

# Labor Supply Responses and Adjustment Frictions: A Tax-Free Year in Iceland

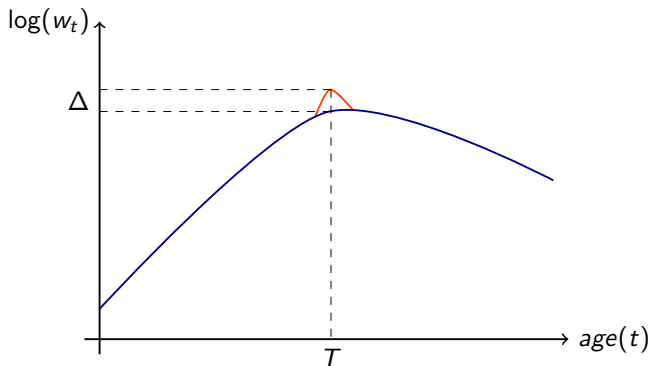
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February 2019

# How does labor supply respond to temporary wage changes?

**Frisch elasticity:** Elasticity of intertemporal substitution in labor supply



# Wide Range of Views on the Size of Frisch Elasticity

- **Macro** models of employment **require large elasticity**
- **Micro** estimates not conclusive, often **small or insignificant**

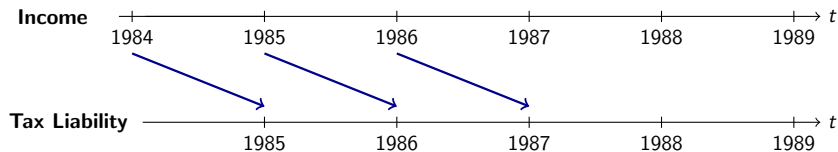
# Notoriously Difficult to Measure Frisch Elasticity

Requires **exogenous** and **transitory** wage changes

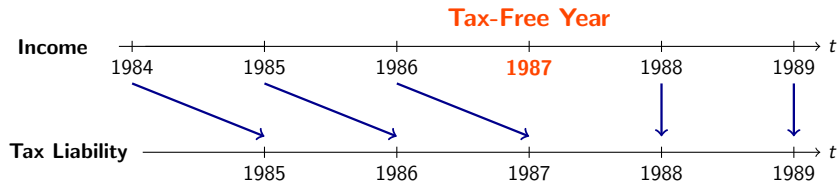
Labor supply responses attenuated by

- **Adjustment frictions**, unless wage changes are **large** (Chetty, 2012)
- **Inattentiveness**, unless wage changes are **salient** (Chetty et al., 2009)

# A Tax-Free Year on Iceland



# A Tax-Free Year on Iceland



# My Contribution

1. Create **employer-employee data** from digitized population records
2. **Two identification strategies**: One is “industry standard” and one is new
3. Estimate **Frisch** elasticities
4. Study the **mechanisms** behind the responses

# Empirical Strategy

		Adjustment Margins	
		Intensive	Extensive
Research Designs	Tax-Bracket DD		
	Life-Cycle DD		



		Adjustment Margins	
		Intensive	Extensive
Research Designs	Tax-Bracket DD	Labor supply elasticity   Adjustment frictions	Labor supply elasticity   Adjustment frictions
	Life-Cycle DD		

**Tax-Bracket DD**

**Life-Cycle DD**

## Adjustment Margins

**Intensive**

**Extensive**

Labor supply elasticity  
| Adjustment frictions

No estimate for bottom  
income group

Labor supply elasticity  
| Adjustment frictions

Cannot estimate entry  
responses

**Tax-Bracket DD**

**Life-Cycle DD**

## Adjustment Margins

**Intensive**

**Extensive**

Labor supply elasticity  
| Adjustment frictions

Labor supply elasticity  
| Adjustment frictions

Labor supply elasticity  
| Adjustment frictions  
± Equilibrium effects

Labor supply elasticity  
| Adjustment frictions  
± Equilibrium effects

Whole population

Entry and exit responses

**Tax-Bracket DD**

**Triple-Diff**

Combined design

**Life-Cycle DD**

## Adjustment Margins

**Intensive**

**Extensive**

Labor supply elasticity  
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 $\pm$  **Equilibrium effects**

Labor supply elasticity  
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 $\pm$  **Equilibrium effects**

# Preview of Results

- **Intensive margin** elasticity: 0.37
- **Extensive margin** semi-elasticity: 0.07

# Anatomy of Labor Supply Responses

## 1. Labor-market attachment

- Individuals with low labor-market attachment have very elastic labor supply

## 2. Job flexibility

- Workers in flexible jobs have much higher elasticities than constrained workers
- Constrained workers take up secondary-jobs

## 3. Family ties and coordination

- Married women more responsive than their husbands
- Husbands have a negative cross-elasticity to their wife's tax-cut

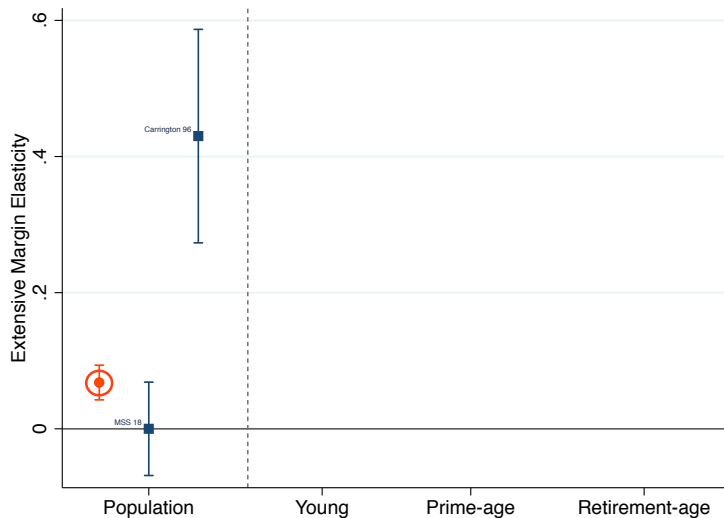
# Roadmap

- 1 Results in Context of Previous Work
- 2 Empirical Setting and Data
- 3 Tax-Bracket DD
- 4 Life-Cycle DD
- 5 Anatomy of Labor Supply Responses
- 6 Conclusion

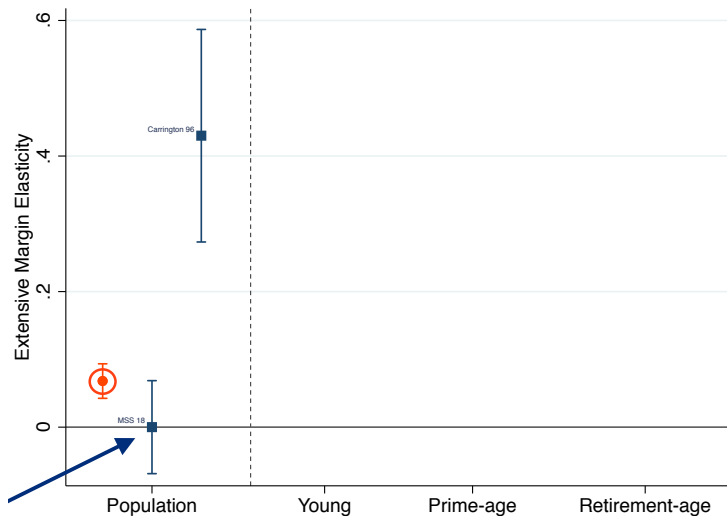
## Results in Context of Previous Work



# Extensive Margin



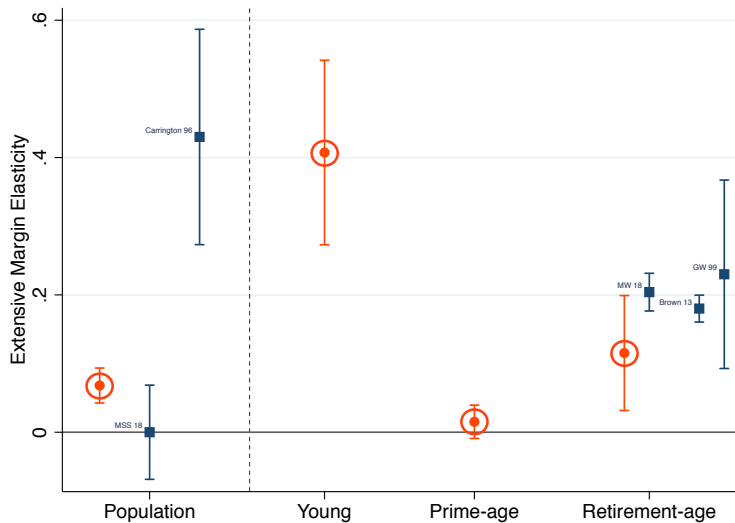
# Extensive Margin



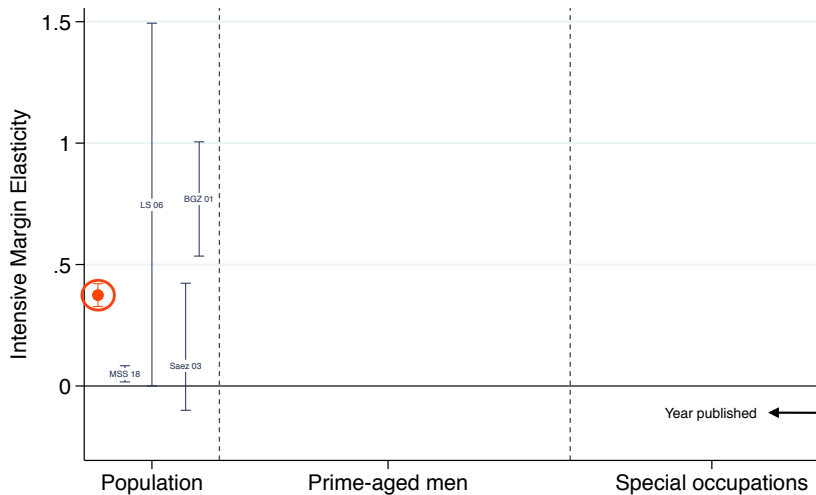
Martinez, Saez, and Siegenthaler (2018): 2 year tax holiday in Switzerland

[More](#)

# Extensive Margin

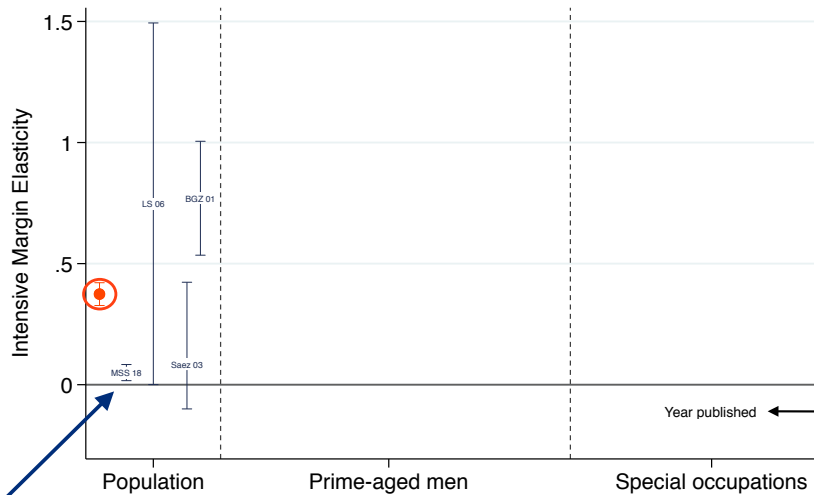


# Intensive Margin



Structural estimates

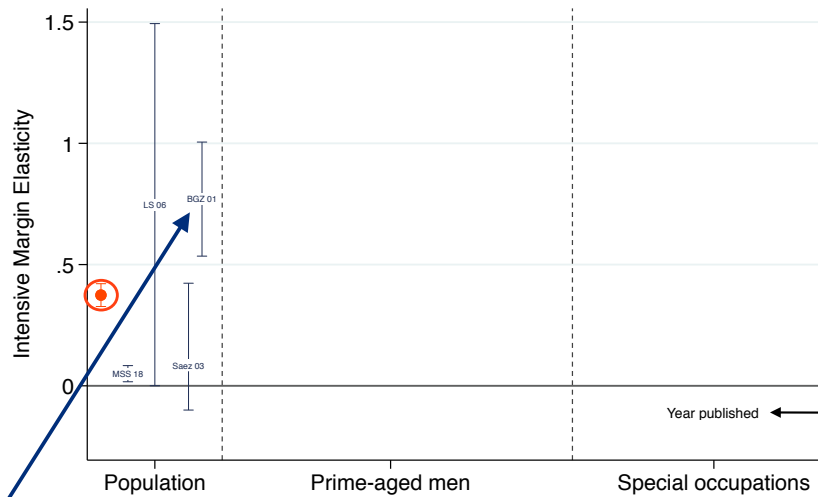
# Intensive Margin



Martinez, Saez, and Siegenthaler (2018): 2 year tax holiday in Switzerland

[More](#)

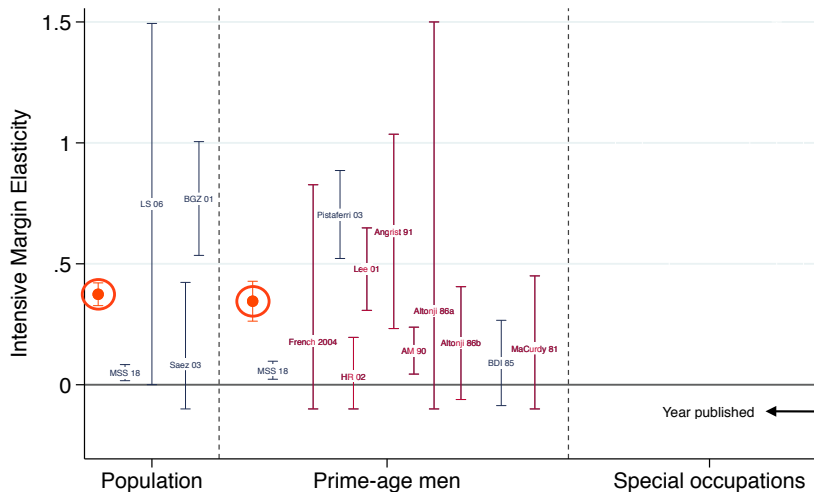
# Intensive Margin



Bianchi, Gudmundsson & Zoega (2001): More work in tax-free year than years before and after

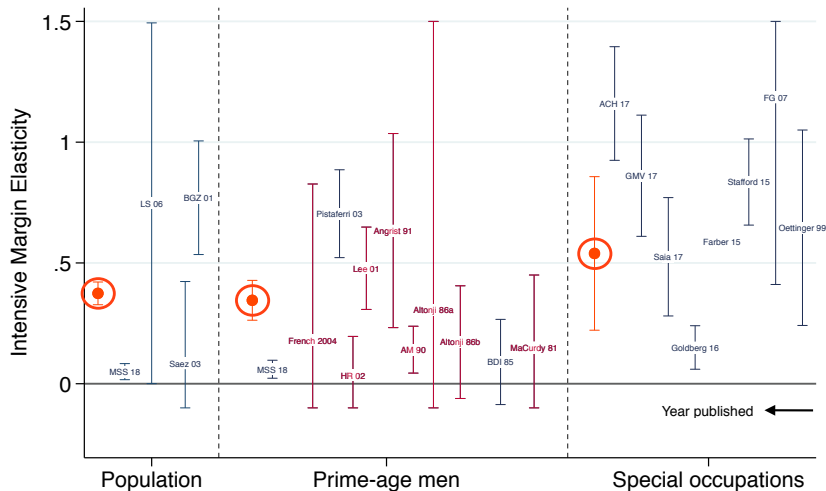
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# Intensive Margin



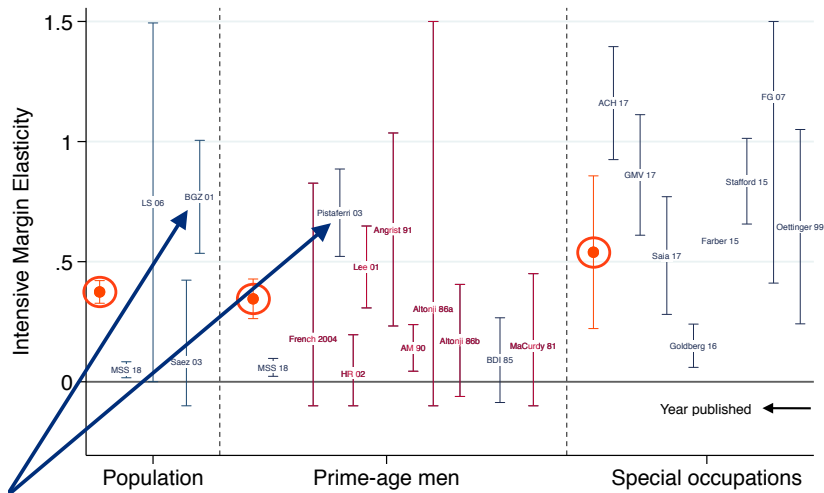
**Group instrument:** Age & education as instrument for wage changes

# Intensive Margin





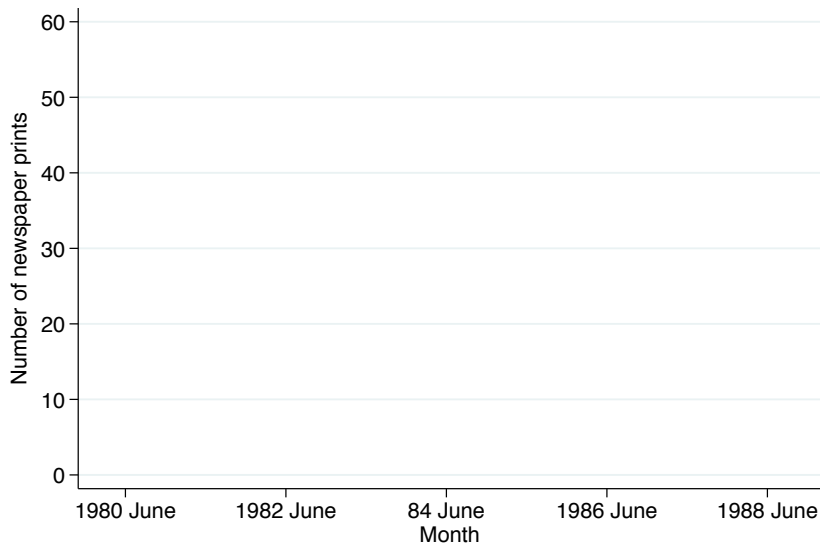
# Intensive Margin



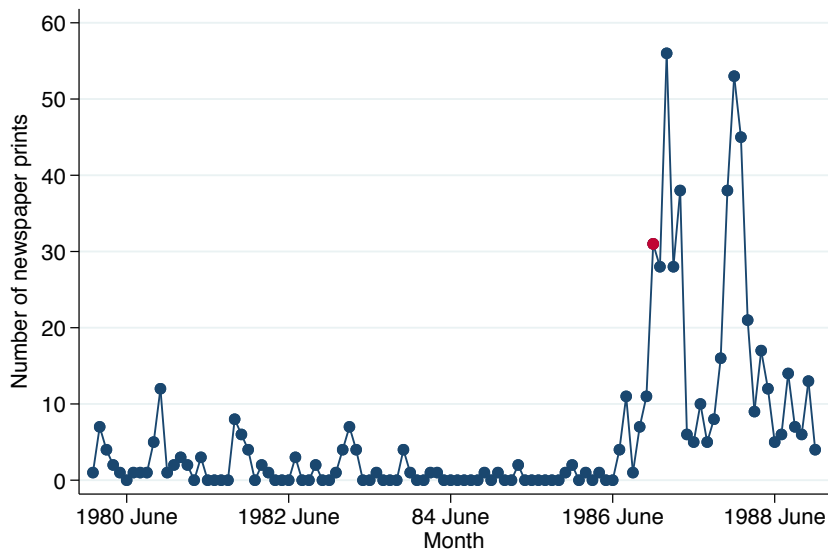
Meta analysis by Chetty et al. (2013) cites only two papers:  
 Bianchi, Gudmundsson & Zoega (2001) and Pistaferri (2003)

## Empirical Setting and Data

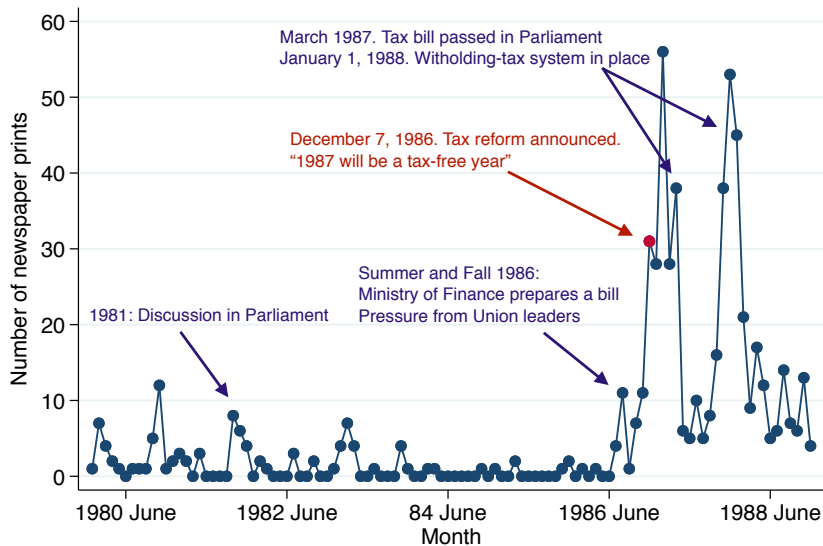
# Time-Line of Events



# Time-Line of Events



# Time-Line of Events



[More](#)

# Salient, Simple and Large Incentive

## 1. **Salient and simple** tax reform

- **All labor earnings** in 1987 tax-free

## 2. **Large** decrease in taxes

- Net-of-tax wages increased by about 20% on average

⇒ Important for identifying behavioral responses under **adjustment frictions** and **inattentiveness**



**I construct a new dataset** from admin records for the working-age population

1. Employer-employee data from **payslips**

- **Digitized payslips back to 1981** – one slip per job
- **All pay**: Wage earnings, contractor pay, commission and bonuses etc.
- **Working time** in weeks – 1 week: 40 hours
  - Full-time job: 52 weeks
  - Two parallel part-time jobs:  $26+26 = 52$  weeks
- Information about jobs and firms (occupation, sector, ...)

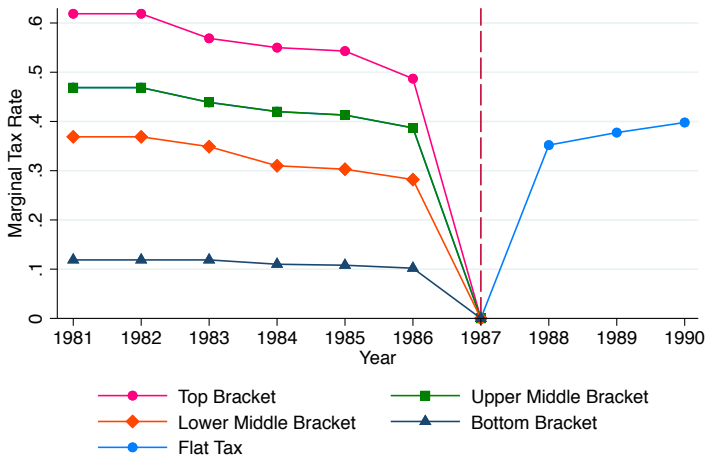
2. Individual **tax records**

- All sources of income, assets, debt, taxes and transfers, back to 1981
- Construct a “tax calculator” for marginal tax rates



## Tax-Bracket Difference-in-Differences

# Research Design: Difference in treatment intensity



Bracket thresholds

# Treatment Status, Sample & Measures of Labor Supply

## Assigning treatment status

- Tax bracket in year  $t$  is endogenous to income in  $t$ 
  - Assign treatment status based on bracket in  $t - 1$  (Feldstein 1995; Gruber-Saez 2002)
  - Treatment intensity: bottom bracket as main control group

## Sample and restrictions

- Restrict sample to core labor force pre-reform
  - Balanced sample – workers observed in all years
  - Pre-reform earnings above *base income* (low-skilled minimum wage)

More

## Measures of labor supply

- Labor earnings; Weeks worked; Employment (earnings  $\geq$  base income)

Tax bracket persistence

# Estimating Equation

$$y_{it} = \text{bracket}_{it-1} + \delta_t + \epsilon \cdot \log(1 - \tau_{it}) + \mathbf{X}'_{it}\gamma + \nu_{it}$$

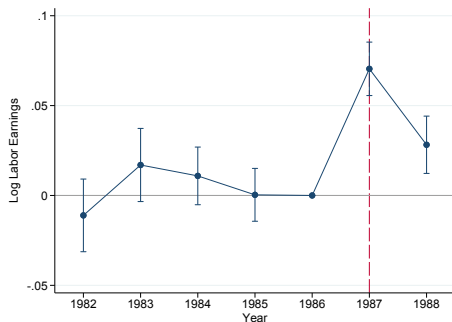
where:

- $\text{bracket}_{it-1}$  are tax-bracket indicators
- $\delta_t$  are common time fixed effects and  $\mathbf{X}_{it}$  is a vector of controls
- $y_{it}$  measures individual  $i$ 's labor supply in year  $t$
- $\epsilon$  **identifies elasticity**: net-of-tax rate instrumented with  $D_{it-1} \times \delta_{t=1987}$

## Identifying Assumption:

- Absent a tax-free year, labor supply of workers in high and low tax brackets would **run parallel**

# Reduced-Form: Labor Earnings & Weeks Worked



(a) Labor Earnings



(b) Weeks Worked

$$y_{it} = \text{bracket}_{i,t-1} + \delta_t + \sum_{t=1982}^{1988} \eta_t \cdot (D_{i,t-1} \times \delta_t) + \mu_{it}$$

Graphical evidence - Earnings

Graphical evidence - Weeks

# Labor Supply Responses

	Earnings (1)	Weeks (2)	Employment (3)
2SLS DD estimate	0.374*** (0.024)	4.926*** (0.784)	-0.033 (0.024)
Reduced form estimate	0.077*** (0.005)	1.023*** (0.162)	-0.004 (0.003)
First stage estimate	0.207*** (0.001)	0.207*** (0.001)	0.127*** (0.001)
Mean of outcome variable	—	48.43	0.914
Observations	526,955	520,438	530,397

*Notes:* Controls are gender, age, education, marital status, whether living in the capital area or not, number of children at age 0-18. Tax rate,  $\tau$ , is marginal tax rate in cases of earnings and weeks, but average tax rate in case of employment, computed as tax payments divided by tax-base. Robust standard errors clustered by individual in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

- Elasticity of weeks worked: 0.10 (5/48.4)

# Labor Supply Responses

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## Decomposition:

- **More weeks** (more daytime work, less vacation etc): **30%**
- More earnings **within weeks** (over-time, effort etc): **70%**

# Self-Employed Are More Responsive — More Flexibility

	Wage earners		Self-employed	
	Earnings (1)	Weeks (2)	Earnings (3)	Weeks (4)
2SLS DD estimate	0.373*** (0.027)	2.337*** (0.787)	0.484*** (0.057)	10.127*** (2.180)
Reduced form estimate	0.076*** (0.005)	0.480*** (0.161)	0.103*** (0.012)	2.161*** (0.464)
First stage estimate	0.205*** (0.001)	0.205*** (0.001)	0.191*** (0.003)	0.191*** (0.003)
Mean of outcome variable	—	46.62	—	58.61
Observations	448,592	441,961	78,363	78,477

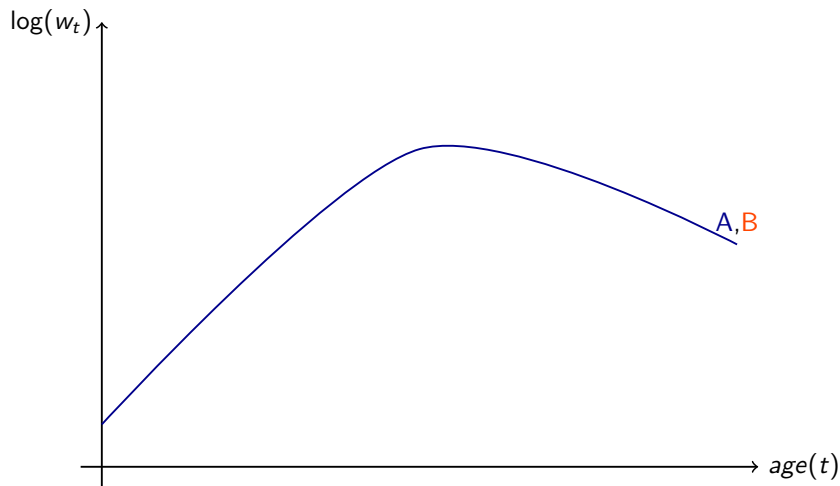
## Evidence of real responses:

- Wage earnings 94% of effect; Commission, bonuses etc less than 1% [Table](#)
- Positive effect on capital income [Table](#)      Fewer hours of sick-leave [Figure](#)

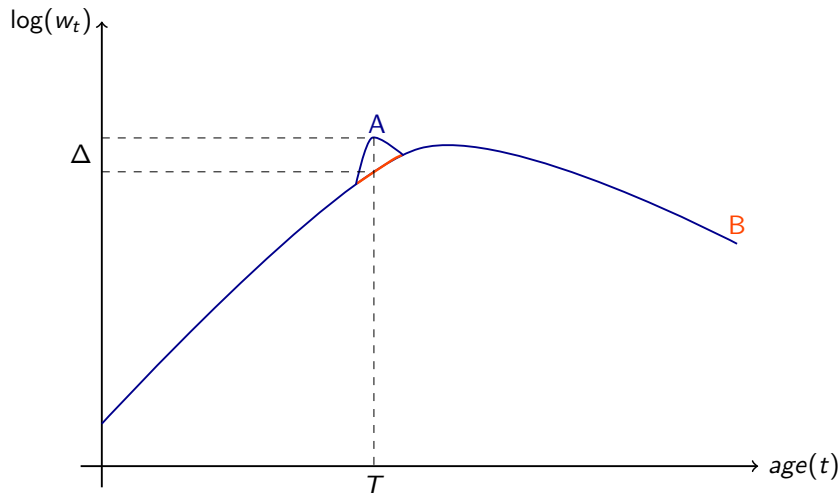


## Life-Cycle Difference-in-Differences

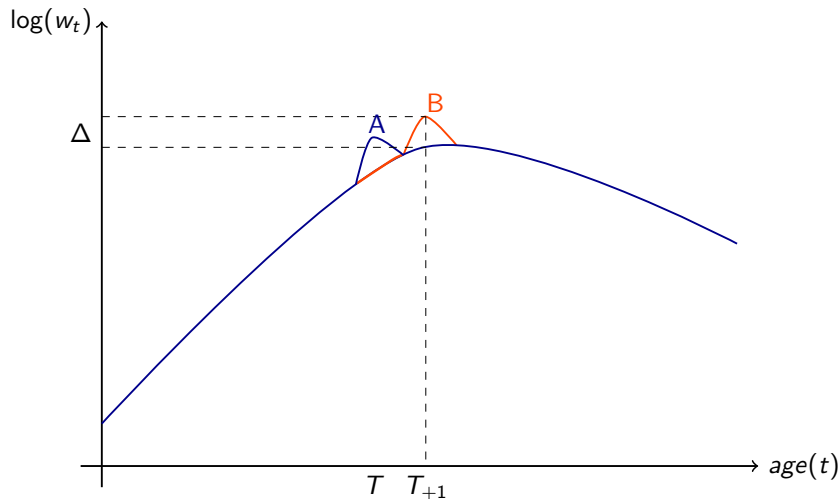
# MaCurdy (1981)



# MaCurdy (1981)



# My Setting



At age  $T$ , **A** is **treated** and **B** is a good **counter-factual**

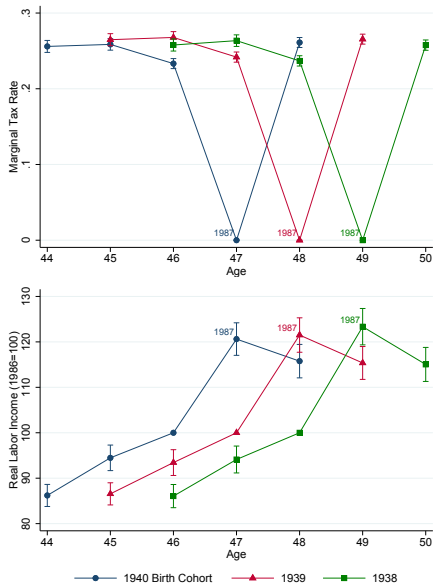
# Empirical Strategy

## Matched Difference-in-Differences:

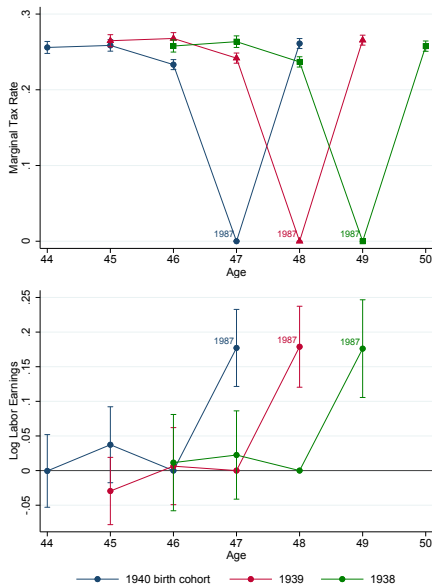
Compare individuals in adjacent birth cohorts **when they are of same age** when some have a tax-free year but others don't

- Tax-free year was an **exogenous and unpredictable** event
- Find similar individuals by **exact matching** within adjacent birth-cohort pairs
  - Pre-treatment characteristics that may correlate with trends in labor supply
  - Gender, marital status, number of children, education, location and income decile

# Graphical Evidence: Labor Earnings

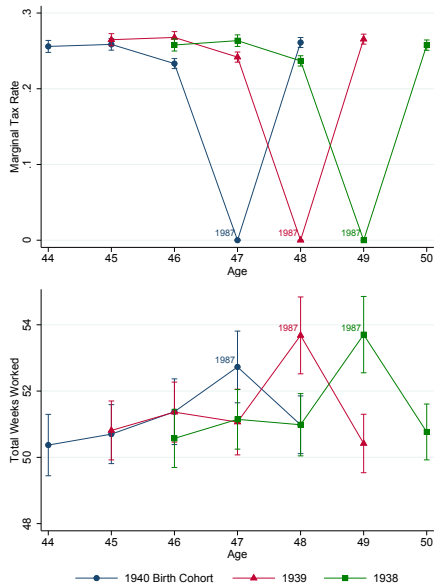


# Graphical Evidence: Labor Earnings



[More](#)

# Graphical Evidence: Weeks Worked





# Labor Supply Responses

	Earnings (1)	Weeks (2)	Employment (3)
2SLS DD estimate	0.654*** (0.016)	3.014*** (0.345)	0.068*** (0.013)
Reduced form estimate	0.145*** (0.003)	0.670*** (0.077)	0.008*** (0.001)
First stage estimate	0.209*** (0.002)	0.209*** (0.002)	0.110*** (0.001)
Mean dependent variable	–	38.37	0.672
Number of observations	546,434	537,774	587,332

Notes: Estimating equation:

$$y_{ik} = \alpha_c + \delta_k + \varepsilon \cdot \log(1 - \tau_{ik}) + \mathbf{X}'_i \gamma + \nu_{ik}$$

where  $\alpha_c$  and  $\delta_k$  are, respectively, birth cohort and event-time fixed effects. All regressions include match strata fixed effects.  $\tau$  is average tax rate in case of employment, but marginal otherwise. Robust standard errors clustered at the match-strata level are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Earnings

Weeks

Employment

Placebo tests

# Summary of Frisch Elasticity Estimates

	Intensive	Extensive
Tax-Bracket DD	0.374*** (0.024)	-0.033 (0.024)
Life-Cycle DD	Intensive & Extensive 0.654*** (0.016)	
		0.068*** (0.013)

# Summary of Frisch Elasticity Estimates

	Intensive	Extensive
Tax-Bracket DD	0.374*** (0.024)	-0.033 (0.024)
Life-Cycle DD	0.529*** (0.010)	0.068*** (0.013)
	<b>Intensive &amp; Extensive</b> 0.654*** (0.016)	

# Summary of Frisch Elasticity Estimates

	Intensive	Extensive
<b>Tax-Bracket DD</b>	0.374*** (0.024)	-0.033 (0.024)
<b>Triple-Diff</b> Combined design		
<b>Life-Cycle DD</b>	0.529*** (0.010)	0.068*** (0.013)
	<b>Intensive &amp; Extensive</b> 0.654*** (0.016)	

Triple-Diff intensive-margin: **0.431\*\*\***

⇒ Equilibrium effects  $\approx 0.10$

## Anatomy of Labor Supply Responses

# What Factors Shape Labor Supply Responses?

Many existing theories – How to direct attention in **most productive directions?**

- **One answer:** “Let the data speak” — use machine-learning as a guide

# What Factors Shape Labor Supply Responses?

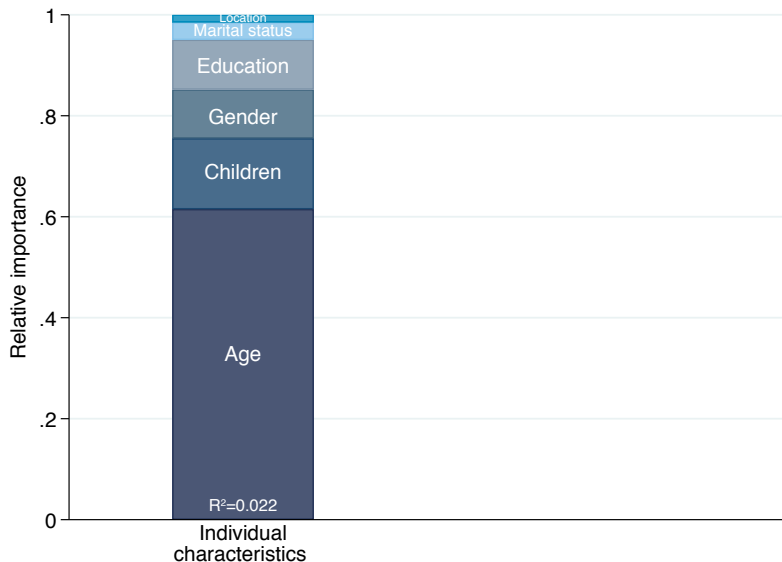
Many existing theories – How to direct attention in **most productive directions?**

- **One answer:** “Let the data speak” — use machine-learning as a guide

My approach

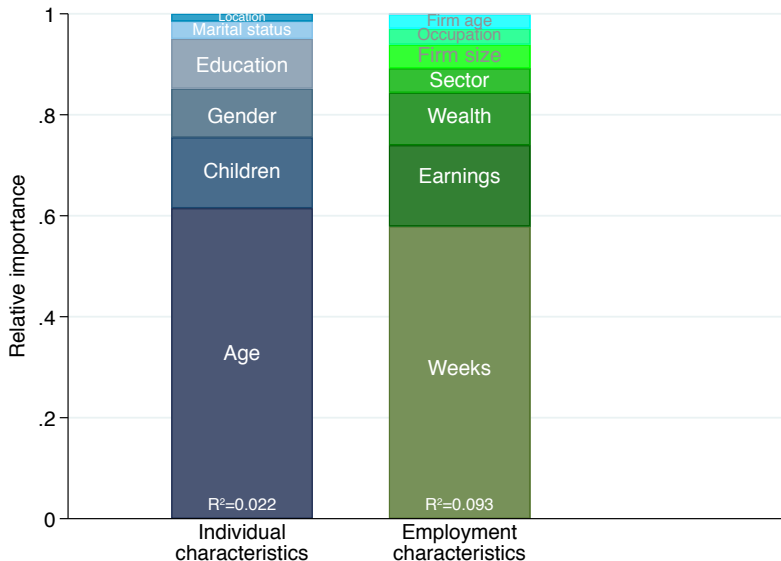
1. Estimate labor supply elasticities at the individual level (matched DD)
2. Rank characteristics by their **importance** using **Random Forest** (Breiman, 2001)
3. Causal estimation **directed by importance**

# Importance of Characteristics

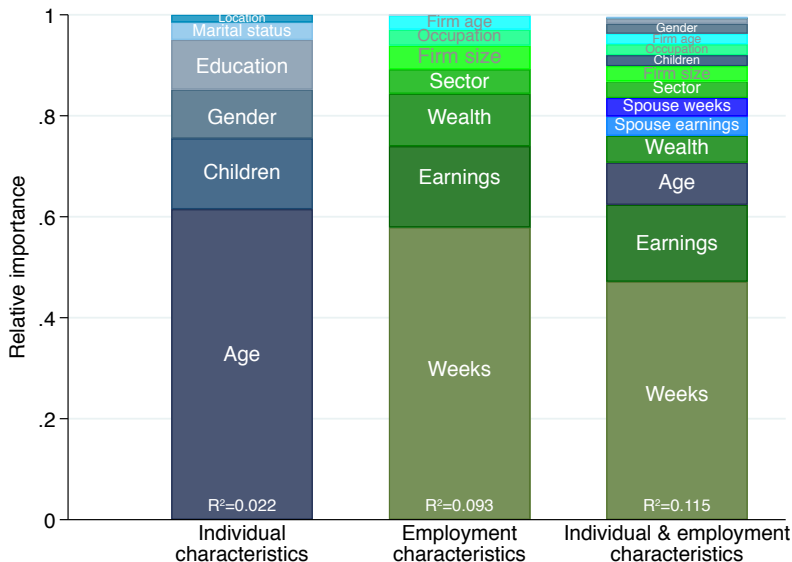




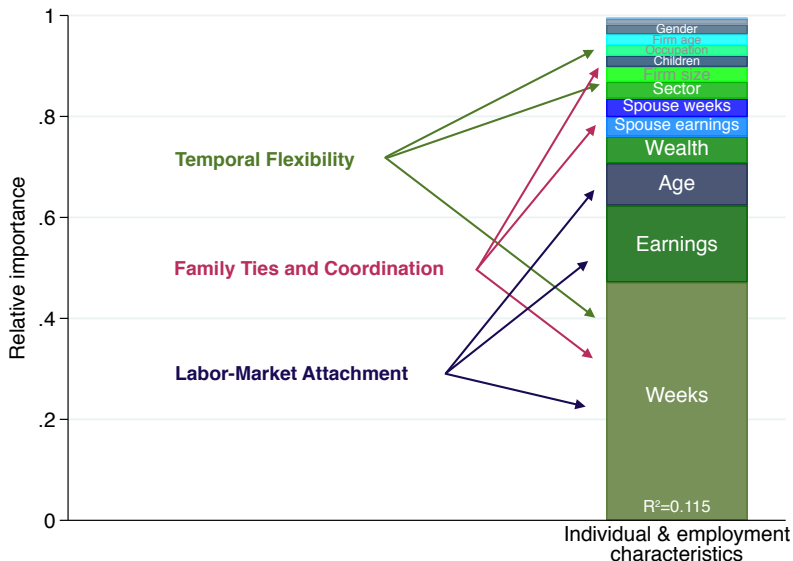
# Importance of Characteristics



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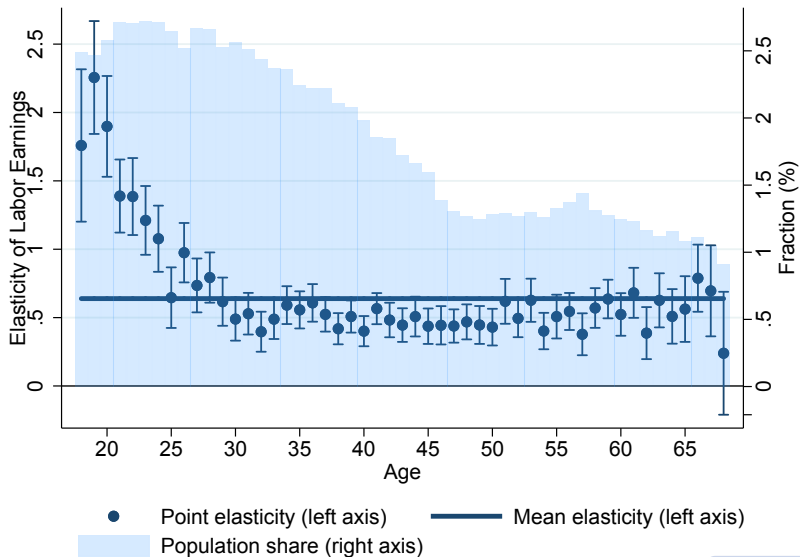
# Importance of Characteristics



# Overview: Three Directions

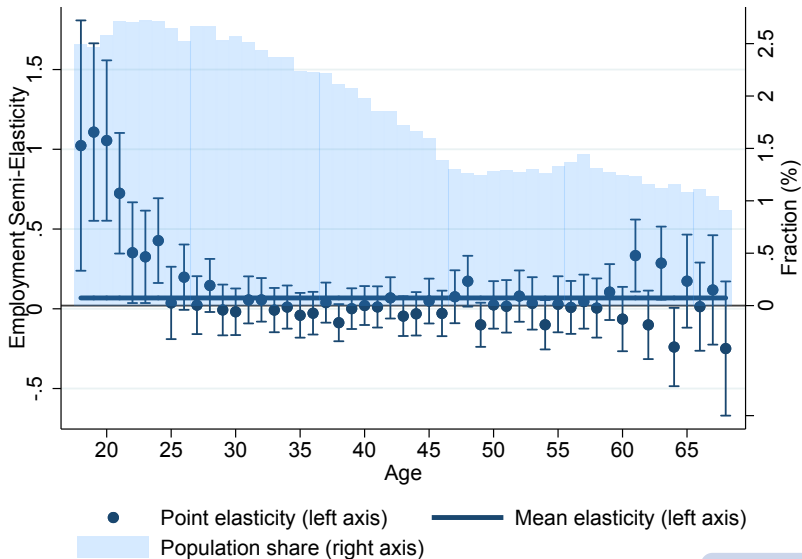
1. **Labor-Market Attachment**
2. Temporal Flexibility
3. Family Ties and Coordination

# Labor Earnings Elasticity by Age



Pre-reform weeks

# Employment Elasticity by Age



Pre-reform weeks

# Overview: Three Directions

## 1. Labor-Market Attachment

- Young cohorts enter the labor market [More](#)
- Old cohorts delay retirement

## 2. Temporal Flexibility

## 3. Family Ties and Coordination

# Overview: Three Directions

1. Labor-Market Attachment
2. **Temporal Flexibility**
3. Family Ties and Coordination



# Adjustment Frictions

Canonical model: Workers can flexibly choose whether and how much to work

- Much work cast doubt on this assumption

- **Adjustment costs** and **Hours constraints** (Hausman, 1980; Ham, 1982; Cogan, 1981; Altonji and Paxson, 1988,1992; Lundberg, 1985; Dickens-Lundberg, 1993; ...)
- Differences in **temporal flexibility** across jobs (Goldin, 2014; Goldin and Katz, 2016; Mas and Pallais, 2017; Hall and Krueger, 2018)

What are the effects of these frictions on labor supply responses?

# Temporal Flexibility

Measure: **Working time dispersion within occupation** in pre-reform years

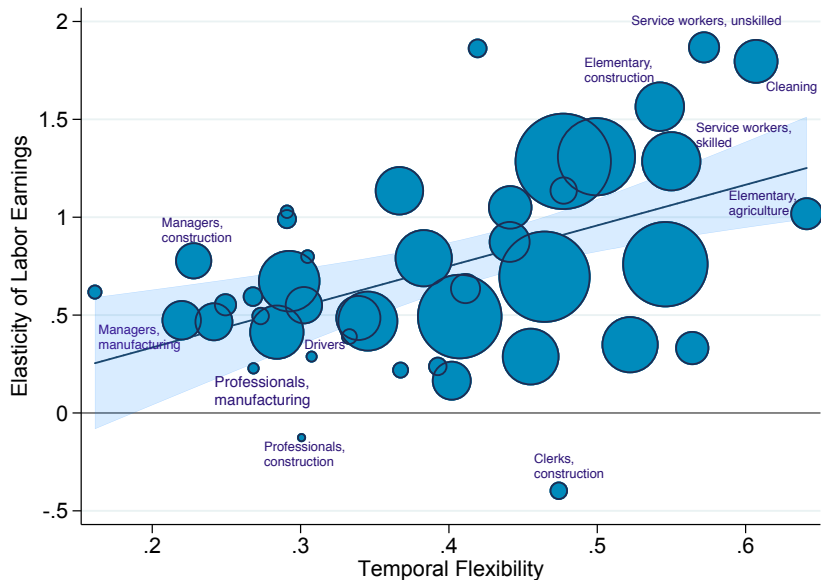
## Large dispersion in working time:

- Easy to switch between part-time & full-time – Pharmacists (Katz-Goldin, 2016)
- Easy to take on additional shifts – Uber drivers (Hall and Krueger, 2018)

$$\text{Coefficient of variation: } CV(\text{weeks}_{ot}) = \frac{\sigma_{ot}}{\mu_{ot}}$$

- **Most flexible:** Service workers (e.g. restaurants), cleaning, elem. agriculture
- **Most rigid:** Managers (manufacturing, construction) [More](#)

# Temporal Flexibility

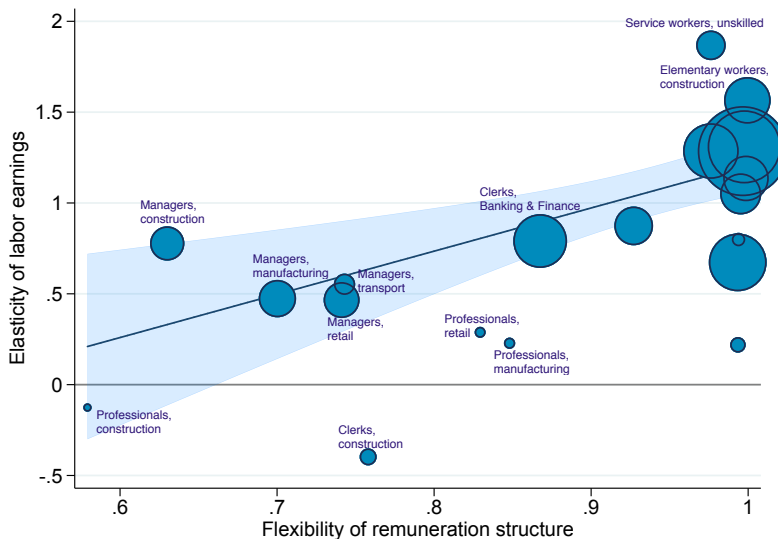


# Hours Constraints

Measure of hours constraints: **Fixed monthly salary**

- Occupation shares based on detailed data on wages and hours [More](#)
- No public sector and not all private sectors and occupations
- **Highest**: Professionals (e.g. engineers) and managers
- **Lowest**: Elementary workers in construction, manufacturing and services

# Hours Constraints: Fixed-Salary Share by Occupations



- Alternative measure: Working 52 weeks in primary job pre-reform

Table

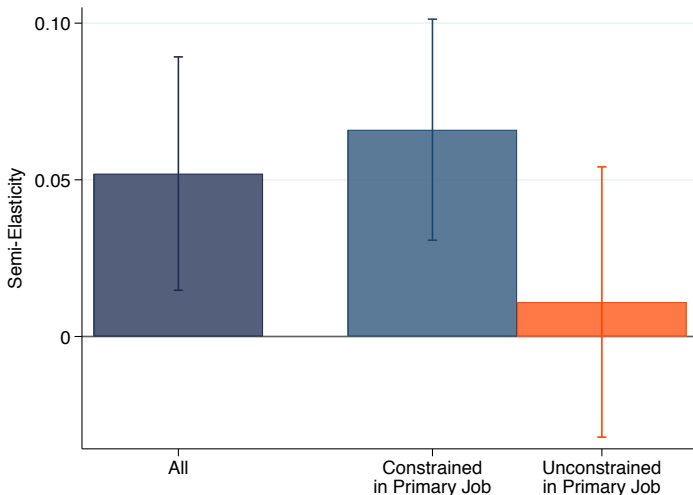
# Overcoming frictions

Sizable responses for workers even in relatively rigid jobs

– How do they overcome frictions?

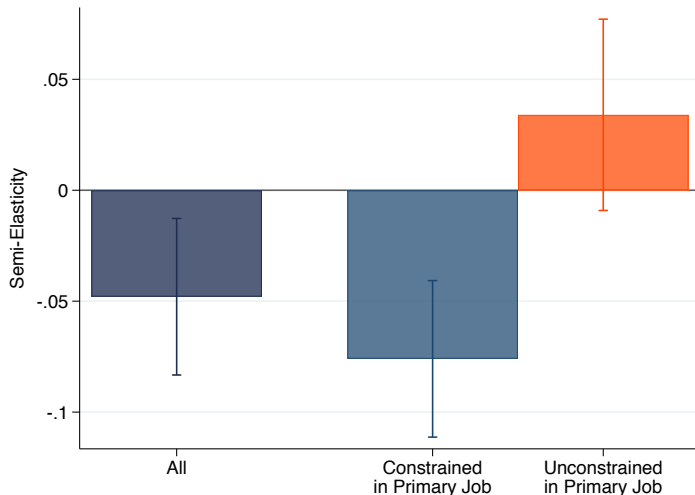
- Hours may be flexible **across jobs** but rigid within jobs (Altonji-Paxson, 1988; 1991)
- Take up **second job** (moonlight) (Shishko-Rostker, 1976; Paxson-Sicherman, 1996)

# Secondary-Job Holding



- Constrained in Primary Job: Working 52 weeks in primary job pre-reform

# Primary-Job Changes



- Constrained in Primary Job: Working 52 weeks in primary job pre-reform



# Decomposition of Labor Supply Responses



[Details](#)

# Overview: Three Directions

1. Labor-Market Attachment
2. Temporal Flexibility
3. **Family Ties and Coordination**

# Husbands, Wives and Family Ties

Studies frequently find larger labor supply elasticities for women than men

(Blundell and MaCurdy, 1999; McClelland and Mok, 2012)

- Do gender differences reflect family ties and coordination in the household?

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Interdependencies in couples' labor supply

1. Couples enjoy spending time together – **leisure times are compliments**
2. Husbands and wives are **substitutes in home production** (Becker, 1965)
3. **Income effect** if spouse's income is used for public goods in the family

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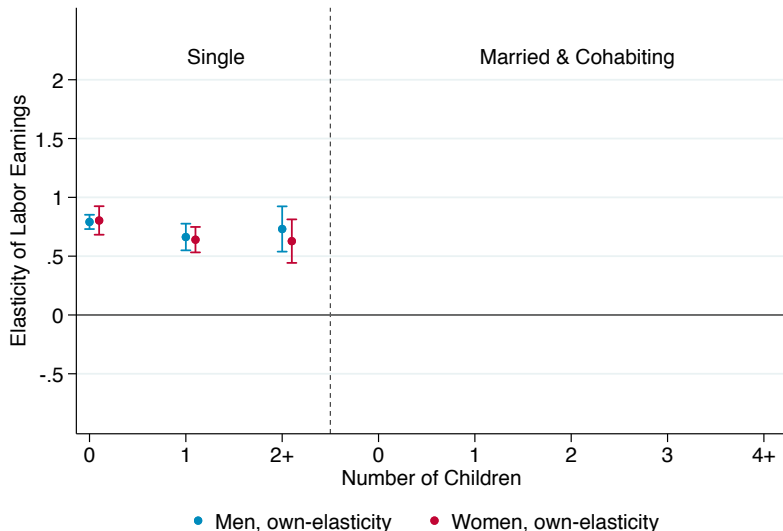
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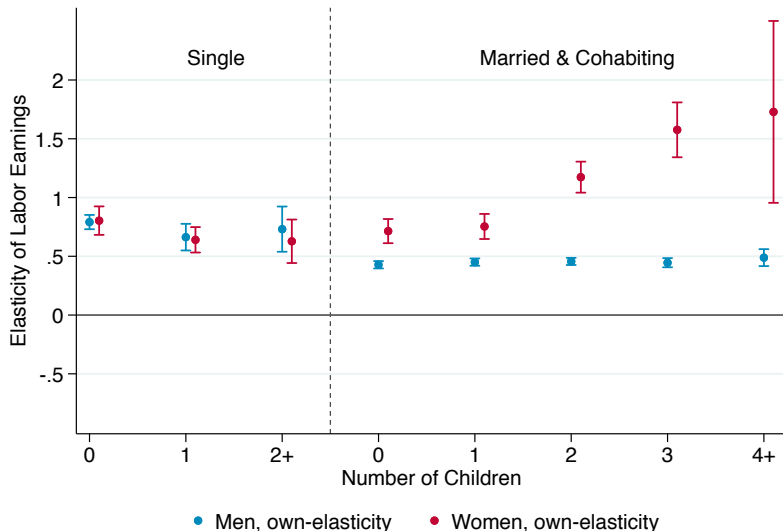
Estimate **own- and cross-elasticities** for husbands and wives

- Individual taxation: Independent variation in taxes across spouses [More](#)

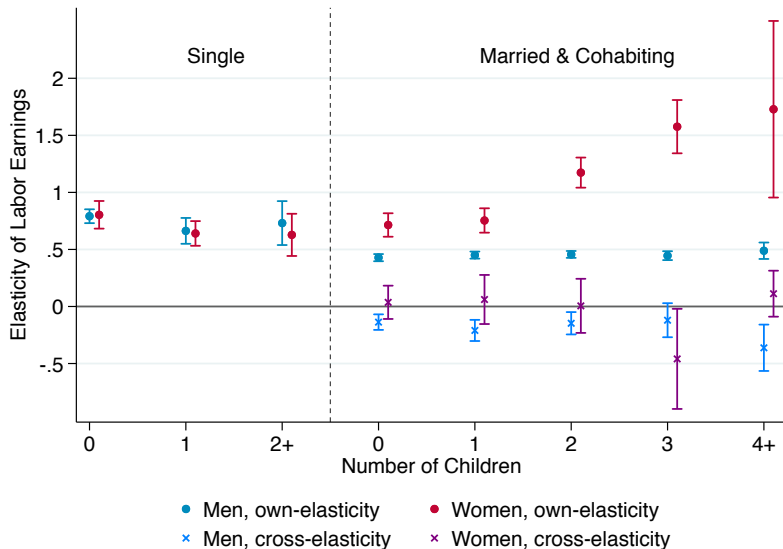
# Marital Status and Number of Children



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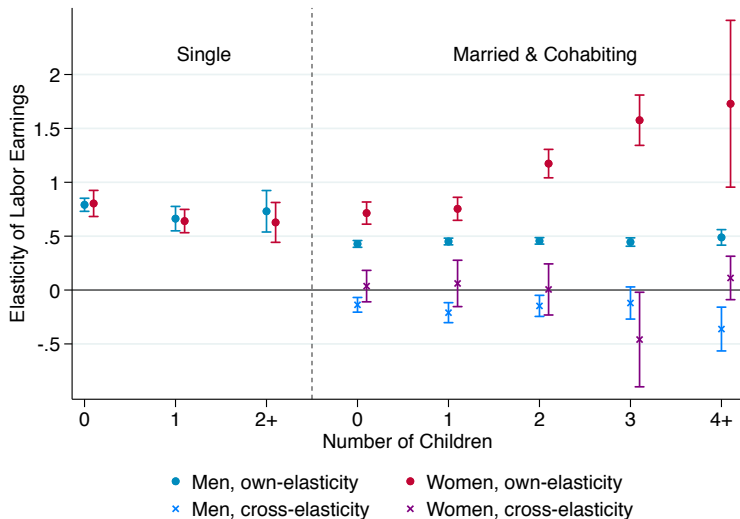


# Marital Status and Number of Children





# Marital Status and Number of Children



**Reorganization** of work: Full-time spouse respond less – Part-time more

Figure

**Substitutability** at home: Young & middle-aged men with (young) children

Table

## Conclusion

# Summary

## People do respond to temporary work incentives

- Work more weeks & hours – earn more income
- Young cohorts enter labor market, older cohorts delay retirement

## Size of average & aggregate responses likely to differ across settings

- Demographic and labor-market structure
  - Extensive margin depends of population share of young and old
  - Young, old, married women (w. more children), flexible-job holders more likely to be in lower tax brackets
- Equilibrium effects and social multipliers
  - Household responses 23% lower than if spouses were treated in isolation
  - Demand for cleaning, child care, restaurant services enables more work

# Going Forward

## Permanent effects of a temporary incentive

- Students delay schooling and some drop out permanently [More](#)
- Exchange higher income in future for income today
- What are the long-term consequences of this decision?

## Consumption and savings

- Labor supply responses generate transitory increase in earnings
- How do households consume and save out of this income?
- Full picture of households' intertemporal behavior

Thank you

## Appendix