

# Razlozi opadanja osjetljivosti ponude rada udanih žena na promjene u razini plaće

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# Explaining the declining labor supply responsiveness of married women

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Statistics Norway

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# Background

- Consensus: the labor supply response of married females are more responsive than that of married males
- But some studies find that the labor supply responses of married females are approaching those of married males
  - ▶ Blau and Kahn (2007); Heim (2007)
- Explanations to the response decline for married females
  - ▶ More career orientation (Blau and Kahn, 2007; Goldin, 2006, 2014)
  - ▶ Heim (2007): small effect of changing demographic characteristics – point to preference shifts
- But no studies have systematically discussed causes behind the decline
- Information on responses important for policy-making

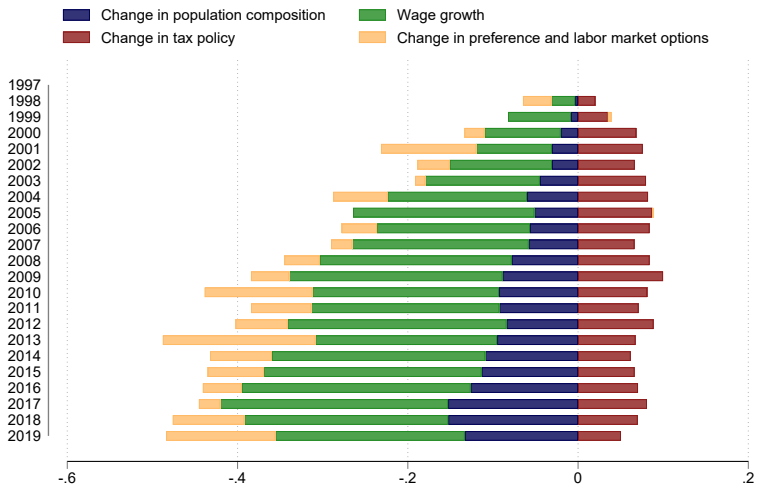
# Contribution of the paper

- Do we see declining female responsiveness in Norway too?
  - ▶ Repeated estimations of structural discrete choice model 1997–2019 used to obtain (simulated) wage elasticities
- Explaining the downward trend in elasticities
  - ▶ Use the repeated cross-sectional evidence and decomposition procedure to discuss explanations
  - ▶ Discuss effects of demographic composition change, wage rate growth, tax policy change, preference shift and change in opportunities in the labor market
- Show results for the Hicksian elasticity too
  - ▶ A challenge to obtain Hicksian elasticities by discrete choice model

# Preview of results

- We find a clear decline in the Marshallian (average) elasticity of married females
  - ▶ Down from approx 0.7 in 1997 to below 0.3 in 2019
  - ▶ Still it is above married males – stable at around 0.1
- Wage rate growth is the most important explanation to the decline
- Hicksian elasticity shows a decline too

# Preview of main result



# Overview of presentation

- Presentation of the discrete choice labor supply model
- Description of the decline in the responsiveness of married females
- Results of procedure to obtain explanations to the decline
- Evidence for the Hicksian elasticity

A discrete choice labor supply model is used



# Controversy concerning structural models

- Concerns about model's ability to generate robust predictions
  - ▶ An influential paper by LaLonde (1986) demonstrated the weakness of “econometric evaluations”
- Quasi-experimental research designs have become popular
- Discussion in the literature about advantages of different approaches involving influential people
  - ▶ Angrist and Pischke (2010); Heckman (2010); Deaton, 2010
  - ▶ Imbens (2010): “Better LATE than nothing”
- In the Norwegian policy-making context
  - ▶ Policy-makers access to simulation results by structural labor supply model – the model presented here
  - ▶ Are in the process of establishing a simulation device based on “external evidence” too – incl estimates from quasi-experiments

# Discrete choice labor supply models

- Departs from random utility model as a basis for discrete choice modeling (McFadden, 1984, 2001)
- A discrete choice of working hours
  - ▶ Choose between  $\langle 0 - 5, 5 - 10, 10 - 15, \dots, 50 - 55 \rangle$
- Discrete choice labor supply model based on stochastic utility theory (van Soest, 1995; Aaberge et al., 1995) have become popular in practical work
  - ▶ Practical tool to deal with nonlinear and non-convex economic budget constraints

# A particular discrete choice model – the job choice model (Dagsvik, 1994; Dagsvik et al., 2014)

- Agents have preferences for consumption ( $C$ ), working hours  $h$ , and type of job ( $z$ )
- The job choice model builds on agents choosing a job  $z$  within a discrete alternative,
- Individual preferences:  $U(C, h, z) = v(C, h) + \varepsilon(z)$  where  $v$  is a deterministic part and  $\varepsilon(z)$  is a random variable
- Economic budget constraint ( $w$ =wage,  $I$ =non-labor income,  $T$ =tax):  $C = wh + I - T(wh, I) \equiv f(wh, I)$

# The job choice model, cont'd

- The terms  $\{\varepsilon(z)\}$  are assumed to be i.i.d. across individuals and across jobs for given  $h$  with the Gumbel cumulative distribution function
- Sources of uncertainty
  - ▶ Unobservable attributes, unobservable individual-specific characteristics, measurement errors, functional misspecification, bounded rationality, etc

## Job choice model, cont'd

$B(h)$  denotes the agent's set of available jobs with hours of work  $h$

Agent chooses job  $z$  in  $B(h)$  if the utility of this job,  $v(f(hw, I), h) + \varepsilon(z)$ , is higher than (or equal to) the utility of all other jobs/options available

## Job choice model, cont'd

We are interested in the probability that the agent shall choose any job within  $B(h)$ ,  $\phi(h)$ , obtained by summing the choice probability over all alternatives within  $B(h)$

$$\phi(h) = \sum_{z \in B(h)} \frac{\exp(v(C, h))}{\sum_{x \in D} \sum_{z \in B} \exp(v(C, h)) + \exp(v(C, h))}$$

Introducing the number of options in the labor market  $m(h)$

$$\phi(h) = \frac{\exp(v(C, h))m(h)}{\exp(v(C_0, 0))m(0) + \sum_{x \in D} \exp(v(C, x))m(x)}$$

Allows the researcher to account for latent restrictions in the labor market

# Job opportunity measure, $m(h)$ , is key part of the job choice model

$m(h) = \theta g(h)$ , where  $\theta$  is the total number of jobs available to the agent, depending on education level

When  $S$  is years of education, we have  $\log \theta_k = \gamma_{k1} + \gamma_{k2}S$  ( $k = F, M$ )

$g(h)$  is the fraction of jobs available to the agent with offered hours of work equal to  $h$ , uniformly distributed, except peaks for full-time and part-time

$m(h) = \theta g(h)$  is estimated jointly with the utility function

# Box-Cox functional form for the deterministic part of the couple utility function

$$\begin{aligned}\log v(C, h_F, h_M) = & \beta_C \left( \frac{[10^{-4}(C - C_0)]^{\alpha_1} - 1}{\alpha_1} \right) \\ & + \left( \frac{(L_F)^{\alpha_F} - 1}{\alpha_F} \right) X_F \beta_F + \left( \frac{(L_M)^{\alpha_M} - 1}{\alpha_M} \right) X_M \beta_M \\ & + \beta_{MF} \left( \frac{(L_M)^{\alpha_M} - 1}{\alpha_M} \right) \left( \frac{(L_F)^{\alpha_F} - 1}{\alpha_F} \right)\end{aligned}$$



# Two-step procedure – estimation by cross-sectional data

- Assign a predicted wage rate to each individual based on a Mincer wage regression (OLS)
  - ▶ Wage rate determined by education, experience and civil status
  - ▶ Random draw of error term in the wage equation (30 draws)
- Estimate the parameters of the utility function and the job opportunity measure by maximum likelihood estimation (MLE)
  - ▶  $g(h)$  is a latent variable that is estimated simultaneously with the deterministic part of the utility function

# Data and estimation

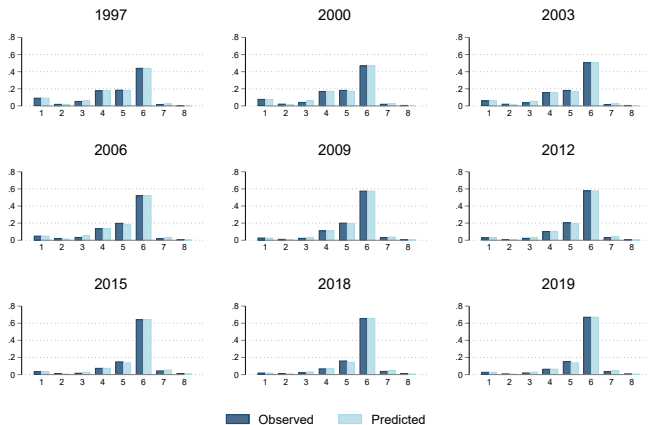
- Estimate the model for each year, 1997–2019
- Data from Labor force survey and Income and wealth statistics for households
  - ▶ Married couples
  - ▶ Age 26–62
  - ▶ Exclude self-employed/unemployed/students/disabled
- Use a detailed tax-benefit calculator to describe disposable income in the discrete choices
  - ▶ Couples have  $8 \times 8$  combinations, but no category for nonwork for males

# Estimation results

	Parameter	Married couples	
		Estimate	Std Error
<b>Preferences</b>			
<i>Consumption</i>			
Exponent	$\alpha_1$	0.7813	0.076
Scale $10^4$	$\alpha_2$	0.6453	0.208
Subsistence	$C_0$	40,000	
<i>Female leisure</i>			
Exponent	$\alpha_3$	-1.6194	0.416
Constant	$\alpha_5$	6.2556	3.201
Log(age/10)	$\alpha_6$	-5.4935	3.676
Log(age/10) squared	$\alpha_7$	1.9800	1.315
No. children under or equal to 6 years	$\alpha_8$	0.2142	0.117
No. children over 6 years	$\alpha_9$	0.1136	0.070
<i>Male leisure</i>			
Exponent	$\alpha_4$	-0.4285	5.618
Constant	$\alpha_{10}$	0.9190	7.993
Log(age/10)	$\alpha_{11}$	-0.9472	2.735
Log(age/10) squared	$\alpha_{12}$	1.6682	0.444
No. children under or equal to 6 years	$\alpha_{13}$	0.2206	0.241
No. children over 6 years	$\alpha_{14}$	0.0084	0.149
<i>Leisure interaction</i>	$\alpha_{15}$	0.6459	0.445
Leisure subsistence	$L_0$	5,110	
<b>Labor market options: females</b>			
Constant	$\gamma_{F1}$	0.1650	1.474
Education	$\gamma_{F2}$	0.4560	0.536
<b>Labor market options: males</b>			
Constant	$\gamma_{M1}$	1.9703	1.891
Education	$\gamma_{M2}$	1.3481	0.705
<b>Opportunity density of hours offered</b>			
Male full-time peak		2.6345	0.114
Female full-time peak		1.5225	0.103
Male part-time peak		-0.1314	0.286
Female part-time peak		-0.1677	0.125
Number of observations		1,619	
Log likelihood		-2,983.8	
McFadden's $\rho^2$		0.55	

# Goodness of fit

## Observed and predicted labor supply behavior for married females



## A little detour on practical use of the model

# Job choice model part of the microsimulation models to assist tax policy-making

- The labor supply is part of the microsimulation models of the LOTTE-system
  - ▶ Labor supply module named LOTTE-Arbeid
  - ▶ Connected to the non-behavioral microsimulation model LOTTE-Skatt
- Job choice model estimated for a smaller sample (than the LOTTE-Skatt sample) because of information on working hours
- Advantageous to simulate labor supply effects for same data set as in LOTTE-Skatt
  - ▶ Estimates transferred to the larger LOTTE-Skatt dataset based on imputation and common variables
- LOTTE-Arbeid less used than LOTTE-Skatt in policy-making

# Use of model in the Norwegian budget process

Tax change	Self-financing ratio, pct
Reduced rate bracket tax, bracket 3	10
Increased threshold bracket tax, bracket 3	9
Reduced rate ordinary income	6
Reduced rate social insurance tax	5
Reduced rate bracket tax, bracket 2	4
Increased threshold bracket tax, bracket 2	2
Increased threshold for max. deduction in minimum stand. deduction	1
Reduced rate bracket tax, bracket 1	0
Increased threshold bracket tax, bracket 1	0
Increased personal allowance	0
Increased rate minimum standard deduction	-16

# Description of the decline in the responsiveness of married women



# Simulated labor supply elasticity

- The estimated models (one for each year) are used to simulate labor supply elasticities with respect to the wage rate

$$e^w = \frac{dh}{dw} \cdot \frac{w}{h}$$

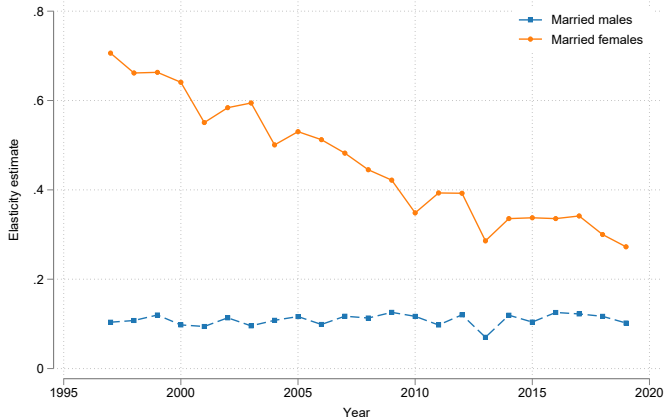
- Report the Marshallian elasticity of the aggregate (average) response in working hours

# Elasticity estimates, 2019

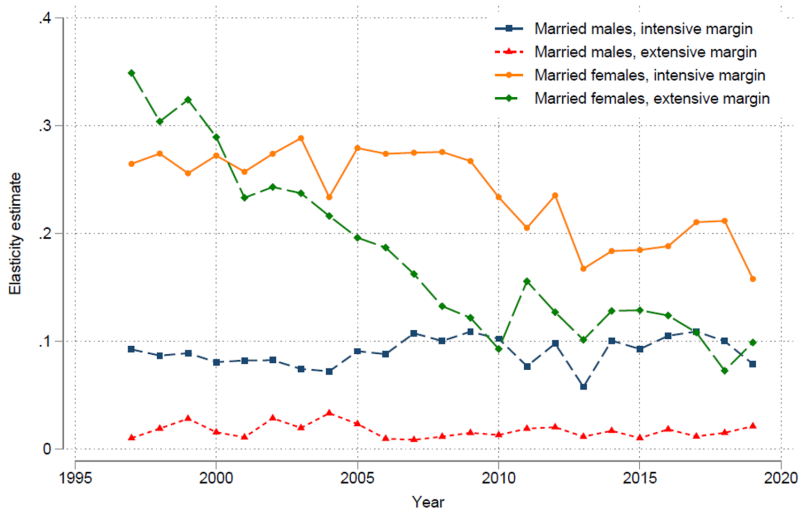
**Table A3:** Gross wage Marshallian labor supply elasticities for individuals in couples, 2019

	Female own wage	Male own wage	Female cross-wage	Male cross-wage
Participation (ext. margin)	0.099	0.021	-0.002	-0.006
Hours cond. on working (int. margin)	0.158	0.079	-0.047	-0.005
Total elasticity	0.273	0.102	-0.046	-0.010

# Declining labor supply elasticity of married women



# Married men and married women – extensive and intensive margins



# A procedure to obtain explanations to the decline

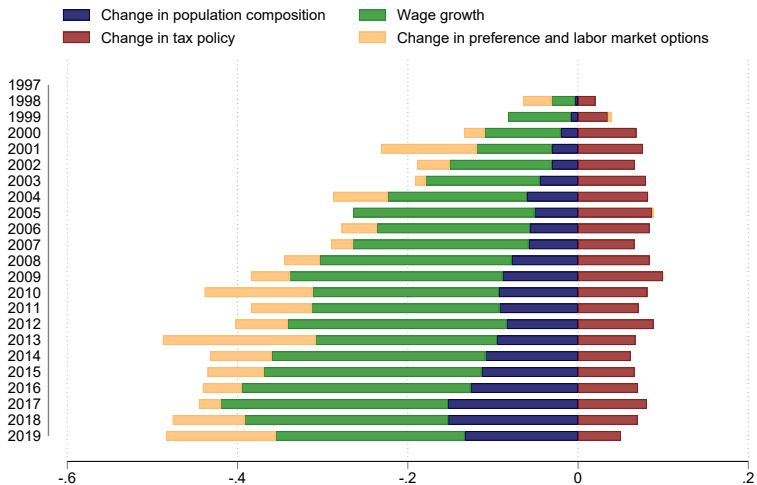
# Explanations to the decline in elasticities

- Population composition change
- Wage rate growth
- Tax scheme change
- Preference shift and change in labor market opportunities merged into one category

# Decomposition method – one specific sequence

- The labor supply elasticity in 1997 serves as the baseline,  $e_{1997}$
- For a given year  $t$ ,  $t \in [1998, 2019]$ , the method separates out effects of different explanations to the decline in response
- Step 1: Holding model parameters fixed to 1997 parameter, get wage elasticity set  $e_{t,1}$  for 1998–2019
  - ▶ Contribution due to sociodemographic factors:  $e_{t,1} - e_{1997}$
- Step 2: Let the gross wage vary over time,  $e_{t,2}$ 
  - ▶ Contribution due to the wage rate growth:  $e_{t,2} - e_{t,1}$
- Step 3: The tax scheme varies over time,  $e_{t,3}$ 
  - ▶ Contribution due to tax schemes change:  $e_{t,3} - e_{t,2}$
- Step 4: Simulations results for full model,  $e_t$ 
  - ▶ Identifies contributions from change in preferences and labor market opportunities:  $e_t - e_{t,3}$

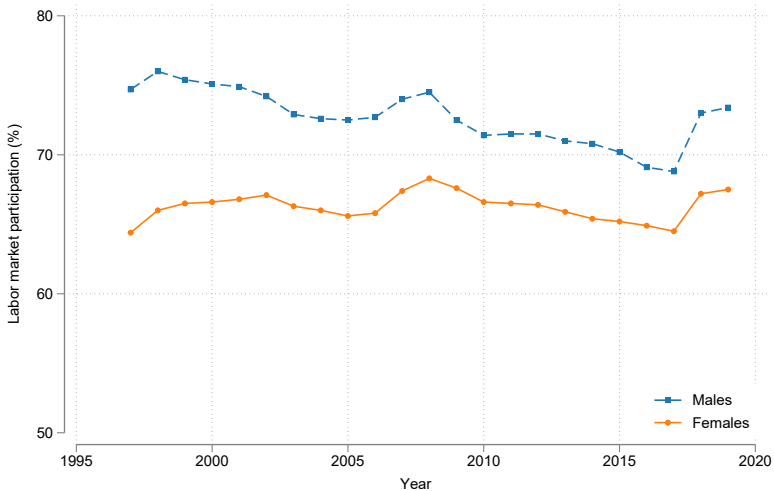
# Decomposition results (Shapley procedure)





## More about some potential driving factors

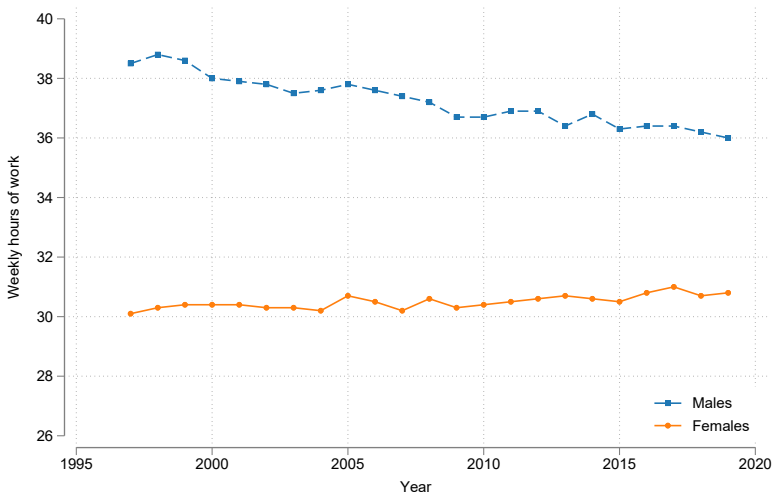
# Gap in participation is narrowing



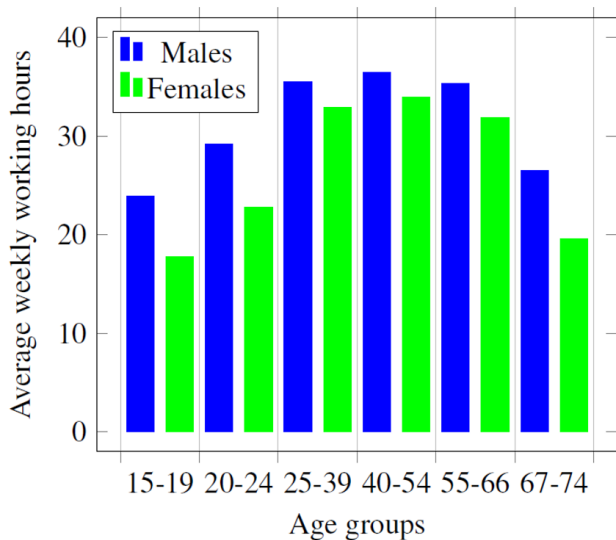
# Increased participation and the decline in response

- Could argue that higher participation rates contributes to the decline in response
  - ▶ Smaller pools of people that can be incentivized to enter the labor force
- Hard to establish a causal relationship between participation and responses – simultaneity

# Average female working hours stable (for those who work)

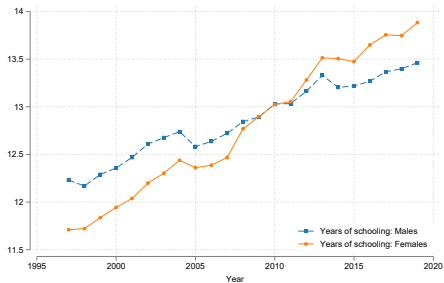


# Female working hours lower over the lifecycle



# Change in female education

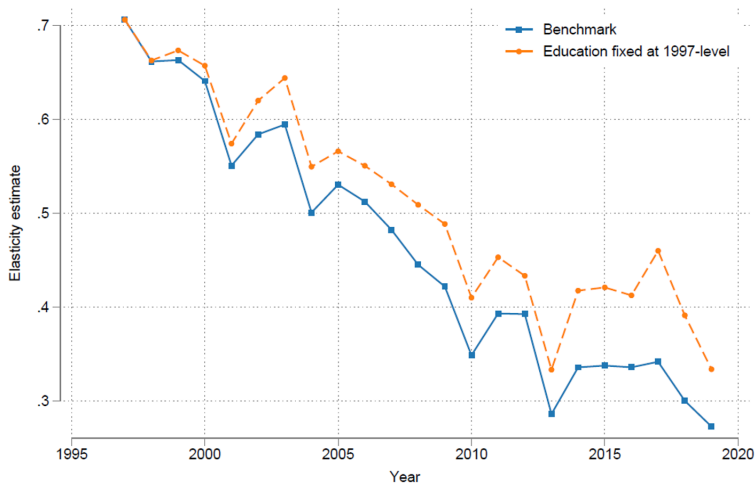
Females have increased their education above males



# Change in education is reflected in three categories of explanations

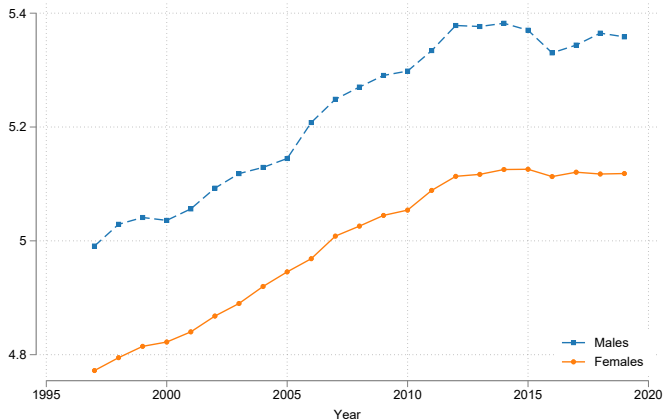
- Education is part of the population composition factor
  - ▶ Increased education levels enter into the wage regression (for fixed parameters)
- Wage rate growth a result of higher education
  - ▶ Parameter estimates of the wage regression change
- Education also influencing labor market opportunities

# Elasticity estimates when married women's education levels are fixed at the 1997-level

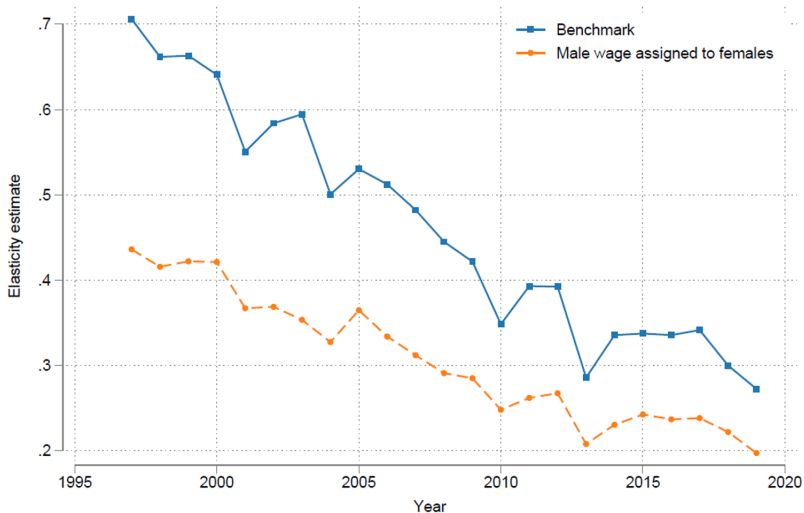




# Log real wage rate (40 years old and 13 years of schooling)

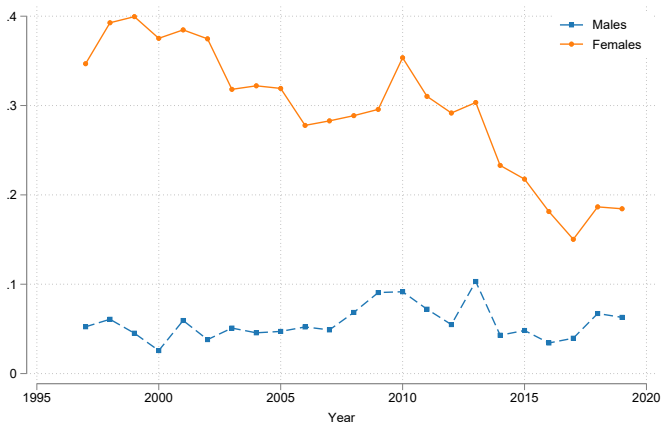


# Elasticity estimates when women are given “male wages”



# More full-time job opportunities

Estimated number of part-time jobs for each full-time job,  
 $m(\text{part})/m(\text{full})$

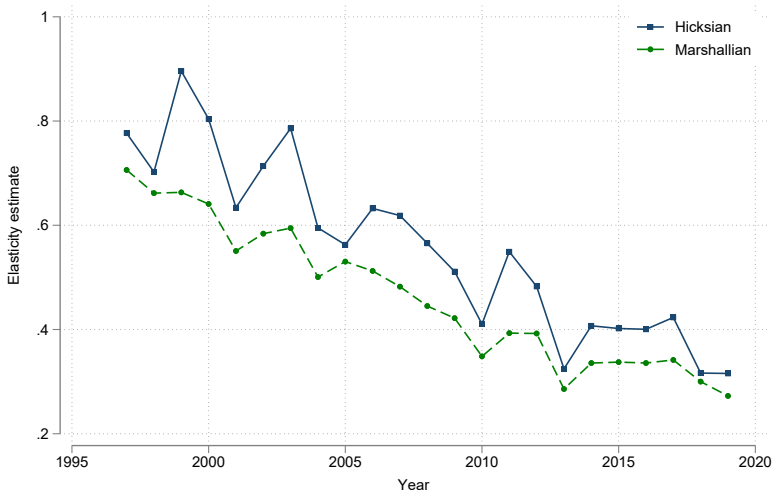


# Tax changes and the decline in response

- Marginal tax rates relatively stable over the period
  - ▶ A little reduction towards the end of the period
- Reduced rates may give larger responses
  - ▶ By definition of how the labor supply elasticities are calculated

# Hicksian elasticity estimates – Dagsvik and Karlstrøm (2005)

# Decline in the compensated elasticity too



# Concluding remarks

# Summary

- Estimate a discrete choice labor supply model on cross-sectional data, for each year 1997-2019
- Find clear downward trend in the simulated labor supply elasticities for married females
- Important to have information on what influences responsiveness
  - ▶ To what extent is response subject to policy control (Slemrod and Kopczuk, 2002)?
- We decompose effects and results suggest
  - ▶ Wage rate growth is the most important contributor
  - ▶ Shift in preferences and labor market opportunities have small effect
  - ▶ Tax policy change contributes to larger response