13. Chetty et al. (2011)	Denmark, married women, top kinks, 1994–2001	0.02	0.00
14. Chetty et al. (2011)	Denmark, middle kinks, 1994–2001	0.00	0.00
15. Chetty et al. (2011)	Denmark tax reforms, 1994–2001	0.00	0.00
	Mean observed elasticity	0.15	

Chetty 2012

Study (1)	Identification (2)	$\hat{\varepsilon}$ (3)
C. Top Income Elasticities		
16. Feldstein (1995)	U.S. Tax Reform Act of 1986	1.04
17. Auten and Carroll (1999)	U.S. Tax Reform Act of 1986	0.57
18. Goolsbee (1999)	U.S. Tax Reform Act of 1986	1.00
19. Saez (2004)	U.S. tax reforms 1960–2000	0.50
20. Kopczuk (2010)	Poland, 2002 tax reform	1.07
	Mean observed elasticity	0.84
D. Macro/Cross Sectional		
21. Prescott (2004)	Cross-country tax variation, 1970–1996	0.46
22. Davis and Henrekson (2005)	Cross-country tax variation, 1995	0.20
23. Blau and Kahn (2007)	U.S. wage variation, 1980–2000	0.31
	Mean observed elasticity	0.32

Chetty 2012


Unified Bounds Using All Studies: (0.47, 0.51)
Unified Bounds Using Studies 1-15: (0.28, 0.54)
Elasticity
Percentage Change in Net of Tax Rate Δ log (1 – τ)
0
0.5
1
1.5
2
2.5
3
20%
30%
40%
50%
60%
70%
80%
90%
100%
16
20
18
4
19
17
21
13
9
1,5
12
6
10
22
11
23

Chetty 2012

- There's a weird disconnect between micro studies and macro studies
- Chetty (2012) proposes it's because one is long-run/large variation (macro) and the other is small changes
- Big differences if there are optimization frictions
- How big do optimization frictions on hours have to be to reconcile the literatures?

Bianci et al 2001

- Before 1988, Iceland taxed this year's income depending on last year's
- Normally, pay tax from 1986 in 1987's income, 1988 with tax base of 1987
- But switched in 1988, so in 1987, never pay taxes on 1987 income (1986 in 1987, 1988 in 1988).
- "Tax-free" year (but still paying taxes, just not punished for earning more)

Bianci et al 2001: Frisch Elasticities

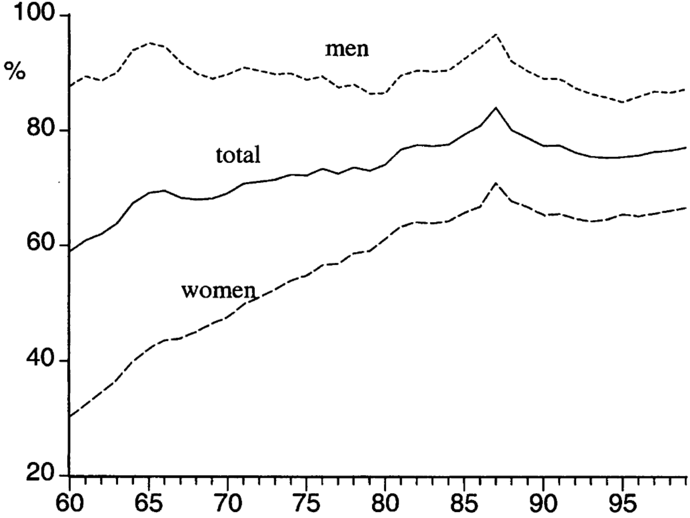
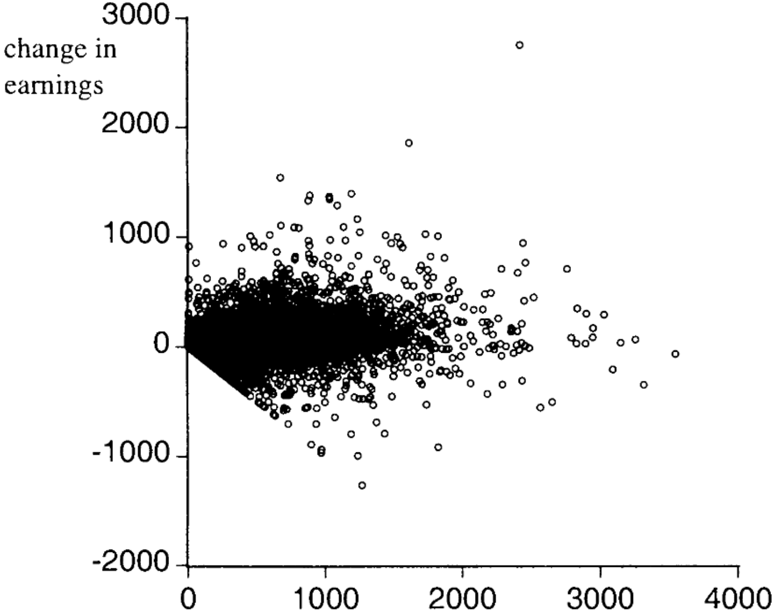


Figure 1. The Employment Rate in Iceland, 1960–1996

Bianci et al 2001: Frisch Elasticities



Bianci et al 2001: Frisch Elasticities

Table 3—Changes in Labor Supply (Percent) Relative to the Average of 1986 and 1988

	Weeks		Earnings	
	Male	Female	Male	Female
Entry and exit in 1987	−1.4	−0.6	0.0	0.2
Δweeks (Δearnings)	6.6	2.0	8.9	2.9
Entry in 1988	−0.2	−0.8	0.0	0.0
Sum	5.0	0.6	8.9	3.1
Both sexes	5.6		12.0	

Elasticity of male earnings of 0.8, much from extensive margin.

Takeaways

- It's easy to think theoretical labor econ is stupid...
- It isn't!
- My read: we've moved toward consensus, importance of "intensive" vs "extensive" and who (young/elderly, women) and optimization frictions